Date	To
September 14, 2016	MTA
	From
Interoffice Correspondence	Elizabeth Roberts, P.E.
	Subject
	Analysis of Traffic Impacts from AET in York

Executive Summary

A study produced by CDM Smith in April 2014 estimated that 3,400 to 5,500 vehicles per day would divert away from the York Toll Plaza if the plaza was converted to All Electronic Tolling (AET). This study analyzed the traffic impacts of the expected traffic diversion to non-interstate highways if the York Toll Plaza is converted to AET. Data from the CDM Smith study was utilized to assess the impacts of this estimated diversion on US Route 1, State Route 236, and other area roadways.

TWO METHODS OF ANALYSIS

The traffic impacts of the diversion were analyzed for two different time periods – an average summer weekday and the peak hour of an average day (non-summer day) using two different methodologies due to the different characteristics of each.

FINDINGS AND CONCLUSIONS

Both analyses identified that traffic would increase on non-interstate highways and depending upon the time of year, the following municipalities would experience significant impacts to key roadways and intersections:

- Ogunquit
- York
- Kittery
- Eliot
- Wells
- South Berwick
- Berwick
- North Berwick
- Sanford
- Kennebunk

Summer Analysis

To analyze an average summer weekday, data from the Maine Department of Transportation's (MaineDOT's) travel demand model was used in collaboration with MaineDOT staff. MaineDOT's travel demand model provides forecasted traffic volumes that reflect an average summer weekday. The travel demand model is a planning tool that looks at travel times and toll costs to determine the most likely routes of travelers. The MaineDOT's travel demand model covers the entire state and includes some of the routes in New Hampshire near the border. The travel demand model provides measures of effectiveness regionally and statewide. The results capture the impacts not only during peak travel hours but also the off-peak travel hours of the day.

The average summer weekday analysis showed that traffic impacts from installing AET at York Toll Plaza would increase traffic on non-interstate highways. Increases in daily summer traffic volumes are expected along US Route 1, with much higher increases in traffic on other non-interstate roadways in

York County such as State Route 236, State Route 109/9 between Exit 19 and US Route 1, and State Route 4 through the Berwicks. Several roadways would see increases of daily summer traffic volumes of 5-50%. Travelers on these inland corridors will experience more delays at intersections already identified by MaineDOT as having a relatively poor level of service. Such intersections include the State Route 236/Depot Road intersection in Eliot and intersections in downtown South Berwick where State Routes 4 and 236 overlap.[1]

Traffic impacts from installing AET at York Toll Plaza could result in an additional 10,715-19,982 additional vehicle hours of travel in York County **per summer day.** Peak summer traffic lasts about 10 weeks. This would result in an additional 750,000 – 1,400,000 vehicle-hours of travel (and corresponding additional vehicle emissions) per summer.

Non-Summer Analysis
A peak hour of an average day in Maine is the hour with the highest amount of traffic during a day where there is an average amount of traffic like May, September, or October. During average traffic months, traffic volumes on US Route 1 are lighter and therefore it is expected that US Route 1 would be the roadway to attract most of the diverting traffic. The average day peak hour analysis focused on the peak hour impacts to key intersections affected by the diversion to the York Toll Plaza.

The MaineDOT Statewide model was not used for the peak hour analysis as it is set up to model a summer weekday and it provides daily traffic volume results. For this analysis, we used an industry accepted traffic analysis software tool – Synchro, results of a 2010 Origin and Destination Study, and travel time information from Google Maps.

The peak hour analysis of an average day showed that two intersections in the study area that already operate at a LOS F would see expected delays triple. At the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit, average delays for Shore Road and Beach Street would increase from 73 seconds (1.2 minutes) to 202-326 seconds (3.4-5.4 minutes). At the intersection of the Turnpike Connector and the SB Turnpike ramps in York, average delays for the southbound off-ramp would increase from 120 seconds (2 minutes) to 253-376 seconds (4.2-6.3 minutes). Converting the York Toll Plaza to AET could triple the delays at the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit and at the SB Turnpike ramps in York during a peak hour of an average day.

A potential conversion of the York Toll Plaza to AET would cause the northbound direction of US Route 1 in Ogunquit to operate over capacity and would cause the southbound direction to operate at 76-86% of its capacity during an average peak hour in May (which was analyzed as it represents a peak hour of an average day). In other words, traffic backups and congestion would happen during peak hours of average traffic months if the York Toll Plaza is converted to AET.

If the York Toll Plaza is converted to AET, there would be an increase in the number of hours during the year when traffic on US Route 1 would be congested in other words stop-and-go conditions. Traffic conditions on US Route 1 that are currently experienced in July and August would occur on the shoulder seasons. Significant traffic volume growth will occur in the months of May, June, September, and October. Stated more simply, summer-like traffic will expand into the Spring and Fall.

During the summer, traffic volumes and corresponding emissions would increase on other non-interstate roads in York County. Daily traffic volumes on some of the major non-interstate roadways in York County could increase by 5-50%, while traffic volumes on the Maine Turnpike decreases. What does this

[1] Maine Department of Transportation Bureau of Transportation Systems Planning. *Route 236 Corridor Study Kittery – Eliot – S. Berwick*: October 2008.

mean for the non-interstate roads? Traffic at unsignalized intersections on impacted roadways would see more delay. The need for signals and intersection improvements at several unsignalized intersections would be accelerated. In contrast, the Maine Turnpike would see a proportionately small decrease in traffic.

Purpose

A study produced by CDM Smith in April 2014 estimated that 3,400 to 5,500 vehicles per day would divert away from the York Toll Plaza if the plaza was converted to all electronic tolling (AET). This study analyzed the traffic impacts of the expected traffic diversion to non-interstate highways if the York Toll Plaza is converted to AET. Data from the CDM Smith study was utilized to assess the impacts of this estimated diversion on US Route 1, State Route 236, and other area roadways.

Detailed Analyses

The estimate of diversion provided by CDM Smith represents the expected number of vehicles that would divert to non-interstate highways during an average day in the year 2015 due to a tolling surcharge for non-E-ZPass vehicles. However, since the anticipated opening year for the AET project in York is now 2019, the traffic analysis of this study focuses on 2019.

2019 Traffic Diversion Estimates

The range of values given by CDM Smith represents an average value of 3,400 vehicles and a 90th percentile confidence interval value of 5,500 vehicles. A 90th percentile confidence interval value is the value at which there is a 90% chance of the actual value being lower than the estimate, or a 10% chance of the actual value being higher than the estimate. Evaluating a range of estimates for diverting traffic gives a reasonable range of possible outcomes to assess risk.

The values for 2019 were calculated from information provided in the CDM Smith report and in collaboration with CDM Smith. The estimate of diversion from CDM Smith's report for 2019 is 918,000 vehicles per year, which would result in an average of 2,515 vehicles per day. CDM Smith also developed a 90th percentile confidence estimate for diversion in 2019 of 4,700 vehicles per day[2].

Analysis time Periods

The impacts of the diverting traffic were analyzed for the following time periods:

1) An average summer weekday
2) The peak hour of an average day

These two time periods were selected because motorists are expected to act differently during these periods. During an average summer weekday, traffic along the route parallel to the Maine Turnpike – US Route 1 is very congested and is therefore not very attractive for traffic diversion. Traffic along US Route 1 is heavy for several hours of a typical summer weekday. Therefore, it is important to understand the impacts of diverting traffic over an entire day during the peak summer traffic months. The results of the analysis of an average summer day was measured in traffic volume increase or decrease, vehicle-miles-traveled (VMT), vehicle-hours-traveled (VHT) and average speeds for all of York County.

During months outside of the summer that are considered average, like May, September, or October, traffic can be expected to behave differently. During average traffic months, traffic conditions on US Route 1 are lighter and therefore it is expected that US Route 1 would be the roadway to attract most of the diverting traffic. To analyze this average condition, only the peak hour of the average day is analyzed. The results of the analysis of the peak hour of an average day was measured in traffic volume increase or decrease, level-of-service (LOS) and vehicle delays.

[2] Email from CDM Smith, February 26, 2016. The 90th percentile confidence estimate is an estimate of diversion that would not be exceeded 90% of the time.

Analysis of Average Summer Weekday

An average summer weekday is a weekday (Monday through Thursday) during the months of July and August, and the last week of June. To analyze an average summer weekday, data from the Maine Department of Transportation's (MaineDOT's) travel demand model was used in collaboration with MaineDOT staff. MaineDOT's travel demand model provides forecasted traffic volumes that reflect an average summer weekday. The travel demand model is a planning tool that looks at travel times and toll costs to determine the most likely routes of travelers. The MaineDOT's travel demand model covers the entire state and includes some of the routes in New Hampshire near the border. The travel demand model provides measures of effectiveness regionally and statewide. The results capture 24-hour impacts rather than peak hour impacts.

The 2019 estimate of diversion (from the previous section) is 2,515 vehicles per day. These diversion estimates represent diversion for an average day. But MaineDOT's travel demand model represents a summer weekday, not an average day. In coordination with CDM Smith, an estimate for summer weekday diversion was developed to check if the summer weekday diversion would be less than the average weekday diversion.

A summer day has more traffic, but travelers are less likely to divert at the same rate as an average day because of the congestion on the parallel route – US Route 1. It was estimated that the summer weekday diversion for 2019 would be higher than the average day estimates from the CDM Smith report. Therefore, the average day estimates developed by CDM Smith could be used for the analysis of a summer weekday.

So, MaineDOT's travel demand model was run with the input of the average diversion from the Maine Turnpike at York of 2,515 vehicles for a summer weekday. MaineDOT's travel demand model was also run with the input for the 90th percentile diversion of an average day of 4,700 vehicles per day (from the previous section), in order to provide a range of values for diversion impacts. The results of the travel demand model for York County are summarized in Table 1.

Table 1 –Traffic Impacts in York County due to AET, Summer Weekday

	2019 Traffic Results without Diversion	Increase due to Average Expected Diversion	% Change from Expected	Increase due to 90th Percentile Expected Diversion	% Change from Expected
Vehicle Miles Traveled (VMT)	7,419,588	94,436	1%	202,692	3%
Vehicle Hours Traveled (VHT)	164,649	10,715	7%	19,982	12%
Average Speeds (mph)	45.1	-2.3	-5%	-3.8	-8%

The results of the travel demand model show that a toll surcharge for non-E-ZPass users at the York Toll Plaza would increase the overall VMT and VHT in York County as vehicles divert from the Maine Turnpike to non-interstate highways – requiring additional travel time and distance. The increase in VHT corresponds with a reduction in average speeds. As vehicles leave the Maine Turnpike and use alternate routes, the distance that they travel becomes longer and this shows as an increase in VMT. As the non-interstate highways become more congested, the total time vehicles spend on the roads increases, which shows as an increase in VHT, and the speeds decrease.

As can be seen from Table 1, traffic impacts from installing AET at York Toll Plaza could result in an additional 10,715-19,982 additional vehicle hours of travel in York County **per summer day.** Peak summer traffic lasts about 10 weeks. This would result in an additional 750,000 – 1,400,000 vehicle-hours of travel (and corresponding additional vehicle emissions) per summer.

Some of the area roadways would be impacted more than others. Depending on origins and destinations of travelers, some roads would be more attractive to those diverting travelers. Figures 1-4 show the increases and percentage increases of daily vehicles on non-interstate highways.

As can be seen from Figures 1 and 3, increases in traffic volumes are expected along US Route 1, but not as much as other roadways such as State Route 236, State Route 109/9, and State Route 4. Figures 2 and 4 show that several roadways would see increases of daily traffic volumes of 5-50%. Tables 2 and 3 show the changes in traffic volumes for the major roads in the study area[3].

Table 2 – Average Daily Traffic Changes on Highways with York AET during Summer

Roadway	Existing Traffic Volume	Traffic Volume Change	% Change
Maine Turnpike North of the York Toll Plaza	67,790	-2,515	-3.7%
Route 1	11,973	777	6.5%
Route 236	6,890	2,127	30.9%
Route 109/9	6,153	1,062	17.3%
Route 4	3,967	2,085	52.6%

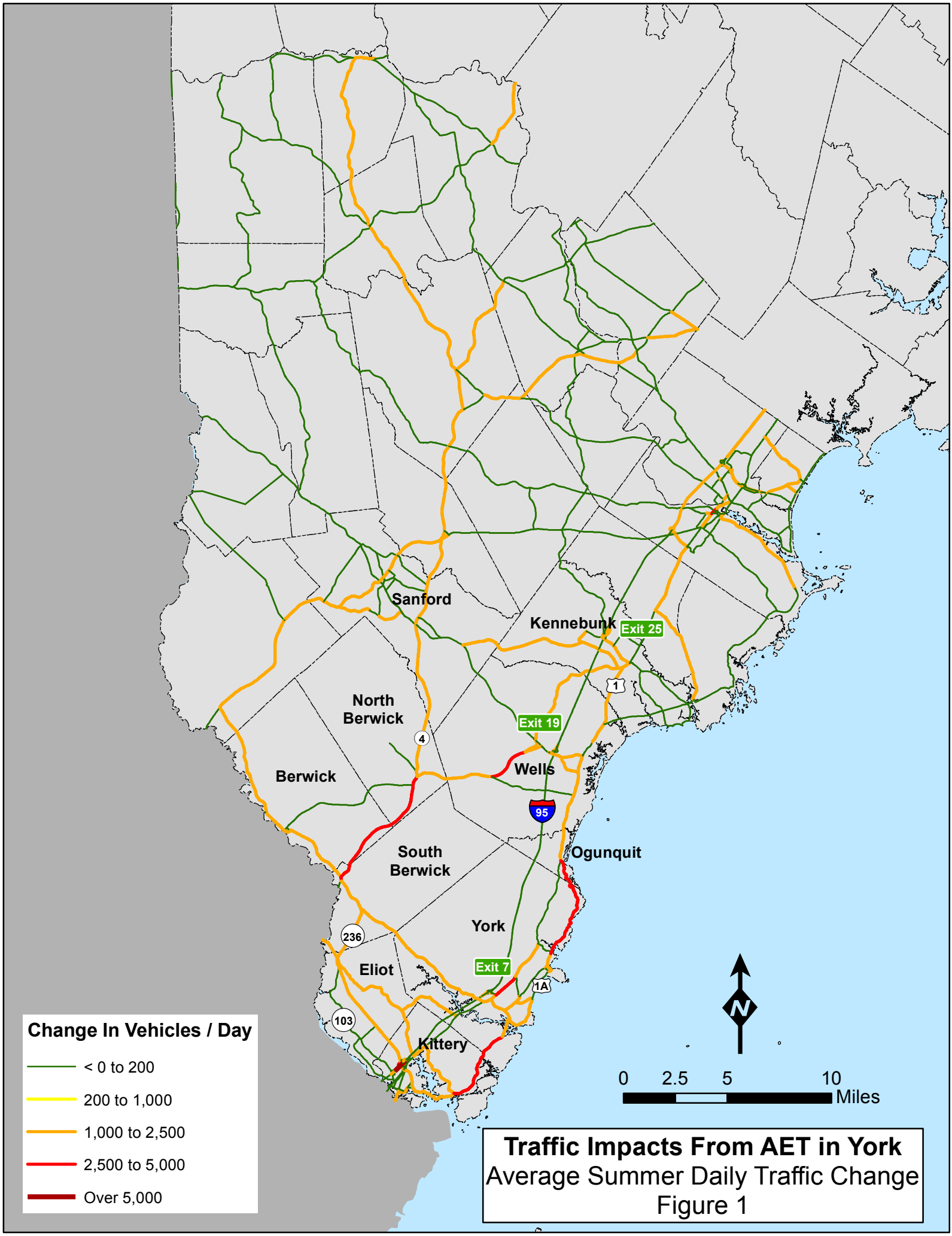
Table 3 – 90th Percentile Daily Traffic Changes on Highways with York AET during Summer

Roadway	Existing Traffic Volume	Traffic Volume Change	% Change
I-95 North of the York Toll Plaza	67,790	-4,700	-6.9%
Route 1	11,973	979	8.2%
Route 236	6,890	2,116	30.7%
Route 109/9	6,153	1,556	25.3%
Route 4	3,967	1,878	47.3%

As can be seen from Tables 2 and 3, only 3.7 to 6.9% of the traffic on the Maine Turnpike is expected to divert. However, this traffic would divert to non-interstate highways where the increase in traffic can be 5-50% over existing levels. In other words, what would be a proportionately small decrease in traffic volumes for the Maine Turnpike will be a proportionately large increase for the non-interstate highways.

As US Route 1 is already over capacity for several hours of a typical summer day, traffic shifts to other non-interstate highways in York County. The sum of the traffic volume changes shown in Tables 2 and 3 does not equal zero because as non-interstate highways become congested, existing travelers of those highways change their routes (secondary shifts).

[3] The MaineDOT's travel demand model loads traffic to the network at a limited number of points, which can have an effect on the appearance of the results. However, the order of magnitude of traffic changes are valid.


Sanford
Kennebunk
Exit 25
North Berwick
Exit 19
Wells
Berwick
95
South Berwick
Ogunquit
York
236
Eliot
Exit 7
1A
103
Kittery
1
4
Change In Vehicles / Day
< 0 to 200
200 to 1,000
1,000 to 2,500
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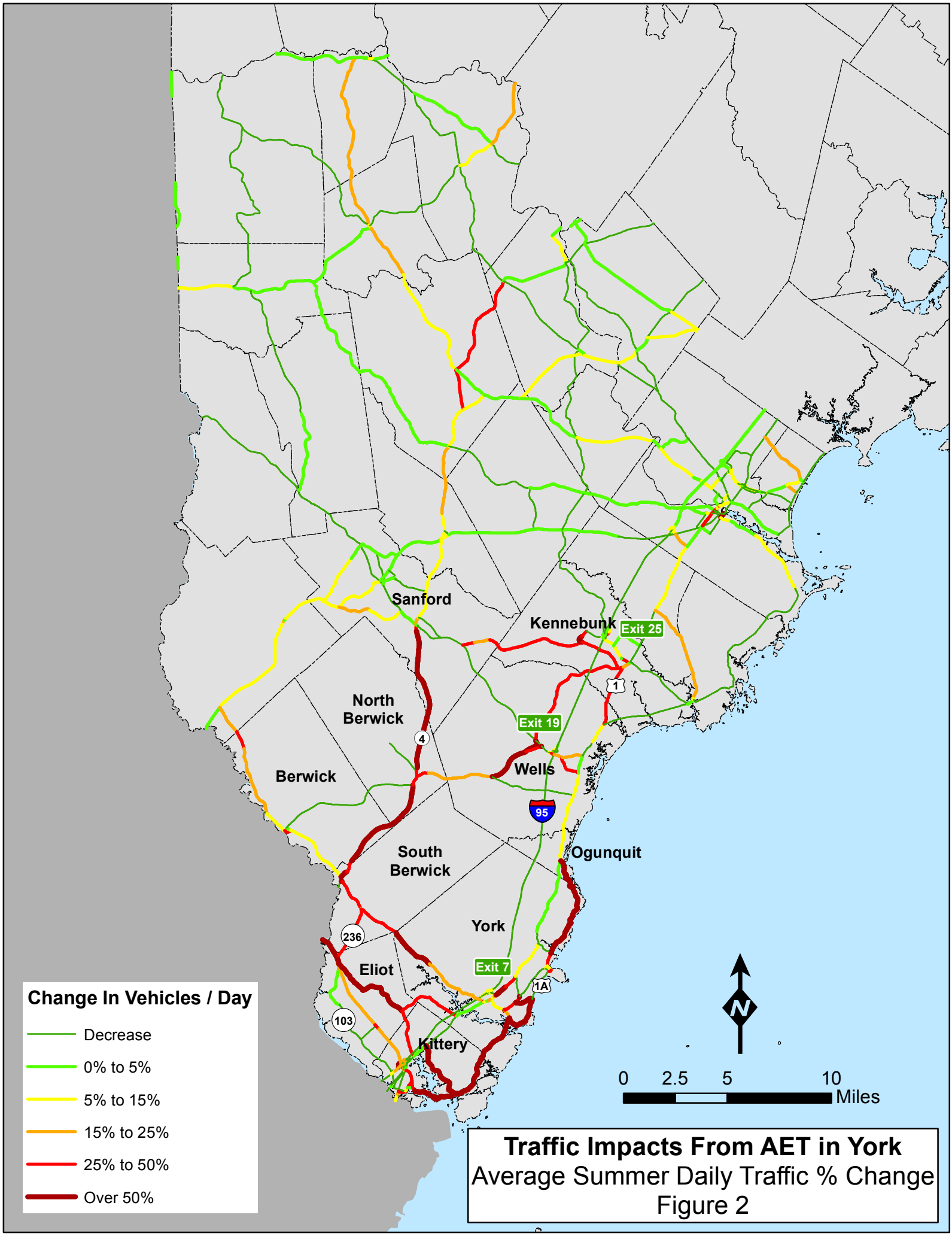
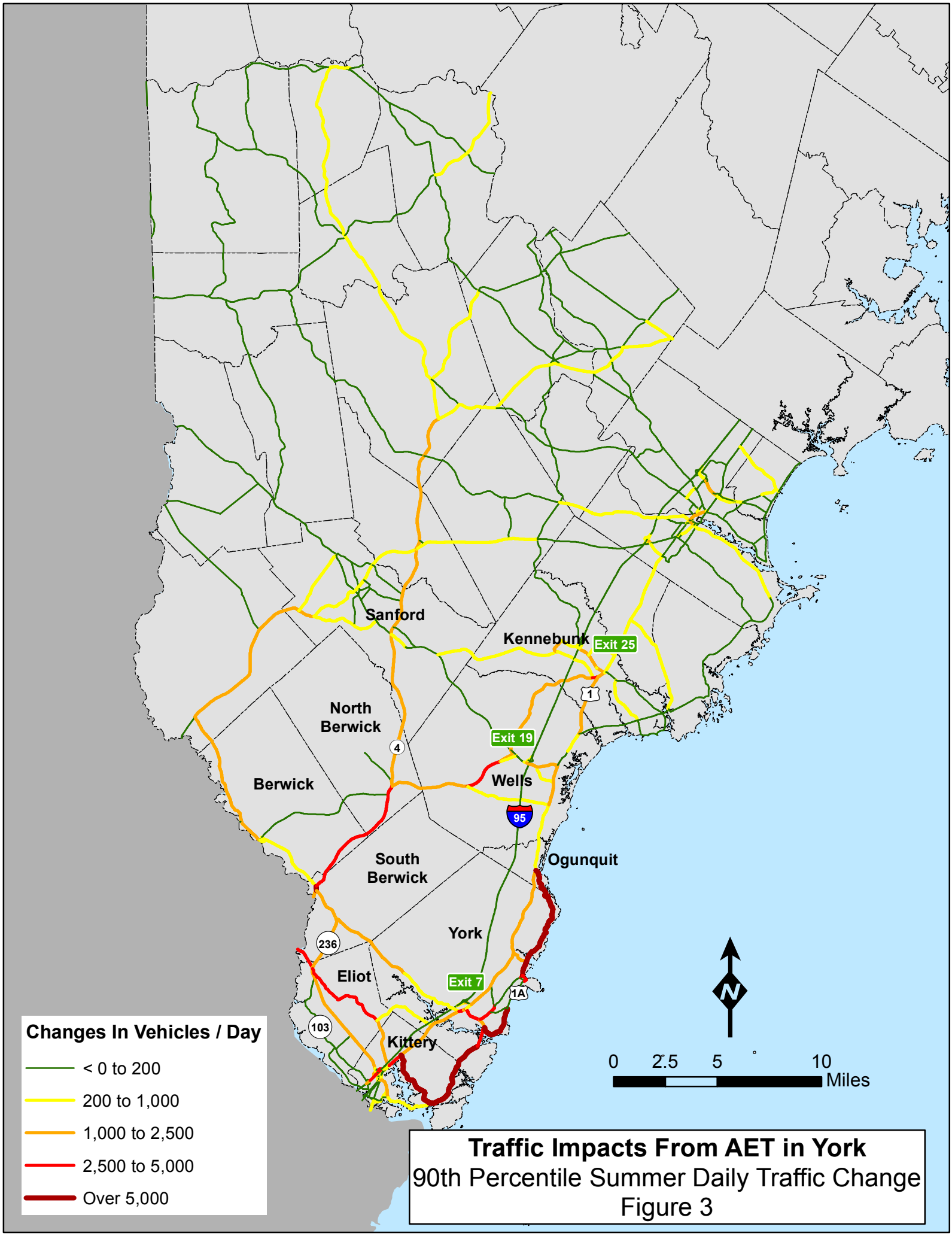
Miles
Traffic Impacts From AET in York
Average Summer Daily Traffic Change
Figure 1



Traffic Impacts From AET in York
Average Summer Daily Traffic % Change
Figure 2


Sanford
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236
Eliot
Exit 7
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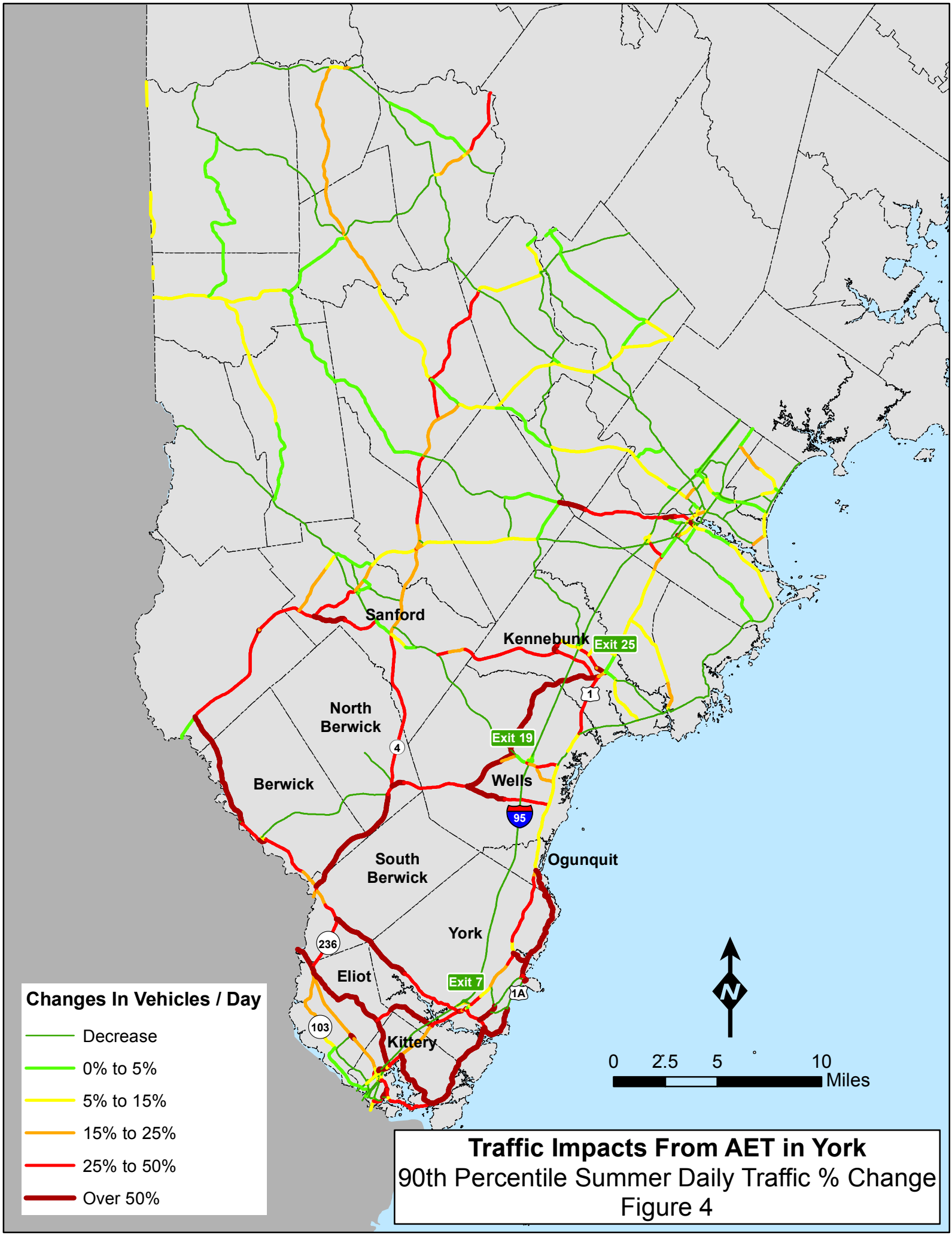
103
Kittery
1
4
Changes In Vehicles / Day
< 0 to 200
200 to 1,000
1,000 to 2,500
2,500 to 5,000
Over 5,000
N
0 2.5 5 10
Miles
Traffic Impacts From AET in York
90th Percentile Summer Daily Traffic Change
Figure 3



Traffic Impacts From AET in York
90th Percentile Summer Daily Traffic % Change
Figure 4

Analysis of Non-Summer Traffic

A peak hour of an average day in Maine is the hour with the highest amount of traffic during a day where there is an average amount of traffic like May, September, or October. During average traffic months, traffic volumes on US Route 1 are lighter and therefore it is expected that US Route 1 would be the roadway to attract most of the diverting traffic. The average day peak hour analysis focused on the peak hour impacts to key intersections affected by the diversion to the York Toll Plaza.

The MaineDOT Statewide model was not used for the peak hour analysis as it is set up to model a summer weekday and it provides daily traffic results. For this analysis, we used an industry accepted traffic analysis software tool – Synchro, results of a 2010 Origin and Destination Study, and travel time information from Google Maps.

The process to analyze the peak hour of an average day was accomplished in the following steps each of which is described in more detail below:

- Develop peak hour diversion estimates from CDM Smith's daily estimates
- Distribute the diverted trips onto the roadway network
- Develop a study area based on the amounts of traffic diverted to the non-interstate highways
- Perform a traffic capacity analysis for the intersections for a no-build and a build scenario
- Perform a critical roadway link capacity analysis

As identified previously, the estimated average diversion for 2019 is 2,515 vehicles per day and the 90th percentile confidence estimate is 4,700 trips per day. In order to determine the peak hour diversion of an average day, a K factor was developed. A K factor is the peak hour traffic volume divided by the daily traffic volume. Data from the York Toll Plaza for a weekday in May from the most recent year data available was used to determine the K factor. A weekday in May corresponds to an average day on US Route 1. A K factor of 0.078 was calculated from the York Toll Plaza data, which results in an expected peak hour diversion of 196 to 366 vehicles.

TRIP DISTRIBUTION

To create a traffic model for the analysis of a peak hour of an average day, a study area was established. Since traffic on US Route 1 is lighter on an average day, it was assumed that the majority of diverting traffic would not be influenced by roadway congestion and would choose either US Route 1 or another route such as State Route 236 depending on the traveler's origin or destination. Data from the Maine Turnpike Authority's 2010 Origin and Destination Study was used to determine what percentage of the diverting vehicles would use US Route 1 or another route.

In 2010, an origin and destination survey was conducted for the Maine Turnpike Authority (MTA). A total of 61,500 surveys were distributed to Maine Turnpike patrons, with 21.3% or 13,095 surveys of those returned. This was a statistically valid number of responses that was received and yielded a confidence level of 95%. It is reasonable to assume that the data collected in the 2010 origin and destination survey is representative of the current pool of Maine Turnpike patrons. Therefore, this data was used to distribute diverting trips if the York Toll were converted to AET.

The first step in developing the distribution of the diverting trips was to apply a series of filters to the 13,095 surveys received and only consider those that were considered "valid" for the purposes of evaluating diversion at the York Toll Plaza. The following is a breakout of the filters used and the total number of surveys remaining after that filter was applied.

Trips passing through the York Toll (4,068 surveys)
This filter was used to extract only those surveys that reported a trip passing through the York Toll Plaza (i.e. northbound trips entering the Maine Turnpike at or south of Exit 7 and exiting north of Exit 7 and southbound trips entering the Maine Turnpike north of Exit 7 and exiting at or south of Exit 7).

Cash Trips (1,228 surveys)
This filter was used to extract only those surveys that reported paying tolls via cash. This filter was applied because HNTB assumes that all patrons who currently use the York Toll and pay using E-ZPass would continue to use the York Toll if it were converted to AET.

Trips not willing to convert to ETC (853 surveys)
Survey participants were asked, in 2010, if they would be willing to convert from cash to E-ZPass if the York Toll were converted from a conventional toll plaza to an Open Road Tolling (ORT) facility. HNTB assumes that if a patron would be willing to convert to E-ZPass if the York Toll were converted to an ORT facility then they would also be willing to convert to E-ZPass if it were converted to an AET facility as well. As a result, patrons that responded positively to this question were removed from further consideration.

Valid Trips (843 surveys)
An additional 10 surveys were determined to contain inaccurate and/or missing information that would be required for the analysis (i.e. a northbound trip reporting with an end destination of New York). These were also removed from consideration.

The remaining 843 surveys are representative of patrons who use the York toll plaza, use cash to pay tolls, and would not be willing to convert to E-ZPass if the York Toll were converted to AET. Moreover, these surveys are representative of the patrons that would likely divert to avoid the York Toll.

The next step was to determine what percentage of traffic would use US Route 1 to avoid the York Toll. It is reasonable to assume that patrons would either A) avoid the York toll by using US Route 1 between the York (Exit 7) and Wells (Exit 19) interchanges or B) completely divert from the Maine Turnpike. To do this, Google maps was used to first estimate the travel time using the Maine Turnpike and then estimate the travel time to completely divert the Maine Turnpike by using the "Avoid Tolls" toggle. To develop a travel time for a trip that would divert from the Maine Turnpike using US Route 1 between York and Wells, 13 minutes was added to the trip time given by Google Maps that could have been made by staying on the Turnpike. The travel times to divert using US Route 1 between York and Wells were then compared to the travel times to completely divert from the Maine Turnpike. All trips whose travel time was greater than 15 minutes to avoid US Route 1, were assumed to avoid the York Toll using US Route 1 between the York and Wells interchanges. Note that HNTB assumed that all northbound trips ending in or southbound trips originating from a town that was either bisected by or located east of I-95 would divert using US Route 1. Figure 5 shows the destination towns of the non-E-ZPass users from the origin and destination survey.

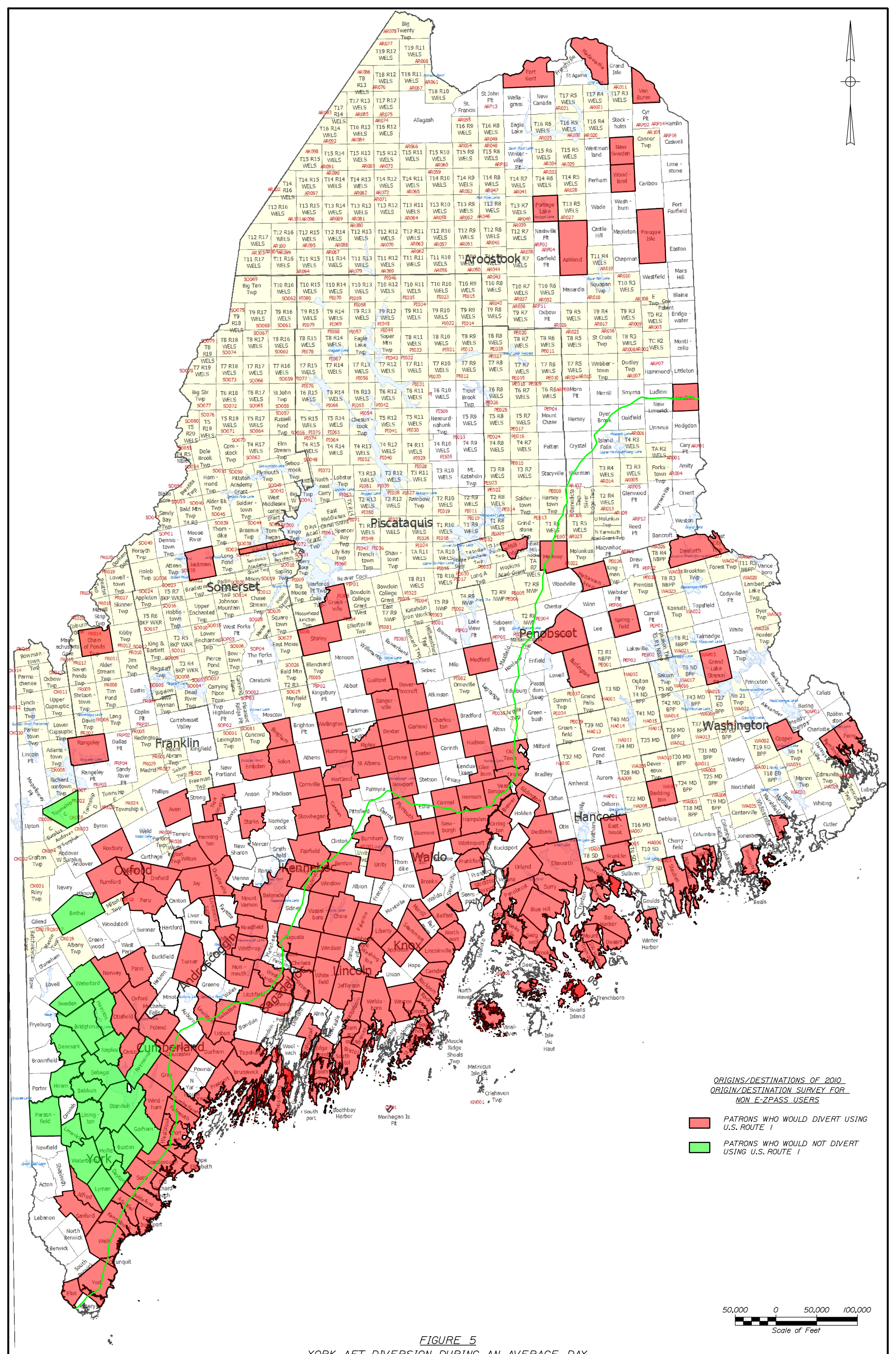


FIGURE 5
YORK AET DIVERSION DURING AN AVERAGE DAY

As shown in Figure 5, all trips with either a northbound destination or a southbound origin located in a town that is shaded in gray are assumed to divert the York toll using roads other than US Route 1. Of the 843 surveys considered, a total 75 surveys (or 8.9%) reported one of these trips. Therefore, it can be expected that only 8.9% of the traffic diverting the York Toll would divert using roads other than US Route 1 during an average day.

STUDY AREA

The study area for the peak hour of an average day analysis, includes the two interchanges on either side of the York Toll Plaza – Exits 7 and 19, the parallel arterial (US Route 1), and arterial roads that provide access to Exits 7 and 19 – the Turnpike Connector in York, and State Route 9/109 in Wells. Other roads were not included in this analysis as the MTA origin and destination survey data indicates that 9% of the trips would not use US Route 1. The intersections that were chosen include those that are expected to have increased turning traffic volumes as well as the intersection of US Route 1 and Beach Street/Shore Road in Ogunquit due to the complexity of that intersection.

The study area contains the following three signalized intersections:

- State Route 109/9 and the Exit 19 ramps
- State Route 109/9 and US Route 1
- US Route 1 and the Turnpike Connector/Stonewall Lane

The remaining three intersections analyzed are unsignalized. They are the following:

- Exit 7 NB ramps and the Turnpike Connector (stop controlled)
- Exit 7 SB ramps and the Turnpike Connector (stop controlled)
- US Route 1 and Beach Street and Shore Road (stop controlled)

TRAFFIC DATA COLLECTION

In order to gain a better understanding of the existing traffic conditions in the study area, traffic data was gathered from available sources. The data collected was used in performing traffic capacity analysis, which estimates traffic congestion and delay. The traffic data that was gathered included 24 hour traffic data as well as hourly turning movement counts.

Twenty-four hour traffic data was gathered from available sources. The most recent data available for an entire year was gathered for the following locations:

- US Route 1 in Ogunquit at the location of MaineDOT's permanent count station,
- York Toll Plaza

Existing hourly turning movement data were collected for the study area intersections from various sources. The turning movement data that was collected was taken during *average traffic* months (May, September, and October).

PEAK HOUR TRAFFIC CAPACITY ANALYSIS DESCRIPTION

An industry accepted traffic analysis software, Synchro, was used to analyze study area intersections. Synchro is a microsimulation traffic model whose methods are based on the Highway Capacity Manual (HCM)[4]. The HCM is an industry-accepted manual that sets forth a methodology to determine the level of service at which traffic operates.

Level of Service (LOS) is a qualitative measure describing operational conditions within a traffic stream. LOS is based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience. Letters designate each level ranging from A to F, where a LOS

[4]Transportation Research Board. *Highway Capacity Manual*, Washington, D.C.: 2000.

of A represents free flow operating conditions and LOS F represents a stop-and-go congested condition. Descriptions of each LOS designation are as follows:

- *LOS A* represents free flow. The general level of comfort and convenience to the motorist is excellent.
- *LOS B* is in the range of stable flow but the level of comfort and convenience is somewhat less than at LOS A.
- *LOS C* is in the range of stable flow, but marks the beginning of the range of flow in which the operation of the individual users becomes significantly affected by the presence of other motorists. The general level of comfort and convenience declines is noticeable at this level.
- *LOS D* represents high density but stable flow. The motorists experience a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operations problems at this level.
- *LOS E* represents operating conditions at or near the capacity level. Comfort and convenience levels are extremely poor. Operations at this level are usually unstable because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.
- *LOS F* represents a stop-and-go condition. More vehicles are on the roadway than can be accommodated.

Generally, most agencies consider a LOS D or better to be an acceptable design standard. Tables 3 and 4 summarize the relationship between delay and LOS for unsignalized intersections and signalized intersections, respectively.

Table 3- LOS Criteria for Unsignalized Intersections

Level of Service	Delay per Vehicle (sec)
A	0.0 to 10.0
B	10.1 to 15.0
C	15.0 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

Table 4 - LOS Criteria for Signalized Intersections

Level of Service	Delay per Vehicle (sec)
A	0.0 to 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

The traffic analysis model Synchro was used to analyze traffic conditions in the study area for 2019 No-Build and 2019 Build conditions.

2019 Traffic Analysis

The process of analyzing traffic within the study area involved starting with peak hour of traffic that represents a peak hour for an average day. The hour 3:00-4:00 was found to be the highest hour of a

typical May weekday for the York Toll Plaza and the count station on US Route 1 in Ogunquit. As such, the hour of 3:00-4:00 would yield the peak hour of the study area.

A traffic network was set up from the traffic data that was gathered. The peak hour traffic volumes were assumed to grow at a rate of 1.1% per year to the opening year of 2019. The peak hour growth rate is consistent with the historic growth rate measured on US Route 1 in Ogunquit during May in the study area.

2019 No-Build traffic congestion and delays were analyzed using the methods described in the previous section. The traffic volumes were input into the traffic capacity model and analyzed. The delay and LOS ratings for each of the nine study area intersections are illustrated in Table 6.

Table 6 – 2019 No-Build Delay & LOS Summary

Intersection Description	**Control**	**Delay (s)**	**LOS**
Route 1 at Turnpike Connector/Stonewall Lane in York	Signal	18.3	B
Route 1 at Route 9/109 in Wells	Signal	12.1	A
Route 1 at Shore Road and Beach Street in Ogunquit	Stop	73.3	F
Turnpike Connector and the NB Turnpike ramps in York	Stop	6.6	A
Turnpike Connector and the SB Turnpike ramps in York	Stop	120.3	F
Route 9 and the Turnpike ramps in Wells	Signal	16.6	B

The level of service results for unsignalized intersections reflects the average delay on the stop controlled approaches to the intersection. The level of service results for signalized intersections reflects the overall delay for the entire intersection. As shown, two of the intersections in the study area are not expected to operate at an acceptable level of service in 2019:

- Route 1 at Shore Road and Beach Street in Ogunquit
- Turnpike Connector and the SB Turnpike ramps in York

2019 BUILD TRAFFIC ANALYSIS

The average traffic diversion and 90th percentile confidence traffic diversion estimates were distributed onto the 2019 study area roadway network based on current traffic distribution at the York Toll Plaza. These Build condition traffic volumes were input into the traffic capacity model and analyzed. The delay and LOS ratings for each of the nine study area intersections are illustrated in Table 7.

Table 7 – 2019 Delay & LOS Summary

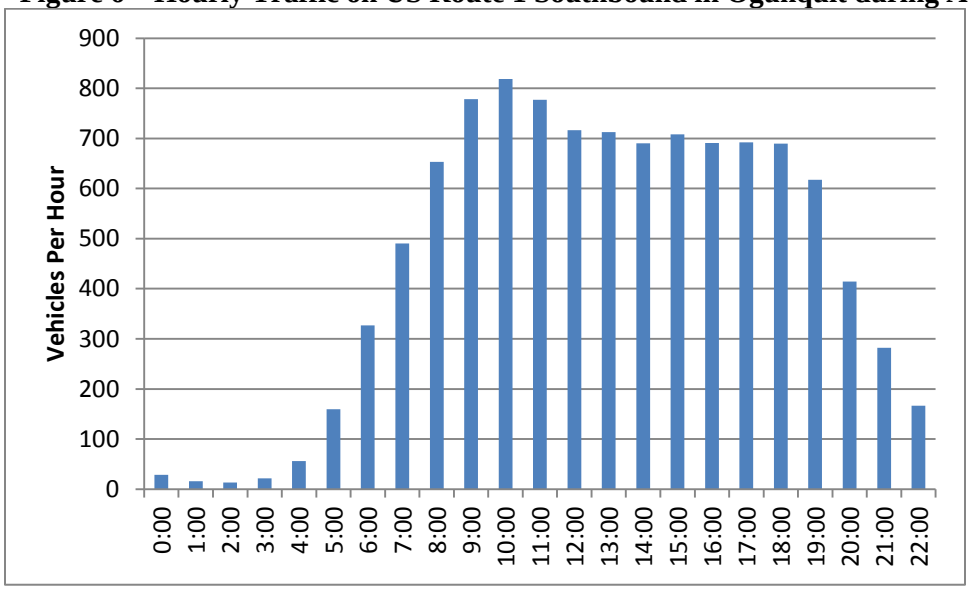
		2019 No Build		2019 Avereage Diversion with AET		2019 90th Percentile Diversion with AET	
Intersection Description	**Traffic Control**	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**	**Delay (s)**	**LOS**
Route 1 at Turnpike Connector/Stonewall Lane in York	Signal	18.3	B	20.1	C	24.9	C
Route 1 at Route 9/109 in Wells	Signal	14.6	B	17.7	B	20.1	C
Route 1 at Shore Road and Beach Street in Ogunquit	Stop	73.3	F	202.4	F	326.2	F
Turnpike Connector and the NB Turnpike ramps in York	Stop	6.6	A	6.6	A	7.3	A
Turnpike Connector and the SB Turnpike ramps in York	Stop	120.3	F	253.1	F	375.8	F
Route 9 and the Turnpike ramps in Wells	Signal	13.9	B	15.8	B	17.3	B

As shown, all intersections analyzed would worsen with AET. Some experience moderate increases in delay, while others would see significant increases in the amount of time it would take to travel through these intersections. The two intersections in the study area that are not expected to operate at an acceptable level of service in 2019 would worsen significantly with additional diversion. At the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit, average delays for Shore Road and Beach Street would increase from 73 seconds (1.2 minutes) to 202-326 seconds (3.4-5.4 minutes). At the intersection of the Turnpike Connector and the SB Turnpike ramps in York, average delays for the southbound off-ramp would increase from 120 seconds (2 minutes) to 253-376 seconds (4.2-6.3 minutes). Converting the York Toll Plaza to AET could triple the delays at the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit and at the intersection of the SB Turnpike ramps and the Turnpike Connector in York during a peak hour of an average day.

CRITICAL ROADWAY LINK CAPACITY ANALYSIS

In addition to the intersection analysis, a roadway link capacity analysis was also performed. Hourly traffic volumes are required to conduct this analysis. The MaineDOT maintains a permanent count station in Ogunquit located just north of Captain Thomas Road. Figure 1 shows the hourly traffic volumes that occurred on an average weekday in August 2014 on US Route 1 Southbound.

Figure 6 – Hourly Traffic on US Route 1 Southbound in Ogunquit during August 2014 Weekdays



As can be seen from Figure 6, traffic volumes on US Route 1 southbound peaks around 10:00 a.m. and falls slightly and remains steady at around 700 vehicles per hour for seven hours. The pattern that this graphic shows is that there is more traffic demand than available roadway capacity. The capacity for the roadway is the amount traffic that gets through the count station on US Route 1 every hour during the plateau – about 700 vehicles per hour. Therefore, whenever traffic on US Route 1 in Ogunquit reaches 700 vehicles per hour per direction, traffic conditions become congested.

According to the traffic count data on US Route 1 for an average weekday in May, there were 428 southbound vehicles and 515 northbound vehicles during 2014. If peak hour traffic grows at the rate of 1.1%, then the expected peak hour traffic volumes for 2019 would be 450 southbound vehicles and 541 northbound vehicles. Table 8 shows the expected 2019 traffic volumes with diverted traffic.

Table 8 – 2019 Average Day Peak Hour Traffic on US Route 1 in Ogunquit

	2019 Traffic without Diversion	Traffic Volume/ Capacity	Average Diversion plus 2019 Traffic	Traffic Volume/ Capacity	90th Percentile Diversion plus 2019 Traffic	Traffic Volume/ Capacity
Northbound	541	0.77	637	0.91	721	1.03
Southbound	450	0.64	532	0.76	603	0.86

As can be seen from Table 8, a potential conversion of the York Toll Plaza to AET would cause the northbound direction of US Route 1 in Ogunquit to operate at 91-103% of its capacity and would cause the southbound direction to operate at 76-86% of its capacity. If a roadway operates at or over capacity, then the amount of traffic that wants to use the roadway cannot be accommodated. Traffic conditions become congested with stop-and-go traffic. The traffic demand would spill into the next hour which affects traffic conditions in that hour.

Traffic backups and congestion would likely occur in the northbound direction during peak hours in May (an average traffic month) if the York Toll Plaza is converted to AET. The southbound direction would also experience additional delays due to the increased volume to capacity ratio. The months of June, September, and October typically have more traffic than May and therefore, traffic backups and congestion would occur during peak hours of these months, as well. Table 9 shows an analysis of hourly

traffic count data for May, June, September, and October. As can be seen from Table 9, there could be 2 – 3 times as many hours of traffic congestion on US Route 1 during average traffic months if the York Toll Plaza is converted to AET.

Table 9 – 2019 Hours of Congested Traffic on US Route 1 in Ogunquit

Month	Total Number of Congested Traffic Hours during Month	Total Number of Congested Traffic Hours during Month with Average Diversion
May	22	62
June	77	164
September	97	193
October	33	94

Conclusions

This study analyzed the traffic impacts of the expected traffic diversion if the York Toll Plaza is converted to AET. The traffic impacts of the diversion were analyzed for two different time periods – an average summer weekday and the peak hour of an average day due to the different characteristics of each.

Both analyses identified that traffic would increase on non-interstate highways and depending upon the time of year, the following municipalities would experience significant impacts to key roadways and intersections:

- Ogunquit
- York
- Kittery
- Eliot
- Wells
- South Berwick
- Berwick
- North Berwick
- Sanford
- Kennebunk

The average summer weekday analysis showed that traffic impacts from installing AET at York Toll Plaza would increase traffic on the non-interstate highways. Increases in daily summer traffic volumes are expected along US Route 1, with much higher increases in traffic volumes on other non-interstate highways in York County such as State Route 236, State Route 109/9, and State Route 4. Several roadways would see increases of daily summer traffic volumes of 5-50%. Travelers on these inland corridors will experience more delays at intersections already identified by MaineDOT as having a relatively poor level of service. Such intersections include the State Route 236/Depot Road intersection in Eliot and intersections in downtown South Berwick where State Routes 4 and 236 overlap[5].

The peak hour analysis of an average summer day showed that two intersections in the study area that already operate at a LOS F would see expected delays triple. At the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit, average delays for Shore Road and Beach Street would increase from 73 seconds (1.2 minutes) to 202-326 seconds (3.4-5.4 minutes). At the intersection of the Turnpike Connector and the SB Turnpike ramps in York, average delays for the southbound off-ramp would increase from 120 seconds (2 minutes) to 253-376 seconds (4.2-6.3 minutes). Converting the York Toll

[5] Maine Department of Transportation Bureau of Transportation Systems Planning. *Route 236 Corridor Study Kittery – Eliot – S. Berwick*: October 2008.

Plaza to AET could triple the delays at the intersection of US Route 1 at Shore Road and Beach Street in Ogunquit and at the SB Turnpike ramps in York during a peak hour of an average day.

A potential conversion of the York Toll Plaza to AET would cause the northbound direction of US Route 1 in Ogunquit to operate over capacity and would cause the southbound direction to operate at 76-86% of its capacity during an average peak hour in May (which was analyzed as it represents a peak hour of an average day). In other words, traffic backups and congestion would happen during peak hours of average traffic months if the York Toll Plaza is converted to AET.

If the York Toll Plaza is converted to AET, there would be an increase in the number of hours during the year when traffic on US Route 1 will be congested in other words stop-and-go conditions. Traffic conditions on US Route 1 that are currently experienced in July and August would occur on the shoulder seasons. Significant traffic volume growth will occur in the months of May, June, September, and October. Stated more simply, summer-like traffic will expand into the Spring and Fall.

During the summer, traffic and corresponding emissions would increase on other non-interstate highways in York County. Daily traffic volumes on some of the non-interstate highways in York County could increase by 5-50%, while traffic volumes on the Maine Turnpike decreases. What does this mean for the non-interstate roads? Traffic at unsignalized intersections on impacted roadways would see more delay. The need for signals and intersection improvements at several unsignalized intersections would be accelerated. In contrast, the Maine Turnpike would see a proportionately small decrease in traffic volumes.