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Responsiveness.  
Results.



## FINAL REPORT

Route 236  
Traffic & Safety Study  
Kittery & Eliot, Maine

PREPARED FOR:  
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August 2019

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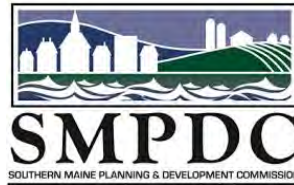
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## **Acknowledgements**

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## **Purpose and Need**

### **From KACTS Request for Technical and Cost Proposals**

“Develop a highway improvement plan that improves the safety and mobility function of the intersections and road segments on State Route 236 in the Study Area as a MaineDOT Priority I Principal Arterial Highway for vehicles, pedestrians and bicyclists.

Coordinate both Towns’ land development planning for the study area with the functional needs of State Route 236 to allow for appropriate rezoning.”

## **Project Objectives**

### **From KACTS Request for Technical and Cost Proposals**

“To preserve existing roadway capacity over the long term (2038 design year) to facilitate through traffic movement and minimize congestion while providing safe vehicular access to new and existing development along Route 236; and

To maintain the functional integrity and improve the safety of the corridor, while accommodating the public and private needs for access and adjacent land parcel



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## Introduction

Route 236 serves many purposes, sometimes with conflicting goals and objectives. It is a high commuter route, not just locally, but regionally as well, meaning that capacity needs to be maintained and improved. Locally, it serves numerous businesses along the corridor, which means that accessibility is of significant value to business owners, employees, and customers. Additionally, there are numerous residences just off the main corridor, including elderly housing. The residents want to be able to travel to and from their homes in a safe and efficient way. Existing geometrics, speeds, and significant traffic volumes along the corridor can make both capacity, accessibility, and perceived safety an issue.

As an initial step in the process of studying and improving the Route 236 corridor, obtaining a clear understanding of how the corridor currently operates or functions is critical. An existing conditions evaluation was completed to set the baseline for which a comparison to the impacts of proposed mitigation could be made. The existing conditions evaluation included; establishing traffic volumes within the corridor, completing capacity / queue analysis, establishing free flow speeds, evaluating the safety of the corridor, completing a signal warrant analysis, and identifying potential development in the area.

After the Existing Conditions Evaluation, the next step in the process of studying and improving Route 236 within the study area was to identify mitigation that could be made throughout the corridor to address the deficiencies and concerns identified in the evaluation. That mitigation includes a variety of approaches, methodologies, and techniques including; signalized intersection improvements, restriping Route 236 for a center left turn lane, center medians, reduction in driveway numbers and widths, relocation of driveways, new driveways, and conversion to one-way sections of roadway.

The following is a summary of the methodology, results, and conclusions of both the existing conditions of the Route 236 corridor and the proposed mitigation measures. Supporting documentation is included in the Appendices.

## Existing Traffic Volumes

To establish traffic volumes throughout the corridor, both turning movement counts as well as automatic traffic recorder (ATR) counts at key locations were provided. The turning movement counts provide traffic volumes for movements at an intersection, while the ATR counts typically provide traffic volumes on a roadway segment. The locations of the counts are shown graphically on the attached Figure 2 in Appendix A. The following summarizes the count locations and results.





### *Corridor Counts*

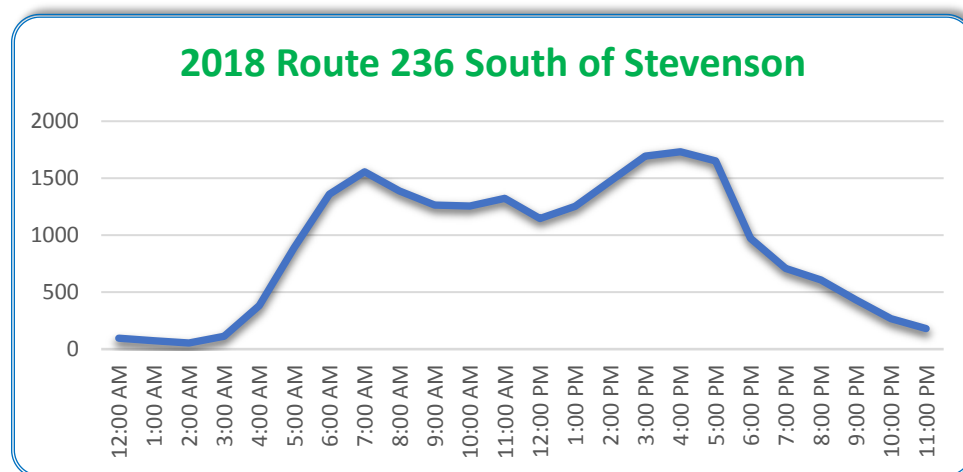
Corridor (ATR) counts were completed at three locations on Route 236, as well as three side streets within the study area. These counts were completed for a minimum of 24 hours. This evaluation has focused on the Route 236 corridor counts, since that is the primary focus of the study. Corridor counts were completed at the following three locations on the specified dates:

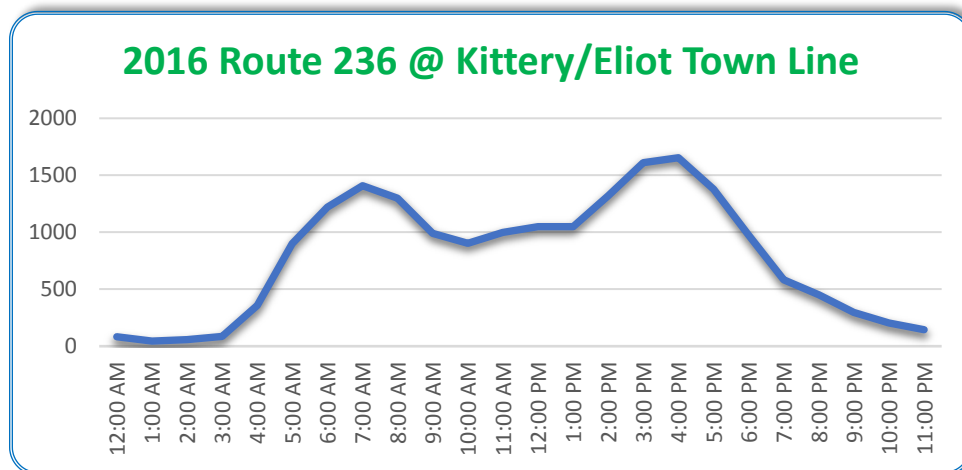
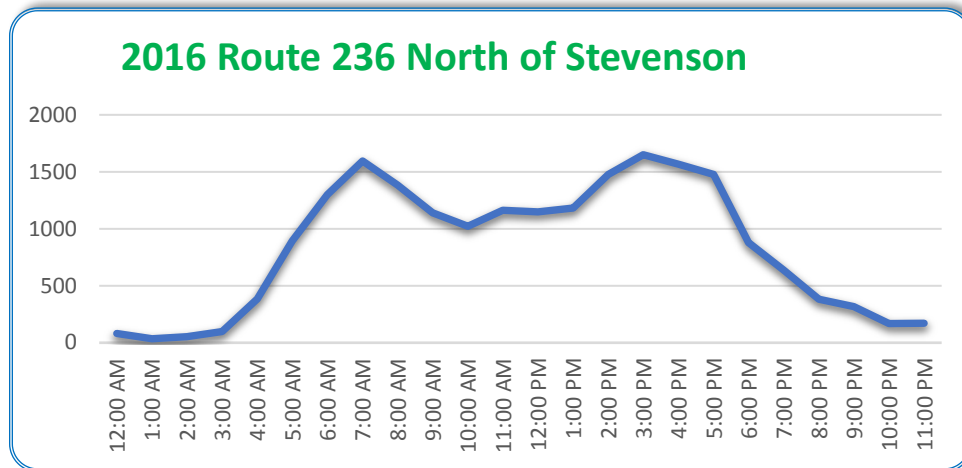
- South of Stevenson Road: June 20, 2018
- North of Stevenson Road: October 4-5, 2016
- Kittery / Eliot Town Line: October 4-5, 2016

These counts are typically used to estimate the Annual Average Daily Traffic (AADT) volume, as well as show the directional distribution of traffic on the corridor. The following are the estimated AADT at each location for the year the count was collected:

- South of Stevenson Road: 18,564 (2018)
- North of Stevenson Road: 17,780 (2016)
- Kittery / Eliot Town Line: 17,460 (2016)

The results of the counts (total volume for both directions) have also been summarized as graphs showing the volume distribution throughout the day.





As shown in the graphs, there are two distinct peaks at all three count locations, one during the AM commuter hour and one during the PM commuter hour. This is typical of a corridor that experiences a lot of commuter traffic and primarily serves as a conduit between bedroom communities and major connections (such as the Interstate) to places of employment. The peak hours are similar; however the PM peak hour is slightly higher at all three locations. These peaks correspond with the peak hours that are evaluated with the turning movement counts, discussed in more detail below.

#### *Turning Movement Counts*

In addition to the corridor counts, turning movement counts were completed by the Southern Maine Planning & Development Commission at the following intersections on the following dates and times:



- Stevenson Road / Martin Road with Route 236: June 20, 2018 from 6:00 AM to 6:00 PM
- MacKenzie Road (Transfer Station) with Route 236: September 12, 2018 from 5:00 AM to 6:00 PM
- Aroma Joes / Fernald Road with Route 236: July 19, 2017 from 6:00 AM to 6:00 PM
- Bolt Hill Road with Route 236: May 16, 2017 from 6:00 AM to 6:00 PM
- Beech Road with Route 236: September 12, 2018 from 5:00 AM to 6:00 PM

As a result of the turning movement counts, the AM and PM peak hours are typically identified at each location. In reviewing the results, the AM peak hour is relatively consistent and starts around 7:15 or 7:30. The PM peak hour is inconsistent and start times vary between 2:45 PM at Fernald Road and 4:45 PM at Beech Road. Those peak hours are shown on the attached Figure 3 in Appendix A.

## 2018 Existing Conditions

Mid-summer is typically considered representative of the peak conditions for traffic volumes. Traffic volumes that are not collected during peak summer months are usually seasonally adjusted to estimate traffic volumes that may be experienced during the peak summer months. Since the traffic counts were not collected during the peak summer months, the raw volumes shown on Figure 3 have been seasonally adjusted based on the weekly group mean factors published by MaineDOT. The following summarizes the adjustment that was applied at each intersection:

- Stevenson Road / Martin Road with Route 236: 1.2%
- MacKenzie Road (Transfer Station) with Route 236: 2.4%
- Aroma Joes / Fernald Road with Route 236: 1.2%
- Bolt Hill Road with Route 236: 3.6%
- Beech Road with Route 236: 2.4%

In addition to the seasonal adjustment, the turning movement volumes at the two signalized intersections that were counted in 2017 (Route 236 / Beech Road & Route 236 / Stevenson Road) were also increased by an annual growth rate to estimate the existing traffic volumes. MaineDOT recommended that an annual growth rate of 0.5% per year be used. The annual growth has been applied to the seasonally adjusted volumes to yield the 2018 Existing Conditions shown on the attached Figure 4 in Appendix A.



## 2038 No-Build Traffic Volumes

The design year for this project was identified as 2038, which is a 20 year horizon. The 0.5% per year annual growth rate has been applied to the 2018 Existing Conditions traffic volumes to forecast the traffic volumes that may be experienced during the design year. A total growth of 10% (0.5% per year straight line growth for 20 years) has been applied to the 2018 traffic volumes to yield the 2038 No Build Traffic Volumes shown on the attached Figure 5 in Appendix A.

## Existing Conditions Capacity Analysis

A capacity analysis has been completed for the study area intersections using Synchro/SimTraffic computer modeling software (Version 10). Level of service rankings are similar to the academic ranking system where an 'A' is good with little control delay and an 'F' represents poor conditions. If the level of service falls below a 'D', an evaluation should be made to determine if mitigation is warranted. The following tables summarize the relationship between control delay per vehicle and level of service:

**Level of Service Criteria for Signalized Intersections**

Level of Service	Control Delay per Vehicle (s)
A	Less than 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	Greater than 80.0

**Level of Service Criteria for Unsignalized Intersections**

Level of Service	Control Delay per Vehicle (s)
A	Less than 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

The capacity analysis has been completed based on the existing intersection geometry and phasing of the traffic signals. The two signalized intersections have been evaluated using optimized signal



timing. The following table summarizes the capacity analysis results. Detailed printouts are included in Appendix B.

**Level of Service Summary**

Approach	Level of Service			
	2018 AM	2018 PM	2038 AM	2038 PM
<b>Stevenson / Martin / Route 236 (S)</b>				
Martin EB	C	C	C	C
Stevenson WB	B	C	B	C
Route 236 NB	B	B	B	C
Route 236 SB	B	B	B	B
<b>Overall</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>C</b>
<b>MacKenzie / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
MacKenzie SW	B	D	C	F
<b>Aroma Joes / Fernald / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
Aroma Joes NE	C	D	E	E
Fernald SW	E	F	F	F
<b>Bolt Hill / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
Bolt Hill NE	C	E	D	F
Bolt Hill SW	C	E	E	F
<b>Beech / Route 236 (S)</b>				
Route 236 SE	B	B	B	B
Route 236 NW	A	B	B	B
Beech NE	B	B	B	B
Beech SW	B	B	B	B
<b>Overall</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>

S=Signalized, U=Unsignalized

As shown in the table, the signalized intersections are forecast to operate at acceptable levels of service in 2038 with existing geometry. The minor street approaches to the unsignalized intersections either currently operate poorly, or are forecast to operate at low or failing levels of service in 2038. During the 2018 AM peak hour most minor street approaches are forecast to operate at acceptable levels of service, but in the 2038 AM peak hour, most minor street approaches are forecast to operate at low or failing levels of service. Mitigation will be explored during later phases of this study to improve those levels of service.





In addition to intersection capacity, the capacity of the Route 236 two lane section within the study area was evaluated. The hourly traffic volume (total for both directions) on Route 236 (based on the turning movement counts) is approximately 1,600 vehicles per hour (vph) during the 2018 AM peak hour and 1,785 vph during the 2018 PM peak hour. During the 2038 no build conditions, the hourly traffic volumes are estimated to be 1,760 vph and 1,965 vph during the AM and PM peak hours respectively. The Highway Capacity Manual (HCM) states; “A two-lane highway’s capacity under base conditions is 1,700 pc/h in one direction, with a limit of 3,200 pc/h for the total of both directions.” Although it would appear that the forecast traffic volumes are less than the capacity, when adjustments for side friction from driveways and larger vehicles are considered, practical capacity is usually considerably less. Therefore, at 1,965 vph forecast for the PM peak hour in 2038, this section of roadway is approaching capacity during peak hours.

## Existing Conditions Queue Analysis

A queue analysis was also completed for the study area intersections using the same Synchro/SimTraffic computer modeling software that was used for the existing conditions capacity analysis. The queuing analysis involves comparing the postdevelopment 95<sup>th</sup> percentile queue lengths of the turn lanes to the available storage lengths. The queue lengths have been rounded up to the nearest five feet. The following table summarizes the postdevelopment 95<sup>th</sup> percentile queue lengths based on SimTraffic analyses. The detailed reports are included in Appendix B.

Queue Analysis Summary

Approach	Storage Length (ft)	Level of Service			
		2018 AM	2018 PM	2038 AM	2038 PM
Stevenson / Martin / Route 236 (S)					
Martin EB LT		45	55	55	60
Martin EB R	50	65	50	65	40
Stevenson WB LTR		55	100	60	110
Route 236 NB L	205	15	110	25	105
Route 236 NB TR		230	535	290	965
Route 236 SB L	225	70	75	100	120
Route 236 SB TR		275	255	420	320
MacKenzie / Route 236 (U)					
Route 236 SE LT		--	55	40	165
Route 236 NW TR		--	--	--	65
MacKenzie SW LR		15	65	20	85
Aroma Joes / Fernald / Route 236 (U)					
Route 236 SE LT		25	25	75	10
Route 236 SE R		--	--	--	--
Route 236 NW LTR		90	75	165	180



Approach	Storage Length (ft)	Level of Service			
		2018 AM	2018 PM	2038 AM	2038 PM
Aroma Joes NE LT		25	40	70	35
Aroma Joes NE R	60	60	35	80	40
Fernald SW LT		65	30	55	140
Fernald SW R <sup>1</sup>	25	25	25	30	20
<b>Bolt Hill / Route 236 (U)</b>					
Route 236 SE LTR		25	135	40	245
Route 236 NW LTR		5	140	5	195
Bolt Hill NE LTR		70	75	50	85
Bolt Hill SW LTR		50	45	65	45
<b>Beech / Route 236 (S)</b>					
Route 236 SE L	165	65	60	60	65
Route 236 SE T		170	110	195	130
Route 236 SE TR		155	95	190	110
Route 236 NW L	225	55	75	55	70
Route 236 NW T		85	155	95	180
Route 236 NW TR		100	165	115	195
Beech NE LT		70	115	85	130
Beech NE R	120	60	60	65	60
Beech SW LT		120	75	115	90
Beech SW R	100	60	55	60	65

<sup>1</sup>There is no formal right turn lane on this approach, however the approach is wide enough that vehicles are anticipated to utilize the approach as a left-through lane with a short right turn pocket.

As shown in the table, the existing storage lengths are forecast to accommodate the 95<sup>th</sup> percentile queue lengths for most approaches. Three areas highlighted in red are slightly longer than storage, but only by one car or less. Additionally, at the unsignalized intersections, although Route 236 is free flowing and not STOP controlled, there is some queuing. This is due to turning vehicles waiting for a gap and blocking through traffic. It should be noted that there are times when activities or road closures in the immediate area or even regionally cause significant capacity and queuing issues. This is a direct result of Route 236 being the primary arterial in the area. Mitigation items will be explored in the next phase of this project to address this deficiency.

## Speed Study

One of the primary concerns that was expressed at the beginning of the study is the perceived speeding of vehicles along this section of Route 236. To qualify / quantify the speeding along this section of Route 236, a vehicular speed study was completed for Route 236 traffic within the study area to calculate the 50<sup>th</sup> and 85<sup>th</sup> percentile speeds. The speed study was conducted approximately 1,650 feet to the northwest of Bolt Hill Road, just north of the self-storage facility.



The location was selected based on discussions at the project Kick-Off Meeting held on September 10, 2018. The primary reasons this location was chosen were; it is within the 45 mph speed zone, it is not too close to high volume side streets or businesses, and it is a level and straight segment of roadway. The speed zones on Route 236 and the location of the speed study is shown on the attached Figures 6 and 7 respectively in Appendix C.

The study was performed using a calibrated radar gun on October 4, 2018 from approximately 11:25 AM to 12:05 PM. In completing the speed study, only free flowing vehicles were recorded. This means that vehicles following other vehicles were not recorded, since their speed can be hindered by the lead vehicle. The free flowing speed for 100 vehicles in each direction (a total of 200 vehicles) was recorded. It should be noted that this is consistent with MaineDOT methodology for conducting speed studies. Many factors contribute to setting a speed limit, but the primary and most influential factor is the 85<sup>th</sup> percentile speed. The 85<sup>th</sup> percentile speed is the maximum speed that 85% of traffic is traveling, or in other words 85% of the drivers are traveling at that speed or less. The 85<sup>th</sup> percentile speed is evaluated by determining the number of vehicles recorded traveling at each speed, then the calculated cumulative total number of vehicles at each consecutive speed, starting with the lowest recorded speed. The following tables summarize the data and the 50<sup>th</sup> and 85<sup>th</sup> percentile speeds. The *italicized* speed is the posted speed limit of 45 mph, the data highlighted green is the 50<sup>th</sup> percentile speed, and the data highlighted in yellow is the 85<sup>th</sup> percentile speed.

### Speed Study Results Summary

Northbound		
Recorded Speed (mph)	Number of Vehicles	Percentile
<35	0	0
35	1	1
36	0	1
37	0	1
38	1	2
39	1	3
40	3	6
41	1	7
42	7	14
43	5	19
44	7	26
<i>45</i>	<i>11</i>	<i>37</i>
46	12	49
47	9	58
48	10	68
49	9	77
50	6	83

Southbound		
Recorded Speed (mph)	Number of Vehicles	Percentile
<35	0	0
35	0	0
36	0	0
37	1	1
38	2	3
39	2	5
40	2	7
41	4	11
42	5	16
43	6	22
44	11	33
<i>45</i>	<i>10</i>	<i>43</i>
46	11	54
47	8	62
48	10	72
49	10	82
50	6	88



51	6	89
52	4	93
53	2	95
54	1	96
55	0	96
>55	4	100

51	3	91
52	5	96
53	1	97
54	1	98
55	2	100
>55	0	100

As shown in the table, the 50<sup>th</sup> percentile speed is 47 mph for northbound traffic and 46 mph for southbound traffic, which is 2 mph and 1 mph over the posted speed limit respectively. The 85<sup>th</sup> percentile speed is 51 mph for northbound traffic and 50 mph for southbound traffic, which is 6 mph and 5 mph over the posted speed limit respectively. Additionally, in the northbound direction, 37% of drivers are traveling at or below the speed limit and in the southbound direction 43% of drivers are traveling at or below the speed limit. Overall, the southbound traffic travels slightly slower than the northbound traffic. This may be due to the southbound traffic traveling through the 35 mph speed zone before entering the 45 mph speed zone, whereas the northbound traffic travels through a 40 mph speed zone before entering the 45 mph speed zone.

## Existing Conditions Safety Evaluation

### *Existing Crash History*

GP obtained the crash report from MaineDOT for 2015-2017, the most recent period available, for the study area when the study started. MaineDOT uses two criteria to identify a High Crash Location (HCL). Both criteria must be met in order to qualify as an HCL.

1. A critical rate factor (CRF) of 1.00 or greater during the most recent three year period.  
A CRF compares the crash rate to the crash rate of similar locations throughout the state.  
A CRF of 1.00 or greater indicates an above average rate of crashes, **and**
2. A minimum of eight crashes during the same three year period.

Based on a review of the crash data, there are no high crash locations within the study area. The following table summarizes the CRF and number of crashes for each location:



### Crash History Summary

Location	CRF	Crashes	HCL
<b>Intersections</b>			
Stevenson Rd / Rt 236	0.28	7	No
MacKenzie Ln / Rt 236	0.14	1	No
Fernald Rd S / Rt 236	0.00	0	No
Aroma Joes / Fernald Rd / Rt 236	0.53	3	No
Town Line Eliot / Kittery	0.28	1	No
Bolt Hill Rd / Rt 236	0.33	2	No
Non Int. / Rt 236	0.18	1	No
Levesque Dr / Rt 236	0.00	0	No
Beech Rd / Rt 236	0.37	<b>9</b>	No
<b>Route 326 Segments</b>			
Stevenson to South of MacKenzie	0.21	5	No
South of MacKenzie to Mackenzie	0.00	0	No
MacKenzie to Fernald S	0.16	1	No
Fernald S to Aroma Joes / Fernald	0.63	2	No
Aroma Joes / Fernald to Town Line	0.43	4	No
Town Line to Bolt Hill	0.51	2	No
Bolt Hill to Non Int.	0.38	<b>11</b>	No
Non. Int to Levesque NW	0.00	0	No
Levesque to Beech NW	0.23	1	No
Beech to Levesque SE	0.21	1	No
Levesque to Non Int. SE	<b>1.00</b>	3	No

As shown in the table, there are no HCLs within the study area. The values in **bold & italics** meet one of the two criteria for an HCL. Only three locations meet one of the two criteria for a HCL.

### Highway Safety Manual Analysis

In addition to reviewing the crash history of the corridor, a Highway Safety Manual (HSM) analysis was completed for the existing corridor conditions to determine a baseline to evaluate the impacts of recommended improvements. Part C.6.1 of the HSM states the following:

*“Classifying an area as urban, suburban, or rural is subject to the roadway characteristics, surrounding population, and land uses, and is at the user’s discretion. In the HSM, the definition of ‘urban’ and ‘rural’ areas is based on Federal Highway Administration (FHWA) guidelines which classify ‘urban’ areas as places inside urban boundaries where the population is greater than 5,000 persons. ‘Rural’ areas are defined as places outside urban areas where the population is less than 5,000. The HSM uses the term ‘suburban’ to refer to outlying portions of an*





*urban area; the predictive method does not distinguish between urban and suburban portions of a developed area.”*

Based on the MaineDOT Online Map Viewer, Route 236 from Stevenson Road to the southern Fernald Road intersection has a Federal Urban/Rural classification of “Urban.” The Federal Urban/Rural classification for Route 236 from Fernald Road to Beech Road is “Rural.” Based on the HSM guidance, the Route 236 corridor from Stevenson Road to Beech Road has been considered Urban and Suburban. Therefore, the evaluation has been based on the HSM 1<sup>st</sup> Edition, Volume 2, Chapter 12 – Predictive Method for Urban and Suburban Arterials. The analysis was completed using a spreadsheet (Appendix D) developed by Karen Dixon, Ph.D., P.E. with Oregon State University and calibrated by MaineDOT based on local information. Since the site specific crash history is available, the Empirical Bayes (EB) method has been applied, which combines observed crash information with the predicted crash frequency to estimate the expected crash frequency. The following table summarizes the results of the existing conditions HSM EB predictive method analysis:

**HSM Analysis Summary: 2018 Existing Conditions**

Location	Predicted Average Crash Frequency (crashes/yr)			Observed Crashes (crashes/yr)	EB Expected Crash Frequency (crashes/yr)
	Total	Fatal/Injury	Property Damage		
Roadway Segments	21.907	5.942	15.966	10.000	13.627
Intersections	11.467	3.984	7.483	7.666	9.542
<b>Total</b>	<b>33.374</b>	<b>9.926</b>	<b>23.449</b>	<b>17.666</b>	<b>23.169</b>

As shown in the table, the Route 236 corridor from Stevenson Road to Beech Road is forecast to experience 23.169 crashes per year with the existing conditions. During the most recent three year period, there was an average of 17.666 crashes per year along the corridor. Therefore, from a safety perspective, the corridor is actually doing better than would be expected. It is critical in moving forward with recommended alternatives that the safety be maintained or improved where possible and that recommendations do not decrease the safety of the corridor.

## **Bolt Hill Signal Warrant Analysis**

As shown previously, the vehicles exiting Bolt Hill Road experience low levels of service, both in the existing PM peak hour and for both peak hours in the future. A signal warrant analysis has been completed for the intersection of Bolt Hill Road with Route 236 to identify if the intersection would meet warrants for signalization. The existing intersection is STOP controlled on both Bolt Hill Road approaches and free flowing traffic on Route 236. The intersection also has a flashing beacon with red for the Bolt Hill Road approaches and amber for the Route 236



approaches to reinforce the conditions. The signal warrant analysis has been completed using the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD uses the following nine warrants to determine if a traffic control signal is justified at a particular location.

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

If any of the nine Warrants is met, a traffic control signal is warranted. However, just because a signal warrant is met does not mean a signal should be installed. Chapter 4C – Traffic Control Signal Needs Studies in the MUTCD discusses these nine Warrants in detail. The evaluation has been based on the turning movement counts completed at the intersection of Bolt Hill Road with Route 236 completed on May 16, 2017 from 6:00 AM to 6:00 PM. The MUTCD requires that the warrant analysis be based on the traffic volumes for an average day. The evaluation has been completed for the 2038 No-Build Conditions. The raw volumes have been seasonally and annually adjusted to the estimated average day volumes using similar methodology as discussed previously. The following table summarizes the hourly volumes for the major (Route 236) and minor (Bolt Hill Road) approaches.

**2038 No Build Average Day Traffic Volumes Summary**

Hour Beginning	Major (Rt 236)	Minor (Bolt Hill Rd)
6:00 AM	1289	22
7:00 AM	1492	41
8:00 AM	1345	45
9:00 AM	1033	34
10:00 AM	960	50
11:00 AM	1025	34
12:00 PM	1068	32
1:00 PM	1045	37
2:00 PM	1335	26
3:00 PM	1680	28
4:00 PM	1632	29
5:00 PM	1477	25



The following summarizes the requirements and evaluation for each Signal Warrant. All referenced tables and figures are attached in Appendix E.

#### Warrant I: Eight Hour Volume

This Warrant requires that one of the following Conditions exist for any eight hours of an average day:

- A. *“The vehicles per hour given in both of the 100 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; or”*
- B. *“The vehicles per hour given in both of the 100 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.”*

It is noted that if the posted speed limit or 85<sup>th</sup> percentile speed limit on the major street is greater than 40 mph, the traffic volumes in the 70% column of Table 4C-1 may be used instead of the 100% columns. Since the posted speed on Route 236 is 45 mph, the 70% columns have been used. Based on a review of Table 4C-1, Condition A requires a major street volume of 350 vehicles per hour and a minor street volume of 105 vehicles per hour for the same eight hours of an average day. Condition A is not met for any hour of an average day. Condition B requires a major street volume of 525 vehicles per hour and a minor street volume of 53 vehicles per hour for the same eight hours of an average day. Condition B is not met for any hour of an average day.

If neither Condition A nor Condition B above are met, both of the following Conditions are required to be met for any eight hours of an average day:

- A. *“The vehicles per hour given in both of the 80 percent columns of Condition A in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection; and”*
- B. *“The vehicles per hour given in both of the 80 percent columns of Condition B in Table 4C-1 exist on the major-street and the higher-volume minor-street approaches, respectively, to the intersection.”*

The MUTCD notes that although both Conditions must be met for eight hours of an average day, they do not need to be satisfied by the same eight hours. Additionally, for major streets with a posted speed limit of greater than 40 mph, the traffic volumes in the 56% columns can be used in place of the 80% columns. Since the posted speed on Route 236 is 45 mph, the 56% columns have been used. Based on a review of Table 4C-1, Condition A requires a major street volume of 280 vehicles per hour and a minor street volume of 84 vehicles per hour. Condition



B requires a major street volume of 420 vehicles per hour and a minor street volume of 42 vehicles per hour. Condition B met is met for two hours of an average day. However, Condition A is not met for any hour of an average day.

Since none of the volume requirements for Warrant 1 are met for eight hours of an average day, **Warrant 1 is not met.**

#### Warrant 2: Four Hour Vehicular Volume

This Warrant requires that the following is met:

*“The need for a traffic control signal shall be considered if an engineering study finds that, for each of any 4 hours of an average day, the plotted points representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) all fall above the applicable curve in Figure 4C-1 for the existing combination of approach lanes.”*

The MUTCD also notes that if the posted speed limit exceeds 40 mph, Figure 4C-2 can be used instead of Figure 4C-1. Since the posted speed on Route 236 is 45 mph, Figure 4C-2 has been used.

Based on a review of Figure 4C-2 and the time periods with the highest minor street volumes, the points fall below the “1 Lane & 1 Lane” line for all four peak hours. Since the points do not fall above the line, **Warrant 2 is not met.**

#### Warrant 3: Peak Hour

This Warrant requires that one of the following Conditions is met for a minimum of one hour of an average day:

- A. *“If all three of the following conditions exist for the same 1 hour (any four consecutive 15-minute periods) of an average day:*
  1. *“The total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equals or exceeds: 4 vehicle-hours for a one-lane approach or 5 vehicle-hours for a two-lane approach; and*
  2. *“The volume on the same minor-street approach (one direction only) equals or exceeds 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes; and*



3. *“The total entering volume serviced during the hour equals or exceeds 650 vehicles per hour for intersections with three approaches or 800 vehicles per hour for intersections with four or more approaches.*

B. *“The plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the higher-volume minor-street approach (one direction only) for 1 hour (any four consecutive 15-minute periods) of an average day falls above the applicable curve in Figure 4C-3 for the existing combination of approach lanes.”*

The MUTCD notes that if the posted speed limit is greater than 40 mph on the major street, Figure 4C-4 may be used in place of Figure 4C-3. Since the posted speed on Route 236 is 45 mph, Figure 4C-4 has been used to evaluate Condition B.

Condition A2 is not met for any hour of the average day. Therefore, Conditions A1 and A3 were not evaluated, since all three must be met to meet the Warrant.

Condition B has been evaluated using the 10:00 AM hour, since it has the highest minor street volume. Based on Figure 4C-4, the 10:00 AM volumes fall below the “1 Lane & 1 Lane” line. Therefore, **Warrant 3 is not met.**

#### Warrant 4: Pedestrian Volume

This Warrant is intended for locations where major street traffic volumes are so high that pedestrian delay is “excessively high” when crossing. This intersection experiences minimal pedestrian volumes, so **Warrant 4 is not applicable.**

#### Warrant 5: School Crossing

This Warrant is intended for locations near a school or locations with high volumes of school aged children crossing the major street. This intersection is not located near a school and is not on a walking route to a school, so **Warrant 5 is not applicable.**

#### Warrant 6: Coordinated Signal System

This Warrant is met if one of the following Conditions is met:

A. *“On a one-way street or a street that has traffic predominantly in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.*





- B. “On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation”*

Route 236 is not a one-way street, so Condition A is not applicable. The two existing traffic control signals on either end of the study area are not currently coordinated and are too far apart to benefit from coordination. Therefore, **Warrant 6 does not apply.**

#### Warrant 7: Crash Experience

This Warrant is met if all three of the following Criteria are met:

- A. “Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency; and*
- B. “Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash; and*
- C. “For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns of Condition A in Table 4C-1 (see Section 4C.02), or the vph in both of the 80 percent columns of Condition B in Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major-street and minor-street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.”*

The crash history for the intersection was obtained from MaineDOT for the period from 2015 to 2017, the most recent three year period available. Based on a review of the collision history have been two collisions at the intersection over the last three years. This is less than the required 5 crashes in one year to meet Criterion B. Since Criterion B is not met and all three Criteria must be met to meet the Warrant, **Warrant 7 is not met.**

#### Warrant 8: Roadway Network

This Warrant is intended for use at intersections of two major routes. Route 236 can be considered a major route, but Bolt Hill Road is not considered a major route. Therefore, **Warrant 8 is not applicable.**



### Warrant 9: Intersection Near a Grade Crossing

This warrant is intended for use at intersections in close proximity to a grade crossing. There are no grade crossings near this intersection. Therefore, **Warrant 9 is not applicable.**

### Warrant Analysis Conclusion

The following summarizes the results of the nine Warrants:

- Warrant 1: Not Met
- Warrant 2: Not Met
- Warrant 3: Not Met
- Warrant 4: Not Applicable
- Warrant 5: Not Applicable
- Warrant 6: Not Applicable
- Warrant 7: Not Met
- Warrant 8: Not Applicable
- Warrant 9: Not Applicable

Since none of the nine signal Warrants are met, a traffic signal is not warranted at the intersection of Bolt Hill with Route 236 for the 2038 No-Build condition.

## **Potential Development within the Study Area**

At the Kick-Off Meeting, GP requested that both municipalities provide a list of potential projects and their locations within the study area. The following summarizes the potential developments:

- Elderly Housing Development: approval for 100 independent living units, 40 assisted living units, and 10 dementia care units
- Modernist Pantry: approval for one 10,000 sf building and one 6,600 sf industrial building
- Large parcel of vacant land that is potentially developable
- Partially vacant lot that is potentially developable
- Currently developed site, with potential development of the second half of the site

These projects should be considered collectively when considering future development of the area and to encourage strong access management. These project locations are shown on the attached Figure in Appendix F.



## Overall Meetings

There were numerous meetings throughout the study process that included: three Steering Committee Meetings, an abutter meeting, and a public meeting. Those meetings were critical in identifying the direction and components of this study and the ultimate identification of the recommended alternatives. A general description of the meetings and the key items that were discussed are identified in the following sections.

### Steering Committee Meetings

Three meetings were held with the Steering Committee; Kick-off meeting, existing conditions review meeting, and recommended improvement / mitigation review. The meetings included representatives from both Kittery and Eliot, the Southern Maine Planning and Development Commission (SMPDC) / Kittery Area Comprehensive Transportation System (KACTS), and MaineDOT. The meeting minutes for each meeting are included in Appendix G.

The first meeting was held on September 10, 2018 to; kick off the project, confirm the purpose and need of the study, receive comments and input on corridor issues and concerns, and discuss the next steps. General discussion points from that meeting included the following, with more details provided in the meeting minutes in Appendix G:

- Although multimodal accommodations on the corridor would be beneficial, vehicular safety improvements should be the primary goal.
- There are insufficient gaps in Route 236 through traffic for turning vehicles, which creates unsafe conditions.
- Route 236 has heavy commuter traffic, with significantly more southbound traffic in the morning and more northbound traffic in the evening. The traffic pattern is heavily influenced by Portsmouth Naval Shipyard.
- Fernald Road is a commonly used cut-through road.
- Route 236 primarily has commercial property adjacent to the corridor and residential property further back, behind the commercial.
- When crashes occur on Spaulding Turnpike or I-95, traffic is often rerouted to Route 236 by GPS, which can add significant traffic to the corridor. Incident management will be an important aspect of the project.
- It was noted that although the crash data does not indicate any high crash locations, there are a lot of near misses, which is just as concerning to the public.
- The sharp angles of intersection for both sides of Fernald Road are difficult.
- Commercial driveways in Eliot are often very wide. Commercial accesses are often closely spaced as well.



- The Kittery Transfer Station traffic experiences significant delay exiting the site during peak hours on Route 236. Operating hours are Tuesday-Saturday, 9AM – 5PM.
- Development on Bolt Hill is approximately 25% completed. Additional development is expected.
- Both police departments have received numerous complaints about the speeds within the study area.
- Everyone in attendance agreed that ideally the final report will create change on the corridor and improvements will be implemented.

The second meeting was held on December 19, 2018 to review the results of the Existing Conditions Evaluation and discuss recommended mitigation items and next steps. General discussion points from that meeting included the following, with more details provided in the meeting minutes in Appendix G:

- Based on a comparison of 2008 annual average traffic volumes (AADT) in a previous MaineDOT study to the 2018 traffic volumes at the Kittery/Eliot Town Line, there was minimal fluctuation, and traffic patterns as shown in the 2008 study are similar to the 2018 volumes, which also reflects typical commuter peak hours.
- The AM peak hours at the study area intersections are consistent across the corridor and the PM peak hours are around 4:00 PM at either end of the corridor and earlier within the corridor.
- The results of the capacity analysis were reviewed. Overall the levels of service for the signalized intersections are acceptable during both 2018 and 2038. The unsignalized intersections experience longer delays on the unsignalized approaches.
- There are a few locations that exceed the storage lengths, however they do not exceed the storage length by a significant amount and it lasts for a short period of time. The queue lengths increase from 2018 to 2038.
- The speed study showed that the posted speed limits are exceeded slightly in both directions. However, the southbound is slightly slower than the northbound.
- No high crash locations in the 2018 study. Bolt Hill Road was a high crash location in the 2008 study. The existing flashing beacon was installed after the 2008 study and may have been a factor in bringing it below the high crash location threshold.
- Existing crash patterns appear to align with the public's complaints of issues around Aroma Joe's.
- The Highway Safety Manual (HSM) evaluation was reviewed. The results will be used as a benchmark to compare mitigation items. Based on the HSM evaluation, the observed crashes were less than the expected crashes.
- None of the signal warrants are met for the Bolt Hill intersection. Signal warrant evaluations for MacKenzie Lane and Fernald Road / Aroma Joe's were not included in the study, but based



on preliminary reviews of the traffic volumes these two locations also would not meet the requirements for signalization.

- RD asked the Committee if there was anything in the report that was a surprise. The following summarizes the responses:
  - The low number of crashes
  - The similarity in traffic volumes between the 2008 study and the 2018 volumes
  - That speeds were not higher
- The following list of potential mitigation items was discussed:
  - Access management, including review of MaineDOT requirements for mobility corridors
  - Modifications at Fernald
  - Signal upgrades
  - Incident management at the signalized intersections
  - Modifications at Bolt Hill, including the consideration of the four options presented in the 2008 study.
  - Turn lanes or a center two way left turn lane
  - Interconnection of lots (either frontage or backage connections)
  - Partial one way roads, i.e. making Fernald one way in for the end of the road so drivers must use Bolt Hill to get onto Route 236.
- DR asked if there were specific requirements to warrant a center turn lane on Route 236. RD said that typically the only limit is on the AADT of a corridor and that Route 236 has an adequate AADT for a center turn lane to be pursued. A two way center left turn lane not only gets left turning vehicles out of the way of through traffic, but also allows two stage gap acceptance when exiting a driveway.
- A suggestion for prohibiting left turns in certain areas and finding ways for vehicles to make a u-turn. A jug-handle for u-turns was suggested, although identifying a location may be difficult.
- A question was asked if a center two way left turn lane could be implemented without MaineDOT approval. The response was that it should be reviewed by MaineDOT. In addition, the Towns would also likely need to complete pavement cores on the shoulders to ensure the pavement is strong enough to support the added traffic volumes.
- A question was asked if a center two way left turn lane would require widening. The response was that the existing pavement width is approximately 42 feet. If the shoulders can be used for travel, then no widening would be required.

The third meeting was April 18, 2019 and was to review the draft recommended improvements, receive comments on the recommended mitigation items, and discuss potential changes before moving forward. General discussion points from that meeting included the following, with more details provided in the meeting minutes in Appendix G. Please note Plan Sheet numbers may have changed since the below comments were made:





- Sheet 1:
  - Existing signal equipment is old and mismatched
  - Recommends one mast arm on each corner instead of spanwire across the intersection, and adding backplates to the signal heads
  - Recommends upgrading equipment to include system that can accommodate incident management (Adaptive Traffic Control, ATC)
- Sheets 2-4:
  - Change striping in front of Dunkin' Donuts to transition to two way center left turn lane
  - Center left turn lane helps maintain through vehicle speeds, increases capacity, improves turning safety, and allows for two stage gap acceptance
  - Beach grass is preferred in the medians by the municipalities; however, it is sometimes a sight distance issue. It is meant to be traffic calming, but can be too much even when it is properly maintained
  - Raised, landscaped medians are high maintenance. If landscaped medians are used, low maintenance plantings are desired. Painted medians were suggested.
  - Long center left turn lanes are sometimes used for illegal passing. The proposed medians are intended to help prevent illegal passing.
  - Some proposed driveway closures and narrowing were identified
  - Center left turn lane design assumes that vehicles will start to decelerate in the travel lane before entering the turn lane. The minimum length shown before a driveway is approximately 100-150 feet. Minimum center left turn lane length is 300 feet, as required by MaineDOT
- Sheet 5A:
  - Proposed formal left turn lanes at Bolt Hill remove left turning vehicles from the through traffic. MaineDOT may advise carrying the center left turn lane through the intersection.
  - Separate turn lanes are proposed on Bolt Hill, which will help capacity but may impact sight distance
- Sheet 5B:
  - Shows approximate two lane roundabout area, which would likely require the acquisition of property
  - Single lane roundabout was considered, but was forecast to operate very poorly
  - Roundabout was suggested at Beech Road, however, there is not enough space at that intersection
- Sheet 6A:
  - Shows the proposed one way entering segment of Fernald Road
  - The corner property has access to both Fernald Road and Route 236. The Fernald Road access is gated. If the gate is removed, this may not be effective, since exiting traffic could use the property's driveways as a cut-through



- Sheet 7:
  - One of the properties shown on this sheet has been purchased, so it is the optimal time to modify the driveway
  - A survey was not completed for this study, so actual property lines may be different than the locations shown

After reviewing the plan set, there was additional discussion. The overall comments are summarized as follows:

- State maintenance turns around at the town facilities when plowing the roads
- The center turn lane would push the travel lane into the shoulder. Pavement cores are required to ensure the pavement depth is adequate
- The break in grade from the travel lane to the shoulder would require an overlay and shim to implement the center left turn lane. The shim would help add depth if the shoulder is inadequate.
- From MacKenzie (Transfer Station) on, Route 236 is town maintained. The Towns would be responsible for maintenance changes.
- The abutter properties need to be notified if their driveways are proposed to be closed
- The two way center left turn lane is anticipated to help trucks exiting the Transfer Station
- The purpose of the medians is to increase traffic calming, reduce illegal passing, and make the corridor more aesthetically pleasing
- MaineDOT would like to do research on maintenance with medians.
- Medians could be constructed after the overlay, but the work would not be as clean
- A jughandle was considered, but there were no suitable locations available



## Abutter Meeting

In identifying the issues and concerns within the study area, and then identifying alternatives to address those concerns, it was also identified that some abutters along the corridor would be impacted. This was especially true for those abutters that had less than ideal access management such as more than one curb cut, exceptionally wide curb cuts, or curb cuts that where spacing between curb cuts or to adjacent intersections was less than ideal.

The abutters that could potentially be effected by the access management mitigation were notified by the respective Towns and invited to a meeting so the recommended mitigation items, and their property specifically, could be discussed. The discussion was an informal roundtable meeting where each abutter was provided an opportunity to discuss their concerns. As a result of that meeting, the plans were adjusted prior to the next step, which was the presentation of the plans to the public.

## Public Meeting

A public meeting was held on June 25, 2019 to discuss the overall project and how we got to that point, present the current plan set to the public, receive comments and input on corridor issues and concerns, discuss next steps. General discussion points included the following.

- Overall Improvements – A brief description of the most significant change to Route 236 corridor was provided, which is the introduction of a center turn lane throughout the corridor with landscaped center medians at select locations.
  - There was a question regarding the purpose of the proposed landscaped center medians and associated vegetation within the medians. The response was that they improve esthetics, eliminates illegal passing, and reduces vehicle speeds
  - There was a concern expressed about trucks driving over the center medians (especially at the Dunkin' Donuts). Trucks park in the center of the road and visit DD.
- Bolt Hill Road Signal Analysis:
  - The methodology for evaluating an unsignalized intersection to see if it warrants installing a traffic signal was discussed. It was identified that this intersection does not meet the necessary standards for signalization.
  - There was a question and discussion about if the age of drivers is considered in the warrants. The response was that all drivers are considered equal and age is not a determining factor.
  - A question was raised if having Fernald as a one-way street would help Bolt Hill Road meet signal warrants? The response was yes, although by itself it would not help the



- intersection meet signal warrants, it will help the intersection get closer to meeting signal warrants.
- Fernald Road converted to a one-way away from Route 236 was also identified as a recommended improvement.
    - There was a question about potential right turn lanes turning off of Route 236 onto Fernald on both sides in order to get slower moving vehicles out of the through lanes ultimately making the movement safer. (This was later evaluated and found not to be warranted due to low volumes of right turning traffic)
    - Multiple concerns were raised about turning vehicles coming out of Aroma Joes located across the street and beside Fernald Road.
  - Study Area / Turning Movement Counts:
    - The strong directional distribution of traffic on Route 236 was discussed, with the majority of traffic heading toward Kittery in the AM and away from Kittery in the PM
    - Seasonal and yearly adjustment factors to traffic volumes were discussed for the existing / proposed conditions
  - Capacity / Queue Analysis:
    - The signalized intersections at each end of the corridor were discussed. The Stevenson Road intersection signal equipment is relatively new; however, a complete upgrade of the Beech Road intersection is being recommended including all new equipment and upgrade to mast arms from span wire as well as retiming / rephrasing of the intersection. The two signalized intersections show acceptable levels of service. However, it was noted that there are events within the regional area that cause significant queuing of traffic along the corridor.
    - The unsignalized intersections along Route 236 show operations with failing levels of service for minor road approaches. It was explained that this is not uncommon for unsignalized minor street approaches to a major arterial.
    - Queueing on Route 236 occurs primarily due to left turning vehicles on Route 236 holding up through traffic.
  - Speed Study:
    - A speed study was completed to capture the 50<sup>th</sup> and 85<sup>th</sup> percentile speeds on Route 236. Generally the speeds were slightly higher than the posted speed limits but were within what would be expected.
  - Crash History:
    - RD explained the crash history of the corridor, what a high crash location (HCL) is, and that there are currently no HCL within the study area.



- Final Questions / Comments / Observations:
  - Generally, the proposed center left turn lane appeared to have overall acceptance
  - There were a few that had concerns about the landscaped center medians but most were either in agreement or silent on the subject.
  - Vegetation in the islands should be either low growing or small trees with no branches for the first approximately four feet so that sight distances would not be blocked.
  - There was a comment about extending the center left turn lane to Stevenson in order to remove the “hour glass” effect on Route 236. This was later considered and added to the plans. (this was later included)

## **Recommended Corridor Mitigation to be Considered**

Before identifying improvements to the corridor, a list of possible mitigation was generated. The mitigation to be considered for the corridor has been separated into short term and long term improvements. Short term improvements are those that can be done with less planning and financial support, while long term improvements include items that take more planning and typically more financial support. The following list is a variety of the mitigation items that were considered:

### **Short Term:**

- Additional or revised signage
- Revised or enhanced striping
- Signal timing / phasing changes
- Maintenance items i.e. trimming of vegetation
- Policy changes within the ordinances
- Access management improvements
- Closure or narrowing of driveways
- Conversion to one-way side streets

### **Long Term:**

- Signalization equipment upgrades
- Repaving or widening of the corridor
- Jug handles
- Realignment of intersection approaches
- Geometric changes such as additional lanes or medians
- Re-evaluation of unsignalized intersections for signalization
- Interconnection or “frontage” roads



The implementation of each mitigation item was evaluated based on the location, existing conditions, and the effectiveness in addressing identified concerns. Many of the items were not pursued because they were not feasible or appropriate for this area. The following section identifies the mitigation items that were found to be appropriate and met the overall goals of the study.

## Recommended Mitigation Items

The following summarizes the recommended mitigation items that are currently identified for the corridor. Detailed plans are included in Appendix H.

### *Center Two-Way Left Turn Lane:*

One of the primary comments from the Steering Committee was that vehicles entering and exiting driveways and side streets from Route 236 experience significant delay during peak hours as well as perceived safety concerns. Route 236 for most of the corridor is a single lane in each direction with paved shoulders, requiring left turning vehicles onto a side street or into a business to stop in the single travel lane in their direction, which results in either stopping through traffic or causing them to go around them using the paved shoulder. Left turning traffic from a business or side street is required to wait for concurrent gaps in traffic for both directions before they can enter the roadway. A mitigation approach that could improve these issues is striping Route 236 for a center two way left turn lane, as shown below:



A center two way left turn lane is an option on the majority of the corridor. Where there is sufficient length between curb cuts, a median could be constructed within the center turn lane, such as the example below:





This landscaped median serves several purposes; it adds visual appeal to the corridor, prevents drivers from using the center turn lane for unauthorized uses such as passing, can help to slow vehicles down along the corridor, and provides the opportunity for “two-stage gap acceptance”. Two-stage gap acceptance is when a vehicle is leaving a side street or business, they can wait for a gap in one direction, move out to the center turn lane, and then wait for a gap in the other direction. Therefore, they would not need gaps in both directions at the same time.

The design or inclusion of the center median within the center turn lane was a point of discussion throughout the study. Some liked it as currently shown, while others wanted a center median but not landscaped, and a third option that was discussed was to not have a raised median but instead have a striped median. All of these choices have impacts to costs, as well as maintenance of the road and the islands. As would be expected, the raised landscaped island would be at the top of the list as far as achieving the most benefits, but would also come with the highest construction and maintenance cost. The striped center median would have still have some benefits, but not as much as the others, but would also come with the lowest construction and maintenance costs. An option could be to install the striped median in the interim and replace them with landscaped or raised if desired at some point in the future.

It should be noted that the implementation of a center two way left turn lane will require completing pavement cores within the shoulders to ensure the existing pavement is thick enough to support through traffic. It is our understanding that MaineDOT was completing this task at the time this Final Study was being submitted. If sufficient pavement depth is not available, the shoulders will need to be reconstructed to adequate depth and may be considered a long term improvement. If the pavement depth is sufficient and only restriping is required, the project may be considered a short term improvement since MaineDOT is repaving the corridor in 2020/2021. This will need further review.



Based on a review of the Highway Safety Manual (HSM), a center two way left turn lane is anticipated to decrease the number of driveway related collisions. Based on a review of the available crash data, there were 8 left turning driveway related collisions within the study area during the most recent three year period (2015-2017). There were several rear end collisions that also occurred, but it was not specified if these involved vehicles queued behind turning traffic.

This recommended mitigation item is anticipated to address several of the Steering Committee concerns such as improving the gaps needed for vehicles to enter or exit the roadway, improving safety when entering and exiting the roadway, reducing travel speeds, getting the turning traffic out of the through traffic stream while they wait to make their turn, and improving the ability of garbage trucks to exit the transfer station (MacKenzie Lane) more easily.

### *Improvements to Signalized Intersection*

There are two signalized intersections within the study area; the intersection of Stevenson Road / Martin Road / Route 236 on the southerly end of the study area in Kittery and the intersection of Beech Road / Route 236 on the northerly end of the study area in Eliot. The Stevenson Road intersection appears to have been updated within the recent past, and includes a new controller, mast arms, new signal heads, lane use signs, and advanced vehicle detection. On the northerly end of the study area at the Beech Road intersection, the intersection does not fare as well and equipment appears antiquated and in need of complete upgrades. Upgrades could improve the safety and operations of the intersection and could include; conversion from span wire to mast arms, new signal heads with backplates to block the sun and retroreflective borders for better nighttime visibility, new signal controller to improve operations, overhead lane use signs, and new vehicle detection.

A new controller and vehicle detection could also be more easily programmed to accommodate unexpected increases in traffic volume due to incidents that occur in surrounding areas and more traffic is directed to this corridor. This increase in traffic volume due to re-routing of traffic from other corridors was identified by the Steering Committee as a concern.

### *Access Management*

Access management includes controlling driveway widths, the number of driveways along a corridor, and the alignment and spacing of curb cuts, all with a goal of limiting the number of potential conflicts along a corridor. All of these items were identified by the Steering Committee as issues along this section of Route 236. Route 236 is considered by MaineDOT as a Mobility corridor for a portion of its length (areas above 35 mph). Mobility corridors have specific requirements from MaineDOT for number, size, and spacing. The attached plans show locations where driveways could be eliminated, driveway widths that should be reduced in width, and re-alignment of driveways.

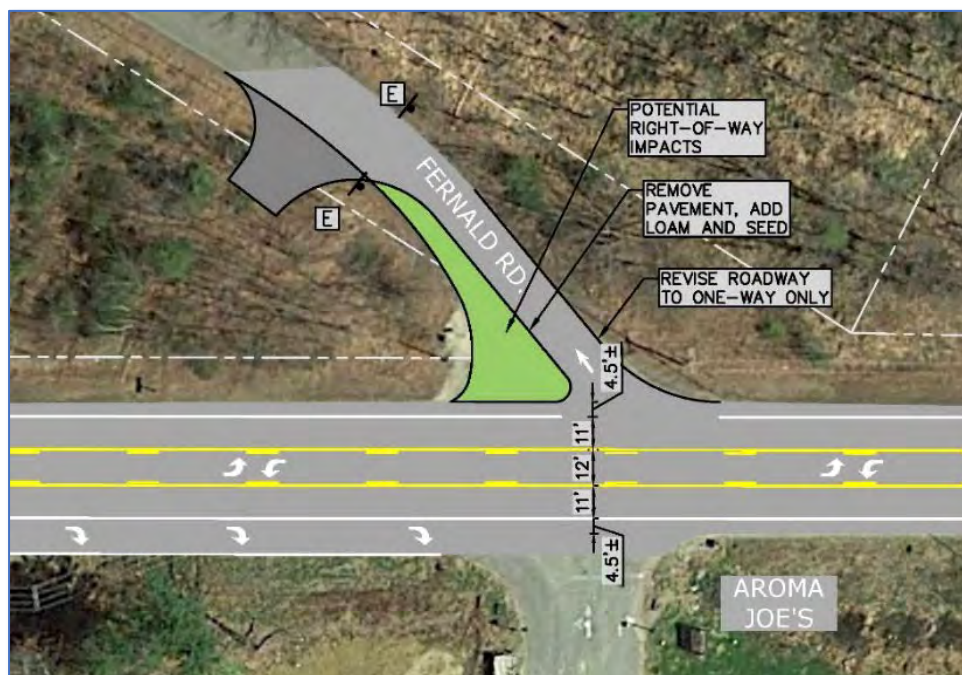




There are numerous properties along this section of Route 236 that have more than one driveway. It was initially proposed that many of the locations be limited to a single driveway and / or excessive widths of driveways be reduced. There was considerable abutter opposition to this mitigation and as a result most of the locations were left unchanged. It is strongly recommended that both the Towns of Kittery and Eliot adopt restrictions in their ordinance that allows only one driveway. This should apply to both new developments as well as existing developments that apply to the Towns for any changes to their site, even if not directly related to their driveways.

### *Fernald Road Modifications*

The northerly most Fernald Road / Route 236 intersection was identified as an area of concern both at the Kick-Off Meeting as well as the Steering Committee Meeting. The issue included the acute angle of the intersection and the difficulty of drivers exiting onto Route 236. To address safety concerns, Fernald Road is shown below and on the attached plans as a one-way away from Route 236, but only for the section of Fernald Road nearest Route 236.

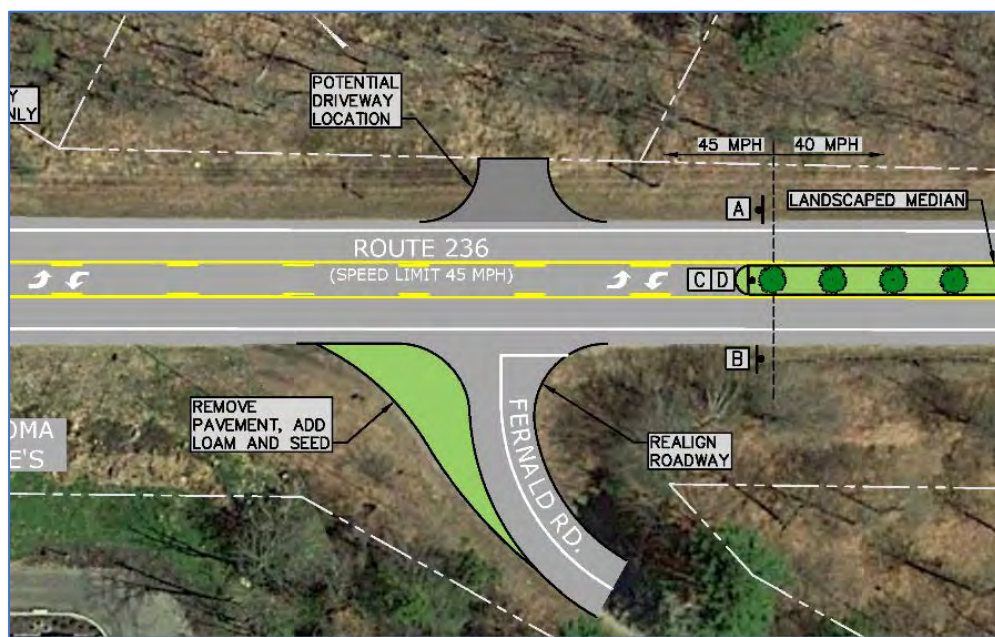


The remainder of Fernald Road maintains two-way traffic to allow residents ease in accessing their property. This mitigation includes the addition of a turn-around area on Fernald Road prior to the one-way segment of the road, as well as signage indicating Do Not Enter. The turn-around area may require right of way acquisition from the adjacent property. Signs indicating this is a



dead-end for those traveling southbound on Fernald Road should also be erected at the intersection with Bolt Hill Road so that drivers do not come down Fernald Road only to realize they need to turn around. It should be noted, that the smoke shop located near the intersection of Fernald Road / Route 236 has access to both Fernald Road and Route 236 and could potentially be used as a cut-through, causing unsafe conditions for the business. This would need to be addressed prior to implementation.

Additionally, the opposite Fernald Road approach meets Route 236 at an acute angle. It could be realigned to meet Route 236 at a more perpendicular angle, as shown below:



As shown above, the realignment also aligns with the recommended location if a future driveway were to be constructed, which creates a safer intersection. This perpendicular angle helps drivers exiting Fernald Road, especially looking right since they would not have to strain to look over their shoulder. It will also help those vehicle turning left from Route 236 onto Fernald Road and decrease the potential of encroaching on the exiting lane. A third benefit of the realignment is that it helps to slow right turning traffic off Route 236 onto Fernald Road, which was expressed during the study process as being a concern.



## Recommended Improvements Capacity Analysis

A capacity analysis was completed for the study area intersections with proposed improvements using Synchro/SimTraffic computer analysis software using the same methodology as the existing conditions analysis. The following table summarize the relationship between control delay and level of service.

**Level of Service Criteria for Signalized Intersections**

Level of Service	Control Delay per Vehicle (s)
A	Less than 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	Greater than 80.0

**Level of Service Criteria for Unsignalized Intersections**

Level of Service	Control Delay per Vehicle (s)
A	Less than 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

The capacity analysis has been completed using the 2038 traffic volumes that were estimated in the existing conditions report and are shown on the attached Figures in Appendix A. The analysis was completed based on the intersection geometry with the proposed improvements. The two signalized intersections have been evaluated using optimized signal timing. For ease of comparison, the results for the 2038 existing geometry analysis have been included in the table. The following table summarizes the capacity analysis results. Detailed results are included in Appendix I.



### Level of Service Summary

Approach	Level of Service			
	Existing		Proposed	
	2038 AM	2038 PM	2038 AM	2038 PM
<b>Stevenson / Martin / Route 236 (S)</b>				
Martin EB	C	C	C	C
Stevenson WB	B	C	B	C
Route 236 NB	B	C	B	C
Route 236 SB	B	B	B	B
<b>Overall</b>	<b>B</b>	<b>C</b>	<b>B</b>	<b>C</b>
<b>MacKenzie / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
MacKenzie SW	C	F	A	E
<b>Aroma Joes / Fernald / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
Aroma Joes NE	E	E	C	C
Fernald SW	F	F	N/A	N/A
<b>Bolt Hill / Route 236 (U)</b>				
Route 236 SE	A	A	A	A
Route 236 NW	A	A	A	A
Bolt Hill NE	D	F	E	F
Bolt Hill SW	E	F	F	F
<b>Beech / Route 236 (S)</b>				
Route 236 SE	B	B	B	B
Route 236 NW	B	B	B	B
Beech NE	B	B	B	B
Beech SW	B	B	B	B
<b>Overall</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>

S=Signalized, U=Unsignalized

As shown in the table, the proposed center two way left turn lane is forecast to improve the operation of the MacKenzie Lane and Aroma Joes. The operation of Bolt Hill Road is forecast to decrease slightly due to the additional traffic that was rerouted from Fernald Road. Additionally, the addition of a right turn lane at the Bolt Hill Road southwest approach is not forecast to have a significant impact on the operation of the intersection. The levels of service of the signalized intersections are forecast to be maintained with adjustments to signal timing.



## Recommended Improvements Queue Analysis

A queue analysis was also completed using the same methodology as that used for the existing conditions analysis. The following table summarizes the postdevelopment 95<sup>th</sup> percentile queue lengths based on SimTraffic analyses. For ease of comparison, the table also shows the results from the 2038 No-Build analysis completed in the Existing Conditions Evaluation. The detailed reports are included in Appendix I.

Queue Analysis Summary

Approach	Storage Length (veh)	95 <sup>th</sup> Percentile Queue Length (veh)			
		Existing		Proposed	
		2038 AM	2038 PM	2038 AM	2038 PM
Stevenson / Martin / Route 236 (S)					
Martin EB LT		2	2	2	2
Martin EB R	2	3	2	3	2
Stevenson VVB LTR		2	4	2	4
Route 236 NB L	8	1	4	2	6
Route 236 NB TR		12	39	11	37
Route 236 SB L	9	4	5	3	4
Route 236 SB TR		17	13	17	14
MacKenzie / Route 236 (U)					
Route 236 SE LT		2	7	N/A	N/A
Route 236 SE L		N/A	N/A	1	1
Route 236 SE T		N/A	N/A	--	--
Route 236 NW TR		--	3	--	--
MacKenzie SW LR		1	3	1	3
Aroma Joes / Fernald / Route 236 (U)					
Route 236 SE LT		3	1	N/A	N/A
Route 236 SE L		N/A	N/A	1	--
Route 236 SE T		N/A	N/A	--	--
Route 236 SE R		--	--	--	--
Route 236 NW LTR		7	7	N/A	N/A
Route 236 NW L		N/A	N/A	1	1
Route 236 NW TR		N/A	N/A	--	--
Aroma Joes NE LT		3	2	1	1
Aroma Joes NE R	2	3	2	2	2
Fernald SW LT		2	6	N/A	N/A
Fernald SW R <sup>1</sup>	1	1	1	N/A	N/A
Bolt Hill / Route 236 (U)					
Route 236 SE LTR		2	10	N/A	N/A
Route 236 SE L		N/A	N/A	1	1



Approach	Storage Length (veh)	95 <sup>th</sup> Percentile Queue Length (veh)			
		Existing		Proposed	
		2038 AM	2038 PM	2038 AM	2038 PM
Route 236 SE TR		N/A	N/A	--	--
Route 236 NW LTR		1	8	N/A	N/A
Route 236 NW L		N/A	N/A	1	1
Route 236 NW TR		N/A	N/A	--	--
Bolt Hill NE LTR		2	4	3	3
Bolt Hill SW LTR		3	2	N/A	N/A
Bolt Hill SW LT		N/A	N/A	5	4
Bolt Hill SW R	2	N/A	N/A	2	2
<b>Beech / Route 236 (S)</b>					
Route 236 SE L	7	3	3	2	3
Route 236 SE T		8	5	8	5
Route 236 SE TR		8	5	7	5
Route 236 NW L	9	2	3	2	4
Route 236 NW T		4	7	4	8
Route 236 NW TR		5	8	5	9
Beech NE LT		4	5	3	6
Beech NE R	5	3	3	3	3
Beech SW LT		5	4	5	4
Beech SW R	4	3	3	2	3

<sup>1</sup>There is no formal right turn lane on this approach, however the approach is wide enough in the existing condition that vehicles are anticipated to utilize the approach as a left-through lane with a short right turn pocket.

As shown in the table, the center two way left turn lane is forecast to improve the queue lengths of MacKenzie Lane and Aroma Joes. The queue lengths at the Bolt Hill Road northwest approach are forecast to increase by two to three vehicles, assuming that one vehicle plus the associated space between vehicles is equal to 25 feet. This increase is due to the additional traffic from Fernald Road that is redirected to Bolt Hill Road. The queue lengths at the two signalized intersections are not forecast to change significantly. Additionally, the addition of a right turn lane at the Bolt Hill Road southwest approach is not forecast to have a significant impact on the queue lengths.

## Preliminary Opinion of Cost

A preliminary opinion of cost (included in Appendix J) was generated for the recommended improvements as shown on the plans provided in Appendix H. The opinion of preliminary cost is based on conceptual plans only, and is subject to revision as the plans are refined. For the center medians, they were considered as raised but not landscaped. A summary of the costs broken into the major components is provided as follows:





Recommended Improvement	Preliminary Opinion of Cost (2019 Dollars)
Center Turn Lane w/ raised medians and signs	\$ 1.5 Million
Beech Road / Route 236 Signal Upgrades	\$225,000
Access Management	\$ 70,000
Fernald Road (both approaches)	\$ 70,000
<b>Approximate Total Preliminary Opinion of Costs</b>	<b>\$ 1.9 Million Dollars</b>

The MaineDOT has previously identified an overlay project in the year 2020 / 2021 for this section of Route 236. Depending on the extent of that overlay, this could reduce the contribution of the Towns to the recommended improvements identified in this study.

As identified previously, to reduce costs, the raised center medians could be either striped or some form of textured pavement.

## Existing Conditions and Recommended Improvements Summary

The following is a summary of the existing conditions findings and recommended improvements:

1. Based on corridor counts completed at three locations on Route 236, there are two distinct peak hours; one in the AM and one in the PM. The PM peak hour volume is slightly higher than the AM peak hour at all three locations.
2. Based on the capacity analysis completed for the 2018 existing conditions and the 2038 no-build conditions, the signalized intersections are forecast to operate at acceptable levels of service in 2018 and 2038. The minor street approaches are forecast to operate at low or failing levels of service during the PM peak hour in both 2018 and 2038.
3. The total hourly traffic volumes for the two lane section of Route 236 are as follows:
  - 2018 AM peak hour: 1,600 vph
  - 2018 PM peak hour: 1,785 vph
  - 2038 AM peak hour: 1,760 vph
  - 2038 PM peak hour: 1,965 vph
4. Based on the queue analysis, the existing intersection storage lengths are forecast to accommodate the 95<sup>th</sup> percentile queue lengths for most approaches. At the unsignalized intersections, during the 2038 AM and PM peak hours there is some queuing on Route 236 due to vehicles turning onto the side streets.



5. A vehicular speed study was completed to the northwest of Bolt Hill Road, within the 45 mph speed zone. Based on the speed study, the 50<sup>th</sup> percentile speed is 47 mph for northbound traffic and 46 mph for southbound traffic, which is 2 mph and 1 mph above the posted speed limit respectively. The 85<sup>th</sup> percentile speed is 51 mph for northbound traffic and 50 mph for southbound traffic, which is 6 mph and 5 mph over the posted speed limit respectively.
6. Based on the 2015-2017 crash report provided by MaineDOT, there are no high crash locations within the study area. However, three locations do meet one of two criteria for a high crash location.
7. Based on an HSM analysis for the corridor, there are forecast to be 23.169 crashes per year. During the most recent three year period, the average was 17.666 crashes per year, thus the corridor does not appear to have a safety deficiency.
8. Based on the signal warrant completed for the intersection of Bolt Hill Road with Route 236, none of the nine MUTCD signal warrants are met. Therefore, a traffic control signal is not warranted at the intersection.
9. Based on information provided by the municipalities, there are five locations that could potentially be developed within the study area in the future.
10. The following mitigation was explored for the corridor:
  - Center Two-Way Left Turn Lane with raised center medians
  - Signalized Intersection Improvements:
    - Adjust timing
    - Upgrade equipment
    - Implement traffic responsive programming
  - Access Management
    - Reduction in number of driveways
    - Reduction in driveway widths
    - Re-alignment of driveways
    - Identification of potential future driveways
  - Modify Fernald Road approaches, one to a one-way away from Route 236 and the other provide a re-alignment to more perpendicular to Route 236.
11. Based on capacity analysis of the proposed improvements, they are forecast to improve the levels of service of MacKenzie Lane and Aroma Joes. The levels of service for Bolt Hill Road are forecast to decrease slightly due to the additional traffic redirected from





Fernald Road. The levels of service of the signalized intersections are forecast to be maintained.

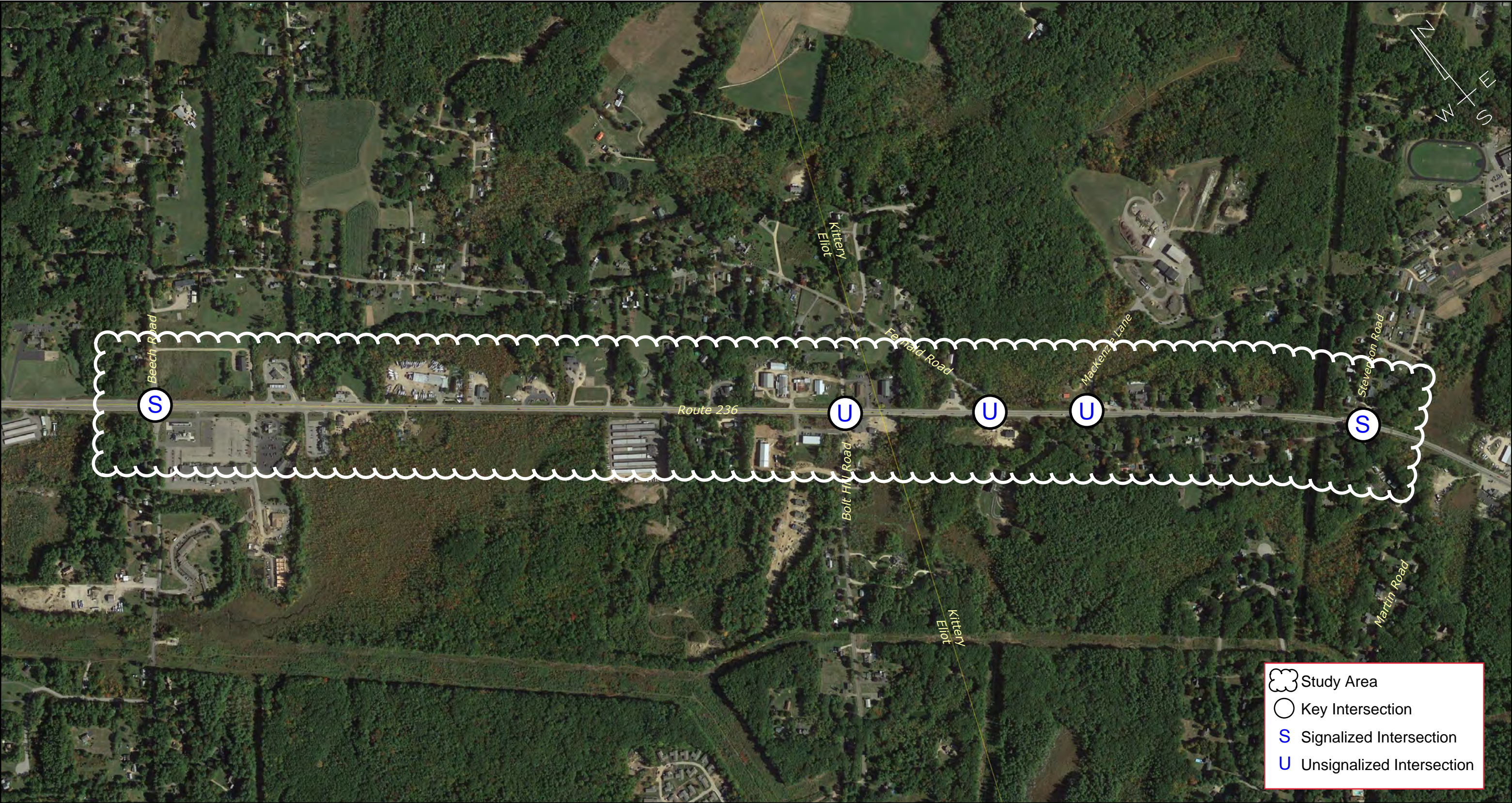
12. Based on the queue analysis, the recommended mitigation is forecast to reduce the 95<sup>th</sup> percentile queue lengths of MacKenzie Lane and Aroma Joes. The queue lengths for Bolt Hill Road are forecast to increase by one to two vehicles. The queue lengths at the signalized intersections are not forecast to change significantly.
13. A preliminary opinion of cost for the recommended alternatives shown on the attached plans is approximately \$ 1.9 million dollars.



# Appendix A

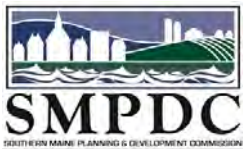
Study Area Figure  
Traffic Volume Figures





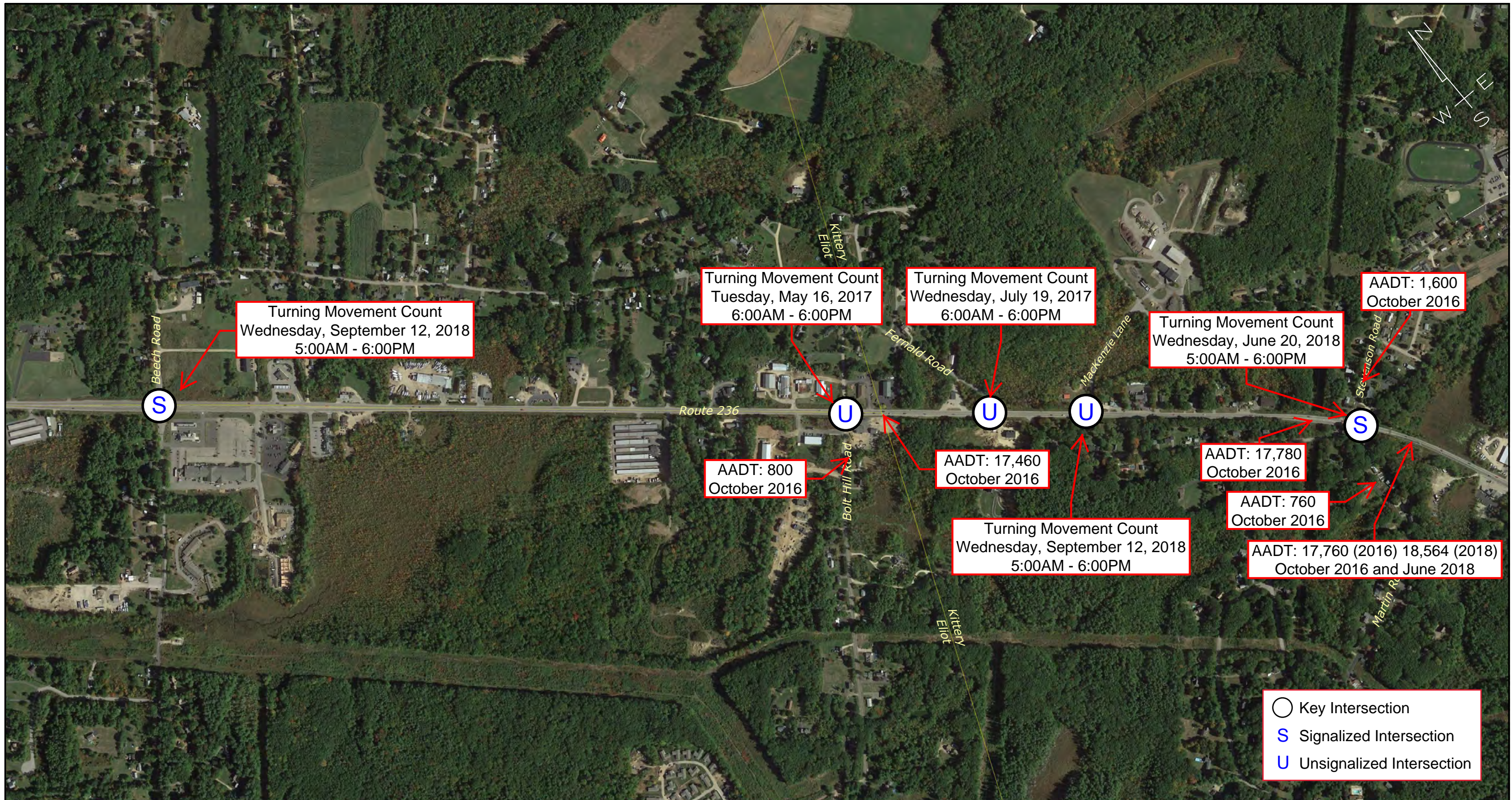
ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE

Design: EAL  
Draft: Date: SEPT 2018  
Checked: RED File Name: 3453 - Study Area



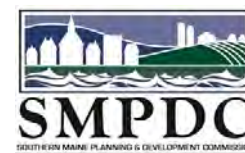
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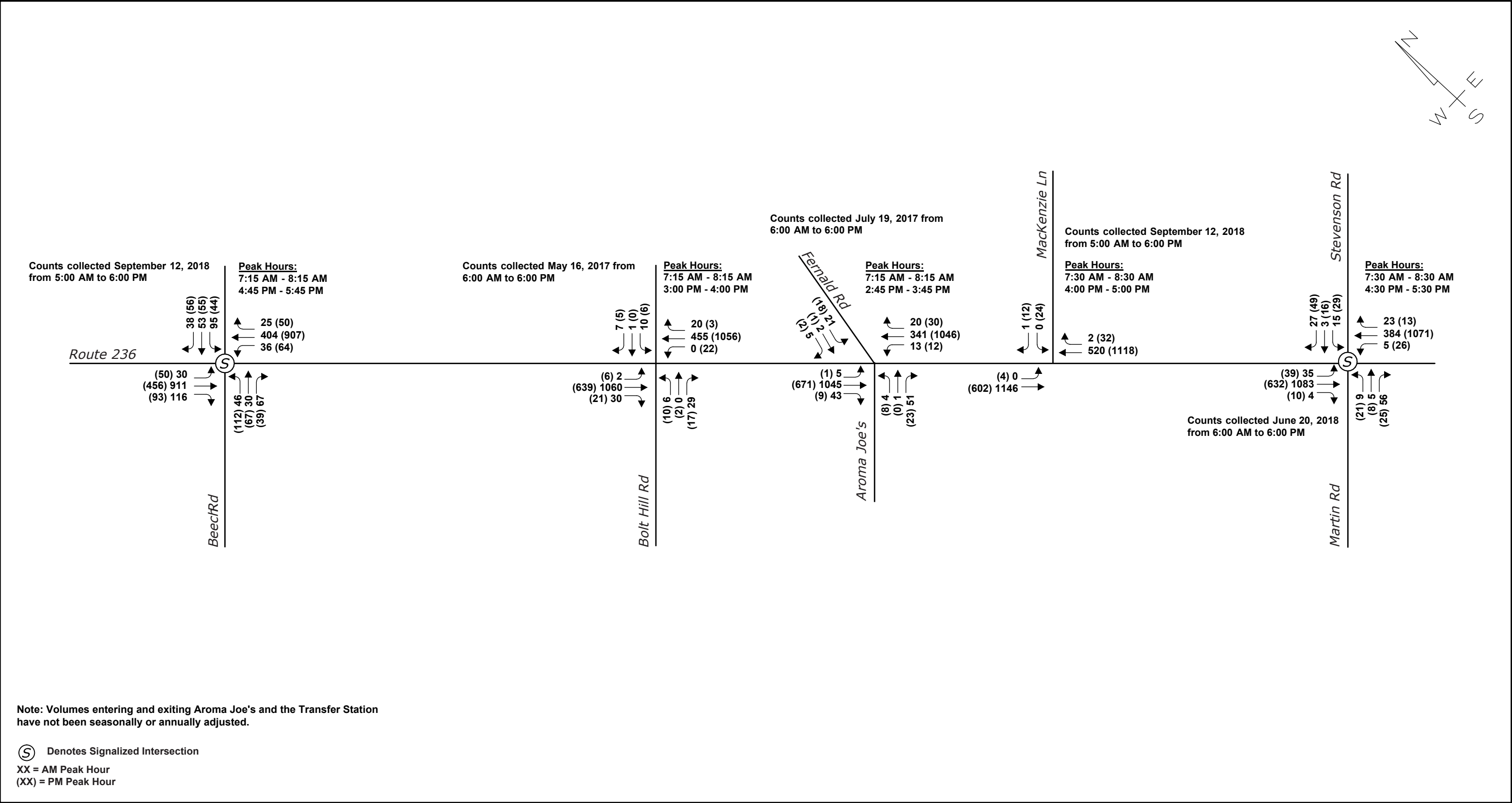
## ROUTE 236 TRAFFIC AND SAFETY STUDY KITTERY & ELIOT, MAINE

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 Draft: DATE: SEPT 2018  
 Checked: RED  
 File Name: 3453 - Study Area



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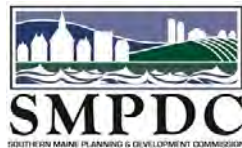




ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE

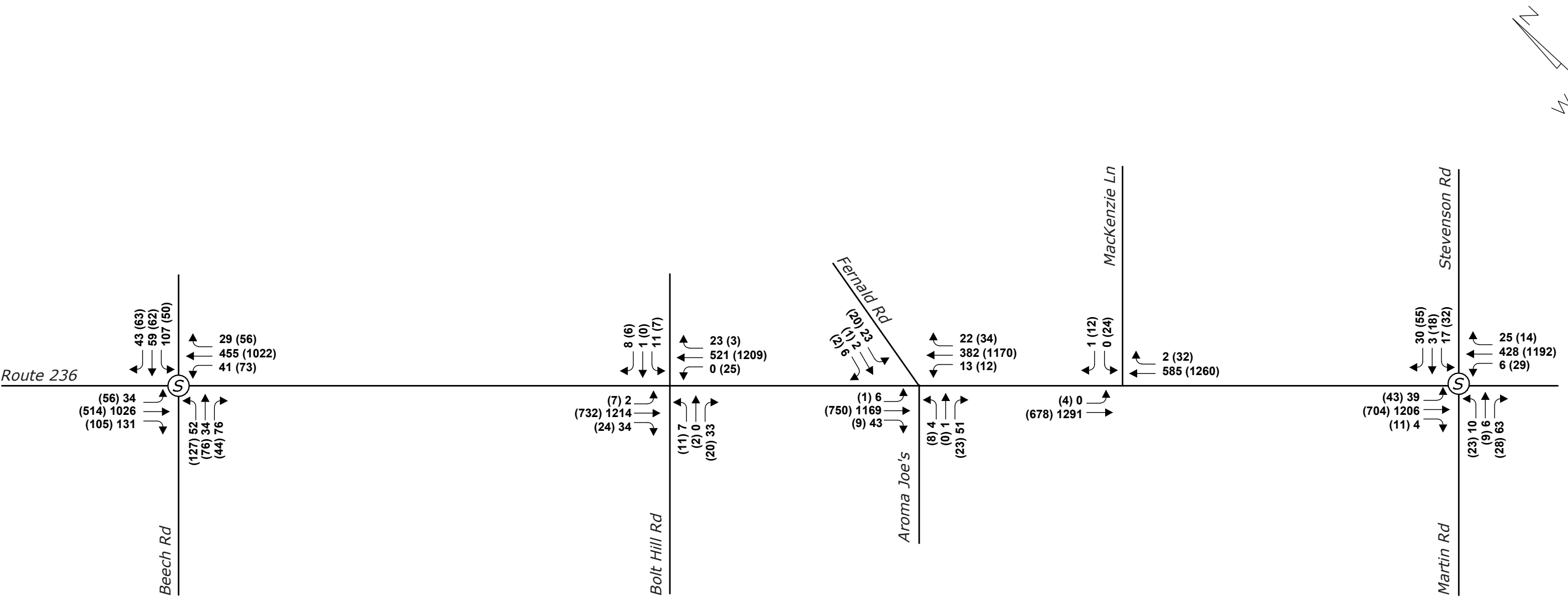
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Checked: EL

Scale: NONE  
Date: NOV 2018  
File Name: 3453- Raw Volumes



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Annual Growth = 0.5% Per Year

Note: Volumes entering and exiting Aroma Joe's and the Transfer Station have not been seasonally or annually adjusted.

Ⓢ Denotes Signalized Intersection

XX = AM Peak Hour

(XX) = PM Peak Hour

ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE





# Appendix B

Existing Conditions Capacity and Queue Analysis  
Results



## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2569	2582	2566	2523	2601	2571
Vehs Exited	2517	2551	2540	2505	2575	2536
Starting Vehs	88	92	100	93	99	91
Ending Vehs	140	123	126	111	125	122
Denied Entry Before	1	1	0	2	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	3596	3660	3539	3610	3618	3605
Travel Time (hr)	125.7	127.6	121.5	123.2	124.2	124.4
Total Delay (hr)	24.2	24.2	21.2	21.1	21.9	22.5
Total Stops	1714	1713	1614	1556	1627	1647
Fuel Used (gal)	111.7	113.3	109.8	110.4	110.0	111.0

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2569	2582	2566	2523	2601	2571
Vehs Exited	2517	2551	2540	2505	2575	2536
Starting Vehs	88	92	100	93	99	91
Ending Vehs	140	123	126	111	125	122
Denied Entry Before	1	1	0	2	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	3596	3660	3539	3610	3618	3605
Travel Time (hr)	125.7	127.6	121.5	123.2	124.2	124.4
Total Delay (hr)	24.2	24.2	21.2	21.1	21.9	22.5
Total Stops	1714	1713	1614	1556	1627	1647
Fuel Used (gal)	111.7	113.3	109.8	110.4	110.0	111.0

### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	3.3	0.1	0.4	0.1	0.3
Total Del/Veh (s)	20.7	16.0	11.3	12.0	12.3
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.1
Total Del/Veh (s)	1.5	2.8	12.7	1.9
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.0	0.0	3.7	0.7	0.1
Total Del/Veh (s)	3.5	2.0	21.6	42.6	4.3
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.1	0.1	0.1	0.1
Total Del/Veh (s)	7.4	2.3	20.9	22.6	6.4
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.0	1.2	0.6	0.3
Total Del/Veh (s)	11.2	9.5	10.3	13.8	10.9
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	0.7
Total Del/Veh (s)	29.8
Denied Entry Before	0
Denied Entry After	0

### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	74	70	70	24	286	106	335
Average Queue (ft)	12	32	25	2	96	24	134
95th Queue (ft)	44	61	54	14	226	67	272
Link Distance (ft)	616		1038		914		1784
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	1	7			2		2
Queuing Penalty (veh)	0	1			0		1

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SW
Directions Served	LR
Maximum Queue (ft)	25
Average Queue (ft)	2
95th Queue (ft)	15
Link Distance (ft)	929
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	NW	NE	NE	SW	SW
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	36	162	26	68	51	41
Average Queue (ft)	2	17	5	27	12	5
95th Queue (ft)	25	90	21	58	35	24
Link Distance (ft)	1028	539	631		929	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				60		25
Storage Blk Time (%)				2	7	0
Queuing Penalty (veh)				0	0	0

#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	NW	NE	SW
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	59	6	95	61
Average Queue (ft)	2	0	28	15
95th Queue (ft)	25	4	66	47
Link Distance (ft)	3208	1028	948	702
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	110	202	189	61	118	125	83	70	163	92
Average Queue (ft)	21	105	85	20	41	46	36	29	64	23
95th Queue (ft)	61	170	153	51	84	98	68	56	119	60
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)		1					0		1	
Queuing Penalty (veh)		0					0		1	

#### Network Summary

Network wide Queuing Penalty: 3
---------------------------------

### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	6.0	61.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	24.0	29.3	7.3	7.4	37.7	7.3
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	73	10	39	97	10	39
Cycles @ Minimum (%)	0	1	14	3	0	14
Cycles Maxed Out (%)	22	13	0	3	19	0
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	5.0	22.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	11.7	19.2	10.3	5.1	19.6	10.3
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	75	7	13	71	3	13
Cycles @ Minimum (%)	7	1	2	29	0	2
Cycles Maxed Out (%)	25	44	6	29	53	6
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2696	2672	2663	2672	2615	2667
Vehs Exited	2666	2642	2620	2621	2584	2629
Starting Vehs	92	116	111	99	122	106
Ending Vehs	122	146	154	150	153	142
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	2	1	0	0	2	0
Travel Distance (mi)	3976	3927	3954	3932	3804	3919
Travel Time (hr)	147.9	142.6	144.1	144.2	138.6	143.5
Total Delay (hr)	32.8	28.5	29.6	30.5	28.3	29.9
Total Stops	2230	2112	2051	2108	2043	2109
Fuel Used (gal)	123.8	122.4	122.2	122.9	117.3	121.7

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2696	2672	2663	2672	2615	2667
Vehs Exited	2666	2642	2620	2621	2584	2629
Starting Vehs	92	116	111	99	122	106
Ending Vehs	122	146	154	150	153	142
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	2	1	0	0	2	0
Travel Distance (mi)	3976	3927	3954	3932	3804	3919
Travel Time (hr)	147.9	142.6	144.1	144.2	138.6	143.5
Total Delay (hr)	32.8	28.5	29.6	30.5	28.3	29.9
Total Stops	2230	2112	2051	2108	2043	2109
Fuel Used (gal)	123.8	122.4	122.2	122.9	117.3	121.7

### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	1.8	0.2	1.4	0.1	0.9
Total Del/Veh (s)	20.8	28.7	19.0	12.1	17.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.0
Total Del/Veh (s)	1.1	7.4	33.6	5.5
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.0	0.0	2.8	0.5	0.1
Total Del/Veh (s)	2.1	3.6	30.8	53.8	4.2
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.1	0.1	0.1	0.1
Total Del/Veh (s)	5.6	5.9	44.4	42.9	6.7
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.3	0.0	0.6	0.9	0.2
Total Del/Veh (s)	10.3	11.9	14.4	11.6	11.7
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	1.0
Total Del/Veh (s)	37.9
Denied Entry Before	0
Denied Entry After	0

### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	67	62	122	193	682	106	353
Average Queue (ft)	22	16	50	30	242	29	115
95th Queue (ft)	51	46	100	108	533	74	255
Link Distance (ft)	616		1038		914		1784
Upstream Blk Time (%)					0		
Queuing Penalty (veh)					0		
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	3	0			9		2
Queuing Penalty (veh)	1	0			2		1

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SE	SW
Directions Served	LT	LR
Maximum Queue (ft)	113	78
Average Queue (ft)	7	30
95th Queue (ft)	55	63
Link Distance (ft)	540	929
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	NW	NE	NE	SW	SW
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	36	159	44	40	42	31
Average Queue (ft)	1	12	12	13	10	4
95th Queue (ft)	25	71	39	33	30	21
Link Distance (ft)	1028	540	538		929	
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)				60		25
Storage Blk Time (%)			1	0	6	1
Queuing Penalty (veh)			0	0	0	0



#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	NW	NE	SW
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	210	238	103	61
Average Queue (ft)	25	29	30	13
95th Queue (ft)	131	138	73	42
Link Distance (ft)	3208	1028	948	702
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	74	125	126	97	182	186	141	95	89	64
Average Queue (ft)	29	64	46	34	90	103	69	19	41	25
95th Queue (ft)	59	106	95	73	155	164	114	56	73	54
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)		0			0		1	0	0	
Queuing Penalty (veh)		0			0		0	0	0	

#### Network Summary

Network wide Queuing Penalty: 5
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### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	5.0	62.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	6.0	45.6	8.9	8.1	48.6	8.9
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	55	4	22	63	9	22
Cycles @ Minimum (%)	41	0	7	34	0	7
Cycles Maxed Out (%)	45	35	4	38	31	4
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	6.0	21.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	6.2	20.7	11.7	6.6	19.8	11.7
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	60	4	9	49	5	9
Cycles @ Minimum (%)	34	0	1	0	0	1
Cycles Maxed Out (%)	40	51	11	31	44	11
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2828	2915	2825	2783	2799	2830
Vehs Exited	2760	2876	2774	2744	2738	2779
Starting Vehs	78	97	100	103	81	90
Ending Vehs	146	136	151	142	142	141
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	1	1	0
Travel Distance (mi)	3887	4122	3840	3949	3951	3950
Travel Time (hr)	140.4	151.2	135.4	142.1	141.3	142.1
Total Delay (hr)	29.9	34.7	26.8	30.2	29.1	30.1
Total Stops	2077	2183	1884	2029	1930	2021
Fuel Used (gal)	121.3	129.4	118.7	122.6	122.4	122.9

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2828	2915	2825	2783	2799	2830
Vehs Exited	2760	2876	2774	2744	2738	2779
Starting Vehs	78	97	100	103	81	90
Ending Vehs	146	136	151	142	142	141
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	1	1	0
Travel Distance (mi)	3887	4122	3840	3949	3951	3950
Travel Time (hr)	140.4	151.2	135.4	142.1	141.3	142.1
Total Delay (hr)	29.9	34.7	26.8	30.2	29.1	30.1
Total Stops	2077	2183	1884	2029	1930	2021
Fuel Used (gal)	121.3	129.4	118.7	122.6	122.4	122.9

### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	3.3	0.1	0.4	0.1	0.4
Total Del/Veh (s)	26.6	16.6	15.0	16.5	16.5
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.1	0.2	0.1	0.1
Total Del/Veh (s)	1.7	3.2	20.4	2.2
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.0	0.0	3.7	0.7	0.1
Total Del/Veh (s)	4.0	3.8	46.7	83.0	6.7
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.2	0.1	0.1	0.2
Total Del/Veh (s)	8.1	3.1	28.6	36.2	7.5
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.0	1.2	0.6	0.3
Total Del/Veh (s)	12.5	10.2	11.5	14.3	12.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	0.7
Total Del/Veh (s)	36.4
Denied Entry Before	0
Denied Entry After	0

### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	88	71	71	31	375	114	555
Average Queue (ft)	16	35	26	5	129	31	198
95th Queue (ft)	54	65	58	22	289	98	420
Link Distance (ft)	616		1038		914		1784
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	1	11			4		5
Queuing Penalty (veh)	0	2			0		2

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SE	SW
Directions Served	LT	LR
Maximum Queue (ft)	44	35
Average Queue (ft)	3	3
95th Queue (ft)	39	18
Link Distance (ft)	539	929
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	NW	NE	NE	SW	SW
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	127	271	132	85	73	45
Average Queue (ft)	8	34	15	37	17	7
95th Queue (ft)	71	164	69	76	52	30
Link Distance (ft)	1028	539	631		929	
Upstream Blk Time (%)		0				
Queuing Penalty (veh)		0				
Storage Bay Dist (ft)				60		25
Storage Blk Time (%)	0		0	13	19	1
Queuing Penalty (veh)	0		0	1	1	0

#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	B14	NW	NE	SW
Directions Served	LTR	T	LTR	LTR	LTR
Maximum Queue (ft)	66	4	100	71	73
Average Queue (ft)	4	0	4	31	23
95th Queue (ft)	34	3	48	64	59
Link Distance (ft)	3208	1521	1028	948	702
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	91	230	222	74	127	139	106	87	136	102
Average Queue (ft)	22	120	106	21	48	59	43	31	65	22
95th Queue (ft)	57	194	190	51	94	113	84	63	113	58
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)		2					0	0	1	0
Queuing Penalty (veh)		1					0	0	1	0

#### Network Summary

Network wide Queuing Penalty: 8
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### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	6.0	61.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	30.7	35.2	8.1	5.6	48.3	8.1
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	64	10	30	92	10	30
Cycles @ Minimum (%)	0	0	11	8	0	11
Cycles Maxed Out (%)	30	21	0	8	41	0
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	5.0	22.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	11.5	21.0	11.5	5.2	21.2	11.5
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	71	7	12	67	4	12
Cycles @ Minimum (%)	10	0	2	33	0	2
Cycles Maxed Out (%)	29	54	12	33	67	12
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2957	2984	2926	2864	2963	2939
Vehs Exited	2886	2923	2877	2833	2927	2890
Starting Vehs	108	109	105	125	140	114
Ending Vehs	179	170	154	156	176	164
Denied Entry Before	0	0	0	0	1	0
Denied Entry After	1	1	0	1	5	1
Travel Distance (mi)	4302	4409	4330	4232	4424	4339
Travel Time (hr)	174.2	176.9	168.8	163.3	174.3	171.5
Total Delay (hr)	50.3	49.3	43.6	41.1	45.7	46.0
Total Stops	3229	2916	2669	2544	2792	2828
Fuel Used (gal)	139.0	142.5	137.0	134.8	141.0	138.9

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2957	2984	2926	2864	2963	2939
Vehs Exited	2886	2923	2877	2833	2927	2890
Starting Vehs	108	109	105	125	140	114
Ending Vehs	179	170	154	156	176	164
Denied Entry Before	0	0	0	0	1	0
Denied Entry After	1	1	0	1	5	1
Travel Distance (mi)	4302	4409	4330	4232	4424	4339
Travel Time (hr)	174.2	176.9	168.8	163.3	174.3	171.5
Total Delay (hr)	50.3	49.3	43.6	41.1	45.7	46.0
Total Stops	3229	2916	2669	2544	2792	2828
Fuel Used (gal)	139.0	142.5	137.0	134.8	141.0	138.9



### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	1.6	0.1	4.7	0.1	2.8
Total Del/Veh (s)	27.4	32.8	34.4	14.2	27.1
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	1	0	1

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.0
Total Del/Veh (s)	1.9	8.5	60.1	7.0
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.0	0.0	3.1	0.4	0.0
Total Del/Veh (s)	2.5	5.0	36.3	311.7	7.9
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.1	0.1	0.1	0.1
Total Del/Veh (s)	7.8	7.8	56.2	74.5	9.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.3	0.0	0.6	0.9	0.2
Total Del/Veh (s)	11.6	13.6	16.0	13.5	13.3
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	2.3
Total Del/Veh (s)	52.0
Denied Entry Before	0
Denied Entry After	1

### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	68	40	133	162	888	178	440
Average Queue (ft)	27	15	55	29	478	36	143
95th Queue (ft)	59	39	106	102	963	116	317
Link Distance (ft)	616		1038		914		1784
Upstream Blk Time (%)					6		
Queuing Penalty (veh)					0		
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	7	0			18		3
Queuing Penalty (veh)	2	0			5		1

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SE	NW	SW
Directions Served	LT	TR	LR
Maximum Queue (ft)	262	70	99
Average Queue (ft)	18	4	37
95th Queue (ft)	131	64	81
Link Distance (ft)	540	1784	929
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	NW	NE	NE	SW	SW
Directions Served	LT	LTR	LT	R	LT	R
Maximum Queue (ft)	15	294	51	49	128	25
Average Queue (ft)	0	32	9	13	43	3
95th Queue (ft)	10	178	34	37	138	20
Link Distance (ft)	1028	540	538		929	
Upstream Blk Time (%)		0				
Queuing Penalty (veh)		2				
Storage Bay Dist (ft)				60		25
Storage Blk Time (%)			1	0	41	1
Queuing Penalty (veh)			0	0	1	0

#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	NW	NE	SW
Directions Served	LTR	LTR	LTR	LTR
Maximum Queue (ft)	436	378	104	47
Average Queue (ft)	49	38	30	14
95th Queue (ft)	242	193	81	42
Link Distance (ft)	3208	1028	948	702
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	72	147	128	76	204	210	156	78	111	81
Average Queue (ft)	31	74	57	37	107	121	81	21	49	32
95th Queue (ft)	63	126	108	68	180	193	127	58	87	64
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)		0			0		2	0	0	0
Queuing Penalty (veh)		0			0		1	0	0	0

#### Network Summary

Network wide Queuing Penalty: 12
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### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	5.0	62.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	6.1	57.9	9.9	10.5	63.1	9.9
g/C Ratio	-0.01	NA	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	48	0	11	55	11	11
Cycles @ Minimum (%)	50	0	5	41	0	5
Cycles Maxed Out (%)	52	74	5	45	59	5
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	6.0	21.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	5.9	21.3	12.6	6.2	20.1	12.6
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	53	4	5	45	4	5
Cycles @ Minimum (%)	38	0	1	0	0	1
Cycles Maxed Out (%)	47	63	18	32	54	18
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

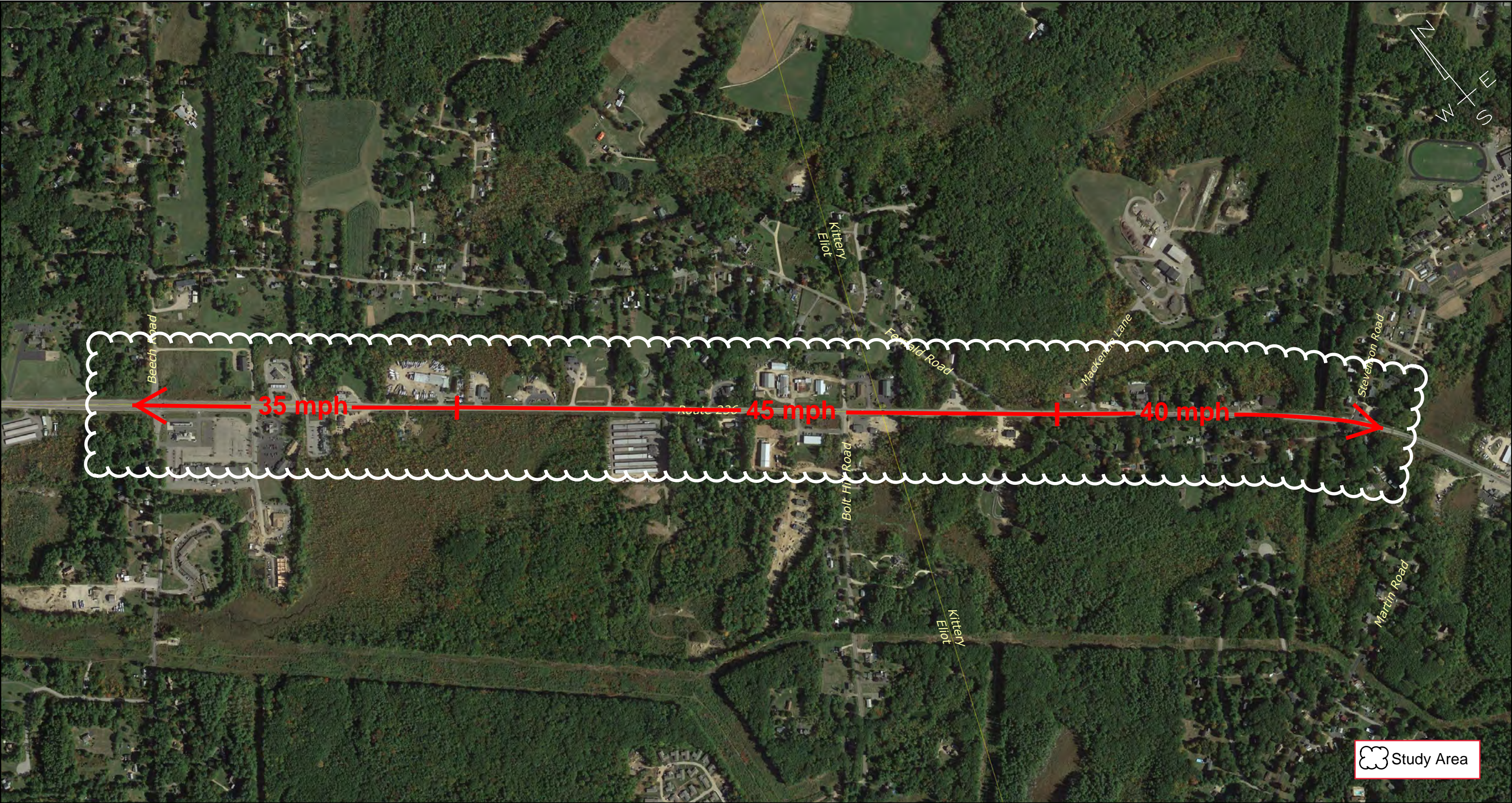
Number of Complete Cycles : 0



# Appendix C

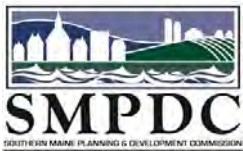
## Speed Study Figures





ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE

Design: EAL  
Draft: Date: SEPT 2018  
Checked: RED File Name: 3453 - Speed Limits



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ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE

Design: EAL    Scale: NONE  
Draft:    Date: NOV 2018  
Checked: RED    File Name: 3453 - 85th Percentile Speed Study



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# Appendix D

MaineDOT Crash History  
HSM Analysis



## Crash Summary Report

### Report Selections and Input Parameters

#### REPORT SELECTIONS

☒ Crash Summary I      ☐ Section Detail      ☒ Crash Summary II      ☐ 1320 Public      ☐ 1320 Private      ☒ 1320 Summary

#### REPORT DESCRIPTION

Kittery/Eliot

Rte. 236/Rogers Rd./Harold L. Dow Hwy from Stevenson Rd. to Beech Rd.

#### REPORT PARAMETERS

Year 2015, Start Month 1 through Year 2017 End Month: 12

Route: <b>0236X</b>	Start Node: <b>56675</b> End Node: <b>56679</b>	Start Offset: <b>0</b> End Offset: <b>0</b>	<input type="checkbox"/> Exclude First Node <input type="checkbox"/> Exclude Last Node
Route: <b>0236S</b>	Start Node: <b>56679</b> End Node: <b>63400</b>	Start Offset: <b>0</b> End Offset: <b>0</b>	<input checked="" type="checkbox"/> Exclude First Node <input checked="" type="checkbox"/> Exclude Last Node
Route: <b>0236S</b>	Start Node: <b>63400</b> End Node: <b>63399</b>	Start Offset: <b>0</b> End Offset: <b>0</b>	<input checked="" type="checkbox"/> Exclude First Node <input checked="" type="checkbox"/> Exclude Last Node

## Maine Department Of Transportation - Traffic Engineering, Crash Records Section

## Crash Summary I

Nodes																
Node	Route - MP	Node Description		U/R	Total Crashes	K	Injury A	Crashes B	Crashes C	PD	Percent Injury	Annual M Ent-Veh	Crash Rate	Critical Rate	CRF	
56675	0236X - 2.03	Int of MARTIN	ROGERS RD STEVENSON RD	9	7	0	0	0	1	6	14.3	7.026	0.33	1.20	0.00	
													Statewide Crash Rate:	0.74		
58074	0236X - 2.38	Int of MACKENZIE LN	ROGERS RD	2	1	0	0	0	1	0	100.0	6.558	0.05	0.37	0.00	
													Statewide Crash Rate:	0.16		
56676	0236X - 2.47	Int of FERNALD RD	ROGERS RD	1	0	0	0	0	0	0	0.0	6.311	0.00	0.30	0.00	
													Statewide Crash Rate:	0.12		
54447	0236X - 2.51	Int of FERNALD RD	ROGERS RD	1	3	0	0	1	1	1	66.7	6.380	0.16	0.30	0.00	
													Statewide Crash Rate:	0.12		
56677	0236X - 2.67	TL Eliot	Kittery	1	1	0	0	0	0	1	0.0	3.218	0.10	0.36	0.00	
													Statewide Crash Rate:	0.12		
56678	0236X - 2.72	Int of BOLT HILL RD	HAROLD L DOW HWY	1	2	0	0	0	2	0	100.0	6.390	0.10	0.30	0.00	
													Statewide Crash Rate:	0.12		
63399	0236X - 3.44	Non Int	HAROLD L DOW HWY	1	1	0	0	0	0	1	0.0	6.179	0.05	0.30	0.00	
													Statewide Crash Rate:	0.12		
63400	0236X - 3.51	Non Int	HAROLD L DOW HWY	1	0	0	0	0	0	0	0.0	5.970	0.00	0.30	0.00	
													Statewide Crash Rate:	0.12		
56679	0236X - 3.64	Int of BEECH RD	HAROLD L DOW HWY	9	9	0	0	0	1	8	11.1	6.841	0.44	1.20	0.00	
													Statewide Crash Rate:	0.74		
Study Years:	3.00	NODE TOTALS:			24	0	0	1	6	17	29.2	54.873	0.15	0.38	0.38	

## Crash Summary Report

### Report Selections and Input Parameters

#### REPORT SELECTIONS

☒ Crash Summary I      ☐ Section Detail      ☒ Crash Summary II      ☐ 1320 Public      ☐ 1320 Private      ☒ 1320 Summary

#### REPORT DESCRIPTION

Kittery/Eliot

Rte. 236/Rogers Rd./Harold L. Dow Hwy from Stevenson Rd. to Beech Rd.

#### REPORT PARAMETERS

Year 2015, Start Month 1 through Year 2017 End Month: 12

Route: 0236X	Start Node: 56675 End Node: 56679	Start Offset: 0 End Offset: 0	<input type="checkbox"/> Exclude First Node <input type="checkbox"/> Exclude Last Node
Route: 0236S	Start Node: 56679 End Node: 63400	Start Offset: 0 End Offset: 0	<input checked="" type="checkbox"/> Exclude First Node <input checked="" type="checkbox"/> Exclude Last Node
Route: 0236S	Start Node: 63400 End Node: 63399	Start Offset: 0 End Offset: 0	<input checked="" type="checkbox"/> Exclude First Node <input checked="" type="checkbox"/> Exclude Last Node

## Crash Summary I

Nodes																
Node	Route - MP	Node Description		U/R	Total Crashes	K	Injury A	Crashes B	Crashes C	PD	Percent Injury	Annual M Ent-Veh	Crash Rate	Critical Rate	CRF	
56675	0236X - 2.03	Int of MARTIN ROGERS RD	STEVENSON RD	9	7	0	0	0	1	6	14.3	7.026	0.33	1.20	0.00	
													Statewide Crash Rate: 0.74			
58074	0236X - 2.38	Int of MACKENZIE LN	ROGERS RD	2	1	0	0	0	1	0	100.0	6.558	0.05	0.37	0.00	
													Statewide Crash Rate: 0.16			
56676	0236X - 2.47	Int of FERNALD RD	ROGERS RD	1	0	0	0	0	0	0	0.0	6.311	0.00	0.30	0.00	
													Statewide Crash Rate: 0.12			
54447	0236X - 2.51	Int of FERNALD RD	ROGERS RD	1	3	0	0	1	1	1	66.7	6.380	0.16	0.30	0.00	
													Statewide Crash Rate: 0.12			
56677	0236X - 2.67	TL Eliot	Kittery	1	1	0	0	0	0	1	0.0	3.218	0.10	0.36	0.00	
													Statewide Crash Rate: 0.12			
56678	0236X - 2.72	Int of BOLT HILL RD	HAROLD L DOW HWY	1	2	0	0	0	2	0	100.0	6.390	0.10	0.30	0.00	
													Statewide Crash Rate: 0.12			
63399	0236X - 3.44	Non Int	HAROLD L DOW HWY	1	1	0	0	0	0	1	0.0	6.179	0.05	0.30	0.00	
													Statewide Crash Rate: 0.12			
63400	0236X - 3.51	Non Int	HAROLD L DOW HWY	1	0	0	0	0	0	0	0.0	5.970	0.00	0.30	0.00	
													Statewide Crash Rate: 0.12			
56679	0236X - 3.64	Int of BEECH RD	HAROLD L DOW HWY	9	9	0	0	0	1	8	11.1	6.841	0.44	1.20	0.00	
													Statewide Crash Rate: 0.74			
Study Years:	3.00	NODE TOTALS:			24	0	0	1	6	17	29.2	54.873	0.15	0.38	0.38	

## Crash Summary I

Sections																	
Start Node	End Node	Element	Offset Begin - End	Route - MP	Section Length	U/R	Total Crashes	K	Injury A	Crashes B	Crashes C	PD	Percent Injury	Annual HMVM	Crash Rate	Critical Rate	CRF
56675	58074	3114298	0 - 0.33	0236X - 2.03	0.33	2	5	0	0	1	1	3	40.0	0.02163	77.05	360.57	0.00
Int of MARTIN ROGERS RD STEVENSON RD				ST RTE 236											Statewide Crash Rate: 218.72		
56675	58074	3114298	0.33 - 0.35	0236X - 2.36	0.02	2	0	0	0	0	0	0	0.0	0.00131	0.00	699.07	0.00
Int of MARTIN ROGERS RD STEVENSON RD				ST RTE 236											Statewide Crash Rate: 218.72		
56676	58074	3118372	0 - 0.09	0236X - 2.38	0.09	1	1	0	0	0	0	1	0.0	0.00582	57.27	348.90	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236											Statewide Crash Rate: 143.78		
54447	56676	3121322	0 - 0.04	0236X - 2.47	0.04	1	2	0	0	0	0	2	0.0	0.00244	273.56	436.64	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236											Statewide Crash Rate: 143.78		
54447	56677	3114951	0 - 0.16	0236X - 2.51	0.16	1	4	0	0	0	2	2	50.0	0.01030	129.46	303.32	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236											Statewide Crash Rate: 143.78		
56677	56678	3114299	0 - 0.05	0236X - 2.67	0.05	1	2	0	0	0	1	1	50.0	0.00322	207.14	406.35	0.00
TL Eliot Kittery				ST RTE 236											Statewide Crash Rate: 143.78		
56678	63399	3129731	0 - 0.72	0236X - 2.72	0.72	1	11	0	1	0	3	7	36.4	0.04309	85.09	225.82	0.00
Int of BOLT HILL RD HAROLD L DOW HWY				ST RTE 236											Statewide Crash Rate: 143.78		
63399	63400	3123588	0 - 0.07	0236X - 3.44	0.07	1	0	0	0	0	0	0	0.0	0.00196	0.00	461.60	0.00
Non Int HAROLD L DOW HWY				ST RTE 236											Statewide Crash Rate: 143.78		
63400	56679	3139530	0 - 0.13	0236X - 3.51	0.13	1	1	0	0	0	0	1	0.0	0.00362	92.12	394.18	0.00
Non Int HAROLD L DOW HWY				ST RTE 236											Statewide Crash Rate: 143.78		
56679	63400	3139531	0 - 0.13	0236S - 0.18	0.13	1	1	0	0	0	1	0	100.0	0.00412	80.88	381.13	0.00
Int of BEECH RD HAROLD L DOW HWY				ST RTE 236S											Statewide Crash Rate: 143.78		
63400	63399	2666856	0 - 0.07	0236S - 0.31	0.07	1	3	0	0	0	0	3	0.0	0.00223	448.38	446.67	1.00
Non Int HAROLD L DOW HWY				ST RTE 236S											Statewide Crash Rate: 143.78		
Study Years: 3.00				Section Totals:	1.81		30	0	1	1	8	20	33.3	0.09974	100.26	219.10	0.46
				Grand Totals:	1.81		54	0	1	2	14	37	31.5	0.09974	180.47	279.01	0.65

## Crash Summary I

Sections																	
Start Node	End Node	Element	Offset Begin - End	Route - MP	Section Length	U/R	Total Crashes	K	Injury A	Crashes B	C	PD	Percent Injury	Annual HMVM	Crash Rate	Critical Rate	CRF
56675	58074	3114298	0 - 0.33	0236X - 2.03	0.33	2	5	0	0	1	1	3	40.0	0.02163	77.05	360.57	0.00
Int of MARTIN ROGERS RD STEVENSON RD				ST RTE 236	Statewide Crash Rate: 218.72												
56675	58074	3114298	0.33 - 0.35	0236X - 2.36	0.02	2	0	0	0	0	0	0	0.0	0.00131	0.00	699.07	0.00
Int of MARTIN ROGERS RD STEVENSON RD				ST RTE 236	Statewide Crash Rate: 218.72												
56676	58074	3118372	0 - 0.09	0236X - 2.38	0.09	1	1	0	0	0	0	1	0.0	0.00582	57.27	348.90	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236	Statewide Crash Rate: 143.78												
54447	56676	3121322	0 - 0.04	0236X - 2.47	0.04	1	2	0	0	0	0	2	0.0	0.00244	273.56	436.64	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236	Statewide Crash Rate: 143.78												
54447	56677	3114951	0 - 0.16	0236X - 2.51	0.16	1	4	0	0	0	2	2	50.0	0.01030	129.46	303.32	0.00
Int of FERNALD RD ROGERS RD				ST RTE 236	Statewide Crash Rate: 143.78												
56677	56678	3114299	0 - 0.05	0236X - 2.67	0.05	1	2	0	0	0	1	1	50.0	0.00322	207.14	406.35	0.00
TL Eliot Kittery				ST RTE 236	Statewide Crash Rate: 143.78												
56678	63399	3129731	0 - 0.72	0236X - 2.72	0.72	1	11	0	1	0	3	7	36.4	0.04309	85.09	225.82	0.00
Int of BOLT HILL RD HAROLD L DOW HWY				ST RTE 236	Statewide Crash Rate: 143.78												
63399	63400	3123588	0 - 0.07	0236X - 3.44	0.07	1	0	0	0	0	0	0	0.0	0.00196	0.00	461.60	0.00
Non Int HAROLD L DOW HWY				ST RTE 236	Statewide Crash Rate: 143.78												
63400	56679	3139530	0 - 0.13	0236X - 3.51	0.13	1	1	0	0	0	0	1	0.0	0.00362	92.12	394.18	0.00
Non Int HAROLD L DOW HWY				ST RTE 236	Statewide Crash Rate: 143.78												
56679	63400	3139531	0 - 0.13	0236S - 0.18	0.13	1	1	0	0	0	1	0	100.0	0.00412	80.88	381.13	0.00
Int of BEECH RD HAROLD L DOW HWY				ST RTE 236S	Statewide Crash Rate: 143.78												
63400	63399	2666856	0 - 0.07	0236S - 0.31	0.07	1	3	0	0	0	0	3	0.0	0.00223	448.38	446.67	1.00
Non Int HAROLD L DOW HWY				ST RTE 236S	Statewide Crash Rate: 143.78												
Study Years: 3.00				Section Totals:	1.81		30	0	1	1	8	20	33.3	0.09974	100.26	219.10	0.46
				Grand Totals:	1.81		54	0	1	2	14	37	31.5	0.09974	180.47	279.01	0.65

Worksheet 3A -- Predicted Crashes by Severity and Site Type and Observed Crashes Using the Site-Specific EB Method for Urban and Suburban Arterials							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Collision type / Site type	Predicted average crash frequency (crashes/year)			Observed crashes, $N_{\text{observed}}$ (crashes/year)	Overdispersion Parameter, k	Weighted adjustment, w	Expected average crash frequency,
	$N_{\text{predicted}}$ (TOTAL)	$N_{\text{predicted}}$ (FI)	$N_{\text{predicted}}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Multiple-vehicle nondriveway							
Stevenson to MacKenzie	3.004	0.872	2.132	0.667	0.840	0.284	1.330
MacKenzie to Fernald S	0.842	0.245	0.598	0.000	0.840	0.586	0.493
Fernald S to Aroma Joes	0.339	0.098	0.240	0.333	0.840	0.779	0.337
Aroma Joes to Bolt Hill	1.867	0.542	1.325	0.333	0.840	0.389	0.930
Bolt Hill to 4-Lane	4.858	1.413	3.445	1.000	0.840	0.197	1.759
4-Lane to Median	0.494	0.152	0.342	0.000	1.010	0.667	0.330
Median to Levesque	0.499	0.142	0.357	0.000	1.320	0.603	0.301
Levesque to Beech	1.054	0.300	0.754	0.667	1.320	0.418	0.829
Single-vehicle							
Stevenson to MacKenzie	0.886	0.166	0.720	1.000	0.810	0.582	0.934
MacKenzie to Fernald S	0.252	0.047	0.205	0.333	0.810	0.830	0.266
Fernald S to Aroma Joes	0.108	0.021	0.088	0.333	0.810	0.919	0.126
Aroma Joes to Bolt Hill	0.562	0.106	0.456	1.000	0.810	0.687	0.699
Bolt Hill to 4-Lane	1.586	0.306	1.280	1.000	0.810	0.438	1.256
4-Lane to Median	0.121	0.030	0.091	0.000	0.910	0.901	0.109
Median to Levesque	0.130	0.021	0.108	0.000	0.860	0.900	0.117
Levesque to Beech	0.275	0.045	0.230	0.000	0.860	0.809	0.223
Multiple-vehicle driveway-related							
Stevenson to MacKenzie	0.984	0.272	0.712	0.000	0.810	0.556	0.548
MacKenzie to Fernald S	0.000	0.000	0.000	0.000	0.810	1.000	0.000
Fernald S to Aroma Joes	0.000	0.000	0.000	0.000	0.810	1.000	0.000
Aroma Joes to Bolt Hill	0.782	0.216	0.566	0.333	0.810	0.612	0.608
Bolt Hill to 4-Lane	1.872	0.517	1.355	0.333	0.810	0.397	0.945
4-Lane to Median	1.229	0.386	0.843	1.333	0.810	0.501	1.281
Median to Levesque	0.037	0.009	0.027	1.333	1.390	0.952	0.100
Levesque to Beech	0.125	0.032	0.093	0.000	1.390	0.852	0.107
INTERSECTIONS							
Multiple-vehicle							
Stevenson	3.312	1.099	2.213	2.333	0.390	0.436	2.760
MacKenzie	0.323	0.132	0.192	0.333	0.800	0.794	0.325
Fernald S	0.440	0.209	0.231	0.333	0.800	0.740	0.412
Aroma Joes-Fernald	1.086	0.398	0.688	0.667	0.400	0.697	0.959
Bolt Hill	1.677	0.637	1.040	0.667	0.400	0.599	1.271
Beech	3.721	1.222	2.499	2.333	0.390	0.408	2.899
Single-vehicle							
Stevenson	0.213	0.055	0.157	0.000	0.360	0.929	0.198
MacKenzie	0.039	0.012	0.027	0.000	1.140	0.957	0.037
Fernald S	0.047	0.015	0.032	0.000	1.140	0.949	0.045
Aroma Joes-Fernald	0.155	0.063	0.093	0.333	0.650	0.908	0.172
Bolt Hill	0.207	0.077	0.130	0.000	0.650	0.881	0.183
Beech	0.246	0.066	0.181	0.667	0.360	0.919	0.281
COMBINED (sum of column)	33.374	9.926	23.449	17.664	--	--	23.169



# Appendix E

Bolt Hill Signal Warrant Analysis



## Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

### Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

### Condition B—Interruption of Continuous Traffic

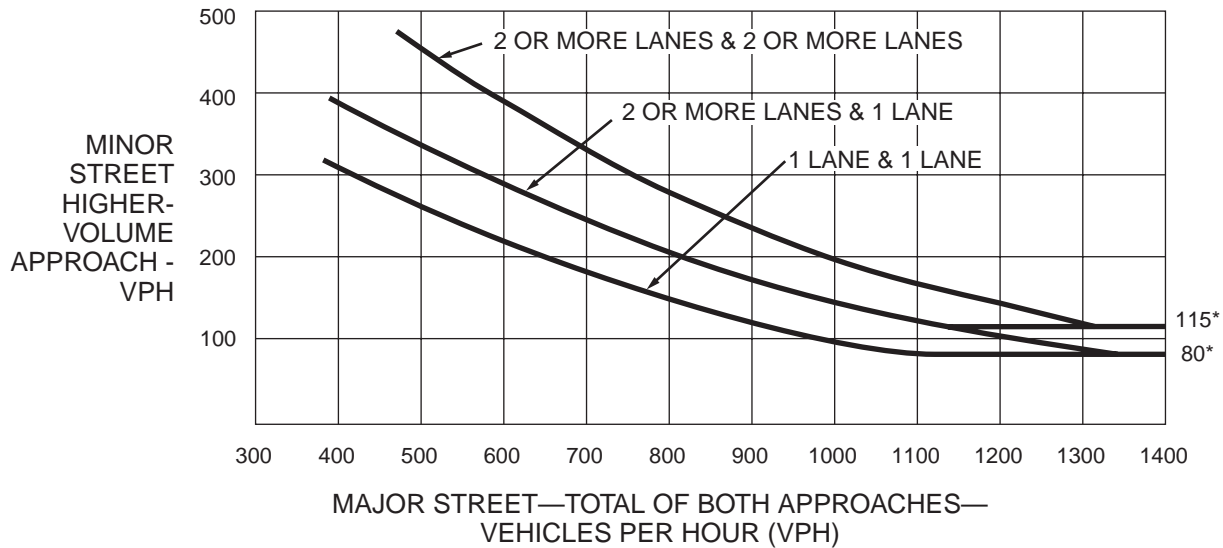
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>	100% <sup>a</sup>	80% <sup>b</sup>	70% <sup>c</sup>	56% <sup>d</sup>
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

<sup>a</sup> Basic minimum hourly volume

<sup>b</sup> Used for combination of Conditions A and B after adequate trial of other remedial measures

<sup>c</sup> May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

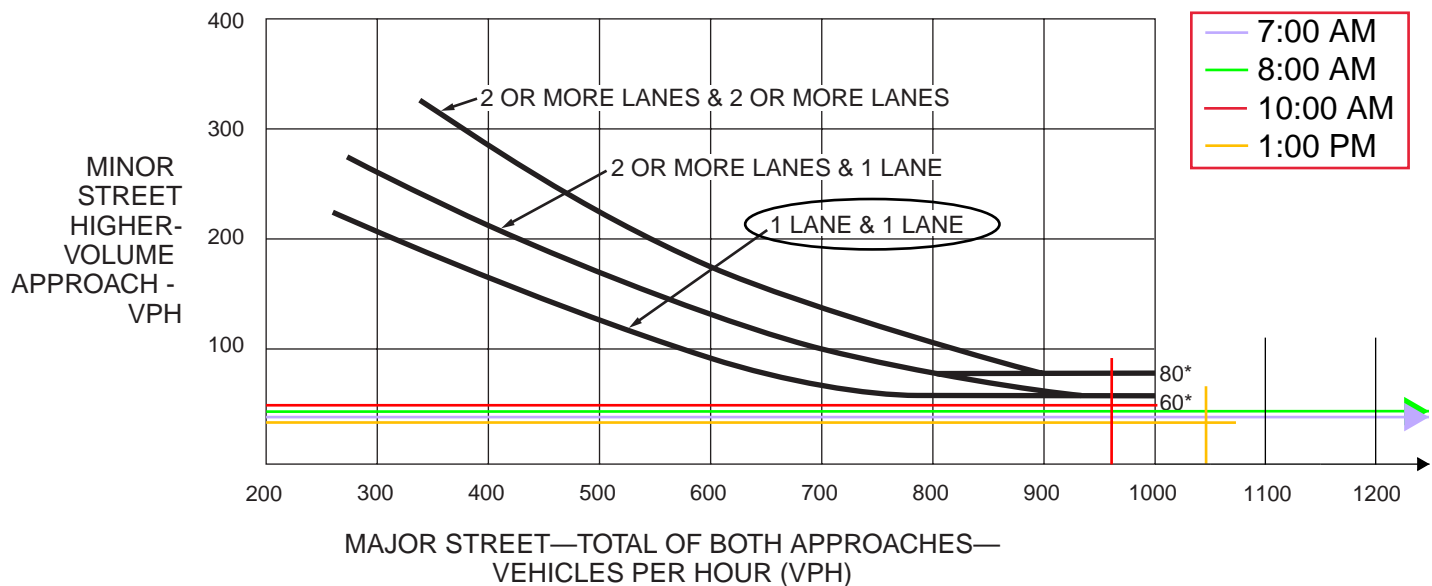
<sup>d</sup> May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

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

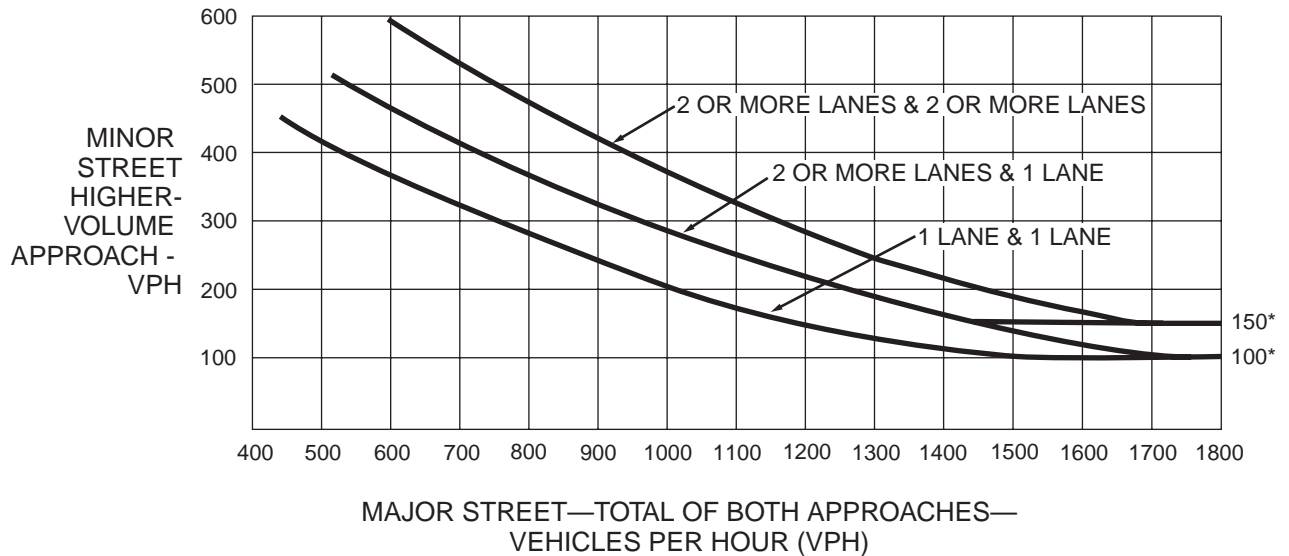
\*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

**Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)**

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



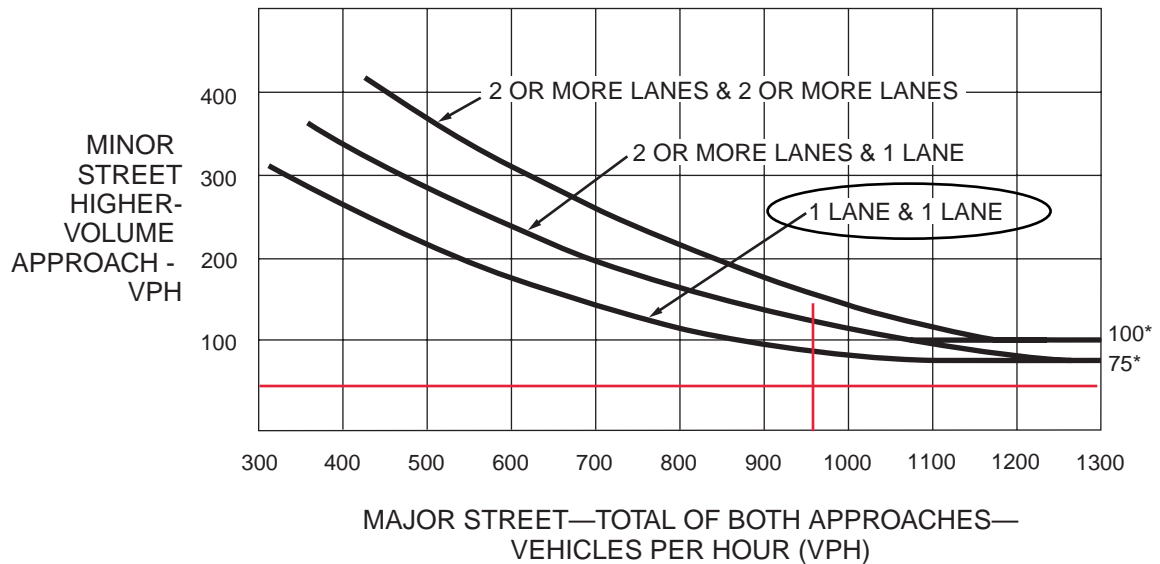
\*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

**Figure 4C-3. Warrant 3, Peak Hour**

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

**Figure 4C-4. Warrant 3, Peak Hour (70% Factor)**

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



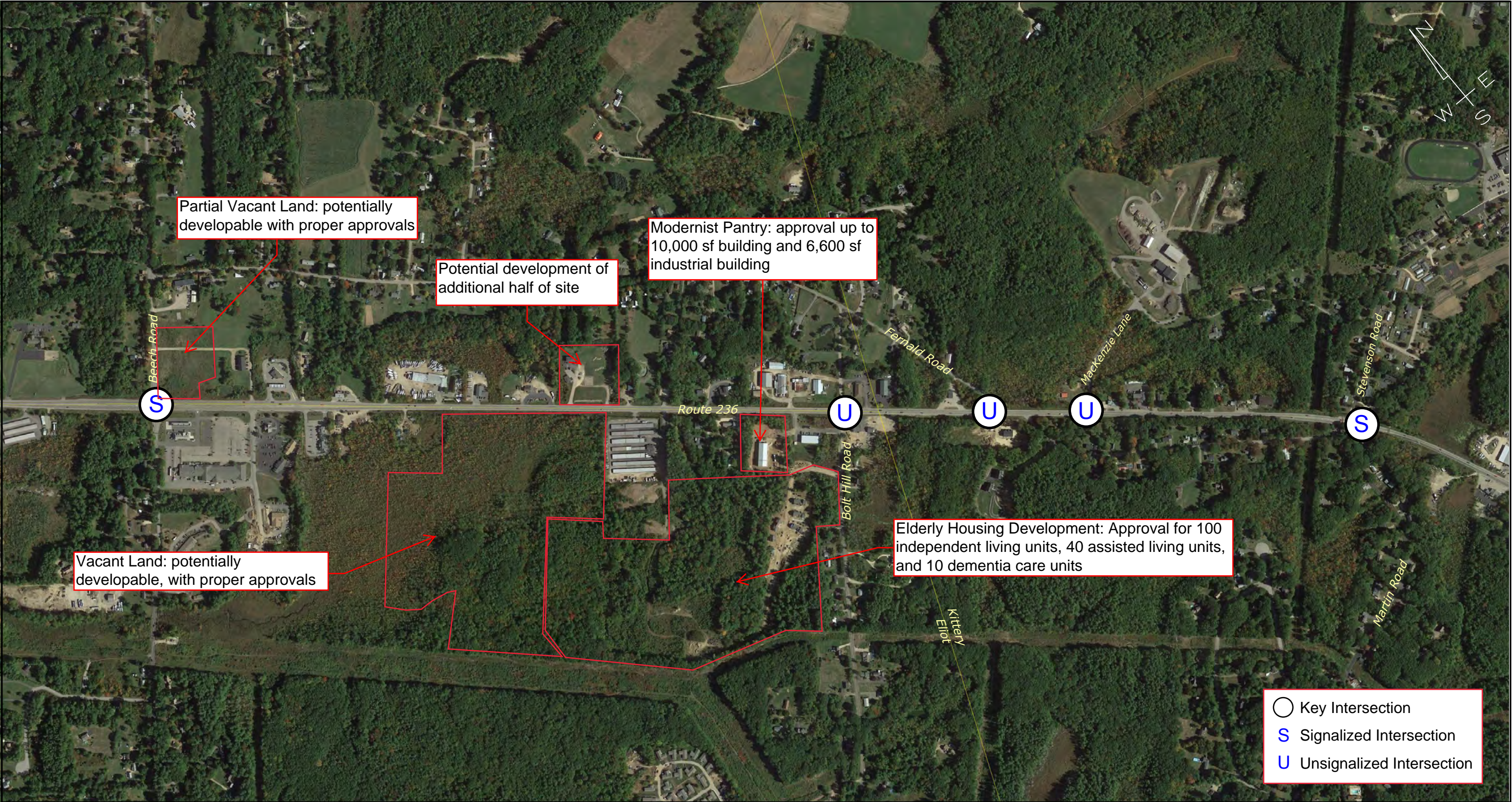
\*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.



# Appendix F

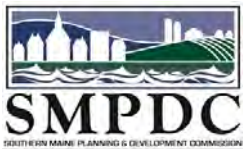
Potential Development Figure





ROUTE 236 TRAFFIC AND SAFETY STUDY  
KITTERY & ELIOT, MAINE

Design: EAL  
Draft: Date: SEPT 2018  
Checked: RED File Name: 3453 - Study Area



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# Appendix G

Meeting Notes

**KACTS – KICK OFF MEETING  
ROUTE 236 CORRIDOR STUDY**

**Project:** Route 236 Corridor Study  
**Date/Location of Meeting:** September 10, 2018; Kittery Town Hall  
**Prepared By:** Emily Leighton / Randy Dunton, GP  
**Attendees:** See attached Sign-In Sheet  
**Distribution:** All Attendees  
**Date of Dist.:** September 13, 2018

Please contact GP within one week of receiving if you would like to add, change, or revise the below minutes.

---

**Purpose of Meeting:**

- Kick off the Route 236 Corridor Study
- Review Purpose and Need Statement
- Receive comments and input on corridor issues and concerns
- Discuss Next Steps

**Summary of Notes:**

The following are items discussed at the meeting:

- Although multimodal accommodations on the corridor would be beneficial, vehicular safety improvements should be the primary goal. There are insufficient gaps in Route 236 through traffic for turning vehicles, which creates unsafe conditions.
- Route 236 has heavy commuter traffic, with significantly more southbound traffic in the morning and more northbound traffic in the evening. The traffic pattern is heavily influenced by Portsmouth Naval Shipyard.
- Fernald Road is a commonly used cut-through road.
- Route 236 primarily has commercial property adjacent to the corridor and residential property further back, behind the commercial. There appear to be wetlands on a portion of the undeveloped property along Route 236 that may limit some development.
- KACTS will complete turning movement counts at the intersections of Beech Road with Route 236 and MacKenzie Lane (Transfer Station) with Route 236 the week of September 10 or September 17.



- When crashes occur on Spaulding Turnpike or I-95, traffic is often rerouted to Route 236 by GPS, which can add significant traffic to the corridor. Incident management will be an important aspect of the project.
- The municipalities have been receiving complaints about safety within the study area for several years.
- There is a large development proposed to the south of the study area. The Town of Kittery is anticipating push-back from the public on the proposed development due to the current perceived safety issues on Route 236.
- Perception will be critical for the success of the study. If there is a perceived issue, even if it is not supported by the data, it should be addressed to build public support of the report.
- Due to the high volumes and perceived safety issues on Route 236, the municipalities have noticed more traffic on Routes 101 and 103. As improvements are implemented on Route 236, traffic may shift back to Route 236 and conditions on Routes 101 and 103 may improve.
- The study area is where the complaints have been made. Although Route 236 to the south of the study area has significant commercial development and is experiencing growth, complaints have not been received in that area.
- Some neighborhood streets, such as Wilson Road, have also experienced diverted traffic from Route 236 and as a result have deteriorated pavement condition.
- It was identified that traffic control (such as intersection signalization) may be required to improve the safety of turning movements, however there was concern that this would slow down the corridor and continue to divert traffic from Route 236. A correctly placed traffic signal could help with traffic platooning and the creation of gaps, so additional traffic may not divert. One potential solution for signalized intersections is Adaptive Traffic Control, which changes in real time based on traffic volumes. This would be especially effective when incidences occur in the area and traffic is rerouted to Route 236.
- It is not known when the Beech Road traffic signal was installed or most recently adjusted.
- It would be good to work with MaineDOT to establish short term improvements that could be implemented immediately, even before the study is officially completed, to show the public that the municipalities are taking action.
- It was noted that although the crash data does not indicate any high crash locations, there are a lot of near misses, which is just as concerning to the public.
- It was also noted that Route 236 is a popular route to the Portsmouth Naval Shipyard.
- There are several retirement communities within and around the study area that contributes elderly drivers to the network.
- The sharp angles of intersection for both sides of Fernald Road are difficult.
- Commercial driveways in Eliot are often very wide. Commercial accesses are often closely spaced as well. A significant concern is the Aroma Joe's access. Access





management is a potential solution that could be implemented and may lead to additional signalization.

- The Kittery Transfer Station traffic experiences significant delay exiting the site during peak hours on Route 236. Operating hours are Tuesday-Saturday, 9AM – 5PM.
- Development on Bolt Hill is approximately 25% completed. Additional development is expected. The municipalities will provide GP with any potential development that may impact the study area traffic volumes.
- Upon review of the speed limit figure provided as supporting documentation, there was question as to where the speed limits are posted. These will be verified in the field. Additionally, a speed study is included in the scope of the project. The municipalities agreed that the study would be well suited in the 45 mph segment. Around Bolt Hill may be a good location. The study will be completed using a radar gun during off peak times and will measure 100 vehicles in each direction to determine the 85<sup>th</sup> percentile speed.
- A gap analysis is not included in the scope of the project.
- Both police departments have received numerous complaints about the speeds within the study area. An Eliot police officer is often sitting near the Cumberland Farms during off peak hours. It has been observed that near the end of the peak hours drivers seem to go fastest.
- Tom Reinauer will provide the two previous studies mentioned in the RFP.
- There is concern that the toll relocation project on I-95 will add more traffic to Route 236 throughout construction.
- There seems to be a significant amount of truck traffic on Route 236, specifically dump trucks and garbage trucks. The Kittery Transfer Station trucks use Route 236, which contributes to the truck traffic.
- Sebago Technics is actively collecting data at the intersection of Route 236 with Stevenson Road through the Gridsmart system. Signal timing could be provided by them. Electric Light manages both signalized intersections in the study area.
- The study will identify short, mid, and long term recommendations. Short term could include striping and signing. Mid term solutions would require more planning and financial support. Long term solutions may include roadway widening or intersection reconstruction such as a roundabout. MaineDOT is generally supportive of roundabouts as a potential alternative.
- Funding for projects is committed until 2022; however, other funding sources may be available.
- The municipalities do not want a speed zone review from MaineDOT at this time.
- Everyone in attendance agreed that ideally the final report will create change on the corridor and improvements will be implemented.



**Action Items:**

- Turning movement counts will be completed by KACTS at the intersections of Route 236 with Beech Road and Route 236 with MacKenzie Lane
- Municipalities will provide GP with potential development impacting the study area
- KACTS will provide the two previous studies mentioned in the RFP
- KACTS and the municipalities will provide property lines to be shown on aerials and concepts plans.

**Next Steps**

- GP plans to submit the existing conditions technical memo in 4-6 weeks
- GP will revise the project schedule in the proposal to reflect the updated timeline and distribute to the attendees.

**KACTS – ADVISORY COMMITTEE MEETING  
ROUTE 236 CORRIDOR STUDY**

**Project:** Route 236 Corridor Study  
**Date/Location of Meeting:** December 19, 2018; Kittery Town Hall  
**Prepared By:** Emily Leighton / Randy Dunton, GP  
**Attendees:** Adam Causey (AC) – Town of Kittery, David Rich (DR) – Town of Kittery, Chris Mann (CM) – MaineDOT, Eric Sanderson (ES) – KACTS/SMPDC, Doug Green (DG) – Town of Eliot, Dana Lee (DL) – Town of Eliot, Joel Moulton (JM) – Town of Eliot, Kendra Amaral (KA) – Town of Kittery, Randy Dunton (RD) – Gorrill Palmer, Emily Leighton (EL) – Gorrill Palmer  
**Distribution:** All Attendees  
**Date of Dist.:** January 14, 2019

Please contact GP within one week of receiving if you would like to add, change, or revise the below minutes.

---

**Purpose of Meeting:**

- Review the Route 236 Corridor Study Existing Conditions Summary dated November 28, 2018
- Receive comments on the Existing Conditions Summary
- Discuss potential mitigation items and next steps

**Summary of Notes:**

RD began the meeting with introductions and a review of the Existing Conditions Summary dated November 28, 2018. The following summarizes the key items discussed and questions raised during the review:

- A study was completed in 2008 by MaineDOT for this segment of Route 236. Based on a comparison of the 2008 annual average traffic volumes (AADT) to the 2018 traffic volumes at the Kittery/Eliot Town Line, there was minimal fluctuation. Additionally, the traffic patterns as shown in the 2008 study are very similar to the 2018 volumes, which also reflects typical commuter peak hours.
- The AM peak hours at the study area intersections are consistent across the corridor and the PM peak hours are around 4:00 PM at either end of the corridor and earlier within the corridor.



- The results of the capacity analysis were reviewed. Overall the levels of service for the signalized intersections are acceptable during both 2018 and 2038. The unsignalized intersections experience longer delays on the unsignalized approaches during 2038 than 2018.

DG clarified that for the signalized intersections even though the 2038 volumes are higher than the 2018 volumes the levels of service are similar. RD responded that the signal timing in the model has been optimized and a recommendation in the final report will be to adjust signal timing and use day plans for specific times of day and/or seasonal variations.

- KA stated that the results are not surprising. Her concern is how to get vehicles onto or off of Route 236 to and from driveways and side streets.
- DL asked if GP had reviewed Portsmouth Naval Shipyard employee statistics. During the recession they laid off many employees and have been building back up since then, which may be why the corridor traffic volumes have not changed since 2008. They are also currently hiring. RD replied that a background growth rate was used to estimate the 2038 traffic volumes, which accounts for growth like that at the Shipyard.
- The results of the queue analysis were reviewed. There are a few locations that exceed the storage lengths, however they do not exceed the storage length by a significant amount and it lasts for a short period of time. The queue lengths increase from 2018 to 2038.
- The methodology and results of the speed study were reviewed. The speed study showed that the posted speed limits are exceeded slightly in both directions. However, the southbound is slightly slower than the northbound.
- The safety evaluation was reviewed. No high crash locations in the 2018 study. Bolt Hill Road was a high crash location in the 2008 study. The existing flashing beacon was installed after the 2008 study and may have been a factor in bringing it below the high crash location threshold.
- KA stated that the existing crash patterns appear to align with the public's complaints of issues around Aroma Joe's. Also noted that there are very few locations within the corridor that did not experience any collisions within the most recent three year period. She also stated that if nothing is done to prevent collisions the number of collisions will likely increase.
- The Highway Safety Manual (HSM) evaluation was reviewed. The results will be used as a benchmark to compare mitigation items. Based on the HSM evaluation, the observed crashes were less than the expected crashes.



- The Bolt Hill signal warrant analysis was reviewed. MaineDOT typically prefers that two of nine warrants as identified in the MUTCD are met, but none are met for the Bolt Hill intersection. Signal warrant evaluations for MacKenzie Lane and Fernald Road / Aroma Joe's were not included in the study, but based on preliminary reviews of the traffic volumes these two locations also would not meet the requirements for signalization. Since this is a State road it would require MaineDOT permission to signalize and they will not approve it unless the warrants are met.
- The potential development within the corridor was reviewed.
- DL stated that Kittery has a Shipyard study. Based on discussions with the Commander, the Shipyard is trying to stagger releases, which explains the slight double traffic peak during the PM peak hour. KA added that since the shifts are early, they are not captured in the AM peak hour volumes, however, since some counts started at 5:00 AM, the employees may be captured. RD also added that staggering shift start and end times is a common Transportation Demand Management (TDM) strategy. GP will encourage the creation of TDM plans for new large traffic generators.
- The figures that were attached to the Existing Conditions Summary were reviewed.
- KA identified that the side streets and the business driveways are the areas where safety issues are occurring, not Route 236 itself. RD stated that these are called "friction points". KA would like these locations studied and said that the existing conditions summary reinforces the reason for the study.
- RD asked the Committee if there was anything in the report that was a surprise. The following summarizes the responses:
  - The low number of crashes
  - The similarity in traffic volumes between the 2008 study and the 2018 volumes
  - That speeds were not higher
- KA stated that Route 236 has not changed significantly, but the developments and side streets have. DG added that there will be more development on Route 236 in the future.
- DL said that he has heard both that drivers speed excessively through the corridor, as well as that traffic is backed up and not moving during the peaks.
- RD then asked the Committee what items they would like to see in the study regarding mitigation. The following summarizes the responses:



- DL: Reduction in friction points and reduce the number of lanes to be crossed when exiting businesses or side streets. DR added that the left turn out of the transfer station is difficult for the trucks.
  - KA: actionable steps to improve friction points and exploring solutions other than signalization, since it is unwarranted, at the side streets.
  - CM: scenarios to address development before it occurs.
  - DL: shared business entrances. AC added that it could be made a condition of approval. DL said that they could pay attention to curb cuts and combine them where appropriate.
- RD said that there would be an overlay in 2020 or 2021, which would be a good time to implement new striping.
- RD provided the following list of potential mitigation items to be evaluated:
  - Access management, including review of MaineDOT requirements for mobility corridors
  - Modifications at Fernald
  - Signal upgrades
  - Incident management at the signalized intersections
  - Modifications at Bolt Hill, including the consideration of the four options presented in the 2008 study.
    - KA added that she did not want a roundabout at this location. CM responded that the majority of people are against roundabouts until they are constructed. DR requested that if a roundabout is considered that it be a single lane, not a double lane.
  - Turn lanes or a center two way left turn lane
  - Interconnection of lots (either frontage or backage connections)
  - Partial one way roads, i.e. making Fernald one way in for the end of the road so drivers must use Bolt Hill to get onto Route 236.
- DR requested that a roundabout not be utilized as mitigation. One was proposed at a different location on Route 236 and was not supported by the public. RD said that a roundabout evaluation will be considered in the report to be thorough, but may not be the recommended option.
- JM suggested that the Depot Road roundabout in Eliot be reviewed as an example. He feels that when many people think of roundabouts, they think of one in Sanford that is too small. CM said that he would provide the roundabout report to GP.
- DR asked if there were specific requirements to warrant a center turn lane on Route 236. RD said that typically the only limit is on the AADT of a corridor and that Route 236 has an adequate AADT for a center turn lane to be pursued. A two way center left turn lane not





only gets left turning vehicles out of the way of through traffic, but also allows two stage gap acceptance when exiting a driveway.

- KA suggested prohibiting left turns in certain areas and finding ways for vehicles to make a u-turn. ES suggested a jug-handle for u-turns, although identifying a location may be difficult. RD added that a roundabout can also be used for u-turns. KA is concerned about a roundabout in a 45 mph speed zone.
- DR suggested a roundabout at Beech Road. JM stated that there would not be enough space due to the level of development.
- DR asked if a center two way left turn lane could be implemented without MaineDOT approval. RD responded that it should be reviewed by MaineDOT. In addition, the Towns would also likely need to complete pavement cores on the shoulders to ensure the pavement is strong enough to support the added traffic volumes.
- RD stated that a memo will be completed in mid February summarizing potential improvements. DR said there may be a slight time crunch due to the paving schedule. RD responded that the study will hopefully be done by April so the Towns have time to plan.
- DG asked if a center two way left turn lane would require widening. RD responded that the existing pavement width is approximately 42 feet. If the shoulders can be used for travel, then no widening would be required.
- JM added that when the school zone is active, traffic appears to be stuck.
- RD said that the Depot roundabout was included in the MaineDOT 2008 study.

#### **Action Items:**

- MaineDOT will provide GP with the Depot roundabout report
- GP will evaluate the potential mitigation items, including those discussed at this meeting

#### **Next Steps**

- GP plans to submit the potential improvements technical memo in approximately six to eight weeks.

**DRAFT**  
**ADVISORY COMMITTEE MEETING**  
**ROUTE 236 CORRIDOR STUDY**

**Project:** Route 236 Corridor Study  
**Date/Location of Meeting:** April 18, 2019; Kittery Town Hall  
**Prepared By:** Emily Leighton / Randy Dunton, Gorrill Palmer  
**Attendees:** Adam Causey – Town of Kittery, David Rich – Town of Kittery, Chris Mann – MaineDOT, Eric Sanderson -KACTS/SMPDC, Doug Green – Town of Eliot, Dana Lee – Town of Eliot, Joel Moulton – Town of Eliot, Kendra Amaral – Town of Kittery, Randy Dunton – Gorrill Palmer, Emily Leighton – Gorrill Palmer  
**Distribution:** All Attendees  
**Date of Distribution:** May 24, 2019

Please contact Gorrill Palmer (GP) within one week of receiving if you would like to add, change, or revise the below minutes.

---

**Purpose of Meeting:**

- Review the Draft Transportation Improvement Plan summary and plans
- Receive comments on the proposed mitigation items
- Discuss potential changes to the proposed mitigation items

**Summary of Notes:**

Randy Dunton (RD) began the meeting with introductions, a review of the last meeting held to discuss the Existing Conditions Summary, and a brief review of the Transportation Improvement Plan (TIP) summary. Then, RD discussed each sheet of the TIP. The following summarizes the discussion on each sheet:

- Sheet I:
  - Existing equipment is old and mismatched
  - Recommends one mast arm on each corner instead of spanwire across the intersection, and adding backplates to the signal heads
  - Recommends upgrading equipment to include system that can accommodate incident management (Adaptive Traffic Control, ATC)
    - This would reduce gaps on the corridor, but only during incidents, which are rare



- Proposed equipment is similar to a project GP recently completed in Yarmouth
- Sheets 2-4:
  - Change striping in front of Dunkin' Donuts to transition to two way center left turn lane
    - Cannot be striped as a designated left turn lane for the Dunkin' Donuts due to a driveway on the opposite side of the road
  - Center left turn lane helps maintain through vehicle speeds, increases capacity, improves turning safety, and allows for two stage gap acceptance
  - A concrete median would not be an ideal treatment
  - Beach grass is preferred in the medians by the municipalities; however, it is sometimes a sight distance issue. It is meant to be traffic calming, but can be too much even when it is properly maintained
  - Raised, landscaped medians are high maintenance. If landscaped medians are used, low maintenance plantings are desired. Painted medians were suggested.
  - Long center left turn lanes are sometimes used for illegal passing. The proposed medians are intended to help prevent illegal passing.
  - If Eliot accepts Route 236 as a state aid road, then Kittery will not be required to maintain the medians
  - Medians are not required to have trees. Plantings cannot interfere with sight distance and if trees are used, they must be small enough so they are not "Deadly Fixed Objects" (DFOs).
  - Bull nose median ends accommodate left turning vehicles better than rounded median ends
  - MaineDOT often needs to replace signs in medians that are struck by vehicles. With correct initial placement they should not be struck.
  - Some proposed driveway closures and identification of potential future driveways on undeveloped lots. Proposed driveway narrowing in locations with excessively wide accesses. All driveway modifications are suggestions and can be altered from what is shown on the plans.
  - Public comment should be obtained before the public meeting
  - Center left turn lane design assumes that vehicles will start to decelerate in the travel lane before entering the turn lane. The minimum length shown before a driveway is approximately 100-150 feet. Minimum center left turn lane length is 300 feet, as required by MaineDOT
- Sheet 5A:
  - Proposed formal left turn lanes at Bolt Hill remove left turning vehicles from the through traffic. May not improve access for vehicles exiting Bolt Hill, but this is how center turn lanes are usually implemented at these types of intersections. MaineDOT may advise carrying the center left turn lane through the intersection.
  - Separate turn lanes are proposed on Bolt Hill, which will help capacity but may impact sight distance



- Sheet 5B:
  - Shows approximate two lane roundabout area, which would likely require the acquisition of property
  - Single lane roundabout was considered, but was forecast to operate very poorly
  - Roundabout could be a nice gateway at for the corridor
  - Would help with access from Bolt Hill. Need to keep it as an option to show those residents that their thoughts are being considered.
  - Roundabout was suggested at Beech Road, however, there is not enough space at that intersection
- Sheet 6A:
  - Shows the proposed one way entering segment of Fernald Road
  - It pushes more exiting traffic to Bolt Hill Road, but may help increase the operation of the Aroma Joe's access
  - The corner property has access to both Fernald Road and Route 236. The Fernald Road access is gated. If the gate is removed, this may not be effective, since exiting traffic could use the property's driveways as a cut-through
- Sheet 7:
  - One of the properties shown on this sheet has been purchased, so it is the optimal time to modify the driveway
  - Property lines may be in slightly different locations than those shown

After reviewing the planset, there was additional discussion on the proposed TIP. The overall comments are summarized as follows:

- State maintenance turns around at the town facilities when plowing the roads
- The center turn lane would push the travel lane into the shoulder. Pavement cores are required to ensure the pavement depth is adequate
- The break in grade from the travel lane to the shoulder would require an overlay and shim to implement the center left turn lane. The shim would help add depth if the shoulder is inadequate.
- From MacKenzie (Transfer Station) on, Route 236 is town maintained. The Towns would be responsible for maintenance changes.
- The properties need to be notified if their driveways are proposed to be closed
- The TIP does not show the proposed overlay
- The two way center left turn lane is anticipated to help trucks exiting the Transfer Station
- The purpose of the medians is to increase traffic calming, reduce illegal passing, and make the corridor more aesthetically pleasing
- MaineDOT would like to do research on maintenance with medians.
- Medians could be constructed after the overlay, but the work would not be as clean
- KACTS/SMPDC will contact impacted property owners



- A jughandle was considered, but there were no suitable locations

At the end of the meeting the schedule was discussed. The following summarizes the anticipated schedule:

- May 6: additional TIP comments to GP
- Week of May 20: Public meeting
- Week of June 17: Draft report submitted to Steering Committee
- July 1: Draft report comments to GP
- Week of July 15: Submit final report

### **Next Steps**

After receiving the additional comments from the Advisory Committee, GP will begin work on the draft final report. When the public meeting is held, public comment will be put into the report.

## **PUBLIC MEETING ROUTE 236 CORRIDOR STUDY**

**Project:** Route 236 Corridor Study  
**Date/Location of Meeting:** June 25, 2019; Kittery Town Hall  
**Prepared By:** Randy Dunton / Michael Cristiani, GP  
**Attendees:** See attached Sign-In Sheet

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### **Purpose of Meeting:**

- Discuss the overall project and how we got to that point
- Present current plan set to the public
- Receive comments and input on any corridor issues and concerns
- Discuss Next Steps

### **Summary of Notes:**

Randy Dunton (RD) began the meeting with introductions, a review of the previous meeting to discuss the corridor plans and potential impacts with abutters, and an overall review of the current plan set. The following summarizes the discussion on each main topic item:

- Overall Improvements – RD gave a brief description of the most significant change to the Route 236 corridor, which is the introduction of a center turn lane throughout the corridor with landscaped center medians at select locations.
  - There was a question regarding the purpose of the proposed landscaped center medians and associated vegetation within the medians. The response was that they improve esthetics, eliminates illegal passing, and reduces vehicle speeds
  - There was a concern expressed about trucks driving over the center medians (especially at the Dunkin' Donuts). Trucks park in the center of the road and visit DD.
- Bolt Hill Road Signal Analysis:
  - RD discussed the methodology for evaluating an unsignalized intersection to see if it warrants installing a traffic signal. It was identified that this intersection does not meet the necessary standards for signalization.
  - There was a question and discussion about if the age of drivers is considered in the warrants. The response was that all drivers are considered equal and age is not a determining factor.





- A question was raised if having Fernald as a one-way street would help Bolt Hill Road meet signal warrants? The response was yes, although by itself it would not help the intersection meet signal warrants, it will help the intersection get closer to meeting signal warrants.
- Fernald Road converted to a one-way away from Route 236 was also identified as a potential improvement.
  - There was a question about potential right turn lanes turning off of Route 236 onto Fernald on both sides in order to get slower moving vehicles out of the through lanes ultimately making the movement safer. (This was later evaluated and found not to be warranted due to low volumes of right turning traffic)
  - Multiple concerns were raised about turning vehicles coming out of Aroma Joes located across the street and beside Fernald Road.
- Study Area / Turning Movement Counts:
  - RD identified the strong directional distribution of traffic on Route 236, with the majority of traffic heading toward Kittery in the AM and away from Kittery in the PM
  - Seasonal and yearly adjustment factors to traffic volumes were discussed for the existing / proposed conditions
  - No comments or concerns were raised; however, there was general concurrence regarding the traffic patterns.
- Capacity / Queue Analysis:
  - The signalized intersections at each end of the corridor were discussed. The Stevenson Road intersection signal equipment is relatively new; however, a complete upgrade of the Beech Road intersection is being recommended including all new equipment and upgrade to mast arms from span wire as well as retiming / rephrasing of the intersection. The two signalized intersections show acceptable levels of service. However, it was noted that there are events within the regional area that cause significant queuing of traffic along the corridor.
  - The unsignalized intersections along Route 236 show operations with a failing levels of service for minor road approaches. It was explained that this is not uncommon for unsignalized minor street approaches to a major arterial.
  - Queueing on Route 236 occurs primarily due to left turning vehicles on Route 236 holding up through traffic. It was discussed that aggressive drivers go around left turning traffic on the shoulders and less aggressive drivers wait behind the left turning vehicle.
  - No Comments or concerns were raised, although there was general concurrence with the findings and discussion.



- Speed Study:
  - RD discussed how and where a speed study was completed to capture the 50<sup>th</sup> and 85<sup>th</sup> percentile speeds on Route 236. Generally the speeds were slightly higher than the posted speed limits but were within what would be expected.
  - A question was asked about lowering speed limit / having the same speed posted along entire corridor. RD explained how / why speed limits are set and that the proposed improvements may assist the municipalities in getting a more uniform speed limit.
- Crash History:
  - RD explained the crash history of the corridor, what a high crash location (HCL) is, and that there are currently no HCL within the study area.
  - There was a question about the accuracy of node locations. RD discussed how crashes are coded and the differences between nodes and links.
  - The point was made that there are a lot of near misses that do not get recorded.
- Final Questions / Comments / Observations:
  - Generally, the proposed center left turn lane appeared to have overall acceptance
  - There were a few that had concerns about the landscaped center medians but most were either in agreement or silent on the subject.
  - There was a question about what type of vegetation should be in the proposed medians. Response was that it would be either low growing or small trees with no branches for the first approximately four feet so that sight distances would not be blocked.
  - There was a comment about extending the center left turn lane to Stevenson in order to remove the “hour glass” effect on Route 236. This was later considered and added to the plans.
  - A comment was raised about multiple trucks getting off of the turnpike to avoid tolls and using Route 236.



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CALCULATED BY \_\_\_\_\_ DATE \_\_\_\_\_  
CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
SCALE \_\_\_\_\_

# Public Meeting - Route 236 June 25, 2019

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FRANK Fortunato	FRANKthermo@Comcast.Net
Rebecca Brown	rebeccabrown@ypinet.com
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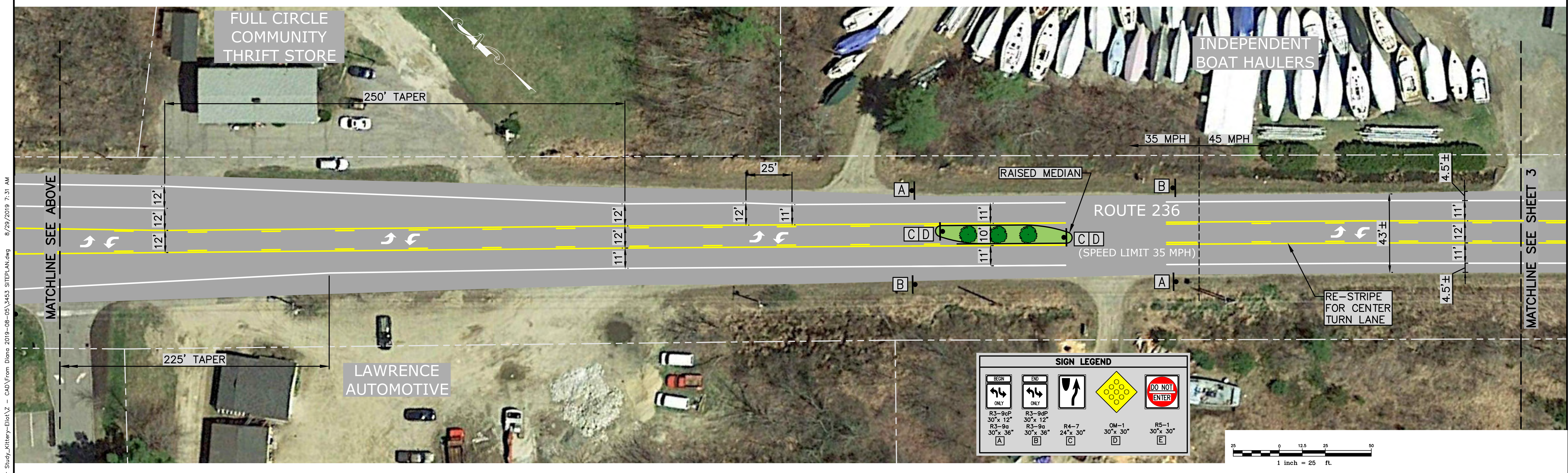
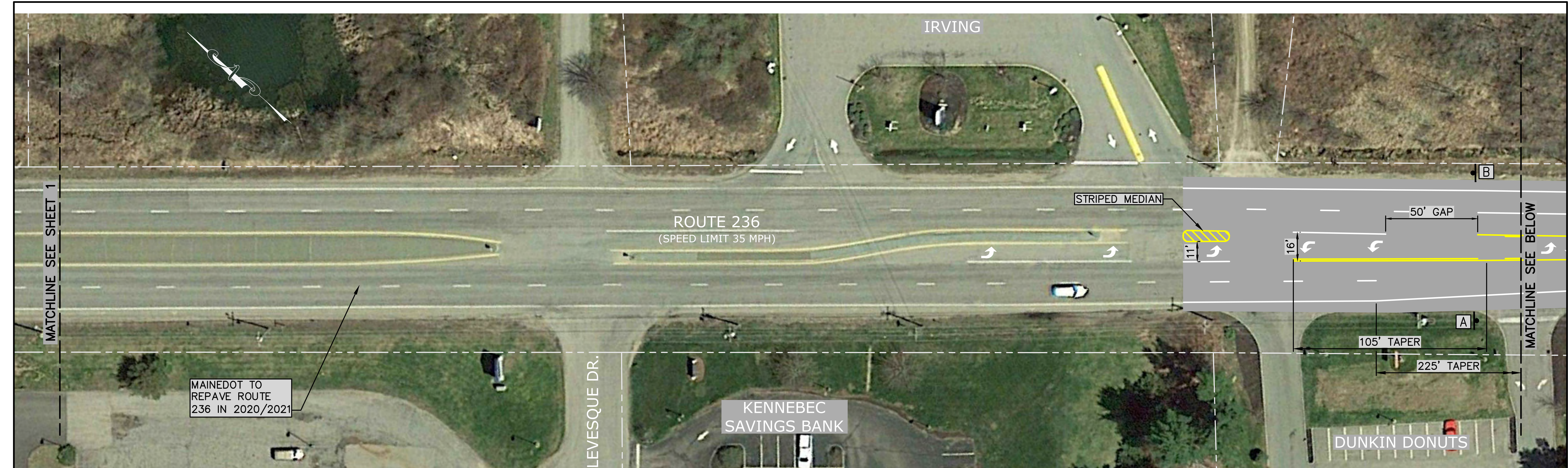
# Appendix H

## Recommended Improvement Plans









1	7/26/2019	REVISED PER PUBLIC COMMENTS
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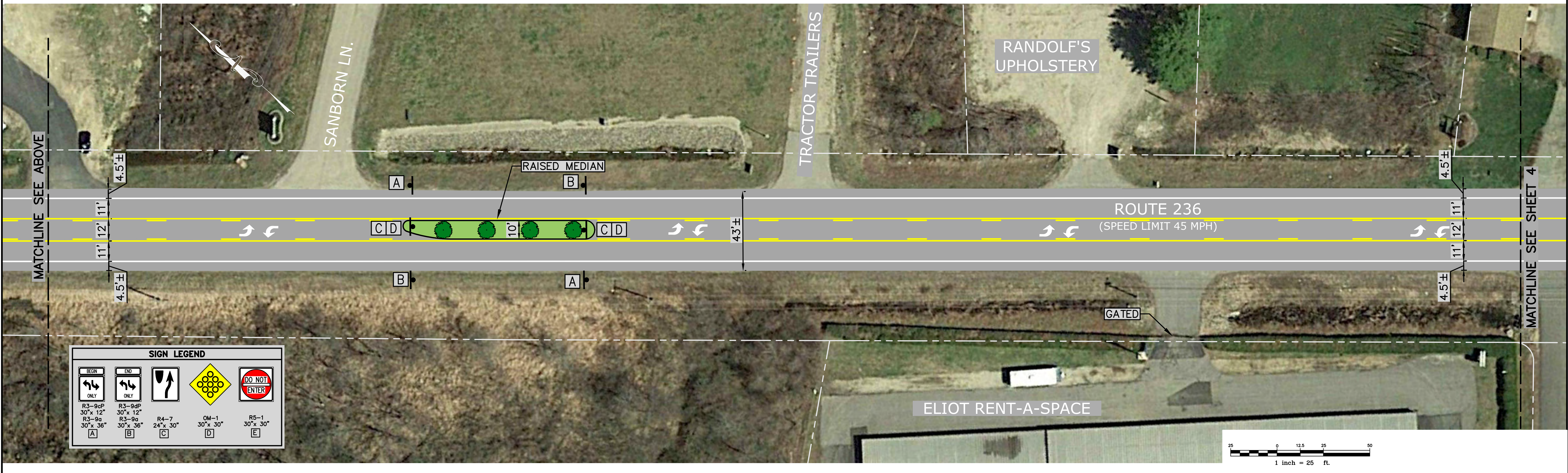
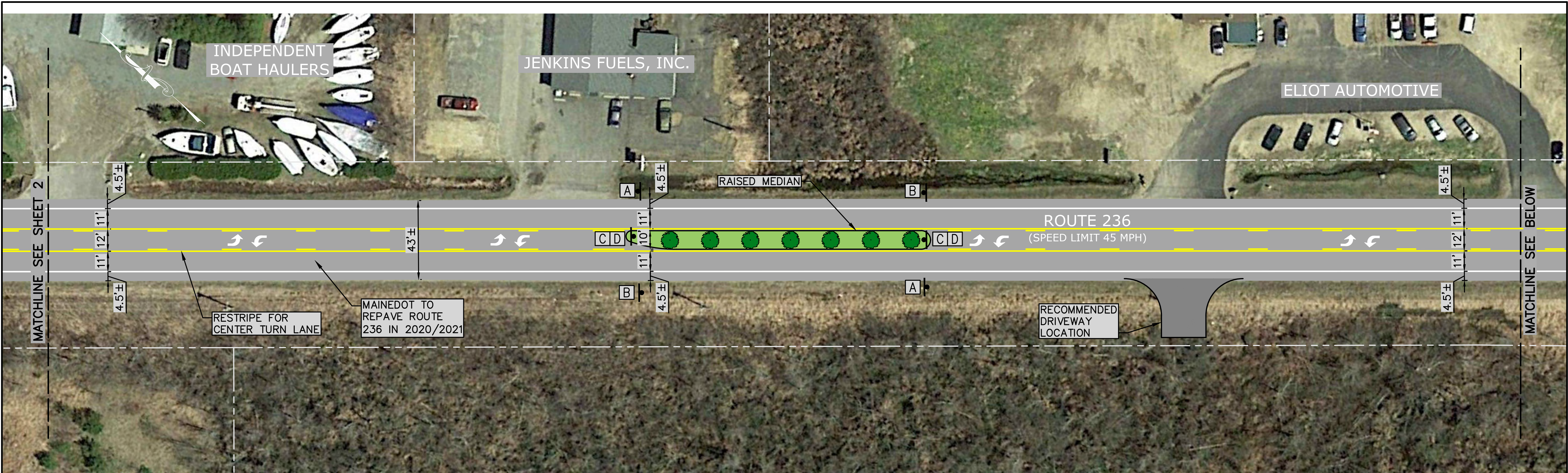
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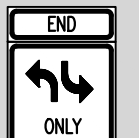



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Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072

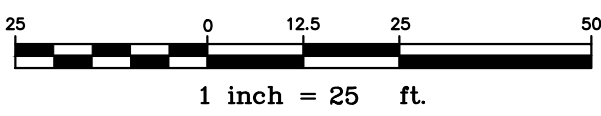
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SIGN LEGEND	
	
R3-9cP 30"x 12" R3-9a 30"x 36" [A]	R3-9dP 30"x 12" R3-9a 30"x 36" [B]
	
R4-7 24"x 30" [C]	OM-1 30"x 30" [D]
	R5-1 30"x 30" [E]



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Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072

Drawing No.

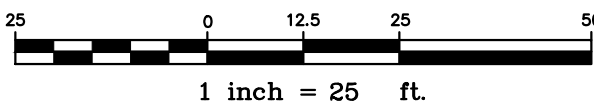
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R3-9aP 30" x 12"	R3-9dP 30" x 12"	R3-9a 30" x 36"	R4-7 24" x 30"	OW-1 30" x 30"
A	B	C	D	E



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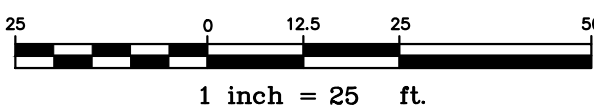
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Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072

Drawing No.
4



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SIGN LEGEND					
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1	7/26/2019	REVISED PER PUBLIC COMMENTS

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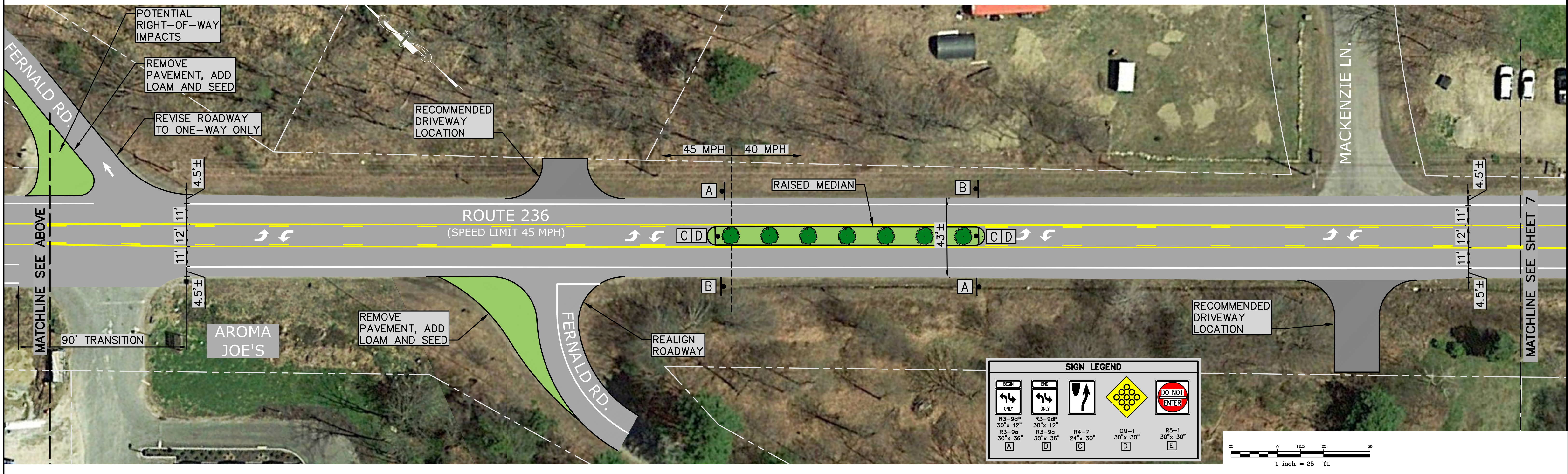
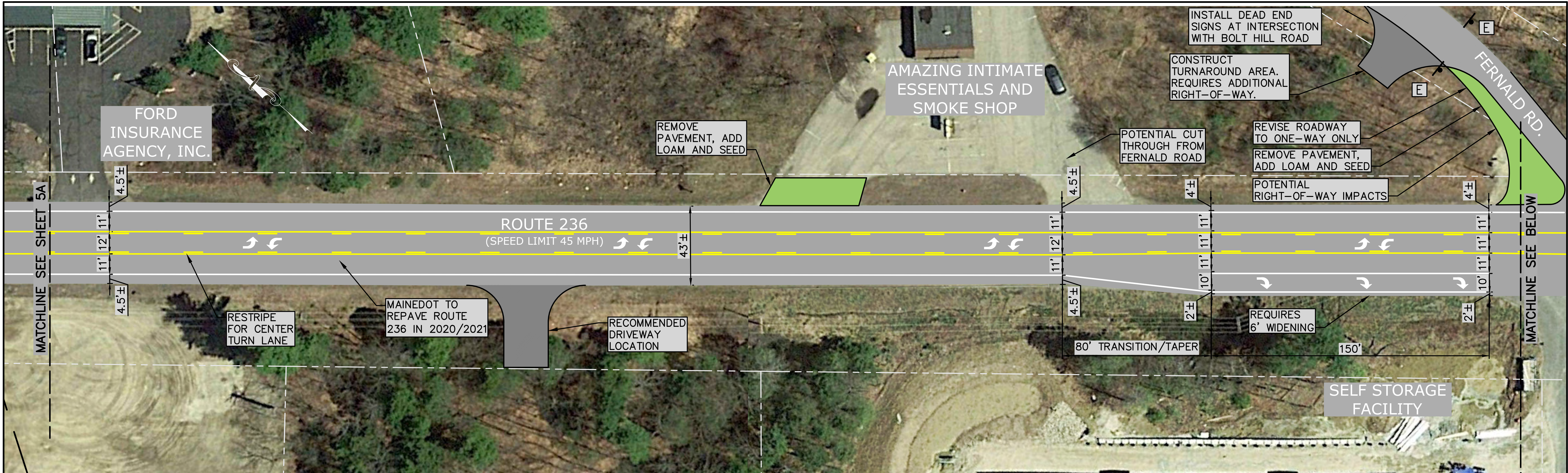
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Drawing Name:	Conceptual Roadway Improvements Plan
Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072

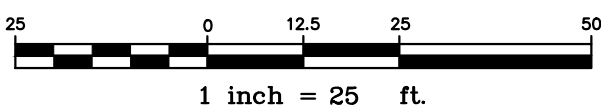
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R3-9cP 30"x 12" R3-9a 30"x 36"	R3-9dP 30"x 12" R3-9a 30"x 36"	R4-7 24"x 30"	OM-1 30"x 30"	R5-1 30"x 30"
A	B	C	D	E



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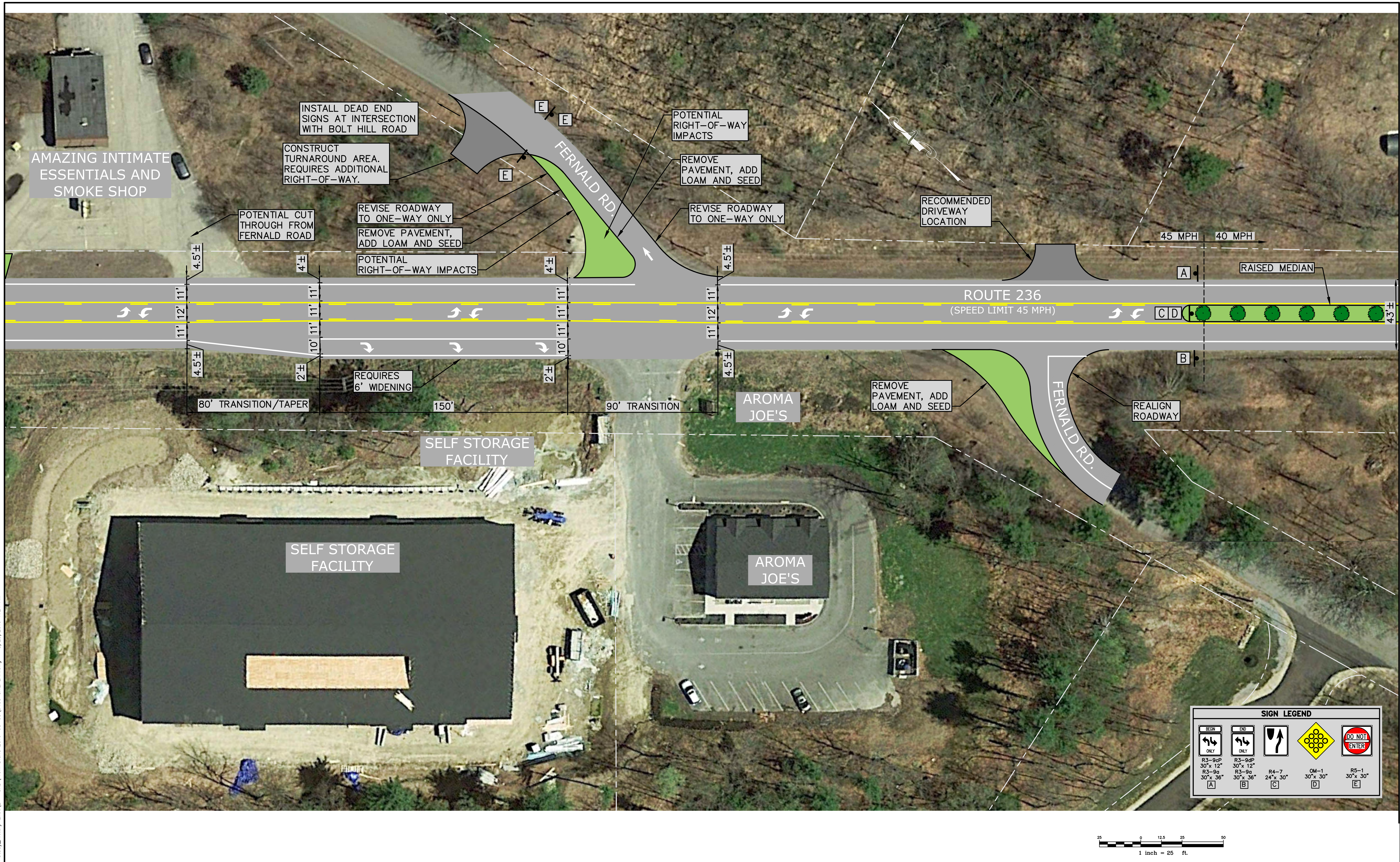
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Client:	<b>KACTS</b> 110 Main Street, Suite 1400, Saco, ME 04072

Drawing No.

6



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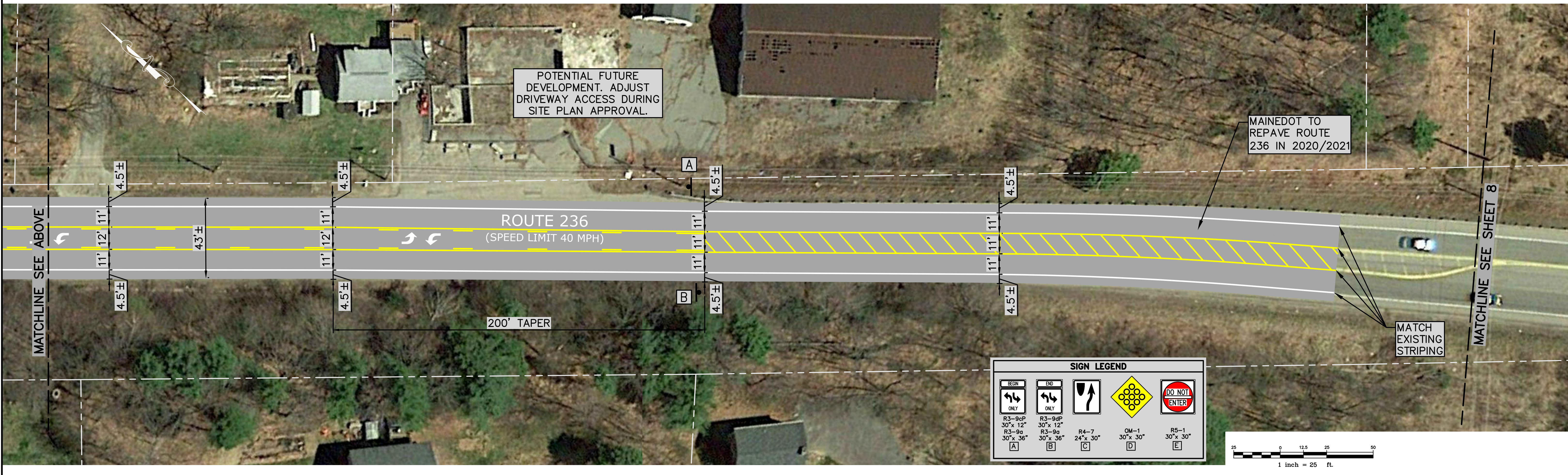
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Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072


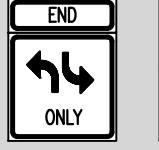
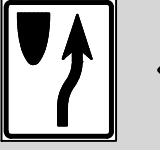
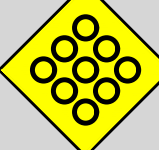
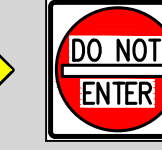
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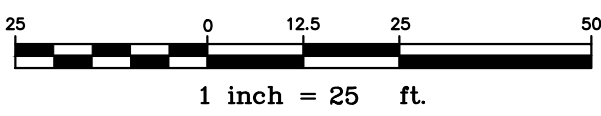
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SIGN LEGEND				
				
R3-90P 30"x 12" R3-90 30"x 36" [A]	R3-90P 30"x 12" R3-90 30"x 36" [B]	R4-7 24"x 30" [C]	QM-1 30"x 30" [D]	R5-1 30"x 30" [E]



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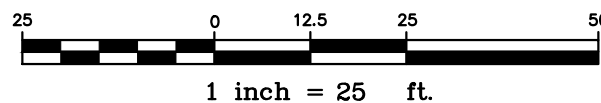
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(S) DENOTES SIGNALIZED INTERSECTION



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Drawing Name:	Conceptual Roadway Improvements Plan
Project:	Route 236 Traffic and Safety Study Kittery and Eliot, Maine
Client:	KACTS 110 Main Street, Suite 1400, Saco, ME 04072

Drawing No.  
8





# Appendix I

Recommended Improvements Capacity and Queue  
Analysis Results



## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2764	2865	2791	2812	2828	2814
Vehs Exited	2700	2805	2734	2804	2790	2769
Starting Vehs	76	103	91	105	110	94
Ending Vehs	140	163	148	113	148	140
Denied Entry Before	0	0	1	0	0	0
Denied Entry After	1	1	1	0	1	0
Travel Distance (mi)	3818	3995	3887	4029	3992	3944
Travel Time (hr)	134.5	143.4	139.0	145.6	140.3	140.5
Total Delay (hr)	26.6	30.8	29.0	31.7	27.6	29.2
Total Stops	1845	2012	1874	2062	1816	1922
Fuel Used (gal)	117.4	125.2	121.0	126.1	123.4	122.6

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2764	2865	2791	2812	2828	2814
Vehs Exited	2700	2805	2734	2804	2790	2769
Starting Vehs	76	103	91	105	110	94
Ending Vehs	140	163	148	113	148	140
Denied Entry Before	0	0	1	0	0	0
Denied Entry After	1	1	1	0	1	0
Travel Distance (mi)	3818	3995	3887	4029	3992	3944
Travel Time (hr)	134.5	143.4	139.0	145.6	140.3	140.5
Total Delay (hr)	26.6	30.8	29.0	31.7	27.6	29.2
Total Stops	1845	2012	1874	2062	1816	1922
Fuel Used (gal)	117.4	125.2	121.0	126.1	123.4	122.6



### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	3.4	0.1	0.4	0.2	0.4
Total Del/Veh (s)	24.7	15.5	13.3	15.4	15.3
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.1	0.1	0.1	0.1
Total Del/Veh (s)	1.6	3.0	27.7	2.1
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	All
Denied Del/Veh (s)	0.0	0.0	3.8	0.1
Total Del/Veh (s)	3.8	1.1	27.5	3.6
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.2	0.1	1.1	0.2
Total Del/Veh (s)	8.5	2.3	41.9	63.5	9.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.3	0.0	1.3	0.6	0.3
Total Del/Veh (s)	13.6	10.5	10.6	14.6	12.7
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	0.8
Total Del/Veh (s)	35.3
Denied Entry Before	0
Denied Entry After	0



### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	83	67	92	27	366	149	470
Average Queue (ft)	12	33	25	4	122	27	192
95th Queue (ft)	44	60	65	19	291	88	370
Link Distance (ft)	616		1038		914		1785
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	0	8			4		4
Queuing Penalty (veh)	0	1			0		1

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	6	31
Average Queue (ft)	0	3
95th Queue (ft)	4	19
Link Distance (ft)		923
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	250	
Storage Blk Time (%)		
Queuing Penalty (veh)		

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	SE	NW	NE	NE
Directions Served	L	R	L	LT	R
Maximum Queue (ft)	20	4	30	69	76
Average Queue (ft)	1	0	4	7	28
95th Queue (ft)	9	3	18	36	63
Link Distance (ft)				626	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	510	205	250		60
Storage Blk Time (%)				0	5
Queuing Penalty (veh)				0	0



#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	SE	B14	B14	NW	NW	NE	SW	SW
Directions Served	L	TR	T		L	TR	LTR	LT	R
Maximum Queue (ft)	17	2	9	10	5	4	90	124	73
Average Queue (ft)	1	0	0	0	0	0	34	43	16
95th Queue (ft)	9	2	6	7	5	3	76	108	56
Link Distance (ft)		3195	1521	1521		1070	942	696	
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)	500				510				50
Storage Blk Time (%)								21	0
Queuing Penalty (veh)								3	0

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	86	265	227	62	126	145	86	68	138	67
Average Queue (ft)	24	131	109	23	49	55	37	30	65	20
95th Queue (ft)	66	217	197	51	98	108	73	56	111	54
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)	0	4					0		2	0
Queuing Penalty (veh)	0	1					0		1	0

#### Network Summary

Network wide Queuing Penalty: 8



### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	6.0	61.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	28.9	36.4	7.5	6.3	48.4	7.5
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	68	10	32	94	11	32
Cycles @ Minimum (%)	0	0	16	6	0	16
Cycles Maxed Out (%)	25	25	0	6	38	0
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	5.0	22.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	12.1	20.2	10.9	5.3	20.9	10.9
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	69	7	9	63	2	9
Cycles @ Minimum (%)	10	0	1	37	0	1
Cycles Maxed Out (%)	31	48	7	37	70	7
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0



## Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2906	2907	2994	2958	2828	2920
Vehs Exited	2868	2814	2951	2877	2796	2858
Starting Vehs	129	89	120	102	105	108
Ending Vehs	167	182	163	183	137	163
Denied Entry Before	2	3	0	1	0	1
Denied Entry After	2	31	0	35	1	14
Travel Distance (mi)	4300	4251	4473	4285	4169	4296
Travel Time (hr)	160.8	169.3	180.5	171.3	155.4	167.5
Total Delay (hr)	36.5	46.3	51.1	46.9	34.8	43.1
Total Stops	2372	2709	3045	2872	2440	2688
Fuel Used (gal)	134.4	135.9	143.2	137.1	130.3	136.2

## Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

## Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2906	2907	2994	2958	2828	2920
Vehs Exited	2868	2814	2951	2877	2796	2858
Starting Vehs	129	89	120	102	105	108
Ending Vehs	167	182	163	183	137	163
Denied Entry Before	2	3	0	1	0	1
Denied Entry After	2	31	0	35	1	14
Travel Distance (mi)	4300	4251	4473	4285	4169	4296
Travel Time (hr)	160.8	169.3	180.5	171.3	155.4	167.5
Total Delay (hr)	36.5	46.3	51.1	46.9	34.8	43.1
Total Stops	2372	2709	3045	2872	2440	2688
Fuel Used (gal)	134.4	135.9	143.2	137.1	130.3	136.2



### 1: Martin Road/Stevenson Road & Route 236 Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	2.1	0.2	10.1	0.1	6.0
Total Del/Veh (s)	22.5	34.6	36.8	12.2	27.9
Denied Entry Before	0	0	1	0	1
Denied Entry After	0	0	14	0	14

### 2: Route 236 & MacKenzie Lane Performance by approach

Approach	SE	NW	SW	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.0
Total Del/Veh (s)	0.8	8.4	29.8	5.9
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 3: Aroma Joe's/Fernand Road & Route 236 Performance by approach

Approach	SE	NW	NE	All
Denied Del/Veh (s)	0.0	0.0	3.0	0.0
Total Del/Veh (s)	1.9	3.0	18.3	2.8
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

### 4: Bolt Hill Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.2	0.1	0.1	0.9	0.1
Total Del/Veh (s)	4.3	4.5	65.0	96.0	7.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### 5: Beech Road & Route 236 Performance by approach

Approach	SE	NW	NE	SW	All
Denied Del/Veh (s)	0.3	0.0	0.6	0.8	0.2
Total Del/Veh (s)	11.5	13.4	15.9	13.2	13.1
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

### Total Network Performance

Denied Del/Veh (s)	4.7
Total Del/Veh (s)	46.8
Denied Entry Before	1
Denied Entry After	14



### Intersection: 1: Martin Road/Stevenson Road & Route 236

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	L	TR	L	TR
Maximum Queue (ft)	80	49	132	229	892	149	327
Average Queue (ft)	21	15	63	40	502	37	120
95th Queue (ft)	58	39	113	137	1005	99	247
Link Distance (ft)	616		1038		914		1784
Upstream Blk Time (%)					8		
Queuing Penalty (veh)					0		
Storage Bay Dist (ft)		50		205		225	
Storage Blk Time (%)	5	0		0	19		1
Queuing Penalty (veh)	1	0		0	5		1

### Intersection: 2: Route 236 & MacKenzie Lane

Movement	SE	SW
Directions Served	L	LR
Maximum Queue (ft)	23	59
Average Queue (ft)	3	24
95th Queue (ft)	16	54
Link Distance (ft)		922
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	250	
Storage Blk Time (%)		
Queuing Penalty (veh)		

### Intersection: 3: Aroma Joe's/Fernand Road & Route 236

Movement	SE	NW	NE	NE
Directions Served	L	L	LT	R
Maximum Queue (ft)	5	23	35	28
Average Queue (ft)	0	3	8	12
95th Queue (ft)	4	15	29	32
Link Distance (ft)			532	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)	510	250		60
Storage Blk Time (%)			0	0
Queuing Penalty (veh)			0	0



#### Intersection: 4: Bolt Hill Road & Route 236

Movement	SE	NW	NE	SW	SW
Directions Served	L	L	LTR	LT	R
Maximum Queue (ft)	26	38	99	107	66
Average Queue (ft)	4	9	33	38	10
95th Queue (ft)	17	30	85	90	41
Link Distance (ft)			942	696	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)	500	510			50
Storage Blk Time (%)				23	1
Queuing Penalty (veh)				2	0

#### Intersection: 5: Beech Road & Route 236

Movement	SE	SE	SE	NW	NW	NW	NE	NE	SW	SW
Directions Served	L	T	TR	L	T	TR	LT	R	LT	R
Maximum Queue (ft)	79	147	125	92	201	207	165	59	123	105
Average Queue (ft)	30	73	53	37	106	120	83	20	49	28
95th Queue (ft)	63	119	101	71	176	192	137	48	92	68
Link Distance (ft)		1676	1676		1521	1521	1607		1690	
Upstream Blk Time (%)										
Queuing Penalty (veh)										
Storage Bay Dist (ft)	165			225				120		100
Storage Blk Time (%)		0			0		2		1	0
Queuing Penalty (veh)		0			0		1		0	0

#### Network Summary

Network wide Queuing Penalty: 11
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### Intersection: 1: Martin Road/Stevenson Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SBL	NBT	EBTL	NBL	SBT	WBT
Maximum Green (s)	5.0	62.0	18.0	5.0	62.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	5.0	56.9	9.9	7.9	59.2	9.9
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	44	2	15	58	7	15
Cycles @ Minimum (%)	56	0	4	38	0	4
Cycles Maxed Out (%)	56	73	7	42	58	7
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

### Intersection: 5: Beech Road & Route 236

Phase	1	2	4	5	6	8
Movement(s) Served	SEL	NWT	NETL	NWL	SET	SWTL
Maximum Green (s)	5.0	22.0	18.0	6.0	21.0	18.0
Minimum Green (s)	5.0	5.0	5.0	5.0	5.0	5.0
Recall	None	None	None	None	None	None
Avg. Green (s)	5.5	21.3	12.9	6.5	20.6	12.9
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	54	1	8	46	5	8
Cycles @ Minimum (%)	42	0	0	0	0	0
Cycles Maxed Out (%)	46	61	20	29	53	20
Cycles with Peds (%)	0	0	0	0	0	0

#### Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0





# Appendix J

Opinion of Cost

Job Number: 3453

**MaineDOT WIN:**

**Project Location:** Route 236, Kittery and Eliot, Maine

**Comments:** Draft Opinion of Probable Cost

**From:** Gorrill Palmer

**Date:** 8/2/2019

**Calculated By:** TPG

**Checked By:** JSW

**Notes:**

1. Opinion of cost does not include right of way, environmental, utility, engineering, or inspection costs.
2. Remediation or removal of any special or hazardous materials not included.
3. Costs based on Draft plans Dated 7/26/2019
4. Does not include Landscaping on the center medians
5. Does not include subsurface drainage

Item	Item Description	Unit	Quantity	Unit Price	Amount
203.20	COMMON EXCAVATION	CY	6225	\$ 20.00	\$ 124,500.00
304.10	AGGREGATE SUBBASE COURSE GRAVEL - TYPE D	CY	3775	\$ 30.00	\$ 113,250.00
403.207	HOT MIX ASPHALT, 19.0 MM HMA	T	1650	\$ 140.00	\$ 231,000.00
403.208	HOT MIX ASPHALT, 12.5 MM HMA (SURFACE)	T	2300	\$ 140.00	\$ 322,000.00
404.208**	HOT MIX ASPHALT, 12.5 MM HMA (Project WIN 24121.00)	T	1500	\$ 140.00	\$ 210,000.00
409.15	BITUMINOUS TACK COAT, APPLIED	G	1775	\$ 12.00	\$ 21,300.00
609.34	CURB TYPE 5	LF	1355	\$ 30.00	\$ 40,650.00
609.35	CURB TYPE 5 - CIRCULAR	LF	125	\$ 80.00	\$ 10,000.00
615.07	LOAM	CY	850	\$ 50.00	\$ 42,500.00
618.13	SEEDING METHOD NUMBER 1	UN	75	\$ 60.00	\$ 4,500.00
619.1201	MULCH	UN	75	\$ 40.00	\$ 3,000.00
627.733	4" WHITE OR YELLOW PAINTED PAVEMENT MARKING LINE	LF	42955	\$ 0.70	\$ 30,068.50
627.75	WHITE OR YELLOW PAVEMENT & CURB MARKING	SF	1910	\$ 3.08	\$ 5,882.80
643.71	TRAFFIC SIGNAL MODIFICATION	LS	1	\$ 225,000.00	\$ 225,000.00
645.292	REG. WARN, CONF, RT SIGNS TYPE II	SF	470	\$ 45.00	\$ 21,150.00
652.00	TRAFFIC CONTROL	LS	1	\$ 50,000.00	\$ 50,000.00
656.75	TEMPORARY SOIL EROSION AND WATER POLLUTION CONTROL	LS	1	\$ 5,000.00	\$ 5,000.00
659.10	MOBILIZATION	LS	1	\$ 100,000.00	\$ 100,000.00

\*\*The Maine DOT overlay Project (WIN 24121.00) will contribute funds to this project approx. equal to this item (\$210,000).

CONSTRUCTION COST	\$ 1,559,801.30
CONTINGENCY (25%)	\$ 389,950.33
TOTAL CONSTRUCTION COST	\$ 1,949,751.63
<b>ROUNDED</b>	<b>\$ 1,950,000.00</b>