BAYSIDE ENGINEERING

June 20, 2023

Zoning Board of Appeals
Town of Groton
173 Main Street
Groton, MA 01450

Attn: Bruce Easom, Chair

Subject: Proposed Residential
500 Main Street, Groton, MA

Dear Chair and Board Members:

Bayside Engineering is in receipt of MDM Transportation Consultants, Inc. (MDM) May 3, 2023 review of the Traffic Impact and Access Study (TIAS) prepared for the proposed redevelopment of 500 Main Street in Groton, MA. The purpose of this letter is to respond to the comments raised on the Bayside TIAS (dated December 9, 2022). Bayside has prepared the responses below.

Existing Conditions

Comment No. 1: ***Study Area*: The study area includes the subject property driveway plus eight (8) locations along Main Street that include intersections at Fitchs Bridge Road/Nod Road, driveways at Anytime Fitness/Groton Residential Gardens, driveways at Groton Residential Gardens/Country Kids Child Development Center, Mill Street, Taylor Street, Arlington Street and Champney Street.**

The selection of these study locations is consistent with guidelines for study area selection published by MassDOT (locations sustaining 100 vehicle-trip increases or that may experience more than a 5% change in volume); MDM concurs that these study locations are appropriate and in context with the likely traffic impacts for the Project.

Response: Bayside concurs.

Comment No. 2: ***Traffic Volumes*: Traffic volumes for study locations were conducted in February 2022 for the weekday AM peak period (7:00 AM to 9:00 AM) and weekday PM peak period (4:00 PM to 6:30 PM), adjusted to reflect seasonal and Pandemic correction factors derived from MassDOT seasonal correction factor data and regional permanent count station data.**

MDM has reviewed these seasonally- and Pandemic-adjusted data and finds that adjusted traffic volumes presented in the TIAS present a

reasonable representation of typical/average traffic volume conditions for weekday peak AM and PM peak hours along Main Street in the study area.

Response: Bayside concurs.

Comment No. 3: ***Accidents/Crash Data*****: The TIAS presents relevant crash data for the study intersections for the period 2015-2019; these data indicate crash rates that are below MassDOT district average for all locations and none of the study locations are listed on the MassDOT high crash location database.**

MDM acknowledges that crash data for the 2015-2019 period presents crash rates that below MassDOT averages, no fatalities are noted for the period evaluated and that study locations are not listed in the MassDOT HSIP list of high crash locations. However, MDM recommends that the crash database review be expanded to include the period 2020-2022 as these data are presently in the MassDOT crash portal and reflect several years additional data including the Pandemic period when crash severity in particular were generally at higher levels throughout the Commonwealth. These additional data may be used to confirm TIAS findings and to validate that safety countermeasures along Main Street in the study area are not warranted, particularly for pedestrians and bicyclists.

Response: Bayside has expanded the study period to include crash data from 2020 to 2022. The results are summarized in Table 1 and the crash data is included in the Appendix.

TABLE 1
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Main Street and Champney Street	Main Street and Arlington Street	Main Street and Taylor Street	Main Street and Mill Street
Year:				
2015	3	1	2	2
2016	1	1	0	0
2017	2	0	1	2
2018	1	0	1	3
2019	1	0	1	3
2020	1	0	2	0
2021	2	0	0	0
2022	4	0	0	3
Total	15	2	7	13
Average:	1.88	0.25	0.88	1.63
Crash Rate:	0.38	0.05	0.20	0.31
Significance:	No	No	No	No
Type:				
Angle	6	1	0	5
Rear-End	4	0	5	3
Head-On	0	0	0	0
Sideswipe	0	0	0	2
Single Vehicle Crash	3	1	2	3
Front-To-Rear	1	0	0	0
Rear-To-Side	1	0	0	0
Unknown	0	0	0	0
Total	15	2	7	13
Time of Day:				
Weekday (7:00 to 9:00 AM)	5	1	1	3
Weekday (4:00 to 6:00 PM)	5	0	1	4
Remainder of Day	5	1	5	6
Total	15	2	7	13
Pavement Conditions:				
Dry	13	2	5	8
Wet	0	0	1	3
Snow/Ice	2	0	1	0
Other	0	0	0	0
Unknown	0	0	0	2
Total	15	2	7	13
Severity:				
Property Damage Only	13	2	4	10
Personal Injury	1	0	3	3
Fatal Accident	0	0	0	0
Unknown	1	0	0	0
Total	15	2	7	13

[a]Source: MassDOT Crash Portal, 2015 to 2022.

TABLE 1
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Main Street and Country Kids Center Driveway	Main Street and Anytime Fitness Driveway	Main Street, Fitchs Bridge Road and Nod Road
Year:			
2015	0	0	1
2016	0	1	0
2017	0	0	0
2018	0	1	1
2019	0	0	3
2020	1	0	0
2021	0	0	1
2022	0	1	1
Total	1	3	7
Average:	0.13	0.38	0.88
Crash Rate:	0.02	0.07	0.17
Significance:	No	No	No
Type:			
Angle	0	1	1
Rear-End	0	2	2
Head-On	0	0	1
Sideswipe	0	0	0
Single Vehicle Crash	1	0	3
Front-To-Rear	0	0	0
Rear-To-Side	0	0	0
Unknown	0	0	0
Total	1	3	7
Time of Day:			
Weekday (7:00 to 9:00 AM)	0	0	0
Weekday (4:00 to 6:00 PM)	0	0	1
Remainder of Day	1	3	6
Total	1	3	7
Pavement Conditions:			
Dry	1	2	3
Wet	0	1	1
Snow/Ice	0	0	2
Other	0	0	0
Unknown	0	0	1
Total	1	3	7
Severity:			
Property Damage Only	1	2	6
Personal Injury	0	1	1
Fatal Accident	0	0	0
Unknown	0	0	0
Total	1	3	7

[a]Source: MassDOT Crash Portal, 2015 to 2022.

With the inclusion of the additional crashes from 2020 through 2022, there were sixteen additional crashes over the three-year period at the seven study area intersections. A review of the additional crashes does not indicate excessive speed was a factor.

Comment No. 4: ***Vehicle Speeds*****: Vehicle speeds presented in the TIAS are derived from 48-hour automatic traffic recorder (ATR) counts conducted by an independent third-party vendor at a location proximate to and south/east of the proposed driveway. The TIAS relies on these data to calculate average and 85th percentile travel speeds along Main Street as the basis for calculating driveway sight line requirements.**

Travel speed data are also provided in the TIAS based on automatic traffic recorder (ATR) counts conducted over a 48-hour period in February 2022. Resulting 85th percentile travel speeds (the speed at which regulatory speed limits are typically established and that serve as the basis for determining driveway sight line requirements) is 43 miles per hour (mph) in both travel directions in the site vicinity. This is generally consistent with the 40 mph posted speed limits for this segment of Main Street and is generally consistent with observed conditions based on MDM field review in May 2023.

Response: Bayside concurs.

Comment No. 5: ***Driveway Sight Distance*****: Calculated minimum stopping sight distance (SSD) requirement for the proposed driveway is 335 feet (minimum) based on measured 85th percentile travel speeds following AASHTO and MassDOT guidance and a design speed (85th percentile) of 43 mph. Ideal sight distance (ISD) is calculated at up to 474 feet from the driveway. For both SSD and ISD, measured sight lines exceed 500 feet in both view/travel directions of the driveway and hence meet or exceed applicable AASHTO sight line criteria.**

MDM observed sight lines at the driveway that are in excess of 800 feet in both travel/approach directions for the site driveway location, and notwithstanding minor grade corrections for the westbound approach (which is less than a 1 percent down-grade within 350 feet of the subject driveway) MDM concurs applicable sight line criteria are met or exceeded. MDM recommends that the applicable sight line triangles be shown on the Site Layout Plan along with measured sight lines indicating that minimum sight line criteria are met. The Site Layout Plan should also include a note citing that "Signs, landscaping and other features located within sight triangle areas shall be designed, installed and

maintained so as not to exceed 2.5-feet in height. Snow windrows located within sight triangle areas that exceed 3.5-feet in height above driveway grade or that would otherwise inhibit sight lines shall be promptly removed."

Response: A sight distance triangle has been added to the site plans. A note has been added (on the Layout Sheet) stating *"Signs, landscaping and other features located within sight triangle areas shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow windrows located within sight triangle areas that exceed 3.5-feet in height above driveway grade or that would otherwise inhibit sight lines shall be promptly removed."*

Comment No. 6: ***Public Transportation*: The TIAS indicates that public transportation is not available within the study area/project vicinity; the nearest public transportation station is the MBTA commuter rail station at Wachusett Station in Fitchburg.**

MDM notes that the Groton Council on Aging operates a van service serving qualified senior residents of the town which may also service the site upon request. Door-to-door transportation services provided through these vans pick up qualified residents at home and take them anywhere in town, to surrounding towns, and even to Boston area hospitals. Rides are provided for medical appointments, social engagements, shopping, errands and more. Applicant should acknowledge and promote this service to qualified residents at time of lease.

Response: The Groton Council on Aging does operate a van service as described in the comment. As part of the Transportation Demand Management (TDM) component of the project, the Transportation Coordinator (TC) of the TDM program will provide the information to eligible seniors.

<u>Future Conditions</u>

Comment No. 7: ***Traffic Growth*: Future traffic volumes are projected to a 7-year horizon using a 0.5 percent annualized growth and additional traffic for specific background projects that include two smaller residential developments (Village at Shepley Hill and Hayes Woods) as well as the Music Center. The applied growth rate of 0.5 percent annual exceeds regional growth trends derived from Central Transportation Planning Staff (CTPS) data of 0.02 percent for the Town of Groton.**

MDM concurs that the annualized growth rate of 0.5 percent exceeds the area historic average annualized growth rate for area roadways;

inclusion of project-specific trip increases for area approved development fall well within the more conservative assumption of area growth and are appropriately included for analysis purposes. Resulting 7-year horizon traffic volumes in the TIAS present a reasonable (and likely conservative) basis for analysis of future-year conditions.

Response: Bayside concurs.

Comment No. 8: ***Planned Area Improvements*****: Consultation with MassDOT indicates no planned area roadway improvements within the study area.**

MDM concurs on the basis of review of MassDOT project database. No further comment.

Response: Bayside concurs.

Comment No. 9: ***Trip Generation*****: Trip estimates for the Project are appropriately based on characteristics published by the Institute of Transportation Engineers (ITE) in *Trip Generation* 11th Edition for mid-rise residential use, Land Use Code (LUC) 221 and Single-Family Attached Housing LUC 215. Resulting peak-hour trip estimates are modest and range from 73 to 81 vehicle-trips during AM and PM peak hours, respectively using this methodology. When compared to prior/historic use of the property as an office, ITE-based trip estimates for residential use are lower on both an hourly and daily (weekday) basis. Office-based trip estimates range from 204 to 208 vehicle-trips for weekday peak hours and approximately 1,442 daily (weekday) trips.**

MDM concurs that appropriate methodology was employed in the TIAS to estimate project-related trips for weekday peak hour and daily conditions. Although comparison to historic site use as an office is presented, there is no credit taken in the analysis for these trips; project impact under future 7-year horizon Build conditions is properly based on only those additional trips that are associated with the residential project relative to No-Build conditions under which the site is inactive/vacant.

Response: Bayside concurs.

Comment No. 10: ***Trip Distribution:*** **Regional trip patterns for Site traffic presented in the TIAS are based on existing area travel patterns, US Census Journey-to-Work data for the Town of Groton and a population-based gravity model to assign project trips to area roadways. MDM finds that the resulting trip distribution is generally consistent with observed patterns including the intersection travel patterns**

observed/documented in the TIAS for peak hours. The vast majority (more than 95 percent) of trips to/from the site are oriented to/from the east where major employment centers exist; Mill Street and Champney Street are expected to accommodate 6 and 11 percent of the project trips respectively based on these patterns.

MDM finds that basis for site trip distribution to be sound and consistent with recommended industry practices and consistent with observed/documented trip patterns for area roadways which exhibit highly directional orientation, consistent with commuter travel to/from employment centers located east of the project site. Resulting trip increases on area roadways represent a relative change of less than 5 percent beyond the project site driveway on Main Street to/from the east and less than 0.5 percent west of the site.

Response: Bayside concurs.

Comment No. 11: *Operations Analysis:* **Operational analyses are presented in the TIAS follow generally accepted traffic engineering practices and protocols, indicating ample capacity at study intersections to accommodate project trip increases. While longer delays are reported for turns from side-street approaches to Main Street (particularly left-turns the Site Driveway), modest trip increases due to the Project are not expected to materially change operations, delays or LOS designation relative to "No Build" conditions.**

MDM notes that the capacity analysis presented in the TIAS does not reflect calibration and is likely to overstate side-street delays and vehicle queues when compared to actual conditions. To illustrate this point, the TIAS includes a delay and queue study for a similar volume side street location (Mill Street) which indicates average delays of less than 30 seconds and maximum vehicle queues of 5 to 6 vehicles during peak hours; modeled results using uncalibrated Synchro® software are highly conservative and show average delays ranging from 60 to 293 seconds and queues of up to 15 vehicles.

MDM advises that the capacity and queue analyses presented in the TIAS be updated to calibrate the Synchro® model to better represent actual measured field conditions (delays and queues) for side streets – specifically at Mill Street and at the Site driveway. These calibrated analysis results are likely to show lower delay values and queues than reported in the TIAS and associated incremental changes in delays/queues under Build conditions.

Response: Bayside, using the observed vehicle delays, calibrated the Synchro analyses for the Main Street intersections with Mill Street and the proposed site driveway. The results are shown in Table 2.

Table 3 shows a comparison of the calibrated Build level-of-service results with the unadjusted results from the TIAS. As shown in Table 3, the calibrated results present a more reasonable level of service summary. The capacity analysis worksheets are included in the Appendix.

Site Parking, Access and Circulation Comments

Comment No. 12: ***Site Parking:*** **The proposed parking supply for the project in the aggregate represents a parking ratio of approximately 2.02 spaces per residential unit inclusive of clubhouse and visitor spaces. A more detailed accounting of spaces include 311 spaces for the apartment units representing a parking supply ratio of 1.85 spaces per unit; 64 spaces for the townhome units representing a parking supply ratio; plus additional spaces for the clubhouse (20 spaces) and townhome visitor spaces (10).**

(a) MDM finds the proposed parking supply adequate to accommodate anticipated peak parking demands per ITE Parking Generation (5th Edition) standards. In fact, the proposed parking supply appears to exceed potential peak demands, allowing the possibility of reducing or banking parking spaces that may not be required to support the project. Applicant should provide an assessment of peak parking demands for the project based on ITE Parking Generation 5th Edition rates and methodology to determine warrant/feasibility of reducing or banking parking to levels that are in line with peak (85th percentile) demands – particularly for the apartment units.

(b) Bicycle parking should be provided at appropriate locations and quantity within the Project site and shown on the Site Plans including covered parking.

TABLE 2
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY – CALIBRATED RESULTS

Critical Movement/ Peak Hour	2022 Existing					2029 No-Build					2029 Build				
	Demand[a]	V/C[b]	Delay[c]	LOS[d]	Queue[e]	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue
Main Street and Primary Site Driveway															
Left-turn movements from Site Driveway (SB):															
Weekday Morning	0	0.00	0.0	A	0	0	0.00	0.0	A	0	55	0.23	22.8	C	22.0
Weekday Evening	0	0.00	0.0	A	0	0	0.00	0.0	A	0	31	0.12	19.2	C	10.0
Right-turn movements from Site Driveway (SB):															
Weekday Morning	0	0.00	0.0	A	0	0	0.00	0.0	A	0	1	0.00	9.5	A	0
Weekday Evening	0	0.00	0.0	A	0	0	0.00	0.0	A	0	1	0.00	13.2	B	0
Main Street and Mill Street															
All movements from Mill Street (NB):															
Weekday Morning	72	0.34	21.4	C	37.0	74	0.37	22.7	C	41.0	76	0.40	25.0	D	46.0
Weekday Evening	159	0.48	62.0	C	62.0	168	0.53	26.0	D	75.0	173	0.58	29.7	D	88.0

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

TABLE 3
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS COMPARISON

Critical Movement/ Peak Hour	2029 Build - Unadjusted					2029 Build - Calibrated				
	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue
Main Street and Primary Site Driveway										
Left-turn movements from Site Driveway (SB):										
Weekday Morning	55	0.51	64.2	F	60	55	0.23	22.8	C	22.0
Weekday Evening	31	0.44	84	F	45	31	0.12	19.2	C	10.0
Right-turn movements from Site Driveway (SB):										
Weekday Morning	1	0.00	10.3	B	0	1	0.00	9.5	A	0
Weekday Evening	1	0.01	24.8	C	0	1	0.00	13.2	B	0
Main Street and Mill Street										
All movements from Mill Street (NB):										
Weekday Morning	0.87	97.9	F	135	0.87	76	0.40	25.0	D	46.0
Weekday Evening	1.95	530.3	F	410	1.95	173	0.58	29.7	D	88.0

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

(c) Applicant should consider designating spaces for a car share service such as Zip Car to encourage lower vehicle ownership rates/use, noting however that implementation of such service is subject to a car share provider opting to place vehicles at the subject property.

Response: Bayside performed a parking calculation using data compiled by the Institute of Traffic Engineers (ITE) Parking Generation, 5th Edition[1]. Based on the ITE data, the 168 apartments would require 222 parking spaces and the thirty-two (32) townhomes would require fifty (50) parking spaces for a total of 272 parking spaces. Currently, 404 parking spaces are being proposed.

Bicycle parking areas are being provided throughout the site. Five (5) different areas are shown on the site plans. The five different locations are:

1. Southwest corner of Building A
2. Southwest corner of Building B
3. Southeast corner of Building B
4. Southeast corner of Building C
5. North of Pavilion adjacent to Clubhouse

[1] *Parking Generation, 5th Edition;* Institute of Transportation Engineers; Washington, D.C.; 2019.

The applicant reached out to Zipcar about the possibility of providing service in this area. Zipcar responded with "*At this time Zipcar does not have a large enough presence in Groton area to be able to launch and operate a residential car sharing program that would deliver a best-in-class experience for your residents and the surrounding community*." At this time, no space is proposed for a car sharing service. If a need arises, and a car sharing service does come to the site, a suitable spot will be identified.

Comment No. 13: ***Site Access Design*: Proposed Site driveway at Main Street is proposed to be modified to include a deceleration lane and modified curb radii. The driveway design is subject to MassDOT review and approval under the Access Permit process and will need to comply with commercial driveway standards on state highways. MDM notes the following aspects of driveway design should be considered by the Applicant:**

(a) ***MDM recommends that the applicable sight line triangles be shown on the Site Layout Plan along with measured sight lines to confirm that minimum sight line criteria are met, and if possible the ideal Intersection Sight Distance (ISD) as calculated based on measured 85th percentile travel speeds along Main Street.***

(b) The Site Layout Plan should also include a note citing that "Signs, landscaping and other features located within sight triangle areas shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow windrows located within sight triangle areas that exceed 3.5-feet height above driveway grade or that would otherwise inhibit sight lines shall be promptly removed."

(c) The relatively high rate of speed along Main Street (85th percentile speed of 43 mph, classified as a high-speed roadway per MassDOT criteria) will require significant deceleration to navigate the right-turn movement into the proposed driveway given the curb radius, perpendicular alignment of the driveway and lack of shoulders along Main Street. Likewise, delivery vehicles (ie, box trucks or equivalent such as UPS or Fed X vehicles) and service/emergency vehicles (ambulances for instance) are likely to make wider turns from Main Street that could potentially encroach into the exiting/departure lane of the driveway if these features are not dimensioned properly. Accordingly, the Applicant proposes a roadway widening along Main Street to provide a dedicated deceleration lane to facilitate such movements. Applicant should validate that the proposed driveway

curb radius and entry lane dimensions are adequate to accommodate these vehicle movements as supported by AutoTurn® vehicle turn analysis/exhibits.

(d) The TIAS identifies a proposed pedestrian crossing of Main Street with controls that include a Rectangular Rapid Flashing Beacon (RRFB). Integration of this crossing relative to the Site driveway should be clarified by the Applicant; the crossing placement within the proposed deceleration lane area should be avoided

(e) Applicant should evaluate the need/feasibility of providing an acceleration lane/zone and/or "recovery lane" along Main Street west of the driveway through consultation with MassDOT. MDM experience suggests that in cases where a deceleration/turn lane is provided at an intersection that a corresponding widening opposite the lane (referred to as a "recovery lane") is typically required by MassDOT to provide a consistent roadway width through the intersection and to reduce potential curb impacts during snow plowing operations. Such recovery lane may also facilitate vehicle acceleration/merging for turns from the site driveway heading west.

Response: The need/feasibility of providing an acceleration lane/zone and/or "recovery lane" along Main Street west of the driveway is not required as the widening of Main Street to provide a deceleration lane into the site is not being contemplated. This was discussed with MassDOT who concurred that the volume of traffic turning right into the site is not sufficient to warrant this widening.

The sight distance triangle has been added to the site plans. A note has been added (on the Layout Sheet) stating *"Signs, landscaping and other features located within sight triangle areas shall be designed, installed and maintained so as not to exceed 2.5-feet in height. Snow windrows located within sight triangle areas that exceed 3.5-feet in height above driveway grade or that would otherwise inhibit sight lines shall be promptly removed."*

In conjunction with the site civil engineer, Dillis and Roy, AutoTURN runs were performed for a single unit box truck (SU-30) and the largest fire truck operated by the Groton Fire Department. Copies of these plans are included in the Appendix to this letter and show that the two vehicles can safely maneuver into and out of the site as well as internally to the site. An AutoTURN run was also performed showing a garbage truck accessing the dumpster.

Shown on the attached Figure 1 is the Conceptual Improvement Plan showing a proposed location for the Rectangular Rapid Flashing Beacon for the pedestrian crossing of Main Street. The applicant will review the location and details of the crossing with MassDOT.

The need/feasibility of providing an acceleration lane/zone and/or "recovery lane" along Main Street west of the driveway is not required as widening of Main Street is not being contemplated. The volume of traffic turning right into the site is not sufficient to warrant this widening.

Comment No. 14: ***(a) Applicant should confirm that the Site Layout Plan provides sufficient maneuvering area to accommodate the Town's largest responding fire apparatus (ladder truck) and service vehicles (SU-30 type design vehicles or equivalent) by conducting AutoTurn® vehicle turn analysis/exhibits.***

(b) Applicant should consult with the Groton Fire Department to determine requirements for emergency vehicle circulation around proposed apartment buildings. The need for additional structured/reinforced travel ways sufficient to accommodate emergency apparatus between proposed Building B and Building C should be determined.

(c) Prepare AutoTurn® vehicle turn analysis/exhibits for service vehicles accessing/circulating to the refuse removal area at the site.

(d) Consideration should be made for a designated ride hail/delivery zone at apartment buildings to accommodate short-term delivery activity (parcel delivery vans, food delivery service, tenant pick-up/drop-off).

Response: The Applicant has met with the Groton Fire Department. Included in the Appendix is their letter on the site circulation.

AutoTURN runs were performed for a single unit box truck (SU-30) and the largest fire truck operated by the Groton fire department. Copies of these plans are included in the Appendix to this letter and show that the two vehicles can safely maneuver into and out of the site as well as internally to the site.

Pick-up and drop-off spaces have been added to the front of the three apartment buildings and to the front of the clubhouse to accommodate short-term delivery activity (parcel delivery vans, food delivery service, tenant pick-up/drop-off, etc.).

Comment No. 15: (***a) The potential for school bus access to the site with centralized pick-up/drop-off area should be considered and discussed with the school department. Alternatively, a school bus waiting area/shelter should be considered at an appropriate location near the Site driveway***

(b) Applicant in the Comprehensive Permit Application commits to installing electric vehicle (EV) charging stations throughout the Project Site. Potential location/number so EV stations/spaces should be identified as well as potential to expand the EV infrastructure in future years as demand for EV vehicles increases over time.

(c) Confirm that Americans with Disabilities Act (ADA) compliant wheelchair ramps and crossings are to be provided at all pedestrian crossings internal to the Project site.

(d) MUTCD-compliant signs and markings should be identified in the site development plans at the site driveway and within the site to ensure positive driver guidance and pedestrian awareness/visibility.

Response: The applicant has discussed the potential for school bus pick up and drop off of students within the site. Locations for pick up and drop off will be identified on the site plan and the Dee Bus Company has agreed to on-site pick up and drop off of students.

EV locations will be provided for approximately 30% of the residential unit count (64+/- EV locations; 200 units). These locations have been added to the site plans.

All pedestrian crossings internal to the Project site, sidewalks and wheelchair ramps will comply with the Americans with Disabilities Act (ADA).

All signs and markings will be MUTCD compliant.

Transportation Demand Management (TDM) Programming

Comment No. 16: TDM Programming: The TIAS identifies elements of a Transportation Demand Management (TDM) program for the site that encourages tenant use of and access to alternative travel modes.

MDM generally concurs with the recommended TDM program, noting that expansion of the program should be considered to also include: designating spaces for a car-share program; designation of a ride hail/delivery zone at apartment buildings to facilitate tenant pick-up/drop-

off and parcel delivery vehicles; notification/promotion of Groton Council on Aging van service and programming for qualified residents at lease-up as part of the "welcome packet"; provision of secure, covered bicycle parking on-site; potential banking of parking spaces as appropriate.

Response: As stated in the response to Comment No. 12, the applicant has reached out to Zipcar about the possibility of providing service in this area. At this time, Zipcar has no interest in providing service in this area. A ride hail/delivery space has been provided at each apartment building and the front of the clubhouse to facilitate tenant pick-up/drop-off and parcel delivery vehicles. As part of the Transportation Demand Management (TDM) component of the project, the Transportation Coordinator (TC) of the TDM program will coordinate with eligible seniors. Bicycle parking areas are being provided throughout the site. Five (5) different areas are shown on the site plans.

Offsite Mitigation Commitments

Comment No. 17: **Applicant proposes offsite mitigative actions that include implementation of a new pedestrian crossing of Main Street in the site vicinity to be equipped with Rapid Rectangular Flashing Beacon (RRFB) indicators; widening of Main Street for a deceleration lane at the site driveway; monitoring of the intersections at Mill Street and at Champney Street post-occupancy to determine need for signal controls and commitment to advance design of signal plans if applicable warrants are met.**

(a) Project-related traffic increases do not independently trigger the need for capacity enhancements at area intersections; however, MDM acknowledges Applicant commitment to advancing design plans for signal control at the cited intersections, subject to meeting applicable warrant criteria. To the extent that signal warrants are met and plans are advanced, implementation of signal improvements is the assumed responsibility of others subject to MassDOT approvals.

(b) Access-related comments cited under Comment 13 should be addressed and updated by Applicant based on MassDOT consultation.

(c) Main Street Pedestrian Crossing. Integration of this crossing relative to the Site driveway should be clarified by the Applicant; the crossing placement within the proposed deceleration lane area should be avoided. MDM understands that one potential location of the new RRFB-equipped pedestrian crossing is at Mill Street; a conceptual improvement plan should be developed by the Applicant indicating approximate location and

design features for such a crossing to ensure it is feasible and can be implemented in such a manner that it meets applicable MUTCD guidance and MassDOT design criteria.

(d) Mill Street Pedestrian Crossing. Field review indicates that there is no marked pedestrian crossing across the Mill Street approach to Main Street; likewise, sidewalk landing areas at Mill Street are located behind the marked STOP bar (which itself is faded/poorly visible) and the crossing lacks tactile warning panels. MDM advises that the pedestrian crossing be improved to ensure ADA compliance including tactile warning panels, appropriate ADA-compliant sidewalk/ramp grading, marked crossing per MUTCD guidance and that the STOP position be adjusted (or crossing be relocated) to ensure that approaching vehicles are in an appropriate stop position before crossing the ped walk. These improvements should be coordinated with the proposed Main Street RRFB crossing design.

(e) Champney Street Sight Line Enhancements. Field review indicates that sight lines looking west from the Champney Street stop position are limited by vegetation, substantially reducing visibility to oncoming (eastbound) vehicles. MDM advises that measures by identified and implemented to improve sight lines at this location (a safety concern) as feasible.

Response: As indicated in the response to Comment No. 13, the need/feasibility of providing an acceleration lane/zone and/or "recovery lane" along Main Street west of the driveway is not required as the widening of Main Street to provide a deceleration lane into the site is not being contemplated. This was discussed with MassDOT who concurred that the volume of traffic turning right into the site is not sufficient to warrant this widening.

The TIAS recommended that upon completion and occupancy of the Project, the intersection of Main and Mill Street and the intersection of Main Street and Champney Street be monitored. If at that time, the traffic volumes meet the MUTCD traffic signal warrant criteria, the project proponent will design a traffic signal system for the intersection. To the extent that signal warrants are met, and plans are advanced, implementation of signal improvements is the assumed responsibility of others subject to MassDOT approvals.

The Applicant will develop a Traffic Monitoring Program (TMP) to begin six months after initial 85% occupancy of the site is achieved and include the following:

a) Monitoring will include turning movement counts at the Main Street intersections with the site driveway, Main Street and with Champney Street. The monitoring counts for the site driveway intersection will occur between the hours of 6:00 AM and 9:00 AM, and between 4:00 PM and 7:00 PM to capture the residential peak generating periods.
b) The monitoring counts for the Main Street intersections with Mill Street and with Champney Street will occur between the hours of 6:00 AM and 7:00 PM to capture the residential peak generating periods, as well as to provide sufficient data for a traffic signal warrant analysis.
c) Initiation of monitoring will allow for early identification of operational deficiencies that may require immediate action/countermeasures by the Applicant.
d) Automatic traffic recorder counts with classification on the site driveway to include a continuous 48-hour period over two (2) weekdays, contiguous with the monitoring counts.
e) Evaluate motor vehicle crash data at the Project site driveway and with the Main Street intersections with Mill Street and with Champney Street.

The results of the monitoring program will be summarized in a report to be provided to the Town of Groton upon completion of the data collection. The report will document the traffic volumes associated with the project and any delays, queuing and crash rates at the intersections.

A Highway Access Permit will be submitted to MassDOT by the Applicant for the site access and the RRFB and any work within the State Highway Layout (SHLO). A copy of the application will be sent to the Town at the same time. Shown on the attached Figure 1 is the Conceptual Improvement Plan showing the proposed location for the Rectangular Rapid Flashing Beacon proposed for the pedestrian crossing of Main Street. The applicant will review the location and details of the crossing with MassDOT.

Bayside concurs that there is no marked pedestrian crossing across the Mill Street approach to Main Street, sidewalk landing areas at Mill Street are located behind the marked STOP and the crossing lacks tactile warning panels. These areas as described are located on private property and the responsibility for any improvements would be at the Town's or the landowner's discretion.

Field review indicates that sight lines looking west from the Champney Street stop position are limited by vegetation. A photo of the existing situation is shown on the following page.

As can be seen, visibility to oncoming (eastbound) vehicles is reduced due to the tree canopies. The applicant has contacted MassDOT to alert them to the described conditions as Main Street is under MassDOT jurisdiction.

Please do not hesitate to contact me if you have any questions or require additional information.

Sincerely,

BAYSIDE ENGINEERING, INC.

Kenneth P. Cram, P.E.
Director, Traffic Engineering

APPENDIX

Crash Data Worksheets
Calibrated Capacity Analysis Worksheets
AutoTURN Drawings
Fire Department Correspondence

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	Road Contributing Circumstance	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Roadway	Near Intersection Roadway
4134070	10/29/2015	Property damage only (none injured)	5:20 AM	No injury	1	D1: (No improper driving)	D1: Not Distracted	Collision with animal - deer	Yes	Dark - lighted roadway	Single vehicle crash	Wet	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)		V1:(No)	V1: W	Rain/Cloudy	No hit and run	V1:(Collision with animal - deer)	None	No, school bus not involved	40	Not reported	V1:(Collision with animal - deer)	42.62573	-71.591633	MAIN STREET	Rte 119
4556933	06/16/2018	Property damage only (none injured)	1:19 PM	No injury	2	D1: (Failed to yield right of way),(Inattention) / D2: (No improper	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Four-way intersection	0	0	Stop signs	Two-way, not divided	V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: S / V2: S	Cloudy	No hit and run	V1:(Collision with motor vehicle in traffic) /	None	No, school bus not involved	40	Yes, device functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in	42.62558	-71.591392	MAIN ST Rte 119 W / NOD RD / FITCHS	
4661160	01/29/2019	Property damage only (none injured)	9:40 PM	No injury	1	D1: (Unknown)		Collision with tree	Yes	Dark - roadway not lighted	Head-on	Snow	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: W	Snow	No hit and run	V1:(Collision with tree)	Road surface condition (wet, icy, snow, slush, etc.)	No, school bus not involved		Yes, device functioning	V1:(Collision with motor vehicle in traffic)	42.62665	-71.592482	NOD RD	
4688476	04/03/2019	Non-fatal injury	11:07 PM	Non-fatal injury - Non-incapacitating	1	D1: (No improper driving)	D1: Not Distracted	Collision with tree	Yes	Dark - roadway not lighted	Single vehicle crash	Dry	Not at junction	0	1	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: W	Clear/Severe crosswinds	No hit and run	V1:(Collision with tree)		No, school bus not involved		Not reported	V1:(Collision with tree)	42.62665	-71.592482	NOD RD	
4728784	07/01/2019	Property damage only (none injured)	3:09 PM	No injury	2	D1: (Unknown) / D2: (Unknown)		Collision with motor vehicle in traffic	Yes	Daylight	Rear-end		Four-way intersection	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor		No, school bus not involved		No, device not functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62619	-71.59251	MAIN ST Rte 119 W / FITCHS BRIDGE RD / NOD RD	
4977786	06/28/2021	Property damage only (none injured)	4:36 PM	No Apparent Injury (O)	2	D1: (Inattention),(Failed to yield right of way) / D2: (No improper	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Four-way intersection	0	0	Stop signs	Two-way, divided, unprotected median	V1: Slowing or stopped in traffic / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: S / V2: S	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) /	None	No, school bus not involved	20	Yes, device functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in	42.62558	-71.591392	MAIN ST / NOD RD	

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Street Number	Roadway
4183609	03/15/2016	Property damage only (none injured)	7:16 PM	No injury	2	D1: (Unknown) / D2: (Unknown)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Dark - roadway not lighted	Angle	Wet	Driveway	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Turning left	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(Yes, vehicle or trailer disabled)	V1: W / V2: E	Rain/Cloudy	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62272	-71.588192	546	MAIN STREET Rte 119 W
4604929	09/24/2018	Property damage only (none injured)	6:29 AM	No injury	2	D1: (No improper driving) / D2: (Followed too closely)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: E / V2: E	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62294	-71.58841	536	MAIN ST Rte 119 E
5075090	02/26/2022	Non-fatal injury	12:21 PM	Suspected Minor Injury (B)	2	D1: (No improper driving) / D2: (Inattention)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	1	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(Yes, vehicle or trailer disabled)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62294	-71.58841	536	MAIN ST

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	Road Contributing Circumstance	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Street Number	Roadway
4846467	05/15/2020	Property damage only (none injured)	9:10 PM	No Apparent Injury (O)	1	D1: (Unknown)	Collision with tree	Yes	Dark - roadway not lighted	Single vehicle crash	Wet	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: E	Rain/Severe crosswinds	No hit and run	V1:(Collision with tree)	Obstruction in roadway	No, school bus not involved	40	Not reported	V1:(Collision with tree)	42.62242	-71.58788	531	MAIN ST

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Roadway
4040313	03/09/2015	Non-fatal injury	7:09 PM	Non-fatal injury - Possible	2	D1: (No improper driving) / D2: (Failed to yield right of way)		Collision with motor vehicle in traffic	Yes	Dark - lighted roadway	Sideswipe, opposite direction	Wet	T-intersection	0	1	Stop signs	Two-way, not divided	V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Passenger car)		V2:(Yes, vehicle or trailer disabled)	V1: E / V2: N	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Yes, device functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.6215	-71.586934	MAIN STREET / MILL STREET
4085594	06/18/2015	Property damage only (none injured)	3:42 PM	No injury	2	D1: (No improper driving) / D2: (No improper driving)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)		V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	No, device not functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62162	-71.587056	MAIN STREET
4343166	02/10/2017	Property damage only (none injured)	5:08 PM	No injury	2	D1: (No improper driving) / D2: (No improper driving)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Unknown	Not at junction	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	No, device not functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62162	-71.587056	MAIN STREET
4596532	12/07/2017	Property damage only (none injured)	12:21 PM	No injury	2	D1: (Failed to yield right of way) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Backing / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: E / V2: S	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	15	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62163	-71.587056	MAIN ST
4537026	05/04/2018	Property damage only (none injured)	2:09 PM	No injury	1	D1: (No improper driving)	D1: Not Distracted	Collision with utility pole	Yes	Daylight	Single vehicle crash	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Tractor/semi-trailer)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: E	Clear	No hit and run	V1:(Collision with utility pole)	No, school bus not involved	40	Not reported	V1:(Collision with utility pole)	42.62162	-71.587053	MAIN ST
4569940	07/02/2018	Property damage only (none injured)	4:00 PM	No injury	2	D1: (Inattention) / D2: (No improper driving)	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Driveway	0	0	No controls	Two-way, not divided	V1: Turning right / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: S	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.62162	-71.587053	MAIN ST
4640792	12/21/2018	Property damage only (none injured)	5:27 PM	No injury	3	D1: (No improper driving) / D2: (No improper driving) / D3: (Inattention)	D1: Not Distracted / D2: Not Distracted / D3: Not Distracted	Collision with motor vehicle in traffic	Yes	Dark - lighted roadway	Rear-end	Wet	Not at junction	0	0	No controls	Two-way, divided, unprotected median	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic / V3: Travelling straight ahead	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility)) / V3:(Passenger car)	V1:(No) / V2:(No) / V3:(No)	V1:(No) / V2:(No) / V3:(Yes, vehicle or trailer disabled)	V1: W / V2: W / V3: W	Rain	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic) / V3:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic) V3:(Collision with motor vehicle in traffic)	42.62135	-71.586773	MAIN ST
4648486	01/07/2019	Non-fatal injury	4:00 PM	Non-fatal injury - Possible	2	D1: (No improper driving) / D2: (Failed to yield right of way)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	T-intersection	0	1	Stop signs	Two-way, not divided	V1: Travelling straight ahead / V2: Entering traffic lane	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: E / V2: N	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Yes, device functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.6215	-71.586938	MAIN ST Rte 119 E / MILL ST
4728789	07/12/2019	Property damage only (none injured)	8:29 AM	No injury	2	D1: (Failed to yield right of way) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle		T-intersection	0	0	Stop signs	Two-way, not divided	V1: Entering traffic lane / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(Yes, vehicle or trailer disabled)	V1: N / V2: E	Cloudy	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Yes, device functioning	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.6215	-71.586938	MAIN ST Rte 119 / MILL ST
4767686	10/25/2019	Property damage only (none injured)	12:56 PM	No injury	1	D1: (No improper driving)	D1: Not Distracted	Collision with utility pole	Yes	Daylight	Single vehicle crash	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility))	V1:(No)	V1:(Unknown)	V1: W	Cloudy	No hit and run	V1:(Collision with utility pole)	No, school bus not involved		Not reported	V1:(Ran off road right),(Collision with utility pole)	42.62162	-71.587062	MAIN ST Rte 119 W

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Roadway
4072159	05/20/2015	Property damage only (none injured)	11:31 AM	No injury	2	D1: (No improper driving) / D2: (Inattention),(Illness)	D1: Not Distracted / D2: Not Distracted	Collision with other movable object	Yes	Daylight	Rear-end	Dry	Traffic circle	0	0	No controls	Two-way, divided, unprotected median	V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)		V1:(No) / V2:(No)	V1: N / V2: N	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61896	-71.584432	MAIN STREET
4163273	12/22/2015	Property damage only (none injured)	3:43 PM	No injury	2	D1: (Operating vehicle in erratic, reckless, careless, negligent or aggressive manner) / D2: (No improper driving)	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Wet	Driveway	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Turning left	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility))		V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: W / V2: W	Rain/Cloudy	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61896	-71.584432	MAIN STREET Rte 119 W
4329528	01/15/2017	Property damage only (none injured)	9:22 AM	No injury	2	D1: (Inattention),(Followed too closely) / D2: (No improper driving)	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1:(No)	V1:(No) / V2:(No)	V1: Not Reported / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61896	-71.584432	MAIN STREET Rte 119
4556931	06/14/2018	Property damage only (none injured)	4:40 PM	No injury	2	D1: (Distracted) / D2: (No improper driving)	D1: Other activity (searching, eating, personal hygiene, etc.) / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(Yes, vehicle or trailer disabled)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	40	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61896	-71.584432	MAIN ST
4716156	06/22/2019	Non-fatal injury	11:42 AM	Non-fatal injury - Non-incapacitating	2	D1: (Followed too closely),(Inattention) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	1	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Light truck(van, mini-van, pickup, sport utility))	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved		Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61897	-71.584447	MAIN ST
4912645	12/20/2020	Non-fatal injury	3:08 PM	Possible Injury (C)	1	D1: (No improper driving)	D1: Not Distracted	Collision with utility pole	Yes	Daylight	Single vehicle crash	Snow	T-intersection	0	0	No controls	Two-way, divided, unprotected median	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: W	Snow	No hit and run	V1:(Collision with utility pole)	No, school bus not involved	40	Not reported	V1:(Ran off road right),(Collision with utility pole)	42.61896	-71.584432	MAIN ST / TAYLOR ST
4913741	12/30/2020	Non-fatal injury	7:58 AM	Suspected Minor Injury (B)	1	D1: (Glare)		Collision with utility pole	Yes	Daylight	Single vehicle crash	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)	V1:(Unknown)	V1:(Yes, vehicle or trailer disabled)	V1: W	Clear	No hit and run	V1:(Collision with utility pole)	No, school bus not involved	40	Not reported	V1:(Collision with utility pole)	42.61905	-71.584518	MAIN ST

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Roadway	Near Intersection Roadway
4078585	08/15/2015	Property damage only (none injured)	11:30 AM	No injury	2	D1: (Inattention),(No improper driving) / D2: (No improper driving)	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	T-intersection	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	30	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.618759	-71.5842368	MAIN STREET / ARLINGTON STREET	
4237339	08/06/2016	Property damage only (none injured)	7:53 AM	No injury	1	D1: (Operating vehicle in erratic, reckless, careless, negligent or aggressive manner),(Over-correcting/over-		Collision with other movable object	Yes	Dark - lighted roadway	Single vehicle crash	Dry	Not at junction	0	0	No controls	Two-way, divided, unprotected median	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(No)	V1: E	Clear	No hit and run	V1:(Collision with other movable object)	No, school bus not involved	30	Not reported	V1:(Collision with other movable object),(Collision with mail box),(Collision with fence)	42.618759	-71.5842368	MAIN STREET Rte 119	ARLINGTON STREET

Crash Number	Crash Date	Crash Severity	Crash Time	Max Injury Severity Reported	Number of Vehicles	Driver Contributing Circumstances (All Drivers)	Driver Distracted By (All Vehicles)	First Harmful Event	Is Geocoded	Light Conditions	Manner of Collision	Road Surface Condition	Roadway Junction Type	Total Fatalities	Total Non-Fatal Injuries	Traffic Control Device Type	Trafficway Description	Vehicle Actions Prior to Crash (All Vehicles)	Vehicle Configuration (All Vehicles)	Vehicle Emergency Use (All Vehicles)	Vehicle Towed From Scene (All Vehicles)	Vehicle Travel Directions (All Vehicles)	Weather Conditions	Hit and Run	Most Harmful Event (All Vehicles)	School Bus Related	Speed Limit	Traffic Control Device Function	Vehicle Sequence of Events (All Vehicles)	Latitude	Longitude	Roadway
4050734	04/27/2015	Property damage only (none injured)	1:08 PM	No injury	1	D1: (Inattention)		Collision with other light pole or other post/support	Yes	Daylight	Single vehicle crash	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Backing	V1:(Single-unit truck (2-axle, 6-tires))		V1:(No)	V1: E	Clear	No hit and run	V1:(Collision with light pole or other post/support)	No, school bus not involved	30	Not reported	V1:(Collision with light pole or other post/support)	42.61418	-71.578746	MAIN STREET
4116673	11/24/2015	Property damage only (none injured)	7:30 AM	No injury	2	D1: (No improper driving) / D2: (Inattention)	D2: Other activity (searching, eating, personal hygiene, etc.)	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: E / V2: E	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61399	-71.578405	MAIN STREET
4139785	11/14/2015	Property damage only (none injured)	9:49 AM	No injury	2	D2: (No improper driving)		Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Light truck(van, mini-van, pickup, sport utility)) / V2:(Passenger car)	V1:(No) / V2:(No)		V1: E / V2: W	Clear	No hit and run	V2:(Collision with motor vehicle in traffic)	No, school bus not involved	30	Not reported	V1:(Collision with motor vehicle in traffic),(Collision with work zone maintenance equipment) V2:(Collision	42.61399	-71.578405	MAIN STREET Rte 119
4301104	12/12/2016	Unknown	7:17 AM	Unknown	1	D1: (Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway,		Collision with utility pole	Yes	Daylight	Single vehicle crash	Snow	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead	V1:(Passenger car)	V1:(No)	V1:(Yes, vehicle or trailer disabled)	V1: E	Snow/Sleet, hail (freezing rain or drizzle)	No hit and run	V1:(Collision with utility pole)	No, school bus not involved	35	Not reported	V1:(Ran off road right),(Collision with utility pole)	42.61399	-71.578405	MAIN STREET Rte 119 E
4329525	01/19/2017	Property damage only (none injured)	8:15 PM	No injury	3	D1: (Followed too closely),(Inattention) / D2: (No improper driving) / D3: (No improper driving)	D1: Other activity (searching, eating, personal hygiene, etc.) / D2: Not Distracted / D3:	Collision with motor vehicle in traffic	Yes	Dark - lighted roadway	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Travelling straight ahead / V2: Slowing or stopped in traffic / V3: Slowing or stopped in traffic	V1:(Passenger car) / V2:(Passenger car) / V3:(Passenger car)	V2:(No) / V3:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No) / V3:(No)	V1: W / V2: W / V3: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic) / V3:(Collision	No, school bus not involved		Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic) V3:(Collision with motor	42.6143	-71.578941	MAIN STREET
4369635	05/19/2017	Property damage only (none injured)	6:03 PM	No injury	2	D1: (No improper driving) / D2: (Followed too closely)	D1: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61418	-71.578746	MAIN STREET Rte 119 W
4530726	03/28/2018	Property damage only (none injured)	5:43 PM	No injury	2	D1: (No improper driving) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with parked motor vehicle	Yes	Daylight	Angle	Dry	Not at junction	0	0	No controls	Unknown	V1: Travelling straight ahead / V2: Parked	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with parked motor vehicle) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	10	No, device not functioning	V1:(Collision with parked motor vehicle) V2:(Collision with motor vehicle in traffic)	42.61399	-71.578404	MAIN ST
4697286	04/29/2019	Property damage only (none injured)	8:46 AM	No injury	3	D1: (No improper driving) / D2: (No improper driving) / D3: (No improper driving)	D1: Not Distracted / D2: Not Distracted / D3: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Turning left / V2: Backing / V3: Backing	V1:(Passenger car) / V2:(Passenger car) / V3:(Other e.g. farm equipment)	V1:(No) / V2:(No) / V3:(No)	V1:(No) / V2:(No) / V3:(No)	V1: E / V2: S / V3: S	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic) / V3:(Collision	No, school bus not involved		Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic) V3:(Collision with motor	42.61397	-71.578372	MAIN ST
4898151	11/10/2020	Property damage only (none injured)	11:36 AM	No Apparent Injury (O)	2	D1: (Failed to yield right of way) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	Not at junction	0	0	No controls	Two-way, not divided	V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(Yes, vehicle or trailer disabled)	V1: E / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61395	-71.578341	MAIN ST
4972721	06/16/2021	Property damage only (none injured)	5:42 PM	No Apparent Injury (O)	2	D1: (Unknown) / D2: (No improper driving)	D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Rear-end	Dry	T-intersection	0	0	No controls	Two-way, divided, unprotected median	V1: Travelling straight ahead / V2: Turning right	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(No) / V2:(No)	V1: W / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	35	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61418	-71.578741	MAIN ST / CHAMPNEY ST
5001759	08/29/2021	Non-fatal injury	5:28 PM	Suspected Minor Injury (B)	2	D1: (Failed to yield right of way) / D2: (No improper driving)	D1: Not Distracted / D2: Not Distracted	Collision with motor vehicle in traffic	Yes	Daylight	Angle	Dry	T-intersection	0	0	No controls	Two-way, not divided	V1: Turning left / V2: Travelling straight ahead	V1:(Passenger car) / V2:(Passenger car)	V1:(No) / V2:(No)	V1:(Yes, vehicle or trailer disabled) / V2:(No)	V1: S / V2: W	Clear	No hit and run	V1:(Collision with motor vehicle in traffic) / V2:(Collision with motor vehicle in traffic)	No, school bus not involved	30	Not reported	V1:(Collision with motor vehicle in traffic) V2:(Collision with motor vehicle in traffic)	42.61418	-71.578741	MAIN ST / CHAMPNEY ST

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Fitchs Bridge Road and Nod Road

INTERSECTION DIAGRAM (Label Approaches)

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	2	15	908	366		**1,291**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **13,734**

TOTAL # OF CRASHES : 7 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **0.88**

CRASH RATE CALCULATION : **0.17** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Main Street, Groton Residential Gardens, and Anytime Fitness Driveway

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	EB	WB	NB	SB		
PEAK HOURLY VOLUMES (AM/PM) :	5	3	929	366		**1,303**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **13,862**

TOTAL # OF CRASHES : 3 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **0.38**

CRASH RATE CALCULATION : **0.07** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Country Kids Child Development Center Driveway

INTERSECTION DIAGRAM (Label Approaches)

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB			
PEAK HOURLY VOLUMES (AM/PM) :	943	367	15			**1,325**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **14,096**

TOTAL # OF CRASHES : 1 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **0.13**

CRASH RATE CALCULATION : **0.02** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Mill Street

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB			
PEAK HOURLY VOLUMES (AM/PM) :	822	375	134			**1,331**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **14,160**

TOTAL # OF CRASHES : 13 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **1.63**

CRASH RATE CALCULATION : **0.31** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Taylor Street

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	WB			
PEAK HOURLY VOLUMES (AM/PM) :	811	336	1			**1,148**

" K " FACTOR : **0.094**

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **12,213**

TOTAL # OF CRASHES : 7

OF YEARS : 8

AVERAGE # OF CRASHES PER YEAR (**A**) : **0.88**

CRASH RATE CALCULATION : **0.20**

RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Arlington Street

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB			
PEAK HOURLY VOLUMES (AM/PM) :	832	336	15			**1,183**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **12,585**

TOTAL # OF CRASHES : 2 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **0.25**

CRASH RATE CALCULATION : **0.05** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Groton COUNT DATE : February 2022

DISTRICT : 3 UNSIGNALIZED : X SIGNALIZED :

~ INTERSECTION DATA ~

MAJOR STREET : Main Street

MINOR STREET(S) : Champney Street

INTERSECTION DIAGRAM (Label Approaches)

North

PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	WB			
PEAK HOURLY VOLUMES (AM/PM) :	776	433	70			**1,279**

" K " FACTOR : **0.094** INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **13,606**

TOTAL # OF CRASHES : 15 # OF YEARS : 8 AVERAGE # OF CRASHES PER YEAR (**A**) : **1.88**

CRASH RATE CALCULATION : **0.38** RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

Comments :

Project Title & Date:

Calibrated Capacity Analysis Worksheets

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	990	133	3	197	58	14
Future Volume (vph)	990	133	3	197	58	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.984				0.974	
Flt Protected				0.999	0.961	
Satd. Flow (prot)	1880	0	0	1744	1867	0
Flt Permitted				0.999	0.961	
Satd. Flow (perm)	1880	0	0	1744	1867	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Heavy Vehicles (%)	3%	1%	0%	9%	2%	0%
Adj. Flow (vph)	1042	140	4	266	91	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1182	0	0	270	113	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 70.9%		ICU Level of Service C	
Analysis Period (min) 15			

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	990	133	3	197	58	14
Future Volume (Veh/h)	990	133	3	197	58	14
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Hourly flow rate (vph)	1042	140	4	266	91	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1182		1386	1112
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1182		1386	1112
tC, single (s)			4.1		*4.6	*4.6
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		71	95
cM capacity (veh/h)			598		316	420

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	1182	270	113
Volume Left	0	4	91
Volume Right	140	0	22
cSH	1700	598	332
Volume to Capacity	0.70	0.01	0.34
Queue Length 95th (ft)	0	1	37
Control Delay (s)	0.0	0.3	21.4
Lane LOS		A	C
Approach Delay (s)	0.0	0.3	21.4
Approach LOS			C

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		

* User Entered Value

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	379	67	3	978	146	13
Future Volume (vph)	379	67	3	978	146	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.980				0.989	
Flt Protected					0.956	
Satd. Flow (prot)	1908	0	0	1881	1916	0
Flt Permitted					0.956	
Satd. Flow (perm)	1908	0	0	1881	1916	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Adj. Flow (vph)	431	76	3	1111	166	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	507	0	0	1114	181	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization 69.4%		ICU Level of Service C	
Analysis Period (min) 15			

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	379	67	3	978	146	13
Future Volume (Veh/h)	379	67	3	978	146	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	431	76	3	1111	166	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			507		1586	469
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			507		1586	469
tC, single (s)			4.1		*3.9	*3.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		54	98
cM capacity (veh/h)			1068		361	808

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	507	1114	181
Volume Left	0	3	166
Volume Right	76	0	15
cSH	1700	1068	378
Volume to Capacity	0.30	0.00	0.48
Queue Length 95th (ft)	0	0	62
Control Delay (s)	0.0	0.1	22.9
Lane LOS		A	C
Approach Delay (s)	0.0	0.1	22.9
Approach LOS			C

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		

* User Entered Value

Lanes, Volumes, Timings

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	1025	138	3	204	60	14
Future Volume (vph)	1025	138	3	204	60	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.984				0.974	
Flt Protected				0.999	0.961	
Satd. Flow (prot)	1880	0	0	1743	1867	0
Flt Permitted				0.999	0.961	
Satd. Flow (perm)	1880	0	0	1743	1867	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Heavy Vehicles (%)	3%	1%	0%	9%	2%	0%
Adj. Flow (vph)	1079	145	4	276	94	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1224	0	0	280	116	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	1025	138	3	204	60	14
Future Volume (Veh/h)	1025	138	3	204	60	14
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Hourly flow rate (vph)	1079	145	4	276	94	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1224		1436	1152
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1224		1436	1152
tC, single (s)			4.1		*4.6	*4.6
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		69	95
cM capacity (veh/h)			577		302	406

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	1224	280	116
Volume Left	0	4	94
Volume Right	145	0	22
cSH	1700	577	317
Volume to Capacity	0.72	0.01	0.37
Queue Length 95th (ft)	0	1	41
Control Delay (s)	0.0	0.3	22.7
Lane LOS		A	C
Approach Delay (s)	0.0	0.3	22.7
Approach LOS			C

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

* User Entered Value

Lanes, Volumes, Timings

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	403	74	3	1017	155	13
Future Volume (vph)	403	74	3	1017	155	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.979				0.989	
Flt Protected					0.956	
Satd. Flow (prot)	1906	0	0	1881	1916	0
Flt Permitted					0.956	
Satd. Flow (perm)	1906	0	0	1881	1916	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Adj. Flow (vph)	458	84	3	1156	176	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	542	0	0	1159	191	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	403	74	3	1017	155	13
Future Volume (Veh/h)	403	74	3	1017	155	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	458	84	3	1156	176	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			542		1662	500
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			542		1662	500
tC, single (s)			4.1		*3.9	*3.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		48	98
cM capacity (veh/h)			1037		342	791

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	542	1159	191
Volume Left	0	3	176
Volume Right	84	0	15
cSH	1700	1037	358
Volume to Capacity	0.32	0.00	0.53
Queue Length 95th (ft)	0	0	75
Control Delay (s)	0.0	0.1	26.0
Lane LOS		A	D
Approach Delay (s)	0.0	0.1	26.0
Approach LOS			D

Intersection Summary			
Average Delay	2.7		
Intersection Capacity Utilization	72.0%	ICU Level of Service	C
Analysis Period (min)	15		

* User Entered Value

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	0	1163	264	17	55	1
Future Volume (vph)	0	1163	264	17	55	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.992			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	1845	1796	0	1865	1669
Flt Permitted					0.950	
Satd. Flow (perm)	0	1845	1796	0	1865	1669
Link Speed (mph)		30	30		30	
Link Distance (ft)		139	255		588	
Travel Time (s)		3.2	5.8		13.4	
Peak Hour Factor	0.94	0.94	0.74	0.74	0.92	0.92
Heavy Vehicles (%)	0%	3%	9%	0%	0%	0%
Adj. Flow (vph)	0	1237	357	23	60	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	1237	380	0	60	1
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		13	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	0.96	0.96	0.96	0.96
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	0	1163	264	17	55	1
Future Volume (Veh/h)	0	1163	264	17	55	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.94	0.94	0.74	0.74	0.92	0.92
Hourly flow rate (vph)	0	1237	357	23	60	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	380				1606	368
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	380				1606	368
tC, single (s)	4.1				*4.6	*4.6
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				77	100
cM capacity (veh/h)	1190				261	803

Direction, Lane #	SE 1	NW 1	SW 1	SW 2
Volume Total	1237	380	60	1
Volume Left	0	0	60	0
Volume Right	0	23	0	1
cSH	1190	1700	261	803
Volume to Capacity	0.00	0.22	0.23	0.00
Queue Length 95th (ft)	0	0	22	0
Control Delay (s)	0.0	0.0	22.8	9.5
Lane LOS			C	A
Approach Delay (s)	0.0	0.0	22.6	
Approach LOS			C	

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

* User Entered Value

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	1074	144	3	219	62	14
Future Volume (vph)	1074	144	3	219	62	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.984				0.975	
Flt Protected				0.999	0.961	
Satd. Flow (prot)	1880	0	0	1743	1868	0
Flt Permitted				0.999	0.961	
Satd. Flow (perm)	1880	0	0	1743	1868	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Heavy Vehicles (%)	3%	1%	0%	9%	2%	0%
Adj. Flow (vph)	1131	152	4	296	97	22
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1283	0	0	300	119	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	1074	144	3	219	62	14
Future Volume (Veh/h)	1074	144	3	219	62	14
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.74	0.74	0.64	0.64
Hourly flow rate (vph)	1131	152	4	296	97	22
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			1283		1511	1207
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			1283		1511	1207
tC, single (s)			4.1		*4.6	*4.6
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		66	94
cM capacity (veh/h)			548		282	386

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	1283	300	119
Volume Left	0	4	97
Volume Right	152	0	22
cSH	1700	548	297
Volume to Capacity	0.75	0.01	0.40
Queue Length 95th (ft)	0	1	46
Control Delay (s)	0.0	0.3	25.0
Lane LOS		A	D
Approach Delay (s)	0.0	0.3	25.0
Approach LOS			D

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

* User Entered Value

Lane Group	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (vph)	1	477	1172	48	31	1
Future Volume (vph)	1	477	1172	48	31	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	13	13	13	13
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.995			0.850
Flt Protected					0.950	
Satd. Flow (prot)	0	1881	1935	0	1865	1669
Flt Permitted					0.950	
Satd. Flow (perm)	0	1881	1935	0	1865	1669
Link Speed (mph)		30	30		30	
Link Distance (ft)		139	255		588	
Travel Time (s)		3.2	5.8		13.4	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.92	0.92
Heavy Vehicles (%)	0%	1%	1%	0%	0%	0%
Adj. Flow (vph)	1	542	1332	55	34	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	543	1387	0	34	1
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(ft)		0	0		13	
Link Offset(ft)		0	0		0	
Crosswalk Width(ft)		16	16		16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	0.96	0.96	0.96	0.96
Turning Speed (mph)	15			9	15	9
Sign Control		Free	Free		Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations						
Traffic Volume (veh/h)	1	477	1172	48	31	1
Future Volume (Veh/h)	1	477	1172	48	31	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.92	0.92
Hourly flow rate (vph)	1	542	1332	55	34	1
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1387				1904	1360
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1387				1904	1360
tC, single (s)	4.1				*3.9	*3.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				88	100
cM capacity (veh/h)	500				287	438

Direction, Lane #	SE 1	NW 1	SW 1	SW 2
Volume Total	543	1387	34	1
Volume Left	1	0	34	0
Volume Right	0	55	0	1
cSH	500	1700	287	438
Volume to Capacity	0.00	0.82	0.12	0.00
Queue Length 95th (ft)	0	0	10	0
Control Delay (s)	0.1	0.0	19.2	13.2
Lane LOS	A		C	B
Approach Delay (s)	0.1	0.0	19.1	
Approach LOS			C	

Intersection Summary			
Average Delay	0.4		
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		

* User Entered Value

Lane Group	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (vph)	430	78	3	1060	160	13
Future Volume (vph)	430	78	3	1060	160	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width (ft)	13	13	12	12	14	14
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.979				0.990	
Flt Protected					0.956	
Satd. Flow (prot)	1906	0	0	1881	1918	0
Flt Permitted					0.956	
Satd. Flow (perm)	1906	0	0	1881	1918	0
Link Speed (mph)	30			30	30	
Link Distance (ft)	255			60	175	
Travel Time (s)	5.8			1.4	4.0	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Heavy Vehicles (%)	1%	0%	0%	1%	0%	0%
Adj. Flow (vph)	489	89	3	1205	182	15
Shared Lane Traffic (%)						
Lane Group Flow (vph)	578	0	0	1208	197	0
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	0			0	14	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	0.96	0.96	1.00	1.00	0.92	0.92
Turning Speed (mph)		9	15		15	9
Sign Control	Free			Free	Stop	

Intersection Summary			
Area Type:	Other		
Control Type: Unsignalized			
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	SET	SER	NWL	NWT	NEL	NER
Lane Configurations						
Traffic Volume (veh/h)	430	78	3	1060	160	13
Future Volume (Veh/h)	430	78	3	1060	160	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.88	0.88	0.88	0.88
Hourly flow rate (vph)	489	89	3	1205	182	15
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			578		1744	534
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			578		1744	534
tC, single (s)			4.1		*3.9	*3.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		43	98
cM capacity (veh/h)			1006		322	774

Direction, Lane #	SE 1	NW 1	NE 1
Volume Total	578	1208	197
Volume Left	0	3	182
Volume Right	89	0	15
cSH	1700	1006	337
Volume to Capacity	0.34	0.00	0.58
Queue Length 95th (ft)	0	0	88
Control Delay (s)	0.0	0.1	29.7
Lane LOS		A	D
Approach Delay (s)	0.0	0.1	29.7
Approach LOS			D

Intersection Summary			
Average Delay	3.0		
Intersection Capacity Utilization	74.5%	ICU Level of Service	D
Analysis Period (min)	15		

* User Entered Value

APT. BUILDING B
(56 UNITS)
TOF = 221.0

APT. BUILDING A
(56 UNITS)
TOF = 221.0

APT. BUILDING C
(56 UNITS)
TOF = 221.0

BUILDING 1

BUILDING 2

BUILDING 3

BUILDING 4

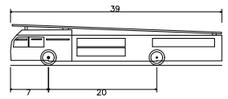
BUILDING 5

BUILDING 6

BUILDING 7

BUILDING 8

PROPOSED
DOG PARK



Aerial Fire Truck
Overall Length
Overall Width
Overall Body Height
Min Body Ground Clearance
Track Width
Lock-to-lock time
Max Wheel Angle

DESIGN VEHICLE

NOT TO SCALE

LEGEND

PROP. FEATURE	DESCRIPTION

PREPARED BY:

DILLIS & ROY
CIVIL DESIGN GROUP

CIVIL ENGINEERS LAND SURVEYORS WETLAND CONSULTANTS
1 MAIN STREET, SUITE 1
LUNENBURG, MA 01462
PHONE: (978) 779-6091
www.dillisandroy.com

OWNER:
500 MG LLC
6 LYBERTY WAY
WESTFORD, MASSACHUSETTS

APPLICANT:
500 MG LLC
6 LYBERTY WAY
WESTFORD, MASSACHUSETTS

SCALE:
60 0 30 60 120 240
1 in. = 60 ft.

DATE: 5/09/2023
DESIGN BY: GSR
DRAWN BY: RPV
CHECKED BY: GSR

AERIAL LADDER TRUCK TURNING MANEUVER PLAN
GROTON FARMS
500 MAIN STREET
GROTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

JOB NO. 6842
DRAWING NO. 6842-VEHICLE
SHEET NO. VT

APT. BUILDING B
(56 UNITS)
TOF = 221.0

APT. BUILDING A
(56 UNITS)
TOF = 221.0

APT. BUILDING C
(56 UNITS)
TOF = 221.0

BUILDING 1

BUILDING 2

BUILDING 3

BUILDING 4

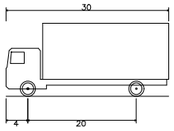
BUILDING 5

BUILDING 6

BUILDING 7

BUILDING 8

PROPOSED
DOG PARK



SU-30 – Single Unit Truck
Overall Length
Overall Width
Overall Body Height
Min Body Ground Clearance
Track Width
Lock-to-lock time
Max Steering Angle (Virtual)

DESIGN VEHICLE

NOT TO SCALE

LEGEND

PROP. FEATURE	DESCRIPTION
- - - - - -	
—— ——	

PREPARED BY:

DILLIS & ROY
CIVIL DESIGN GROUP

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500 MG LLC
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WESTFORD, MASSACHUSETTS

APPLICANT:
500 MG LLC
6 LYBERTY WAY
WESTFORD, MASSACHUSETTS

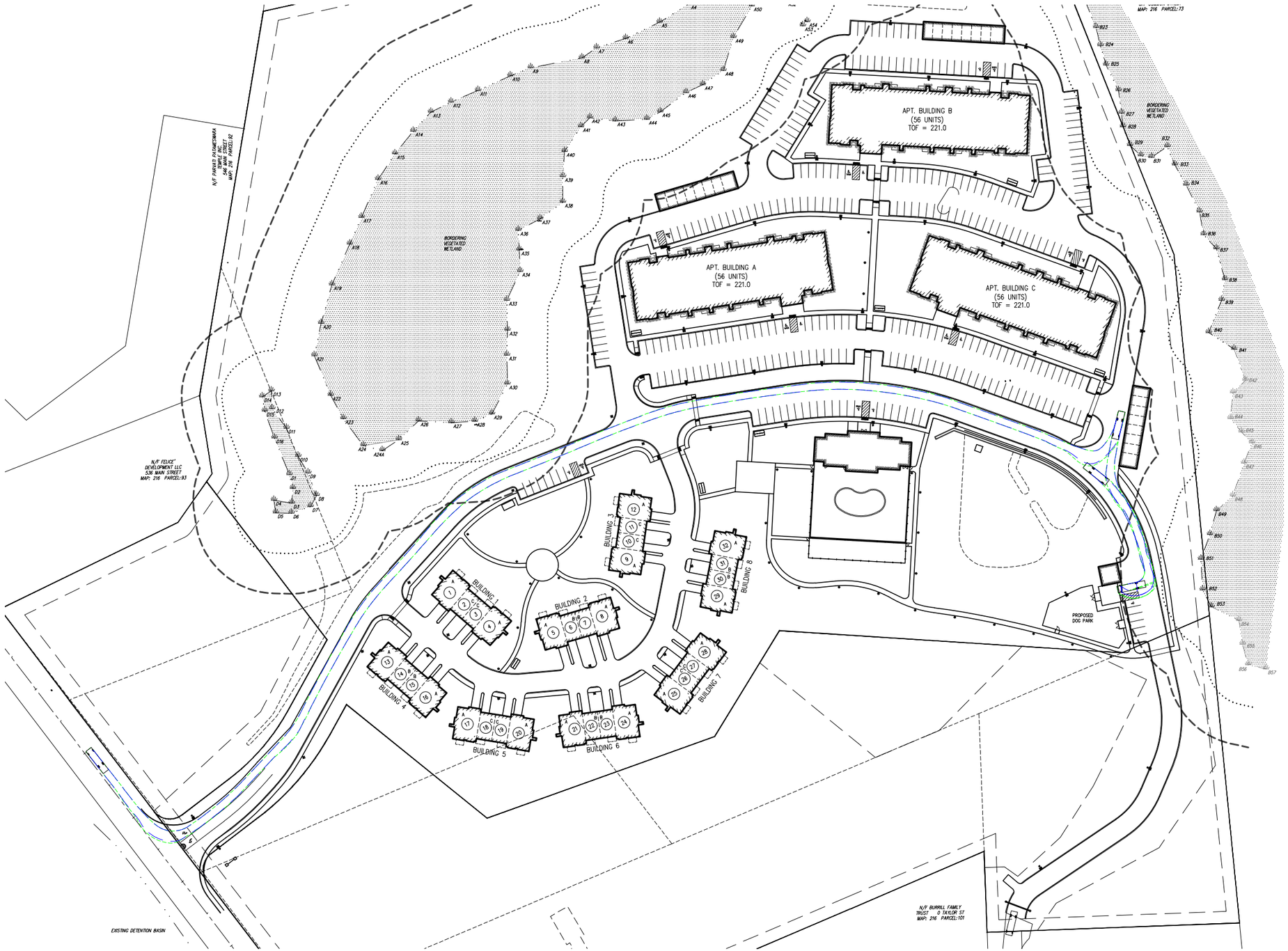
SCALE:
60 0 30 60 120 240
1 in. = 60 ft.

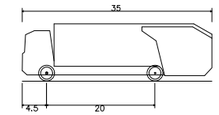
DATE: 5/09/2023
DESIGN BY: GSR
DRAWN BY: RPV
CHECKED BY: GSR

SU-30 TURNING MANEUVER PLAN
GROTON FARMS
500 MAIN STREET
GROTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

JOB NO. 6842
DRAWING NO. 6842-VEHICLE
SHEET NO. VT





Garbage Truck	
Overall Length	35.000ft
Overall Width	8.375ft
Overall Body Height	10.546ft
Min Body Ground Clearance	1.000ft
Track Width	8.375ft
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	29.300ft

DESIGN VEHICLE

NOT TO SCALE

LEGEND

PROP. FEATURE	DESCRIPTION
- - - - - -	TRUCK OVERHANG
——— ———	WHEEL PATH

PREPARED BY:
DILLIS & ROY
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WESTFORD, MASSACHUSETTS

APPLICANT:
500 MG LLC
6 LYBERTY WAY
WESTFORD, MASSACHUSETTS

SCALE:
60 0 30 60 120 240
1 in. = 60 ft.

DATE: 5/22/2023
DESIGN BY: GSR
DRAWN BY: RPV
CHECKED BY: GSR

DISPOSAL VEHICLE TURNING MANEUVER PLAN
GROTON FARMS
500 MAIN STREET
GROTON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

JOB NO. 6842
DRAWING NO. 6842-VEHICLE
SHEET NO. VT

Groton Fire Department

Fire ~ EMS ~ Rescue

"Together We Serve the Community"

45 Farmers Row
Groton, Massachusetts 01450
Tel: (978) 448-6333

May 17, 2023

Groton Zoning Board of Appeals
173 Main St
Groton, MA 01450
Attn: Bruce Easom, Chair

Re: 500 Main St Site

Omni Development has submitted the attached plans related the outside site plans for the proposed 40B at 500 Main St. The Fire Department has reviewed these plans and approves of them.

The Fire Department reviews the plans to gauge our anticipated operations with the vehicle access and hydrant locations. Vehicle access is typically looked at in terms of a 43-foot vehicle (ladder truck) being able to make all turns within the project. This ensures that the aerial device can be used to rescue trapped individuals as well as provide other support functions for firefighting. The proposed turning templates are acceptable for Fire Department access.

Fire hydrants are reviewed in order to ensure that they are readily available to support both the internal fire suppression system as well as firefighting. After working with the Omni Team as well as Dillis and Roy, the hydrant locations and sizes of mains are sufficient for our operations.

If you have any further questions, please let me know.

Respectfully,

Steele McCurdy, Fire Chief