Vanasse & Associates inc
Transportation Engineers & Planners

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Suite 140
Andover, MA 01810

Ref: 8670

November 7, 2022

Mr. Peter Bemis
Engineering Design Consultants, Inc.
32 Turnpike Road
Southborough, MA 01772

Re: Updated Transportation Impact Assessment – Proposed Warehouse
Hopping Brook Business Park, Holliston, Massachusetts

Dear Peter:

Vanasse & Associates, Inc. (VAI) has prepared this updated Transportation Impact Assessment (TIA) in order to determine the potential impact on the transportation infrastructure associated with the proposed construction of 550,000 square foot (sf) warehouse facility to be located at 555 Hopping Brook Road in Holliston, Massachusetts (hereafter referred to as the "Project"). Previously the Project proposed two phases of development: an 800,000 sf warehouse under Phase 1 and a future 700,000 sf warehouse under Phase 2. The future warehouse is no longer part of the Project and the proposed facility has been reduced to 550,000 sf. In order to provide a consistent basis for comparison with the previously proposed project, background conditions and design years have not been changed but the reduction of the warehouse development to 550,000 sf from 800,000 sf has been included. Updates to the Project trip-generation, capacity analysis and traffic signal warrant analysis are provided.

PROJECT DESCRIPTION AND BACKGROUND

The Project site was originally reviewed through an Environmental Notification Form (ENF) with 3,000,000 sf of development to include office space, research and development (R&D), high technology assembly uses, and approximately 9,684 parking spaces anticipating 36,900 vehicle trips per day in 1982 (EOEA No. 4411 ENF). The original program was defined as Phase I and Phase II and required to file Draft and Final Environmental Impact Reports (EIRs). After Massachusetts Environmental Policy Act (MEPA) review, the FEIR was issued on June 14, 1983. In 2002, a Notice of Project Change (NPC) was filed to modify the program to include 558,000 sf of office space, manufacturing, and warehouse space after construction of Phase I. In 2018, a 59,724 sf marijuana growing and processing facility (PharmaCann) was permitted as part of Phase II (this facility can expand up to an additional 55,000 sf) and a 25,200 sf industrial building was recently permitted within part of the original Phase I Project limits. These components are currently under construction. Currently, a total of 720,288 sf of development exists at the park. The proposed Project will entail the construction of a 550,000 sf warehouse building to be located at 555 Hopping Brook Road. Therefore, the full build-out of the site will include the components currently under construction plus the 550,000 sf warehouse facility. The location of the Project site, relative to the surrounding roadway network, is displayed in Figure 1.

Figure 1

Site Location Map

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EXISTING CONDITIONS

Traffic-volume data for the study area intersection, Washington Street (Route 16) at Hopping Brook Road was collected in December 2019 as part of a prior TIA filed in January 2020. Manual turning movement counts (TMCs) were conducted at the study area intersection from 7:00 to 9:00 AM and from 3:00 to 6:00 PM, These time periods were selected for analysis purposes as they are representative of the peak-traffic-volume hours for both the Project and the adjacent roadway network. In addition, automatic traffic recorder counts (ATR) were conducted in December 9016 on Washington Street east of Hopping Brook Road and on Hopping Brook Road south of Washington Street for 96-hours (Monday-Thursday).

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, traffic-volume data from the Massachusetts Department of Transportation (MassDOT) Continuous Count Station No. 3180 located on Interstate 495 (I-495) in Medway were reviewed. Based on a review of this data, it was determined that traffic volumes for the month of December are approximately 8.0 percent below average-month conditions. As such, the raw traffic count data was adjusted upward accordingly. The 2020 Existing weekday morning and weekday evening peak-hour traffic volumes are graphically depicted on Figure 2.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2027, which reflects a seven-year planning horizon consistent with MassDOT's Guidelines. Independent of the Project, traffic volumes on the roadway network in the year 2027 under No-Build conditions include all existing traffic and new traffic resulting from background traffic growth. Anticipated Project-generated traffic volumes superimposed upon the 2027 No-Build traffic volumes reflect 2027 Build traffic-volume conditions with the Project.

Future Traffic Growth

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

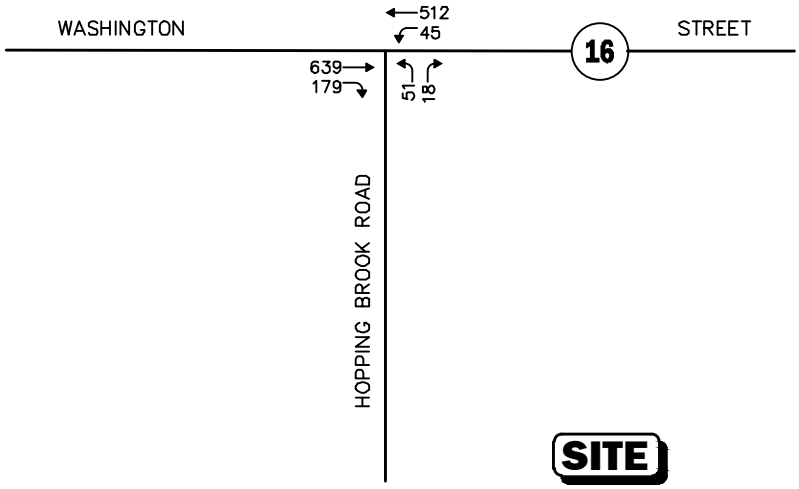
An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, potential population growth and development external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

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

Specific Development by Others

The Planning Department of the Town of Holliston was contacted in order to determine if there were any projects planned within the study area that would have an impact on future traffic volumes at the study intersections. Based on these discussions, the following projects were identified for inclusion in this

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



WEEKDAY EVENING PEAK HOUR (4:30-5:30 PM)

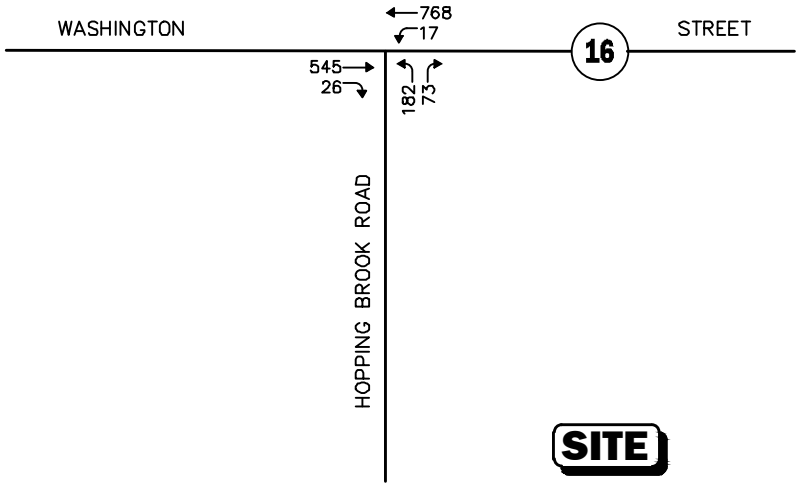


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Figure 2

2020 Existing Peak-Hour Traffic Volumes

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assessment:

- ***Industrial Building, 56 Boynton Road, Holliston, Massachusetts.*** This project will entail the construction of a 25,200 sf of a single-story industrial building to be located at 56 Boynton Road.

- ***PharmaCannis MA, 465 Hopping Brook Road, Holliston, Massachusetts.*** This project is currently under construction at 465 Hopping Brook Road and consists of 59,724 sf a single-story cannabis growth and processing center.

- ***Landscaping Company, 2016 Washington Street, Holliston, Massachusetts.*** This project will entail the construction of a 4,950 sf of a landscaping company to be located at 2016 Washington Street. Traffic volumes associated with this project within the study area are expected to be relatively minor and would be reflected in the general background traffic growth rate (discussion follows).

Traffic volumes associated with the aforementioned specific development projects by others were obtained from trip-generation information available from the Institute of Transportation Engineers (ITE)[1] for the appropriate land use and were assigned to the study area roadway network based on existing traffic patterns where no other information was available. No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

Traffic-volume data compiled by MassDOT in Holliston and Medfield were reviewed. Based on a review of this data, it was determined that traffic volumes within the study area have increased by an average of 0.81 percent per year over the past several years. In order to provide a conservative (high) analysis scenario and a prudent planning condition for the Project, a slightly higher (1.0 percent per year) compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

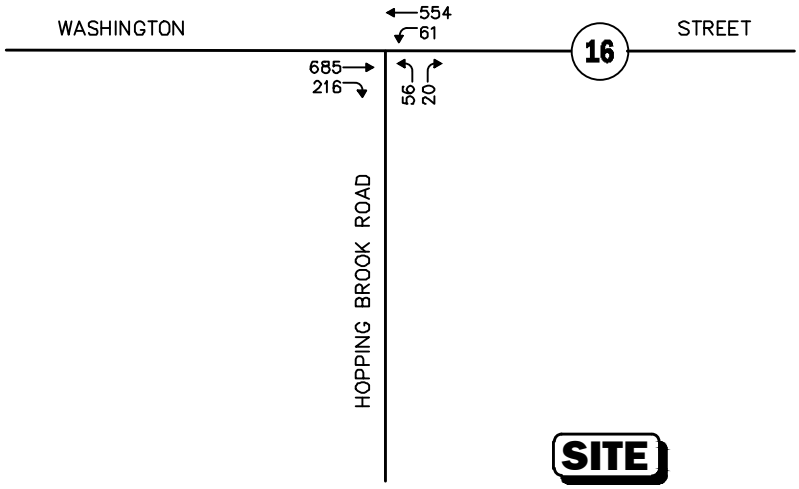
MassDOT and the Town of Holliston were consulted in order to determine if there were any planned future roadway improvement projects expected to be completed by 2027. Based on these discussions, no roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

No-Build Traffic Volumes

The 2027 No-Build condition peak-hour traffic volumes were developed by applying the 1.0 percent per year compounded annual background traffic growth rate to the 2020 Existing peak-hour traffic volumes and then adding the peak-hour traffic volumes associated with the identified specific development projects by others. The resulting 2027 No-Build weekday morning and evening peak-hour traffic volumes are shown on Figure 3.

[1]*Trip Generation,* Tenth Edition; Institute of Transportation Engineers; Washington, DC; 2017.

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



WEEKDAY EVENING PEAK HOUR (4:30-5:30 PM)

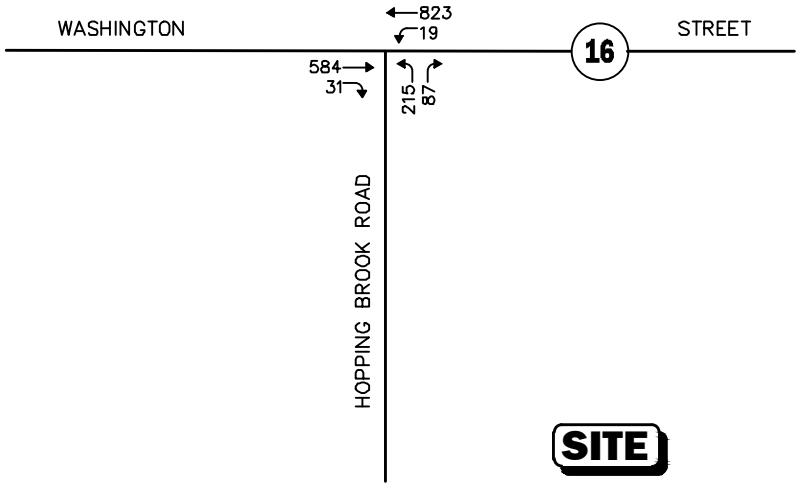


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Figure 3

2027 No-Build
Peak-Hour Traffic Volumes

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PROJECT-GENERATED TRAFFIC

Design year (2027 Build) traffic volumes for the study area roadways were determined by estimating Project-generated traffic volumes and assigning those volumes on the study roadways. The following sections describe the methodology used to develop the anticipated traffic characteristics of the Project.

As proposed, the Project will entail the construction of a 550,000 sf warehouse building. In order to develop the traffic characteristics of the Project, trip-generation statistics published by the ITE for similar land uses as that proposed were used. ITE Land Use Code (LUC) 150, *Warehousing*, was used to develop the traffic characteristics of the Project.

The warehouse land use code was chosen as the most appropriate land use to Project trips. This is based on information provided by the client that potential tenants for the site are proposing a building consistent with a standard warehouse use and no other warehouse uses such as High-Cube Transload, High-Cube Fulfillment Center (Sort and Non-Sort), and High-Cube Parcel Hub are being considered. Some of these are directly related to freight delivery facilities while others would require a high degree of automation not anticipated to be constructed with the Project. For these reasons, LUC 150 was chosen to estimate trips for the Project.

In order to account for truck trips generated by the Project, the base trip-generation calculations were disaggregated into car trips and truck trips using truck percentage statistics provided for warehouse uses from the ITE *Trip Generation Manual Supplement*.[2] The vehicle trips for the Project, with appropriate adjustments for truck and passenger vehicle trips, are summarized in Table 1.

Table 1
PROJECT TRIP-GENERATION SUMMARY

Time Period/Direction	Vehicle Trips[a]	Trucks[b]	Cars
Weekday Daily	958	258	700
Weekday Morning Peak Hour:			
Entering	72	9	63
Exiting	22	3	19
Total	94	12	82
Weekday Evening Peak Hour:			
Entering	28	4	24
Exiting	77	12	65
Total	105	16	89

[a]Based on ITE LUC 150, *Warehousing* (550,000 sf).
[b]Percentage of truck trips: Weekday, 27 percent; weekday morning, 13 percent; weekday evening, 15 percent. From *Trip Generation Manual Supplement* 10th Edition Appendix C: Truck Trips as Percent of Total Vehicle Trips.

[2]*Trip Generation Manual Supplement*; 10th Edition; ITE; Washington, D.C.; 2020.

As can be seen in Table 1, the Project is expected to generate approximately 958 vehicle trips on an average weekday (two-way volume over the operational day of the Project), with 94 vehicle trips (72 entering and 22 exiting) expected during the weekday morning peak hour and 105 vehicle trips (28 entering and 77 exiting) expected during the weekday evening peak hour. Furthermore, the Project is expected to generate approximately 258 truck trips on an average weekday, with 12 truck trips (9 entering and 3 exiting) expected during the weekday morning peak hour and 16 truck trips (4 entering and 12 exiting) expected during the weekday evening peak hour.

Based on the latest revisions to the Hopping Brook Business Park development program, the Park is expected to generate fewer vehicle trips than previously calculated in the November 18, 2020 TIA.[3] This is shown in Table 2, which identifies existing trips, programmed trips for developments under construction, and the Project consisting of a 550,000 sf warehouse.

Table 2
TRIP-GENERATION SUMMARY

Time Period/Direction	Existing Park[a]	Under Construction[b]	Proposed Project[c]	Full Buildout	TIA: November 18, 2020[d]	Delta
Weekday Daily	3,034	422	958	4,414	5,918	-1,504
Weekday Morning Peak Hour:						
Entering	246	53	72	371	496	-125
Exiting	50	7	22	79	115	-36
Total	296	60	94	450	611	-161
Weekday Evening Peak Hour:						
Entering	38	7	28	73	122	-49
Exiting	222	47	77	346	477	-131
Total	260	54	105	419	599	-180

[a]Based on traffic counts of Hopping Brook Road conducted in 2019 and 720,288 sf of development.

[b]Includes PharmaCann cultivation facility and industrial building expansion; trips based on ITE LUC 110, *Light Industrial* and 84,924 sf.

[c]From Table 1.

[d]From *Transportation Impact Assessment - Proposed Warehouse and Project Buildout Hopping Brook Business Park, Holliston, Massachusetts*; November 18, 2020.

As shown in Table 2, the current development program is expected to generate 1,504 less vehicle trips on an average weekday than the previous development program with 161 less vehicle trips (125 entering and 36 exiting) expected during the weekday morning peak hour and 180 less vehicle trips (49 entering and 131 existing) expected during the weekday evening peak hour.

[3]*Transportation Impact Assessment – Proposed Warehouse and Project Buildout – Hopping Brook Business Park, Holliston, Massachusetts*; Vanasse & Associates Inc.; November 18, 2020.

TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of generated trips to and from the Project site was determined based on a review of existing traffic patterns within the study area and the location of connections to the Interstate Highway System (IHS). The general trip distribution for the Project is graphically depicted on Figure 4, with separate distribution figures for the cars and trucks expected to travel to and from the site. The weekday morning and evening project gendered peak-hour traffic volumes are graphically depicted on Figure 5. The car and truck trips are shown separately on these figures.

FUTURE TRAFFIC VOLUMES - BUILD AND ULTIMATE-BUILD CONDITIONS

The 2027 Build condition traffic volumes consist of the 2027 No-Build traffic volumes with the additional traffic expected to be generated by the Project added to them. The 2027 Build weekday morning and evening peak-hour traffic volumes are graphically depicted on Figure 6.

A summary of peak-hour projected traffic-volume increases outside of the study area that is the subject of this assessment is shown in Table 3. These volumes are based on the expected increases from the Project.

Table 3
PEAK-HOUR TRAFFIC-VOLUME INCREASES

Location/Peak Hour	2027 No-Build	2027 Build	Traffic-Volume Increase Over No-Build	Percent Increase Over No-Build
Washington Street, east of Hopping Brook Road:				
Weekday Morning	1,320	1,345	25	1.9
Weekday Evening	1,513	1,539	26	1.7
Washington Street, west of Hopping Brook Road:				
Weekday Morning	1,511	1,580	69	4.6
Weekday Evening	1,653	1,732	79	4.8

As shown in Table 3, Project-related traffic-volume increases outside of the study area relative to 2027 No-Build conditions are anticipated to range from 1.7 to 4.8 percent during the peak periods, with vehicle increases shown to range from 25 to 79 vehicles. ***Outside of the Washington Street corridor, level of impact would not be readily apparent on the roadway network over existing conditions.***

TRAFFIC SIGNAL WARRANTS

Legend:

XX Cars

(XX) Trucks

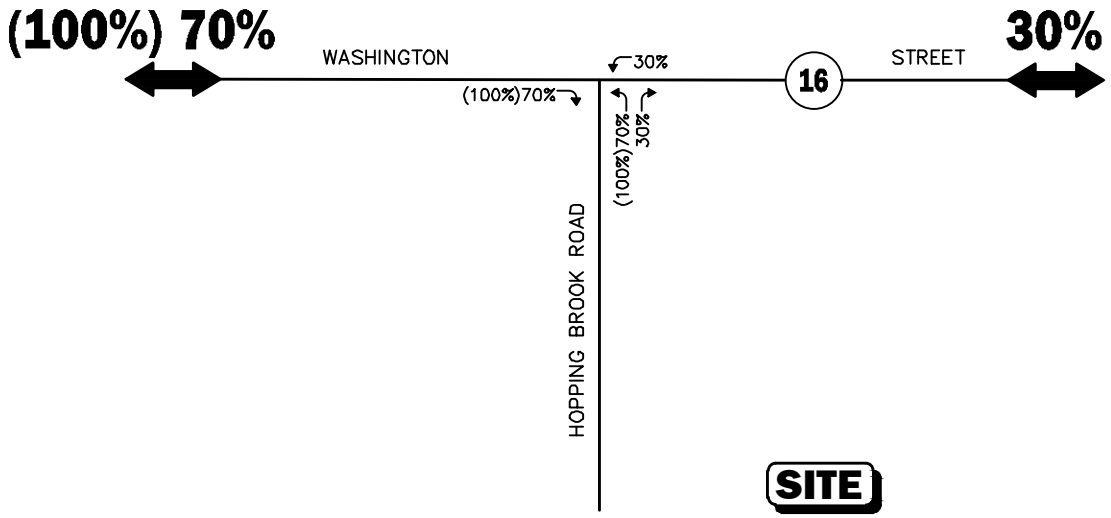

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Figure 4

Trip Distribution Map

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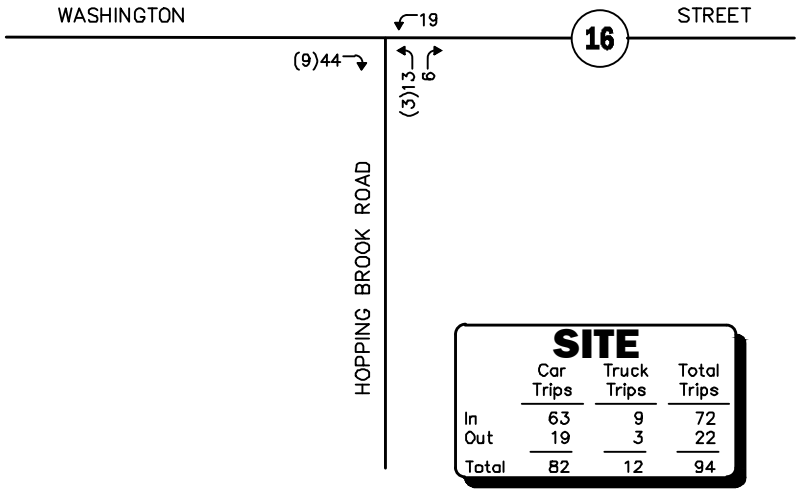
WEEKDAY MORNING PEAK HOUR (7:30-8:30 AM)

Legend:

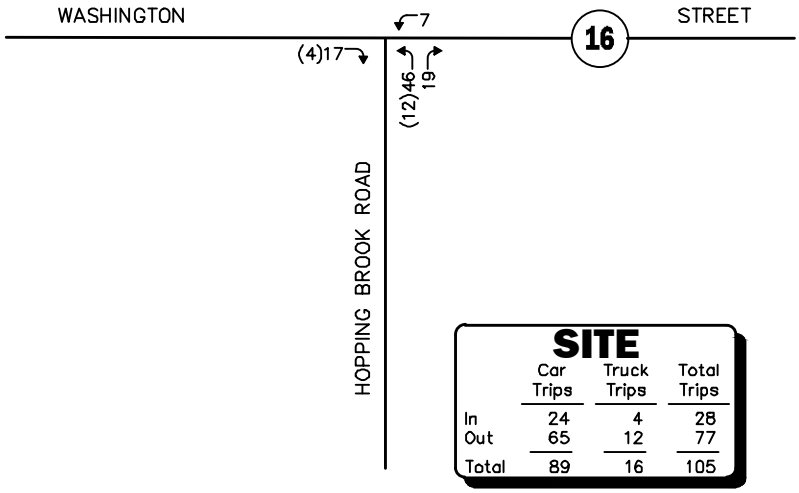
XX Car Trips
(XX) Truck Trips



SITE

	Car Trips	Truck Trips	Total Trips
In	63	9	72
Out	19	3	22
Total	82	12	94

WEEKDAY EVENING PEAK HOUR (4:30-5:30 PM)



SITE

	Car Trips	Truck Trips	Total Trips
In	24	4	28
Out	65	12	77
Total	89	16	105

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Figure 5

Project-Generated Peak-Hour Traffic Volumes

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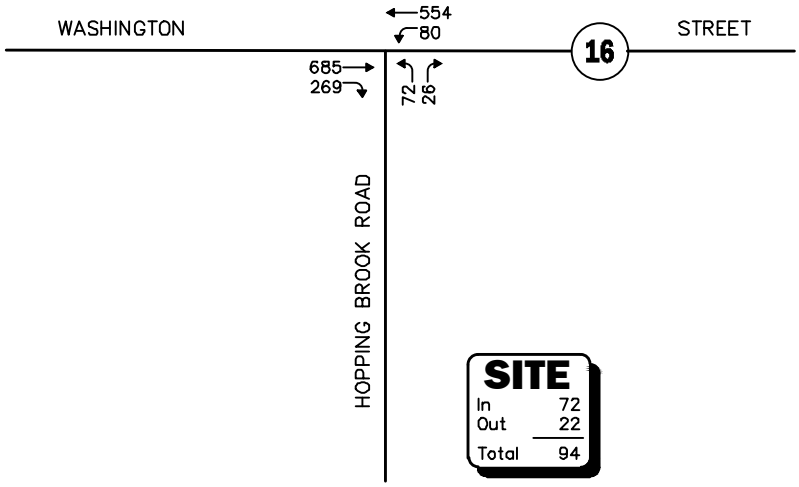
WEEKDAY MORNING PEAK HOUR (7:30-8:30 AM)



WEEKDAY EVENING PEAK HOUR (4:30-5:30 PM)

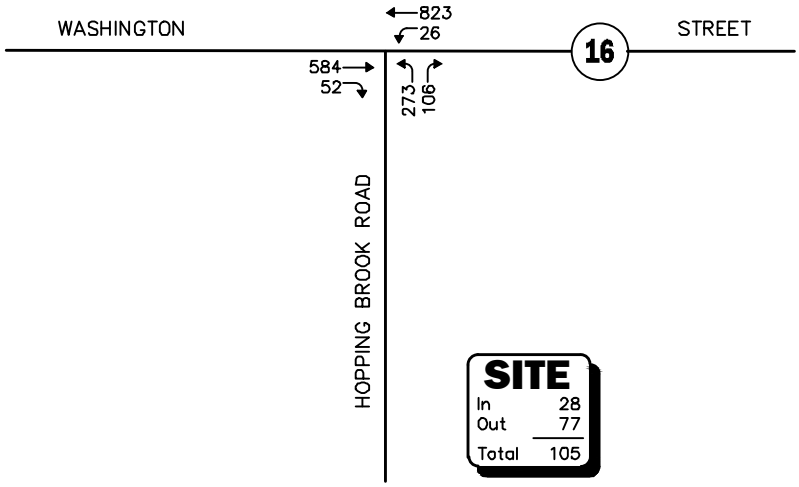


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Figure 6

2027 No-Build
Peak-Hour Traffic Volumes

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The *Manual on Uniform Traffic Control Devices* (MUTCD)[4] establishes nine warrants or criteria to evaluate a location for the installation or retention of a traffic signal. At least one of the nine warrants should be satisfied in order to justify the installation or retention of a traffic signal; however, satisfaction of a warrant in and of itself does not justify traffic signal control. An engineering evaluation of the location in question should indicate that the establishment of traffic signal control will improve the overall safety and/or operation of the intersection. Table 4 identifies the nine traffic signal warrants that were reviewed for this analysis.

Table 4
TRAFFIC SIGNAL WARRANTS

Warrant No.	Description
1	Eight-Hour Vehicular Volume
2	Four-Hour Vehicular Volume
3	Peak Hour
4	Pedestrian Volume
5	School Crossing
6	Coordinated Signal System
7	Crash Experience
8	Roadway Network
9	Intersection near a Grade Crossing

TMCs and automatic traffic recorder (ATR) count data collected in December 2019 and ITE time of day distributions for LUC 150 were used to develop hourly trip estimates for the traffic signal warrant analysis at the intersection of Washington Street at Hopping Brook Road. These volumes were seasonally adjusted to average-month conditions.

Under 2020 Existing conditions, the intersection of Washington Street with Hopping Brook Road meets the 4-hour and peak-hour traffic-volume warrants. Under 2027 Build conditions, the intersection meets all three of the traffic-volume warrants: the 8-hour, 4-hour, and peak hour, respectively.

Warrant 4 is related to pedestrian volume at an intersection. This warrant requires a minimum of 75 pedestrians per hour for each of four hours or a minimum of 93 pedestrians per hour for a peak hour. However, minimal pedestrian activity was observed during the peak hours, therefore this warrant is not met.

Warrant 5 is related to street crossings by schoolchildren, including elementary through high school students. This warrant requires a minimum of 20 schoolchildren crossing during the highest crossing hour. Again, minimal pedestrian activity was observed during the peak hours, therefore this warrant is not met.

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

Warrant 6 is related to the potential installation of a traffic signal at an intersection in the middle of a coordinated signal system to improve progressive traffic movement on a corridor. The intersections are not in a coordinated signal system, therefore this warrant is not met.

Warrant 7 is related to crash experience and involves adequate trial of alternatives with no reduction in the outcome of crashes and five or more reported crashes of a type that could be corrected by a traffic control signal have occurred within a twelve-month period. A review of crash history indicates that at the intersections experienced 4 crashes or less over the five-year review period (2015-2019); therefore, this warrant is not met.

Warrant 8 is related to the installation of a signal to encourage concentration and organization of traffic flow on a roadway network. As with Warrant 6, the intersections are not part of a coordinated signal system and are also not at the intersection of two major routes that might benefit from organization of traffic flows. Therefore, this warrant is not met.

Warrant 9 is related to the installation of a signal at an intersection near a railroad grade crossing, where none of the other warrants are met, but the proximity of the intersection to a railroad grade crossing is the principal reason to consider installation of signal control. As there are no railroad grade crossings near the intersections, so this warrant is not met.

Table 5 summarizes the Traffic Signal Warrants for the 2020 Existing and 2027 Build conditions.

Table 5
TRAFFIC SIGNAL WARRANTS ANALYSIS RESULTS[a]

Warrant No.	Description	Satisfied for 2020 Existing Conditions	Satisfied for 2027 Build Conditions
1	Eight-Hour Vehicular Volume	No	Yes
2	Four-Hour Vehicular Volume	Yes	Yes
3	Peak Hour	Yes	Yes
4	Pedestrian Volume	No	No
5	School Crossing	No	No
6	Coordinated Signal System	No	No
7	Crash Experience	No	No
8	Roadway Network	No	No
9	Grade Crossing	No	No

[a]TSWA based on counts conducted in December 2019.

As shown in Table 5, the intersection of Washington Street with Hopping Brook Road meets the 4-hour and peak-hour volume-related signal warrants under 2020 existing conditions and meets all three volume-related warrants under 2027 Build conditions. Therefore, VAI has determined that a traffic signal at this location is warranted.

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantify traffic flow within the study area. To assess quality of flow, roadway capacity, and vehicle queue analyses were conducted under Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study. A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[5] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Signalized Intersections

The six levels of service for signalized intersections may be described as follows:

- *LOS A* describes operations with very low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop, and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures is frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Levels of service for signalized intersections were calculated using the Percentile Delay Method implemented as a part of the Synchro 11 software as required by MassDOT. The Percentile Delay Method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on "percentile" delay. Level-of-service designations are based on the criterion of percentile delay per vehicle and is a measure of: i) driver discomfort; ii) motorist frustration; and iii) fuel consumption; and includes a uniform delay based on percentile volumes using a Poisson arrival pattern, an initial queue move-up time, and a queue interaction delay that accounts for delays resulting from queues extending from adjacent intersections. Table 6 summarizes the relationship between level-of-service and percentile delay and uses the same numerical delay thresholds as the *Highway Capacity Manual* (HCM)[6] method. The tabulated percentile delay criterion may be applied in assigning level-of-service designations to individual lane

[5]The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2016.

[6]*Highway Capacity Manual*; 6th Edition; Transportation Research Board; Washington, DC; 2016.

groups, to individual intersection approaches, or to entire intersections.

Table 6
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS

Level of Service	Percentile Delay Per Vehicle (Seconds)
A	<10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	>80.0

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach Road, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the HCM. Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the HCM. Table 7 summarizes the relationship between level of service and average control delay for two-way STOP-controlled and all-way STOP-controlled intersections.

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

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

[a]Source: *Highway Capacity Manual 6*; Transportation Research Board; Washington, DC; 2016.

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2020 Existing, 2027 No-Build, 2027 Build, and 2027 Build Mitigated conditions for the study area intersection. The results of the intersection capacity analyses are summarized in Table 8 and Table 9. The detailed analysis results are presented in the Appendix.

Washington Street at Hopping Brook Road (Unsignalized)

Under 2020 Existing, during both peak periods, left-turning movement exiting Hopping Brook Road was shown to operate at LOS F while the right-turning movement operate at LOS B. Under 2027 No-Build, the left-turning movement exiting Hopping Brook Road was shown to continue to operate at LOS F during the weekday morning and evening peak hours and right-turning movement was shown to operate at LOS B during the weekday morning peak hour and at LOS C during weekday evening peak hour. No changes in level of service occurred due to the addition of Project traffic except for the northbound right-turn movement which went from LOS B under 2027 No-Build conditions to LOS C under 2027 Build conditions. Although the level of service decreased from B to C, the increase in average delay only increases by 0.2 seconds per vehicle which would be unnoticeable to drivers.

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

Unsignalized Intersection/ Peak Hour/Movement	2020 Existing				2027 No-Build				2027 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand	Delay	LOS	Queue 95th	Demand	Delay	LOS	Queue 95th
Washington Street at Hopping Brook Road:												
Weekday Morning:												
Washington Street EB TH/RT	818	0.0	A	0	901	0.0	A	0	954	0.0	A	0
Washington Street WB LT/TH	557	0.8	A	0	615	1.0	A	0	634	1.4	A	1
Hopping Brook Road NB LT	51	>50.0	F	4	56	>50.0	F	6	72	>50.0	F	5
Hopping Brook Road NB RT	18	14.8	B	0	20	15.9	C	0	26	16.3	C	1
Weekday Evening:												
Washington Street EB TH/RT	571	0.0	A	0	615	0.0	A	0	636	0.0	A	0
Washington Street WB LT/TH	785	0.2	A	0	842	0.2	A	0	849	0.3	A	1
Hopping Brook Road NB LT	182	>50.0	F	17	215	>50.0	F	24	273	>50.0	F	27
Hopping Brook Road NB RT	73	13.7	B	1	87	14.8	B	1	106	15.0	C	1

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

Washington Street at Hopping Brook Road (Signalized)

As shown in Table 9, during both peak periods, the intersection operates at an overall LOS C. In addition, all movements operate at LOS C or better.

Table 9
SIGNALIZED INTERSECTION CAPACITY ANALYSIS SUMMARY

Signalized Intersection/ Peak Hour/Critical Movement	2027 Build V/C[a]	Delay	LOS	Queue Ave/95th
Washington Street at Hopping Brook Road:				
Weekday Morning:				
Washington Street EB TH/RT	0.95	35.0	C	16/30
Washington Street WB LT	0.40	10.1	B	1/2
Washington Street WB TH	0.46	6.2	A	4/7
Hopping Brook Road NB LT	0.38	35.0	C	2/3
Hopping Brook Road NB RT	0.13	12.8	B	0/1
Overall	--	**23.6**	**C**	--
Weekday Evening:				
Washington Street EB TH/RT	0.73	21.4	C	7/19
Washington Street WB LT	0.09	7.8	A	1/1
Washington Street WB TH	0.85	22.2	C	11/20
Hopping Brook Road NB LT	0.69	32.9	C	5/9
Hopping Brook Road NB RT	0.23	6.4	A	0/2
Overall	--	**22.4**	**C**	--

[a]Volume-to-capacity ratio.
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]Queue length, in vehicle.
NB = northbound; EB = eastbound; WB = westbound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

CONCLUSIONS

Vanasse & Associates, Inc. (VAI) has completed this updated TIA in order to determine the potential impact on the transportation infrastructure associated with the proposed construction of 550,000 square foot (sf) warehouse facility to be located at 555 Hopping Brook Road in Holliston, Massachusetts. Based on the assessment VAI has concluded the following:

- The Project is expected to generate approximately 958 vehicle trips on an average weekday (two-way volume), with 94 vehicle trips (72 entering and 22 exiting) expected during the weekday morning peak hour and 105 vehicle trips (28 entering and 77 exiting) expected during the weekday evening peak hour. Furthermore, the Project is expected to generate approximately 258 truck trips on an average weekday, with 12 truck trips (9 entering and 3 exiting) expected during the weekday morning peak hour and 16 truck trips (4 entering and 12 exiting) expected during the weekday evening peak hour.

- The intersection of Washington Street and Hopping Brook Road should provide an exclusive left-turn lane westbound on Washington Street and exclusive left-turn and right-turn lanes on Hopping Brook Road.

- The intersection of Washington Street with Hopping Brook Road meets 4-hour and peak-hour traffic-volume warrants under 2020 Existing conditions, and it meets 8-hour, 4-hour, and peak-hour traffic-volume warrants under 2027 Build conditions. Therefore, a signal is warranted at this location.

- When signalized under 2027 Build conditions, the intersection of Washington Street with Hopping Brook Road operates at an overall LOS C during the weekday morning and weekday evening peak hours.

Based on the above, VAI concludes that the 550,000 sf warehouse can be constructed and will cause minimal impact to the surrounding roadway infrastructure with the implementation of improvements proposed at the intersection of Washington Street with Hopping Brook Road.

Sincerely,

VANASSE & ASSOCIATES, INC.

Scott W. Thornton, P.E.,
Principal

Professional Engineer in CT, MA, and NH

Derek Roach, P.E.,
Senior Transportation Engineer

Professional Engineer in MA

Enclosure: Appendix

APPENDIX

TRAFFIC COUNT DATA
SEASONAL ADJUSTMENT DATA
GROWTH RATE DATA
TRIP GENERATION CALCULATIONS
TRAFFIC SIGNAL WARRANT ANALYSIS
CAPACITY ANALYSIS

TRAFFIC COUNT DATA

TURNING MOVEMENT COUNT REDUCTION WORKSHEET

INTERSECTION: Washington Street at Hopping Brook Driove
COUNT DATE: 7AM-9AM Wednesday 12/18/19 3PM-6PM Thursday 12/12/19

Counted By: ZRB
Weather Conditions: Clear 20-30 deg F

TIME:	Washington Street WB				Washington Street EB					Hopping Brook Drive NB					SB				TOTAL (15 Min.)	TOTAL (Hour)
	L	T	R	Total	L	T	R	RR	Total	L	T	R	RR	Total	L	T	R	Total		
6:30 - 6:45				0					0					0				0	0	
6:45 - 7:00				0					0					0				0	0	
7:00 - 7:15	9	72		81		90	44		134	3		2		5				0	220	
7:15 - 7:30	9	68		77		129	59		188	8		4		12				0	277	497
7:30 - 7:45	9	119		128		114	52		166	22		7		29				0	323	820
7:45 - 8:00	15	130		145		151	43		194	12		1		13				0	352	1172
8:00 - 8:15	13	122		135		149	54		203	13		6		19				0	357	1309
8:15 - 8:30	8	103		111		172	30		202	4		4		8				0	321	1353
8:30 - 8:45	7	106		113		147	40		187	5		3		8				0	308	1338
8:45 - 9:00	7	113		120		130	25		155	3		7		10				0	285	1271
9:00 - 9:15				0					0					0				0	0	914
9:15 - 9:30				0					0					0				0	0	593
				0					0					0				0	0	
TOTAL	77	833	0	910	0	1082	347	0	1429	70	0	34	0	104	0	0	0	0	2443	
15:00 - 15:15	7	136		143		90	18		108	46		18		64				0	315	
15:15 - 15:30	4	129		133		87	8		95	20		9		29				0	257	
15:30 - 15:45	9	169		178		105	8		113	63		22		85				0	376	
15:45 - 16:00	4	178		182		117			117	39		12		51				0	350	1298
16:00 - 16:15	2	165		167		104	5		109	51		14		65				0	341	1324
16:15 - 16:30	3	180		183		114	9		123	28		9		37				0	343	1410
16:30 - 16:45	6	185		191		124	7		131	42		19		61				0	383	1417
16:45 - 17:00	3	156		159		113	13		126	45		17		62				0	347	1414
17:00 - 17:15	5	178		183		126	5		131	57		26		83				0	397	1470
17:15 - 17:30	3	185		188		137	1		138	38		11		49				0	375	1502
17:30 - 17:45	1	175		176		110	3		113	33		4		37				0	326	1445
17:45 - 18:00	2	149		151		116	2		118	16		8		24				0	293	1391
TOTAL 4:00 - 6:00	49	1985	0	2034	0	1343	79	0	1422	478	0	169	0	647	0	0	0	0	4103	

PEAK HOUR VOLUMES:

TIME: MORNING PEAK PERIOD	Washington Street WB				Washington Street EB					Hopping Brook Drive NB					0 SB				TOTAL (Hour)	
	L	T	R	Total	L	T	R	RR	Total	L	T	R	RR	Total	L	T	R	Total		
7:30 - 7:45	9	119		128		114	52		166	22		7		29				0	323	
7:45 - 8:00	15	130		145		151	43		194	12		1		13				0	352	
8:00 - 8:15	13	122		135		149	54		203	13		6		19				0	357	
8:15 - 8:30	8	103		111		172	30		202	4		4		8				0	321	
	45	474	0	519	0	586	179	0	765	51	0	18	0	69	0	0	0	0	1353	
PHF				0.89					0.94					0.59					0.95	PHF

TIME: EVENING PEAK PERIOD	Washington Street WB				Washington Street EB					Hopping Brook Drive NB					0 SB				TOTAL (Hour)	
	L	T	R	Total	L	T	R	RR	Total	L	T	R	RR	Total	L	T	R	Total		
16:30 - 16:45	6	185		191		124	7		131	42		19		61				0	383	383
16:45 - 17:00	3	156		159		113	13		126	45		17		62				0	347	730
17:00 - 17:15	5	178		183		126	5		131	57		26		83				0	397	1127
17:15 - 17:30	3	185		188		137	1		138	38		11		49				0	375	1502
	17	704	0	721	0	500	26	0	526	182	0	73	0	255	0	0	0	0	1502	
PHF				0.94					0.95					0.77				####	0.95	PHF

Washington Street (Route 16)
approx 500' east of Hopping Brook Road
City, State: Holliston, MA
Client: EDC/ P. Bemis

PRECISION DATA INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

197374 A Volume
Site Code: TBA
Date Start: 12/16/19
Date End: 12/19/19

Start	12/16/19		12/17/19		12/18/19		12/19/19		12/20/19		12/21/19		12/22/19		Week Average	
Time	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB
12:00 AM	19	18	17	18	35	16	29	28	*	*	*	*	*	*	25	20
01:00	16	12	13	20	22	20	22	16	*	*	*	*	*	*	18	17
02:00	4	13	5	16	12	20	5	17	*	*	*	*	*	*	6	16
03:00	6	18	14	25	21	30	13	24	*	*	*	*	*	*	14	24
04:00	16	44	30	68	28	61	25	42	*	*	*	*	*	*	25	54
05:00	89	312	80	284	93	268	81	296	*	*	*	*	*	*	86	290
06:00	244	**620**	225	502	238	573	249	**590**	*	*	*	*	*	*	239	**571**
07:00	426	609	368	**507**	434	574	416	575	*	*	*	*	*	*	411	566
08:00	**489**	577	**394**	446	**502**	**624**	426	560	*	*	*	*	*	*	**453**	552
09:00	457	428	345	330	409	487	429	434	*	*	*	*	*	*	410	420
10:00	438	443	311	333	412	423	410	408	*	*	*	*	*	*	393	402
11:00	465	421	303	332	464	426	**457**	405	*	*	*	*	*	*	422	396
12:00 PM	509	466	356	293	530	437	486	465	*	*	*	*	*	*	470	415
01:00	504	457	371	376	533	444	492	441	*	*	*	*	*	*	475	430
02:00	607	534	472	339	615	493	597	503	*	*	*	*	*	*	573	467
03:00	**705**	496	542	375	699	536	687	472	*	*	*	*	*	*	658	470
04:00	670	567	570	408	681	564	681	591	*	*	*	*	*	*	650	532
05:00	694	**612**	**572**	**412**	**704**	**637**	**706**	**612**	*	*	*	*	*	*	**669**	**568**
06:00	590	412	354	226	587	418	596	438	*	*	*	*	*	*	532	374
07:00	318	302	214	189	447	262	365	304	*	*	*	*	*	*	336	264
08:00	221	222	161	130	265	242	257	221	*	*	*	*	*	*	226	204
09:00	182	142	122	83	232	165	211	183	*	*	*	*	*	*	187	143
10:00	91	106	81	72	107	145	119	132	*	*	*	*	*	*	100	114
11:00	62	49	82	32	88	69	104	66	*	*	*	*	*	*	84	54
Total	7822	7880	6002	5816	8158	7934	7863	7823	0	0	0	0	0	0	7462	7363
Day	15702		11818		16092		15686		0		0		0		14825	
AM Peak	08:00	06:00	08:00	07:00	08:00	08:00	11:00	06:00	-	-	-	-	-	-	08:00	06:00
Vol.	489	620	394	507	502	624	457	590	-	-	-	-	-	-	453	571
PM Peak	15:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	-	-	-	-	-	-	17:00	17:00
Vol.	705	612	572	412	704	637	706	612	-	-	-	-	-	-	669	568

Hopping Brook Road
Approx 450' south of Washington Street
City, State: Holliston, MA
Client: EDC/ P. Bemis

PRECISION
D A T A
INDUSTRIES, LLC
46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdillc.com

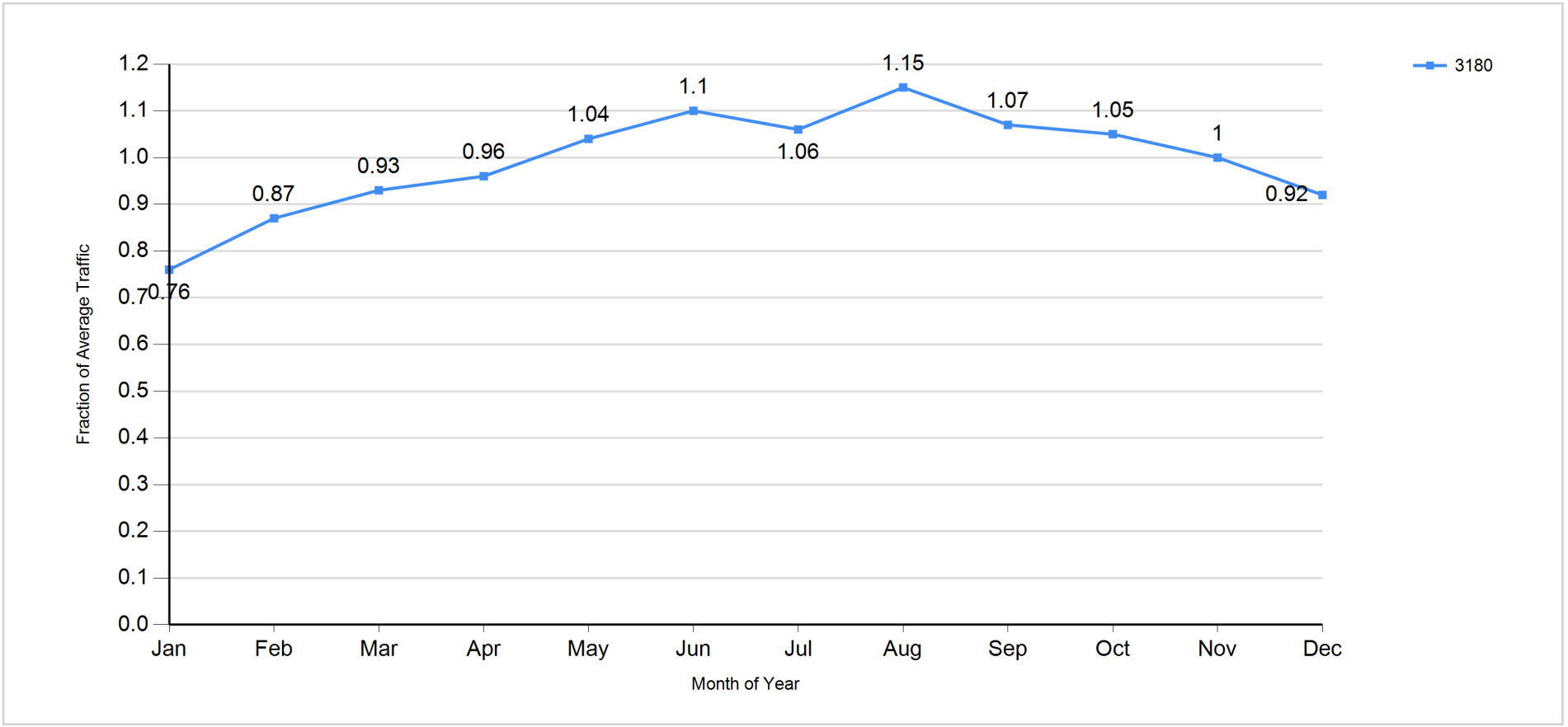
197374 B Volume
Site Code: TBA
Date Start: 12/16/19
Date End: 12/19/19

Start	12/16/19		12/17/19		12/18/19		12/19/19		12/20/19		12/21/19		12/22/19		Week Average	
Time	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
12:00 AM	0	0	6	0	3	2	5	0	*	*	*	*	*	*	4	0
01:00	2	1	12	1	8	2	8	0	*	*	*	*	*	*	8	1
02:00	2	1	4	2	13	0	8	2	*	*	*	*	*	*	7	1
03:00	1	1	2	1	2	6	1	1	*	*	*	*	*	*	2	2
04:00	1	17	1	17	4	22	1	18	*	*	*	*	*	*	2	18
05:00	7	84	16	95	15	102	13	90	*	*	*	*	*	*	13	93
06:00	20	239	34	237	45	**256**	41	**241**	*	*	*	*	*	*	35	243
07:00	52	**263**	39	**260**	59	240	48	219	*	*	*	*	*	*	50	**246**
08:00	54	184	60	169	43	195	40	179	*	*	*	*	*	*	49	182
09:00	53	102	27	91	41	106	43	97	*	*	*	*	*	*	41	99
10:00	52	74	51	59	62	69	75	95	*	*	*	*	*	*	60	74
11:00	**96**	67	**61**	60	**93**	69	**97**	85	*	*	*	*	*	*	**87**	70
12:00 PM	175	128	92	79	193	**143**	211	**145**	*	*	*	*	*	*	168	124
01:00	86	**138**	79	**84**	106	139	99	140	*	*	*	*	*	*	92	**125**
02:00	128	100	104	73	101	115	122	101	*	*	*	*	*	*	114	97
03:00	189	56	218	53	174	64	176	53	*	*	*	*	*	*	189	56
04:00	221	45	**224**	38	232	32	212	38	*	*	*	*	*	*	222	38
05:00	**231**	27	194	28	**260**	32	**223**	27	*	*	*	*	*	*	**227**	28
06:00	52	21	67	21	69	23	58	26	*	*	*	*	*	*	62	23
07:00	34	6	26	9	11	10	26	15	*	*	*	*	*	*	24	10
08:00	20	5	12	12	15	6	10	3	*	*	*	*	*	*	14	6
09:00	8	5	10	1	5	2	6	4	*	*	*	*	*	*	7	3
10:00	7	4	6	4	11	6	10	4	*	*	*	*	*	*	8	4
11:00	5	1	4	0	4	1	6	1	*	*	*	*	*	*	5	1
Total	1496	1569	1349	1394	1569	1642	1539	1584	0	0	0	0	0	0	1490	1544
Day	3065		2743		3211		3123		0		0		0		3034	
AM Peak	11:00	07:00	11:00	07:00	11:00	06:00	11:00	06:00	-	-	-	-	-	-	11:00	07:00
Vol.	96	263	61	260	93	256	97	241	-	-	-	-	-	-	87	246
PM Peak	17:00	13:00	16:00	13:00	17:00	12:00	17:00	12:00	-	-	-	-	-	-	17:00	13:00
Vol.	231	138	224	84	260	143	223	145	-	-	-	-	-	-	227	125

SEASONAL ADJUSTMENT DATA

Massachusetts Highway Department

Traffic Pattern by Month for 1/1/2017 - 12/31/2017



Traffic Pattern by Month for 1/1/2017 - 12/31/2017

Factor Group	Station	Weight	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
U1-Boston	3180	0	0.756	0.867	0.927	0.962	1.042	1.097	1.062	1.149	1.073	1.048	1.000	0.918
	Average of Weighted Factors		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

GROWTH RATE DATA

General Background Traffic Growth - Daily Traffic Volumes

CITY/TOWN	ROUTE/STREET	LOCATION	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average Annual
Medfield	Route 27	NORTH MEADOWS ROAD		7,500								*8,513*	*8,547*	***1.2%***
Holliston	Route 16	WASHINGTON STREET	19,300	19,368	19,659	20,893	21,023	22,179	*19,653*	*19,908*	20,127	*20,409*	*20,491*	**0.47%**
														0.81%

TRIP GENERATION CALCULATIONS

Institute of Transportation Engineers (ITE)
Trip Generation, 10th Edition
Land Use Code (LUC) 110 - General Light Industrial

Average Vehicle Trips Ends vs: 1000 Sq. Feet Gross Floor Area
Independent Variable (X): 84.92

AVERAGE WEEKDAY DAILY

T = 4.96 * X
T = 4.96 * 84.92
T = 421.22
T = 422 vehicle trips
with 50% (211 vpd) entering and 50% (211 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.70 * X
T = 0.70 * 84.92
T = 59.45
T = 60 vehicle trips
with 88% (53 vph) entering and 12% (7 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.63 * X
T = 0.63 * 84.92
T = 53.50
T = 54 vehicle trips
with 13% (7 vph) entering and 87% (47 vph) exiting.

Institute of Transportation Engineers (ITE)
Trip Generation, 10 th Edition
Land Use Code (LUC) 150 - Warehousing

Average Vehicle Trips Ends vs: 1000 Sq. Feet Gross Floor Area
Independent Variable (X): 550

AVERAGE WEEKDAY DAILY

T = 1.74 * (X)
T = 1.74 * 550
T = 957.00
T = 958 vehicle trips
with 50% (479 vpd) entering and 50% (479 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.17 * (X)
T = 0.17 * 550
T = 93.50
T = 94 vehicle trips
with 77% (72 vph) entering and 23% (22 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

T = 0.19 * (X)
T = 0.19 * 550
T = 104.50
T = 105 vehicle trips
with 27% (28 vph) entering and 73% (77 vph) exiting.

TRAFFIC SIGNAL WARRANT ANALYSIS

Warrants Analysis

File Name:	Warrants Exisitng- Right Turn removed.xsw
Analyst:	RE
Agency:	VAI
Date Performed:	9/30/2020
Time Analyzed:	
Jurisdiction:	MassDOT/Holliston
Analysis Year:	2020 Existing
Project Description:	Warehouse
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 42	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 9000	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 0

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane Usage		TR			LT			LR				

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Hour												
07 - 08	0	391	53	28	586	0	37	0	0	0	0	0
08 - 09	0	430	59	28	571	0	36	0	0	0	0	0
09 - 10	0	390	53	21	435	0	30	0	0	0	0	0
10 - 11	0	373	51	20	417	0	44	0	0	0	0	0
11 - 12	0	401	55	20	410	0	64	0	0	0	0	0
12 - 13	0	446	61	21	430	0	123	0	0	0	0	0
13 - 14	0	450	62	21	446	0	67	0	0	0	0	0
14 - 15	0	544	74	23	484	0	83	0	0	0	0	0
15 - 16	0	624	86	23	487	0	138	0	0	0	0	0
16 - 17	0	618	84	27	551	0	162	0	0	0	0	0
17 - 18	0	635	87	28	589	0	166	0	0	0	0	0
18 - 19	0	505	68	19	388	0	45	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 70%	1A 56%	1B 70%	1B 56%	2 70%	3A 70%	3B 56%	4A 70%	4B 56%
07 - 08	1058	37	1095	No	No	No	No	No	No	No	No	No
08 - 09	1088	36	1124	No	No	No	No	No	No	No	No	No
09 - 10	899	30	929	No	No	No	No	No	No	No	No	No
10 - 11	861	44	905	No	No	No	Yes	No	No	No	No	No
11 - 12	886	64	950	No	No	Yes	Yes	Yes	No	No	No	No
12 - 13	958	123	1081	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
13 - 14	979	67	1046	No	No	Yes	Yes	Yes	No	No	No	No
14 - 15	1125	83	1208	No	No	Yes	Yes	Yes	No	Yes	No	No
15 - 16	1220	138	1358	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
16 - 17	1280	162	1442	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	1339	166	1505	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
18 - 19	980	45	1025	No	No	No	Yes	No	No	No	No	No
Total	12673	995	13668	4	4	7	9	7	0	5	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume [ ]
- A. Minimum Vehicular Volumes [ ]
- B. Interruption of Continuous Traffic [ ]
- 56% Vehicular --and-- Interruption Volumes [ ]

Warrant 2: Four-Hour Vehicular Volume [X]
- Four-Hour Vehicular Volumes [X]

Warrant 3: Peak Hour [X]
- A. Peak-Hour Conditions [ ]
- B. Peak-Hour Vehicular Volume Hours Met [X]

Warrant 4: Pedestrian Volume [ ]
- A. Four Hour Volumes [ ]
- B. One-Hour Volumes [ ]

Warrant 5: School Crossing [ ]
- Gaps Same Period [ ]
- Student Volumes [ ]
- Nearest Traffic Control Signal [X]

Warrant 6: Coordinated Signal System [ ]
- Degree of Platooning [ ]

Warrant 7: Crash Experience [ ]
- A. Adequate Trials of Alternatives [ ]
- B. Reported Crashes [ ]
- C. 56% Volumes for Warrants 1A, 1B --or-- 4 [X]

Warrant 8: Roadway Network [ ]
- A. Weekday Volume [ ]
- B. Weekend Volume [ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

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Warrants Analysis

File Name:	Warrants Build - Right Turn removed.xsw
Analyst:	RE
Agency:	VAI
Date Performed:	11/4/2022
Time Analyzed:	
Jurisdiction:	MassDOT/Holliston
Analysis Year:	2027 Build
Project Description:	Warehouse
Units:	U.S. Customary

General

Major Street Direction: East-West	Population <10,000: No
Starting Time Interval: 7	Coordinated Signal System: No
Median Type: Undivided	Crashes Per Year: 0
Major Street Speed (mi/h): 42	Adequate Trials of Crash Experience Alternatives: No
Nearest Signal (ft): 9000	

School Crossing and Roadway Network

Number of Students in Highest Hour: 0	Two or More Major Routes: No
Number of Adequate Gaps in Period: 0	Weekend Count: No
Number of Minutes in Period: 0	5-year Growth Factor (%): 0

Railroad Crossing

Grade Crossing Approach: None	Rail Traffic (trains/day): 0
Highest Volume Hour with Trains: Unknown	High Occupancy Buses (%): 0
Distance to Stop Line (ft): -	Tractor-Trailer Trucks (%): 0

Geometry and Traffic

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane Usage		TR			LT			LR				

Traffic Volumes (veh/h)

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Hour												
07 - 08	0	419	0	0	628	0	83	0	0	0	0	0
08 - 09	0	461	0	0	612	0	76	0	0	0	0	0
09 - 10	0	418	0	0	466	0	87	0	0	0	0	0
10 - 11	0	400	0	0	447	0	101	0	0	0	0	0
11 - 12	0	430	0	0	440	0	118	0	0	0	0	0
12 - 13	0	478	0	0	461	0	185	0	0	0	0	0
13 - 14	0	482	0	0	478	0	117	0	0	0	0	0
14 - 15	0	583	0	0	519	0	138	0	0	0	0	0
15 - 16	0	669	0	0	522	0	215	0	0	0	0	0
16 - 17	0	663	0	0	591	0	221	0	0	0	0	0
17 - 18	0	681	0	0	631	0	221	0	0	0	0	0
18 - 19	0	541	0	0	416	0	60	0	0	0	0	0

Pedestrian Volumes and Gaps (Per Hour)

	Eastbound		Westbound		Northbound		Southbound	
	Gaps	Volume	Gaps	Volume	Gaps	Volume	Gaps	Volume
Hour								
07 - 08	0	0	0	0	0	0	0	0
08 - 09	0	0	0	0	0	0	0	0
09 - 10	0	0	0	0	0	0	0	0
10 - 11	0	0	0	0	0	0	0	0
11 - 12	0	0	0	0	0	0	0	0
12 - 13	0	0	0	0	0	0	0	0
13 - 14	0	0	0	0	0	0	0	0
14 - 15	0	0	0	0	0	0	0	0
15 - 16	0	0	0	0	0	0	0	0
16 - 17	0	0	0	0	0	0	0	0
17 - 18	0	0	0	0	0	0	0	0
18 - 19	0	0	0	0	0	0	0	0

Delay

Hour	Eastbound secs/veh	Eastbound veh-hrs	Westbound secs/veh	Westbound veh-hrs	Northbound secs/veh	Northbound veh-hrs	Southbound secs/veh	Southbound veh-hrs
07 - 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
08 - 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
09 - 10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 - 11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 - 12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12 - 13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 - 14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 - 15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15 - 16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16 - 17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17 - 18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18 - 19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Summary

Hour	Major Volume	Minor Volume	Total Volume	1A 70%	1A 56%	1B 70%	1B 56%	2 70%	3A 70%	3B 56%	4A 70%	4B 56%
07 - 08	1047	83	1130	No	No	Yes	Yes	Yes	No	Yes	No	No
08 - 09	1073	76	1149	No	No	Yes	Yes	Yes	No	Yes	No	No
09 - 10	884	87	971	No	Yes	Yes	Yes	Yes	No	No	No	No
10 - 11	847	101	948	No	Yes	Yes	Yes	Yes	No	No	No	No
11 - 12	870	118	988	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
12 - 13	939	185	1124	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
13 - 14	960	117	1077	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
14 - 15	1102	138	1240	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
15 - 16	1191	215	1406	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
16 - 17	1254	221	1475	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	1312	221	1533	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
18 - 19	957	60	1017	No	No	Yes	Yes	No	No	No	No	No
Total	12436	1622	14058	7	9	12	12	11	0	9	0	0

Results

Warrant 1: Eight-Hour Vehicular Volume	[X]
A. Minimum Vehicular Volumes	[ ]
B. Interruption of Continuous Traffic	[X]
56% Vehicular --and-- Interruption Volumes	[X]
Warrant 2: Four-Hour Vehicular Volume	[X]
Four-Hour Vehicular Volumes	[X]
Warrant 3: Peak Hour	[X]
A. Peak-Hour Conditions	[ ]
B. Peak-Hour Vehicular Volume Hours Met	[X]
Warrant 4: Pedestrian Volume	[ ]
A. Four Hour Volumes	[ ]
B. One-Hour Volumes	[ ]
Warrant 5: School Crossing	[ ]
Gaps Same Period	[ ]
Student Volumes	[ ]
Nearest Traffic Control Signal	[X]
Warrant 6: Coordinated Signal System	[ ]
Degree of Platooning	[ ]
Warrant 7: Crash Experience	[ ]
A. Adequate Trials of Alternatives	[ ]
B. Reported Crashes	[ ]
C. 56% Volumes for Warrants 1A, 1B --or-- 4	[X]
Warrant 8: Roadway Network	[ ]
A. Weekday Volume	[ ]
B. Weekend Volume	[ ]

Warrant 9: Grade Crossing [ ]
   A. Grade Crossing within 140 ft --and-- [ ]
   B. Peak-Hour Vehicular Volumes [ ]

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CAPACITY ANALYSIS

Intersection	
Int Delay, s/veh	4.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	639	179	45	512	51	18
Future Vol, veh/h	639	179	45	512	51	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	89	89	60	60
Heavy Vehicles, %	0	0	2	0	5	2
Mvmt Flow	680	190	51	575	85	30

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	870	0	1452	775
Stage 1	-	-	-	-	775	-
Stage 2	-	-	-	-	677	-
Critical Hdwy	-	-	4.12	-	6.45	6.22
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.218	-	3.545	3.318
Pot Cap-1 Maneuver	-	-	775	-	142	398
Stage 1	-	-	-	-	449	-
Stage 2	-	-	-	-	499	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	775	-	128	398
Mov Cap-2 Maneuver	-	-	-	-	128	-
Stage 1	-	-	-	-	449	-
Stage 2	-	-	-	-	451	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	60.3
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	128	398	-	-	775	-
HCM Lane V/C Ratio	0.664	0.075	-	-	0.065	-
HCM Control Delay (s)	76.4	14.8	-	-	10	0
HCM Lane LOS	F	B	-	-	A	A
HCM 95th %tile Q(veh)	3.6	0.2	-	-	0.2	-

Intersection	
Int Delay, s/veh	52.8

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	545	26	17	768	182	73
Future Vol, veh/h	545	26	17	768	182	73
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	94	94	77	77
Heavy Vehicles, %	0	0	0	0	2	2
Mvmt Flow	574	27	18	817	236	95

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	601	0	1441	588
Stage 1	-	-	-	-	588	-
Stage 2	-	-	-	-	853	-
Critical Hdwy	-	-	4.1	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.2	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	986	-	~ 146	509
Stage 1	-	-	-	-	555	-
Stage 2	-	-	-	-	418	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	986	-	~ 141	509
Mov Cap-2 Maneuver	-	-	-	-	~ 141	-
Stage 1	-	-	-	-	555	-
Stage 2	-	-	-	-	404	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	281.3
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	141	509	-	-	986	-
HCM Lane V/C Ratio	1.676	0.186	-	-	0.018	-
HCM Control Delay (s)	$ 388.7	13.7	-	-	8.7	0
HCM Lane LOS	F	B	-	-	A	A
HCM 95th %tile Q(veh)	17.1	0.7	-	-	0.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	9.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	685	216	61	554	56	20
Future Vol, veh/h	685	216	61	554	56	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	89	89	60	60
Heavy Vehicles, %	0	0	2	0	5	2
Mvmt Flow	729	230	69	622	93	33

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	959	0	1604	844
Stage 1	-	-	-	-	844	-
Stage 2	-	-	-	-	760	-
Critical Hdwy	-	-	4.12	-	6.45	6.22
Critical Hdwy Stg 1	-	-	-	-	5.45	-
Critical Hdwy Stg 2	-	-	-	-	5.45	-
Follow-up Hdwy	-	-	2.218	-	3.545	3.318
Pot Cap-1 Maneuver	-	-	717	-	114	363
Stage 1	-	-	-	-	417	-
Stage 2	-	-	-	-	456	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	717	-	97	363
Mov Cap-2 Maneuver	-	-	-	-	97	-
Stage 1	-	-	-	-	417	-
Stage 2	-	-	-	-	389	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	122.6
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	97	363	-	-	717	-
HCM Lane V/C Ratio	0.962	0.092	-	-	0.096	-
HCM Control Delay (s)	160.7	15.9	-	-	10.6	0
HCM Lane LOS	F	C	-	-	B	A
HCM 95th %tile Q(veh)	5.7	0.3	-	-	0.3	-

Intersection	
Int Delay, s/veh	97.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	584	31	19	823	215	87
Future Vol, veh/h	584	31	19	823	215	87
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	94	94	77	77
Heavy Vehicles, %	0	0	0	0	2	2
Mvmt Flow	615	33	20	876	279	113

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	648	0	1548	632
Stage 1	-	-	-	-	632	-
Stage 2	-	-	-	-	916	-
Critical Hdwy	-	-	4.1	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.2	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	947	-	~ 126	480
Stage 1	-	-	-	-	530	-
Stage 2	-	-	-	-	390	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	947	-	~ 121	480
Mov Cap-2 Maneuver	-	-	-	-	~ 121	-
Stage 1	-	-	-	-	530	-
Stage 2	-	-	-	-	374	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	$ 482.5
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	121	480	-	-	947	-
HCM Lane V/C Ratio	2.308	0.235	-	-	0.021	-
HCM Control Delay (s)	$ 671.7	14.8	-	-	8.9	0
HCM Lane LOS	F	B	-	-	A	A
HCM 95th %tile Q(veh)	24.1	0.9	-	-	0.1	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Int Delay, s/veh	8.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	685	269	80	554	72	26
Future Vol, veh/h	685	269	80	554	72	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	89	89	92	92
Heavy Vehicles, %	0	5	2	0	9	4
Mvmt Flow	729	286	90	622	78	28

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	1015	0	1674	872
Stage 1	-	-	-	-	872	-
Stage 2	-	-	-	-	802	-
Critical Hdwy	-	-	4.12	-	6.49	6.24
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	-	-	2.218	-	3.581	3.336
Pot Cap-1 Maneuver	-	-	683	-	101	347
Stage 1	-	-	-	-	398	-
Stage 2	-	-	-	-	429	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	683	-	81	347
Mov Cap-2 Maneuver	-	-	-	-	81	-
Stage 1	-	-	-	-	398	-
Stage 2	-	-	-	-	343	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	137.4
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	81	347	-	-	683	-
HCM Lane V/C Ratio	0.966	0.081	-	-	0.132	-
HCM Control Delay (s)	181.1	16.3	-	-	11.1	0
HCM Lane LOS	F	C	-	-	B	A
HCM 95th %tile Q(veh)	5.2	0.3	-	-	0.5	-

Intersection	
Int Delay, s/veh	128.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	584	52	26	823	273	106
Future Vol, veh/h	584	52	26	823	273	106
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	94	94	92	92
Heavy Vehicles, %	0	11	0	0	8	2
Mvmt Flow	615	55	28	876	297	115

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	670	0	1575	643
Stage 1	-	-	-	-	643	-
Stage 2	-	-	-	-	932	-
Critical Hdwy	-	-	4.1	-	6.48	6.22
Critical Hdwy Stg 1	-	-	-	-	5.48	-
Critical Hdwy Stg 2	-	-	-	-	5.48	-
Follow-up Hdwy	-	-	2.2	-	3.572	3.318
Pot Cap-1 Maneuver	-	-	930	-	~ 117	473
Stage 1	-	-	-	-	512	-
Stage 2	-	-	-	-	374	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	930	-	~ 110	473
Mov Cap-2 Maneuver	-	-	-	-	~ 110	-
Stage 1	-	-	-	-	512	-
Stage 2	-	-	-	-	352	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.3	$ 616.8
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	110	473	-	-	930	-
HCM Lane V/C Ratio	2.698	0.244	-	-	0.03	-
HCM Control Delay (s)	$ 850.5	15	-	-	9	0
HCM Lane LOS	F	C	-	-	A	A
HCM 95th %tile Q(veh)	27.4	0.9	-	-	0.1	-

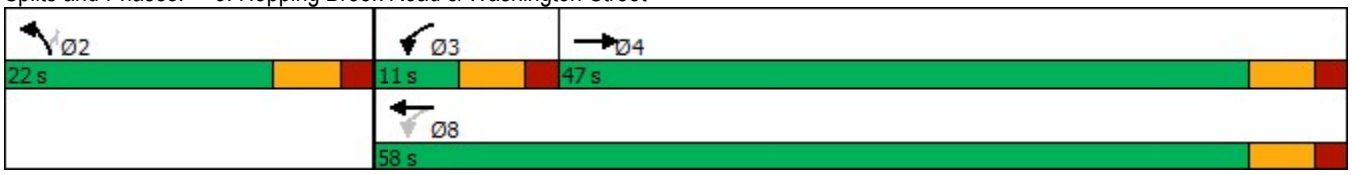
Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	685	269	80	554	72	26
Future Volume (vph)	685	269	80	554	72	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0	0
Storage Lanes		0	1		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.962					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1802	0	1770	1900	1656	1553
Flt Permitted			0.084		0.950	
Satd. Flow (perm)	1802	0	156	1900	1656	1553
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	36					28
Link Speed (mph)	30			30	30	
Link Distance (ft)	515			535	833	
Travel Time (s)	11.7			12.2	18.9	
Peak Hour Factor	0.94	0.94	0.89	0.89	0.92	0.92
Heavy Vehicles (%)	0%	5%	2%	0%	9%	4%
Adj. Flow (vph)	729	286	90	622	78	28
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1015	0	90	622	78	28
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	1
Detector Template	Thru		Left	Thru	Left	Right
Leading Detector (ft)	100		20	100	20	20
Trailing Detector (ft)	0		0	0	0	0
Detector 1 Position(ft)	0		0	0	0	0
Detector 1 Size(ft)	6		20	6	20	20
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	0.0
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	4		3	8	2	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	24.0		11.0	24.0	22.0	22.0
Total Split (s)	47.0		11.0	58.0	22.0	22.0
Total Split (%)	58.8%		13.8%	72.5%	27.5%	27.5%
Maximum Green (s)	41.0		5.0	52.0	16.0	16.0
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0	6.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Act Effct Green (s)	41.4		49.8	49.8	8.7	8.7
Actuated g/C Ratio	0.59		0.71	0.71	0.12	0.12
v/c Ratio	0.95		0.40	0.46	0.38	0.13
Control Delay	35.0		10.1	6.2	35.0	12.8
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	35.0		10.1	6.2	35.0	12.8
LOS	C		B	A	C	B
Approach Delay	35.0			6.7	29.1	
Approach LOS	C			A	C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 70.6			
Natural Cycle: 90			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.95			
Intersection Signal Delay: 23.6		Intersection LOS: C	
Intersection Capacity Utilization 76.0%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 3: Hopping Brook Road & Washington Street



Lane Group	EBT	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	1015	90	622	78	28
v/c Ratio	0.95	0.40	0.46	0.38	0.13
Control Delay	35.0	10.1	6.2	35.0	12.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.0	10.1	6.2	35.0	12.8
Queue Length 50th (ft)	397	10	94	33	0
Queue Length 95th (ft)	#747	32	178	71	21
Internal Link Dist (ft)	435		455	753	
Turn Bay Length (ft)		150			
Base Capacity (vph)	1070	225	1411	378	376
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.95	0.40	0.44	0.21	0.07

Intersection Summary

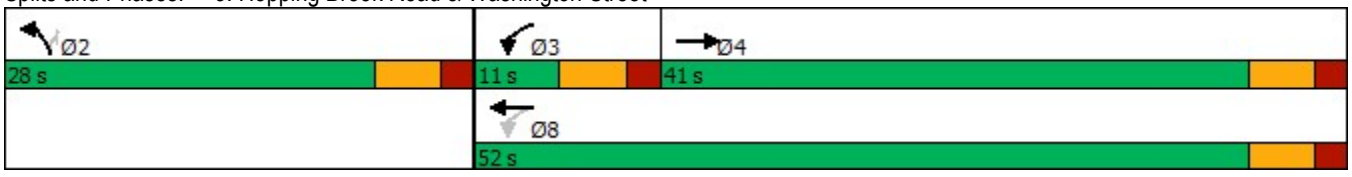
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	584	52	26	823	273	106
Future Volume (vph)	584	52	26	823	273	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0	150		0	0
Storage Lanes		0	1		1	1
Taper Length (ft)			25		25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.989					0.850
Flt Protected			0.950		0.950	
Satd. Flow (prot)	1862	0	1805	1900	1671	1583
Flt Permitted			0.175		0.950	
Satd. Flow (perm)	1862	0	332	1900	1671	1583
Right Turn on Red		Yes				Yes
Satd. Flow (RTOR)	7					115
Link Speed (mph)	40			40	30	
Link Distance (ft)	515			535	833	
Travel Time (s)	8.8			9.1	18.9	
Peak Hour Factor	0.95	0.95	0.94	0.94	0.92	0.92
Heavy Vehicles (%)	0%	11%	0%	0%	8%	2%
Adj. Flow (vph)	615	55	28	876	297	115
Shared Lane Traffic (%)						
Lane Group Flow (vph)	670	0	28	876	297	115
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Right	Left	Left	Left	Right
Median Width(ft)	12			12	12	
Link Offset(ft)	0			0	0	
Crosswalk Width(ft)	16			16	16	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)		9	15		15	9
Number of Detectors	2		1	2	1	1
Detector Template	Thru		Left	Thru	Left	Right
Leading Detector (ft)	100		20	100	20	20
Trailing Detector (ft)	0		0	0	0	0
Detector 1 Position(ft)	0		0	0	0	0
Detector 1 Size(ft)	6		20	6	20	20
Detector 1 Type	Cl+Ex		Cl+Ex	Cl+Ex	Cl+Ex	Cl+Ex
Detector 1 Channel						
Detector 1 Extend (s)	0.0		0.0	0.0	0.0	0.0
Detector 1 Queue (s)	0.0		0.0	0.0	0.0	0.0
Detector 1 Delay (s)	0.0		0.0	0.0	0.0	0.0
Detector 2 Position(ft)	94			94		
Detector 2 Size(ft)	6			6		
Detector 2 Type	Cl+Ex			Cl+Ex		
Detector 2 Channel						
Detector 2 Extend (s)	0.0			0.0		
Turn Type	NA		pm+pt	NA	Prot	Perm
Protected Phases	4		3	8	2	

Lane Group	EBT	EBR	WBL	WBT	NBL	NBR
Permitted Phases			8			2
Detector Phase	4		3	8	2	2
Switch Phase						
Minimum Initial (s)	5.0		5.0	5.0	5.0	5.0
Minimum Split (s)	24.0		11.0	24.0	24.0	24.0
Total Split (s)	41.0		11.0	52.0	28.0	28.0
Total Split (%)	51.3%		13.8%	65.0%	35.0%	35.0%
Maximum Green (s)	35.0		5.0	46.0	22.0	22.0
Yellow Time (s)	4.0		4.0	4.0	4.0	4.0
All-Red Time (s)	2.0		2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0		0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0		6.0	6.0	6.0	6.0
Lead/Lag	Lag		Lead			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Recall Mode	None		None	None	Min	Min
Act Effct Green (s)	31.2		34.8	34.8	16.4	16.4
Actuated g/C Ratio	0.49		0.54	0.54	0.26	0.26
v/c Ratio	0.73		0.09	0.85	0.69	0.23
Control Delay	21.4		7.8	22.2	32.9	6.4
Queue Delay	0.0		0.0	0.0	0.0	0.0
Total Delay	21.4		7.8	22.2	32.9	6.4
LOS	C		A	C	C	A
Approach Delay	21.4			21.7	25.5	
Approach LOS	C			C	C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 64			
Natural Cycle: 65			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 22.4		Intersection LOS: C	
Intersection Capacity Utilization 68.4%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: Hopping Brook Road & Washington Street



Lane Group	EBT	WBL	WBT	NBL	NBR
Lane Group Flow (vph)	670	28	876	297	115
v/c Ratio	0.73	0.09	0.85	0.69	0.23
Control Delay	21.4	7.8	22.2	32.9	6.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	21.4	7.8	22.2	32.9	6.4
Queue Length 50th (ft)	166	5	261	106	0
Queue Length 95th (ft)	#475	16	491	215	37
Internal Link Dist (ft)	435		455	753	
Turn Bay Length (ft)		150			
Base Capacity (vph)	1096	302	1408	612	653
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.61	0.09	0.62	0.49	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.