

Traffic Impact Study

Residential Development

3102 Cranberry Highway (Route 6)
Wareham, MA

Prepared by
McMahon Associates, Inc.
300 Myles Standish Boulevard, Suite 201
Taunton, MA 02780
508.823.2245

Prepared for
Dakota Partners, Inc.

November 2017

TABLE OF CONTENTS

INTRODUCTION.....	1
<i>PROJECT DESCRIPTION</i>	<i>1</i>
<i>STUDY METHODOLOGY</i>	<i>3</i>
<i>STUDY AREA INTERSECTIONS.....</i>	<i>3</i>
EXISTING CONDITIONS.....	4
<i>ROADWAY NETWORK</i>	<i>4</i>
<i>PEDESTRIAN, BICYCLE AND TRANSIT ACCOMMODATIONS.....</i>	<i>4</i>
<i>EXISTING TRAFFIC VOLUMES</i>	<i>5</i>
<i>CRASH SUMMARY</i>	<i>7</i>
FUTURE CONDITIONS	8
<i>FUTURE ROADWAY IMPROVEMENTS.....</i>	<i>8</i>
<i>BACKGROUND TRAFFIC GROWTH</i>	<i>8</i>
<i>2024 NO BUILD TRAFFIC VOLUMES.....</i>	<i>9</i>
<i>SITE-GENERATED TRAFFIC</i>	<i>11</i>
<i>PROJECT TRIP DISTRIBUTION AND ASSIGNMENT</i>	<i>11</i>
<i>2024 FUTURE BUILD PEAK HOUR TRAFFIC VOLUMES</i>	<i>12</i>
<i>LEVEL-OF-SERVICE CRITERIA</i>	<i>15</i>
<i>CAPACITY ANALYSIS RESULTS.....</i>	<i>15</i>
<i>TRANSPORTATION DEMAND MANAGEMENT.....</i>	<i>17</i>
<i>SIGHT DISTANCE</i>	<i>17</i>
CONCLUSION	19

LIST OF TABLES

Table 1: Vehicular Trip Generation	11
Table 2: Peak Hour Intersection Capacity Analysis.....	16
Table 3: Sight Distance Requirements.....	18

LIST OF FIGURES

Figure 1: Site Location.....	2
Figure 2: 2017 Existing Peak Hour Traffic Volumes	6
Figure 3: 2024 No Build Peak Hour Traffic Volumes	10
Figure 4: Direction of Arrivals and Departures.....	13
Figure 5: 2024 Build Weekday Peak Hour Traffic Volumes	14

LIST OF APPENDICES

Appendix A: Manual Turning Movement Counts	
Appendix B: Crash Summary	
Appendix C: Traffic Projection Model	
Appendix D: Highway Capacity Manual Methodologies	
Appendix E: 2017 Existing Capacity/Level-of-Service Analysis	
Appendix F: 2024 No Build Capacity/Level-of-Service Analysis	
Appendix G: 2024 Build Capacity/Level-of-Service Analysis	
Appendix H: Capacity/Level-of-Service Summary	

INTRODUCTION

McMahon Associates has reviewed the existing traffic operations and potential traffic impacts associated with the proposed residential development located at the intersection of Cranberry Highway (Route 6) and Red Brook Road in Wareham, Massachusetts. The purpose of this study is to evaluate the existing and projected traffic operational and safety conditions in the vicinity of the site and identify mitigating measures to offset potential project-related traffic impacts on the surrounding roadways, if necessary. This study has determined that with the proposed project in place, safe and efficient access will be provided to the project site.

The assessment is based on a review of current traffic volumes and crash data collected for this study, and the anticipated traffic generating characteristics of the proposed development. This study examines existing and projected traffic operations (both with and without the proposed development) at key intersections in the vicinity of the project site. The study area was chosen based on a review of the surrounding roadway network and the anticipated traffic generating characteristics of the proposed development. This study provides a detailed analysis of traffic operations during the weekday morning and weekday afternoon peak hours, when the combination of adjacent roadway volumes and potential traffic increases associated with the project would be greatest.

Based on the analysis presented in this study, the project-related traffic expected to be generated by the development will have a minimal effect on the area roadways and intersections. This report documents these findings.

Project Description

As shown in Figure 1, the proposed project site is located at 3102 Cranberry Highway (Route 6), in the northwestern corner of the intersection of Cranberry Highway (Route 6) and Red Brook Road, in Wareham, Massachusetts. The site is bounded by Red Brook Road to the east, commercial properties to the west, undeveloped land to the north, and Cranberry Highway (Route 6) to the south.

The project site presently consists of the Starlight motel. Access for the existing motel is provided by a full access driveway on Cranberry Highway (Route 6). The project proposes to raze the existing motel structure and construct a 174-unit apartment development comprised of six buildings. The site is proposed to be accessed via one full access driveway on Red Brook Road and one right-turn in/right-turn out driveway on Cranberry Highway (Route 6).



Figure 1
Site Location
Residential Development
Wareham, MA

Study Methodology

This study evaluates existing and projected traffic operations at study area intersections for the weekday morning and weekday afternoon peak hour traffic conditions when the combination of adjacent roadway volumes and potential traffic increases associated with the project would be greatest.

The study was conducted in three steps. The first step involved an inventory of existing traffic conditions in the vicinity of the site. As part of this inventory, traffic counts were collected at key intersections during the weekday morning and weekday afternoon peak periods. Crash data was obtained from the Massachusetts Department of Transportation (MassDOT) to evaluate existing safety deficiencies within the study area.

The second step of the study builds upon data collected in the first step and establishes the basis for evaluating the transportation impacts associated with future conditions. In this step, the projected traffic demands of other future developments that could influence traffic volumes at the study area intersections were assessed. Existing 2017 traffic volumes were projected to 2024 No Build (without project) conditions and 2024 Build (with project) conditions.

The final step identifies measures, if necessary, to improve existing and future traffic operations and safety, minimize potential traffic impacts, and provide safe and efficient access to the project site.

Study Area Intersections

The area identified for detailed analysis in this study was determined based on a review of the anticipated traffic generating characteristics of the proposed project and a review of the surrounding roadway network serving the project site. The study area intersections include:

- Cranberry Highway (Route 6) at Red Brook Road
- Cranberry Highway (Route 6) at site driveway
- Red Brook Road at proposed site driveway

EXISTING CONDITIONS

Effective evaluation of potential traffic impacts associated with the proposed development requires a thorough understanding of the existing traffic conditions on the roadways and intersections serving the project site. The assessment of existing conditions consists of an inventory of the roadway and intersection geometries and traffic control devices, collection of peak-period traffic volumes, and a review of recent crash history. A discussion of this information is presented below.

Roadway Network

The project site benefits from excellent access via the local and regional roadway systems. A brief description of the principal roadways serving the project site is presented below.

Cranberry Highway (Route 6)

Cranberry Highway (Route 6) runs in the east-west direction through the Town of Wareham and is classified as an urban minor arterial under MassDOT jurisdiction. In the vicinity of the project site Cranberry Highway (Route 6) is primarily a four-lane, two-way roadway abutted by commercial properties and provides two travel lanes in each direction measuring 12 feet in width with varying shoulder widths. Cranberry Highway (Route 6) has a posted speed limit of 35 miles per hour (mph).

Red Brook Road

Red Brook Road is classified as an urban minor arterial under the Town of Wareham jurisdiction and connects to Cranberry Highway to the west and to Head of the Bay Road to the east. Red Brook Road is primarily a two-lane, two-way roadway that is 24 feet in width with 12-foot wide travel lanes in each direction and no marked shoulders. Red Brook Road is under stop control at its intersection with Cranberry Highway and is generally abutted by residential properties. The posted speed limit on Red Brook Road is 30 mph.

Pedestrian, Bicycle and Transit Accommodations

There are currently no sidewalks located on Cranberry Highway (Route 6) or Red Brook Road, however, as part of a future MassDOT project expected to begin in 2018, sidewalks are planned to be installed on both sides of Cranberry Highway (Route 6) and Red Brook Road in the vicinity of the proposed site. In addition, a crosswalk with a pedestrian signal are planned to be provided at the intersection of Cranberry Highway (Route 6) and Red Brook Road when the intersection is converted to a traffic signal. No bicycle accommodations are currently provided within the study area, however five-foot wide bicycle tolerant shoulders are planned to be provided as part of the future MassDOT project. In addition, bicycle signal loop detectors would be provided at the new signalized intersection. Cranberry Highway (Route 6) is serviced by the Greater Attleboro Taunton Regional Transit Authority (GATRA) Onset/Wareham Link 2 bus route with multiple stops along the corridor. The service runs on

weekdays generally between 8:00 AM and 6:00 PM, as well as on Saturdays generally between 9:00 AM and 6:00 PM with less frequent stops.

Existing Traffic Volumes

To assess peak hour traffic conditions, Manual Turning Movement Counts (MTMC) were conducted at the study area intersections. Traffic count data was collected during the weekday morning peak period from 7:00 AM to 9:00 AM, and weekday afternoon peak period from 4:00 PM to 6:00 PM on Tuesday, May 2, 2017 at the existing Starlight Motel driveway on Cranberry Highway (Route 6).

Traffic volume data for the study for the intersection of Cranberry Highway (Route 6) at Red Brook Road was referenced from the Sonic Restaurant Traffic Impact Study prepared by McMahon Associates dated March 2017. The traffic counts were collected on Wednesday, January 4, 2017 during the weekday morning peak period from 7:00 AM to 9:00 AM, and weekday afternoon peak period from 4:00 PM to 6:00 PM.

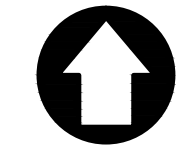
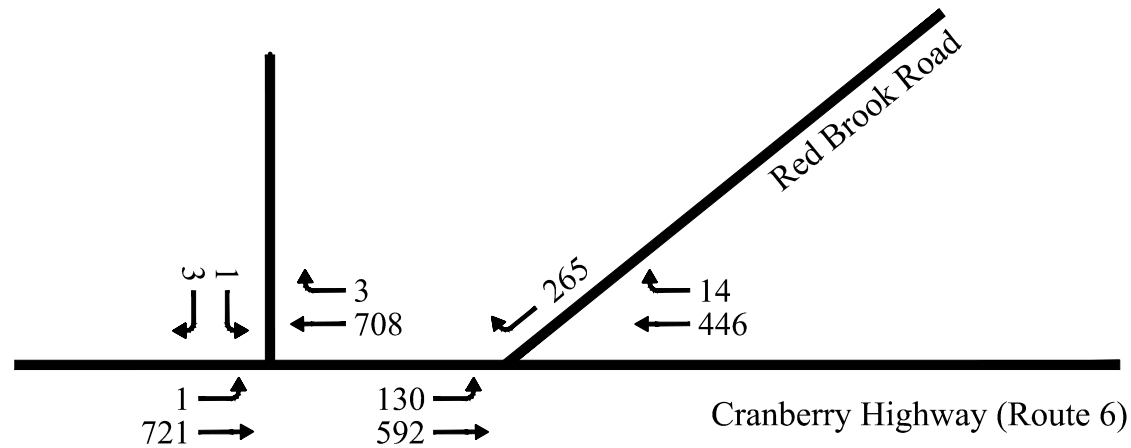
Existing Peak Hour Traffic Volumes

The results of the MTMC counts are tabulated by 15-minute periods in Appendix A. The four highest consecutive 15-minute intervals during each of these count periods constitute the peak hours that are the basis of this traffic analysis. Based on a review of the traffic count data, the weekday morning peak hour on Cranberry Highway (Route 6) occurs between 7:45 AM and 8:45 AM, and the weekday afternoon peak hour is shown to occur between 4:15 PM and 5:15 PM.

Seasonal Variation

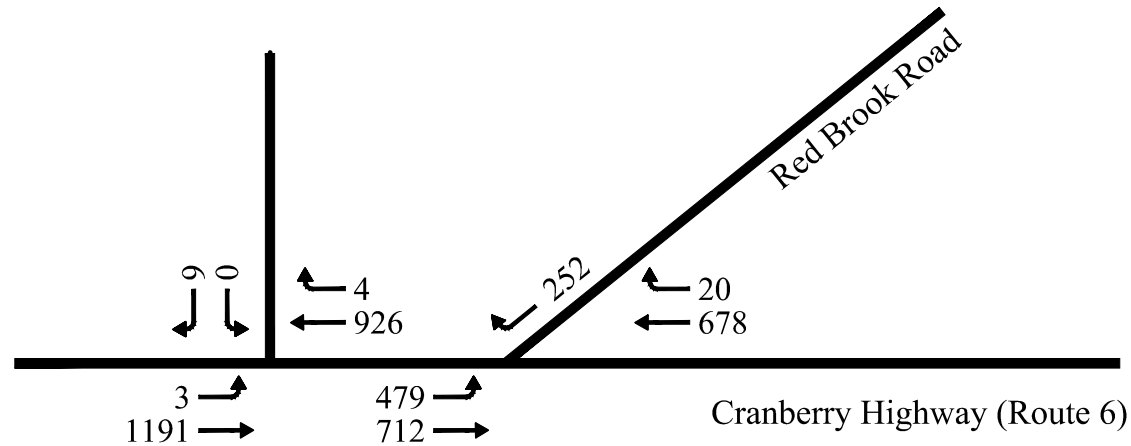
In order to determine seasonal variation in this area, traffic data from a nearby continuous count station on Interstate 195 in Wareham, Massachusetts was reviewed. Based on the data provided, traffic volumes in the month of January are lower than an average month, and traffic volumes in the month of May are higher than an average month in this area. Therefore, to provide a conservative analysis, the existing peak hour traffic volumes for the intersection of Cranberry Highway (Route 6) at Red Brook Road that were collected in January were seasonally adjusted upward by approximately 24% to reflect an average month, and the existing traffic volumes collected in May were not adjusted. The adjusted peak hourly traffic flows are depicted in Figure 2 for the weekday morning and weekday afternoon peak hours.

Weekday AM



SCHEMATIC-
NOT TO SCALE

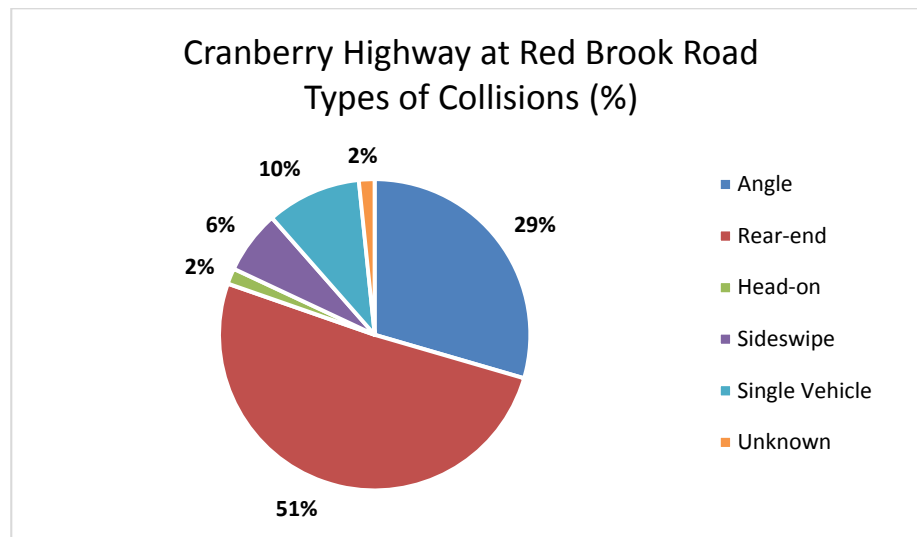
Weekday PM



Crash Summary

Crash data for the study area intersections was obtained from MassDOT for the most recent five-year period available. This data includes complete yearly crash summaries for 2010, 2011, 2012, 2013 and 2014. A summary of the crash data is presented in Appendix B.

The unsignalized intersection of Cranberry Highway (Route 6) at Red Brook Road had a total of 61 reported crashes over the five-year period analyzed, resulting in a crash rate of 1.41 crashes per million entering vehicles, which is higher than both the District 5 and statewide average of 0.58 crashes per million entering vehicles for an unsignalized intersection. This intersection was identified as a high crash location under the Federal Highway Association (FHWA)'s Highway Safety Improvement Program (HSIP) in 2012-2014. A Road Safety Audit (RSA) dated December 2012 was completed for this intersection. A majority of the collisions were rear end and angle collisions which are common at unsignalized intersections. Of the crashes that were reported, 15 of the crashes resulted in personal injury and the other 46 collisions resulted in property damage only. As part of a future MassDOT roadway improvement project on Cranberry Highway (Route 6), a traffic signal is planned to be installed at this intersection. The new traffic signal is expected to address the existing safety issues at the intersection.



During the five-year period analyzed, there were no reported crashes at the existing site driveway on Cranberry Highway (Route 6).

FUTURE CONDITIONS

To determine future traffic demands on the study area roadways, the 2017 Existing traffic volumes were projected to the future year 2024, when the proposed development is expected to be fully built and occupied. Independent of the proposed project, traffic volumes on the roadways in 2024 are assumed to include all existing traffic, as well as new traffic resulting from general growth in the study area and from other planned development projects. The potential background traffic growth unrelated to the proposed project was considered in the development of the 2024 No Build (without project) peak hour traffic volume networks. The anticipated traffic increases associated with the proposed development were then added to the 2024 No Build volumes to reflect the 2024 Build (with project) traffic conditions. A more detailed description of the development of the 2024 No Build and 2024 Build traffic volume networks follows.

Future Roadway Improvements

Planned roadway improvement projects can affect area travel patterns and future traffic operations. To develop a clearer understanding of future area roadway operations, McMahon confirmed that there is a future MassDOT design project to reconstruct Cranberry Highway (Route 6) and several intersections to address existing safety issues. A concrete median barrier is planned to be installed on Cranberry Highway (Route 6) and left turns would be provided only at specified signalized or unsignalized intersections for motorists to U-turn to the various commercial businesses along the corridor. The 100% Design plans dated March 2016 and a Functional Design Report (FDR) dated June 2010 were obtained from MassDOT for reference in this traffic impact study. Intersection improvements are proposed for the study area intersection of Cranberry Highway (Route 6) at Red Brook Road which is further detailed below.

As part of the MassDOT project, which is tentatively scheduled to begin in 2018, the intersection of Cranberry Highway (Route 6) and Red Brook Road is proposed to be signalized with additional lane improvements. The intersection is proposed to operate with three phases for vehicular traffic, including a lead eastbound and westbound left turn/U-turn phase on Cranberry Highway, a phase for through traffic on Cranberry Highway (Route 6) with permissive left turns, and a phase for southbound traffic from Red Brook Road. There is also a push-button activated exclusive pedestrian phase for a proposed crosswalk along the eastern leg of the intersection. The southbound approach is proposed to be realigned and provide exclusive left and right turn lanes. For the purposes of this traffic impact study, the planned MassDOT improvements at the intersection of Cranberry Highway (Route 6) and Red Brook Road have been included in the future-year traffic analysis.

Background Traffic Growth

Traffic growth is primarily a function of changes in motor vehicle use and expected land development in the region. To predict a rate at which traffic on the roadways in the vicinity

of the site can be expected to grow during the seven-year forecast period (2017 to 2024), both historic traffic growth and planned area developments were examined.

Historic Traffic Growth

A background growth rate of one percent per year was identified in order to forecast increases in general traffic volumes on the study area roadways and intersections for our future analyses. The traffic growth rate for the project area was confirmed by the Southeastern Regional Planning and Economic Development District (SRPEDD). This rate captures growth associated with general changes in population and accounts for other small developments in the vicinity of the study area.

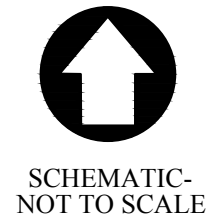
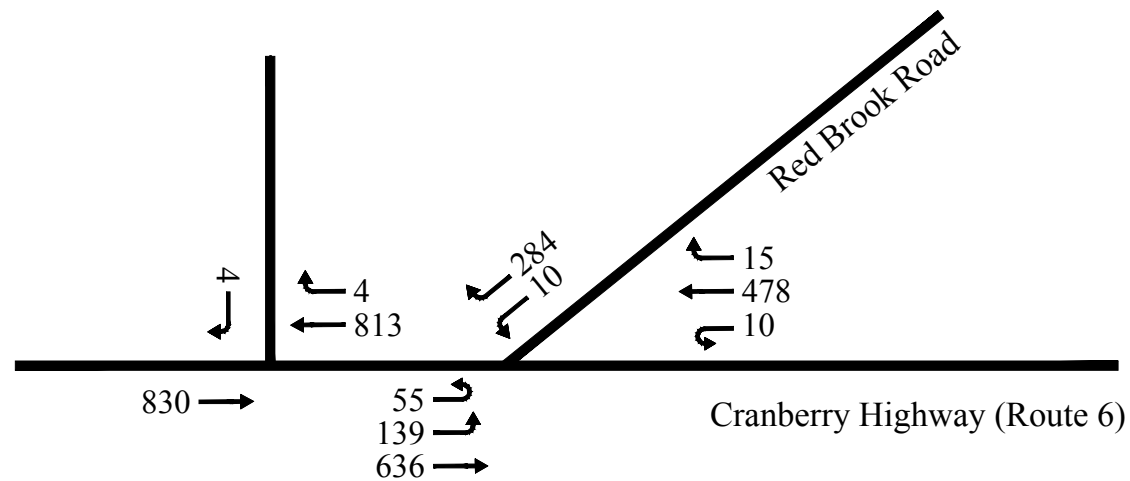
Site-Specific Growth

Based on information provided by the Wareham Town Planner, there are multiple developments proposed along this corridor including a small used car dealership and tire store. Based on input from SRPEDD, Cranberry Highway (Route 6) has experienced a decrease in volume in past years. Therefore, the one percent annual growth is expected to capture any small new developments within the vicinity of the project area.

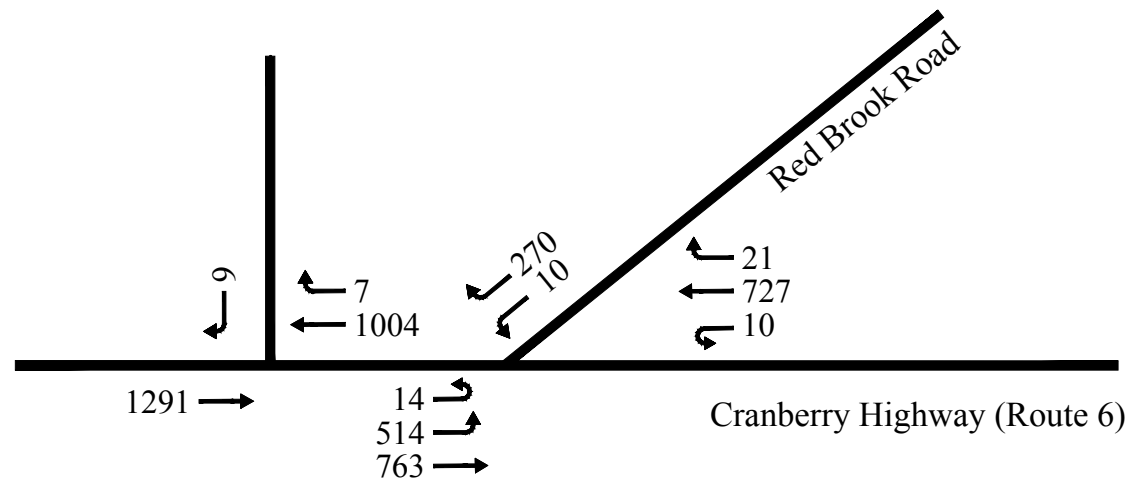
2024 No Build Traffic Volumes

The 2017 Existing peak hour traffic volumes were grown by one percent per year over the seven-year study horizon (2017 to 2024) added to establish the 2024 base future traffic volumes. The 2024 No Build weekday morning and weekday afternoon peak hour traffic volume networks are illustrated in Figure 3, and are documented in the traffic projection model presented in Appendix C of this report.

Weekday AM



Weekday PM



Site-Generated Traffic

The Institute of Transportation Engineers (ITE) is a national research organization of transportation professionals. Their publication, *Trip Generation Manual, 9th Edition*, provides traffic generation information for various land uses compiled from studies conducted by members nationwide. Vehicle trip estimates for the proposed residential development were developed based on data presented in this publication for Land Use Code 220 (Apartment). This reference establishes vehicle trip rates based on actual traffic counts conducted at similar existing developments.

Table 1 presents the projected future trip generation volumes of the proposed residential development during a typical weekday, the weekday morning peak hour and the weekday afternoon peak hour. The trip generation rates were developed based the land use code described above for the 174 unit apartment complex. The proposed development would remove trips associated with the existing motel on the site. Therefore the existing motel trips, counted in May 2017, were removed in order to determine the increase in vehicle trips expected to be generated by the project.

Table 1
Vehicular Trip Generation

<u>Description</u>	Weekday AM Peak Hour			Weekday PM Peak Hour		
	<u>In</u>	<u>Out</u>	<u>Total</u>	<u>In</u>	<u>Out</u>	<u>Total</u>
Proposed Residential Development ⁽¹⁾	18	71	89	73	40	113
Existing Starlight Motel ^{(2) (3)}	<u>4</u>	<u>4</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>13</u>
Total Additional Project Trips	14	67	81	66	34	100

(1) ITE Land Use Code 220 (Apartment) based on 174 units

(2) Peak hour volumes based on traffic counts collected on May 2, 2017

(3) Daily volumes estimated using ITE Land Use Code 320 (Motel) based on 17 occupied rooms

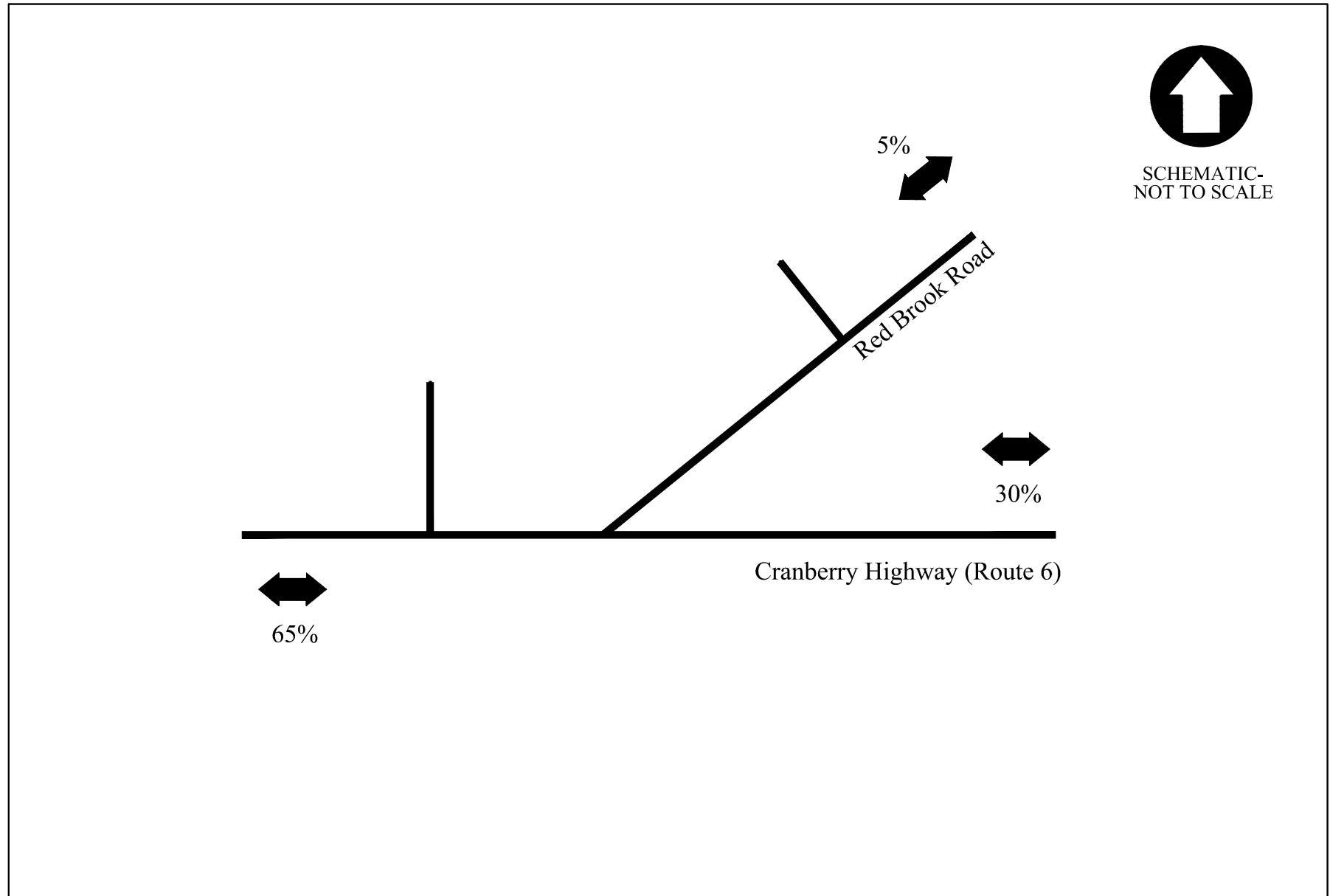
As shown in Table 1, the proposed residential development is estimated to result in an increase of approximately 81 vehicle trips (14 vehicles entering, 67 vehicles exiting) during the weekday morning peak hour, and approximately 100 vehicle trips (66 vehicles entering, 34 vehicles exiting) during the weekday afternoon peak hour.

Project Trip Distribution and Assignment

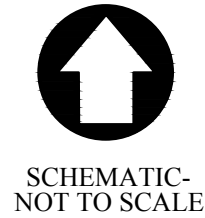
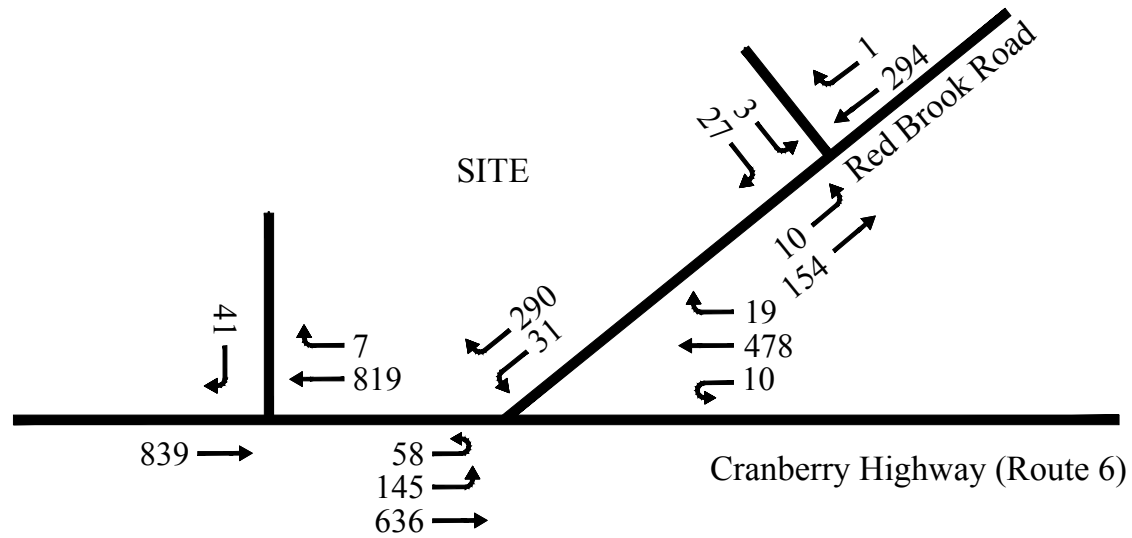
The additional traffic expected to be generated by the proposed development was distributed onto the study area roadways and intersections based on 2010 Journey to Work Census data. New vehicle trips are expected to access and egress the project site via the Cranberry Highway (Route 6) and Red Brook Road. The resulting arrival and departure patterns are presented in Figure 4.

2024 Future Build Peak Hour Traffic Volumes

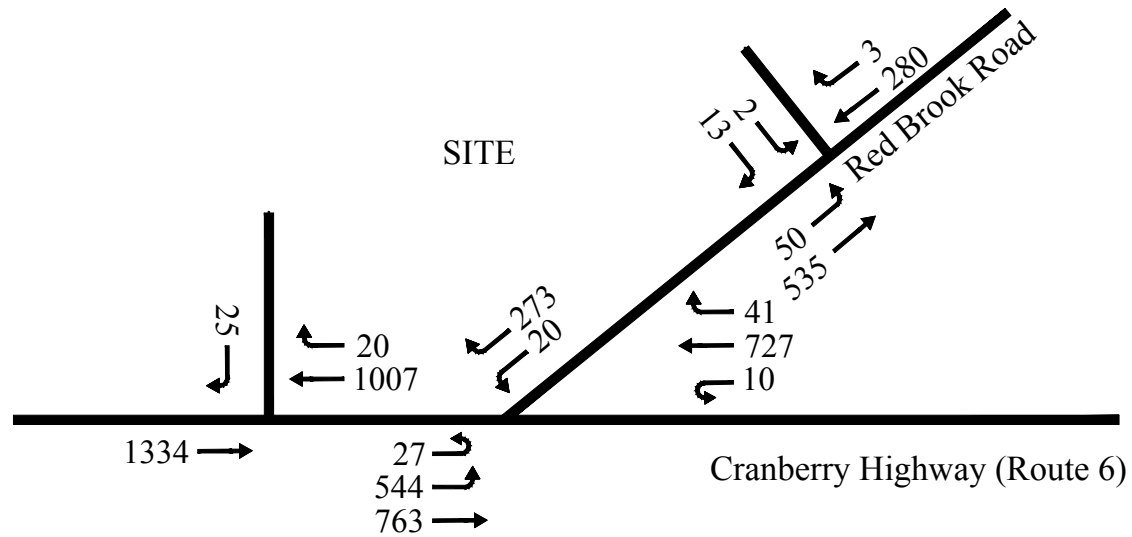
To establish the 2024 Build peak hour traffic volumes, the project-related traffic was assigned to the surrounding roadway network based on the project distribution patterns presented in Figure 4. These project trips were then added to the 2024 No Build peak hour traffic volumes to reflect the 2024 Build peak hour traffic volumes. The resulting 2024 Build weekday morning and weekday afternoon peak hour traffic volumes are presented in Figure 5.



Weekday AM



Weekday PM



TRAFFIC OPERATIONS ANALYSIS

In previous sections of this report, the quantity of traffic on the study area roadways was described. The following section describes the quality of traffic flow at the study area intersections for the given travel demands. As a basis for this assessment, intersection capacity analyses were conducted using Synchro capacity analysis software for the study area intersections under the 2017 Existing, 2024 No Build and 2024 Build peak hour traffic conditions. This analysis is based on procedures contained in the Highway Capacity Manual (HCM) which are summarized in Appendix D. A discussion of the evaluation criteria and a summary of the results of the capacity analyses are presented below.

Level-of-Service Criteria

Operating levels-of-service (LOS) are reported on a scale of A to F with A representing the best conditions (with little or no delay) and F representing the worst operating conditions (long delays). Typically, in an urbanized area, LOS D is considered adequate.

Capacity Analysis Results

Intersection capacity analyses were conducted for the study area intersections to evaluate the 2017 Existing, 2024 No Build and 2024 Build peak hour traffic conditions. Based on our analysis, the peak hour of the adjacent street traffic occurs between 7:45 AM and 8:45 AM during the weekday morning peak period and between 4:15 PM and 5:15 PM during the weekday afternoon peak period.

The capacity analysis results for the 2017 Existing, 2024 No Build and 2024 Build conditions are presented in Appendix E, Appendix F and Appendix G, respectively. The results of the capacity analyses are presented in Table 2 below.

Table 2
Peak Hour Intersection Capacity Analysis

			2017 Existing						2024 No Build						2024 Build					
Intersection	Movement		Morning			Afternoon			Morning			Afternoon			Morning			Afternoon		
			LOS ¹	Delay ²	V/C ³	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Cranberry Highway (Route 6) at Red Brook Road	EB	L	A	8.8	0.13	C	15.3	0.60	C	21.4	0.50	F	92.6	1.09	C	21.2	0.50	F	125.0	1.18
		T	A	0.0	0.00	A	0.0	0.00	A	7.4	0.36	A	6.3	0.34	A	7.3	0.35	A	6.3	0.34
	WB	TR	A	0.0	0.00	A	0.0	0.00	C	24.0	0.05	C	33.7	0.07	C	24.6	0.05	C	34.1	0.07
		U	n/a	n/a	n/a	n/a	n/a	n/a	B	19.0	0.55	C	22.8	0.69	B	19.5	0.56	C	22.7	0.69
	SB	L	n/a	n/a	n/a	n/a	n/a	n/a	C	21.1	0.04	C	29.5	0.06	C	22.4	0.13	C	30.4	0.11
		R	B	12.6	0.38	C	16.6	0.51	A	9.8	0.63	B	12.5	0.70	B	10.1	0.64	B	12.4	0.70
	Overall		n/a	n/a	n/a	n/a	n/a	n/a	B	13.0	0.63	C	31.7	1.09	B	13.3	0.64	D	40.2	1.18
Cranberry Highway (Route 6) at Site Driveway	EB	LT	A	0.0	0.00	A	0.1	0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		T	n/a	n/a	n/a	n/a	n/a	n/a	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00
	WB	TR	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00
	SB	LR	B	14.1	0.01	B	12.1	0.01	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		R	n/a	n/a	n/a	n/a	n/a	n/a	B	11.6	0.01	B	12.6	0.02	B	12.2	0.09	B	13.1	0.07
Red Brook Road at Site Driveway	EB	LR	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	B	10.5	0.05	B	11.3	0.03
	NB	LT	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	A	0.5	0.01	A	0.7	0.04
	SB	TR	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	A	0.0	0.00	A	0.0	0.00

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio

n/a Not Applicable

Table 2 reports the level-of-service results for the study area intersections during the weekday morning and weekday afternoon peak hours (which can also be found in Appendix H). The specific capacity analysis results of the study area intersections are discussed below.

Cranberry Highway (Route 6) at Red Brook Road

The capacity analysis indicates that under 2017 Existing conditions the stop-controlled southbound right-turn approach on Red Brook Road at its intersection with Cranberry Highway (Route 6) operates at LOS B during the weekday morning peak hour and LOS C during the weekday afternoon peak hour. The 2024 No Build conditions reflect the introduction of a new MassDOT traffic signal at this intersection. Under 2024 No Build conditions, the signalized intersection of Cranberry Highway (Route 6) at Red Brook Road is expected to operate at an overall LOS B during the weekday morning peak hour and at an overall LOS C during the weekday afternoon peak hour. All movements are expected to operate at LOS C or better with the exception of the eastbound left turn and u-turn during the weekday afternoon peak hour, which is expected to operate at LOS F.

Under the 2024 Build conditions, the signalized intersection of Cranberry Highway (Route 6) at Red Brook Road is expected to continue to operate at acceptable levels-of-service. With the proposed project in place, all movements would be expected to continue to operate at LOS C or better with the exception of the eastbound left turn and u-turn movement during the weekday afternoon peak hour.

Cranberry Highway (Route 6) at Site Driveway

The existing motel site driveway on Cranberry Highway (Route 6) is shown to operate at LOS B during both the weekday morning and weekday afternoon peak hours. The motel driveway would be expected to operate at LOS B during both peak hours under 2024 No Build conditions.

Under 2024 Build conditions, the proposed residential site driveway on Cranberry Highway (Route 6) is expected to operate at LOS B during the weekday morning and weekday afternoon peak hours.

Red Brook Road at Site Driveway

The proposed site driveway on Red Brook Road is expected to operate at LOS B and under capacity during the weekday morning and weekday afternoon peak hours under 2024 Build conditions. All movements on Red Brook Road are expected to operate at LOS A during both peak hours analyzed.

Sight Distance

A field review of the available sight distance was conducted for the proposed site driveway locations. The posted speed limit on Cranberry Highway (Route 6) is 35 mph and the posted speed limit on Red Brook Road is 30 mph.

The American Association of State Highway and Transportation Officials' (AASHTO) publication, *A Policy on Geometric Design, 2011 Edition*, defines minimum and desirable sight distances at intersections. The minimum sight distance is based on the required stopping sight distance (SSD) for vehicles traveling along the main road, whereas the intersection sight distance (ISD) is a more conservative value that accounts for driver comfort. According to AASHTO, "If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient time to anticipate and avoid collisions." The following table summarizes the available sight distances at the study area intersections.

Table 3
Sight Distance Requirements

Intersection	Movement	Looking (Direction)	Speed (mph)	SSD ¹ Required (ft)	ISD ¹ Required (ft)	Sight Distance Measured (ft)	Meets Requirements
Site Driveway at Cranberry Highway (Route 6)	Right Turn	Left (West)	35	250	330	500+	Yes
Site Driveway at Red Brook Road	Right Turn	Left (North)	30	200	290	375	Yes
	Left Turn	Right (South)	30	200	290	500+	Yes

¹ - Based on AASHTO requirements for stopping sight distance (see AASHTO Exhibit 3-1)

As shown in Table 3, the sight distance looking left (west) at the proposed site driveway on Cranberry Highway (Route 6) is over 500 feet. While the driveway is located within a horizontal curve on Route 6, sight lines are generally unobstructed due to the position of the driveway.

The sight distance looking right (south) at the proposed site driveway on Red Brook Road was measured to be over 500 feet and extends through the intersection of Red Brook Road and Cranberry Highway which is planned to be under signal control in 2018. The sight distance looking left (north) at the proposed site driveway on Red Brook Road was measured to be 375 feet and was partially obstructed by the vegetation located to the east of the proposed driveway. It is expected that the sight distance at the proposed driveway would improve related to the improvements at the Cranberry Highway (Route 6)/Red Brook Road intersection where the existing curb line will be realigned as part of the MassDOT project. In addition, vegetation should be maintained along the property frontage to ensure adequate sight lines are maintained. Proposed landscaping features should be designed to not obstruct sight lines.

CONCLUSION

The proposed residential development project on Cranberry Highway (Route 6) consists of 174 apartment units within six buildings and would be located in the northwest corner of the intersection of Cranberry Highway (Route 6) and Red Brook Road. Access to the proposed site would be provided via a right-turn in/right-turn out only driveway on Cranberry Highway (Route 6), and a full access driveway on Red Brook Road.

Based on ITE data, the proposed residential development is estimated to result in approximately 81 vehicle trips (14 vehicles entering, 67 vehicles exiting) during the weekday morning peak hour and approximately 100 vehicle trips (66 vehicles entering, 34 vehicles exiting) during the weekday afternoon peak hour.

The capacity analysis indicates that the future signalized intersection of Cranberry Highway (Route 6) and Red Brook Road is expected to operate at an overall LOS B during the weekday morning peak hour and overall LOS D during the weekday afternoon peak hour, with all movements expected to operate at LOS C or better with the exception of the eastbound left turn and u-turn movement during the weekday afternoon peak hour which is expected to operate at LOS F. The proposed site driveways on Cranberry Highway (Route 6) and Red Brook Road are expected to operate under capacity at LOS B during both the weekday morning and weekday afternoon peak hours.

Based on the analysis results presented in this report, the proposed residential development is expected to have a minimal impact on the operations of the study area roadways.

Appendix for Traffic Impact Study

Residential Development

Wareham, MA

Prepared by
McMahon Associates, Inc.
300 Myles Standish Boulevard, Suite 201
Taunton, MA 02780
508.823.2245

Prepared for
Dakota Partners, Inc.

November 2017

APPENDIX A

Manual Turning Movement Counts

Transportation Data Corporation

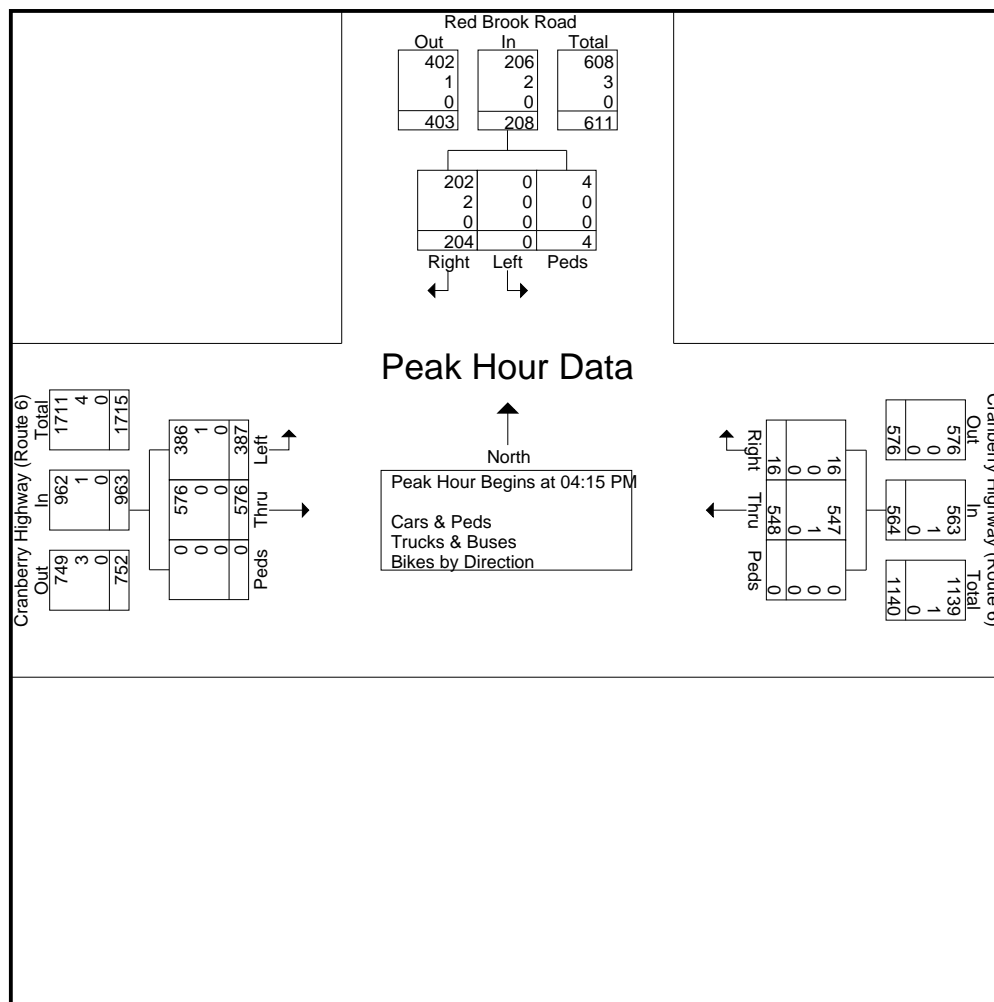
Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838EE
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	48	0	2	50	4	128	0	132	152	96	0	248	430
04:30 PM	53	0	1	54	2	133	0	135	137	93	0	230	419
04:45 PM	62	0	1	63	5	150	0	155	129	95	0	224	442
05:00 PM	41	0	0	41	5	137	0	142	158	103	0	261	444
Total Volume	204	0	4	208	16	548	0	564	576	387	0	963	1735
% App. Total	98.1	0	1.9		2.8	97.2	0		59.8	40.2	0		
PHF	.823	.000	.500	.825	.800	.913	.000	.910	.911	.939	.000	.922	.977
Cars & Peds	202	0	4	206	16	547	0	563	576	386	0	962	1731
% Cars & Peds	99.0	0	100	99.0	100	99.8	0	99.8	100	99.7	0	99.9	99.8
Trucks & Buses	2	0	0	2	0	1	0	1	0	1	0	1	4
% Trucks & Buses	1.0	0	0	1.0	0	0.2	0	0.2	0	0.3	0	0.1	0.2
Bikes by Direction	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bikes by Direction	0	0	0	0	0	0	0	0	0	0	0	0	0



Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838EE
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Bikes by Direction

Start Time	Red Brook Road From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			Int. Total
	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	1	0	0	1
Total	0	0	0	0	0	0	1	0	0	1
Grand Total	0	0	0	0	0	0	1	0	0	1
Apprch %	0	0	0	0	0	0	100	0	0	
Total %	0	0	0	0	0	0	100	0	0	

Start Time	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				Int. Total
	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	0	0	0	0	1	0	0	1	1
Total Volume	0	0	0	0	0	0	0	0	1	0	0	1	1
% App. Total	0	0	0		0	0	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.250	.000	.000	.250	.250

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 05:00 PM

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838EE
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Trucks & Buses

	Red Brook Road From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	1	0	0	0	0	0	2	1	0	4
04:15 PM	1	0	0	0	0	0	0	0	0	1
04:30 PM	1	0	0	0	0	0	0	0	0	1
04:45 PM	0	0	0	0	1	0	0	0	0	1
Total	3	0	0	0	1	0	2	1	0	7
05:00 PM	0	0	0	0	0	0	0	1	0	1
05:15 PM	1	0	0	0	3	0	2	0	0	6
05:30 PM	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	1	2	0	0	0	0	3
Total	1	0	0	1	5	0	2	1	0	10
Grand Total	4	0	0	1	6	0	4	2	0	17
Apprch %	100	0	0	14.3	85.7	0	66.7	33.3	0	
Total %	23.5	0	0	5.9	35.3	0	23.5	11.8	0	

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 05:00 PM													
05:00 PM	0	0	0	0	0	0	0	0	0	1	0	1	1
05:15 PM	1	0	0	1	0	3	0	3	2	0	0	2	6
05:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:45 PM	0	0	0	0	1	2	0	3	0	0	0	0	3
Total Volume	1	0	0	1	1	5	0	6	2	1	0	3	10
% App. Total	100	0	0		16.7	83.3	0		66.7	33.3	0		
PHF	.250	.000	.000	.250	.250	.417	.000	.500	.250	.250	.000	.375	.417

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838EE
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Cars & Peds

	Red Brook Road From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	56	0	1	5	154	0	133	81	0	430
04:15 PM	47	0	2	4	128	0	152	96	0	429
04:30 PM	52	0	1	2	133	0	137	93	0	418
04:45 PM	62	0	1	5	149	0	129	95	0	441
Total	217	0	5	16	564	0	551	365	0	1718
05:00 PM	41	0	0	5	137	0	158	102	0	443
05:15 PM	29	0	2	2	121	0	141	88	0	383
05:30 PM	50	0	3	4	132	0	130	76	0	395
05:45 PM	46	0	0	4	124	0	108	68	0	350
Total	166	0	5	15	514	0	537	334	0	1571
Grand Total	383	0	10	31	1078	0	1088	699	0	3289
Apprch %	97.5	0	2.5	2.8	97.2	0	60.9	39.1	0	
Total %	11.6	0	0.3	0.9	32.8	0	33.1	21.3	0	

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	47	0	2	49	4	128	0	132	152	96	0	248	429
04:30 PM	52	0	1	53	2	133	0	135	137	93	0	230	418
04:45 PM	62	0	1	63	5	149	0	154	129	95	0	224	441
05:00 PM	41	0	0	41	5	137	0	142	158	102	0	260	443
Total Volume	202	0	4	206	16	547	0	563	576	386	0	962	1731
% App. Total	98.1	0	1.9		2.8	97.2	0		59.9	40.1	0		
PHF	.815	.000	.500	.817	.800	.918	.000	.914	.911	.946	.000	.925	.977

tel (781) 587-0086 cell (781) 439-4999

File Name : 04838EE
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

[illegible]

Transportation Data Corporation

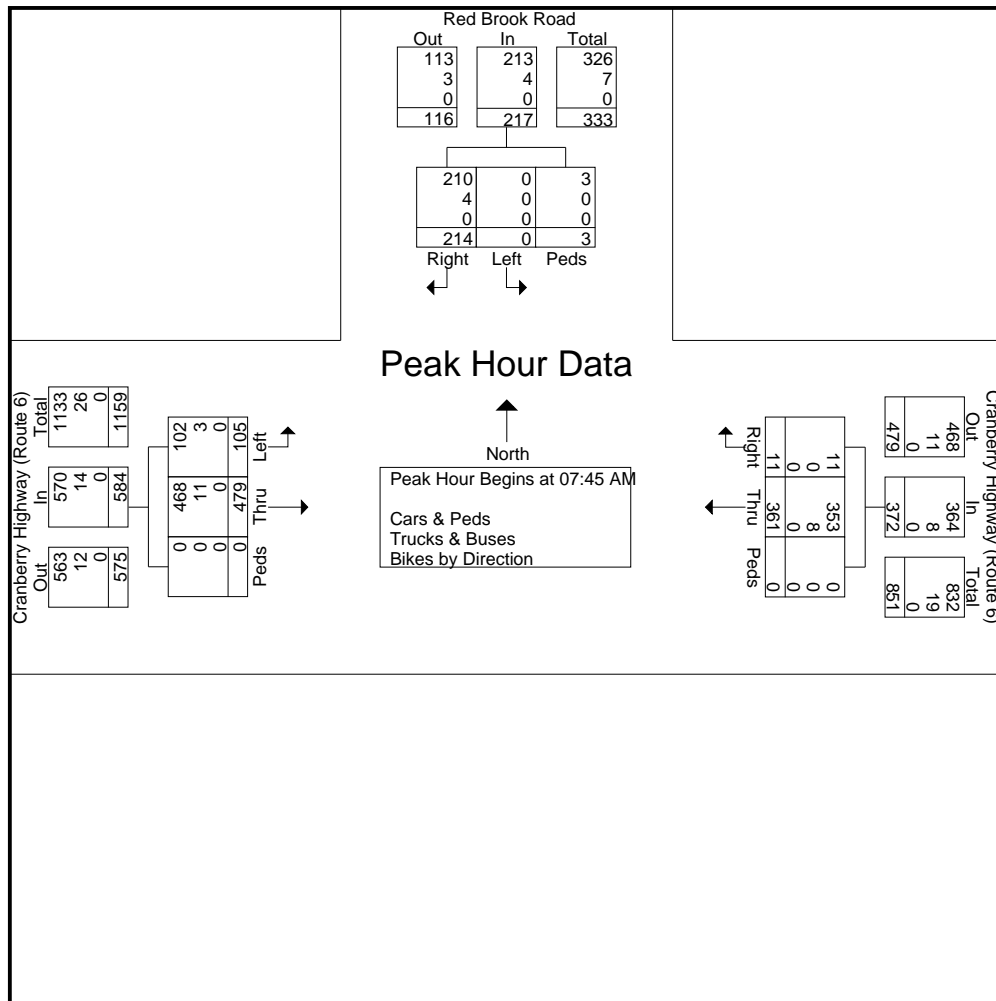
Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838E
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	58	0	2	60	3	89	0	92	141	22	0	163	315
08:00 AM	47	0	1	48	0	94	0	94	119	28	0	147	289
08:15 AM	53	0	0	53	5	86	0	91	110	30	0	140	284
08:30 AM	56	0	0	56	3	92	0	95	109	25	0	134	285
Total Volume	214	0	3	217	11	361	0	372	479	105	0	584	1173
% App. Total	98.6	0	1.4		3	97	0		82	18	0		
PHF	.922	.000	.375	.904	.550	.960	.000	.979	.849	.875	.000	.896	.931
Cars & Peds	210	0	3	213	11	353	0	364	468	102	0	570	1147
% Cars & Peds	98.1	0	100	98.2	100	97.8	0	97.8	97.7	97.1	0	97.6	97.8
Trucks & Buses	4	0	0	4	0	8	0	8	11	3	0	14	26
% Trucks & Buses	1.9	0	0	1.8	0	2.2	0	2.2	2.3	2.9	0	2.4	2.2
Bikes by Direction	0	0	0	0	0	0	0	0	0	0	0	0	0
% Bikes by Direction	0	0	0	0	0	0	0	0	0	0	0	0	0



Mario Perone, mperone1@verizon.net
tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838E
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Bikes by Direction

[illegible][illegible]

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838E
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Trucks & Buses

	Red Brook Road From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	1	0	0	0	2	0	4	1	0	8
07:15 AM	1	0	0	0	1	0	2	1	0	5
07:30 AM	0	0	0	0	3	0	0	2	0	5
07:45 AM	1	0	0	0	2	0	2	1	0	6
Total	3	0	0	0	8	0	8	5	0	24
08:00 AM	1	0	0	0	3	0	2	1	0	7
08:15 AM	1	0	0	0	2	0	3	1	0	7
08:30 AM	1	0	0	0	1	0	4	0	0	6
08:45 AM	1	0	0	0	1	0	2	0	0	4
Total	4	0	0	0	7	0	11	2	0	24
Grand Total	7	0	0	0	15	0	19	7	0	48
Apprch %	100	0	0	0	100	0	73.1	26.9	0	
Total %	14.6	0	0	0	31.2	0	39.6	14.6	0	

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	1	0	0	1	0	2	0	2	2	1	0	3	6
08:00 AM	1	0	0	1	0	3	0	3	2	1	0	3	7
08:15 AM	1	0	0	1	0	2	0	2	3	1	0	4	7
08:30 AM	1	0	0	1	0	1	0	1	4	0	0	4	6
Total Volume	4	0	0	4	0	8	0	8	11	3	0	14	26
% App. Total	100	0	0		0	100	0		78.6	21.4	0		
PHF	1.00	.000	.000	1.00	.000	.667	.000	.667	.688	.750	.000	.875	.929

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Red Brook Road
E/W: Cranberry Highway (Route 6)
City, State: Wareham, MA
Client: McM/E. Buck

File Name : 04838E
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

Groups Printed- Cars & Peds

	Red Brook Road From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	65	0	1	1	82	0	85	12	0	246
07:15 AM	71	0	0	1	92	0	98	17	0	279
07:30 AM	64	0	2	3	85	0	108	16	0	278
07:45 AM	57	0	2	3	87	0	139	21	0	309
Total	257	0	5	8	346	0	430	66	0	1112
08:00 AM	46	0	1	0	91	0	117	27	0	282
08:15 AM	52	0	0	5	84	0	107	29	0	277
08:30 AM	55	0	0	3	91	0	105	25	0	279
08:45 AM	48	0	0	2	77	0	114	24	0	265
Total	201	0	1	10	343	0	443	105	0	1103
Grand Total	458	0	6	18	689	0	873	171	0	2215
Apprch %	98.7	0	1.3	2.5	97.5	0	83.6	16.4	0	
Total %	20.7	0	0.3	0.8	31.1	0	39.4	7.7	0	

	Red Brook Road From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:15 AM													
07:15 AM	71	0	0	71	1	92	0	93	98	17	0	115	279
07:30 AM	64	0	2	66	3	85	0	88	108	16	0	124	278
07:45 AM	57	0	2	59	3	87	0	90	139	21	0	160	309
08:00 AM	46	0	1	47	0	91	0	91	117	27	0	144	282
Total Volume	238	0	5	243	7	355	0	362	462	81	0	543	1148
% App. Total	97.9	0	2.1		1.9	98.1	0		85.1	14.9	0		
PHF	.838	.000	.625	.856	.583	.965	.000	.973	.831	.750	.000	.848	.929

tel (781) 587-0086 cell (781) 439-4999

File Name : 04838E
Site Code : Y1661311
Start Date : 1/4/2017
Page No : 1

[illegible]

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

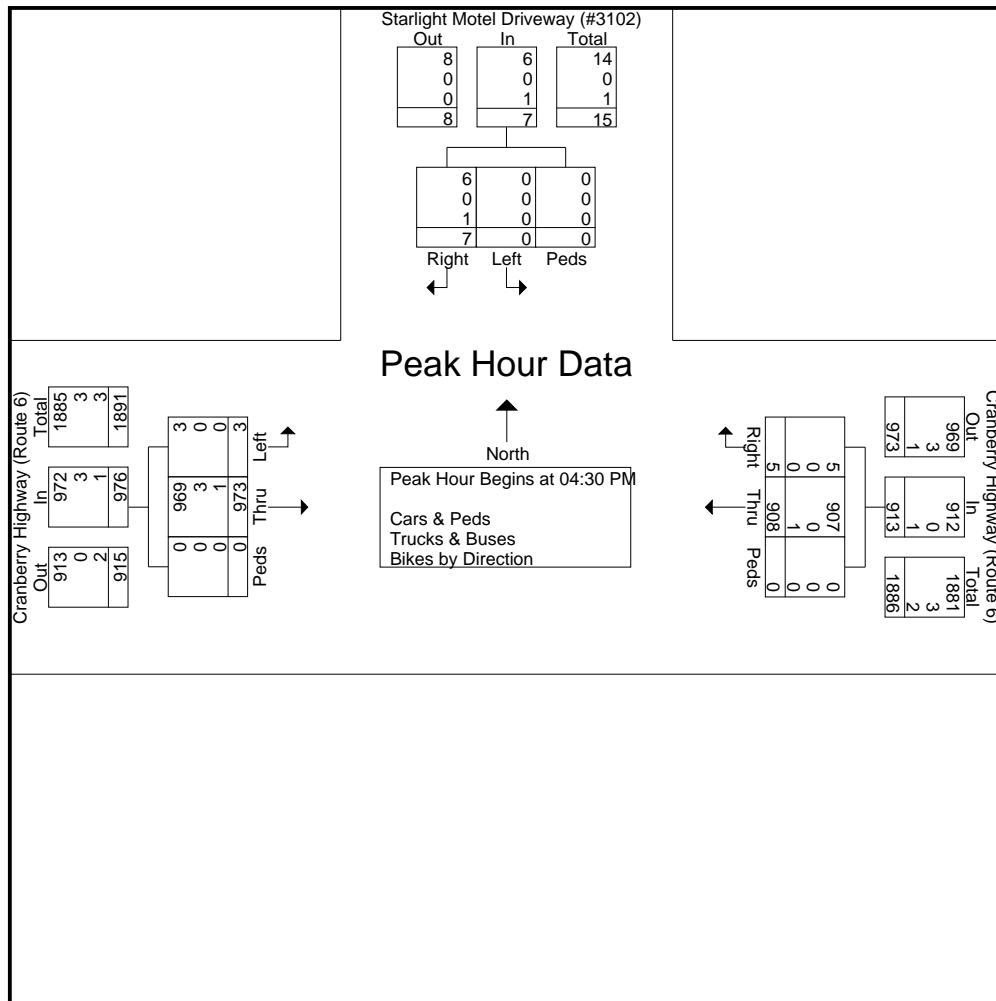
File Name : 04886AA

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	0	0	0	0	2	243	0	245	236	0	0	236	481
04:45 PM	2	0	0	2	0	213	0	213	252	2	0	254	469
05:00 PM	4	0	0	4	2	234	0	236	240	1	0	241	481
05:15 PM	1	0	0	1	1	218	0	219	245	0	0	245	465
Total Volume	7	0	0	7	5	908	0	913	973	3	0	976	1896
% App. Total	100	0	0		0.5	99.5	0		99.7	0.3	0		
PHF	.438	.000	.000	.438	.625	.934	.000	.932	.965	.375	.000	.961	.985
Cars & Peds	6	0	0	6	5	907	0	912	969	3	0	972	1890
% Cars & Peds	85.7	0	0	85.7	100	99.9	0	99.9	99.6	100	0	99.6	99.7
Trucks & Buses	0	0	0	0	0	0	0	0	3	0	0	3	3
% Trucks & Buses	0	0	0	0	0	0	0	0	0.3	0	0	0.3	0.2
Bikes by Direction	1	0	0	1	0	1	0	1	1	0	0	1	3
% Bikes by Direction	14.3	0	0	14.3	0	0.1	0	0.1	0.1	0	0	0.1	0.2



Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886AA

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Bikes by Direction

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0
04:15 PM	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	1	0	1	0	0	2
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	1	0	0	2
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	1	0	0	0	0	0	0	0	0	1
05:30 PM	0	0	0	1	0	0	1	0	0	2
05:45 PM	0	0	0	0	0	0	0	0	0	0
Total	1	0	0	1	0	0	1	0	0	3
Grand Total	1	0	0	1	1	0	2	0	0	5
Apprch %	100	0	0	50	50	0	100	0	0	
Total %	20	0	0	20	20	0	40	0	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	0	0	0	0	0	1	0	1	1	0	0	1	2
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	1	0	0	1	0	0	0	0	0	0	0	0	1
Total Volume	1	0	0	1	0	1	0	1	1	0	0	1	3
% App. Total	100	0	0		0	100	0		100	0	0		
PHF	.250	.000	.000	.250	.000	.250	.000	.250	.250	.000	.000	.250	.375

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886AA

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Trucks & Buses

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	0	1	0	0	0	0	1
04:15 PM	0	0	0	0	0	0	1	0	0	1
04:30 PM	0	0	0	0	0	0	1	0	0	1
04:45 PM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	2	0	0	3
05:00 PM	0	0	0	0	0	0	2	0	0	2
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	1	0	0	0	0	1
05:45 PM	0	0	0	0	1	0	0	0	0	1
Total	0	0	0	0	2	0	2	0	0	4
Grand Total	0	0	0	0	3	0	4	0	0	7
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	42.9	0	57.1	0	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:15 PM													
04:15 PM	0	0	0	0	0	0	0	0	1	0	0	1	1
04:30 PM	0	0	0	0	0	0	0	0	1	0	0	1	1
04:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	2	0	0	2	2
Total Volume	0	0	0	0	0	0	0	0	4	0	0	4	4
% App. Total	0	0	0		0	0	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.500	.000	.000	.500	.500

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886AA

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Cars & Peds

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	0	225	0	243	0	0	468
04:15 PM	0	0	0	0	203	0	239	0	0	442
04:30 PM	0	0	0	2	242	0	234	0	0	478
04:45 PM	2	0	0	0	213	0	252	2	0	469
Total	2	0	0	2	883	0	968	2	0	1857
05:00 PM	4	0	0	2	234	0	238	1	0	479
05:15 PM	0	0	0	1	218	0	245	0	0	464
05:30 PM	2	0	0	0	246	0	230	0	0	478
05:45 PM	0	0	0	1	203	0	207	0	0	411
Total	6	0	0	4	901	0	920	1	0	1832
Grand Total	8	0	0	6	1784	0	1888	3	0	3689
Apprch %	100	0	0	0.3	99.7	0	99.8	0.2	0	
Total %	0.2	0	0	0.2	48.4	0	51.2	0.1	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	0	0	0	0	2	242	0	244	234	0	0	234	478
04:45 PM	2	0	0	2	0	213	0	213	252	2	0	254	469
05:00 PM	4	0	0	4	2	234	0	236	238	1	0	239	479
05:15 PM	0	0	0	0	1	218	0	219	245	0	0	245	464
Total Volume	6	0	0	6	5	907	0	912	969	3	0	972	1890
% App. Total	100	0	0		0.5	99.5	0		99.7	0.3	0		
PHF	.375	.000	.000	.375	.625	.937	.000	.934	.961	.375	.000	.957	.986

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886AA

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Cars & Peds - Trucks & Buses - Bikes by Direction

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
04:00 PM	0	0	0	0	226	0	243	0	0	469
04:15 PM	0	0	0	0	203	0	240	0	0	443
04:30 PM	0	0	0	2	243	0	236	0	0	481
04:45 PM	2	0	0	0	213	0	252	2	0	469
Total	2	0	0	2	885	0	971	2	0	1862
05:00 PM	4	0	0	2	234	0	240	1	0	481
05:15 PM	1	0	0	1	218	0	245	0	0	465
05:30 PM	2	0	0	1	247	0	231	0	0	481
05:45 PM	0	0	0	1	204	0	207	0	0	412
Total	7	0	0	5	903	0	923	1	0	1839
Grand Total	9	0	0	7	1788	0	1894	3	0	3701
Apprch %	100	0	0	0.4	99.6	0	99.8	0.2	0	
Total %	0.2	0	0	0.2	48.3	0	51.2	0.1	0	
Cars & Peds	8	0	0	6	1784	0	1888	3	0	3689
% Cars & Peds	88.9	0	0	85.7	99.8	0	99.7	100	0	99.7
Trucks & Buses	0	0	0	0	3	0	4	0	0	7
% Trucks & Buses	0	0	0	0	0.2	0	0.2	0	0	0.2
Bikes by Direction	1	0	0	1	1	0	2	0	0	5
% Bikes by Direction	11.1	0	0	14.3	0.1	0	0.1	0	0	0.1

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 04:30 PM													
04:30 PM	0	0	0	0	2	243	0	245	236	0	0	236	481
04:45 PM	2	0	0	2	0	213	0	213	252	2	0	254	469
05:00 PM	4	0	0	4	2	234	0	236	240	1	0	241	481
05:15 PM	1	0	0	1	1	218	0	219	245	0	0	245	465
Total Volume	7	0	0	7	5	908	0	913	973	3	0	976	1896
% App. Total	100	0	0		0.5	99.5	0		99.7	0.3	0		
PHF	.438	.000	.000	.438	.625	.934	.000	.932	.965	.375	.000	.961	.985
Cars & Peds	6	0	0	6	5	907	0	912	969	3	0	972	1890
% Cars & Peds	85.7	0	0	85.7	100	99.9	0	99.9	99.6	100	0	99.6	99.7
Trucks & Buses	0	0	0	0	0	0	0	0	3	0	0	3	3
% Trucks & Buses	0	0	0	0	0	0	0	0	0.3	0	0	0.3	0.2
Bikes by Direction	1	0	0	1	0	1	0	1	1	0	0	1	3
% Bikes by Direction	14.3	0	0	14.3	0	0.1	0	0.1	0.1	0	0	0.1	0.2

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

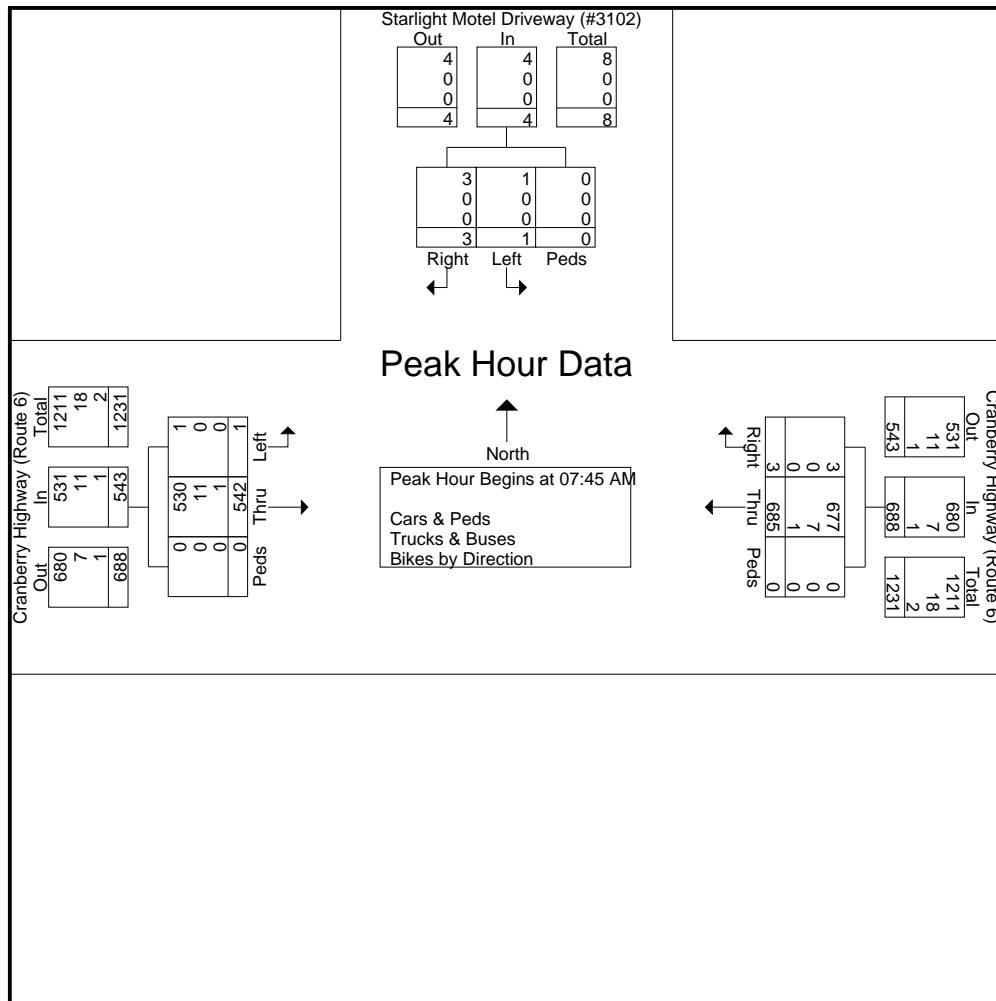
File Name : 04886A

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	2	1	0	3	0	173	0	173	147	0	0	147	323
08:00 AM	0	0	0	0	2	154	0	156	114	1	0	115	271
08:15 AM	1	0	0	1	1	173	0	174	136	0	0	136	311
08:30 AM	0	0	0	0	0	185	0	185	145	0	0	145	330
Total Volume	3	1	0	4	3	685	0	688	542	1	0	543	1235
% App. Total	75	25	0		0.4	99.6	0		99.8	0.2	0		
PHF	.375	.250	.000	.333	.375	.926	.000	.930	.922	.250	.000	.923	.936
Cars & Peds	3	1	0	4	3	677	0	680	530	1	0	531	1215
% Cars & Peds	100	100	0	100	100	98.8	0	98.8	97.8	100	0	97.8	98.4
Trucks & Buses	0	0	0	0	0	7	0	7	11	0	0	11	18
% Trucks & Buses	0	0	0	0	0	1.0	0	1.0	2.0	0	0	2.0	1.5
Bikes by Direction	0	0	0	0	0	1	0	1	1	0	0	1	2
% Bikes by Direction	0	0	0	0	0	0.1	0	0.1	0.2	0	0	0.2	0.2



Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886A

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Bikes by Direction

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	1	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	1	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	1	0	0	2
Grand Total	0	0	0	0	1	0	1	0	0	2
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	50	0	50	0	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	1	0	1	0	0	0	0	1
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	1	0	0	1	1
Total Volume	0	0	0	0	0	1	0	1	1	0	0	1	2
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.250	.000	.250	.250	.000	.000	.250	.500

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886A

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Trucks & Buses

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	3	0	4	0	0	7
07:15 AM	0	0	0	0	1	0	3	0	0	4
07:30 AM	0	0	0	0	2	0	1	0	0	3
07:45 AM	0	0	0	0	0	0	3	0	0	3
Total	0	0	0	0	6	0	11	0	0	17
08:00 AM	0	0	0	0	5	0	1	0	0	6
08:15 AM	0	0	0	0	1	0	7	0	0	8
08:30 AM	0	0	0	0	1	0	0	0	0	1
08:45 AM	0	0	0	0	2	0	3	0	0	5
Total	0	0	0	0	9	0	11	0	0	20
Grand Total	0	0	0	0	15	0	22	0	0	37
Apprch %	0	0	0	0	100	0	100	0	0	
Total %	0	0	0	0	40.5	0	59.5	0	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:30 AM													
07:30 AM	0	0	0	0	0	2	0	2	1	0	0	1	3
07:45 AM	0	0	0	0	0	0	0	0	3	0	0	3	3
08:00 AM	0	0	0	0	0	5	0	5	1	0	0	1	6
08:15 AM	0	0	0	0	0	1	0	1	7	0	0	7	8
Total Volume	0	0	0	0	0	8	0	8	12	0	0	12	20
% App. Total	0	0	0		0	100	0		100	0	0		
PHF	.000	.000	.000	.000	.000	.400	.000	.400	.429	.000	.000	.429	.625

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886A

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Cars & Peds

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	0	1	0	0	120	0	111	0	0	232
07:15 AM	0	0	0	1	140	0	129	0	0	270
07:30 AM	2	0	0	1	151	0	154	0	0	308
07:45 AM	2	1	0	0	173	0	144	0	0	320
Total	4	2	0	2	584	0	538	0	0	1130
08:00 AM	0	0	0	2	148	0	113	1	0	264
08:15 AM	1	0	0	1	172	0	129	0	0	303
08:30 AM	0	0	0	0	184	0	144	0	0	328
08:45 AM	1	1	0	0	160	0	150	0	0	312
Total	2	1	0	3	664	0	536	1	0	1207
Grand Total	6	3	0	5	1248	0	1074	1	0	2337
Apprch %	66.7	33.3	0	0.4	99.6	0	99.9	0.1	0	
Total %	0.3	0.1	0	0.2	53.4	0	46	0	0	

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	2	1	0	3	0	173	0	173	144	0	0	144	320
08:00 AM	0	0	0	0	2	148	0	150	113	1	0	114	264
08:15 AM	1	0	0	1	1	172	0	173	129	0	0	129	303
08:30 AM	0	0	0	0	0	184	0	184	144	0	0	144	328
Total Volume	3	1	0	4	3	677	0	680	530	1	0	531	1215
% App. Total	75	25	0		0.4	99.6	0		99.8	0.2	0		
PHF	.375	.250	.000	.333	.375	.920	.000	.924	.920	.250	.000	.922	.926

Transportation Data Corporation

Mario Perone, mperone1@verizon.net

tel (781) 587-0086 cell (781) 439-4999

N: Starlight Motel Driveway (#3102)

E/W: Cranberry Highway (Route 6)

City, State: E. Wareham, MA

Client: McM/C. Medeiros

File Name : 04886A

Site Code : Y1725111

Start Date : 5/2/2017

Page No : 1

Groups Printed- Cars & Peds - Trucks & Buses - Bikes by Direction

	Starlight Motel Driveway (#3102) From North			Cranberry Highway (Route 6) From East			Cranberry Highway (Route 6) From West			
Start Time	Right	Left	Peds	Right	Thru	Peds	Thru	Left	Peds	Int. Total
07:00 AM	0	1	0	0	123	0	115	0	0	239
07:15 AM	0	0	0	1	141	0	132	0	0	274
07:30 AM	2	0	0	1	153	0	155	0	0	311
07:45 AM	2	1	0	0	173	0	147	0	0	323
Total	4	2	0	2	590	0	549	0	0	1147
08:00 AM	0	0	0	2	154	0	114	1	0	271
08:15 AM	1	0	0	1	173	0	136	0	0	311
08:30 AM	0	0	0	0	185	0	145	0	0	330
08:45 AM	1	1	0	0	162	0	153	0	0	317
Total	2	1	0	3	674	0	548	1	0	1229
Grand Total	6	3	0	5	1264	0	1097	1	0	2376
Apprch %	66.7	33.3	0	0.4	99.6	0	99.9	0.1	0	
Total %	0.3	0.1	0	0.2	53.2	0	46.2	0	0	
Cars & Peds	6	3	0	5	1248	0	1074	1	0	2337
% Cars & Peds	100	100	0	100	98.7	0	97.9	100	0	98.4
Trucks & Buses	0	0	0	0	15	0	22	0	0	37
% Trucks & Buses	0	0	0	0	1.2	0	2	0	0	1.6
Bikes by Direction	0	0	0	0	1	0	1	0	0	2
% Bikes by Direction	0	0	0	0	0.1	0	0.1	0	0	0.1

	Starlight Motel Driveway (#3102) From North				Cranberry Highway (Route 6) From East				Cranberry Highway (Route 6) From West				
Start Time	Right	Left	Peds	App. Total	Right	Thru	Peds	App. Total	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1													
Peak Hour for Entire Intersection Begins at 07:45 AM													
07:45 AM	2	1	0	3	0	173	0	173	147	0	0	147	323
08:00 AM	0	0	0	0	2	154	0	156	114	1	0	115	271
08:15 AM	1	0	0	1	1	173	0	174	136	0	0	136	311
08:30 AM	0	0	0	0	0	185	0	185	145	0	0	145	330
Total Volume	3	1	0	4	3	685	0	688	542	1	0	543	1235
% App. Total	75	25	0		0.4	99.6	0		99.8	0.2	0		
PHF	.375	.250	.000	.333	.375	.926	.000	.930	.922	.250	.000	.923	.936
Cars & Peds	3	1	0	4	3	677	0	680	530	1	0	531	1215
% Cars & Peds	100	100	0	100	100	98.8	0	98.8	97.8	100	0	97.8	98.4
Trucks & Buses	0	0	0	0	0	7	0	7	11	0	0	11	18
% Trucks & Buses	0	0	0	0	0	1.0	0	1.0	2.0	0	0	2.0	1.5
Bikes by Direction	0	0	0	0	0	1	0	1	1	0	0	1	2
% Bikes by Direction	0	0	0	0	0	0.1	0	0.1	0.2	0	0	0.2	0.2

APPENDIX B

Crash Summary

	Cranberry Highway at Starlight Motel	Cranberry Highway at Red Brook Road
2010	0	5
2011	0	17
2012	0	14
2013	0	14
2014	<u>0</u>	<u>11</u>
Total	0	61
Type		
Angle	0	18
Rear-end	0	31
Rear-to-rear	0	0
Head-on	0	1
Sideswipe	0	4
Bicycle	0	0
Pedestrian	0	0
Single Vehicle	0	6
Unknown	<u>0</u>	<u>1</u>
Total	0	61
Severity		
Property Damage	0	46
Personal Injury	0	15
Fatality	0	0
Other	<u>0</u>	<u>0</u>
Total	0	61
Weather		
Clear	0	44
Cloudy	0	8
Rain	0	5
Snow	0	2
Ice	0	1
Sleet	0	0
Fog	0	1
Unknown	<u>0</u>	<u>0</u>
Total	0	61
Time		
7:00 AM to 9:00 AM	0	3
9:00 AM to 4:00 PM	0	31
4:00 PM to 6:00 PM	0	13
6:00 PM to 7:00 AM	<u>0</u>	<u>14</u>
Total	0	61
Crash Rate	0.00	1.41
Statewide Average	0.58	0.58
District 5 Average	0.58	0.58

Source: MassDOT

APPENDIX C

Traffic Projection Model

TRAFFIC PROJECTION MODEL

Wareham Residential
 Weekday Morning Peak Hour
 Wareham, MA

Intersection	Dir.	Turn	2017 Existing Volumes	2017 Adjusted Volumes	Cranberry Highway Recon. Re-Dis. Trips	Background Growth 7 yrs (at 1 % per year)	2024 No-Build Volumes	New Project PERCENT ENTER	New Project Trips ENTER	New Project PERCENT EXIT	New Project Trips EXIT	New Project Trips TOTAL	2024 Build Volumes
Cranberry Highway (Route 6) at Red Brook Road	EB	U	0	0	51	4	55	20%	3		0	3	58
		L	105	130		9	139	45%	6		0	6	145
	WB	T	479	592	1	43	636		0		0	0	636
		U	0	0	10	0	10		0		0	0	10
		T	361	446		32	478		0		0	0	478
		R	11	14		1	15	30%	4		0	4	19
	SB	L	0	0	10	0	10		0	30%	21	21	31
		R	214	265		19	284		0	10%	6	6	290
	EB	L	1	1	-1	0	0		0		0	0	0
		T	721	721	53	56	830	65%	9		0	9	839
Cranberry Highway (Route 6) at Site Driveway	WB	T	708	708	50	55	813		0	10%	6	6	819
		R	3	3	1	0	4	20%	3		0	3	7
	SB	L	1	1	-1	0	0		0		0	0	0
		R	3	3	1	0	4	55%	0		37	37	41
	EB	L	0	0		0	0		0	5%	3	3	3
		R	0	0		0	0	75%	0	40%	27	27	27
Red Brook Road at Site Driveway	NB	L	0	0		0	0		10		0	10	10
		T	116	116		8	154		0		0	0	154
	SB	T	214	214		15	294		0		0	0	294
		R	0	0		0	0	5%	1		0	1	1

Peak: 7:45 AM - 8:45 AM

**Wareham Residential
Weekday Afternoon Peak Hour
Wareham, MA**

Peak: 4:15 PM - 5:15 PM

APPENDIX D

Highway Capacity Manual Methodologies

CAPACITY/LEVEL-OF-SERVICE ANALYSES METHODOLOGY

The detailed capacity/level-of-service analysis contained in this traffic impact study was performed in accordance with the standard techniques contained in the *Highway Capacity Manual*.⁽¹⁾ By definition, capacity represents “the maximum rate of flow that can reasonably be expected to pass a point on a uniform section of a lane or roadway under prevailing roadway, traffic, and control conditions.” The level of functioning of an intersection or a uniform section of a lane or roadway can be expressed in terms of levels of service. Level of service (LOS) is defined as “a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers”. Such measures include “speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.”

At unsignalized intersections, a methodology for evaluating the relative functioning of intersections controlled by stop or yield signs has been developed, and is based on several assumptions, including:

- Major street flows are not affected by the minor (stop-sign controlled) street movements.
- Left turns from the major street to the minor street are influenced only by opposing major street through flow.
- Minor street left turns are impeded by all major street traffic plus opposing minor street traffic.
- Minor street through traffic is impeded by all major street traffic.
- Minor street right turns are impeded only by the major street traffic coming from the left.

The concept of stop-controlled or yield-controlled intersection analysis is based on the estimate of average total delay on minor streets. The methodology of analysis relies on three elements: the size and distribution of gaps in the major traffic stream, the usefulness of these gaps to the minor stream drivers, and the relative priority of the various traffic streams at the intersection. The results of the analysis provide an estimate of average total delay for the various critical movements at the unsignalized intersections. Correlation between average total delay and the respective levels of service are provided for unsignalized intersections as follows:

(1) *Transportation Research Board, Highway Capacity Manual 2010, published by the Transportation Research Board, Washington, DC, 2010.*

<i>Unsignalized Intersections</i>	
Level of Service	Control Delay Per Vehicle (seconds)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F	> 50

At signalized intersections, an additional element must be considered: time allocation. Level of service is based on the average control delay per vehicle for various movements within the intersection. Volume/capacity relationships also affect the operations of signalized intersections. Thus, both volume/capacity and delay must be considered to evaluate the overall operation of a signalized intersection. Correlation between average delay per vehicle and the respective levels of service are provided for signalized intersections as follows:

<i>Signalized Intersections</i>	
Level of Service	Control Delay Per Vehicle (seconds)
A	≤ 10
B	>10 – 20
C	>20 – 35
D	>35 – 55
E	>55 – 80
F	> 80

APPENDIX E

2017 Existing Capacity/Level-of-Service Analysis

Intersection

Int Delay, s/veh 0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	1	721	708	3	1	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	93	93	80	80
Heavy Vehicles, %	0	2	1	0	0	0
Mvmt Flow	1	784	761	3	1	4

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	765	0	1157
Stage 1	-	-	763
Stage 2	-	-	394
Critical Hdwy	4.1	-	6.8
Critical Hdwy Stg 1	-	-	5.8
Critical Hdwy Stg 2	-	-	5.8
Follow-up Hdwy	2.2	-	3.5
Pot Cap-1 Maneuver	857	-	193
Stage 1	-	-	426
Stage 2	-	-	656
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	857	-	193
Mov Cap-2 Maneuver	-	-	193
Stage 1	-	-	426
Stage 2	-	-	655

Approach	EB	WB	SB
HCM Control Delay, s	0	0	14.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	857	-	-	-	400
HCM Lane V/C Ratio	0.001	-	-	-	0.013
HCM Control Delay (s)	9.2	0	-	-	14.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection

Int Delay, s/veh 3.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	130	592	446	14	0	265
Conflicting Peds, #/hr	3	0	0	3	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	Free	-	None
Storage Length	0	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	90	90	98	98	90	90
Heavy Vehicles, %	3	2	2	0	0	2
Mvmt Flow	144	658	455	14	0	294

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	455	0	1073
Stage 1	-	-	455
Stage 2	-	-	618
Critical Hdwy	4.16	-	6.8
Critical Hdwy Stg 1	-	-	5.8
Critical Hdwy Stg 2	-	-	5.8
Follow-up Hdwy	2.23	-	3.5
Pot Cap-1 Maneuver	1095	-	218
Stage 1	-	-	611
Stage 2	-	-	506
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1092	-	189
Mov Cap-2 Maneuver	-	-	189
Stage 1	-	-	611
Stage 2	-	-	439

Approach	EB	WB	SB
HCM Control Delay, s	1.6	0	12.6
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	SBLn1
Capacity (veh/h)	1092	-	-	769
HCM Lane V/C Ratio	0.132	-	-	0.383
HCM Control Delay (s)	8.8	-	-	12.6
HCM Lane LOS	A	-	-	B
HCM 95th %tile Q(veh)	0.5	-	-	1.8

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	3	1191	926	4	0	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	92	92	80	80
Heavy Vehicles, %	0	1	0	0	0	0
Mvmt Flow	3	1241	1007	4	0	8

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	1011	0	1636
Stage 1	-	-	1009
Stage 2	-	-	627
Critical Hdwy	4.1	-	6.8
Critical Hdwy Stg 1	-	-	5.8
Critical Hdwy Stg 2	-	-	5.8
Follow-up Hdwy	2.2	-	3.5
Pot Cap-1 Maneuver	694	-	93
Stage 1	-	-	318
Stage 2	-	-	500
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	694	-	92
Mov Cap-2 Maneuver	-	-	92
Stage 1	-	-	318
Stage 2	-	-	493

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	12.1
HCM LOS			B

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	694	-	-	-	518
HCM Lane V/C Ratio	0.005	-	-	-	0.014
HCM Control Delay (s)	10.2	0.1	-	-	12.1
HCM Lane LOS	B	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection

Int Delay, s/veh 5.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Vol, veh/h	479	712	678	20	0	252
Conflicting Peds, #/hr	4	0	0	4	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	Free	-	None
Storage Length	0	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	91	91	83	80
Heavy Vehicles, %	1	0	1	0	0	1
Mvmt Flow	521	774	745	22	0	315

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	745	0	2173
Stage 1	-	-	745
Stage 2	-	-	1428
Critical Hdwy	4.12	-	6.8
Critical Hdwy Stg 1	-	-	5.8
Critical Hdwy Stg 2	-	-	5.8
Follow-up Hdwy	2.21	-	3.5
Pot Cap-1 Maneuver	865	-	41
Stage 1	-	-	435
Stage 2	-	-	191
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	862	-	16
Mov Cap-2 Maneuver	-	-	16
Stage 1	-	-	435
Stage 2	-	-	76

Approach	EB	WB	SB
HCM Control Delay, s	6.2	0	16.6
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	SBLn1
Capacity (veh/h)	862	-	-	622
HCM Lane V/C Ratio	0.604	-	-	0.506
HCM Control Delay (s)	15.3	-	-	16.6
HCM Lane LOS	C	-	-	C
HCM 95th %tile Q(veh)	4.2	-	-	2.9

APPENDIX F

2024 No Build Capacity/Level-of-Service Analysis

Wareham Residential Development
1: Cranberry Highway & Red Brook Road

2024 No Build Weekday AM

11/06/2017



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Lane Configurations									
Traffic Volume (vph)	55	139	636	10	478	15	10	284	
Future Volume (vph)	55	139	636	10	478	15	10	284	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	0	1757	3539	1770	3525	0	1805	1583	
Flt Permitted		0.950		0.950			0.950		
Satd. Flow (perm)	0	1749	3539	1770	3525	0	1805	1583	
Right Turn on Red						Yes		Yes	
Satd. Flow (RTOR)					2			316	
Link Speed (mph)			30		30		30		
Link Distance (ft)			193		739		955		
Travel Time (s)			4.4		16.8		21.7		
Confl. Peds. (#/hr)		3				3			
Peak Hour Factor	0.92	0.90	0.90	0.92	0.98	0.98	0.90	0.90	
Heavy Vehicles (%)	2%	3%	2%	2%	2%	0%	0%	2%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	214	707	11	503	0	11	316	
Turn Type	Prot	Prot	NA	Prot	NA		Prot	Perm	
Protected Phases	1	1	6	5	2		4		9
Permitted Phases								4	
Detector Phase	1	1	6	5	2		4	4	
Switch Phase									
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0		6.0	6.0	7.0
Minimum Split (s)	11.0	11.0	14.0	10.5	16.0		14.0	14.0	31.0
Total Split (s)	25.0	25.0	46.0	25.0	46.0		26.0	26.0	31.0
Total Split (%)	19.5%	19.5%	35.9%	19.5%	35.9%		20.3%	20.3%	24%
Yellow Time (s)	3.0	3.0	4.5	3.5	4.0		4.0	4.0	3.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	6.5	4.5	6.0		6.0	6.0	
Lead/Lag	Lead	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes				
Recall Mode	None	None	Min	None	Min		None	None	None
Act Effect Green (s)		12.0	27.7	6.1	12.7		7.2	7.2	
Actuated g/C Ratio		0.24	0.56	0.12	0.26		0.15	0.15	
v/c Ratio		0.50	0.36	0.05	0.55		0.04	0.63	
Control Delay		21.4	7.4	24.0	19.0		21.1	9.8	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		21.4	7.4	24.0	19.0		21.1	9.8	
LOS		C	A	C	B		C	A	
Approach Delay			10.6		19.1		10.2		
Approach LOS			B		B		B		
Queue Length 50th (ft)		49	40	3	61		3	0	
Queue Length 95th (ft)		125	131	18	128		16	60	
Internal Link Dist (ft)			113		659		875		
Turn Bay Length (ft)									
Base Capacity (vph)		730	2906	754	2931		750	842	
Starvation Cap Reductn		0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0		0	0	



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Storage Cap Reductn		0	0	0	0		0	0	
Reduced v/c Ratio		0.29	0.24	0.01	0.17		0.01	0.38	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 49.3

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.63

Intersection Signal Delay: 13.0






Intersection LOS: B

Intersection Capacity Utilization 56.2%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Cranberry Highway & Red Brook Road

 Ø1	 Ø2	 Ø9	 Ø4
25 s	46 s	31 s	26 s
 Ø5	 Ø6		
25 s	46 s		

Intersection

Int Delay, s/veh 0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	830	813	4	0	4
Future Vol, veh/h	0	830	813	4	0	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	89	89	80	80
Heavy Vehicles, %	0	2	1	0	0	0
Mvmt Flow	0	883	913	4	0	5

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	-	0	- 0 - 459
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	-	-	- - 6.9
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	-	-	- - 3.3
Pot Cap-1 Maneuver	0	-	- - 0 554
Stage 1	0	-	- - 0 -
Stage 2	0	-	- - 0 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	- - 554
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	11.6
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	554
HCM Lane V/C Ratio	-	-	-	0.009
HCM Control Delay (s)	-	-	-	11.6
HCM Lane LOS	-	-	-	B
HCM 95th %tile Q(veh)	-	-	-	0

Wareham Residential Development
1: Cranberry Highway & Red Brook Road

2024 No Build Weekday PM

11/06/2017



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Lane Configurations		↔	↔	↔	↔		↔	↔	
Traffic Volume (vph)	14	514	763	10	727	21	10	270	
Future Volume (vph)	14	514	763	10	727	21	10	270	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Storage Length (ft)		0		0		0	100	0	
Storage Lanes		1		1		0	1	1	
Taper Length (ft)		25		25			25		
Satd. Flow (prot)	0	1788	3610	1805	3558	0	1805	1599	
Flt Permitted		0.950		0.950			0.950		
Satd. Flow (perm)	0	1780	3610	1805	3558	0	1805	1599	
Right Turn on Red						Yes		Yes	
Satd. Flow (RTOR)					2			338	
Link Speed (mph)			30		30		30		
Link Distance (ft)			193		739		955		
Travel Time (s)			4.4		16.8		21.7		
Confl. Peds. (#/hr)		4				4			
Peak Hour Factor	0.92	0.92	0.92	0.91	0.91	0.91	0.80	0.80	
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	1%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	574	829	11	822	0	13	338	
Turn Type	Prot	Prot	NA	Prot	NA		Prot	Perm	
Protected Phases	1	1	6	5	2		4		9
Permitted Phases								4	
Detector Phase	1	1	6	5	2		4	4	
Switch Phase									
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0		6.0	6.0	7.0
Minimum Split (s)	11.0	11.0	32.5	10.5	16.0		14.0	14.0	31.0
Total Split (s)	25.0	25.0	46.0	25.0	46.0		26.0	26.0	31.0
Total Split (%)	19.5%	19.5%	35.9%	19.5%	35.9%		20.3%	20.3%	24%
Yellow Time (s)	3.0	3.0	4.5	3.5	4.0		4.0	4.0	3.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	6.5	4.5	6.0		6.0	6.0	
Lead/Lag	Lead	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?			Yes	Yes					
Recall Mode	None	None	Min	None	Min		None	None	None
Act Effect Green (s)		20.3	46.1	6.4	23.1		8.0	8.0	
Actuated g/C Ratio		0.30	0.67	0.09	0.34		0.12	0.12	
v/c Ratio		1.09	0.34	0.07	0.69		0.06	0.70	
Control Delay		92.6	6.3	33.7	22.8		29.5	12.5	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		92.6	6.3	33.7	22.8		29.5	12.5	
LOS		F	A	C	C		C	B	
Approach Delay			41.6		23.0		13.1		
Approach LOS			D		C		B		
Queue Length 50th (ft)		~255	49	4	144		5	0	
Queue Length 95th (ft)		#600	170	21	234		19	43	
Internal Link Dist (ft)			113		659		875		
Turn Bay Length (ft)							100		



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Base Capacity (vph)		529	2423	547	2105		533	711	
Starvation Cap Reductn		0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0		0	0	
Storage Cap Reductn		0	0	0	0		0	0	
Reduced v/c Ratio		1.09	0.34	0.02	0.39		0.02	0.48	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 68.7

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.09

Intersection Signal Delay: 31.7

Intersection LOS: C

Intersection Capacity Utilization 80.9%

ICU Level of Service D

Analysis Period (min) 15





~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Cranberry Highway & Red Brook Road

 Ø1	 Ø2	 Ø9	 Ø4
25 s	46 s	31 s	26 s
 Ø5	 Ø6		
25 s	46 s		

Intersection

Int Delay, s/veh 0

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	1291	1004	7	0	6
Future Vol, veh/h	0	1291	1004	7	0	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	96	96	92	92	80	80
Heavy Vehicles, %	0	1	0	0	0	0
Mvmt Flow	0	1345	1091	8	0	8

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	-	0	- 0 - 550
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	-	-	- - 6.9
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	-	-	- - 3.3
Pot Cap-1 Maneuver	0	-	- 0 484
Stage 1	0	-	- 0 -
Stage 2	0	-	- 0 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	- - 484
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.6
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	484
HCM Lane V/C Ratio	-	-	-	0.015
HCM Control Delay (s)	-	-	-	12.6
HCM Lane LOS	-	-	-	B
HCM 95th %tile Q(veh)	-	-	-	0

APPENDIX G

2024 Build Capacity/Level-of-Service Analysis

Wareham Residential Development
1: Cranberry Highway & Red Brook Road

2024 Build Weekday AM

11/06/2017



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Lane Configurations									
Traffic Volume (vph)	58	145	636	10	478	19	31	290	
Future Volume (vph)	58	145	636	10	478	19	31	290	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	0	1757	3539	1770	3517	0	1805	1583	
Flt Permitted		0.950		0.950			0.950		
Satd. Flow (perm)	0	1749	3539	1770	3517	0	1805	1583	
Right Turn on Red						Yes		Yes	
Satd. Flow (RTOR)					3			322	
Link Speed (mph)			30		30		30		
Link Distance (ft)			193		739		148		
Travel Time (s)			4.4		16.8		3.4		
Confl. Peds. (#/hr)		3				3			
Peak Hour Factor	0.92	0.90	0.90	0.92	0.98	0.98	0.90	0.90	
Heavy Vehicles (%)	2%	3%	2%	2%	2%	0%	0%	2%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	224	707	11	507	0	34	322	
Turn Type	Prot	Prot	NA	Prot	NA		Prot	Perm	
Protected Phases	1	1	6	5	2		4		9
Permitted Phases								4	
Detector Phase	1	1	6	5	2		4	4	
Switch Phase									
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0		6.0	6.0	7.0
Minimum Split (s)	11.0	11.0	14.0	10.5	16.0		14.0	14.0	31.0
Total Split (s)	25.0	25.0	46.0	25.0	46.0		26.0	26.0	31.0
Total Split (%)	19.5%	19.5%	35.9%	19.5%	35.9%		20.3%	20.3%	24%
Yellow Time (s)	3.0	3.0	4.5	3.5	4.0		4.0	4.0	3.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	6.5	4.5	6.0		6.0	6.0	
Lead/Lag	Lead	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes				
Recall Mode	None	None	Min	None	Min		None	None	None
Act Effect Green (s)		12.8	28.7	6.2	12.9		7.2	7.2	
Actuated g/C Ratio		0.25	0.57	0.12	0.26		0.14	0.14	
v/c Ratio		0.50	0.35	0.05	0.56		0.13	0.64	
Control Delay		21.2	7.3	24.6	19.5		22.4	10.1	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		21.2	7.3	24.6	19.5		22.4	10.1	
LOS		C	A	C	B		C	B	
Approach Delay			10.6		19.6		11.2		
Approach LOS			B		B		B		
Queue Length 50th (ft)		52	40	3	63		9	0	
Queue Length 95th (ft)		131	131	18	131		33	61	
Internal Link Dist (ft)			113		659		68		
Turn Bay Length (ft)									
Base Capacity (vph)		716	2850	739	2868		735	836	
Starvation Cap Reductn		0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0		0	0	



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Storage Cap Reductn		0	0	0	0		0	0	
Reduced v/c Ratio		0.31	0.25	0.01	0.18		0.05	0.39	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 50.3

Natural Cycle: 80

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.64

Intersection Signal Delay: 13.3

Intersection LOS: B

Intersection Capacity Utilization 57.2%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Cranberry Highway & Red Brook Road

Ø1	Ø2	Ø9	Ø4
25 s	46 s	31 s	26 s
Ø5	Ø6		
25 s	46 s		

Intersection




Int Delay, s/veh 0.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	839	819	7	0	41
Future Vol, veh/h	0	839	819	7	0	41
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	94	94	89	89	80	80
Heavy Vehicles, %	0	2	1	0	0	0
Mvmt Flow	0	893	920	8	0	51

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	-	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	6.9
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	3.3
Pot Cap-1 Maneuver	0	-	0
Stage 1	0	-	0
Stage 2	0	-	0
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	550
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	SB
HCM Control Delay, s	0	0	12.2
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	550
HCM Lane V/C Ratio	-	-	-	0.093
HCM Control Delay (s)	-	-	-	12.2
HCM Lane LOS	-	-	-	B
HCM 95th %tile Q(veh)	-	-	-	0.3

Intersection						
Int Delay, s/veh	0.8					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	27	10	154	294	1
Future Vol, veh/h	3	27	10	154	294	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	29	11	167	320	1
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	510	321	321	0	-	0
Stage 1	321	-	-	-	-	-
Stage 2	189	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	523	720	1239	-	-	-
Stage 1	735	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	518	720	1239	-	-	-
Mov Cap-2 Maneuver	518	-	-	-	-	-
Stage 1	728	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Approach	EB	NB		SB		
HCM Control Delay, s	10.5	0.5		0		
HCM LOS	B					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1239	-	693	-	-	
HCM Lane V/C Ratio	0.009	-	0.047	-	-	
HCM Control Delay (s)	7.9	0	10.5	-	-	
HCM Lane LOS	A	A	B	-	-	
HCM 95th %tile Q(veh)	0	-	0.1	-	-	

Wareham Residential Development
1: Cranberry Highway & Red Brook Road

2024 Build Weekday PM

11/06/2017



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Lane Configurations									
Traffic Volume (vph)	27	544	763	10	727	41	20	273	
Future Volume (vph)	27	544	763	10	727	41	20	273	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	
Satd. Flow (prot)	0	1803	3610	1770	3576	0	1805	1599	
Flt Permitted		0.950		0.950			0.950		
Satd. Flow (perm)	0	1796	3610	1770	3576	0	1805	1599	
Right Turn on Red						Yes		Yes	
Satd. Flow (RTOR)					5			341	
Link Speed (mph)			30		30		30		
Link Distance (ft)			193		739		143		
Travel Time (s)			4.4		16.8		3.3		
Confl. Peds. (#/hr)		4				4			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.91	0.91	0.83	0.80	
Heavy Vehicles (%)	2%	0%	0%	2%	0%	0%	0%	1%	
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	620	829	11	844	0	24	341	
Turn Type	Prot	Prot	NA	Prot	NA		Prot	Perm	
Protected Phases	1	1	6	5	2		4		9
Permitted Phases								4	
Detector Phase	1	1	6	5	2		4	4	
Switch Phase									
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0		6.0	6.0	7.0
Minimum Split (s)	11.0	11.0	32.5	10.5	16.0		14.0	14.0	31.0
Total Split (s)	25.0	25.0	46.0	25.0	46.0		26.0	26.0	31.0
Total Split (%)	19.5%	19.5%	35.9%	19.5%	35.9%		20.3%	20.3%	24%
Yellow Time (s)	3.0	3.0	4.5	3.5	4.0		4.0	4.0	3.0
All-Red Time (s)	2.0	2.0	2.0	1.0	2.0		2.0	2.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0		0.0	0.0	
Total Lost Time (s)		5.0	6.5	4.5	6.0		6.0	6.0	
Lead/Lag	Lead	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?			Yes	Yes					
Recall Mode	None	None	Min	None	Min		None	None	None
Act Effect Green (s)		20.3	46.7	6.4	23.8		8.1	8.1	
Actuated g/C Ratio		0.29	0.67	0.09	0.34		0.12	0.12	
v/c Ratio		1.18	0.34	0.07	0.69		0.11	0.70	
Control Delay		125.0	6.3	34.1	22.7		30.4	12.4	
Queue Delay		0.0	0.0	0.0	0.0		0.0	0.0	
Total Delay		125.0	6.3	34.1	22.7		30.4	12.4	
LOS		F	A	C	C		C	B	
Approach Delay			57.1		22.9		13.6		
Approach LOS			E		C		B		
Queue Length 50th (ft)		~301	51	4	150		9	0	
Queue Length 95th (ft)		#661	170	21	241		29	42	
Internal Link Dist (ft)			113		659		63		
Turn Bay Length (ft)									
Base Capacity (vph)		527	2430	530	2094		527	709	
Starvation Cap Reductn		0	0	0	0		0	0	
Spillback Cap Reductn		0	0	0	0		0	0	



Lane Group	EBU	EBL	EBT	WBU	WBT	WBR	SBL	SBR	Ø9
Storage Cap Reductn		0	0	0	0		0	0	
Reduced v/c Ratio		1.18	0.34	0.02	0.40		0.05	0.48	

Intersection Summary

Area Type: Other

Cycle Length: 128

Actuated Cycle Length: 69.4

Natural Cycle: 120

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 1.18

Intersection Signal Delay: 40.2

Intersection LOS: D

Intersection Capacity Utilization 84.1%

ICU Level of Service E

Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Cranberry Highway & Red Brook Road

 Ø1	 Ø2	 Ø9	 Ø4
25 s	46 s	31 s	26 s
 Ø5	 Ø6		
25 s	46 s		

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↑
Traffic Vol, veh/h	0	1334	1007	20	0	25
Future Vol, veh/h	0	1334	1007	20	0	25
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	89	89	91	91	80	80
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	1499	1107	22	0	31




Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	-	0	- 0 - 565
Stage 1	-	-	- - -
Stage 2	-	-	- - -
Critical Hdwy	-	-	- - 6.9
Critical Hdwy Stg 1	-	-	- - -
Critical Hdwy Stg 2	-	-	- - -
Follow-up Hdwy	-	-	- - 3.3
Pot Cap-1 Maneuver	0	-	- - 0 473
Stage 1	0	-	- - 0 -
Stage 2	0	-	- - 0 -
Platoon blocked, %	-	-	- - -
Mov Cap-1 Maneuver	-	-	- - 473
Mov Cap-2 Maneuver	-	-	- - -
Stage 1	-	-	- - -
Stage 2	-	-	- - -

Approach	EB	WB	SB
HCM Control Delay, s	0	0	13.1
HCM LOS			B

Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	-	-	-	473
HCM Lane V/C Ratio	-	-	-	0.066
HCM Control Delay (s)	-	-	-	13.1
HCM Lane LOS	-	-	-	B
HCM 95th %tile Q(veh)	-	-	-	0.2

Intersection

Int Delay, s/veh 0.7

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	2	13	50	535	280	3
Future Vol, veh/h	2	13	50	535	280	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	14	54	582	304	3

Major/Minor	Minor2	Major1	Major2
Conflicting Flow All	996	306	307
Stage 1	306	-	-
Stage 2	690	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	271	734	1254
Stage 1	747	-	-
Stage 2	498	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	254	734	1254
Mov Cap-2 Maneuver	254	-	-
Stage 1	699	-	-
Stage 2	498	-	-

Approach	EB	NB	SB
HCM Control Delay, s	11.3	0.7	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1254	-	586	-	-
HCM Lane V/C Ratio	0.043	-	0.028	-	-
HCM Control Delay (s)	8	0	11.3	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

APPENDIX H

Capacity / Level of Service Analysis

Capacity Analysis Summary
Wareham Residential
Wareham, MA

Weekday Morning Peak Hour									
Intersection	Movement	2017 Existing			2024 No Build			2024 Build	
		LOS ¹	Delay ²	V/C ³	LOS	Delay	V/C	LOS	Delay
Cranberry Highway (Route 6) at Red Brook Road	EB L	A	8.8	0.13	C	21.4	0.50	C	21.2
	T	A	0.0	0.00	A	7.4	0.36	A	7.3
	WB TR	A	0.0	0.00	C	24.0	0.05	C	24.6
	U	n/a	n/a	n/a	B	19.0	0.55	B	19.5
	SB L	n/a	n/a	n/a	C	21.1	0.04	C	22.4
	R	B	12.6	0.38	A	9.8	0.63	B	10.1
Overall		n/a	n/a	n/a	B	13.0	0.63	B	13.3
Cranberry Highway (Route 6) at Site Driveway	EB LT	A	0.0	0.00	n/a	n/a	n/a	n/a	n/a
	T	n/a	n/a	n/a	A	0.0	0.00	A	0.0
	WB TR	A	0.0	0.00	A	0.0	0.00	A	0.0
	SB LR	B	14.1	0.01	n/a	n/a	n/a	n/a	n/a
	R	n/a	n/a	n/a	B	11.6	0.01	B	12.2
Red Brook Road at Site Driveway	EB LR	n/a	n/a	n/a	n/a	n/a	n/a	B	10.5
	NB LT	n/a	n/a	n/a	n/a	n/a	n/a	A	0.5
	SB TR	n/a	n/a	n/a	n/a	n/a	n/a	A	0.0

1 Level-of-Serice

2 Average vehicle delay in seconds

3 Volume to capacity ratio

n/a Not Applicable

Queue Summary
Wareham Residential
Wareham, MA

Weekday Morning Peak Hour									
Intersection	Movement	2017 Existing			2024 No Build			2024 Build	
		50th Queue ¹	95th Queue ²	50th Queue	95th Queue	50th Queue	95th Queue	50th Queue	95th Queue
Cranberry Highway (Route 6) at Red Brook Road	EB L	n/a	13	49	125	52	131		131
	T	n/a	0	40	131	40	131		131
	WB TR	n/a	0	3	18	3	18		18
	U	n/a	n/a	61	128	63	131		131
	SB L	n/a	n/a	3	16	9	33		33
	R	n/a	45	0	60	0	61		61
Cranberry Highway (Route 6) at Site Driveway	EB LT	n/a	0	n/a	n/a	n/a	n/a		n/a
	T	n/a	n/a	n/a	0	n/a	0		0
	WB TR	n/a	0	n/a	0	n/a	0		0
	SB LR	n/a	0	n/a	n/a	n/a	n/a		n/a
	R	n/a	n/a	n/a	0	n/a	8		8
Red Brook Road at Site Driveway	EB LR	n/a	n/a	n/a	n/a	n/a	3		3
	NB LT	n/a	n/a	n/a	n/a	n/a	0		0
	SB TR	n/a	n/a	n/a	n/a	n/a	0		0

1 50th Percentile Queue Length (ft)

2 95th Percentile Queue Length (ft)

n/a Not Applicable

Capacity Analysis Summary
Wareham Residential
Wareham, MA

Weekday Afternoon Peak Hour											
		2017 Existing			2024 No Build			2024 Build			
Intersection	Movement	LOS ¹	Delay ²	V/C ³	LOS	Delay	V/C	LOS	Delay	V/C	
Cranberry Highway (Route 6) at Red Brook Road	EB L	C	15.3	0.60	F	92.6	1.09	F	125.0	1.18	
	T	A	0.0	0.00	A	6.3	0.34	A	6.3	0.34	
	WB TR	A	0.0	0.00	C	33.7	0.07	C	34.1	0.07	
	U	n/a	n/a	n/a	C	22.8	0.69	C	22.7	0.69	
	SB L	n/a	n/a	n/a	C	29.5	0.06	C	30.4	0.11	
	R	C	16.6	0.51	B	12.5	0.70	B	12.4	0.70	
	Overall	n/a	n/a	n/a	C	31.7	1.09	D	40.2	1.18	
Cranberry Highway (Route 6) at Site Driveway	EB LT	A	0.1	0.01	n/a	n/a	n/a	n/a	n/a	n/a	
	T	n/a	n/a	n/a	A	0.0	0.00	A	0.0	0.00	
	WB TR	A	0.0	0.00	A	0.0	0.00	A	0.0	0.00	
	SB LR	B	12.1	0.01	n/a	n/a	n/a	n/a	n/a	n/a	
	R	n/a	n/a	n/a	B	12.6	0.02	B	13.1	0.07	
Red Brook Road at Site Driveway	EB LR	n/a	n/a	n/a	n/a	n/a	n/a	B	11.3	0.03	
	NB LT	n/a	n/a	n/a	n/a	n/a	n/a	A	0.7	0.04	
	SB TR	n/a	n/a	n/a	n/a	n/a	n/a	A	0.0	0.00	

1 Level-of-Service

2 Average vehicle delay in seconds

3 Volume to capacity ratio

n/a Not Applicable

Queue Summary
Wareham Residential
Wareham, MA

Weekday Afternoon Peak Hour									
Intersection	Movement	2017 Existing			2024 No Build			2024 Build	
		50th Queue ¹	95th Queue ²	50th Queue	95th Queue	50th Queue	95th Queue	50th Queue	95th Queue
Cranberry Highway (Route 6) at Red Brook Road	EB L	n/a	105	255	600	301	661		
	T	n/a	0	49	170	51	170		
	WB TR	n/a	0	4	21	4	21		
	U	n/a	n/a	144	234	150	241		
	SB L	n/a	n/a	5	19	9	29		
	R	n/a	73	0	43	0	42		
Cranberry Highway (Route 6) at Site Driveway	EB LT	n/a	0	n/a	n/a	n/a	n/a		
	T	n/a	n/a	n/a	0	n/a	0		
	WB TR	n/a	0	n/a	0	n/a	0		
	SB LR	n/a	0	n/a	n/a	n/a	n/a		
	R	n/a	n/a	n/a	0	n/a	5		
Red Brook Road at Site Driveway	EB LR	n/a	n/a	n/a	n/a	n/a	3		
	NB LT	n/a	n/a	n/a	n/a	n/a	3		
	SB TR	n/a	n/a	n/a	n/a	n/a	0		

1 50th Percentile Queue Length (ft)

2 95th Percentile Queue Length (ft)

n/a Not Applicable