

TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED RESIDENTIAL DEVELOPMENT

*275 Forest Ridge Road
Concord, Massachusetts*

Prepared for:
**WP East Aquisitions, LLC &
Pinebrook Group, LLC**

October 2024

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

MDM.

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*275 Forest Ridge Road
Concord, Massachusetts*

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential development to be located at 275 Forest Ridge Road in Concord, Massachusetts. The proximity of the Site in relation to the regional transportation system is shown in **Figure 1**. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of Site-related traffic.

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

E.1 PROJECT DESCRIPTION

The Site comprises approximately 13.1± acres located at 275 Forest Ridge Road in Concord, Massachusetts. The Site includes Camp Thoreau which includes, buildings, pools, cabins and recreational areas that are adjacent to the Thoreau Club which comprises recreational facilities that include but are not limited to a pool, athletic fields and courts and small ancillary buildings. Site access is currently provided via two driveways along the Thoreau Club driveway.

Under proposed conditions, 237 units of multifamily housing will be constructed across two buildings. Parking supply will comprise of 354± surface spaces and 40± garage bays. The project will include onsite amenities and a dog park. Access/egress to the Site will be consolidated to a single boulevard style full access driveway located along the existing Camp Thoreau and Thoreau Club driveways. As part of the project the Camp Thoreau buildings and uses will all be removed.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of Main Street and Forest Ridge Road and the primary study intersection of Main Street at Forest Ridge Road that provide a primary means of access to the Site as well as the secondary study intersections of the Forest Ridge Road cul-de-sac and Camp Thoreau/ Thoreau Club Driveways to quantifying area traffic patterns. The study area includes the following study intersections:

Primary Study Intersection:

- Main Street at Forest Ridge Road (Unsignalized)
- Forest Ridge Road at Black Birch Lane/Sweet Birch Lane (Traffic Circle)

Secondary Study Intersections:

- Thoreau Club Driveway at Camp Thoreau Driveway
- Thoreau Club Driveway Internal Intersections

E.3 SUMMARY OF ANALYSIS AND FINDINGS

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

The analyses presented in this TIAS are based on industry-standard trip rates and methodology published by the Institute of Transportation Engineers (ITE). Based on industry-standard trip rates the proposed residential development generates approximately 88 vehicle trips during the weekday morning peak hour (20 entering and 68 exiting) and 92 vehicle trips during the weekday evening peak hour (56 entering and 36 exiting). On a daily basis, the development would generate approximately 1,076 vehicle trips on a weekday. Journey to work data for the Town of Concord served as the primary basis for distribution for the residential trips to/from the Site.

Capacity analyses indicate that project will not result in any consequential changes in intersection operations compared to No-Build conditions. Under Build conditions, capacity analyses indicate that the unsignalized Forest Ridge Road approach to Route 62 will continue to operate below capacity at LOS D or better during the weekday morning and weekday evening peak hours. Mainline vehicular movements along Route 62 will continue to operate with minimal delay. Based on a review of Warrants 2 and 3, a traffic signal will continue to *not be warranted* at the Main Street intersection with Forest Ridge Road under conditions with the proposed residential development in place. Likewise, under Build conditions with the proposed residential project in place, the critical northbound and southbound approaches to the traffic circle will operate at 16% capacity during the peak hours. Accordingly, no off-site roadway improvements are warranted to accommodate the project.

E.4 PARKING DEMANDS

Industry standard peak parking rates published by ITE indicate a peak parking demand rate range of 1.23 to 1.45 spaces per unit for a multi-family housing complex. Empirical peak parking rates observed at area multi-family complexes range between 1.29 and 1.44 spaces per unit which is highly consistent with the ITE data. Based on the parking data reviewed, the projected peak parking demand is estimated at between 292 and 344 vehicles at full build-out and occupancy (237 units). As shown, the peak parking demand will be adequately accommodated by the proposed parking supply of 394± marked spaces. The data outlined in this memorandum supports the requested parking relief with respect to the requirements set forth by local zoning.

E.5 RECOMMENDATIONS

MDM finds Main Street and Forest Ridge Road roadways within the site vicinity can accommodate modest traffic increases of the project. Relative traffic increases for the proposed project represent an inconsequential change in operations compared to No-Build conditions and are immaterial to traffic operations along Main Street (Route 62). However, several mitigation actions are identified to support the project to ensure that site access meets applicable safety criteria, to enhance neighborhood walking/bicycling and to reduce dependency on single-occupant auto use. These include (a) access-related improvements, (b) pedestrian and bicycle accommodations and (c) TDM actions as summarized below.

Access/Egress Improvements

- *Driveway Design.* The final driveway alignment, widths and curb radii have been designed to accommodate the Town's largest fire apparatus (ladder truck) and single unit delivery trucks. The final driveway layout achieves a perpendicular alignment to the exiting Thoreau Club driveway. Signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) should be installed on the approach to the Thoreau Club driveway including a "STOP" sign (R2-1) and "STOP" line pavement markings.
- *Sight Line Triangles.* The available sight lines at the Thoreau Club driveway intersection with the proposed site driveway will satisfy the recommended sight line requirements from AASHTO. New plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow accumulation (windrows) located within sight triangle areas that exceed 3.5-feet in height or that would otherwise inhibit sight lines shall be promptly removed.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections.* The Site Plan incorporates sidewalks that connect the proposed buildings, on-site surface parking areas, amenity space, and the expansive existing sidewalk network that is already in place along Forest Ridge Road, Main Street, the existing Thoreau Club, and internal neighborhood roadways. As part of the project, ADA compliant crosswalks and markings should be provided at all internal crosswalks, and a crosswalk with ADA compliant ramps should be provided on the exiting Thoreau Club driveway to the north of the proposed site driveway.
- *Bicycle Amenities.* The Proponent should incorporate secure weather-protected bicycle racks to encourage and facilitate this mode of transportation to/from the Site by residents. Additional bike racks near the entranceways should also be provided to accommodate visitors.

Transportation Demand Management (TDM) Program

The Proponent is committed to reduce auto dependency by residents by implementing a TDM program. A preliminary list of potential TDM program elements may include the following, subject to refinement of the development program and further evaluation by the Proponent:

- *Vehicle Charging Stations.* Electric vehicle charging stations/outlets should be provided for resident use. The proponent should place additional conduit within the parking area to facilitate additional charging stations to meet actual demand over time.
- *Bicycle Facilities.* Provide bicycle parking, including secure weather protected racks for residents and conveniently located racks for visitors proximate to the building entrances.
- *On-Site Amenities.* The Proponent should provide on-site amenities that may include a fitness center for residents, mailroom, a club room, and other features for residents.
- *Pedestrian Infrastructure.* Sidewalk connections will be provided along primary pedestrian desire lines that connect building entrances with the surface parking areas, on-site amenities, and the existing sidewalk network in the area.

E.6 CONCLUSIONS

In summary, the proposed residential development will be accommodated well within capacity of Main Street, Forest Ridge Road and the primary intersection of Main Street at Forester Ridge Road with no discernable impact to traffic flow and at operating levels compared to No-Build conditions. The Forest Ridge Road will continue to operate well below capacity at LOS D or better during the peak hours. Accordingly, no off-site roadway improvements are warranted to accommodate the project. The available sight lines at the proposed site driveway intersection with the existing Thoreau Club driveway will exceed the recommended sight line requirements from AASHTO. The proposed parking supply while less than the zoning requirement will be adequate to accommodate the peak parking demands for the Site based on industry standard and empirical parking rates. Proposed access/egress improvements, pedestrian and bicycle accommodations, and TDM program as outlined in the *Conclusions and Recommendations* will establish a framework of minimizing Site traffic impacts by encouraging non-motorized travel modes and pedestrian accommodation that is compatible with other projects in the area.

1.0 INTRODUCTION

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential development to be located at 275 Forest Ridge Road in Concord, Massachusetts. The proximity of the Site in relation to the regional transportation system is shown in **Figure 1**. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of Site-related traffic.

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1.1 PROPOSED DEVELOPMENT

The Site comprises approximately 13.1± acres located at 275 Forest Ridge Road in Concord, Massachusetts. The Site includes Camp Thoreau which includes, buildings, pools, cabins and recreational areas that are adjacent to the Thoreau Club which comprises recreational facilities that include but are not limited to a pool, athletic fields and courts and small ancillary buildings. Site access is currently provided via two driveways along the Thoreau Club driveway.

Under proposed conditions, 237 units of multifamily housing will be constructed across two buildings. Parking supply will comprise of 354± surface spaces and 40± garage bays. The project will include onsite amenities and a dog park. Access/egress to the Site will be consolidated to a single boulevard style full access driveway located along the existing Thoreau Club driveway. As part of the project the Camp Thoreau buildings and uses will all be removed. A preliminary site plan from Allen & Major Associates, Inc. is shown in **Figure 2**.

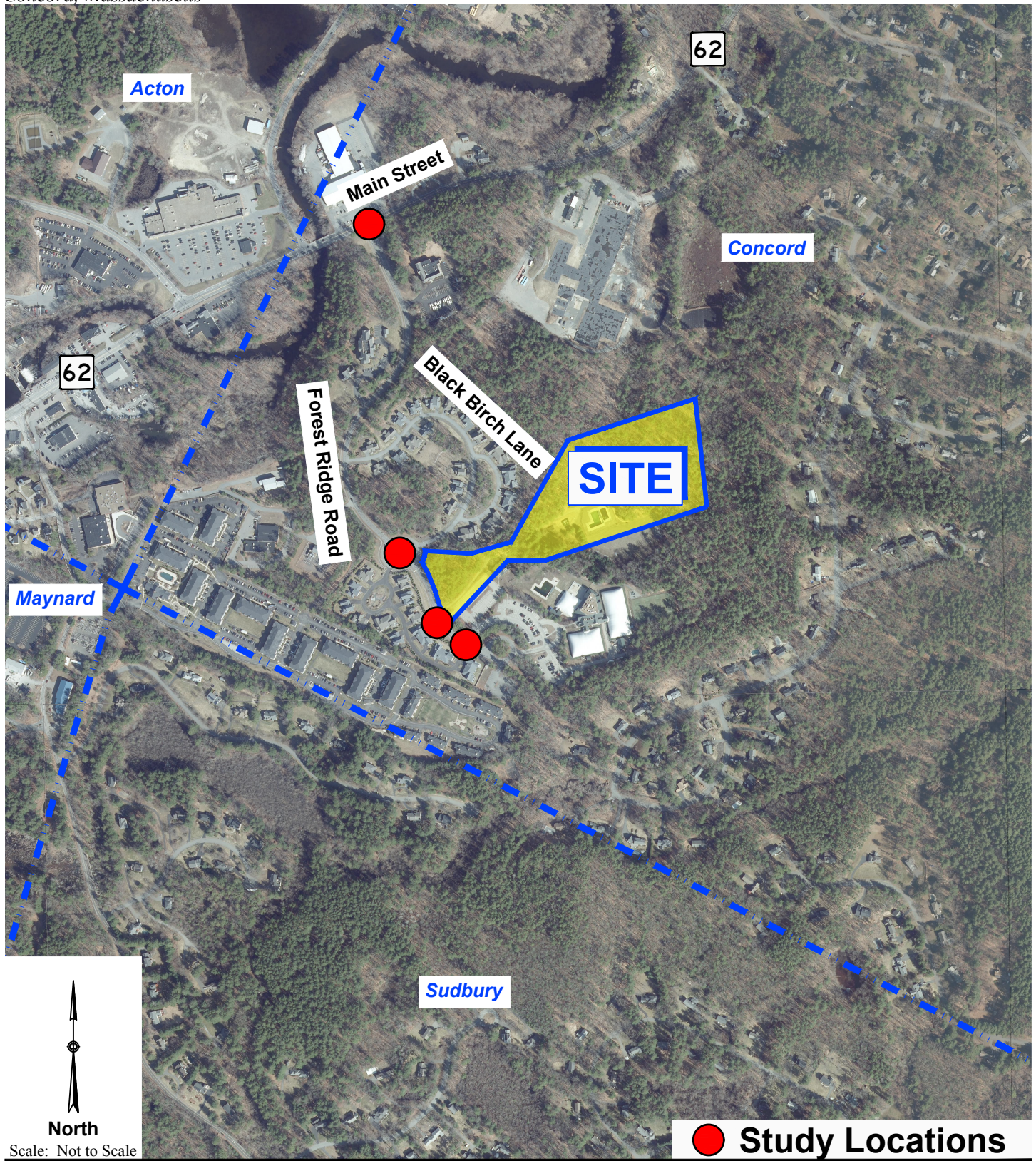


Figure 1

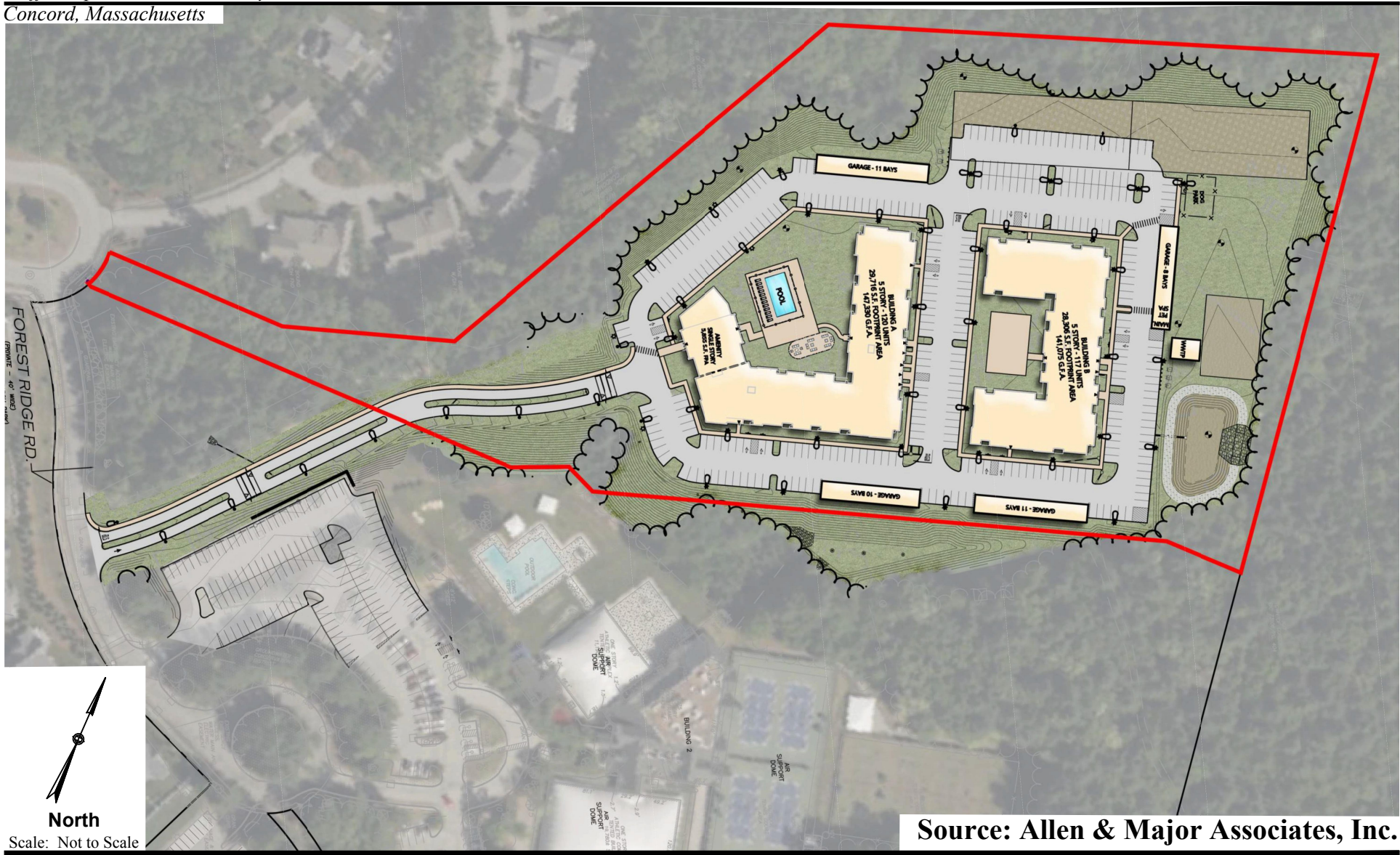


Figure 2

1.2 STUDY METHODOLOGY

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

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of Main Street and Forest Ridge Road and the primary study intersection of Main Street at Forest Ridge Road that provide a primary means of access to the Site as well as the secondary study intersections of Forest Ridge Road cul-de-sac and Camp Thoreau/ Thoreau Club Driveways to quantifying area traffic patterns. The study area includes the following study intersections:

Primary Study Intersection:

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Secondary Study Intersections:

- Thoreau Club Driveway at Camp Thoreau Driveway
- Thoreau Club Driveway Internal Intersections

2.0 EXISTING CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, the existing roadway system and the existing traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersections within the study area. Specifically, this section presents an overview of the traffic data collection program, existing traffic volumes, and safety issues.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersection are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under local jurisdiction. The study area and intersections are depicted in **Figure 1**.

2.1.1 Roadways

Main Street (Route 62)

Main Street (Route 62) is classified by MassDOT as an Urban Principal Arterial roadway under local (town) jurisdiction. This roadway generally runs in a northeast-southwest direction with the study area and provides a connection between route 2 and the center of Concord to the east and the center of Maynard to the west. The roadway provides one lane of travel in the southwest and northeast directions, separated by a double yellow centerline, with additional turn lanes at its major intersections. The regulatory speed limit along Route 62 in the study area is 35 mph. Land use along Route 62 include residential homes as well as commercial properties including Stop and Shop, Valley Sports Aena and industrial land uses.

Forest Ridge Road

Forest Ridge Road is classified as a local roadway under private jurisdiction according to MassDOT. Forest Ridge Road generally runs in a north-south direction connecting to Route 62 to the north and ends in a traffic circle at the northern end of the Thoreau Club driveway. Land use along Forest Ridge Road includes a variety of residential land uses, the Thoreau Club, and Camp Thoreau properties.

2.1.2 Intersections

Main Street (Route 62) at Forest Ridge Road

Main Street (Route 62) meets Forest Ridge Road to form a three-legged, unsignalized intersection under local jurisdiction. The Route 62 eastbound approach to the intersection includes one shared through/right turn lane. The Route 62 westbound approach is marked as a wide single lane approach to allow through movements to by-pass left turn movements. The Forest Ridge Road northbound approach to Route 62 includes a right-turn lane and one left-turn lane under “STOP” control. Two driveways for the Valley Sports Arena are located approximately 100± ft immediately adjacent to the east and west of the intersection along Main Street. Land uses at the intersection include undeveloped land and the Valley Sports Arena.

Forest Ridge Road at Sweet Birch Lane/ Black Birch Lane/ The Thoreau Club Driveway

Forest Ridge Road meets Sweet Birch Lane/ Black Birch Lane/ The Thoreau Club Driveway to form a four-legged, unsignalized traffic circle intersection under private jurisdiction. The Forest Ridge Road/ The Thoreau Club Driveway approaches include single travel lanes under “Yield” control. The Sweet Birch Lane and Black Birch Lane include single travel lane approaches to the traffic circle under “Stop” sign control. The traffic circle includes a single counterclockwise circulating lane. Land uses near the intersection include residential homes and undeveloped land.

2.2 BASELINE TRAFFIC VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in October 2023 and October 2024. Automatic traffic recorder counts (ATRs) were conducted along Main Street and Forest Ridge Road, while manual turning movement counts (TMCs) were conducted at the existing study intersections. Traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods of the Site and adjacent roadway network.

2.2.1 Daily Traffic

Daily traffic volumes along Main Street to the west of Forest Ridge Road was collected in October 2024 and along Forest Ridge Road to the south of Main Street was collected in October 2023 and are summarized in **Table 1**. Detailed traffic count data is included in the **Appendix**.

TABLE 1
BASELINE TRAFFIC VOLUME SUMMARY

Time Period	Daily Volume (vpd) ¹	Percent Daily Traffic ²	Peak Hour Volume (vph) ³	Peak Flow Direction ⁴	Peak Hour Directional Volume (vph)
<i>Main Street (Route 62) west of Forest Ridge Road</i>					
Weekday Morning Peak Hour	12,860	8%	1,026	70% EB	715
Weekday Evening Peak Hour	12,860	8%	1,007	56% WB	567
<i>Forest Ridge Road</i>					
Weekday Morning Peak Hour	1,990	9%	184	65% SB	120
Weekday Evening Peak Hour	1,990	8%	152	53% SB	80

¹Two-way daily traffic expressed in vehicles per day without seasonal adjustment.

²The percent of daily traffic that occurs during the peak hour.

³Two-way peak-hour volume expressed in vehicles per hour.

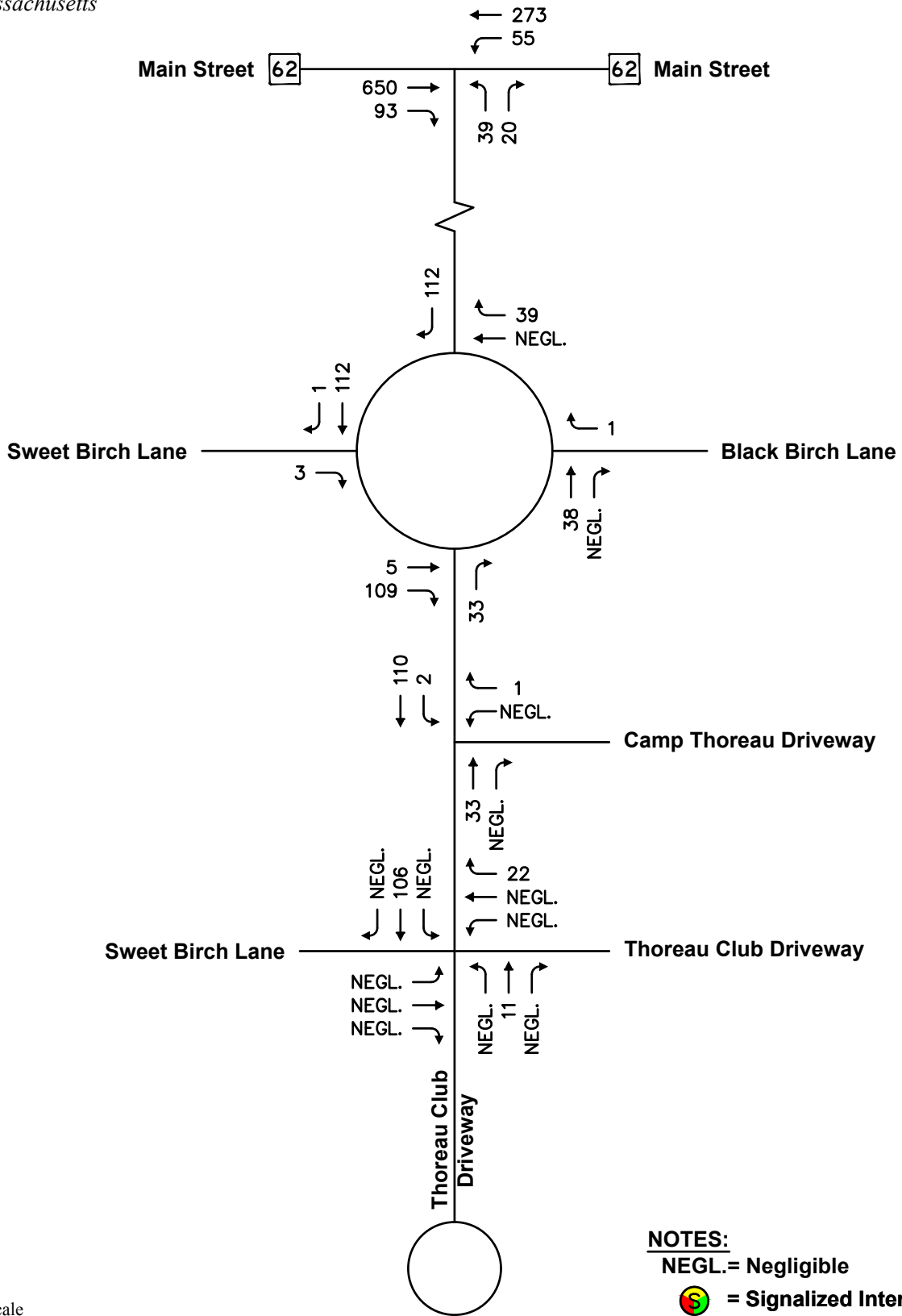
⁴NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

As summarized in **Table 1**,

- *Main Street (Route 62)*. The daily traffic volume on Main Street to the west of Forest Ridge Road was approximately 12,860 vehicles per day (vpd) during a typical weekday. Peak hour traffic flow on Main Street ranges from approximately 1,007 to 1,026 vehicles per hour (vph) which represents 8 percent of daily traffic flow. The traffic flow is skewed in the eastbound direction during the weekday morning peak hour and westbound during the weekday evening peak hour which is consistent with commuter traffic in the area.
- *Forest Ridge Road*. The daily traffic volume on Forest Ridge Road to the south of Main Street was approximately 1,990 vehicles per day (vpd) during a typical weekday. Peak hour traffic flow on Forest Ridge Road ranges from approximately 152 to 184 vehicles per hour (vph) which represents 8 to 9 percent of daily traffic flow on Forest Ridge Road.

2.2.2 Peak-Hour Traffic Volumes

Peak-hour traffic volumes at the study area intersections were collected in October 2023 and October 2024. Comparison of the traffic count data maintained by MassDOT for nearby permanent count stations indicates that October is representative of above-average volume conditions (approximately 5 percent above average month conditions). As a conservative measure, no adjustment (decrease) was made to the traffic counts to represent average conditions. To present 2024 Baseline conditions the 2023 turning movement counts were adjusted by 0.5 percent for one-year and then additional trips to/from Main Street were added through project area for additional activity at the Thoreau Club. The 2024 Baseline weekday morning and weekday evening peak hour traffic volume networks for study intersections are depicted in **Figure 3** and **Figure 4**. Permanent count station data, seasonal adjustment data, and expanded traffic volume networks are provided in the **Appendix**.



North
 Scale: Not to Scale

Figure 3

2024 Baseline Conditions
 Weekday Morning Peak Hour Volumes

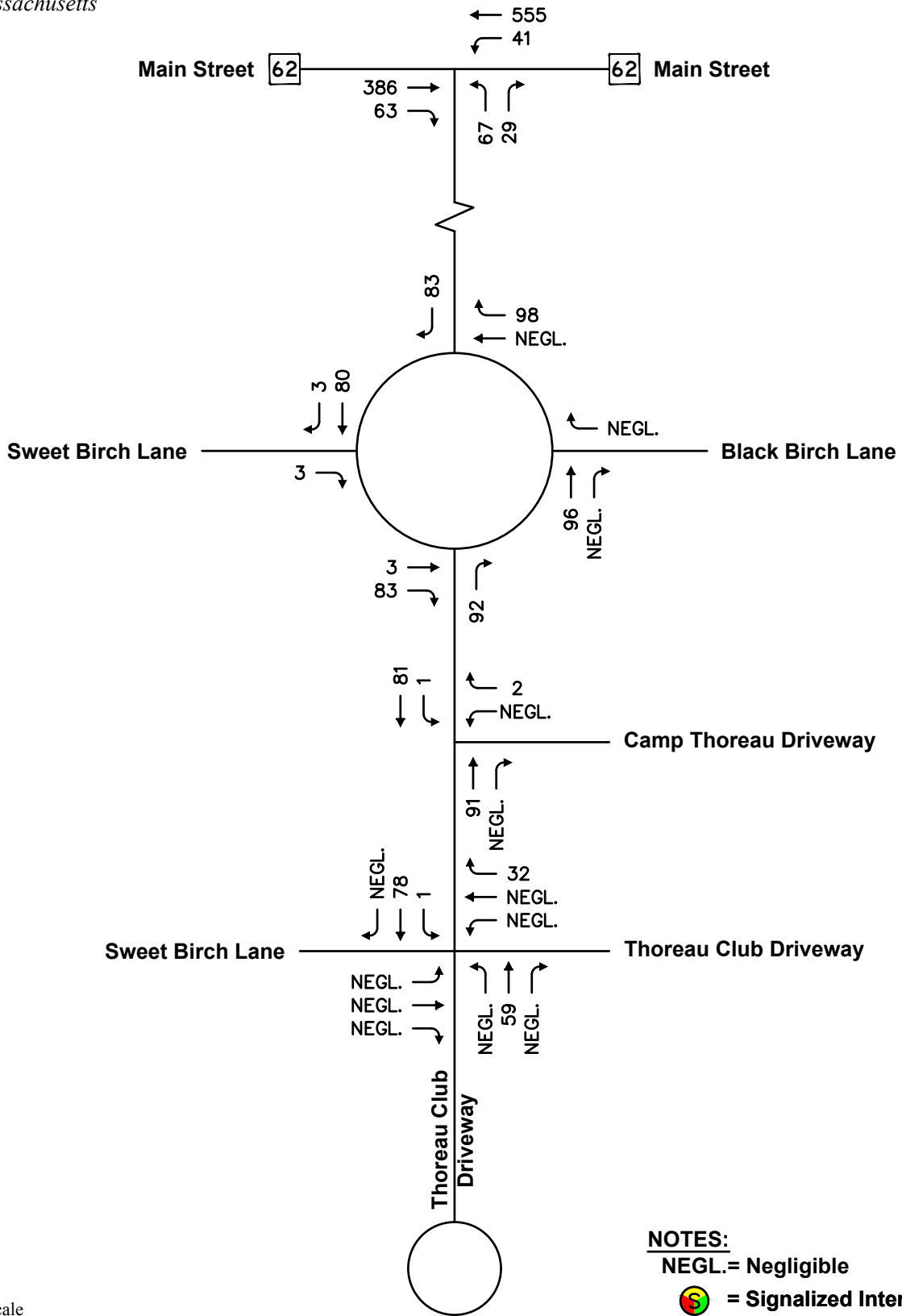


Figure 4

2.4 SAFETY

In order to identify crash trends and safety characteristics for the study intersections, crash data were obtained from MassDOT for the Town of Concord for the five-year period of 2019 through 2023. Crash data for the study intersections is summarized in **Table 2** with detailed data provided in the **Appendix**.

Crash rates were calculated for the study area intersections as reported in **Table 2**. This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 4 (which includes the Town of Concord) crash rate to be 0.57 for unsignalized intersections. This rate represents MassDOT's "average" crash experience for District 4 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted. A review of Highway Safety Improvement Project (HSIP) locations was also conducted.

**TABLE 2
INTERSECTION CRASH SUMMARY
2019 THROUGH 2023¹**

Data Category	STUDY LOCATION	
	Main Street (Route 62) at Forest Ridge Road	Unsignalized
Traffic Control		
Crash Rate ²		0.24
MassDOT Avg. Rate ³		0.57
<i>Year:</i>		
2019		2
2020		0
2021		1
2022		1
<u>2023</u>		<u>2</u>
Total		6
<i>Type:</i>		
Angle		1
Rear-End		2
Head-On		1
Sideswipe		0
Single Vehicle		2
Other/Unknown		0
<i>Severity:</i>		
P. Damage Only		6
Personal Injury		0
Fatality		0
Other/Unknown		0
<i>Conditions:</i>		
Dry		4
Wet		1
Snow/Ice		1
Other/Unknown		0
<i>Time:</i>		
7:00 to 9:00 AM		0
4:00 to 6:00 PM		3
Rest of Day		3

¹Source: MassDOT Crash Database

²Crashes per million entering vehicles

³District 4 Average Crash Rate

As summarized in **Table 2**,

- *Main Street at Forest Ridge Road.* Six (6) crashes were reported for the Main Street unsignalized intersection with Forest Ridge Road. The resulting crash rate of 0.24 is lower than the District 4 average of 0.57. The reported crashes included one (1) angle/sideswipe type collision, two (2) rear-end type collisions, one (1) head-on type collision and two (2) single vehicle collisions. All (100%) of the crashes resulted in property damage only, generally indicative of low-speed crashes. No fatalities or pedestrian-related incidents were reported during the study period. A review of the data indicates that there were also no crashes at the adjacent Valley Sport Area driveways during the study period.
- *Forest Ridge Road – Traffic Circle.* No crashes were reported at the Forest Ridge Road traffic circle intersections with Sweet Birch Lane and Black Birch Lane during the study period.
- *Thoreau Camp/ The Thoreau Club internal intersections.* No crashes were reported at the internal intersections with the Thoreau Camp or The Thoreau Club driveways during the study period.

In summary, based on extensive review of MassDOT crash data, the study intersections, experienced crash rates below the District 4 averages and none of the intersection are listed as high crash (HSIP) locations; therefore, no immediate safety countermeasures are warranted based on the crash history at the study intersections.

2.5 SIGHT LINE ANALYSIS

An evaluation of sight lines was conducted at the Site driveway location to ensure that minimum recommended sight lines are available at the proposed Site driveway intersection with the existing Thoreau Club driveway. The evaluation documents existing sight lines for vehicles as they relate to the Thoreau Club driveway comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards¹ reference two types of sight distance which are relevant at the Site driveway intersection: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the Site driveway intersection were compared to minimum SSD and ISD recommendations for the travel speeds in the Site vicinity.

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

Stopping Sight Distance

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

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the northbound and southbound Thoreau Club driveway approaches to the Site driveway. **Table 3** presents a summary of the available SSD as they relate to Main Street and AASHTO's recommended SSD.

**TABLE 3
STOPPING SIGHT DISTANCE SUMMARY
THOREAU CLUB DRIVEWAY APPROACHES TO PROPOSED SITE DRIVEWAY**

Approach/ Travel Direction	Available SSD	AASHTO Recommended ¹	
		Regulatory Speed Limit ²	Criteria Satisfied
<i>Northbound</i>	275± Feet	80 Feet	Yes
<i>Southbound</i>	350± Feet	80 Feet	Yes

¹Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet with adjustments for average grade within the sight line area.

²Based on 15 mph turning speed from cul-de-sac.

As summarized in **Table 3** analysis results indicate that the available sight lines on the site driveway approach to the Thoreau Club driveway exceed AASHTO's recommended SSD criteria for both travel directions along the Thoreau Club driveway based on a 15-mph turning speed from the adjacent cul-de-sac and Traffic Circle.

Intersection Sight Distance

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

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 10 feet from the edge of the travel way) for the northbound and southbound directions along the existing Thoreau Club driveway. **Table 4** presents a summary of the available ISD for the departure from the Site driveway and AASHTO's minimum recommended ISD.

**TABLE 4
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURES TO THE THOREAU CLUB DRIVEWAY**

View Direction	Available ISD	AASHTO Minimum ¹	AASHTO Ideal ¹
		Regulatory Speed Limit ²	Regulatory Speed Limit ²
Looking North	350± Feet	80 Feet	170 Feet
Looking South	275± Feet	80 Feet	145 Feet

¹Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet. Minimum value as noted represents SSD per AASHTO guidance.

²Based on 15 mph turning speed from cul-de-sac.

The results of the ISD analysis presented in **Table 4** indicate that the available sight lines looking north and south from the proposed site driveway onto the existing Thoreau Club driveway exceed the recommended minimum and ideal sight line requirements from AASHTO for the regulatory speeds along the Thoreau Club driveway. MDM recommends new plantings (shrubs, bushes) and structures (walls, fences, etc.) should be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow accumulation (windrows) located within sight triangle areas that exceed 3.5-feet in height or that would otherwise inhibit sight lines shall be promptly removed.

3.0 FUTURE CONDITIONS

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

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

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

3.1 BACKGROUND TRAFFIC GROWTH

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

3.1.1 Historical Area Growth

Nearby permanent count station data published by MassDOT indicates a 0.3 percent per year growth rate. For purposes of this evaluation, a 0.5 percent compounded annual growth rate was used (3.6 percent increase over a 7-year horizon). This growth rate is slightly higher than historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Appendix**.

3.1.2 Background Development-Related Growth

Development of future No-Build traffic volumes also considers traffic generated from specific area developments. Based on review of available project databases in the Town of Concord, Town of Maynard, Town of Acton and review of Massachusetts Environmental Policy Act (MEPA) files there *is one* project in the immediate area that *may increase* traffic volumes in the project study vicinity. This evaluation included consideration of traffic for the NOVO Riverside Commons residential project at 292 & 294 Baker Avenue; however, review of the traffic study for this project indicates that trip increases in the study location (Main Street at Forest Ridge Road) are accounted for under general background growth assumptions. Additionally, the Site-specific development project in the area that may increase baseline traffic at the study intersections as follows:

- *Apartments at Powder Mill*. This project consists of the development of a 230 units residential apartment building to be located along Route 62 in Acton, MA. Trips were estimated based on ITE data and distributed onto the roadway network based on Journey to Work data. Site-specific trip tracings for the project provided in the **Appendix**.

3.2 NO-BUILD TRAFFIC VOLUMES

To account for future traffic growth along the corridor, the 0.5 percent annual growth rate was applied to Baseline traffic volumes over a seven-year period and estimated traffic from the development background project listed above. Future 2031 No-Build traffic volumes are displayed in **Figure 5** and **Figure 6**.

3.3 SITE-GENERATED TRAFFIC

The methodology utilized to estimate the future trip-generation characteristics of the proposed development are summarized below. In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for the Land Use Code (LUC) based on trip rates for Multifamily House (Mid-Rise) (LUC 221).

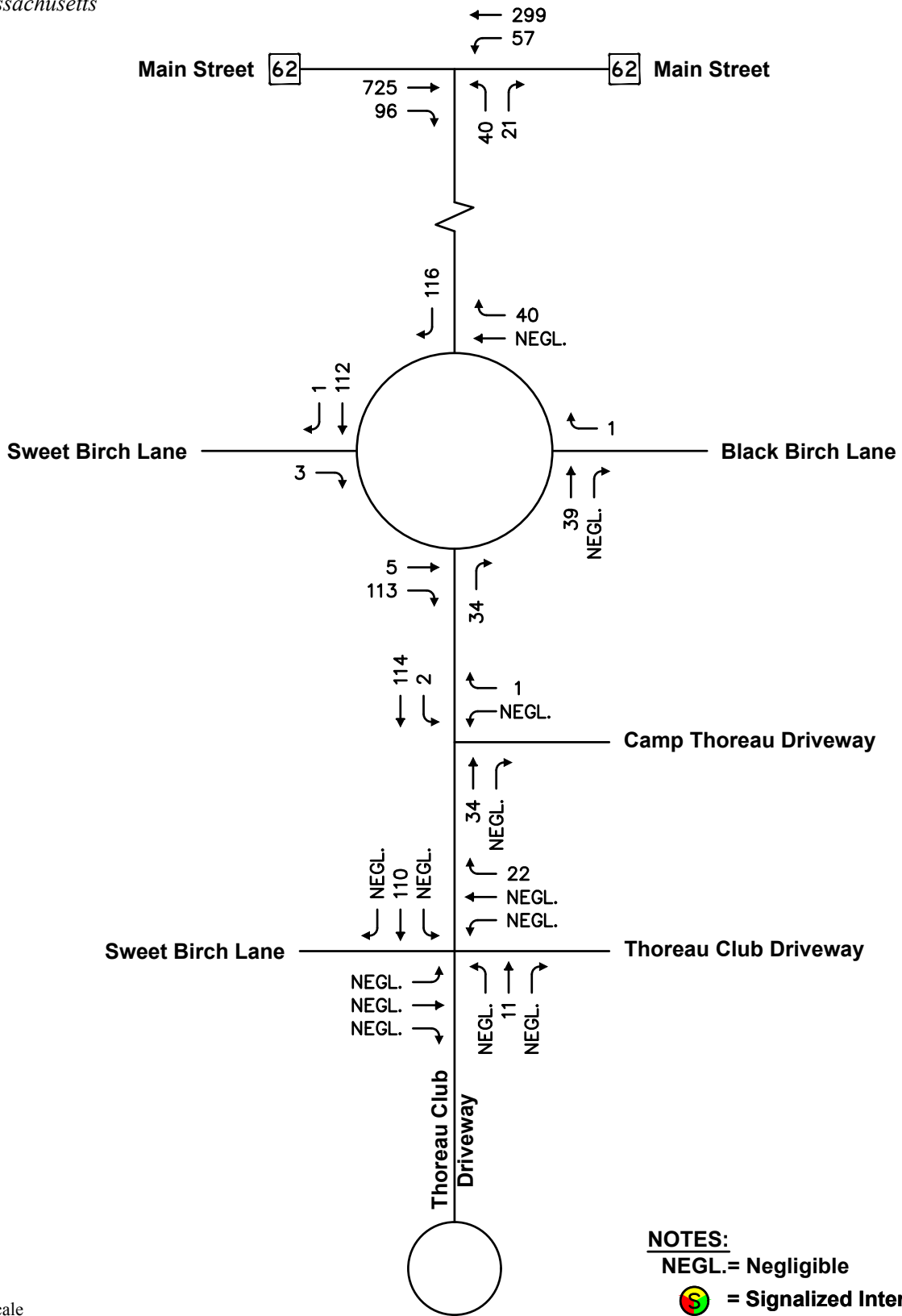
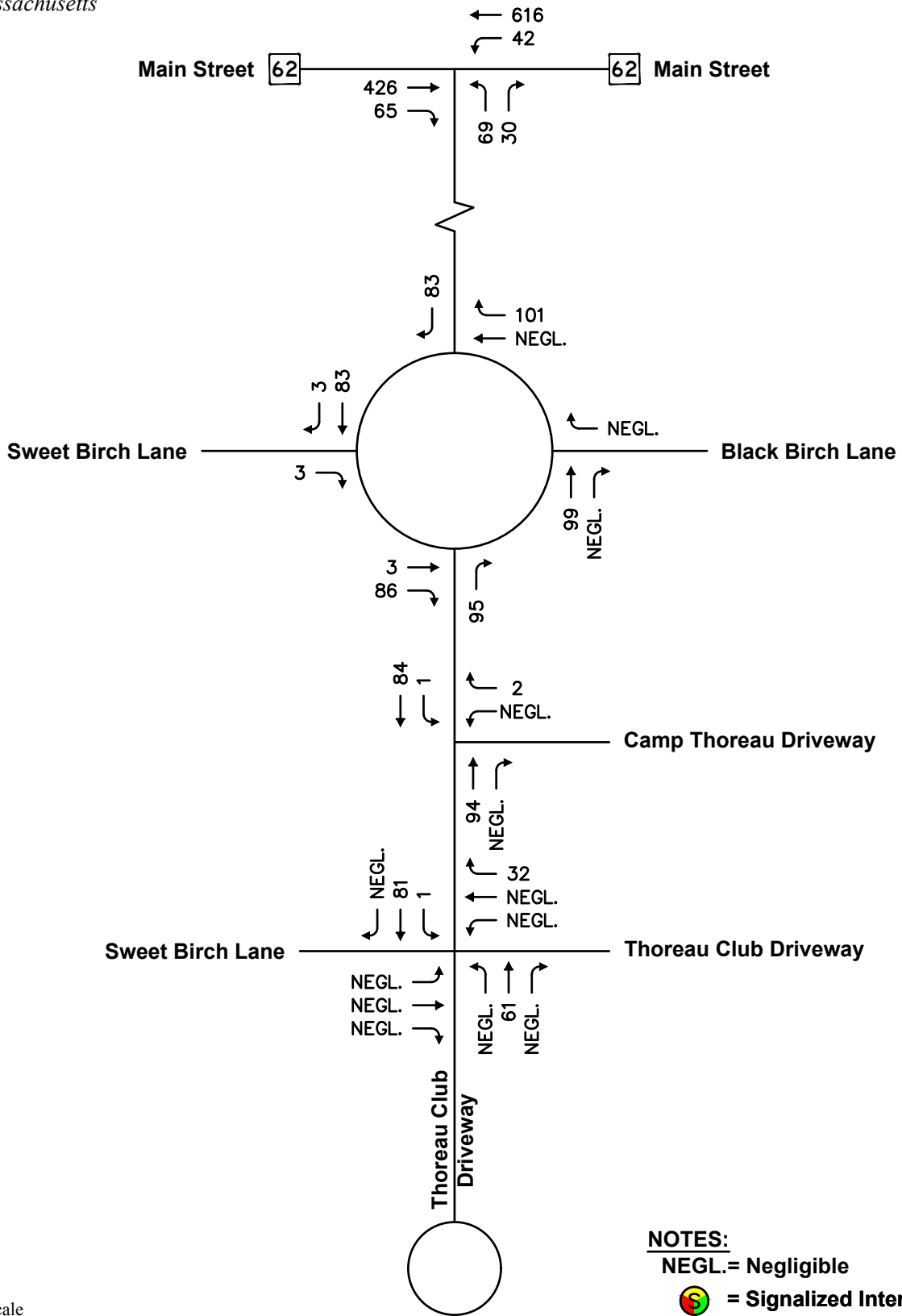


Figure 5



Scale: Not to Scale

Figure 6

Table 5 presents the trip-generation estimates for the proposed development based on ITE methodology and EEA/MassDOT guidelines without no adjustments for alternative transportation modes.

**TABLE 5
TRIP-GENERATION SUMMARY¹**

Peak Hour/Direction	Site Trips ¹
<i>Weekday Morning Peak Hour:</i>	
Entering	20
<u>Exiting</u>	<u>68</u>
Total	88
<i>Weekday Evening Peak Hour:</i>	
Entering	56
<u>Exiting</u>	<u>36</u>
Total	92
<i>Weekday Daily (24 hours)</i>	1,076

Source: ITE *Trip Generation*, 11th Edition; 2021.

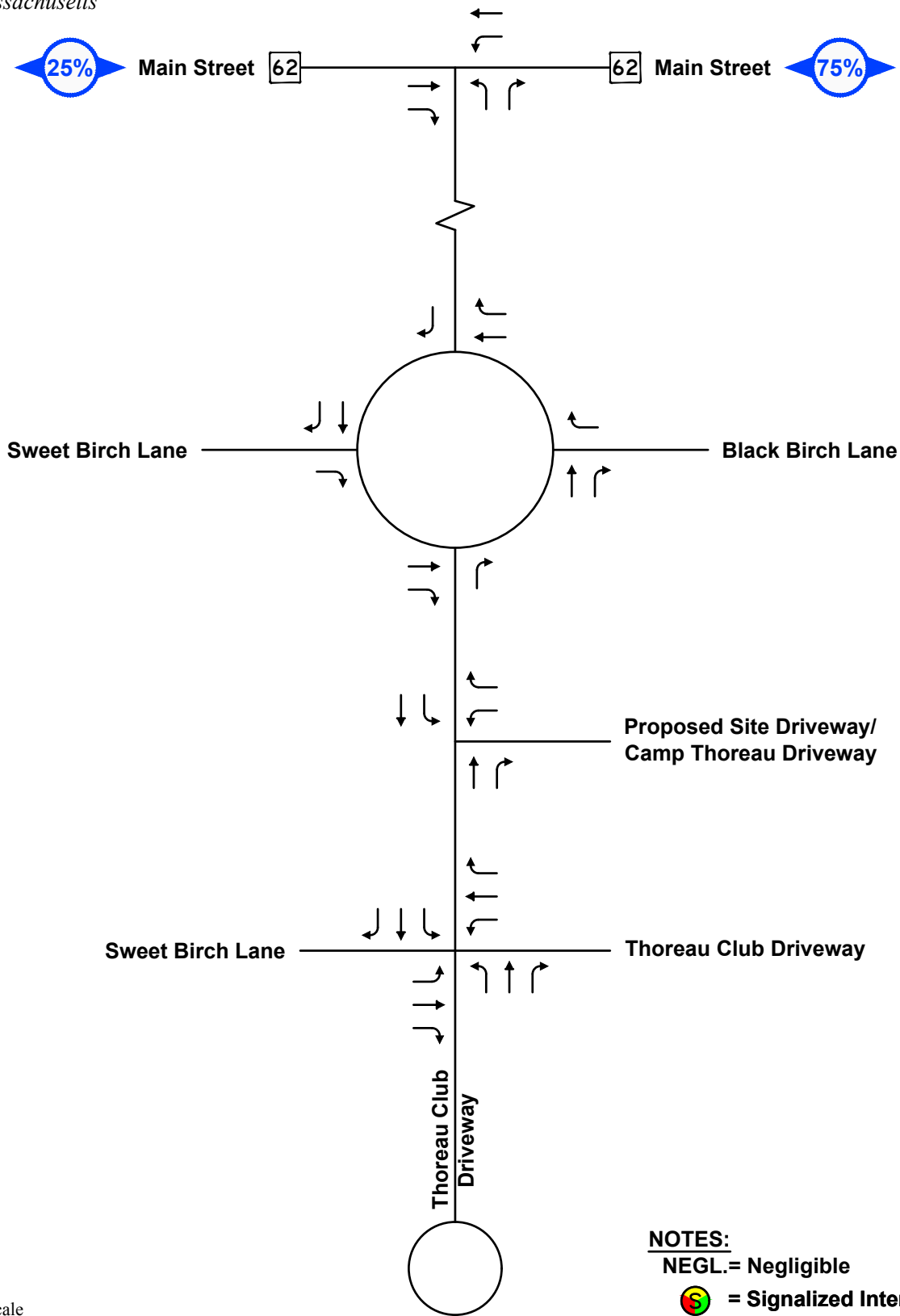
¹ITE LUC 237 – Multifamily Housing (Mid-Rise) to 237 units.

As summarized in **Table 5**, based on industry-standard trip rates, the proposed residential development generates approximately 88 vehicle trips during the weekday morning peak hour (20 entering and 68 exiting) and 92 vehicle trips during the weekday evening peak hour (56 entering and 36 exiting). On a daily basis, the development would generate approximately 1,076 vehicle trips on a weekday.

3.4 TRIP DISTRIBUTION & ASSIGNMENT

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including area population centers and the efficiency of these roadways leading to the Site. Journey to work census data serve as the primary basis for determining the trip distribution pattern for the proposed residential development, which is presented in **Figure 7**. Trip distribution calculations for the Site are provided in the **Appendix**.

Development-related trips for the Site were assigned to the roadway network using the ITE trip-generation estimates shown in **Table 5** and the distribution patterns presented in **Figure 7**. New development-related trips at each intersection for the weekday morning and weekday evening peak hours are quantified in **Figure 8** and **Figure 9**, respectively.



NOTES:
 NEGL.= Negligible
 = Signalized Intersection

North
 Scale: Not to Scale

Figure 7

Trip Distribution

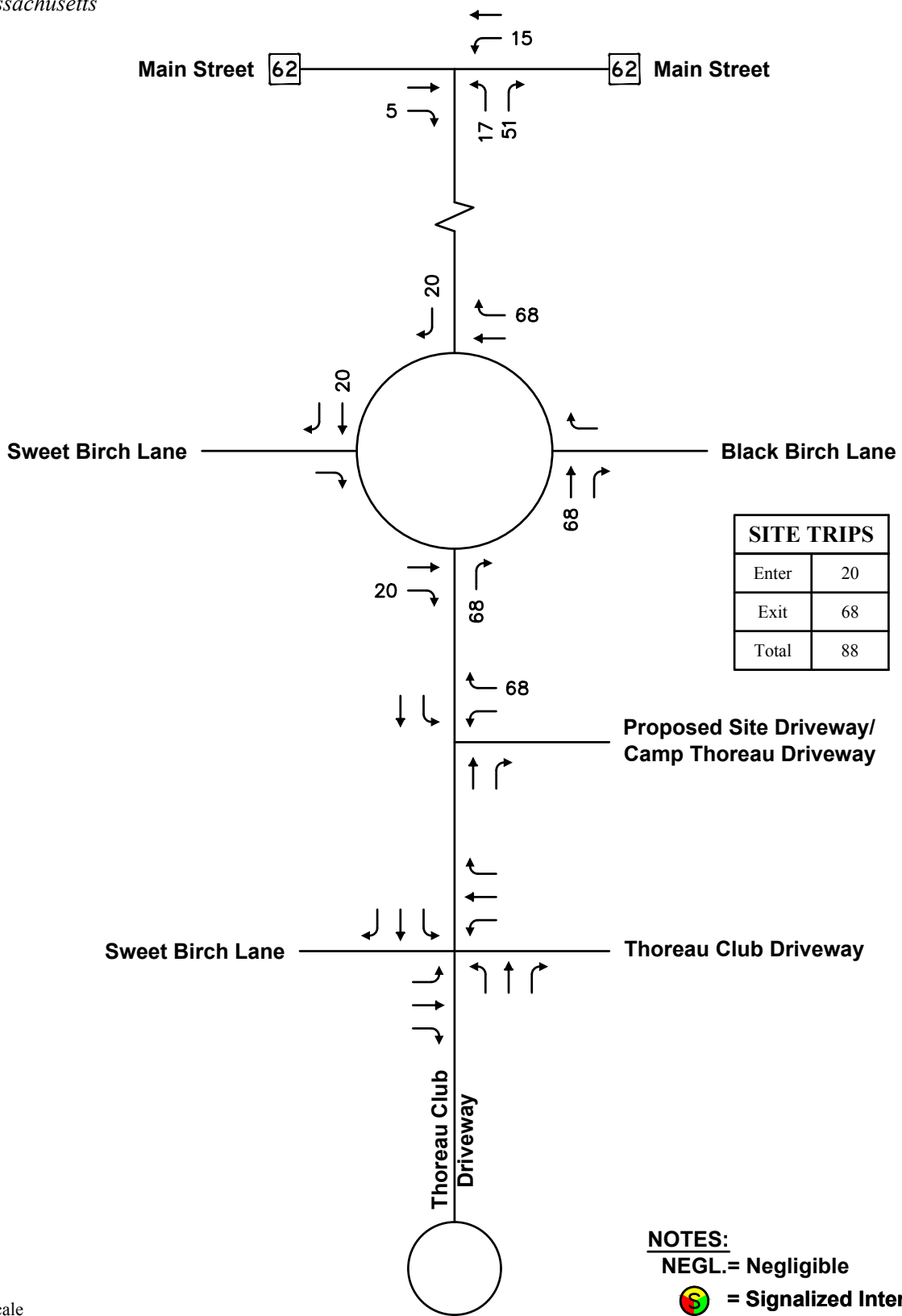


Figure 8

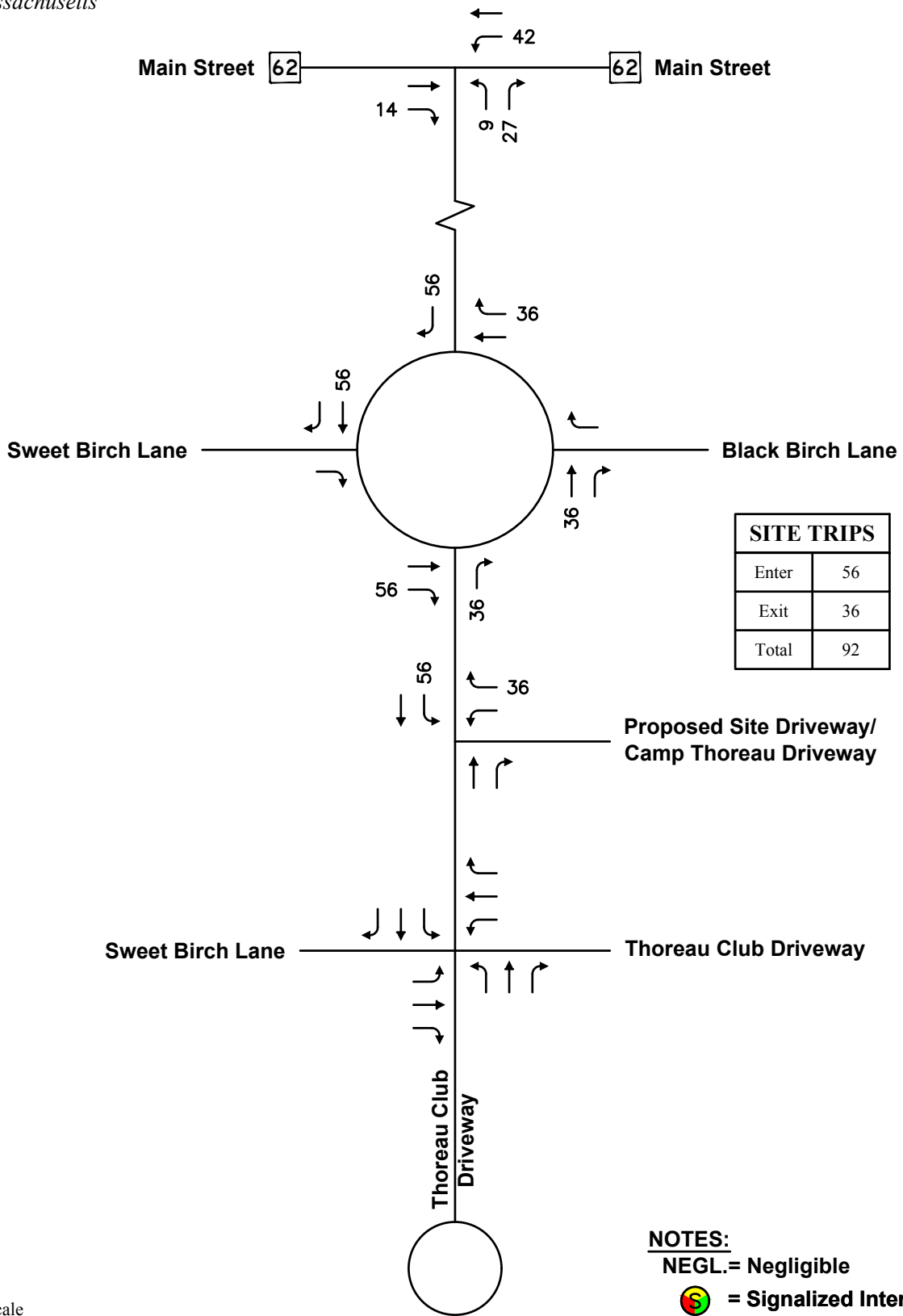


Figure 9

3.5 BUILD TRAFFIC VOLUMES

Future Build traffic volumes were arrived at by adding development-specific traffic volumes for the project to the 2031 No-Build conditions. The 2031 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours are displayed in **Figure 10** and **Figure 11**, respectively.

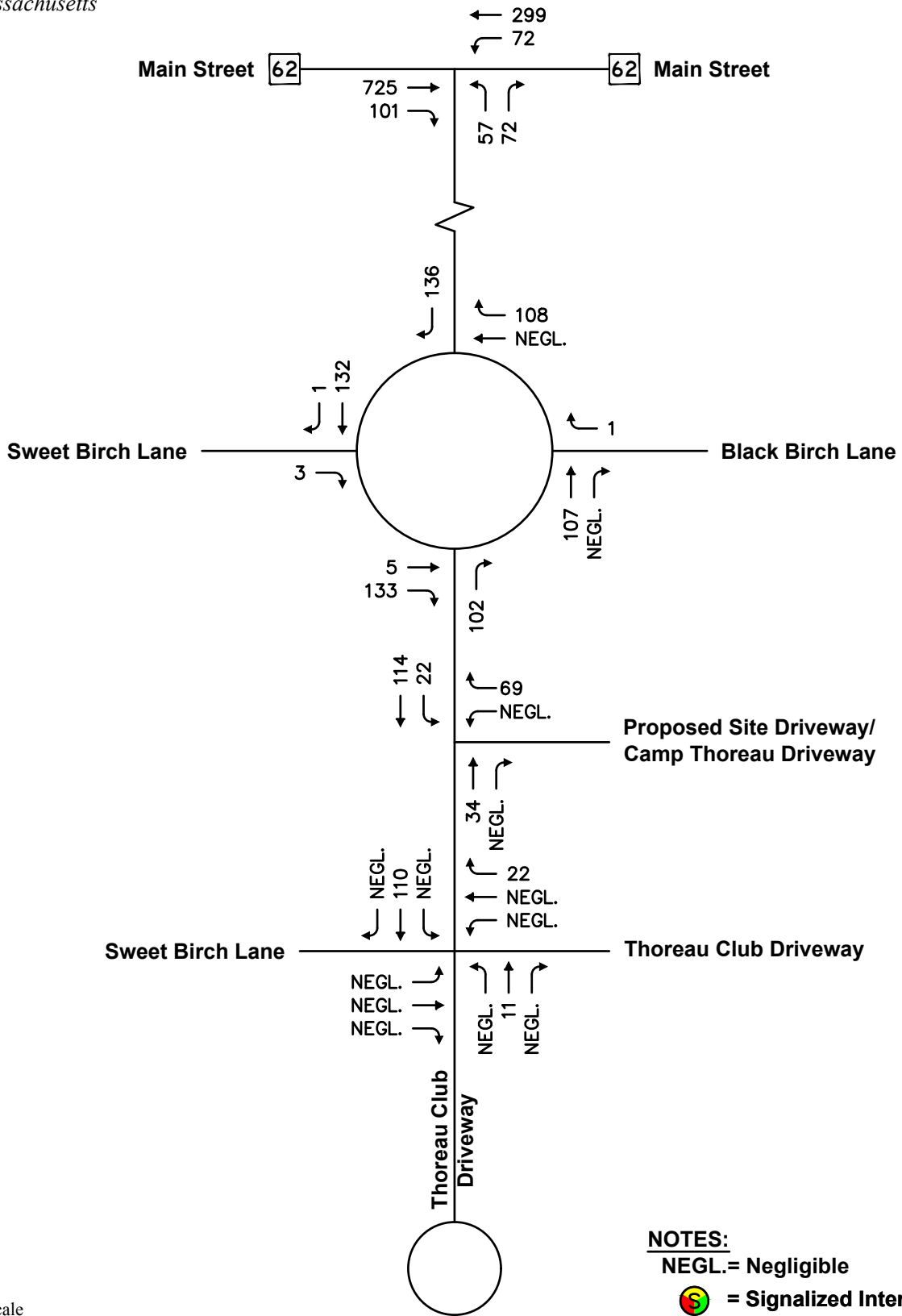


Figure 10

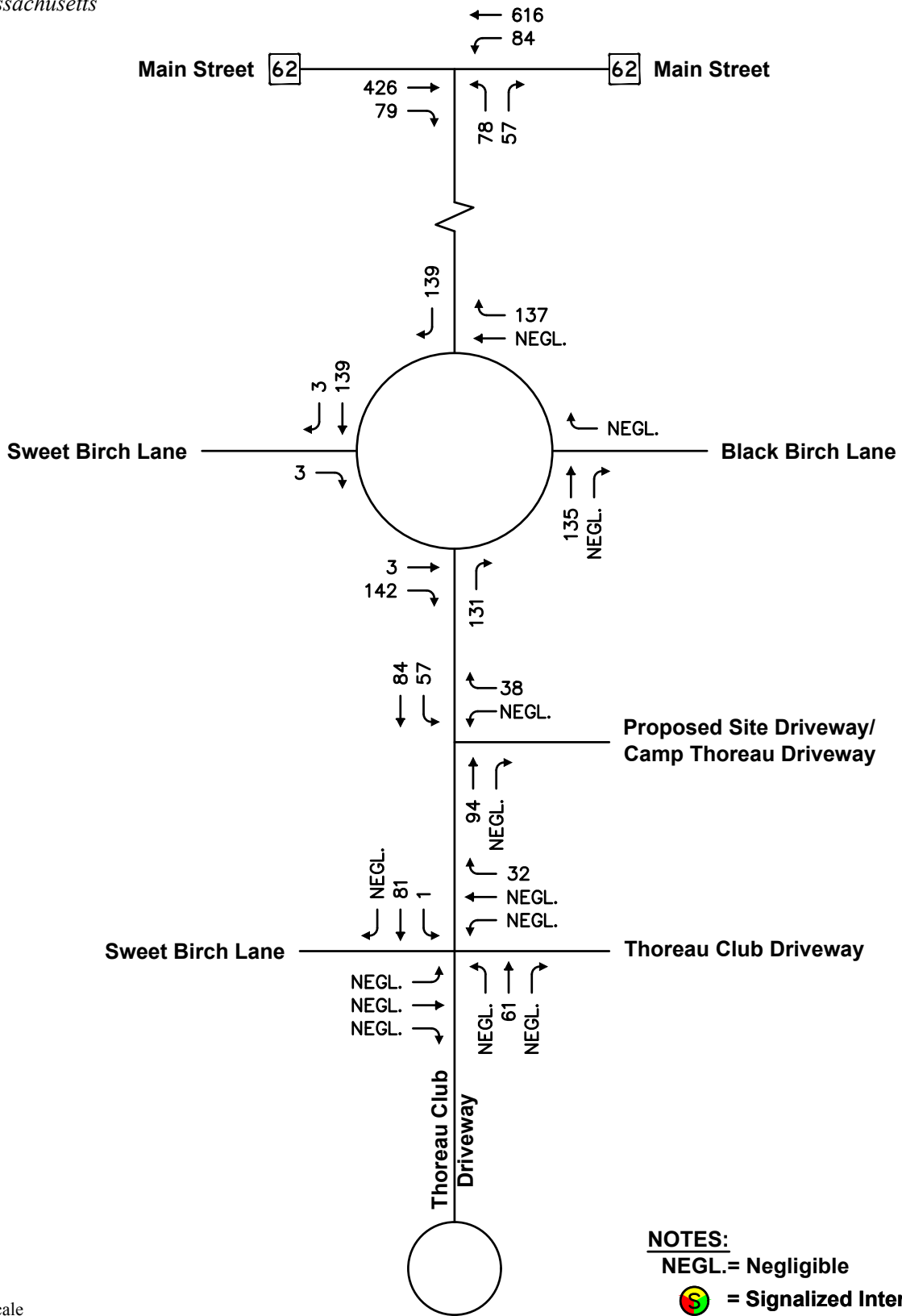


Figure 11

4.0 TRAFFIC OPERATIONS ANALYSIS

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

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the Highway Capacity Manual 6th edition (HCM6). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

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

4.2.1 Level of Service Analysis

The capacity analysis results for the primary study intersections is summarized in **Table 6** for the weekday morning and weekday evening peak hours, respectively. Detailed analysis results are presented in the **Appendix**.

TABLE 6
INTERSECTION CAPACITY ANALYSIS RESULTS

Time Period	Approach	2024 Baseline			2031 No-Build			2031 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS
<i>Weekday Morning Peak Hour</i>										
Main Street (Route 62) at Forest Ridge Road	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Westbound	0.07	<5	A	0.08	<5	A	0.10	<5	A
	NB Left ⁵	0.17	23	C	0.20	26	D	0.31	32	D
	NB Right ⁵	0.03	10	A	0.03	10	A	0.11	11	B
Forest Ridge Road at Sweet Birch Lane/ Black Birch Lane/ Thoreau Club Dwy	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Northbound	0.03	<5	A	0.03	<5	A	0.08	<5	A
	Southbound	0.09	<5	A	0.09	<5	A	0.11	<5	A
<i>Weekday Evening Peak Hour</i>										
Main Street (Route 62) at Forest Ridge Road	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Westbound	0.04	<5	A	0.04	<5	A	0.08	<5	A
	NB Left ⁵	0.25	22	C	0.29	26	D	0.40	34	D
	NB Right ⁵	0.03	9	A	0.04	9	A	0.07	9	A
Forest Ridge Road at Sweet Birch Lane/ Black Birch Lane/ Thoreau Club Dwy	Eastbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Westbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Northbound	0.10	<5	A	0.11	<5	A	0.15	<5	A
	Southbound	0.10	<5	A	0.10	<5	A	0.16	<5	A

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

⁵ Calibrated based on delay study during the critical weekday evening peak hour.

Under future Build conditions capacity analyses indicate the following key findings as summarized in **Table 6**:

- *Main Street at Forest Ridge Road.* Under future Build conditions, the proposed development does not result in any significant change in operations at the primary interaction of Main Street at Forest Ridge Road intersection compared to No-Build conditions. The unsignalized Forest Ridge Road approach to Route 62 will continue to operate below capacity at LOS D or better during the weekday morning and weekday evening peak hours. Mainline vehicular movements along Route 62 will continue to operate with minimal delay. Additionally, field observations indicate the Valley Sports Center was in operation during both the weekday morning and evening peak hours; however, the driveways resulted in little to no interactions with minimal influence on operations at the Main Street at Forester Ridge Road operations (entering and exiting movements) during the peak hours. A traffic signal warrant evaluation is provided for this location under *Section 5.0* below.

- *Forest Ridge Road at Sweet Birch Lane, Black Birch Lane and The Thoreau Club Driveway.* Under Build conditions, capacity analyses indicate that the unsignalized roundabout intersection will continue to operate well below capacity at LOS A or better during the weekday morning and weekday evening peak hours. Under Build conditions with the proposed residential project in place, the critical northbound and southbound approaches will operate at 16% capacity during the peak hours.

5.0 TRAFFIC SIGNAL EVALUATION

A review of the traffic volumes at the intersection indicates that the majority of the turns from Forest Ridge Road are right turns which generally don't warrant a traffic signal and the capacity analysis provided under *Section 4.2*, indicates that the critical left turn movements from Forest Ridge Road onto Main Street will continue to operate well below capacity (70% reserve capacity) at LOS D or better during the peak hours.

Despite adequate capacity and operations, the need for traffic signal installation at the Main Street (Route 62) intersection with Forest Ridge Road was evaluated using procedures found in the Manual on Uniform Traffic Control Devices (MUTCD) 11th Edition² in order to justify installation of traffic signals at the intersection, one or more of the following nine signal warrants should be met.

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

The warrants reviewed for this report is based on the Manual on Uniform Traffic Control Devices (MUTCD) 11th Edition and include *Warrant 2: Four-Hour Vehicular Volume* and *Warrant 3: Peak Hour Vehicular Volume*. The traffic signal warrant was reviewed based on the following conditions: 2024 Baseline traffic volumes plus site generated traffic with a regulatory speed limit along Main Street (Route 62) of 35 mph. Based on a review of Warrants 2 and 3, a traffic signal will continue to *not be warranted* at the intersection of Main Street and Forest Ridge Road under conditions with the proposed residential development in place. Detailed calculation sheets are included in the **Appendix**.

² *Manual on Uniform Traffic Control Devices, 11th Edition* US Department of Transportation, Washington, DC, December 2023.

6.0 *PARKING ANALYSIS*

6.1 *PROJECTED PARKING DEMAND*

Projected peak parking demands at the site are evaluated based on parking rates and methodology published by the Institute of Transportation Engineers (ITE) and empirical parking data from suburban multi-family housing projects in the Commonwealth. The project proposes to have parking supply levels that are less than the local zoning requirements.

Local Zoning Requirements

Given the project is proposed as a 40B development local zoning requirements generally do not apply. That said, a review of the local zoning requirements indicates that 2.0 spaces per dwelling unit are required for multi-family developments in this area. Based on 237 units the project would require 474 parking spaces to satisfy the local zoning requirement. At 394 spaces the proposed parking supply as proposed is 1.66 spaces per unit.

6.1.1 *Peak Parking Rates – ITE*

Peak parking generation rates for residential land uses, including apartment complexes, are published by the Institute of Transportation Engineers (ITE) in *Parking Generation*³ which provides a basis for identifying parking demand characteristics for residential developments. These parking rates represent peak characteristics for each land use type as “stand-alone” uses that have differing peak parking periods. **Table 7** provides a summary of standard peak parking demands for the multifamily residential (mid-rise) uses.

³ *Parking Generation, 6th Edition*, Institute of Transportation Engineers, Washington D.C. October 2023.

TABLE 7
PEAK PARKING DEMAND – ITE

Source	Peak Parking Rate	Peak Parking Demand
ITE Average Peak ¹	1.23 (per Unit)	292
ITE 95% Confidence ²	1.31 (per Unit)	311
ITE 85 th Percentile ³	1.45 (per Unit)	344

¹Average peak period demand per LUC 221 (Mid-Rise Apartment) for a General Urban/Suburban location applied to 237 Units.

²95% Confidence Interval for ITE LUC 221 peak parking generation rate applied to 237 Units.

³85th Percentile Parking Demand for ITE LUC 221 peak parking generation rate. applied to 237 Units.

As summarized in **Table 7**, standard residential peak parking demand for the 237-unit project ranges from 292 to 344 vehicles based on *ITE parking generation* rates with peak demands occurring during the overnight hours. Daytime hour demand (8 AM to 6 PM) will be 35 to 50 percent lower than overnight peak demands based on ITE time-of-day demand statistics. The onsite parking supply of 394 onsite parking spaces will accommodate the peak residential parking demands at the Site with a 13% surplus during peak periods.

6.1.2 Peak Parking Rates – Empirical

Parking observations at six (6) multi-family housing complexes were conducted during the overnight peak period. It is noted that access to garage spaces was restricted for the West Village development at the time of the observations; however, as a conservative measure all garage units were assumed to be fully occupied at the time of the count. Parking activity, residential unit count and associated peak parking rate for each of the multi-family residential complexes are presented in **Table 8** for comparison to the ITE parking rates.

TABLE 8
PEAK PARKING DEMAND – Empirical Data from Area Multi-Family Complexes

Development	City/Town	# Units	Peak Parking Usage	Peak Parking Rate (spaces per unit)
West Village ¹	Mansfield	204	283	1.39
Concord Mews	Concord	350	504	1.44
Cloverleaf	Natick	183	236	1.29
Chapel Hill West	Framingham	168	220	1.31
Chapel Hill East	Framingham	174	225	1.29
Martins Landing	North Reading	97	129	1.33
AVERAGE		208	294	1.34

¹Access to garage spaces was restricted; as a conservative measure, all garage units were assumed to be occupied at the time of the count. Peak demand includes observed surface parking activity plus all garage units as each garage is assumed to be occupied.

As presented in **Table 8**, peak parking demand rate of 1.34 spaces per unit exhibited by area multi-family housing complexes is highly consistent with ITE peak parking demand data described above. When applied to the proposed 237-unit project the peak parking demand for the proposed residential use is estimated to be approximately 318 spaces which is below the proposed parking supply of 394 marked spaces with an excess parking of approximately 19% (76± surplus spaces).

6.1.3 Parking Summary

In summary, industry standard peak parking rates published by ITE indicate a peak parking demand rate range of 1.23 to 1.45 spaces per unit for a multi-family housing complex. Empirical peak parking rates observed at area multi-family complexes range between 1.29 and 1.44 spaces per unit which is highly consistent with the ITE data. Based on the parking data reviewed, the projected peak parking demand is estimated at between 292 and 344 vehicles at full build-out and occupancy (237 units). As shown, the peak parking demand will be adequately accommodated by the proposed parking supply of 394± marked spaces. The data outlined in this memorandum supports the requested parking relief with respect to the requirements set forth by local zoning.

7.0 RECOMMENDATIONS AND CONCLUSIONS

7.1 RECOMMENDATIONS

MDM finds Main Street and Forest Ridge Road roadways within the site vicinity can accommodate modest traffic increases of the project. Relative traffic increases for the proposed project represent an inconsequential change in operations compared to No-Build conditions and are immaterial to traffic operations along Main Street (Route 62). However, several mitigation actions are identified to support the project to ensure that site access meets applicable safety criteria, to enhance neighborhood walking/bicycling and to reduce dependency on single-occupant auto use. These include (a) access-related improvements, (b) pedestrian and bicycle accommodations and (c) TDM actions as summarized below.

Access/Egress Improvements

- *Driveway Design.* The final driveway alignment, widths and curb radii have been designed to accommodate the Town's largest fire apparatus (ladder truck) and single unit delivery trucks. The final driveway layout achieves a perpendicular alignment to the exiting Thoreau Club driveway. Signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) should be installed on the approach to the Thoreau Club driveway including a "STOP" sign (R2-1) and "STOP" line pavement markings.
- *Sight Line Triangles.* The available sight lines at the Thoreau Club driveway intersection with the proposed site driveway will satisfy the recommended sight line requirements from AASHTO. New plantings (shrubs, bushes) and structures (walls, fences, etc.) shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow accumulation (windrows) located within sight triangle areas that exceed 3.5-feet in height or that would otherwise inhibit sight lines shall be promptly removed.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections.* The Site Plan incorporates sidewalks that connect the proposed buildings, on-site surface parking areas, amenity space, and the expansive existing sidewalk network that is already in place along Forest Ridge Road, Main Street, the existing Thoreau Club, and internal neighborhood roadways. As part of the project, ADA compliant crosswalks and markings should be provided at all internal crosswalks, and a crosswalk with ADA compliant ramps should be provided on the exiting Thoreau Club driveway to the north of the proposed site driveway.
- *Bicycle Amenities.* The Proponent should incorporate secure weather-protected bicycle racks to encourage and facilitate this mode of transportation to/from the Site by residents. Additional bike racks near the entranceways should also be provided to accommodate visitors.

Transportation Demand Management (TDM) Program

The Proponent is committed to reduce auto dependency by residents by implementing a TDM program. A preliminary list of potential TDM program elements may include the following, subject to refinement of the development program and further evaluation by the Proponent:

- *Vehicle Charging Stations.* Electric vehicle charging stations/outlets should be provided for resident use. The proponent should place additional conduit within the parking area to facilitate additional charging stations to meet actual demand over time.
- *Bicycle Facilities.* Provide bicycle parking, including secure weather protected racks for residents and conveniently located racks for visitors proximate to the building entrances.
- *On-Site Amenities.* The Proponent should provide on-site amenities that may include a fitness center for residents, mailroom, a club room, and other features for residents.
- *Pedestrian Infrastructure.* Sidewalk connections will be provided along primary pedestrian desire lines that connect building entrances with the surface parking areas, on-site amenities, and the existing sidewalk network in the area.

7.2 CONCLUSIONS

In summary, the proposed residential development will be accommodated well within capacity of Main Street, Forest Ridge Road and the primary intersection of Main Street at Forester Ridge Road with no discernable impact to traffic flow and at operating levels compared to No-Build conditions. The Forest Ridge Road will continue to operate well below capacity at LOS D or better during the peak hours. Accordingly, no off-site roadway improvements are warranted to accommodate the project. The available sight lines at the proposed site driveway intersection with the existing Thoreau Club driveway will exceed the recommended sight line requirements from AASHTO. The proposed parking supply while less than the zoning requirement will be adequate to accommodate the peak parking demands for the Site based on industry standard and empirical parking rates. Proposed access/egress improvements, pedestrian and bicycle accommodations, and TDM program as outlined in the *Conclusions and Recommendations* will establish a framework of minimizing Site traffic impacts by encouraging non-motorized travel modes and pedestrian accommodation that is compatible with other projects in the area.

APPENDIX

- Traffic Volume Data
- Seasonal/Yearly Growth Data
- Crash Data
- Sight Distance Calculations
- Background Projects
- Trip Generation
- Trip Distribution Calculations
- Delay Study
- Capacity Analysis
- Signal Warrant Analysis

□ Traffic Volume Data

N/S: Forest Ridge Road
E/W: Main Street
Concord, MA

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Site Code : 1319
Start Date : 10/10/2024
Page No : 1

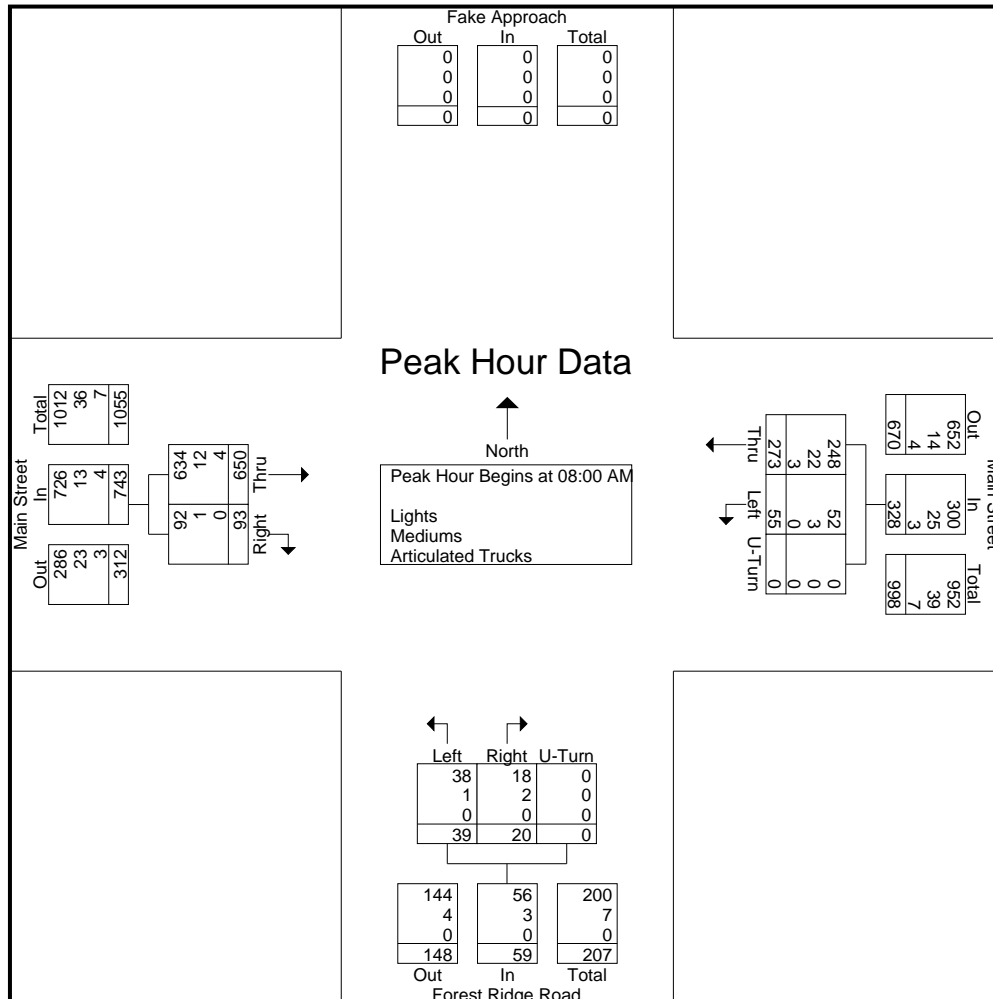
Groups Printed- Lights - Mediums - Articulated Trucks

Start Time	Main Street From East				Forest Ridge Road From South				Main Street From West			Int. Total
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	App. Total	
07:00 AM	40	4	0	44	6	9	0	15	7	152	159	218
07:15 AM	50	7	0	57	5	7	0	12	19	130	149	218
07:30 AM	40	4	0	44	0	8	0	8	6	155	161	213
07:45 AM	82	4	0	86	2	4	0	6	12	180	192	284
Total	212	19	0	231	13	28	0	41	44	617	661	933
08:00 AM	52	10	0	62	3	8	0	11	16	173	189	262
08:15 AM	67	19	0	86	2	8	0	10	33	172	205	301
08:30 AM	64	13	0	77	7	9	0	16	20	166	186	279
08:45 AM	90	13	0	103	8	14	0	22	24	139	163	288
Total	273	55	0	328	20	39	0	59	93	650	743	1130
04:00 PM	136	12	0	148	7	22	0	29	18	97	115	292
04:15 PM	129	12	0	141	12	10	0	22	29	77	106	269
04:30 PM	147	9	0	156	5	21	0	26	7	99	106	288
04:45 PM	143	8	0	151	5	14	0	19	9	113	122	292
Total	555	41	0	596	29	67	0	96	63	386	449	1141
05:00 PM	118	11	0	129	7	9	0	16	9	90	99	244
05:15 PM	153	9	0	162	8	15	0	23	4	87	91	276
05:30 PM	130	6	0	136	15	13	0	28	5	119	124	288
05:45 PM	139	7	0	146	7	10	0	17	14	105	119	282
Total	540	33	0	573	37	47	0	84	32	401	433	1090
Grand Total	1580	148	0	1728	99	181	0	280	232	2054	2286	4294
Apprch %	91.4	8.6	0		35.4	64.6	0		10.1	89.9		
Total %	36.8	3.4	0	40.2	2.3	4.2	0	6.5	5.4	47.8	53.2	
Lights	1515	144	0	1659	97	178	0	275	230	2002	2232	4166
% Lights	95.9	97.3	0	96	98	98.3	0	98.2	99.1	97.5	97.6	97
Mediums	60	4	0	64	2	2	0	4	2	44	46	114
% Mediums	3.8	2.7	0	3.7	2	1.1	0	1.4	0.9	2.1	2	2.7
Articulated Trucks	5	0	0	5	0	1	0	1	0	8	8	14
% Articulated Trucks	0.3	0	0	0.3	0	0.6	0	0.4	0	0.4	0.3	0.3

N/S: Forest Ridge Road
E/W: Main Street
Concord, MA

File Name : 1319_Forest_at_Main_2024_TMC_1236148_10-10-2024
Site Code : 1319
Start Date : 10/10/2024
Page No : 2

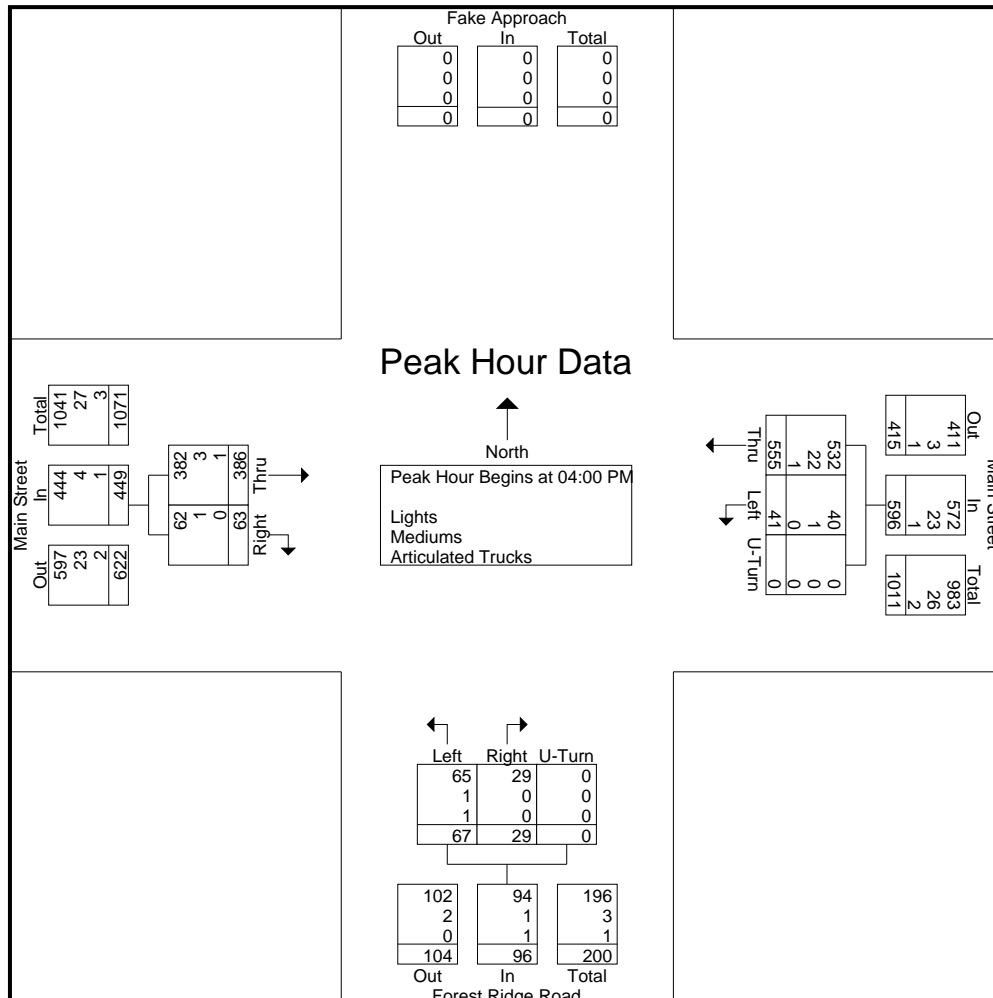
Start Time	Main Street From East				Forest Ridge Road From South				Main Street From West			Int. Total
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1												
Peak Hour for Entire Intersection Begins at 08:00 AM												
08:00 AM	52	10	0	62	3	8	0	11	16	173	189	262
08:15 AM	67	19	0	86	2	8	0	10	33	172	205	301
08:30 AM	64	13	0	77	7	9	0	16	20	166	186	279
08:45 AM	90	13	0	103	8	14	0	22	24	139	163	288
Total Volume	273	55	0	328	20	39	0	59	93	650	743	1130
% App. Total	83.2	16.8	0		33.9	66.1	0		12.5	87.5		
PHF	.758	.724	.000	.796	.625	.696	.000	.670	.705	.939	.906	.939
Lights	248	52	0	300	18	38	0	56	92	634	726	1082
% Lights	90.8	94.5	0	91.5	90.0	97.4	0	94.9	98.9	97.5	97.7	95.8
Mediums	22	3	0	25	2	1	0	3	1	12	13	41
% Mediums	8.1	5.5	0	7.6	10.0	2.6	0	5.1	1.1	1.8	1.7	3.6
Articulated Trucks	3	0	0	3	0	0	0	0	0	4	4	7
% Articulated Trucks	1.1	0	0	0.9	0	0	0	0	0	0.6	0.5	0.6



N/S: Forest Ridge Road
E/W: Main Street
Concord, MA

File Name : 1319_Forest_at_Main_2024_TMC_1236148_10-10-2024
Site Code : 1319
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Page No : 3

Start Time	Main Street From East				Forest Ridge Road From South				Main Street From West			Int. Total
	Thru	Left	U-Turn	App. Total	Right	Left	U-Turn	App. Total	Right	Thru	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1												
Peak Hour for Entire Intersection Begins at 04:00 PM												
04:00 PM	136	12	0	148	7	22	0	29	18	97	115	292
04:15 PM	129	12	0	141	12	10	0	22	29	77	106	269
04:30 PM	147	9	0	156	5	21	0	26	7	99	106	288
04:45 PM	143	8	0	151	5	14	0	19	9	113	122	292
Total Volume	555	41	0	596	29	67	0	96	63	386	449	1141
% App. Total	93.1	6.9	0		30.2	69.8	0		14	86		
PHF	.944	.854	.000	.955	.604	.761	.000	.828	.543	.854	.920	.977
Lights	532	40	0	572	29	65	0	94	62	382	444	1110
% Lights	95.9	97.6	0	96.0	100	97.0	0	97.9	98.4	99.0	98.9	97.3
Mediums	22	1	0	23	0	1	0	1	1	3	4	28
% Mediums	4.0	2.4	0	3.9	0	1.5	0	1.0	1.6	0.8	0.9	2.5
Articulated Trucks	1	0	0	1	0	1	0	1	0	1	1	3
% Articulated Trucks	0.2	0	0	0.2	0	1.5	0	1.0	0	0.3	0.2	0.3



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

SB: Forest Ridge Road
E/W: Loop Road
Concord, MA

File Name : 1319_Forest_Ridge_at_Loop_NW_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks - Bicycles on Road

Start Time	Forest Ridge Road From North				Loop Road From East				Loop Road From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	
07:00 AM	7	0	0	7	2	1	0	3	0	0	0	0	10
07:15 AM	15	0	0	15	3	0	0	3	0	0	0	0	18
07:30 AM	9	0	0	9	3	0	0	3	0	0	0	0	12
07:45 AM	11	0	0	11	8	0	0	8	0	0	0	0	19
Total	42	0	0	42	16	1	0	17	0	0	0	0	59
08:00 AM	23	0	0	23	7	0	0	7	0	0	0	0	30
08:15 AM	27	0	0	27	9	0	0	9	0	0	0	0	36
08:30 AM	19	0	1	20	16	0	0	16	0	0	0	0	36
08:45 AM	24	0	0	24	6	0	0	6	0	0	0	0	30
Total	93	0	1	94	38	0	0	38	0	0	0	0	132
04:00 PM	17	0	0	17	10	8	0	18	0	0	0	0	35
04:15 PM	18	0	0	18	8	1	0	9	0	0	0	0	27
04:30 PM	14	0	0	14	8	0	0	8	0	0	0	0	22
04:45 PM	21	0	0	21	8	0	0	8	0	0	0	0	29
Total	70	0	0	70	34	9	0	43	0	0	0	0	113
05:00 PM	10	0	0	10	25	0	1	26	0	0	0	0	36
05:15 PM	13	0	0	13	16	0	0	16	0	0	0	0	29
05:30 PM	10	0	0	10	11	0	0	11	0	0	0	0	21
05:45 PM	33	0	0	33	16	0	0	16	0	0	0	0	49
Total	66	0	0	66	68	0	1	69	0	0	0	0	135
Grand Total	271	0	1	272	156	10	1	167	0	0	0	0	439
Apprch %	99.6	0	0.4		93.4	6	0.6		0	0	0		
Total %	61.7	0	0.2	62	35.5	2.3	0.2	38	0	0	0	0	
Lights	269	0	1	270	154	2	1	157	0	0	0	0	427
% Lights	99.3	0	100	99.3	98.7	20	100	94	0	0	0	0	97.3
Mediums	2	0	0	2	2	0	0	2	0	0	0	0	4
% Mediums	0.7	0	0	0.7	1.3	0	0	1.2	0	0	0	0	0.9
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	8	0	8	0	0	0	0	8
% Bicycles on Road	0	0	0	0	0	80	0	4.8	0	0	0	0	1.8

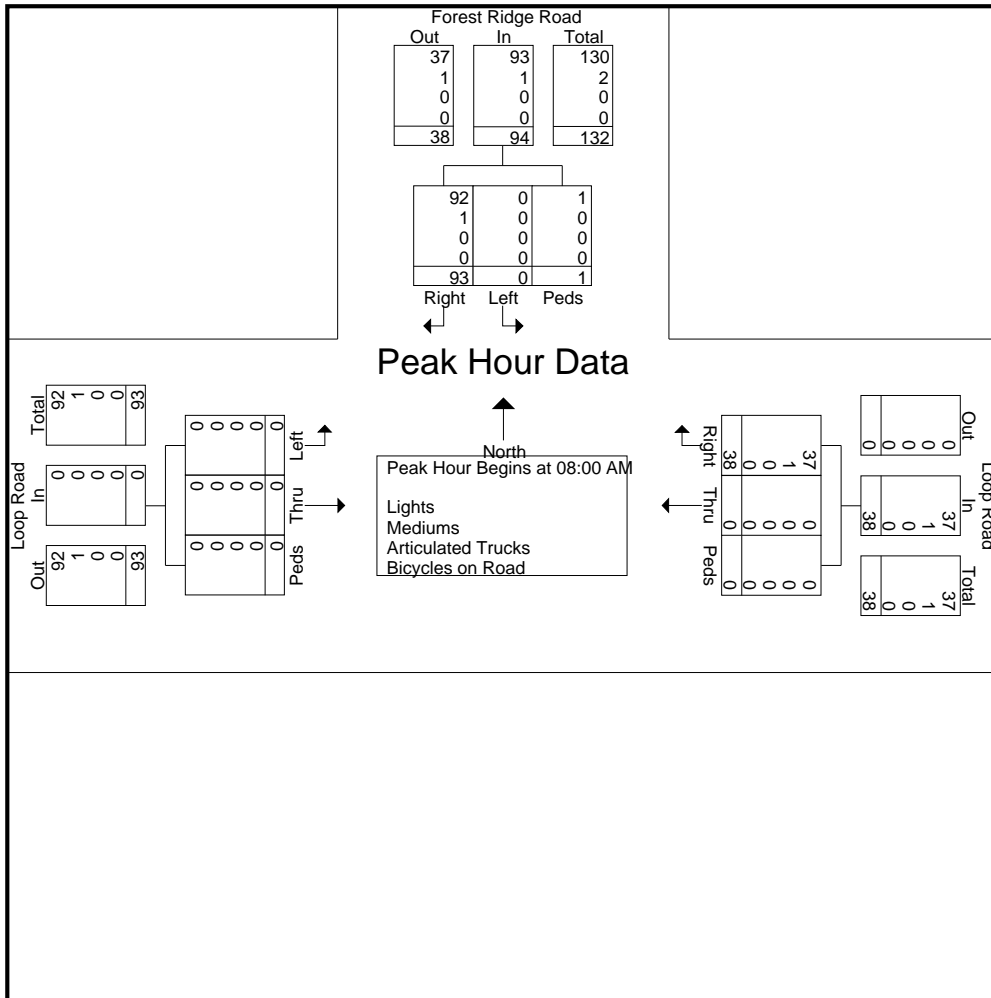
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

SB: Forest Ridge Road
E/W: Loop Road
Concord, MA

File Name : 1319_Forest_Ridge_at_Loop_NW_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 2

Start Time	Forest Ridge Road From North				Loop Road From East				Loop Road From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	23	0	0	23	7	0	0	7	0	0	0	0	30
08:15 AM	27	0	0	27	9	0	0	9	0	0	0	0	36
08:30 AM	19	0	1	20	16	0	0	16	0	0	0	0	36
08:45 AM	24	0	0	24	6	0	0	6	0	0	0	0	30
Total Volume	93	0	1	94	38	0	0	38	0	0	0	0	132
% App. Total	98.9	0	1.1	100	97.4	0	0	97.4	0	0	0	0	98.5
PHF	.861	.000	.250	.870	.594	.000	.000	.594	.000	.000	.000	.000	.917
Lights	92	0	1	93	37	0	0	37	0	0	0	0	130
% Lights	98.9	0	100	98.9	97.4	0	0	97.4	0	0	0	0	98.5
Mediums	1	0	0	1	1	0	0	1	0	0	0	0	2
% Mediums	1.1	0	0	1.1	2.6	0	0	2.6	0	0	0	0	1.5
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



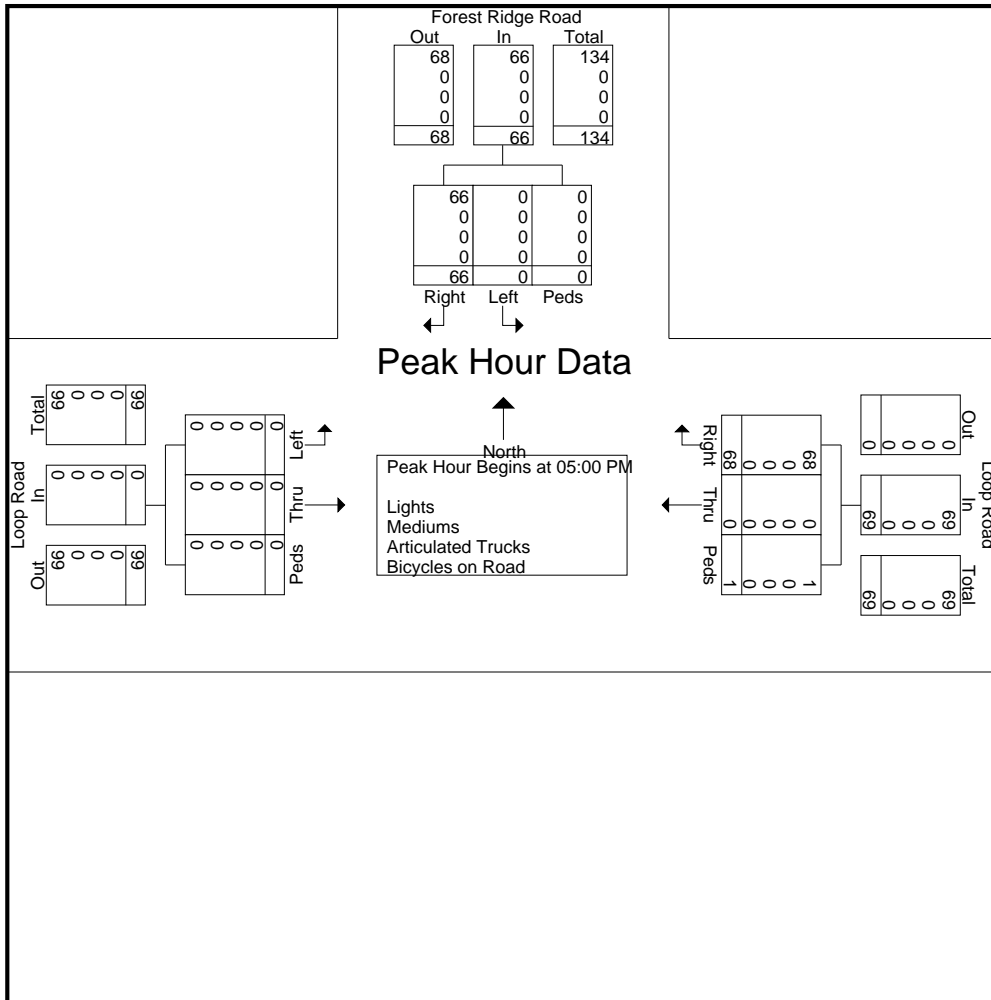
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

SB: Forest Ridge Road
E/W: Loop Road
Concord, MA

File Name : 1319_Forest_Ridge_at_Loop_NW_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 3

Start Time	Forest Ridge Road From North				Loop Road From East				Loop Road From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	10	0	0	10	25	0	1	26	0	0	0	0	36
05:15 PM	13	0	0	13	16	0	0	16	0	0	0	0	29
05:30 PM	10	0	0	10	11	0	0	11	0	0	0	0	21
05:45 PM	33	0	0	33	16	0	0	16	0	0	0	0	49
Total Volume	66	0	0	66	68	0	1	69	0	0	0	0	135
% App. Total	100	0	0		98.6	0	1.4		0	0	0		
PHF	.500	.000	.000	.500	.680	.000	.250	.663	.000	.000	.000	.000	.689
Lights	66	0	0	66	68	0	1	69	0	0	0	0	135
% Lights	100	0	0	100	100	0	100	100	0	0	0	0	100
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Loop Road
WB: Black Birch Lane
Concord, MA

File Name : 1319_Black_Birch_at_Loop_NE_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks - Bicycles on Road

Start Time	Loop Road From North				Black Birch Lane From East				Loop Road From South				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
07:00 AM	0	0	0	0	1	0	1	2	1	2	0	3	5
07:15 AM	0	0	0	0	0	0	0	0	0	3	0	3	3
07:30 AM	0	0	0	0	0	0	0	0	0	3	0	3	3
07:45 AM	0	0	0	0	1	0	0	1	0	7	0	7	8
Total	0	0	0	0	2	0	1	3	1	15	0	16	19
08:00 AM	0	0	0	0	0	0	2	2	0	7	0	7	9
08:15 AM	0	0	0	0	0	0	0	0	0	9	0	9	9
08:30 AM	0	0	0	0	1	0	1	2	0	15	0	15	17
08:45 AM	0	0	0	0	0	0	0	0	0	6	0	6	6
Total	0	0	0	0	1	0	3	4	0	37	0	37	41
04:00 PM	0	0	0	0	1	0	0	1	0	18	0	18	19
04:15 PM	0	0	0	0	1	0	0	1	2	8	0	10	11
04:30 PM	0	0	0	0	0	0	0	0	2	8	0	10	10
04:45 PM	0	0	0	0	2	0	0	2	0	6	0	6	8
Total	0	0	0	0	4	0	0	4	4	40	0	44	48
05:00 PM	0	0	0	0	0	0	0	0	0	25	0	25	25
05:15 PM	0	0	0	0	0	0	1	1	0	14	0	14	15
05:30 PM	0	0	0	0	0	0	0	0	0	11	0	11	11
05:45 PM	0	0	0	0	0	0	0	0	0	16	0	16	16
Total	0	0	0	0	0	0	1	1	0	66	0	66	67
Grand Total	0	0	0	0	7	0	5	12	5	158	0	163	175
Apprch %	0	0	0	0	58.3	0	41.7		3.1	96.9	0		
Total %	0	0	0	0	4	0	2.9	6.9	2.9	90.3	0	93.1	
Lights	0	0	0	0	6	0	5	11	5	149	0	154	165
% Lights	0	0	0	0	85.7	0	100	91.7	100	94.3	0	94.5	94.3
Mediums	0	0	0	0	0	0	0	0	0	2	0	2	2
% Mediums	0	0	0	0	0	0	0	0	0	1.3	0	1.2	1.1
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	1	0	0	1	0	7	0	7	8
% Bicycles on Road	0	0	0	0	14.3	0	0	8.3	0	4.4	0	4.3	4.6

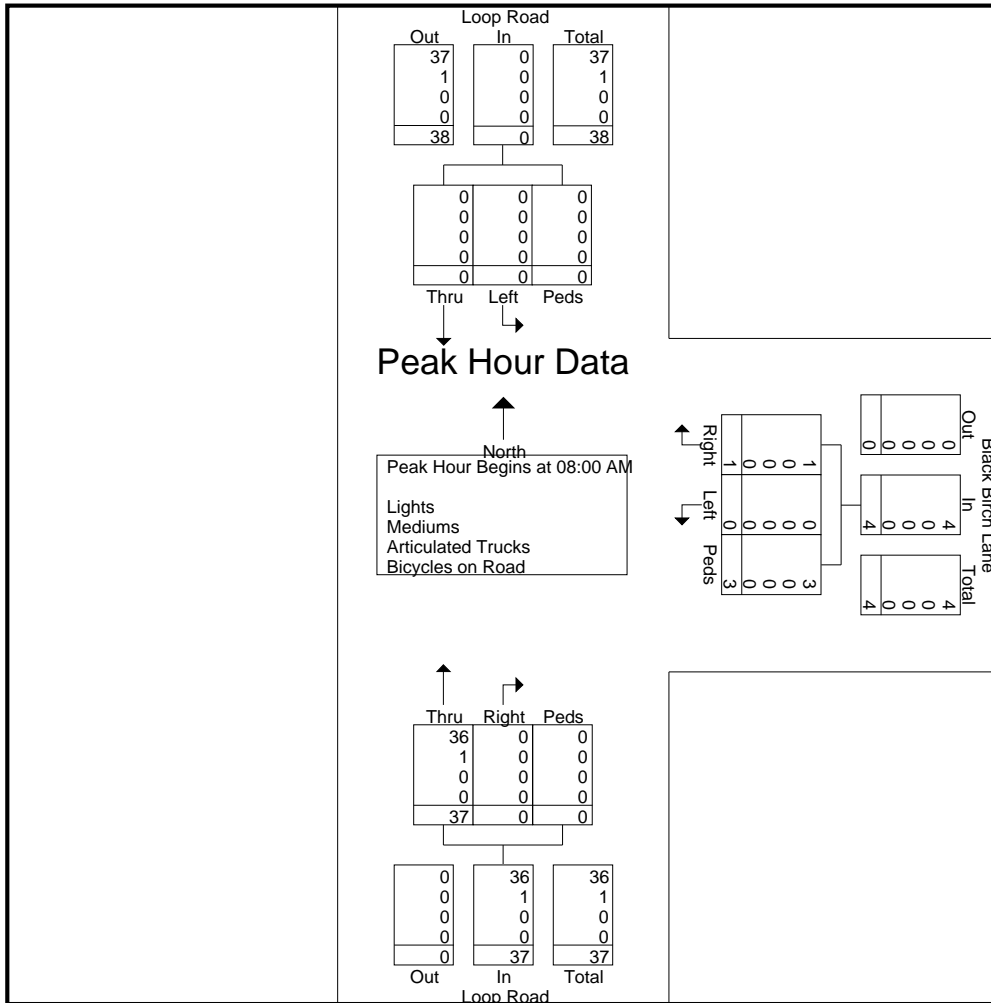
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Loop Road
WB: Black Birch Lane
Concord, MA

File Name : 1319_Black_Birch_at_Loop_NE_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 2

Start Time	Loop Road From North				Black Birch Lane From East				Loop Road From South				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 08:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	0	0	0	0	0	0	2	2	0	7	0	7	9
08:15 AM	0	0	0	0	0	0	0	0	0	9	0	9	9
08:30 AM	0	0	0	0	1	0	1	2	0	15	0	15	17
08:45 AM	0	0	0	0	0	0	0	0	0	6	0	6	6
Total Volume	0	0	0	0	1	0	3	4	0	37	0	37	41
% App. Total	0	0	0	0	25	0	75	100	0	100	0	100	100
PHF	.000	.000	.000	.000	.250	.000	.375	.500	.000	.617	.000	.617	.603
Lights	0	0	0	0	1	0	3	4	0	36	0	36	40
% Lights	0	0	0	0	100	0	100	100	0	97.3	0	97.3	97.6
Mediums	0	0	0	0	0	0	0	0	0	1	0	1	1
% Mediums	0	0	0	0	0	0	0	0	0	2.7	0	2.7	2.4
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



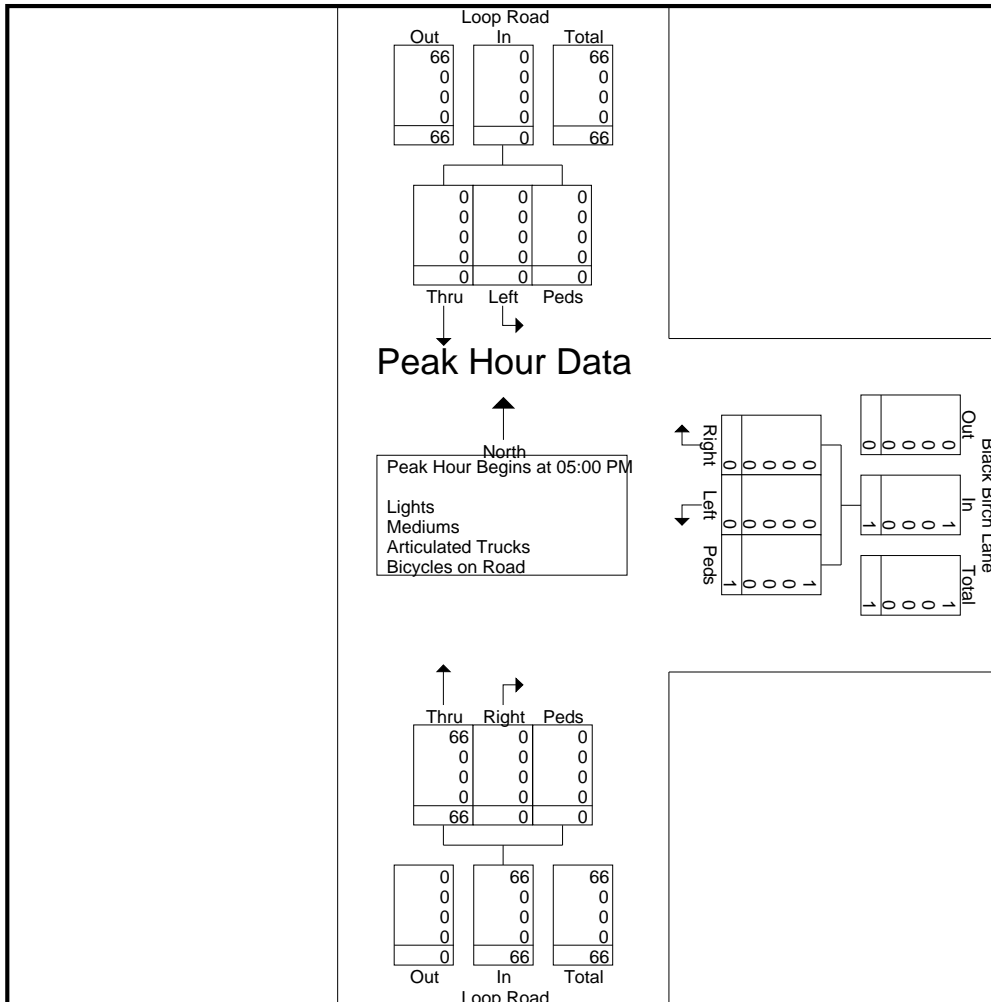
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28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Loop Road
WB: Black Birch Lane
Concord, MA

File Name : 1319_Black_Birch_at_Loop_NE_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 3

Start Time	Loop Road From North				Black Birch Lane From East				Loop Road From South				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	0	0	0	0	0	0	0	0	0	25	0	25	25
05:15 PM	0	0	0	0	0	0	1	1	0	14	0	14	15
05:30 PM	0	0	0	0	0	0	0	0	0	11	0	11	11
05:45 PM	0	0	0	0	0	0	0	0	0	16	0	16	16
Total Volume	0	0	0	0	0	0	1	1	0	66	0	66	67
% App. Total	0	0	0	0	0	0	100	100	0	100	0	100	100
PHF	.000	.000	.000	.000	.000	.000	.250	.250	.000	.660	.000	.660	.670
Lights	0	0	0	0	0	0	1	1	0	66	0	66	67
% Lights	0	0	0	0	0	0	100	100	0	100	0	100	100
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Loop Road
NB: Forest Ridge Road
Concord, MA

File Name : 1319_Forest_Ridge_at_Loop_SE_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks - Bicycles on Road

Start Time	Loop Road From East				Forest Ridge Road From South				Loop Road From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
07:00 AM	0	0	0	0	1	0	1	2	7	1	0	8	10
07:15 AM	0	0	0	0	3	0	0	3	14	0	0	14	17
07:30 AM	0	0	0	0	2	0	0	2	10	1	0	11	13
07:45 AM	0	0	0	0	6	0	0	6	10	1	0	11	17
Total	0	0	0	0	12	0	1	13	41	3	0	44	57
08:00 AM	0	0	0	0	6	0	3	9	21	0	0	21	30
08:15 AM	0	0	0	0	8	0	0	8	29	1	0	30	38
08:30 AM	0	0	0	0	13	0	0	13	16	3	0	19	32
08:45 AM	0	0	0	0	5	0	0	5	24	1	0	25	30
Total	0	0	0	0	32	0	3	35	90	5	0	95	130
04:00 PM	0	0	0	0	9	0	1	10	17	9	0	26	36
04:15 PM	0	0	0	0	7	0	0	7	15	3	0	18	25
04:30 PM	0	0	0	0	8	0	2	10	11	1	0	12	22
04:45 PM	0	0	0	0	6	0	2	8	20	0	0	20	28
Total	0	0	0	0	30	0	5	35	63	13	0	76	111
05:00 PM	0	0	0	0	24	0	0	24	13	1	1	15	39
05:15 PM	0	0	0	0	12	0	1	13	11	1	0	12	25
05:30 PM	0	0	0	0	11	0	0	11	10	1	0	11	22
05:45 PM	0	0	0	0	15	0	0	15	32	0	0	32	47
Total	0	0	0	0	62	0	1	63	66	3	1	70	133
Grand Total	0	0	0	0	136	0	10	146	260	24	1	285	431
Apprch %	0	0	0	0	93.2	0	6.8	93.2	91.2	8.4	0.4	96.1	
Total %	0	0	0	0	31.6	0	2.3	33.9	60.3	5.6	0.2	66.1	
Lights	0	0	0	0	136	0	10	146	258	15	1	274	420
% Lights	0	0	0	0	100	0	100	100	99.2	62.5	100	96.1	97.4
Mediums	0	0	0	0	0	0	0	0	0	2	0	2	2
% Mediums	0	0	0	0	0	0	0	0	0	8.3	0	0.7	0.5
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	2	7	0	9	9
% Bicycles on Road	0	0	0	0	0	0	0	0	0.8	29.2	0	3.2	2.1

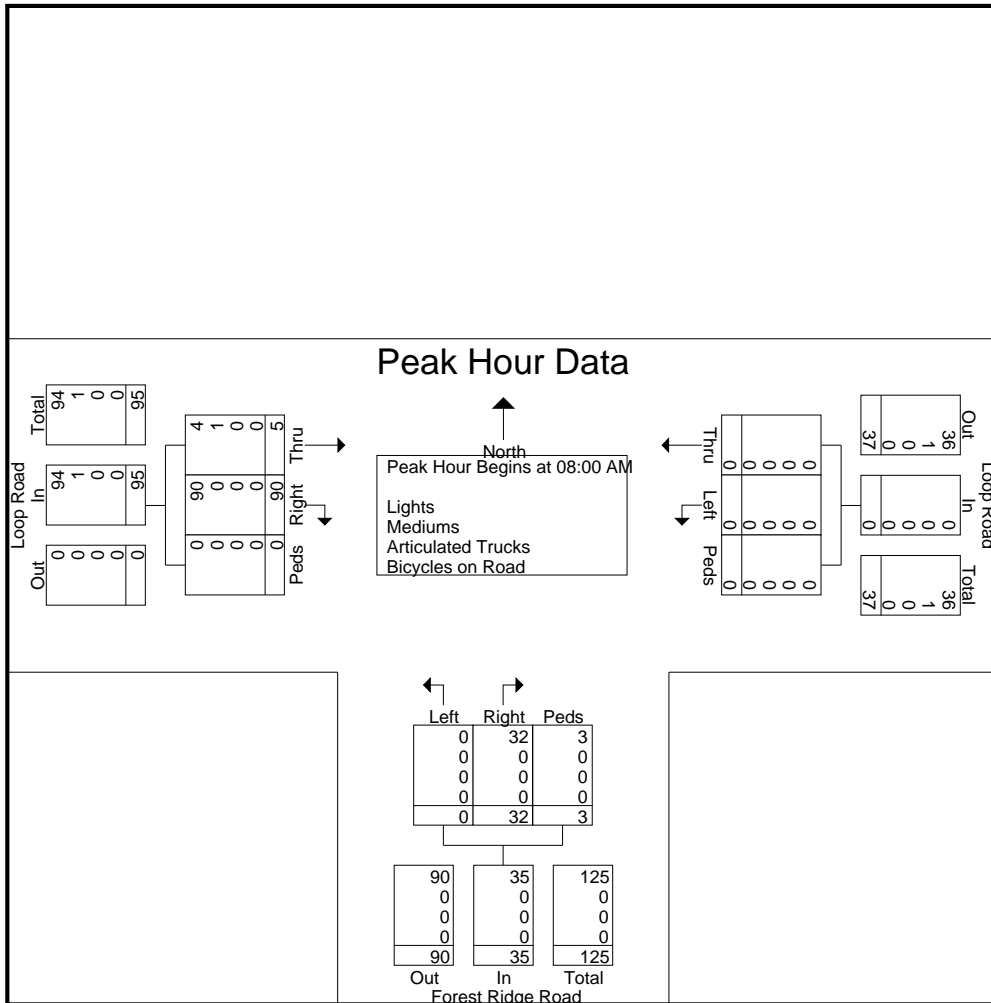
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Loop Road
NB: Forest Ridge Road
Concord, MA

File Name : 1319_Forest_Ridge_at_Loop_SE_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 2

Start Time	Loop Road From East				Forest Ridge Road From South				Loop Road From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	0	0	0	0	6	0	3	9	21	0	0	21	30
08:15 AM	0	0	0	0	8	0	0	8	29	1	0	30	38
08:30 AM	0	0	0	0	13	0	0	13	16	3	0	19	32
08:45 AM	0	0	0	0	5	0	0	5	24	1	0	25	30
Total Volume	0	0	0	0	32	0	3	35	90	5	0	95	130
% App. Total	0	0	0	0	91.4	0	8.6		94.7	5.3	0		
PHF	.000	.000	.000	.000	.615	.000	.250	.673	.776	.417	.000	.792	.855
Lights	0	0	0	0	32	0	3	35	90	4	0	94	129
% Lights	0	0	0	0	100	0	100	100	100	80.0	0	98.9	99.2
Mediums	0	0	0	0	0	0	0	0	0	1	0	1	1
% Mediums	0	0	0	0	0	0	0	0	0	20.0	0	1.1	0.8
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Loop Road
NB: Forest Ridge Road
Concord, MA

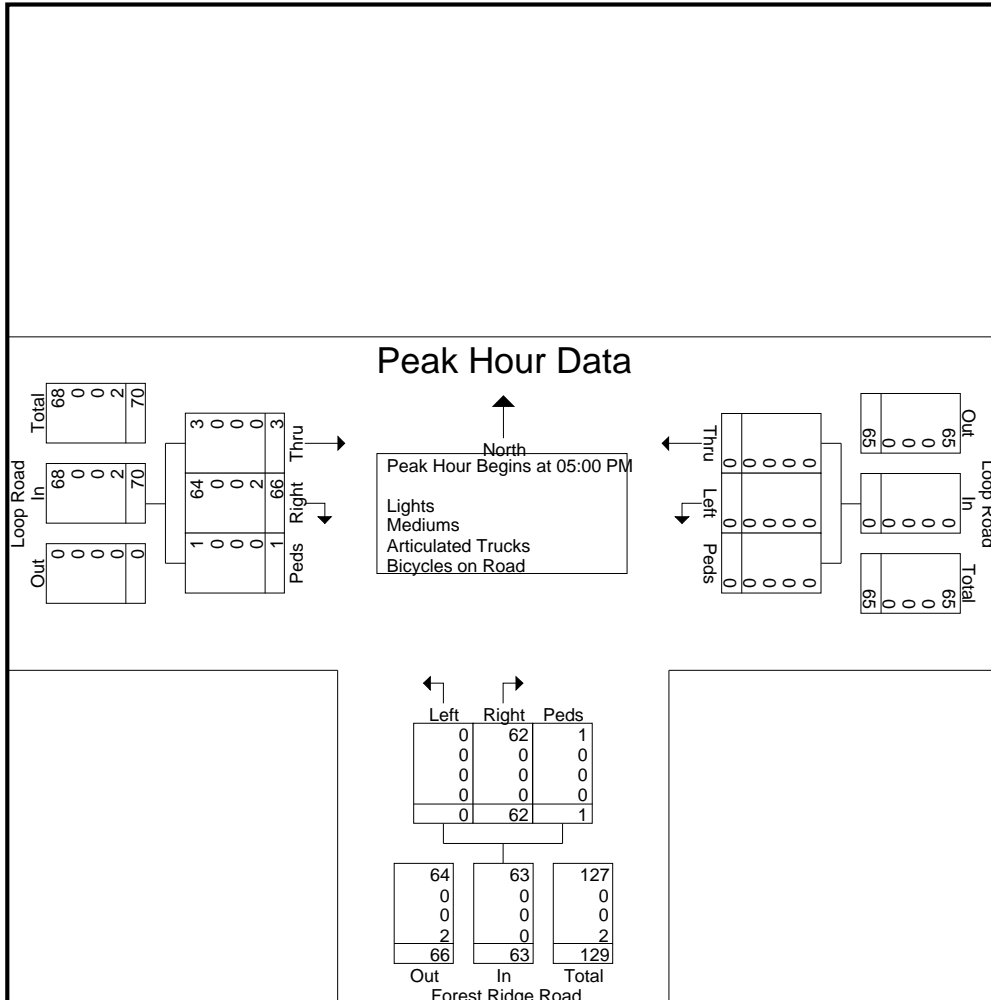
File Name : 1319_Forest_Ridge_at_Loop_SE_10-26-2023

Site Code : 1319

Start Date : 10/26/2023

Page No : 3

Start Time	Loop Road From East				Forest Ridge Road From South				Loop Road From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	0	0	0	0	24	0	0	24	13	1	1	15	39
05:15 PM	0	0	0	0	12	0	1	13	11	1	0	12	25
05:30 PM	0	0	0	0	11	0	0	11	10	1	0	11	22
05:45 PM	0	0	0	0	15	0	0	15	32	0	0	32	47
Total Volume	0	0	0	0	62	0	1	63	66	3	1	70	133
% App. Total	0	0	0	0	98.4	0	1.6	94.3	94.3	4.3	1.4	70	133
PHF	.000	.000	.000	.000	.646	.000	.250	.656	.516	.750	.250	.547	.707
Lights	0	0	0	0	62	0	1	63	64	3	1	68	131
% Lights	0	0	0	0	100	0	100	100	97.0	100	100	97.1	98.5
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	2	0	0	2	2
% Bicycles on Road	0	0	0	0	0	0	0	0	3.0	0	0	2.9	1.5



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Loop Road
NB: Sweet Birch Lane
Concord, MA

File Name : 1319_Sweet_Birch_at_Loop_SW_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks - Bicycles on Road

Start Time	Loop Road From East				Sweet Birch Lane From South				Loop Road From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
07:00 AM	0	0	0	0	0	0	0	0	0	8	0	8	8
07:15 AM	0	0	0	0	0	0	0	0	0	14	0	14	14
07:30 AM	0	0	0	0	1	0	1	2	0	10	0	10	12
07:45 AM	0	0	0	0	1	0	5	6	0	9	0	9	15
Total	0	0	0	0	2	0	6	8	0	41	0	41	49
08:00 AM	0	0	0	0	0	0	0	0	1	23	0	24	24
08:15 AM	0	0	0	0	1	0	0	1	0	29	0	29	30
08:30 AM	0	0	0	0	2	0	0	2	0	18	0	18	20
08:45 AM	0	0	0	0	0	0	0	0	0	23	0	23	23
Total	0	0	0	0	3	0	0	3	1	93	0	94	97
04:00 PM	0	0	0	0	0	0	0	0	1	27	0	28	28
04:15 PM	0	0	0	0	0	0	2	2	0	18	0	18	20
04:30 PM	0	0	0	0	0	0	0	0	1	13	0	14	14
04:45 PM	0	0	1	1	0	0	1	1	0	20	0	20	22
Total	0	0	1	1	0	0	3	3	2	78	0	80	84
05:00 PM	0	0	0	0	1	0	0	1	0	11	0	11	12
05:15 PM	0	0	0	0	1	0	2	3	1	9	0	10	13
05:30 PM	0	0	0	0	1	0	2	3	1	12	0	13	16
05:45 PM	0	0	0	0	0	0	1	1	1	31	0	32	33
Total	0	0	0	0	3	0	5	8	3	63	0	66	74
Grand Total	0	0	1	1	8	0	14	22	6	275	0	281	304
Apprch %	0	0	100		36.4	0	63.6		2.1	97.9	0		
Total %	0	0	0.3	0.3	2.6	0	4.6	7.2	2	90.5	0	92.4	
Lights	0	0	1	1	8	0	14	22	5	266	0	271	294
% Lights	0	0	100	100	100	0	100	100	83.3	96.7	0	96.4	96.7
Mediums	0	0	0	0	0	0	0	0	0	2	0	2	2
% Mediums	0	0	0	0	0	0	0	0	0	0.7	0	0.7	0.7
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	1	7	0	8	8
% Bicycles on Road	0	0	0	0	0	0	0	0	16.7	2.5	0	2.8	2.6

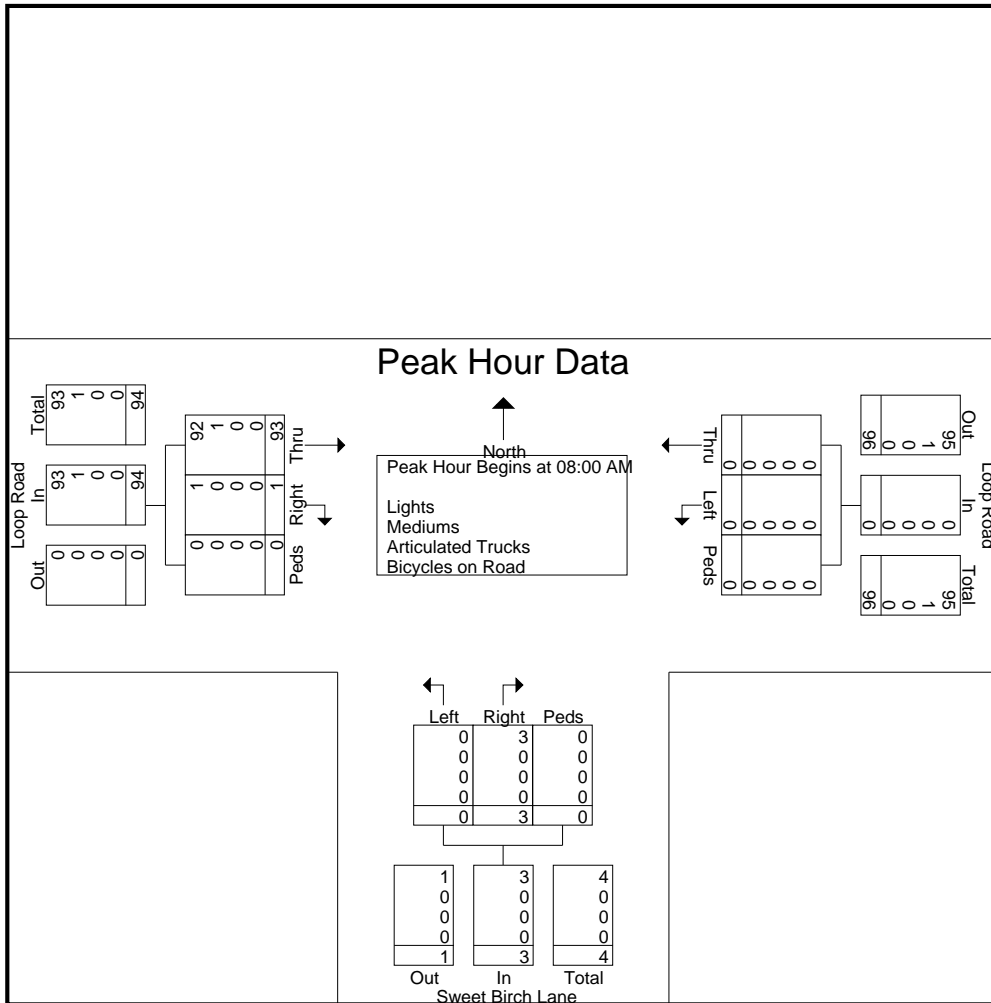
MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

E/W: Loop Road
NB: Sweet Birch Lane
Concord, MA

File Name : 1319_Sweet_Birch_at_Loop_SW_10-26-2023
Site Code : 1319
Start Date : 10/26/2023
Page No : 2

Start Time	Loop Road From East				Sweet Birch Lane From South				Loop Road From West				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	0	0	0	0	0	0	0	0	1	23	0	24	24
08:15 AM	0	0	0	0	1	0	0	1	0	29	0	29	30
08:30 AM	0	0	0	0	2	0	0	2	0	18	0	18	20
08:45 AM	0	0	0	0	0	0	0	0	0	23	0	23	23
Total Volume	0	0	0	0	3	0	0	3	1	93	0	94	97
% App. Total	0	0	0	0	100	0	0	100	1.1	98.9	0	98.9	99.0
PHF	.000	.000	.000	.000	.375	.000	.000	.375	.250	.802	.000	.810	.808
Lights	0	0	0	0	3	0	0	3	1	92	0	93	96
% Lights	0	0	0	0	100	0	0	100	100	98.9	0	98.9	99.0
Mediums	0	0	0	0	0	0	0	0	0	1	0	1	1
% Mediums	0	0	0	0	0	0	0	0	0	1.1	0	1.1	1.0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0

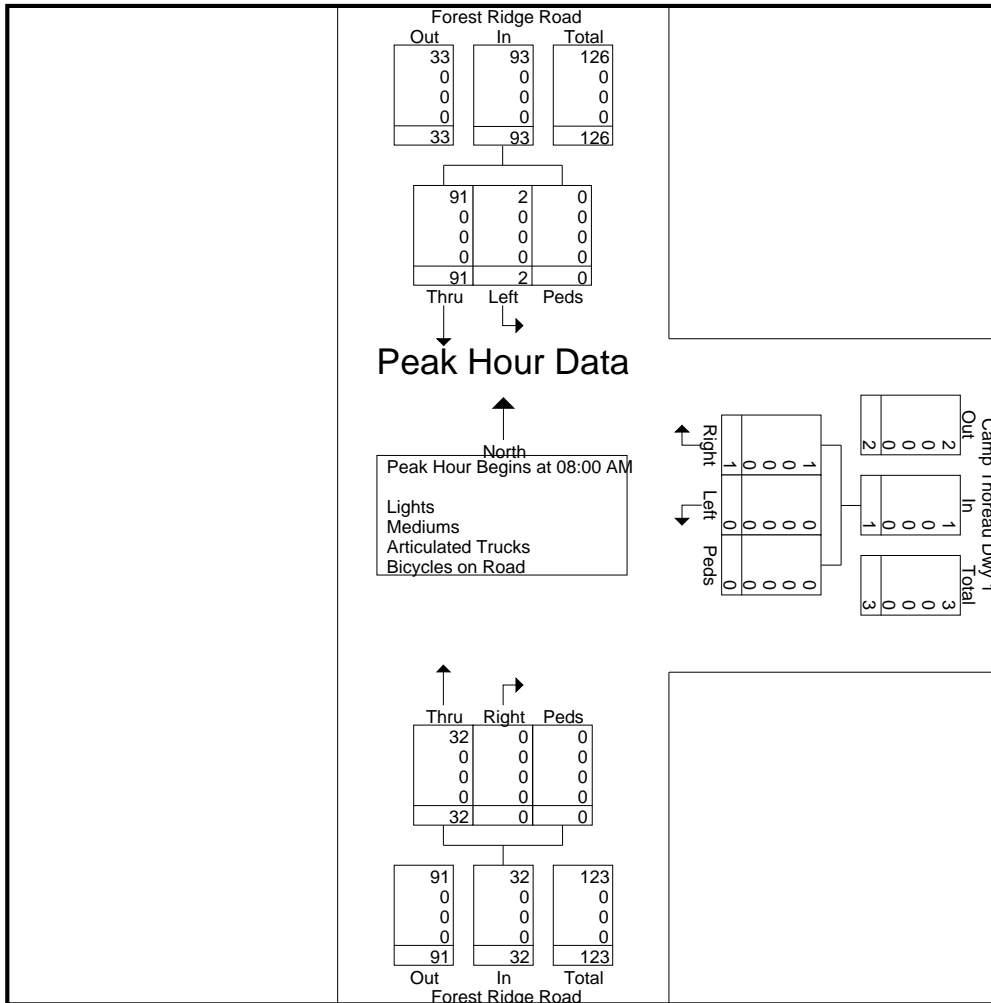


MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Forest Ridge Road File Name : 1319_Forest_Ridge_at_Camp_Thoreau_First_10-26-2023
 WB: Camp Thoreau North Dwy Site Code : 1319
 Concord, MA Start Date : 10/26/2023
 Page No : 2

Start Time	Forest Ridge Road From North				Camp Thoreau Dwy 1 From East				Forest Ridge Road From South				Int. Total
	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 08:00 AM													
08:00 AM	20	1	0	21	1	0	0	1	0	5	0	5	27
08:15 AM	30	0	0	30	0	0	0	0	0	9	0	9	39
08:30 AM	19	0	0	19	0	0	0	0	0	12	0	12	31
08:45 AM	22	1	0	23	0	0	0	0	0	6	0	6	29
Total Volume	91	2	0	93	1	0	0	1	0	32	0	32	126
% App. Total	97.8	2.2	0		100	0	0		0	100	0		
PHF	.758	.500	.000	.775	.250	.000	.000	.250	.000	.667	.000	.667	.808
Lights	91	2	0	93	1	0	0	1	0	32	0	32	126
% Lights	100	100	0	100	100	0	0	100	0	100	0	100	100
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0



MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Forest Ridge Road File Name : 1319_Forest_Ridge_at_Thoreau+_Sweet_Birch_10-26-2023
 WB: Camp Thoreau South Dwy Site Code : 1319
 EB: Sweet Birch Lane Start Date : 10/26/2023
 Concord, MA Page No : 1

Groups Printed- Lights - Mediums - Articulated Trucks - Bicycles on Road

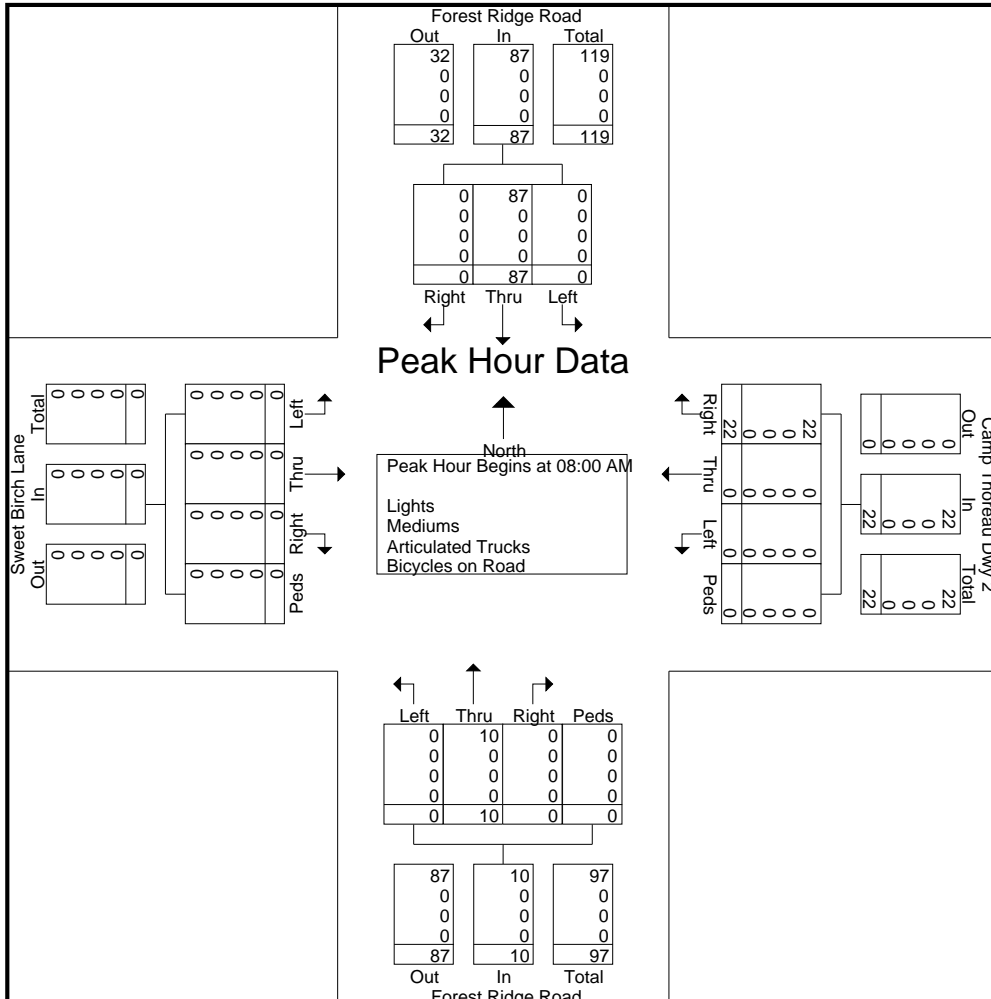
Start Time	Forest Ridge Road From North				Camp Thoreau Dwy 2 From East					Forest Ridge Road From South					Sweet Birch Lane From West					Int. Total	
	Right	Thru	Left	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total		
07:00 AM	0	5	0	5	2	0	0	0	2	0	0	0	0	0	0	0	0	0	1	1	8
07:15 AM	0	17	0	17	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	21
07:30 AM	0	6	0	6	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	8
07:45 AM	0	7	0	7	2	0	0	0	2	0	2	0	0	2	0	0	0	0	0	0	11
Total	0	35	0	35	10	0	0	0	10	0	2	0	0	2	0	0	0	1	1	48	
08:00 AM	0	19	0	19	5	0	0	0	5	0	2	0	0	2	0	0	0	0	0	0	26
08:15 AM	0	31	0	31	6	0	0	0	6	0	2	0	0	2	0	0	0	0	0	0	39
08:30 AM	0	15	0	15	6	0	0	0	6	0	5	0	0	5	0	0	0	0	0	0	26
08:45 AM	0	22	0	22	5	0	0	0	5	0	1	0	0	1	0	0	0	0	0	0	28
Total	0	87	0	87	22	0	0	0	22	0	10	0	0	10	0	0	0	0	0	119	
04:00 PM	0	18	1	19	5	0	0	0	5	0	4	0	0	4	0	0	0	2	2	30	
04:15 PM	0	14	0	14	2	0	0	0	2	0	4	0	0	4	0	0	0	2	2	22	
04:30 PM	0	12	0	12	4	0	0	0	4	0	6	0	0	6	0	0	0	2	2	24	
04:45 PM	0	19	0	19	5	0	0	0	5	0	1	0	0	1	0	0	0	0	0	25	
Total	0	63	1	64	16	0	0	0	16	0	15	0	0	15	0	0	0	6	6	101	
05:00 PM	0	12	1	13	7	0	0	0	7	0	12	0	0	12	0	0	0	0	0	32	
05:15 PM	0	9	0	9	7	0	0	0	7	0	10	0	0	10	0	0	0	1	1	27	
05:30 PM	0	11	0	11	8	0	0	0	8	0	3	0	0	3	0	0	0	2	2	24	
05:45 PM	0	29	0	29	10	0	0	0	10	0	4	0	0	4	0	0	0	0	0	43	
Total	0	61	1	62	32	0	0	0	32	0	29	0	0	29	0	0	0	3	3	126	
Grand Total	0	246	2	248	80	0	0	0	80	0	56	0	0	56	0	0	0	10	10	394	
Apprch %	0	99.2	0.8		100	0	0	0		0	100	0	0		0	0	0	100			
Total %	0	62.4	0.5	62.9	20.3	0	0	0	20.3	0	14.2	0	0	14.2	0	0	0	2.5	2.5		
Lights	0	245	2	247	80	0	0	0	80	0	56	0	0	56	0	0	0	10	10	393	
% Lights	0	99.6	100	99.6	100	0	0	0	100	0	100	0	0	100	0	0	0	100	100	99.7	
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Bicycles on Road	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
% Bicycles on Road	0	0.4	0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Forest Ridge Road File Name : 1319_Forest_Ridge_at_Thoreau+_Sweet_Birch_10-26-2023
 WB: Camp Thoreau South Dwy Site Code : 1319
 EB: Sweet Birch Lane Start Date : 10/26/2023
 Concord, MA Page No : 2

Start Time	Forest Ridge Road From North				Camp Thoreau Dwy 2 From East					Forest Ridge Road From South					Sweet Birch Lane From West					Int. Total	
	Right	Thru	Left	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total		
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	0	19	0	19	5	0	0	0	5	0	2	0	0	2	0	0	0	0	0	0	26
08:15 AM	0	31	0	31	6	0	0	0	6	0	2	0	0	2	0	0	0	0	0	0	39
08:30 AM	0	15	0	15	6	0	0	0	6	0	5	0	0	5	0	0	0	0	0	0	26
08:45 AM	0	22	0	22	5	0	0	0	5	0	1	0	0	1	0	0	0	0	0	0	28
Total Volume	0	87	0	87	22	0	0	0	22	0	10	0	0	10	0	0	0	0	0	0	119
% App. Total	0	100	0	100	100	0	0	0	100	0	100	0	0	100	0	0	0	0	0	0	119
PHF	.000	.702	.000	.702	.917	.000	.000	.000	.917	.000	.500	.000	.000	.500	.000	.000	.000	.000	.000	.000	.763
Lights	0	87	0	87	22	0	0	0	22	0	10	0	0	10	0	0	0	0	0	0	119
% Lights	0	100	0	100	100	0	0	0	100	0	100	0	0	100	0	0	0	0	0	0	119
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

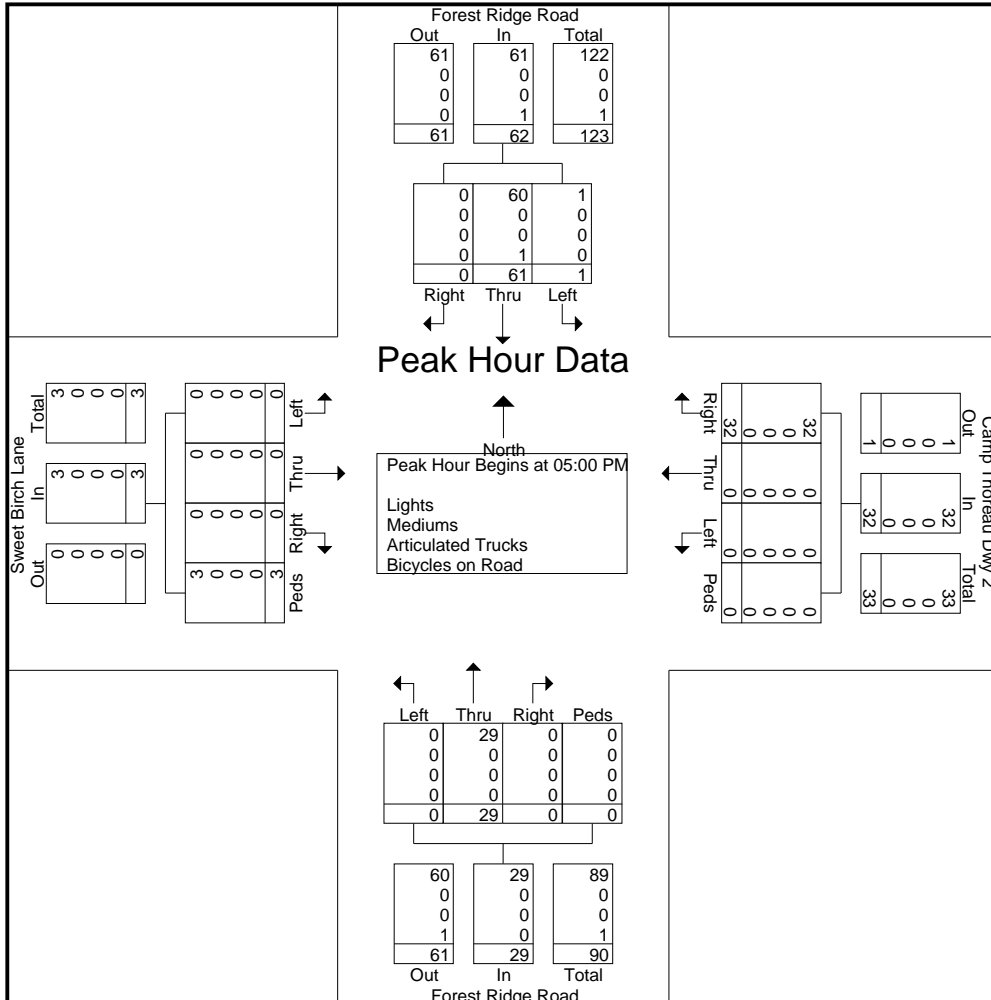


MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA, 01752

N/S: Forest Ridge Road File Name : 1319_Forest_Ridge_at_Thoreau+_Sweet_Birch_10-26-2023
 WB: Camp Thoreau South Dwy Site Code : 1319
 EB: Sweet Birch Lane Start Date : 10/26/2023
 Concord, MA Page No : 3

	Forest Ridge Road From North				Camp Thoreau Dwy 2 From East					Forest Ridge Road From South					Sweet Birch Lane From West					
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																				
Peak Hour for Entire Intersection Begins at 05:00 PM																				
05:00 PM	0	12	1	13	7	0	0	0	7	0	12	0	0	12	0	0	0	0	0	32
05:15 PM	0	9	0	9	7	0	0	0	7	0	10	0	0	10	0	0	0	1	1	27
05:30 PM	0	11	0	11	8	0	0	0	8	0	3	0	0	3	0	0	0	2	2	24
05:45 PM	0	29	0	29	10	0	0	0	10	0	4	0	0	4	0	0	0	0	0	43
Total Volume	0	61	1	62	32	0	0	0	32	0	29	0	0	29	0	0	0	3	3	126
% App. Total	0	98.4	1.6		100	0	0	0		0	100	0	0		0	0	0	100		
PHF	.000	.526	.250	.534	.800	.000	.000	.000	.800	.000	.604	.000	.000	.604	.000	.000	.000	.375	.375	.733
Lights	0	60	1	61	32	0	0	0	32	0	29	0	0	29	0	0	0	3	3	125
% Lights	0	98.4	100	98.4	100	0	0	0	100	0	100	0	0	100	0	0	0	100	100	99.2
Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mediums	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bicycles on Road	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
% Bicycles on Road	0	1.6	0	1.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8



□ Seasonal/Yearly Growth Data

SECTION I - CONTINUOUS COUNTING STATION MONTHLY AVERAGE DAILY TRAFFIC

STATION 403 - CONCORD - RTE.2 - 0.2 km EAST OF CONCORD ROTARY

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
10	41,546 -6%	41,883 -4%	46,472 -6%	50,492 -12%	45,910 0%	46,524 -1%	43,534 0%	39,595 9%	40,709 10%	46,285 -2%	43,576 -1%	44,350 -5%	44,240 -2%
11	39,037 6%	40,138 5%	43,732 -2%	44,191 0%	45,777 0%	46,145 -1%	43,496 -7%	43,117 4%	44,740 0%	45,508 -1%	43,282 -1%	42,043 -1%	43,434 0%
12	41,311 1%	42,111 -7%	43,069 -2%	44,294 -3%	45,759 -3%	45,640 -1%	40,408 4%	44,775 -3%	44,720 -1%	44,904 0%	42,980 -1%	41,701 3%	43,473 -1%
13	41,792 -6%	39,095 -6%	42,007 2%	42,993 2%	44,222 3%	44,984 2%	41,995 4%	43,310 1%	44,422 -1%	45,062 2%	42,684 2%	42,773 12%	42,945 1%
15	39,457 6%	36,908 15%	42,703 4%	44,051 1%	45,401 3%	45,790 4%	43,572 3%	43,700 6%	43,992 3%	46,043 2%	43,701 4%	47,747 -9%	43,589 3%
16	41,896 3%	42,396 1%	44,580 1%	44,670 1%	46,737 2%	47,669 2%	45,004 2%	46,441 1%	45,499 4%	47,080 4%	45,357 3%	43,312 -1%	45,053 2%
17	43,250 0%	43,008 3%	45,196 0%	45,139 4%	47,491 1%	48,619 1%	45,789 -3%	46,860 -2%	47,255 -5%	48,955 -1%	46,715 -9%	42,828 5%	45,855 0%
18	43,289	44,164	45,201	46,965	48,147	49,054	44,492	45,928	44,882	48,454	42,446	45,171	45,683
Seasonal Adjustment Factor (to average month)	1.07	1.08	1.00	0.98	0.96	0.95	1.02	1.00	1.00	0.95	1.01	1.01	Growth 0.33%

□ Crash Data

Crash Date	Crash Severity	Crash Time	Number of Vehicles	Light Conditions	Manner of Collision	Road Surface Condition	Total Fatalities	Total Non-Fatal Injuries	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Most Harmful Event (All Vehicles)	X	Y	Roadway
08/14/2019	Property damage only (none injured)	11:36 AM	2	Daylight	Angle	Dry	0	0	V1: Travelling straight ahead / 0 V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: S	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	206125.0313	910204.5629	MAIN ST / FOREST RIDGE RD
08/13/2019	Property damage only (none injured)	3:23 PM	2	Daylight	Rear-end	Dry	0	0	V1: Travelling straight ahead / 0 V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1: E / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	206134.2292	910208.7996	MAIN ST
03/22/2021	Property damage only (none injured)	2:03 PM	1	Daylight	Single vehicle crash	Dry	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: W	Clear	V1:(Collision with other movable object)	206111.5228	910198.3668	MAIN ST
10/27/2022	Property damage only (none injured)	4:55 PM	2	Daylight	Rear-end	Wet	0	0	V1: Travelling straight ahead / 0 V2: Turning left	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1: N / V2: N	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	206111.5228	910198.3668	MAIN ST
01/23/2023	Property damage only (none injured)	3:10 PM	1	Daylight	Single vehicle crash	Snow	0	0	V1: Travelling straight ahead	V1:(Passenger car)	V1: W	Snow	V1:(Other)	206111.5228	910198.3668	MAIN ST Rte
07/20/2023	Property damage only (none injured)	3:24 PM	2	Daylight	Front to Front	Dry	0	0	V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1: N / V2: E	Clear	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	206125.0313	910204.5629	RD Rte / FOREST RIDGE

□ Sight Distance Calculations

Stopping Sight Distance - Regulatory

Existing Thoreau Club Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	NB	15	55.125	21.6	76.7
Direction 2	SB	15	55.125	21.6	76.7

<u>INPUTS</u>	<u>Direction 1</u>	<u>Direction 2</u>
Travel Direction	NB	SB
Speed	15	15
Grade	0	0
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = 1.47 x t x V

Brake Distance = $V^2 / (30 \times ((a/32.2)+G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G= roadway grade

a - deceleration rate (ft/sec²)

Intersection Sight Distance Calculations

Source: *A Policy on Geometric Design of Highways and Street, 7th Edition*; AASHTO; 2018.

Passenger Car

$$ISD = 1.47 * V * t$$

V = speed

t = time gap

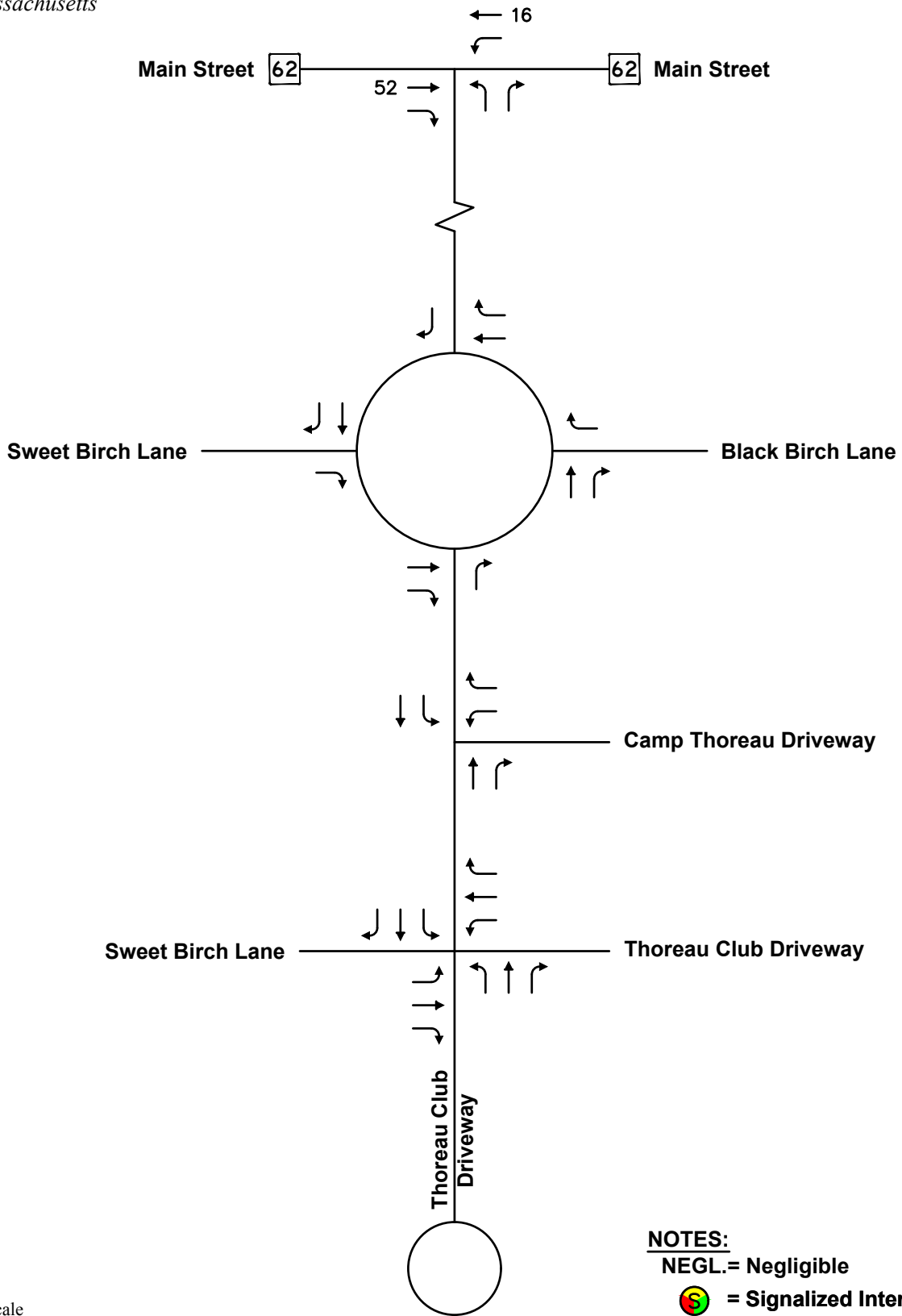
t = 7.5 s for a passenger car for Left Turn from a Stop

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

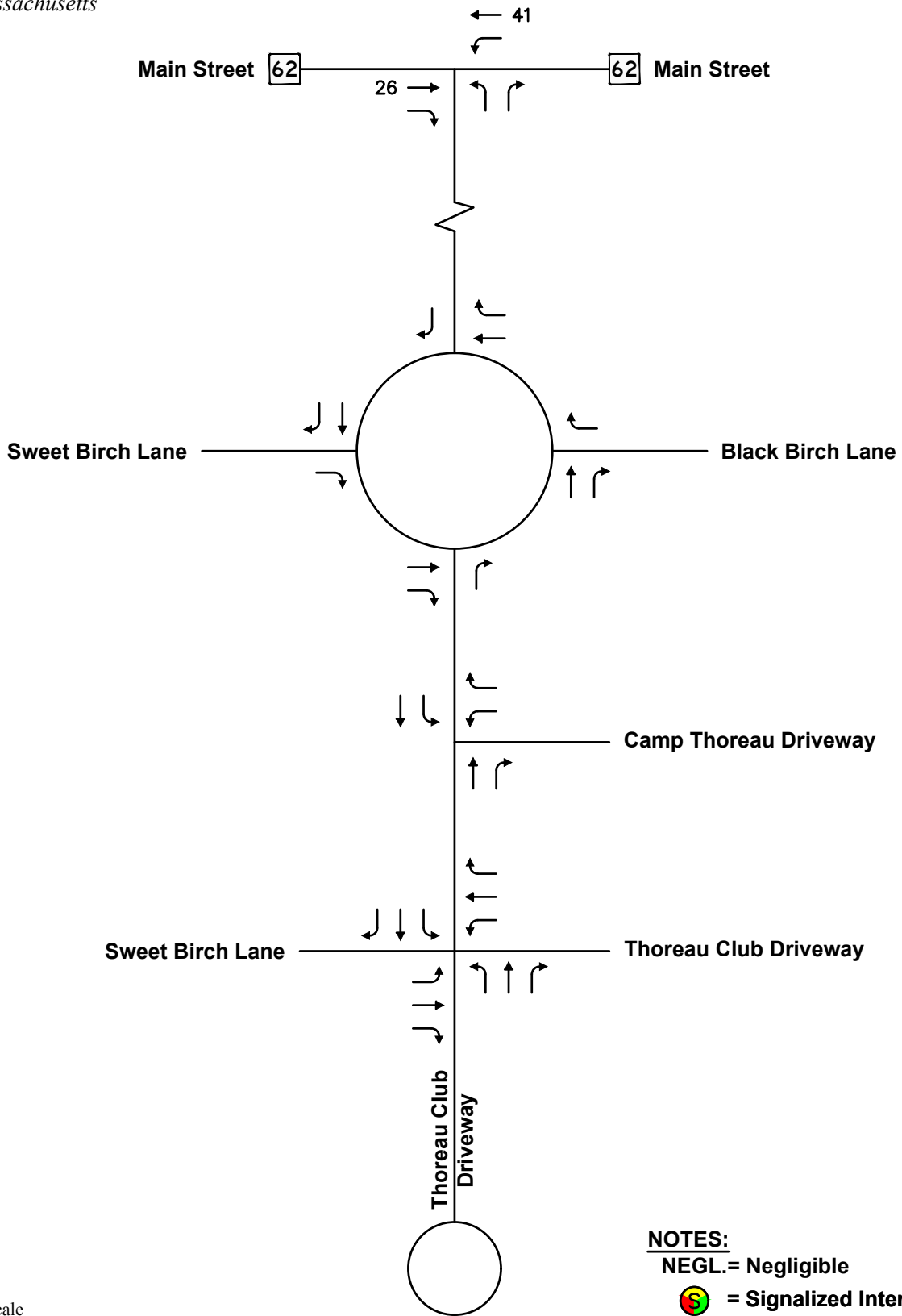
Thoreau Club Driveway

Looking North (left-turn from a stop)	ISD = 1.47*	Average Speed 25	* 7.5 =	Ideal ISD 275.625	SAY 280 feet
Looking South (right-turn from a stop)	ISD = 1.47*	Average Speed 25	* 6.5 =	Ideal ISD 238.875	SAY 240 feet

□ Background Projects



Scale: Not to Scale



□ Trip Generation

Institute of Transportation Engineers (ITE) 11th Edition
Land Use Code (LUC) 221 - Multifamily Housing (Mid-Rise)

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 237

AVERAGE WEEKDAY DAILY

$$T = 4.54 * X$$

$$T = 4.54 * 237$$

$$T = 1075.98$$

$$T = 1,076 \text{ vehicle trips}$$

with 50% (538 vpd) entering and 50% (538 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.37 * X$$

$$T = 0.37 * 237$$

$$T = 87.69$$

$$T = 88 \text{ vehicle trips}$$

with 23% (20 vph) entering and 77% (68 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.39 * X$$

$$T = 0.39 * 237$$

$$T = 92.43$$

$$T = 92 \text{ vehicle trips}$$

with 61% (56 vph) entering and 39% (36 vph) exiting.

SATURDAY DAILY

$$T = 4.57 * X$$

$$T = 4.57 * 237$$

$$T = 1083.09$$

$$T = 1,084 \text{ vehicle trips}$$

with 50% (542 vpd) entering and 50% (542 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 0.39 * X$$

$$T = 0.39 * 237$$

$$T = 92.43$$

$$T = 92 \text{ vehicle trips}$$

with 49% (45 vph) entering and 51% (47 vph) exiting.

□ Trip Distribution Calculations

Journey-to-Work Distribution

US Census Journey-to-Work Data

Residence Town Name	Workplace Town Name	All Workers	% of Total Rounded
Concord town	Concord town	2,595	34.9%
Concord town	Boston city	1,049	14.1%
Concord town	Cambridge city	606	8.2%
Concord town	Waltham city	263	3.5%
Concord town	Lexington town	251	3.4%
Concord town	Burlington town	216	2.9%
Concord town	Acton town	174	2.3%
Concord town	Framingham town	162	2.2%
Concord town	Woburn city	92	1.2%
Concord town	Chelmsford town	90	1.2%
Concord town	Bedford town	86	1.2%
Concord town	Westford town	84	1.1%
Concord town	Lowell city	81	1.1%
Concord town	Weston town	80	1.1%
Concord town	Billerica town	73	1.0%
Concord town	Natick town	72	1.0%
Concord town	Lincoln town	71	1.0%
Concord town	Newton city	64	0.9%
Concord town	Sudbury town	61	0.8%
Concord town	Medford city	60	0.8%
Concord town	Littleton town	57	0.8%
Concord town	Groton town	56	0.8%
Concord town	Danvers town	55	0.7%
Concord town	Marlborough city	55	0.7%
Concord town	Wellesley town	54	0.7%
Concord town	Watertown Town city	51	0.7%
Concord town	Andover town	50	0.7%
Concord town	Worcester city	42	0.6%
Concord town	Wilmington town	38	0.5%
Concord town	Belmont town	37	0.5%
Concord town	Brookline town	36	0.5%
	Sub-Total	6,762	91%
	Other	668	9%
	Total	7,430	100%

Workplace	To/From Routes				Total
	Route 62		Route 62		
	(To/From West)	(To/From East)	(To/From East)	(To/From West)	
Concord town		0.0%	100%	34.9%	34.9%
Boston city	50%	7.1%	50%	7.1%	14.1%
Cambridge city		0.0%	100%	8.2%	8.2%
Waltham city	50%	1.8%	50%	1.8%	3.5%
Lexington town		0.0%	100%	3.4%	3.4%
Burlington town		0.0%	100%	2.9%	2.9%
Acton town	50%	1.2%	50%	1.2%	2.3%
Framingham town	100%	2.2%		0.0%	2.2%
Woburn city		0.0%	100%	1.2%	1.2%
Chelmsford town	50%	0.6%	50%	0.6%	1.2%
Bedford town		0.0%	100%	1.2%	1.2%
Westford town	50%	0.6%	50%	0.6%	1.1%
Lowell city	50%	0.5%	50%	0.5%	1.1%
Weston town	100%	1.1%		0.0%	1.1%
Billerica town		0.0%	100%	1.0%	1.0%
Natick town	100%	1.0%		0.0%	1.0%
Lincoln town	50%	0.5%	50%	0.5%	1.0%
Newton city	50%	0.4%	50%	0.4%	0.9%
Sudbury town	100%	0.8%		0.0%	0.8%
Medford city		0.0%	100%	0.8%	0.8%
Littleton town	100%	0.8%		0.0%	0.8%
Groton town	100%	0.8%		0.0%	0.8%
Danvers town		0.0%	100%	0.7%	0.7%
Marlborough city	100%	0.7%		0.0%	0.7%
Wellesley town	50%	0.4%	50%	0.4%	0.7%
Watertown Town city		0.0%	100%	0.7%	0.7%
Andover town	50%	0.3%	50%	0.3%	0.7%
Worcester city	100%	0.6%		0.0%	0.6%
Wilmington town		0.0%	100%	0.5%	0.5%
Belmont town		0.0%	100%	0.5%	0.5%
Brookline town	50%	0.2%	50%	0.2%	0.5%
Sub-Total		21.4%		69.6%	91.0%
Other		2.1%		6.9%	9.0%
Total		23.6%		76.4%	100.0%
	SAY	25%		75%	100%

□ Delay Study

Forest Ridge Road
 at Main Street
 Concord, MA

File Name : 1391 Delay Study
 Site Code : 00001391
 Start Date : 10/30/2024
 Page No : 1

Summary Information:

4:00:00 PM - 5:00:00 PM	Left Turn	Right Turn
Total Vehicle Count:	67	29
Delayed Vehicle Count:	67	29
Through Vehicle Count:	0	0
Average Stopped Time:	22.46	4.241
Maximum Stopped Time:	85	13
Min. Secs. for Delay:	0	0
Average Queue:	0.44	0.038
Queue Density:	1.50	1.017
Maximum Queue:	7	2
Delay in Vehicle Hour:	0.45	0.04
Total Delay:	1505	123

□ Capacity Analysis

HCM 6th TWSC
1: Forest Ridge Road & Main Street

2024 Baseline Conditions
Weekday Morning Peak Hour

Intersection						
Int Delay, s/veh	1.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↔			↔	↔	↔
Traffic Vol, veh/h	650	93	55	273	39	20
Future Vol, veh/h	650	93	55	273	39	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	97
Heavy Vehicles, %	2	1	9	6	3	10
Mvmt Flow	691	99	59	290	41	21

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	790	0	1149
Stage 1	-	-	-	-	741
Stage 2	-	-	-	-	408
Critical Hdwy	-	-	4.19	-	5.8
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.43
Follow-up Hdwy	-	-	2.281	-	3.527
Pot Cap-1 Maneuver	-	-	800	-	267
Stage 1	-	-	-	-	470
Stage 2	-	-	-	-	669
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	800	-	244
Mov Cap-2 Maneuver	-	-	-	-	244
Stage 1	-	-	-	-	470
Stage 2	-	-	-	-	610

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

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	244	733	-	-	800	-
HCM Lane V/C Ratio	0.17	0.028	-	-	0.073	-
HCM Control Delay (s)	22.8	10.1	-	-	9.9	0
HCM Lane LOS	C	B	-	-	A	A
HCM 95th %tile Q(veh)	0.6	0.1	-	-	0.2	-

Intersection

Intersection Delay, s/veh	3.2			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	3	1	36	123
Demand Flow Rate, veh/h	3	1	36	124
Vehicles Circulating, veh/h	123	39	3	0
Vehicles Exiting, veh/h	1	0	123	40
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	2.7	2.8	3.3
Approach LOS	A	A	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	3	1	36	124
Cap Entry Lane, veh/h	1217	1326	1376	1380
Entry HV Adj Factor	1.000	1.000	1.000	0.990
Flow Entry, veh/h	3	1	36	123
Cap Entry, veh/h	1217	1326	1376	1366
V/C Ratio	0.002	0.001	0.026	0.090
Control Delay, s/veh	3.0	2.7	2.8	3.3
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

HCM 6th TWSC
1: Forest Ridge Road & Main Street

2024 Baseline Conditions
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	1.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	386	63	41	555	67	29
Future Vol, veh/h	386	63	41	555	67	29
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	1	2	2	4	3	0
Mvmt Flow	394	64	42	566	68	30

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	458	0	1076
Stage 1	-	-	-	-	426
Stage 2	-	-	-	-	650
Critical Hdwy	-	-	4.12	-	5.8
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.43
Follow-up Hdwy	-	-	2.218	-	3.527
Pot Cap-1 Maneuver	-	-	1103	-	292
Stage 1	-	-	-	-	657
Stage 2	-	-	-	-	518
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1103	-	276
Mov Cap-2 Maneuver	-	-	-	-	276
Stage 1	-	-	-	-	657
Stage 2	-	-	-	-	489

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	18.3
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	276	892	-	-	1103	-
HCM Lane V/C Ratio	0.248	0.033	-	-	0.038	-
HCM Control Delay (s)	22.3	9.2	-	-	8.4	0
HCM Lane LOS	C	A	-	-	A	A
HCM 95th %tile Q(veh)	1	0.1	-	-	0.1	-

HCM 6th Roundabout

2024 Baseline Conditions

2: Thoreau Club Driveway/Forest Ridge Road & Sweet Birch Lane/Black Birch Lane Weekday Evening Peak Hour

Intersection

Intersection Delay, s/veh	3.4			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	5	0	142	133
Demand Flow Rate, veh/h	5	0	142	133
Vehicles Circulating, veh/h	128	147	5	0
Vehicles Exiting, veh/h	5	0	128	147
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	0.0	3.4	3.4
Approach LOS	A	-	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	5	0	142	133
Cap Entry Lane, veh/h	1211	1188	1373	1380
Entry HV Adj Factor	1.000	1.000	1.000	1.000
Flow Entry, veh/h	5	0	142	133
Cap Entry, veh/h	1211	1188	1373	1380
V/C Ratio	0.004	0.000	0.103	0.096
Control Delay, s/veh	3.0	3.0	3.4	3.4
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

HCM 6th TWSC
 1: Forest Ridge Road & Main Street

2031 No-Build Conditions
 Weekday Morning Peak Hour

Intersection

Int Delay, s/veh	1.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	725	96	57	299	40	21
Future Vol, veh/h	725	96	57	299	40	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	97
Heavy Vehicles, %	2	1	9	6	3	10
Mvmt Flow	771	102	61	318	43	22

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	873	0	1262
Stage 1	-	-	-	-	822
Stage 2	-	-	-	-	440
Critical Hdwy	-	-	4.19	-	5.8
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.43
Follow-up Hdwy	-	-	2.281	-	3.527
Pot Cap-1 Maneuver	-	-	744	-	233
Stage 1	-	-	-	-	430
Stage 2	-	-	-	-	647
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	744	-	210
Mov Cap-2 Maneuver	-	-	-	-	210
Stage 1	-	-	-	-	430
Stage 2	-	-	-	-	582

Approach	EB	WB	NB
HCM Control Delay, s	0	1.6	21
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	210	702	-	-	744	-
HCM Lane V/C Ratio	0.203	0.031	-	-	0.082	-
HCM Control Delay (s)	26.4	10.3	-	-	10.3	0
HCM Lane LOS	D	B	-	-	B	A
HCM 95th %tile Q(veh)	0.7	0.1	-	-	0.3	-

Intersection				
Intersection Delay, s/veh	3.2			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	3	1	37	127
Demand Flow Rate, veh/h	3	1	37	128
Vehicles Circulating, veh/h	127	40	3	0
Vehicles Exiting, veh/h	1	0	127	41
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	2.7	2.8	3.4
Approach LOS	A	A	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	3	1	37	128
Cap Entry Lane, veh/h	1212	1325	1376	1380
Entry HV Adj Factor	1.000	1.000	1.000	0.990
Flow Entry, veh/h	3	1	37	127
Cap Entry, veh/h	1212	1325	1376	1366
V/C Ratio	0.002	0.001	0.027	0.093
Control Delay, s/veh	3.0	2.7	2.8	3.4
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

HCM 6th TWSC
1: Forest Ridge Road & Main Street

2031 No-Build Conditions
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	1.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	426	65	42	616	69	30
Future Vol, veh/h	426	65	42	616	69	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	1	2	2	4	3	0
Mvmt Flow	435	66	43	629	70	31

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	501	0	1183
Stage 1	-	-	-	-	468
Stage 2	-	-	-	-	715
Critical Hdwy	-	-	4.12	-	5.8
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.43
Follow-up Hdwy	-	-	2.218	-	3.527
Pot Cap-1 Maneuver	-	-	1063	-	256
Stage 1	-	-	-	-	628
Stage 2	-	-	-	-	483
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1063	-	240
Mov Cap-2 Maneuver	-	-	-	-	240
Stage 1	-	-	-	-	628
Stage 2	-	-	-	-	453

Approach	EB	WB	NB
HCM Control Delay, s	0	0.5	21
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	240	874	-	-	1063	-
HCM Lane V/C Ratio	0.293	0.035	-	-	0.04	-
HCM Control Delay (s)	26.1	9.3	-	-	8.5	0
HCM Lane LOS	D	A	-	-	A	A
HCM 95th %tile Q(veh)	1.2	0.1	-	-	0.1	-

Intersection

Intersection Delay, s/veh	3.4			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	5	0	146	133
Demand Flow Rate, veh/h	5	0	146	133
Vehicles Circulating, veh/h	128	151	5	0
Vehicles Exiting, veh/h	5	0	128	151
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	0.0	3.5	3.4
Approach LOS	A	-	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	5	0	146	133
Cap Entry Lane, veh/h	1211	1183	1373	1380
Entry HV Adj Factor	1.000	1.000	1.000	1.000
Flow Entry, veh/h	5	0	146	133
Cap Entry, veh/h	1211	1183	1373	1380
V/C Ratio	0.004	0.000	0.106	0.096
Control Delay, s/veh	3.0	3.0	3.5	3.4
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

HCM 6th TWSC
1: Forest Ridge Road & Main Street

2031 Build Conditions
Weekday Morning Peak Hour

Intersection						
Int Delay, s/veh	2.5					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	725	101	72	299	57	72
Future Vol, veh/h	725	101	72	299	57	72
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	97
Heavy Vehicles, %	2	1	9	6	3	10
Mvmt Flow	771	107	77	318	61	74

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	878	0	1297 825
Stage 1	-	-	-	-	825 -
Stage 2	-	-	-	-	472 -
Critical Hdwy	-	-	4.19	-	5.8 3.4
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.43 -
Follow-up Hdwy	-	-	2.281	-	3.527 3.39
Pot Cap-1 Maneuver	-	-	741	-	223 701
Stage 1	-	-	-	-	429 -
Stage 2	-	-	-	-	626 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	741	-	195 701
Mov Cap-2 Maneuver	-	-	-	-	195 -
Stage 1	-	-	-	-	429 -
Stage 2	-	-	-	-	547 -

Approach	EB	WB	NB
HCM Control Delay, s	0	2	20.1
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	195	701	-	-	741	-
HCM Lane V/C Ratio	0.311	0.106	-	-	0.103	-
HCM Control Delay (s)	31.6	10.7	-	-	10.4	0
HCM Lane LOS	D	B	-	-	B	A
HCM 95th %tile Q(veh)	1.3	0.4	-	-	0.3	-

Intersection				
Intersection Delay, s/veh	3.4			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	3	1	111	144
Demand Flow Rate, veh/h	3	1	111	145
Vehicles Circulating, veh/h	144	114	3	0
Vehicles Exiting, veh/h	1	0	144	115
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.0	2.9	3.3	3.5
Approach LOS	A	A	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	3	1	111	145
Cap Entry Lane, veh/h	1191	1228	1376	1380
Entry HV Adj Factor	1.000	1.000	1.000	0.990
Flow Entry, veh/h	3	1	111	144
Cap Entry, veh/h	1191	1228	1376	1366
V/C Ratio	0.003	0.001	0.081	0.105
Control Delay, s/veh	3.0	2.9	3.3	3.5
LOS	A	A	A	A
95th %tile Queue, veh	0	0	0	0

HCM 6th TWSC
1: Forest Ridge Road & Main Street

2031 Build Conditions
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	2.9					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	426	79	84	616	78	57
Future Vol, veh/h	426	79	84	616	78	57
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	1	2	2	4	3	0
Mvmt Flow	435	81	86	629	80	58

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	516	0	1277 476
Stage 1	-	-	-	-	476 -
Stage 2	-	-	-	-	801 -
Critical Hdwy	-	-	4.12	-	5.8 3.3
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.43 -
Follow-up Hdwy	-	-	2.218	-	3.527 3.3
Pot Cap-1 Maneuver	-	-	1050	-	229 870
Stage 1	-	-	-	-	623 -
Stage 2	-	-	-	-	440 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1050	-	200 870
Mov Cap-2 Maneuver	-	-	-	-	200 -
Stage 1	-	-	-	-	623 -
Stage 2	-	-	-	-	385 -

Approach	EB	WB	NB
HCM Control Delay, s	0	1	23.8
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	200	870	-	-	1050	-
HCM Lane V/C Ratio	0.398	0.067	-	-	0.082	-
HCM Control Delay (s)	34.4	9.4	-	-	8.7	0
HCM Lane LOS	D	A	-	-	A	A
HCM 95th %tile Q(veh)	1.8	0.2	-	-	0.3	-

Intersection

Intersection Delay, s/veh	3.8			
Intersection LOS	A			
Approach	EB	WB	NB	SB
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	5	0	202	219
Demand Flow Rate, veh/h	5	0	202	219
Vehicles Circulating, veh/h	214	207	5	0
Vehicles Exiting, veh/h	5	0	214	207
Ped Vol Crossing Leg, #/h	0	0	0	0
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	3.3	0.0	3.8	3.9
Approach LOS	A	-	A	A
Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Follow-Up Headway, s	2.609	2.609	2.609	2.609
Critical Headway, s	4.976	4.976	4.976	4.976
Entry Flow, veh/h	5	0	202	219
Cap Entry Lane, veh/h	1109	1117	1373	1380
Entry HV Adj Factor	1.000	1.000	1.000	1.000
Flow Entry, veh/h	5	0	202	219
Cap Entry, veh/h	1109	1117	1373	1380
V/C Ratio	0.005	0.000	0.147	0.159
Control Delay, s/veh	3.3	3.2	3.8	3.9
LOS	A	A	A	A
95th %tile Queue, veh	0	0	1	1

□ Signal Warrant Analysis

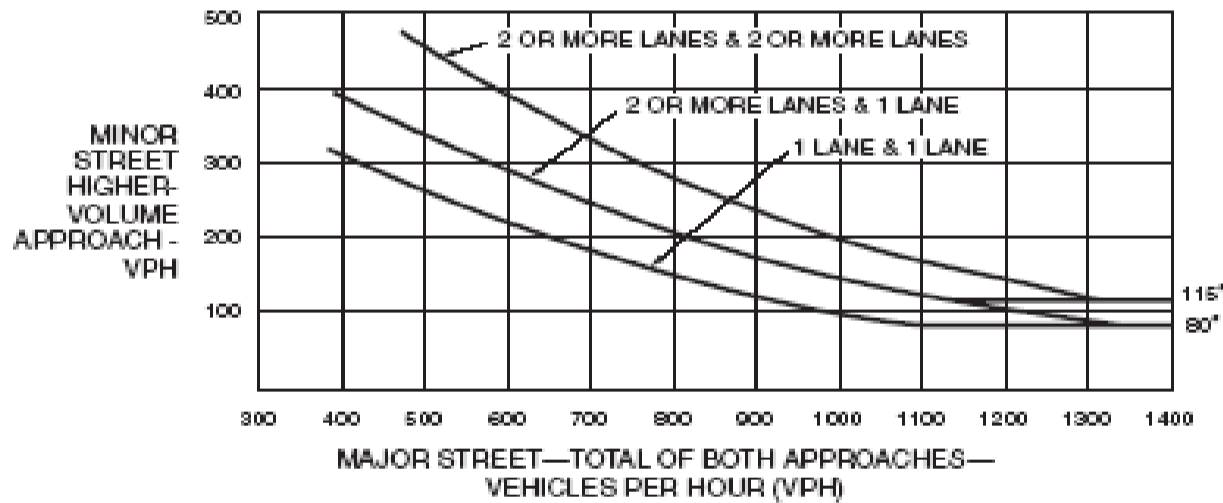
MUTCD Traffic Signal Warrant #2 Analysis

Project Name 1391 Concord
Date Baseline 2024 + Site Trips

	Street Name	Direction
Major 1	Main Street	EB
Major 2	Main Street	WB
Minor 1	Forest Rideg Road	NB
Minor 2	n/a	0

Node	Time Period	Main Street Major St. 1 Approach Volume	Main Street Major St. 2 Approach Volume	Total Major St. Volume	Forest Rideg Road Minor St. 1 Approach Volume	n/a Minor St. 2 Approach Volume	Higher Minor St. Volume	Warrant 2 Threshold Met
1	6:00-7:00 AM	374	133	507	30	0	30	NO
2	7:00-8:00 AM	664	243	907	48	0	48	NO
3	8:00-9:00 AM	717	342	1059	85	0	85	NO
4	9:00-10:00 AM	538	391	929	98	0	98	NO
5	10:00-11:00 AM	446	369	815	122	0	122	NO
6	11:00 AM-12:00 PM	436	393	829	123	0	123	NO
7	12:00-1:00 PM	454	433	887	132	0	132	NO
8	1:00 PM - 2:00 PM	435	439	874	93	0	93	NO
9	2:00 PM - 3:00 PM	455	446	901	98	0	98	NO
10	3:00 PM - 4:00 PM	419	541	960	126	0	126	NO
11	4:00 PM - 5:00 PM	439	595	1034	115	0	115	NO
12	5:00 PM - 6:00 PM	465	575	1040	132	0	132	YES
							Hours Met	1

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street

MUTCD Traffic Signal Warrant #3 Analysis

Project Name 1391 Concord
Date Baseline 2024 + Site Trips

	Street Name	Direction
Major 1	Main Street	EB
Major 2	Main Street	WB
Minor 1	Forest Rideg Road	NB
Minor 2	n/a	

Node	Time Period	Main Street Major St. 1 Approach Volume	Main Street Major St. 2 Approach Volume	Total Major St. Volume	Forest Rideg Road Minor St. 1 Approach Volume	n/a Minor St. 2 Approach Volume	Higher Minor St. Volume	Warrant 3 Threshold Met
1	6:00-7:00 AM	374	133	507	30	0	30	NO
2	7:00-8:00 AM	664	243	907	48	0	48	NO
3	8:00-9:00 AM	717	342	1059	85	0	85	NO
4	9:00-10:00 AM	538	391	929	98	0	98	NO
5	10:00-11:00 AM	446	369	815	122	0	122	NO
6	11:00 AM-12:00 PM	436	393	829	123	0	123	NO
7	12:00-1:00 PM	454	433	887	132	0	132	NO
8	1:00 PM - 2:00 PM	435	439	874	93	0	93	NO
9	2:00 PM - 3:00 PM	455	446	901	98	0	98	NO
10	3:00 PM - 4:00 PM	419	541	960	126	0	126	NO
11	4:00 PM - 5:00 PM	439	595	1034	115	0	115	NO
12	5:00 PM - 6:00 PM	465	575	1040	132	0	132	NO
							Hours Met	0

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.