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Town of Barnstable Road Safety Audit

Route 28 at Osterville-West Barnstable Road Intersection

November 2012





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Prepared by the Cape Cod Commission in cooperation with the Town of Barnstable, and MassDOT Highway Division Traffic Safety and District 5 Offices.



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Background

All levels of government— local, regional, state, and federal—have been considering locations where crashes are most severe for many years. Several years ago the national consensus was that there should be goals to reduce crashes, and in the 2005 federal legislation: *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU), there was more emphasis on improving highway safety along with a dedicated funding program—the Highway Safety Improvement Program (HSIP). The latest federal legislation: *Moving Ahead for Progress in the 21st Century* (MAP-21), signed into law on July 6, 2012, has consolidated many highway programs while retaining the Highway Safety Improvement Program (HSIP) as one of the five core highway programs.

In an effort to reduce the number of crash-related fatalities and incapacitating injuries, Massachusetts developed a Strategic Highway Safety Plan in 2006. The mission of the Safety Plan is to “Develop, promote, implement, and evaluate data-driven, multidisciplinary strategies to maximize safety for users of the roadway system.” One of the many strategies noted in the Safety Plan is to “conduct Road Safety Audits (RSA) at high-crash locations throughout the Commonwealth.” MassDOT incorporated the RSA as a requirement for securing Federal funding (Highway Safety Improvement Program [HSIP] funds) for safety projects.

The Federal Highway Administration (FHWA) defines a Road Safety Audit (RSA) as the formal safety examination of an existing or future road or intersection by an independent, multidisciplinary team. The purpose of an RSA is to identify potential safety issues and possible opportunities for safety improvements while considering all roadway users.

The Cape Cod Commission, serving as the regional planning agency for the fifteen towns on Cape Cod, has reviewed many transportation locations over the years during various processes, including the Regional Transportation Plan, the Transportation Improvement Program, and Developments of Regional Impact, considering the existing safety issues and potential improvements. In addition, the CCC began looking at specific safety locations annually through safety studies and Road Safety Audits (RSAs). A portion of the federal HSIP funds are allocated for improvements to the region’s highest crash locations.

Introduction

The Town of Barnstable has 45,193 residents as of the 2010 United States Census of Population, and is the most populous of the fifteen towns on Cape Cod. Although the town lost a little population from the year 2000 to 2010 in the United States Census of Population, it remains the 27th highest community in the state for population. In centerline roadway miles, Barnstable is ranked 5th in the state. While the Town lost a little population, the Barnstable urbanized area (UZA) population did still grow and



remains fourth highest in the state, following Boston, Springfield, and Worcester UZA populations.

Barnstable is the home of seven villages. Each is unique with its various attributes: beaches and harbors, golf courses, shopping places, and museums. In addition, all the villages have residential components, and approximately twenty-two public and private schools are located in the town, and one for higher education—Cape Cod Community College. Barnstable is home to regional services and activities, such as the Cape Cod Hospital, the intermodal transportation center, Barnstable Municipal Airport (the third busiest airport in the state), the ferry connections to Nantucket and Martha's Vineyard, and the County government complex. In conclusion, there is a lot of activity in the Town.

In March 2012, CCC staff presented a safety update and potential Road Safety Audit (RSA) locations to the Cape Cod Joint Transportation Committee (CCJTC), and the resulting 2012 RSA locations selected by the CCJTC included the Barnstable intersection of Route 28 at Osterville-West Barnstable Road with an equivalent property damage only (EPDO) of 54, ranking it as one of the highest safety problem intersection in Barnstable County.

Project Data

The crash reports were requested from the Town of Bourne for this Road Safety Audit and were supplied by the Bourne Police Department. The crash data were reviewed and a crash diagram was developed. In reviewing the crashes by manner of collision, there were 50% angle crashes, 31% rear-end, and 15% same direction sideswipe. More than a third of the crashes, or 35%, occurred during the hours from 10 a.m. to 2 p.m., while the next highest percentage at 23% were between 2 and 6 p.m. Most of the crashes, or 77%, were in daylight with 62% in clear weather. The highest driver contributing codes were 23% that failed to yield right of way, and 18% due to driver inattention.

CCC staff also prepared a graph of the traffic volume data. The average daily traffic on Route 28 is about 23,000. Turning movement counts (TMCs) were performed for the intersection of Route 28 and Osterville-West Barnstable Road in 2008 and again in 2012.

The crash diagram, summary data, and the traffic count data are included in the appendices.

Multidisciplinary Team

The Road Safety Audit was scheduled with MassDOT and the Town. The Road Safety Audit meeting was held on September 28, 2012, beginning around 10:00 a.m., at the Barnstable Department of Public Works (DPW). The multidisciplinary team also



visited the site: Barnstable, Route 28 at Osterville-West Barnstable Road intersection, during the RSA meeting, and then reconvened at the DPW conference room.

Table 1. Participating Audit Team Members

Audit Team Member	Agency / Affiliation
Roger Parsons, P.E.	Town Engineer, Barnstable
Philip Field	Centerville-Osterville-Marstons Mills (COMM) Fire Department
Lisa Schletzbaum	MassDOT Highway Div., Safety
Tom Currier, P.E.	MassDOT Highway Div., Supervising Project Manager
Pamela Haznar, P.E.	MassDOT Highway Div.– District 5
Edward Feeney	MassDOT Highway Div.– District 5
Barbara Lachance	MassDOT Highway Div.– District 5
Corey O'Connor	MassDOT Highway Div., Safety
Priscilla N. Leclerc	Senior Transportation Planner, Cape Cod Commission

Project Location and Description

The intersection of Route 28 at Osterville-West Barnstable Road in the Town of Barnstable is a four way signalized intersection, with the roadways crossing at a right angle. Route 28 is functionally classified in this section as an urban principal arterial, while Osterville-West Barnstable Road is an urban collector.

Figure 1. Locus Map

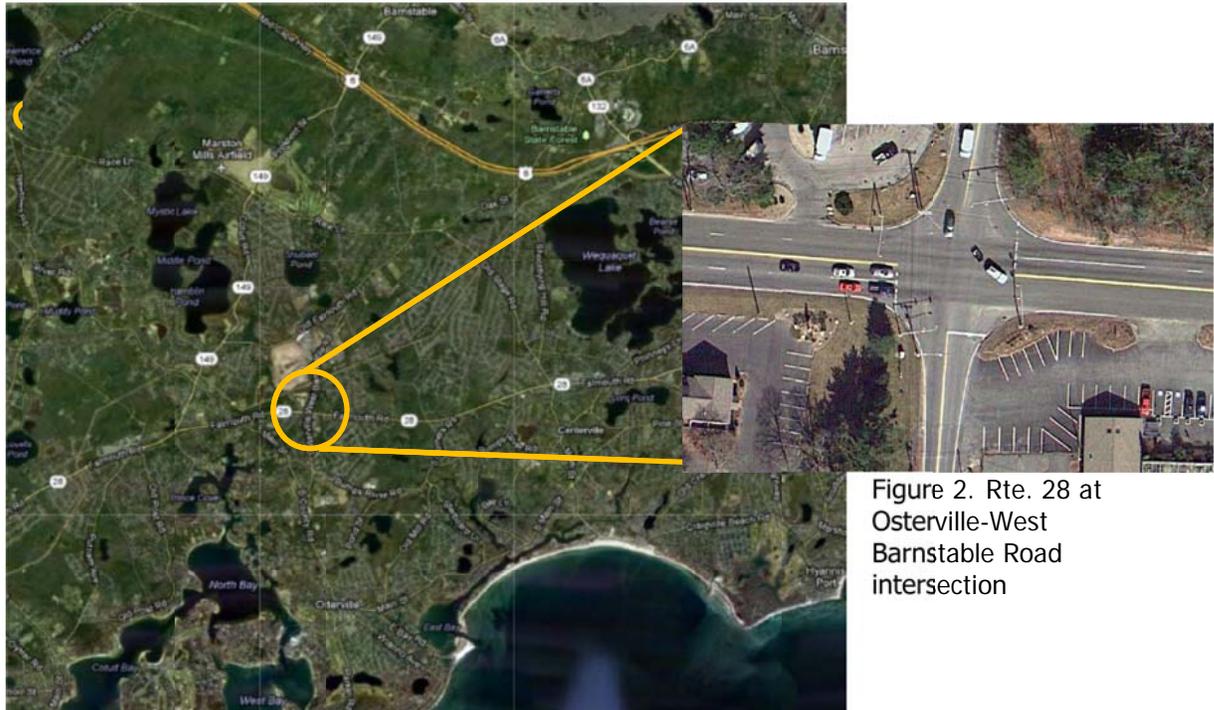


Figure 2. Rte. 28 at Osterville-West Barnstable Road intersection



Road Safety Audit:

The RSA Team met for discussion of the existing conditions, visited the site for field observations, and returned to discuss the safety issues at the location. The summary crash data, crash diagram, and traffic volume chart were brought to the RSA team meeting, and are included in the Appendices. In addition, a turning movement count for the intersection is included in the Appendix.

The RSA Team reviewed the crash diagram, the crash summary, the traffic volumes, and discussed the existing conditions.

The Barnstable Police Department provided local crash reports, and 26 crashes were found to be at the location from September 1, 2009-September 13, 2012, with 19 property damage only, 7 injury crashes, and no fatal crashes. The resulting equivalent property damage only (EPDO) for just these crashes is 54. Of the 26 crashes from 2009-2012, the majority, or 50%, were angle crashes, with 31% rear-end, and 15% sideswipe in the same direction crashes.

Road Safety Audit observations of the safety issues and potential enhancements, and a summary table follow.



Audit Observations and Potential Safety Enhancements

SAFETY ISSUE #1. CONFLICTING MOVEMENTS

Observation:

Team discussion included the traffic volumes and volumes of turning vehicles in opposition to the speeds of the through traffic. The lack of protected left turn movements at the signal for the Route 28 legs, with few gaps in the straight-through traffic, is a major safety issue. It was mentioned that many times, the traffic signal would be changing to yellow, or even red, before the vehicle waiting to turn left could attempt the turn with a clear gap. As a result, the waiting vehicle is then still sometimes in the middle of the intersection while the crossing traffic is beginning the green signal phase.



Another observation was that vehicles taking opposing left turns from the Route 28 legs may have reduced visibility at times by the opposite vehicle waiting to turn left, and not see the through vehicle behind the vehicle waiting to turn.

Improved control of access management for the adjacent property driveways to alleviate conflicts at the intersection was also noted as a potential benefit.

With the recent completion of the improvements at nearby Route 28 signals, and the inclusion of left turn lanes, it may be that the driver expectation is to have a similar configuration at this intersection. Through vehicle drivers may not be expecting turning vehicles because they expect the turning vehicles will have their own signal phase.

Enhancement:

Provide more control and definition at the intersection and adjacent property driveways; consider installation of left turn lanes and phases on Route 28.



SAFETY ISSUE #2. DRIVER BEHAVIOR and SPEED

Observation:

Issues with driver behavior were discussed, and included speeding, inattention, disregarding or not seeing the traffic signal, and failure to yield right-of-way. In one crash report, the driver reported feeling that there was enough time to turn, and the vehicle came up very fast.



Speed is also an issue when moving forward from the stop line on green, and racing to be first in the merge area. With two lane travel along Route 28 and limited passing opportunities, drivers may try to overtake other cars at the intersections.



Occurrences of red light running were mentioned, and it may be more in the Route 28 eastbound direction. Sun glare may be an issue to signal visibility at times. The Route 28 posted speed is 50 miles per hour (mph) except in the vicinity of the intersection where it is reduced to 45 mph. It may be that vehicles travelling along at higher speeds choose to continue through the intersection instead of stop when the light turns yellow.



Enhancement:

Review signal timing to ensure that the clearance time (yellow and all red time) is adequate for the 85th percentile speeds and according to the Institute of Transportation Engineers (ITE) *Traffic Engineering Handbook* equation. When the intersection is reconstructed, consider providing dilemma zone detection.

Provide periodic enforcement to provide visibility that promotes calming and improved behavior.



SAFETY ISSUE #3. SIGHT DISTANCE AND VEGETATION

Observation:

The team observations on sight distance and vegetation were related, and therefore, the issue categories are combined. On Route 28, the sight distance is reasonable although speeds are apt to be high. A comment was made that the signal heads should be black backplates to improve visibility.

The Osterville-West Barnstable Road approaches to the intersection do have vegetative obstructions. From the Northbound approach on Osterville-West Barnstable Road looking easterly on Route 28, a stand of trees is close to the roadway. From the south on Osterville-West Barnstable Road approaching the intersection, vegetation on the island at the corner of Mahoney's Garden Center has grown higher.



Enhancement:

Trim vegetation for improved sight triangle at the intersection.

Add black backplates to the signal heads for improved visibility.





SAFETY ISSUE #4. SIGNS

Observation:

Signs in the vicinity of the intersection are generally sufficient but do need to be brought up to date with requirements for retro-reflectivity.

It was mentioned that there may be drivers looking for Osterville-West Barnstable Road, and perhaps suddenly slowing or stopping in order to negotiate a turn once the road name sign is visible, possibly leading to rear-end crashes. It was pointed out that the street name sign is difficult to read. Rear-end crashes at this intersection made up the second highest type of crash at 31% of all crashes.

Enhancement:

Upgrade signs for retro-reflectivity.

Add a white on green sign in advance of the intersection with "Osterville-West Barnstable Road next signal".





SAFETY ISSUE #5. PAVEMENT AND MARKINGS

Observation:

Pavement condition, level, and markings are in fair condition.

The pavement levels on the Osterville-West Barnstable Road approaches are slightly lower than the Route 28 pavement level. The pavement on the Route 28 approach toward Hyannis is rutted.



Enhancement:

With intersection improvements the pavement level and markings should be improved, as feasible.





SAFETY ISSUE #6. BICYCLE / PEDESTRIAN ACCOMMODATIONS

Observation:

There are no bicycle or pedestrian accommodations at this intersection.

Enhancement:

Upgrade bicycle and pedestrian accommodations with future maintenance and/or reconstruction efforts.

Consider adding an island with the left turn lanes for a break in bicycle/pedestrian crossing of Route 28.





SAFETY ISSUE #7. TRAFFIC SIGNAL EQUIPMENT



Observation:

The traffic signal equipment at this intersection was reported to be lacking in pre-emption capabilities for emergency vehicle access. It was mentioned that with modern quiet vehicles, the sirens are not heard by drivers, and the signal pre-emption equipment is necessary to allow for safer passage of emergency vehicles.

It was also mentioned that the signal head backplates should be in black for improved visibility.



Enhancement:

Install pre-emption equipment in the traffic signal for emergency responders.

Add black backplates to the signal heads.



Summary of Road Safety Audit

The summary list of the Road Safety Audit observations and enhancements is provided to assist in the design and/or implementation of potential improvements elicited during the process. It is also recommended that any design process for more involved geometric changes include further analysis and public input.

Safety payoff estimates are subjective and may be based on the relative percent of crashes that may be reduced by the enhancement based on known and documented crash reduction factors, if available, or estimated crash reduction based on a stated source [for example, low (<30%), medium (31% to 70%), and high (>71%)]. The time frame is categorized as short-term (<1 year), medium-term (1 to 3 years), or long-term (>3 years). The costs are categorized as low (<\$10,000), medium (\$10,001 to \$50,000), or high (>\$50,001).



Table 2. Potential Safety Enhancement Summary

Safety Issue	Potential Safety Enhancement	Safety Payoff	Time Frame	Cost	Responsible Agency
Conflicting Movements Volumes & Turning Vehicles	Add left turn lanes on the Route 28 approaches	High	Medium to Long-term	High	MassDOT with local input
Driver Behavior and Speed	Continue periodic enforcement of the speed limit.	Low	Medium-term	Medium	Police
Sight Distance and Vegetation	Trim or remove bushes on the island to the right of Osterville West Barnstable Road northbound approach	Low	Short-term	Low	MassDOT with local input
	Trim or cut back vegetation as necessary to allow improved visibility to the left on the Osterville West Barnstable Road southbound approach	Low	Short-term	Low	
Signs Condition Directional guidance	All signs to be Retro reflective Add advance street name signs to inform travelers that Osterville-West Barnstable Road is the next street	Low to Medium	Short-term	Low	MassDOT with local input
Pavement & Markings	Adjust pavement level where lower on the Cranberry Highway approach to turn left onto Sandwich Road to bring up to Sandwich Road level	Low	Medium-term	Medium to High	MassDOT with local input
Bicycle / Pedestrian accommodation	Consider improved accommodation for bicyclists and pedestrians with future improvements or maintenance projects Consider adding an island with the left turn lanes for a break in bicycle/pedestrian crossing of the roadway	Medium	Medium to Long-term	Medium to High	MassDOT with local input
Traffic Signal Equipment	Install pre-emption equipment for emergency vehicle priority. Add black backplates to the signal heads.	Low	Medium-term	Medium to High	MassDOT with local input

Appendix A. RSA Meeting Agenda

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BARNSTABLE, MASSACHUSETTS 02630

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Road Safety Audit (RSA) Meeting

BARNSTABLE, ROUTE 28 at YARMOUTH ROAD

Friday, September 28, 2012

1:00 p.m. – 3:00 p.m.

Location: Barnstable Department of Public Works Conference Room
382 Falmouth Road (Route 28), Hyannis, MA 02601

1:00 p.m. Welcome and Introductions

1:10 p.m. Review of Site Specific Material

- Crash and Traffic Volume Summaries– provided in advance
- Existing Geometries and Conditions

1:30 p.m. Visit the Site

- Assemble as a group at the site for observation of conditions
- As a group, identify areas for improvement

2:15 p.m. Post Visit Discussion / Completion of RSA

- Discuss observations and finalize findings
- Discuss potential improvements and finalize recommendations

3:00 p.m. Adjourn for the Day

Next Steps: After the RSA meeting, CCC staff will prepare a draft document and circulate it to participants. Participants are asked to comment and respond to the draft document to assure it is reflective of the RSA completed by the multidisciplinary team.

With comments submitted, a final document is then produced; the final document is expected to be available in October 2012.

Appendix B. RSA Audit Team Contact List

Participating Audit Team Members

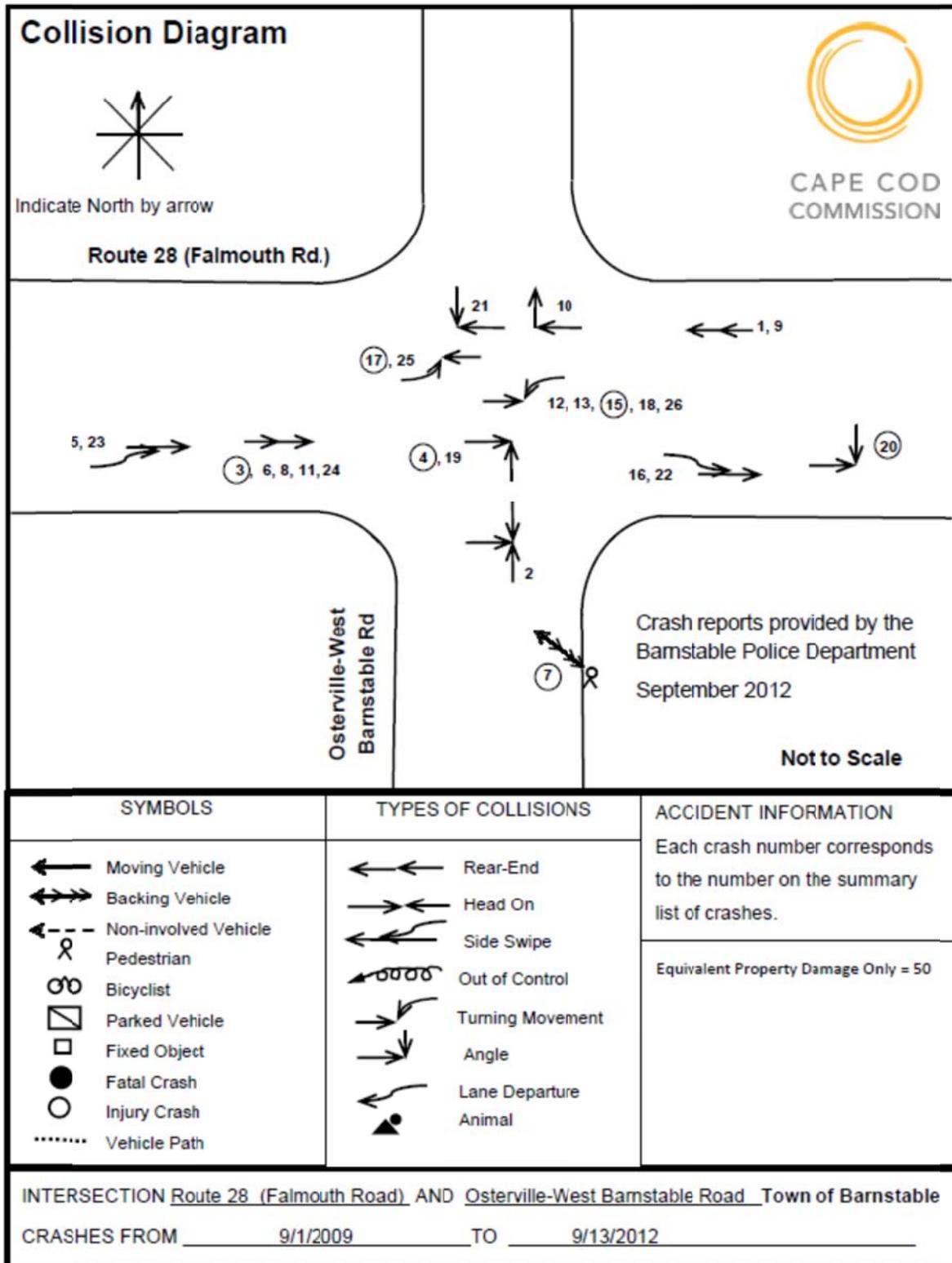
Barnstable Department of Public Works, and site visit

RSA Location: Route 28 at Osterville-West Barnstable Road intersection

September 28, 2012

Audit Team Member	Agency/Affiliation	Email address
Roger Parsons, P.E.	Town Engineer, Barnstable	roger.parsons@town.barnstable.ma.us
Philip Field	COMM Fire Department	pfield@commfiredistrict.com
Lisa Schletzbaum	MassDOT Highway Div., Safety	Lisa.Schletzbaum@mhd.state.ma.us
Tom Currier, P.E.	MassDOT Highway Div., Supervising Project Manager	Thomas.Currier@DOT.state.ma.us
Pamela Haznar, P.E.	MassDOT Highway Div.– District 5	Pamela.Haznar@state.ma.us
Edward Feeney	MassDOT Highway Div.– District 5	Edward.Feeney@state.ma.us
Barbara Lachance	MassDOT Highway Div.– District 5	Barbara.Lachance@state.ma.us
Corey O'Connor	MassDOT Highway Div., Safety	corey.oconnor@state.ma.us
Priscilla N. Leclerc	Senior Transportation Planner, Cape Cod Commission	pleclerc@capecodcommission.org

Appendix C. Detailed Crash Data



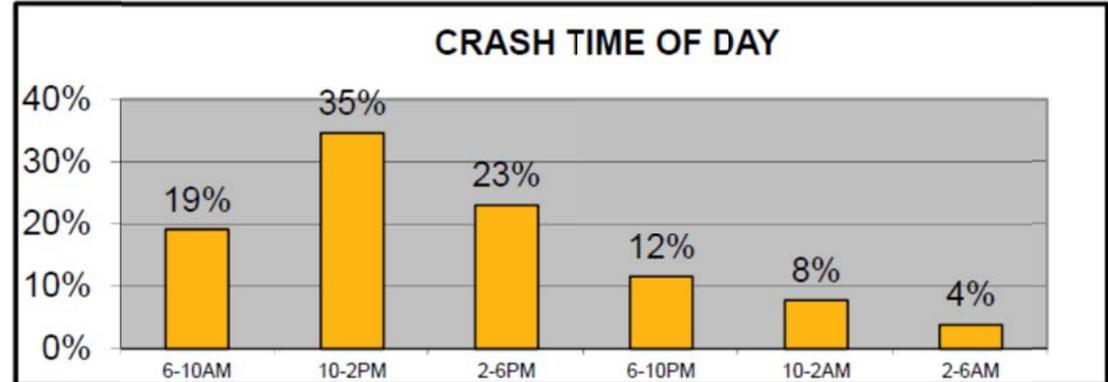
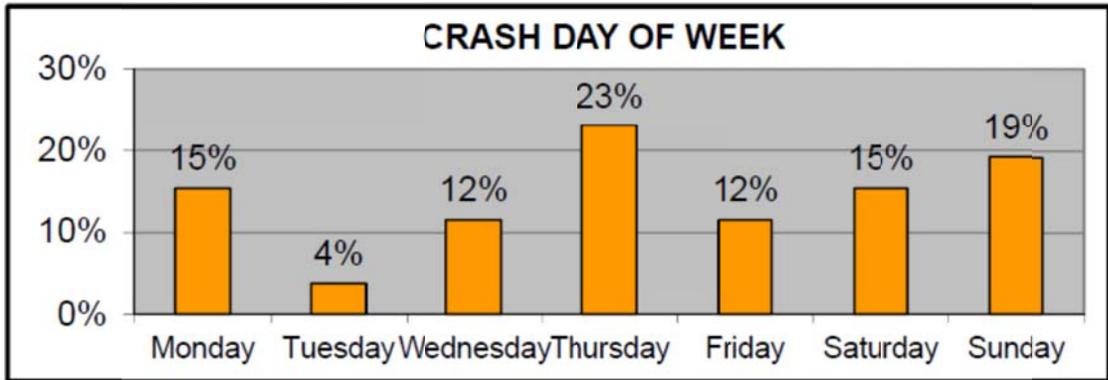
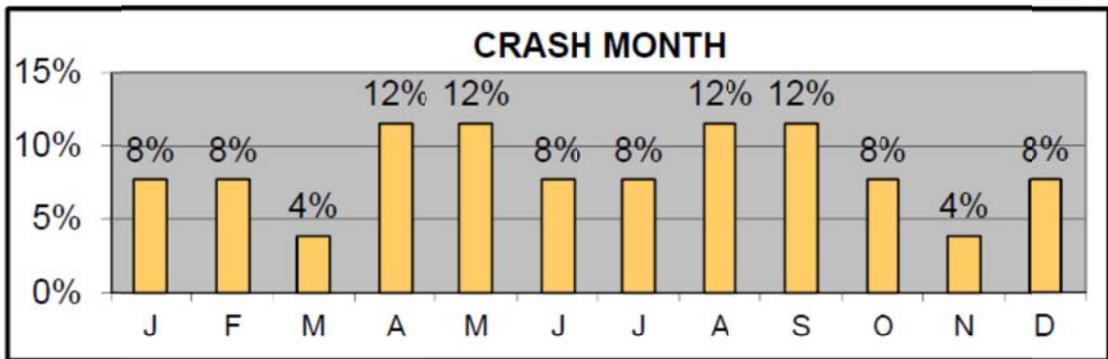
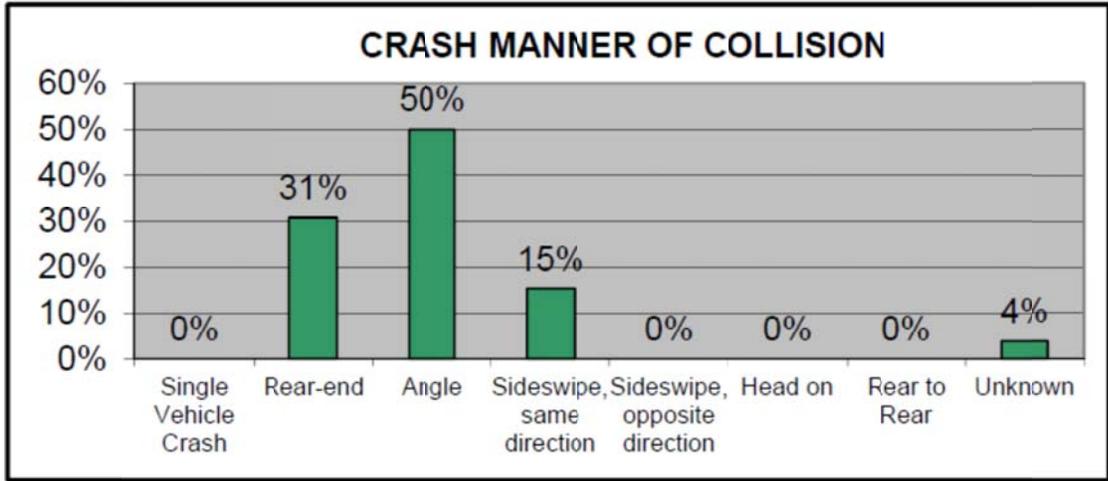
Source: Crash Diagram developed based on September 2009-2012 crash reports provided by the Town of Barnstable Police Department

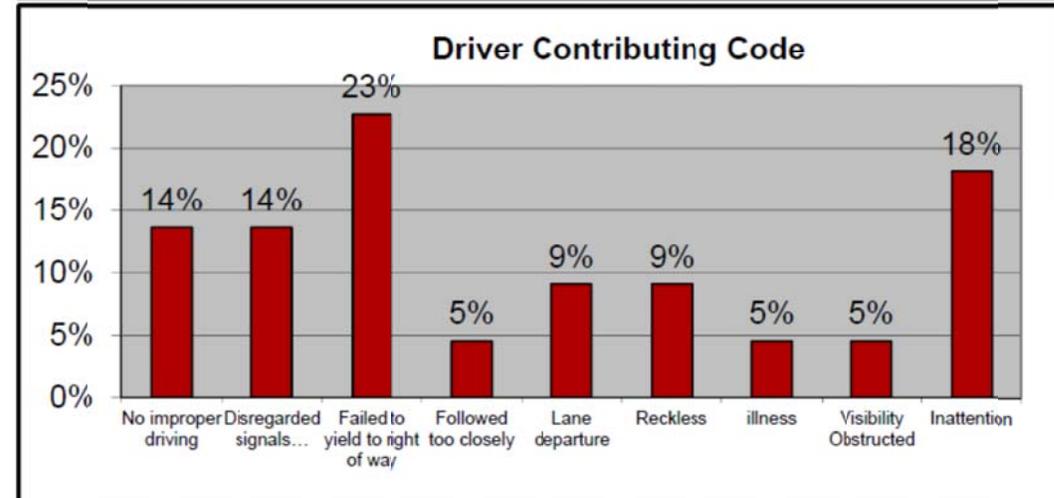
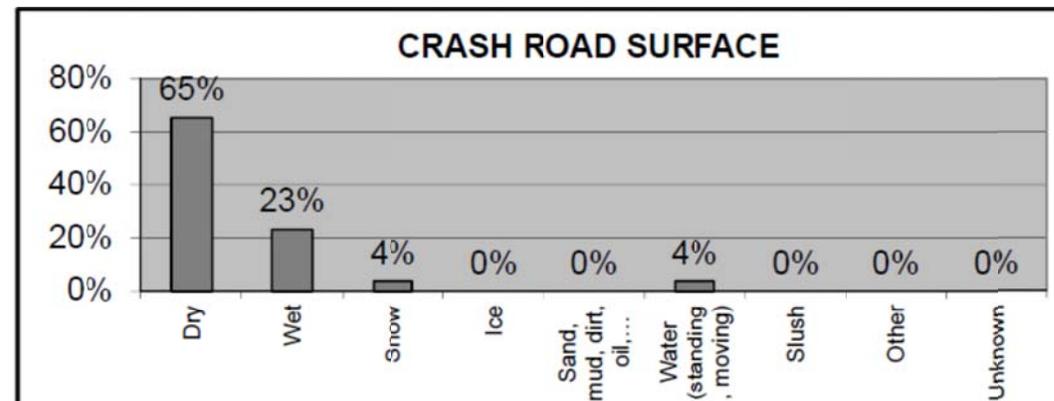
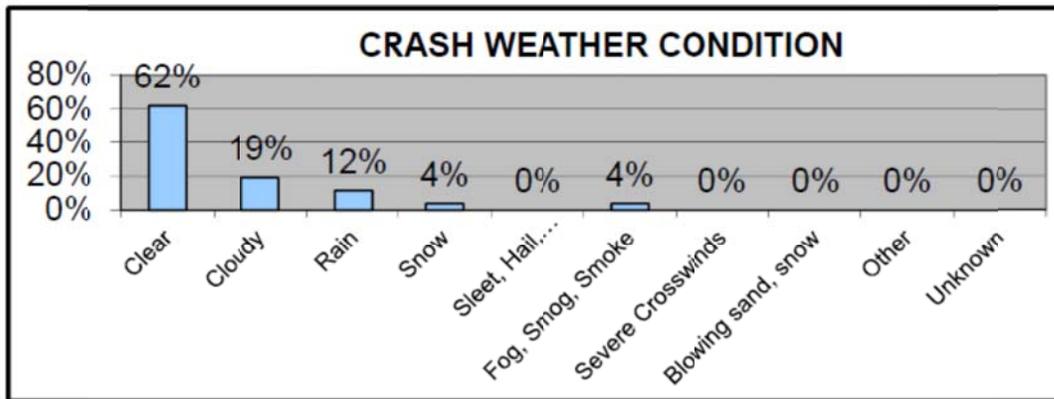
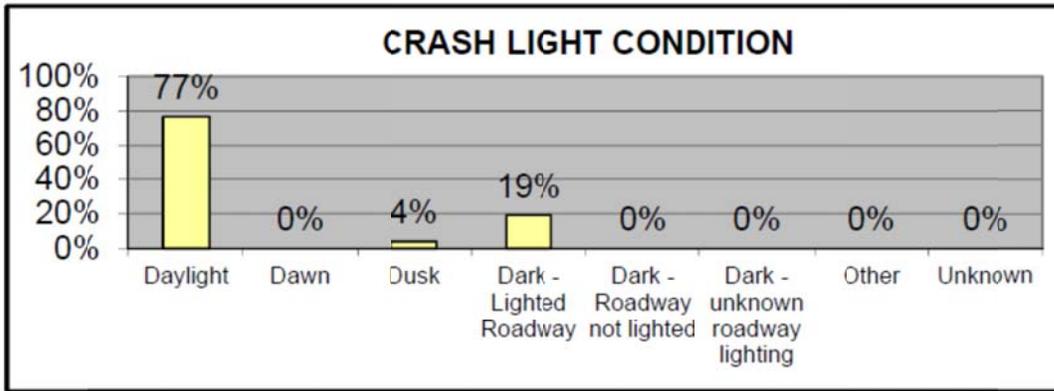
Crash #	Crash Date	Day	Crash Time	# of Vehicles	# of injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Vehicle Sequence of Events	Age of Driver - Veh. 1	Age of Driver - Veh. 2	Road Surface	Weather	Driver Contributing Code
1	9/27/2009	Sun	9:29 AM	2	0	Rear-end	V1 slowing or stopped V2 slowing or stopped	V1: W V2: W	V2 comes to stop in traffic at signal; V1 did not stop in time and rear-ended V2	46	45	water	cloudy	V1 10 reckless erratic
2	10/15/2009	Thu	5:16 PM	3	0	Angle	V1 turning left V2 trav straight ahead	V1: S V2: E V3: N	V1 with trailer turning left onto OstWB Rd; V2 EB hit trailer resulting in hitting V3 stopped at signal	28	44	wet	rain	1 no improper driving
3	11/4/2009	Wed	1:06 PM	2	1	Rear-end	V1 slowing or stopped V2 traveling straight ahead	V1: E V2: E	V1 EB stopped to turn left and hit by V2 (rear-end)	25	54	dry	clear	V1 16 illness
4	12/7/2009	Mon	11:27 AM	2	1	Angle	V1 trav straight ahead V2 trav straight ahead	V1: N V2: E	V1 NB turning left onto Rte. 28 (disregarding red signal) and hit by V2 EB on Rte. 28	27	84	dry	clear	V1 3 Disregarded traffic signs, signals, rd markings
5	4/1/2010	Thu	4:35 PM	2	0	Sideswipe same direction	V1 changing lanes V2 trav straight ahead	V1: E V2: E	V1 changing lanes and hit V2	48	49	dry	clear	V1 19 inattention
6	6/12/2010	Sat	10:55 AM	2	0	Rear-end	V1 slowing or stopped V2 slowing or stopped	V1: E V2: E	V1 hit V2 in traffic as light turned green, and V1 quickly turned left on OstWB Rd (red car)	unk	77	dry	clear	unknown
7	6/27/2010	Sun	11:43 AM	1	1	Other	V1 backing	V1: N pedestrian	V1 backing up into Mahoney's and hit large cart knocking it into a nearby 63-yr-old pedestrian	77		dry	clear	unknown
8	7/27/2010	Tue	4:57 PM	2	0	Rear-end	V1 slowing or stopped V2 traveling straight ahead	V1: E V2: E	heavy traffic V1 stopping in traffic was hit by V2	33	42	dry	clear	1 no improper driving
9	8/23/2010	Mon	12:48 PM	2	0	Rear-end	V1 slowing or stopped V2 slowing or stopped	V1: W V2: W	V1 slowing stopping in traffic and V2 sliding on wet pavement into V1	58	21	wet	rain	V2 19 inattention

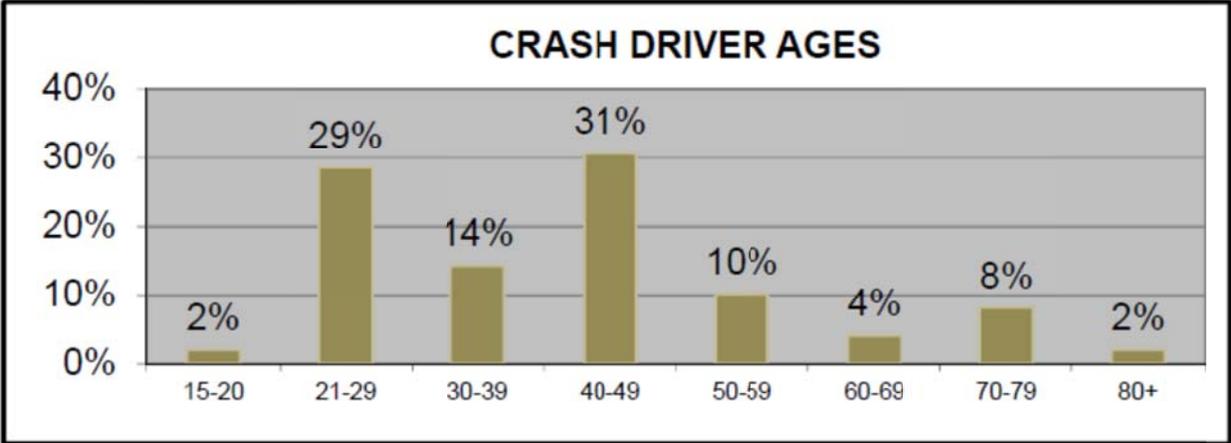
Crash #	Crash Date	Day	Crash Time	# of Vehicles	# of injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Vehicle Sequence of Events	Age of Driver - Veh. 1	Age of Driver - Veh. 2	Road Surface	Weather	Driver Contributing Code
10	9/30/2010	Thu	8:02 AM	2	0	Angle	V1 turning right V2 trav. straight	V1: W V2: N	V2 NB OstWB Rd and V1 turning right from Rte. 28 hits trailer	71	22	wet	clear	V1 4 Failed to yield ROW
11	10/1/2010	Fri	5:28 PM	2	0	Rear-end	V1 slowing or stopped V2 slowing or stopped	V1: E V2: E	V2 stopped on Rte. 28 EB at red light and hit by V1	22	53	wet	cloudy, rain	V1 5 followed too closely
12	12/22/2010	Wed	4:24 PM	2	0	Angle	V1 traveling straight V2 turning left	V1: E V2: W	V1 Rte. 28 EB hit by V2 from Rte. 28 WB turning left onto OstWB Rd	40	41	unk	cloudy	V2 4 Failed to yield ROW
13	1/13/2011	Thu	9:27 AM	2	0	Angle	V1 traveling straight V2 turning left	V1: E V2: S	V2 turning left after truck cleared the intersection did not see V1 in 2nd lane and hit V1; V1 EB sees V2 turning but cannot stop in time	20	41	wet	clear	V2 4 Failed to yield ROW
14	2/4/2011	Fri	12:01 PM	2	0	Rear-end	V1 traveling straight V2 slowing or stopped	V1: E V2: E	V2 stopped on Rte. 28 EB at red light and hit by V1; V1 left scene	unk	23	dry	cloudy	unknown
15	4/17/2011	Sun	10:48 AM	2	2	Angle	V1 traveling straight V2 turning left	V1: E V2: S	V1 EB green light did not see V2 and hit V2; V2 was attempting to turn left - a car had let V2 go	25	(not reported)	dry	clear	1 no improper driving
16	5/15/2011	Sun	3:17 AM	2	0	Sideswipe same direction	V1 turning right V2 traveling straight	V1: E V2: E	V1 turns right from left lane into V2 in right lane both EB on Rte 28 (3rd car behind chasing?)	21	25	wet	cloudy	V1 9 Failure to keep in lane; V2 1 no improper driving
17	5/26/2011	Thu	10:04 PM	2	1	Angle	V1 turning left V2 traveling straight	V1: E V2: W	V1 turning left from Rte 28 EB and did not see V2 on the other side of third V that had turned S; V1 and V2 collide	18	31	dry	cloudy, fog	V1 4 Failed to yield ROW; V2 1 no improper driving
18	7/9/2011	Sat	6:13 PM	2	0	Sideswipe opposite direction	V1 turning left V2 traveling straight	V1: S V2: E	V1 Rte 28 WB waiting to turn left, begins turn & collides with V2 Rte 28 EB (V1 Op statement included that V2 came up very fast and landed at the far end of Mahoney's after collision)	38	38	dry	clear	unknown

Crash #	Crash Date	Day	Crash Time	# of Vehicles	# of injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Vehicle Sequence of Events	Age of Driver - Veh. 1	Age of Driver - Veh. 2	Road Surface	Weather	Driver Contributing Code
19	8/26/2011	Fri	12:54 PM	2	0	Angle	V1 traveling straight V2 traveling straight	V1: E V2: N	V1 Rte 28 EB as the signal turning red and V2 proceeds and both vehicles collide	39	40	dry	clear	V1 3 Disregarded traffic signs, signals, rd markings
20	9/5/2011	Mon	7:28 PM	2	2	Angle	V1 traveling straight V2 turning right	V1: E V2: E	V1 (motorcycle) Rte 28 EB and V2 Rte 28 EB and both vehicles collide; V1 Op stated that V2 pulled over right into him	52	74	dry	cloudy	V1 10 reckless erratic
21	1/21/2012	Sat	7:00 PM	2	0	Angle	V1 traveling straight V2 traveling straight	V1: W V2: S	V1 Rte 28W when hit by V2 from OstWB Rd SB; V2 reported unable to stop - snow	47	26	snow	snow	V1 3 Disregarded traffic signs, signals, rd markings
22	2/5/2012	Sun	3:04 PM	2	0	Sideswipe same direction	V1 overtaking passing V2 traveling straight	V1: E V2: E	V1 & V2 both Rte 28 EB thru intersection and V1 tries to pass V2 in merge area and vehicles collide	36	44	dry	clear	V1 9 Failure to keep in lane
23	3/17/2012	Sat	1:31 AM	2	0	Angle (sideswipe same dir)	V1 changing lanes V2 trav straight ahead	V1: E V2: E	V1 approaching intersection in right lane but wants to turn left; V1 moves into left lane hitting V2	23	28	dry	clear	V1 19 inattention
24	4/30/2012	Mon	8:55 AM	2	0	Rear-end	V1 slowing or stopped V2 slowing or stopped	V1: E V2: E	V2 stopped in traffic and hit by V1 - rear-end	41	47	dry	clear	V1 19 inattention, 20 distracted
25	5/31/2012	Thu	6:58 AM	2	0	Angle	V1 turning left V2 traveling straight	V1: E V2: W	V1 Rte 28 E and V2 Rte 28 W; V1 attempted LT and collision	56	41	dry	clear	V1 4 Failed to yield ROW 6 made an improper turn
26	8/1/2012	Wed	1:32 PM	2	1	Angle	V1 turning left V2 traveling straight	V1: W V2: S	V1 Rte 28 WB attempted LT while V2 traveling straight and collision	65	60	dry	clear	V1 18 visibility obstructed

Source: Barnstable Police Department crash reports for this location from September 2009-2012.







Appendix D. Additional Information

- Turning Movement Count Data
- Hourly Traffic Volumes Graph

Cape Cod Commission

3225 Main St
Barnstable MA 02630

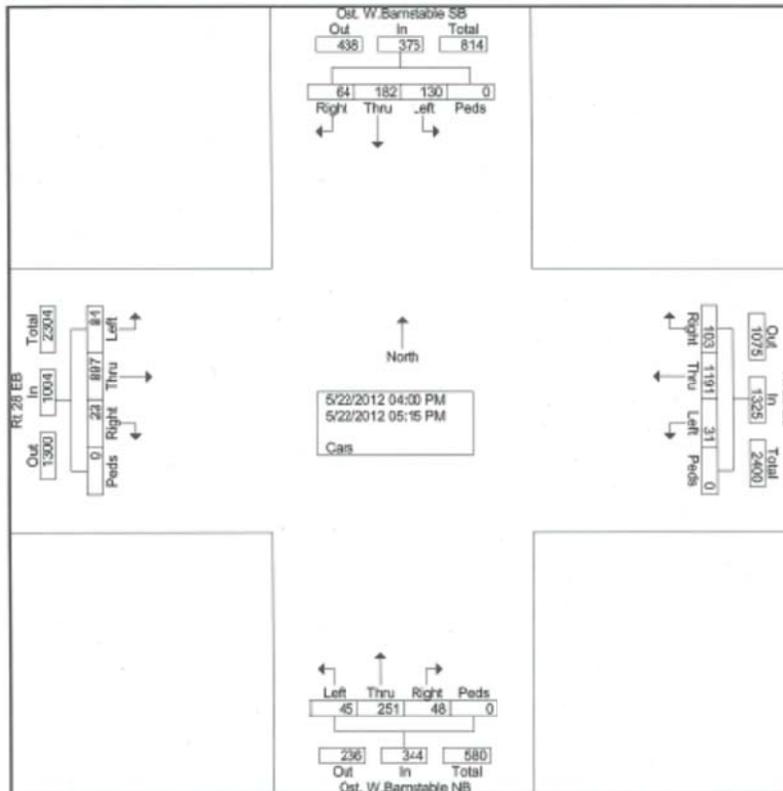
www.capecodcommission.org

Rt 28 @ Osterville-W.Barnstable Rd
Town: Barnstable
Counted by: PT, KW
Counters: 4, 5

File Name : 2887_05222012
Site Code : 00002887
Start Date : 5/22/2012
Page No : 1

Groups Printed- Cars

Start Time	Ost. W. Barnstable SB From North				Rt 28 EB From East				Ost. W. Barnstable NB From South				Rt 28 EB From West				Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	
04:00 PM	26	28	17	0	4	174	19	0	9	44	4	0	12	138	1	0	476
04:15 PM	29	33	8	0	6	202	17	0	7	45	10	0	16	146	5	0	525
04:30 PM	19	41	7	0	7	201	11	0	13	48	10	0	16	152	5	0	530
04:45 PM	19	26	8	0	3	199	19	0	6	30	8	0	14	132	3	0	467
Total	93	128	41	0	20	776	66	0	35	167	32	0	58	568	14	0	1998
05:00 PM	22	29	8	0	6	193	17	0	3	43	7	0	15	173	4	0	521
05:15 PM	15	25	14	0	5	222	20	0	7	41	9	0	11	156	5	0	530
Grand Total	130	182	64	0	31	1191	103	0	45	251	48	0	84	897	23	0	3049
Apprch %	34.6	48.4	17	0	2.3	89.9	7.8	0	13.1	73	14	0	8.4	89.3	2.3	0	
Total %	4.3	6	2.1	0	1	39.1	3.4	0	1.5	8.2	1.6	0	2.8	29.4	0.8	0	



May 22, 2012 Turning Movement Count-Cars

Cape Cod Commission

3225 Main St
Barnstable MA 02630

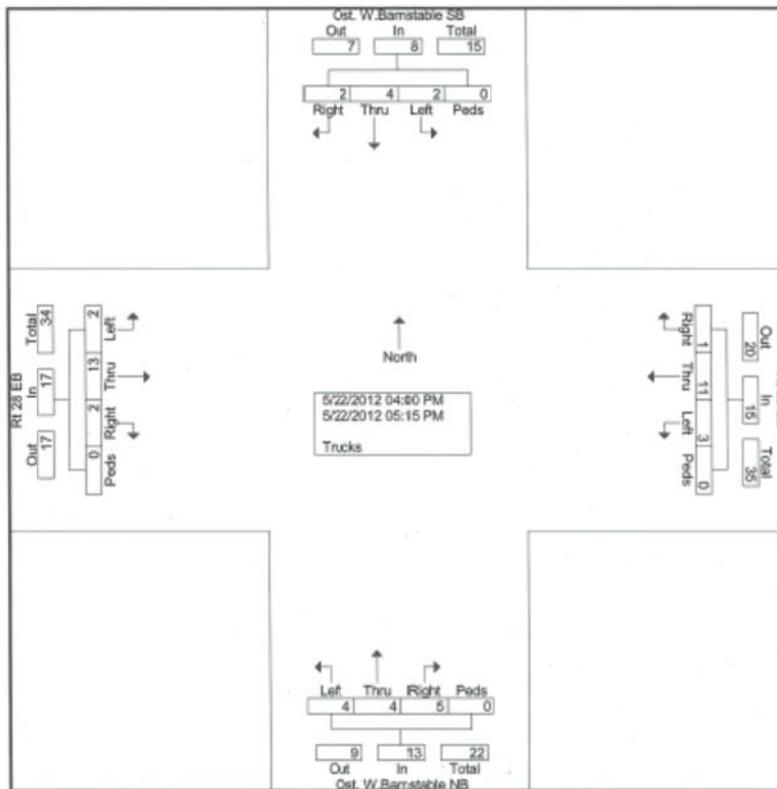
www.capecodcommission.org

Rt 28 @ Osterville-W.Barnstable Rd
Town: Barnstable
Counted by: PT, KW
Counters: 4, 5

File Name : 2887_05222012
Site Code : 00002887
Start Date : 5/22/2012
Page No : 1

Groups Printed- Trucks

Start Time	Ost. W.Barnstable SB From North				Rt 28 EB From East				Ost. W.Barnstable NB From South				Rt 28 EB From West				Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	
04:00PM	0	2	0	0	0	4	0	0	2	0	2	0	1	3	1	0	15
04:15PM	1	1	0	0	0	4	0	0	0	2	2	0	1	3	0	0	14
04:30PM	0	1	0	0	0	2	0	0	1	1	0	0	0	3	0	0	8
04:45PM	0	0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	4
Total	1	4	0	0	1	11	1	0	3	3	4	0	2	10	1	0	41
05:00PM	1	0	1	0	1	0	0	0	1	0	1	0	0	1	1	0	7
05:15PM	0	0	1	0	1	0	0	0	0	1	0	0	0	2	0	0	5
Grand Total	2	4	2	0	3	11	1	0	4	4	5	0	2	13	2	0	53
Apprch %	25	50	25	0	20	73.3	6.7	0	30.8	30.8	38.5	0	11.8	76.5	11.8	0	
Total %	3.8	7.5	3.8	0	5.7	20.8	1.9	0	7.5	7.5	9.4	0	3.8	24.5	3.8	0	



May 22, 2012 Turning Movement Count-Trucks

Cape Cod Commission

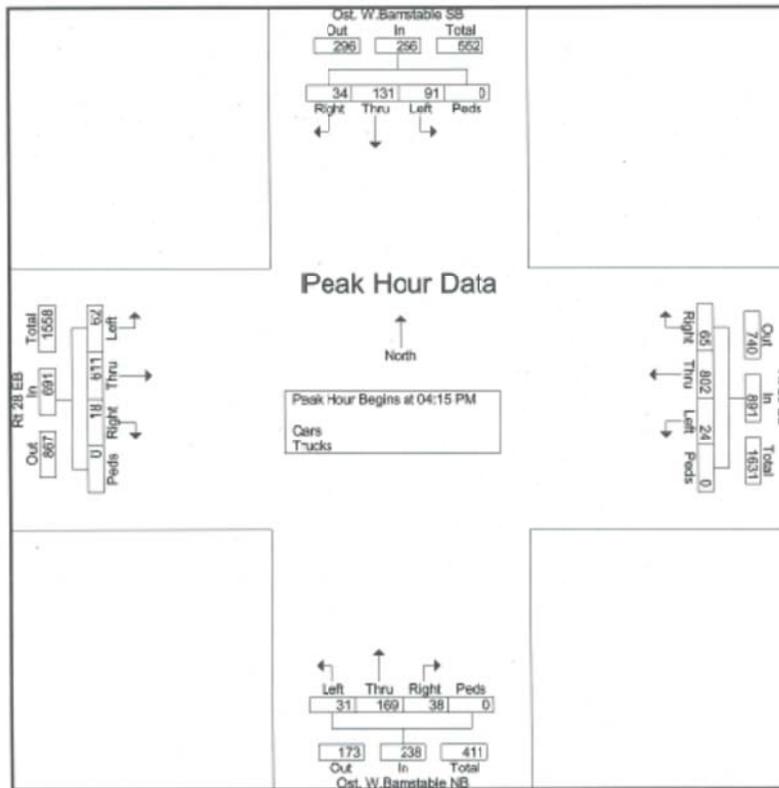
3225 Main St
Barnstable MA 02630

www.capecodcommission.org

Rt 28 @ Osterville-W. Barnstable Rd
Town: Barnstable
Counted by: PT, KW
Counters: 4, 5

File Name : 2887_05222012
Site Code : 00002887
Start Date : 5/22/2012
Page No : 2

Start Time	Ost. W. Barnstable SB From North					Rt 28 EB From East					Ost. W. Barnstable NB From South					Rt 28 EB From West					Int. Total
	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	
Peak Hour Analysis From 04:00 PM to 05:15 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	30	34	9	0	73	6	206	17	0	229	7	47	12	0	66	17	149	5	0	171	539
04:30 PM	19	42	7	0	68	7	203	11	0	221	14	49	10	0	73	16	155	5	0	176	538
04:45 PM	19	26	8	0	53	4	200	20	0	224	6	30	8	0	44	14	133	3	0	150	471
05:00 PM	23	29	10	0	62	7	193	17	0	217	4	43	8	0	55	15	174	5	0	194	528
Total Volume	91	131	34	0	256	24	802	65	0	891	31	169	38	0	238	62	611	18	0	691	2076
% App. Total	35.5	51.2	13.3	0		2.7	90	7.3	0		13	71	16	0		9	88.4	2.6	0		
PHF	.758	.780	.850	.000	.877	.857	.973	.813	.000	.973	.554	.862	.792	.000	.815	.912	.878	.900	.000	.890	.963



May 22, 2012 Turning Movement Count-Peak Hour Data

Cape Cod Commission

3225 Main St
Barnstable MA 02630

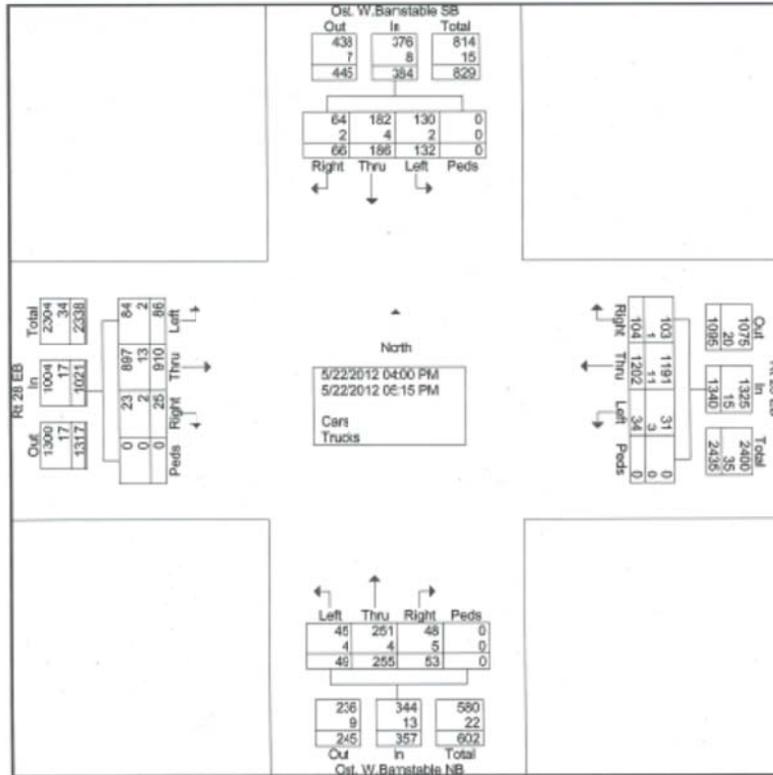
www.capecodcommission.org

Rt 28 @ Osterville-W. Barnstable Rd
Town: Barnstable
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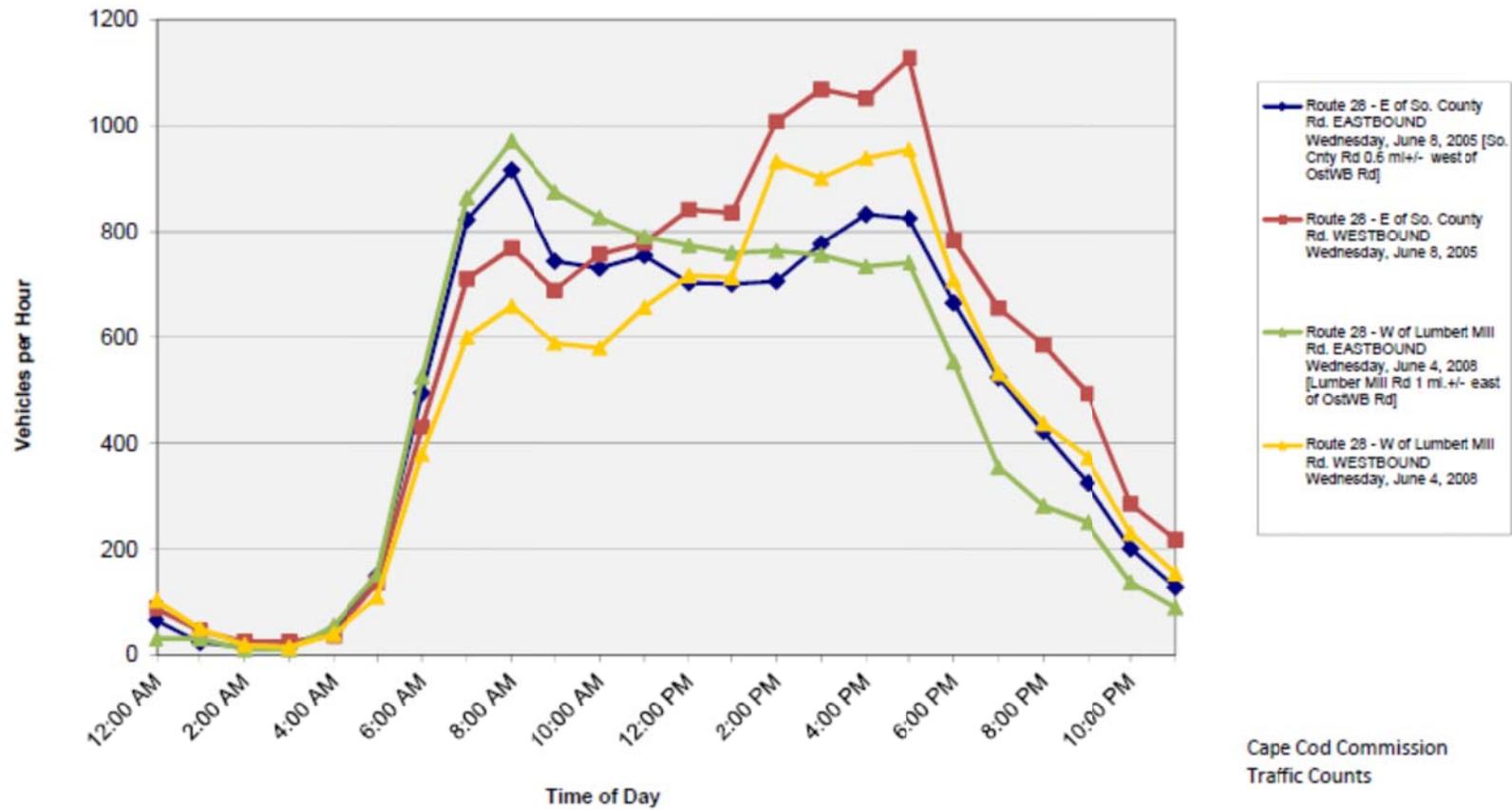
Groups Printed- Cars - Trucks

Start Time	Ost. W. Barnstable SB From North				Rt 28 EB From East				Ost. W. Barnstable NB From South				Rt 28 EB From West				Int. Total
	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	
04:00 PM	26	30	17	0	4	178	19	0	11	44	6	0	13	141	2	0	461
04:15 PM	30	34	9	0	6	206	17	0	7	47	12	0	17	149	5	0	539
04:30 PM	19	42	7	0	7	203	11	0	14	49	10	0	16	155	5	0	538
04:45 PM	19	26	8	0	4	200	20	0	6	30	8	0	14	133	3	0	471
Total	94	132	41	0	21	787	67	0	38	170	36	0	60	578	15	0	2039
05:00 PM	23	29	10	0	7	193	17	0	4	43	8	0	15	174	5	0	528
05:15 PM	15	25	15	0	6	222	20	0	7	42	9	0	11	158	5	0	535
Grand Total	132	186	66	0	34	1202	104	0	49	255	53	0	86	910	25	0	3102
Approch %	34.4	48.4	17.2	0	2.5	89.7	7.8	0	13.7	71.4	14.8	0	8.4	89.1	2.4	0	
Total %	4.3	6	2.1	0	1.1	38.7	3.4	0	1.6	8.2	1.7	0	2.8	29.3	0.8	0	
Cars	130	182	64	0	31	1191	103	0	45	251	48	0	84	897	23	0	3049
% Cars	98.5	97.8	97	0	91.2	99.1	99	0	91.8	98.4	90.6	0	97.7	98.6	92	0	98.3
Trucks	2	4	2	0	3	11	1	0	4	4	5	0	2	13	2	0	53
% Trucks	1.5	2.2	3	0	8.8	0.9	1	0	8.2	1.6	9.4	0	2.3	1.4	8	0	1.7



May 22, 2012 Turning Movement Count-Cars and Trucks

Barnstable Route 28 near Osterville-West Barnstable Road, Hourly Traffic Volumes by Direction



Cape Cod Commission
Traffic Counts

Appendix E. Road Safety Audit References

Road Safety Audit References

Road Safety Audits. Institute of Transportation Engineers and U.S. Department of Transportation, Federal Highway Administration, www.roadwaysafetyaudits.org.

FHWA Road Safety Audit Guidelines. U.S. Department of Transportation, Federal Highway Administration, 2006.

Desktop Reference for Crash Reduction Factors. Report No. FHWA-SA-08-011. U.S. Department of Transportation, Federal Highway Administration, September 2008

MassDOT Highway Division Traffic Engineering and Safety resources online, at <http://www.mhd.state.ma.us/default.asp?pgid=trafficIndex&sid=level2>

U.S. DOT Memorandum from Tony Furst, Acting Associate Administrator for Safety, to Division Administrators, January 12, 2012, Promoting the Implementation of Proven Safety Countermeasures