



CAPE COD
COMMISSION

2020 REGIONAL TRANSPORTATION PLAN

Technical Appendix C: Safety

JULY 15,
2019



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Technical Appendix C: Safety

The concern over safety is made clear in the first goal of the Regional Transportation Plan:

“Provide safe travel options for all users”

Transportation users have a right to a transportation system where their person and possessions will arrive at their destinations unharmed and undamaged. Moreover, protecting the value of freight traveling over the transportation network is essential to the economy of Cape Cod. Therefore, it is important that transportation infrastructure be designed to minimize the possibility of hazardous situations or accidents. Existing traffic laws must also be enforced to prevent the improper use of the transportation system. For all of these reasons, the Regional Transportation Plan sets the goal of providing safety for people and goods.

This appendix includes sections describing the seasonal and year-round issues affecting transportation safety including a description of the Cape demographics and some information about how they will change over time. Summaries of important safety studies are presented as well.

BARNSTABLE COUNTY HIGH CRASH LOCATIONS

In 2019, the Cape Cod Commission completed an effort to rank the top intersections of critical safety concern across Cape Cod. Before the data could be gathered and sorted into any particular order or rank, it was necessary to specify the characteristics that signify an intersection as a safety concern. The Commission decided that there are several ways to interpret crash data – meaning, several possible ways to determine which intersections are of highest safety concern.

The Cape Cod Commission identified four methods of sorting data to create a top list of intersections of critical safety concern:

- **Based on Number of Crashes:** Perhaps most simple method is to look at the total number of crashes for each location and then rank them from most number of crashes to least. This method is very basic, in that it does not consider the severity of the crashes or the number of vehicles using the roadway.
- **Based on Equivalent Property Damage Only (EPDO):** This method considers the severity of each location’s crashes. A location’s EPDO value is determined using a formula that weights each crash based on whether it included a fatality, an injury but no fatality, or property damage only. Fatal crashes are assigned a value of ten; injuries are assigned a value of five; and property damage only crashes are assigned a value of one. To determine an intersection’s EPDO, the weighted values are summed to an aggregate value. Under this method, the intersection with the highest EPDO value is ranked most hazardous.

- **Based on Crash Rate:** A crash rate for a location compares the number of crashes to the number of vehicles passing through it. The crash rate is interpreted as number of crashes per million entering vehicles. It is possible that a location with many crashes is not geometrically flawed or in poor condition, but merely a victim of the law of averages – many entering vehicles inflating the number of crashes. The crash rate method attempts to distinguish locations with safety problems relative to their usage.
- **Based on EPDO Rate:** This method is based on the same idea as using the crash rate, whereas it compares an intersection’s EPDO to its usage. The EPDO rate is interpreted as EPDO per million entering vehicles. The vehicle with the largest EPDO rate is ranked number one under this method.

Base data for this analysis was provided by the Massachusetts Department of Transportation (MassDOT) in the form of geographically located crash clusters for the most recently available five years of data (2012-2016). The data provided by MassDOT included the number of reported crashes at each location and the severity of the crashes. It should be noted, however, that this dataset only includes incidents whose reports contained enough information to accurately locate them. Of the 26,616 crash reports collected by the Massachusetts Registry of Motor Vehicles, 25,060 incidents were located by MassDOT. The incidents are mapped on the following figure.

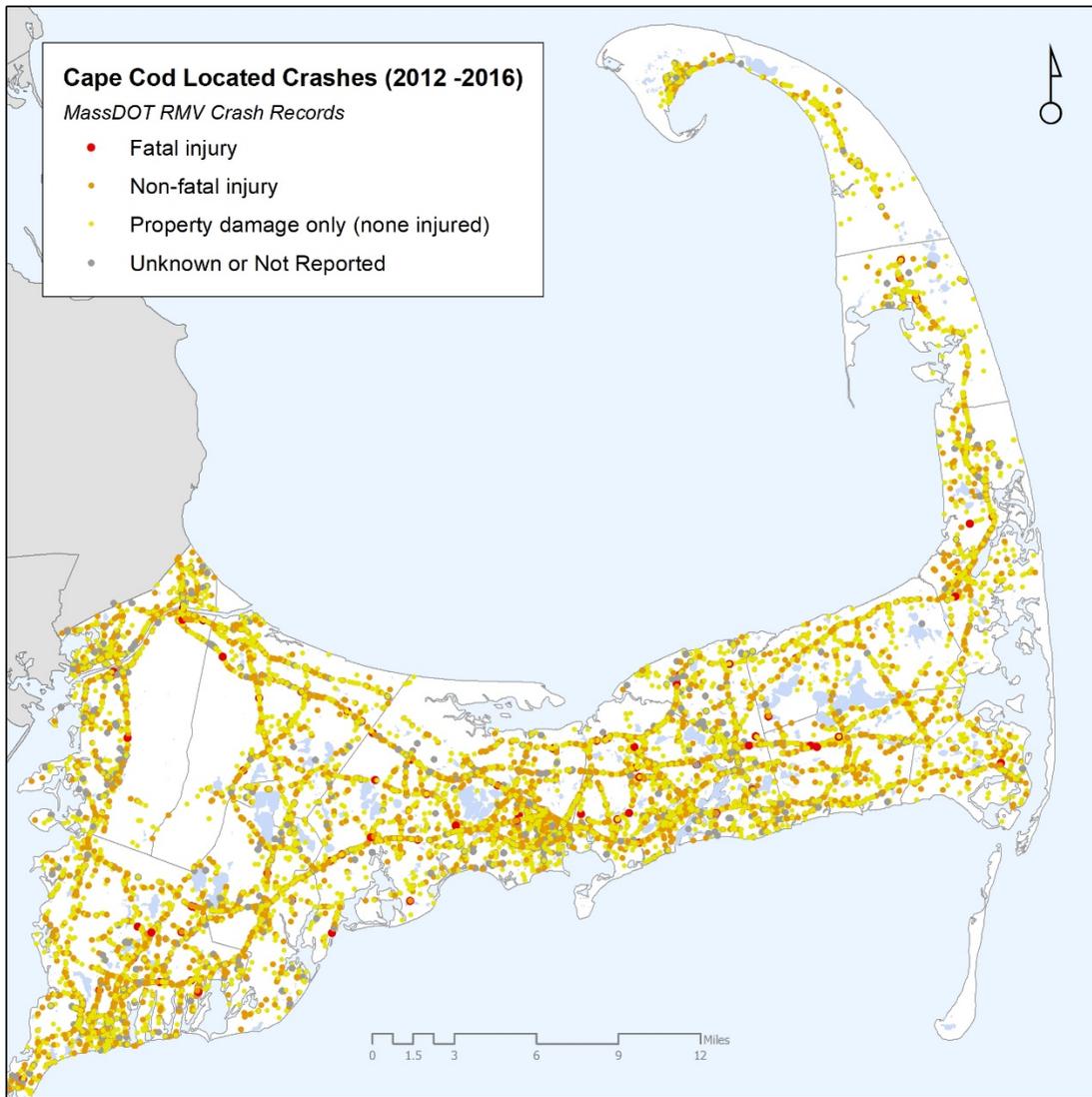


FIGURE 1. Cape Cod Located Crashes 2012-2016

(Source: MassDOT Crash Records)

TABLE 1. Top Locations Based on Number of Crashes

Rank Crashes	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	170	254	3.6	5.4
2	Barnstable	Route 28 (Falmouth Road) and Bearses Way	153	285	3.2	5.9
3	Barnstable	Route 28 (Iyannough Road) at Yarmouth Road	136	260	3.0	5.7
4	Yarmouth	Route 28 at Old Main Street/North Main Street	106	212	3.7	7.5
5	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	105	181	2.6	4.4
6	Falmouth	Route 28 (East Falmouth Highway) at Old Meeting House Road/Davisville Road	104	216	3.7	7.6
7	Barnstable	Route 132 (Iyannough Road) at Bearses Way	98	194	2.1	4.2
8	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	87	131	2.2	3.3
9	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall/Capetown Plaza	80	140	1.6	2.8
10	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	73	145	1.8	3.5
11	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	66	106	3.1	4.9
12	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	64	136	1.7	3.6
13	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	63	179	1.8	5.0
14	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opoechee Road	61	141	1.2	2.8
15	Barnstable	Route 28 (Falmouth Road) at Putnam Avenue	58	110	1.7	3.2
16	Barnstable	Route 28 (Falmouth Road) at Cotuit Road/Prince Avenue	58	134	1.3	3.1
17	Barnstable	Route 132 (Iyannough Road) at Independence Drive	55	123	1.3	2.8
18	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	52	165	1.5	4.6
19	Bourne	Meetinghouse Lane at State Road/Canal Street	52	92	2.1	3.8
20	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	51	115	1.5	3.3
21	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	51	95	0.8	1.5
22	Falmouth	Route 28 (Davis Straits) at Dillingham Avenue/Spring Bars Road	48	80	2.3	3.9
23	Yarmouth	Route 28 at East Main Street	46	74	1.2	2.0
24	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	46	94	1.6	3.2
25	Dennis	Route 28 (Main Street) at Route 134 (East-West Dennis Road)/Swan River Road	46	66	1.5	2.2
26	Bourne	Route 6 (Scenic Highway) at Nightingale Road	46	78	1.0	1.7
27	Yarmouth	Station Avenue at White's Path/Workshop Road	45	77	1.0	1.7
28	Barnstable	Route 28 (Falmouth Road) at Phinneys Lane	44	108	1.1	2.6
29	Barnstable	Route 28 (Falmouth Road) at Mary Dunn Way	44	96	1.3	2.8
30	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	44	124	3.4	9.6
31	Falmouth	Route 28 (Main Street) at Scranton Avenue	43	79	1.8	3.4
32	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	43	87	1.4	2.8
33	Barnstable	West Main Street at Barnstable High School Entrance	42	86	2.0	4.1
34	Barnstable	Route 28 (Falmouth Road) at Centerville Shopping Center	42	90	0.8	1.7
35	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	41	65	1.4	2.2
36	Falmouth	Route 28 (Palmer Avenue) at Jones Road/Ter Heun Drive	40	80	1.4	2.8
37	Mashpee	Route 151 (Nathan Ellis Highway) at Market Street	40	68	1.2	2.1
38	Barnstable	South Street at Ocean Street/Old Colony Road	40	88	1.5	3.4
39	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	40	76	1.1	2.0
40	Yarmouth	Route 28 at Higgins Crowell Road/Berry Avenue	38	82	1.3	2.8
41	Sandwich	Quaker Meeting House Road at Cotuit Road	38	62	1.3	2.2
42	Mashpee	Route 151 (Nathan Ellis Highway) at Algonquin Avenue	38	94	1.5	3.8
43	Mashpee	Route 130 (Main Street) at Great Neck Road N	38	70	1.9	3.5
44	Wellfleet	Route 6 at Main Street	38	66	1.6	2.7
45	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	37	110	1.0	3.0
46	Falmouth	Jones Road at Gifford Street	36	76	1.3	2.8
47	Barnstable	Route 28 (Falmouth Road) at Lincoln Road	36	96	1.7	4.6
48	Mashpee	Route 28 at Job's Fishing Road/Donna's Lane	35	67	0.8	1.4
49	Falmouth	Spring Bars Road at Worcester Court	35	71	2.2	4.5
50	Barnstable	Route 28 (Falmouth Road) at Bell Tower Mall	35	75	0.7	1.4

Source: MassDOT Crash Records 2012-2016

TABLE 2. Top Locations Based on Equivalent Property Damage Only

Rank EPDO	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Barnstable	Route 28 (Falmouth Road) and Bears Way	153	285	3.2	5.9
2	Barnstable	Route 28 (Iyannough Road) at Yarmouth Road	136	260	3.0	5.7
3	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	170	254	3.6	5.4
4	Falmouth	Route 28 (East Falmouth Highway) at Old Meeting House Road/Davisville Road	104	216	3.7	7.6
5	Yarmouth	Route 28 at Old Main Street/North Main Street	106	212	3.7	7.5
6	Barnstable	Route 132 (Iyannough Road) at Bears Way	98	194	2.1	4.2
7	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	105	181	2.6	4.4
8	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	63	179	1.8	5.0
9	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	52	165	1.5	4.6
10	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	73	145	1.8	3.5
11	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opochee Road	61	141	1.2	2.8
12	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall/Capetown Plaza	80	140	1.6	2.8
13	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	64	136	1.7	3.6
14	Barnstable	Route 28 (Falmouth Road) at Cotuit Road/Prince Avenue	58	134	1.3	3.1
15	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	87	131	2.2	3.3
16	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	44	124	3.4	9.6
17	Barnstable	Route 132 (Iyannough Road) at Independence Drive	55	123	1.3	2.8
18	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	51	115	1.5	3.3
19	Barnstable	Route 28 (Falmouth Road) at Putnam Avenue	58	110	1.7	3.2
20	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	37	110	1.0	3.0
21	Barnstable	Route 28 (Falmouth Road) at Phinneys Lane	44	108	1.1	2.6
22	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	66	106	3.1	4.9
23	Barnstable	Route 28 (Falmouth Road) at Mary Dunn Way	44	96	1.3	2.8
24	Barnstable	Route 28 (Falmouth Road) at Lincoln Road	36	96	1.7	4.6
25	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	51	95	0.8	1.5
26	Mashpee	Route 151 (Nathan Ellis Highway) at Algonquin Avenue	38	94	1.5	3.8
27	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	46	94	1.6	3.2
28	Bourne	Meetinghouse Lane at State Road/Canal Street	52	92	2.1	3.8
29	Barnstable	Route 28 (Falmouth Road) at Centerville Shopping Center	42	90	0.8	1.7
30	Mashpee	Great Neck Road N at Old Barnstable Road	28	88	1.2	3.8
31	Barnstable	South Street at Ocean Street/Old Colony Road	40	88	1.5	3.4
32	Falmouth	Sandwich Road at Brick Kiln Road	31	87	1.3	3.7
33	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	43	87	1.4	2.8
34	Barnstable	Route 132 (Iyannough Road) at Shootflying Hill Road	34	86	0.7	1.9
35	Barnstable	West Main Street at Barnstable High School Entrance	42	86	2.0	4.1
36	Yarmouth	Route 28 at Camp Street	32	84	0.8	2.2
37	Barnstable	Route 132 (Iyannough Road) at Attucks Lane	31	84	0.6	1.5
38	Barnstable	Route 28 (Falmouth Road) at Stub Toe Road	29	82	0.7	2.1
39	Yarmouth	Route 28 at Higgins Crowell Road/Berry Avenue	38	82	1.3	2.8
40	Falmouth	Route 28 (Palmer Avenue) at Jones Road/Ter Heun Drive	40	80	1.4	2.8
41	Falmouth	Route 28 (Davis Straits) at Dillingham Avenue/Spring Bars Road	48	80	2.3	3.9
42	Barnstable	Phinneys Lane at Old Strawberry Hill Road	23	79	1.4	4.9
43	Falmouth	Route 28 (Main Street) at Scranton Avenue	43	79	1.8	3.4
44	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	34	78	0.8	1.9
45	Bourne	Route 6 (Scenic Highway) at Nightingale Road	46	78	1.0	1.7
46	Yarmouth	Station Avenue at White's Path/Workshop Road	45	77	1.0	1.7
47	Barnstable	West Main Street at Pitchers Way	33	77	0.9	2.1
48	Falmouth	Jones Road at Gifford Street	36	76	1.3	2.8
49	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	40	76	1.1	2.0
50	Barnstable	Route 28 (Falmouth Road) at Bell Tower Mall	35	75	0.7	1.4

Source: MassDOT Crash Records 2012-2016

TABLE 3. Top Locations based on Crash Rate

Rank	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Yarmouth	Route 28 at Old Main Street/North Main Street	106	212	3.7	7.5
2	Falmouth	Route 28 (East Falmouth Highway) at Old Meeting House Road/Davisville Road	104	216	3.7	7.6
3	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	170	254	3.6	5.4
4	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	44	124	3.4	9.6
5	Barnstable	Route 28 (Falmouth Road) and Bearses Way	153	285	3.2	5.9
6	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	66	106	3.1	4.9
7	Barnstable	Route 28 (Iyannough Road) at Yarmouth Road	136	260	3.0	5.7
8	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	105	181	2.6	4.4
9	Brewster	Route 124 (Harwich Road) at Tubman Road	23	39	2.4	4.0
10	Falmouth	Route 28 (Davis Straits) at Dillingham Avenue/Spring Bars Road	48	80	2.3	3.9
11	Falmouth	Spring Bars Road at Worcester Court	35	71	2.2	4.5
12	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	87	131	2.2	3.3
13	Yarmouth	Forest Road at Old Town House Road	32	48	2.1	3.2
14	Bourne	Meetinghouse Lane at State Road/Canal Street	52	92	2.1	3.8
15	Barnstable	Route 132 (Iyannough Road) at Bearses Way	98	194	2.1	4.2
16	Barnstable	South Street at High School Road	31	63	2.1	4.3
17	Barnstable	Route 132 (Iyannough Road) at Cape Cod Community College N. Entrance	23	47	2.0	4.2
18	Barnstable	West Main Street at Barnstable High School Entrance	42	86	2.0	4.1
19	Barnstable	Stevens Street at Bassett Lane	29	65	2.0	4.4
20	Barnstable	Barnstable Road at Charles Street/Center Street	30	54	2.0	3.5
21	Mashpee	Route 130 (Main Street) at Great Neck Road N	38	70	1.9	3.5
22	Falmouth	Route 28 (Main Street) at Scranton Avenue	43	79	1.8	3.4
23	Mashpee	Great Neck Road N at Quashnet Road	30	54	1.8	3.2
24	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	63	179	1.8	5.0
25	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	73	145	1.8	3.5
26	Barnstable	Route 28 (Falmouth Road) at Lincoln Road	36	96	1.7	4.6
27	Barnstable	Main Street at High School Road Extension	28	48	1.7	2.9
28	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	64	136	1.7	3.6
29	Barnstable	Route 28 (Falmouth Road) at Putnam Avenue	58	110	1.7	3.2
30	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall/Capetown Plaza	80	140	1.6	2.8
31	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	46	94	1.6	3.2
32	Wellfleet	Route 6 at Main Street	38	66	1.6	2.7
33	Barnstable	South Street at Ocean Street/Old Colony Road	40	88	1.5	3.4
34	Dennis	Route 28 (Main Street) at Route 134 (East-West Dennis Road)/Swan River Road	46	66	1.5	2.2
35	Mashpee	Route 151 (Nathan Ellis Highway) at Algonquin Avenue	38	94	1.5	3.8
36	Sandwich	Route 6A (Old King's Highway) at Route 130/Tupper Road	26	62	1.5	3.5
37	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	51	115	1.5	3.3
38	Falmouth	Route 151 (Nathan Ellis Highway) at Cloverfields Way/Sam Turner Road/Boxberry Hill Road	21	57	1.5	4.0
39	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	52	165	1.5	4.6
40	Barnstable	Phinneys Lane at Old Strawberry Hill Road	23	79	1.4	4.9
41	Dennis	Route 28 (Main Street) at Depot Street	26	58	1.4	3.2
42	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	41	65	1.4	2.2
43	Falmouth	Route 28 (Palmer Avenue) at Jones Road/Ter Heun Drive	40	80	1.4	2.8
44	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	43	87	1.4	2.8
45	Sandwich	Quaker Meeting House Road at Cotuit Road	38	62	1.3	2.2
46	Falmouth	Jones Road at Gifford Street	36	76	1.3	2.8
47	Sandwich	Route 6A at Quacker Meeting House Road/Spring Hill Road	28	48	1.3	2.3
48	Barnstable	Route 28 (Falmouth Road) at Cotuit Road/Prince Avenue	58	134	1.3	3.1
49	Falmouth	Sandwich Road at Brick Kiln Road	31	87	1.3	3.7
50	Yarmouth	Route 28 at Higgins Crowell Road/Berry Avenue	38	82	1.3	2.8

Source: MassDOT Crash Records 2012-2016

TABLE 4. Top Locations based on EPDO Rate

1	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	44	124	3.4	9.6
2	Falmouth	Route 28 (East Falmouth Highway) at Old Meeting House Road/Davisville Road	104	216	3.7	7.6
3	Yarmouth	Route 28 at Old Main Street/North Main Street	106	212	3.7	7.5
4	Barnstable	Route 28 (Falmouth Road) and Bearses Way	153	285	3.2	5.9
5	Barnstable	Route 28 (Iyannough Road) at Yarmouth Road	136	260	3.0	5.7
6	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	170	254	3.6	5.4
7	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	63	179	1.8	5.0
8	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	66	106	3.1	4.9
9	Barnstable	Phinneys Lane at Old Strawberry Hill Road	23	79	1.4	4.9
10	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	52	165	1.5	4.6
11	Barnstable	Route 28 (Falmouth Road) at Lincoln Road	36	96	1.7	4.6
12	Falmouth	Spring Bars Road at Worcester Court	35	71	2.2	4.5
13	Barnstable	Stevens Street at Bassett Lane	29	65	2.0	4.4
14	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	105	181	2.6	4.4
15	Barnstable	South Street at High School Road	31	63	2.1	4.3
16	Barnstable	Route 132 (Iyannough Road) at Bearses Way	98	194	2.1	4.2
17	Barnstable	Route 132 (Iyannough Road) at Cape Cod Community College N. Entrance	23	47	2.0	4.2
18	Barnstable	West Main Street at Barnstable High School Entrance	42	86	2.0	4.1
19	Brewster	Route 124 (Harwich Road) at Tubman Road	23	39	2.4	4.0
20	Falmouth	Route 151 (Nathan Ellis Highway) at Cloverfields Way/Sam Turner Road/Boxberry Hill Road	21	57	1.5	4.0
21	Falmouth	Old Barnstable Road at Carriage Shop Road	18	62	1.1	3.9
22	Falmouth	Route 28 (Davis Straits) at Dillingham Avenue/Spring Bars Road	48	80	2.3	3.9
23	Mashpee	Great Neck Road N at Old Barnstable Road	28	88	1.2	3.8
24	Bourne	Meetinghouse Lane at State Road/Canal Street	52	92	2.1	3.8
25	Mashpee	Route 151 (Nathan Ellis Highway) at Algonquin Avenue	38	94	1.5	3.8
26	Falmouth	Sandwich Road at Brick Kiln Road	31	87	1.3	3.7
27	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	64	136	1.7	3.6
28	Sandwich	Route 6A (Old King's Highway) at Route 130/Tupper Road	26	62	1.5	3.5
29	Barnstable	Barnstable Road at Charles Street/Center Street	30	54	2.0	3.5
30	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	73	145	1.8	3.5
31	Mashpee	Route 130 (Main Street) at Great Neck Road N	38	70	1.9	3.5
32	Barnstable	South Street at Ocean Street/Old Colony Road	40	88	1.5	3.4
33	Falmouth	Route 28 (Main Street) at Scranton Avenue	43	79	1.8	3.4
34	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	51	115	1.5	3.3
35	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	87	131	2.2	3.3
36	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	46	94	1.6	3.2
37	Yarmouth	Forest Road at Old Town House Road	32	48	2.1	3.2
38	Mashpee	Great Neck Road N at Quashnet Road	30	54	1.8	3.2
39	Barnstable	Route 28 (Falmouth Road) at Putnam Avenue	58	110	1.7	3.2
40	Dennis	Route 28 (Main Street) at Depot Street	26	58	1.4	3.2
41	Barnstable	Route 28 (Falmouth Road) at Cotuit Road/Prince Avenue	58	134	1.3	3.1
42	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	37	110	1.0	3.0
43	Barnstable	Main Street at High School Road Extension	28	48	1.7	2.9
44	Yarmouth	West Yarmouth Road at Buck Island Road	22	59	1.1	2.9
45	Yarmouth	Route 28 at Higgins Crowell Road/Berry Avenue	38	82	1.3	2.8
46	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall/Capetown Plaza	80	140	1.6	2.8
47	Falmouth	Jones Road at Gifford Street	36	76	1.3	2.8
48	Falmouth	Route 28 (Waquoit Highway) at Metoxit Road	20	60	0.9	2.8
49	Barnstable	Route 132 (Iyannough Road) at Independence Drive	55	123	1.3	2.8
50	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opoechee Road	61	141	1.2	2.8

Source: MassDOT Crash Records 2012-2016

CAPE COD DRIVERS

The demographics of Cape Cod depict a typical year-round resident that is older than the average population in the United States. Over 59% of Cape Cod's population as reported in the U.S Census Bureau (2017 estimates) was aged 45 or older (as compared to 40% for the national average). This trend is continuing. The migration of retirees to Cape Cod and a stable aging population is not being offset by new younger residents or births. With the trend toward an older population in America, the Federal Highway Administration (FHWA) has recognized that older drivers require special consideration. This recognition is demonstrated in the publication of several recent documents and a special address to Congress by the National Highway Traffic and Safety Administration (NHTSA). The focus in both cases was on the behavior of older drivers with respect to the "typical" driver. The NHTSA address also included issues related to younger drivers. Recommended guidelines for design standards that will help accommodate the needs of an older driver are also included in the literature.

Another dimension defining the unique character of Cape Cod drivers is their seasonal nature. The Cape is inundated with visitors, many of whom are not familiar with Cape Cod roads. Drivers that are used to city streets or parkways are also subjected to the scenic rural roads that compose a significant part of the Cape's character. The physical nature of these roadways may be somewhat unfamiliar to off-Cape drivers, leading to safety concerns.

Among the many drivers that visit to the Cape in the summer are a large number of younger motorists. These drivers have less experience in familiar surroundings and even less in the Cape driving environment. This coupled with a "vacation attitude" requires more considerations for roadway design and planning. These considerations must also be balanced with the natural qualities that bring people to Cape Cod.

The Senior Driver

A large and increasing percentage of Cape drivers are 65 and older. According to the Census Bureau 2017 estimates, 28% or 60,860 residents of Barnstable County are aged 65 or older. This steadily increasing proportion of drivers will experience declining vision, slowed decision making and reaction times, additional difficulty in dividing attention between potential conflicts and traffic information, and reductions in strength, flexibility, and overall fitness. In many cases, these difficulties will outweigh the additional experience that older drivers have operating an automobile. The large majority of drivers who suffer from age-related driving deficiencies are not aware that a problem exists.

The overwhelming majority of Cape intersections are at grade. Based on FHWA crash statistics for drivers, 80 years and older, more than 50% of fatal crashes occur at intersections. This is compared with 24% or less for drivers up to age 50. According to studies referenced in the FHWA *Older Driver Highway Design Handbook* (1998), as driver age increases, involvement in intersection crashes

increase as well. Older drivers typically experience two types of at-grade intersection difficulties. Left turn difficulties result from lack of sufficient caution and poor positioning on the road during the turn. Stopping difficulties result from a failure to stop, a failure to make complete stops at stop signs, and stops that were abrupt. Comparing survey responses of drivers aged 66 to 68 with those aged 77 and older, showed that the older group had more difficulty following pavement markings, finding the beginning of left hand turn lanes, and driving across intersections. Another study of older drivers indicated that the most challenging aspect of intersection negotiation is making left turns during the green, left turn permitted signal phase. The protected “green arrow” left hand turn has been identified as an important improvement for older drivers.

Nighttime driving is associated with a higher crash risk for all drivers; however the effect of aging on vision is particularly compounded by the effect of darkness. The aging process causes gradual declines in a variety of ways; acuity, contrast sensitivity, glare-recovery, and peripheral vision. These declining functions make night driving particularly difficult for older drivers. The ability to notice and recognize objects at night and in low-light conditions such as dawn, dusk, rain, fog, haze, and snow is a chief concern. According to studies referenced in the FHWA handbook show that between age 20 and age 70, contrast sensitivity is reduced by a factor of three. This places the typical older driver at a relative disadvantage in low-light conditions. As expected, older drivers require significantly larger letters to read unfamiliar signs. Current sign standards are based on an assumed vision of 20/25 (as opposed to “perfect” 20/20 vision). Older drivers require a standard of 20/46.

Older Driver recommendations

Based on the issues associated with the older driving population on Cape Cod the following suggestions are recommended as considerations for Cape Cod roadway improvements. Many of these recommendations are from FHWA's *Older Driver Highway Design Handbook* (1998). This resource should be consulted for more details. The Older Driver Handbook includes other recommendations and guidelines that should be considered in Cape roadway design but their use should also be tempered to maintain the character of Cape Cod's roadways.

Recommendations to accommodate older drivers include:

- Considering protected left turn phases into signalized intersections;
- Maintaining delineation through more frequent restriping and street cleaning;
- Improving signage standards to include larger lettering;
- Improving lighting level standards, in particular at intersections. Consider placing utilities underground and installing breakaway safety poles for lighting;
- Considering “all red” phases for signalized intersections;
- Establishing driver education programs for older drivers; and
- Providing education on other options for mobility.

Mobility programs to provide alternatives to driving also need to be improved. This was a major topic at Cape Cod's February 2000 Transit Summit. The recommendations from the Summit included a "dual challenge" of reducing auto dependency and meeting the needs of the transit dependent and those in need of human services. By improving mobility options, significant safety improvements may be realized

Young Drivers

Safety and age-related crash statistics indicate that younger drivers' (under age 25) problems exceed those of any other age group. The shorter average trip length of older drivers is accompanied by a higher frequency of fatal crashes. Young drivers outnumber, out-travel, out-crash, and die more frequently by any other measure. There are slight differences between younger and older drivers in the types of crashes they experience. For example, young drivers have more speeding and alcohol-related crashes. Younger drivers' crashes are frequently caused by inexperience, poor judgment, and risk taking, while older drivers' crashes are more often related to reduced physical and cognitive capabilities.

Although most crashes occur at intersections, young drivers show a greater tendency than other age groups to be involved in non-intersection crashes. According to NHTSA statistics, 43% of crashes by drivers age 15 to 24 are at non-intersection locations. That number reduces to 41% for drivers age 25 to 64 and 31% for drivers age 65 to 74.

Younger drivers are more prone to risk-taking behavior and are subject to influences of youth culture and peer pressure. Many of these characteristics are evident in young visitors to Cape Cod.

Younger Driver Recommendations

Recommendations to accommodate younger driver safety issues are divided between residents and visitors:

- Increased education for local young drivers.
- Additional enforcement and warnings during the busy traffic season to reach out to young visitor drivers.
- Develop and implement an advertising campaign and roadside signage reminding drivers that traffic and drunk-driving laws are strictly enforced on Cape Cod.

Additional Recommendations

Additional recommendations include:

- Better signage for visitors directing them to popular destinations (e.g., larger, well-located signs to direct patrons of the Hyannis Transportation Center may improve safety at the driveway on Route 28).
- Signage explaining the rotary “rules of the road” and similar information to be included in visitor brochures and Cape-related websites

THE CAPE COD ROADWAY

There are nearly 3,900 miles of roadways in Barnstable County. These include 574 miles of Arterials and 213 miles of Collectors. The remaining 3,076 miles included local roads and the many miles of unimproved ways. The typical posted speed limit on the Cape is less than 40 miles per hour (mph) and, on average, the roadways carry 175% more traffic in July and August than they do in January and February.

The character of Cape Cod’s rural roads includes narrow lanes and a typical speed limit of 35 mph. Most roads do not have shoulders and bicycles must often share the lanes with motorists. Many of the older roads evolved from Native American trails and stagecoach routes. Roadway geometry is therefore less accommodating than current state and federal standards. Included in the goals of this Plan is the preservation of the scenic and rural character of Cape Cod’s narrow, winding roads. However, this must be accompanied by a program of enforcement and education especially for the drivers that visit the Cape in the summer.

Safety Improvements through Intersection Modification

To help quantify the benefits of various safety treatments, several resources were consulted including *The Traffic Safety Toolbox: A Primer on Traffic Safety*, Chapter 28, Institute of Transportation Engineers, 2000; and *Prediction of the Expected Safety Performance of Rural Two-Lane Highways*, Chapter 5, Federal Highway Administration, 2000. These reports include discussions on various vehicular access treatments and predictions of “Accident Reduction.”

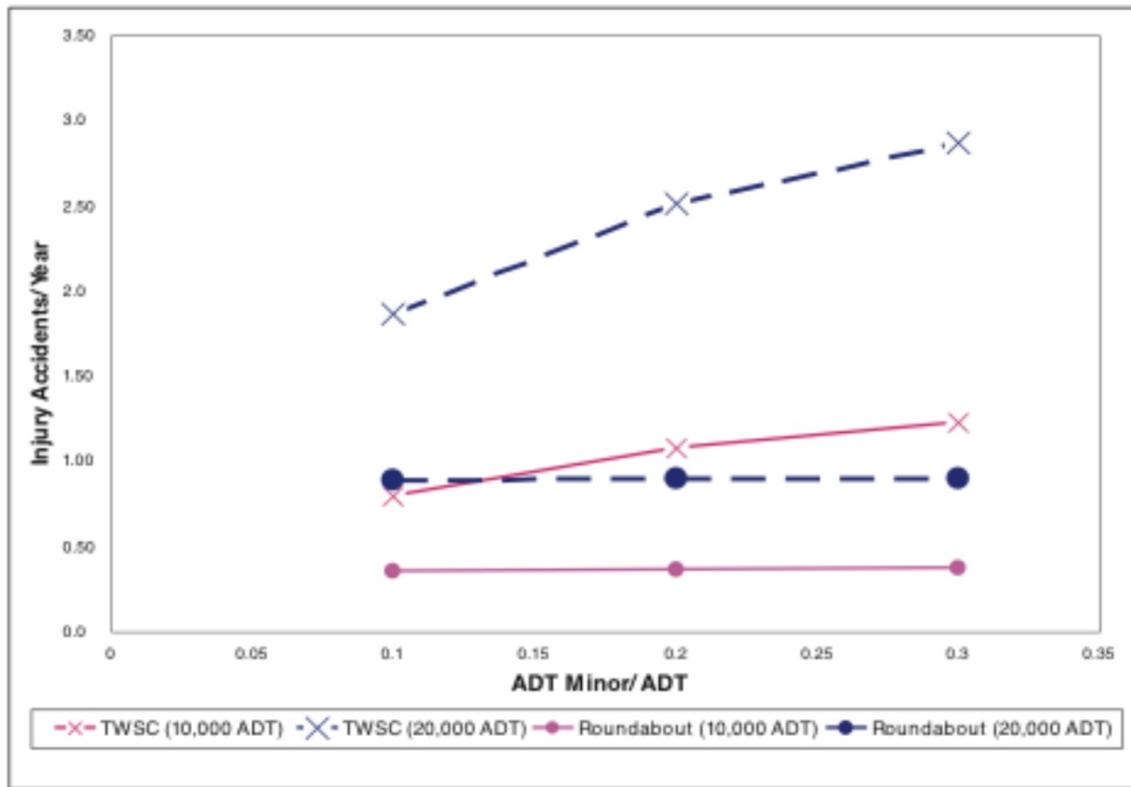
MODERN ROUNDABOUTS V. FOUR-WAY INTERSECTIONS

A roundabout is a type of circular intersection with specific design and traffic control features. These features include yield control of all entering traffic, channelized approaches, and appropriate geometric curvature to ensure that travel speeds on the circulatory roadway are typically less than 20 mph. The decision to install a roundabout as a safety improvement should be based on a demonstrated safety problem of a type susceptible to correction by a roundabout. FHWA’s *Roundabouts: an Informational Guide*, (FHWA –RD-00-067, June 2000) provides a review of the safety improvements afforded by roundabouts. For example, safety problems that could be improved by a roundabout include:

- High rates of crashes such as right angle, head-on, left/through, U-turns, etc.
- High crash severity that could be reduced by slower speeds
- Site visibility problems that reduce the effectiveness of stop sign control
- Inadequate separation of movements, especially on single-lane approaches

The following figure shows that roundabouts have fewer annual injury crashes than rural two-way stop-controlled (TWSC) intersections, and the total number of crashes at roundabouts is relatively insensitive to minor street demand volumes.

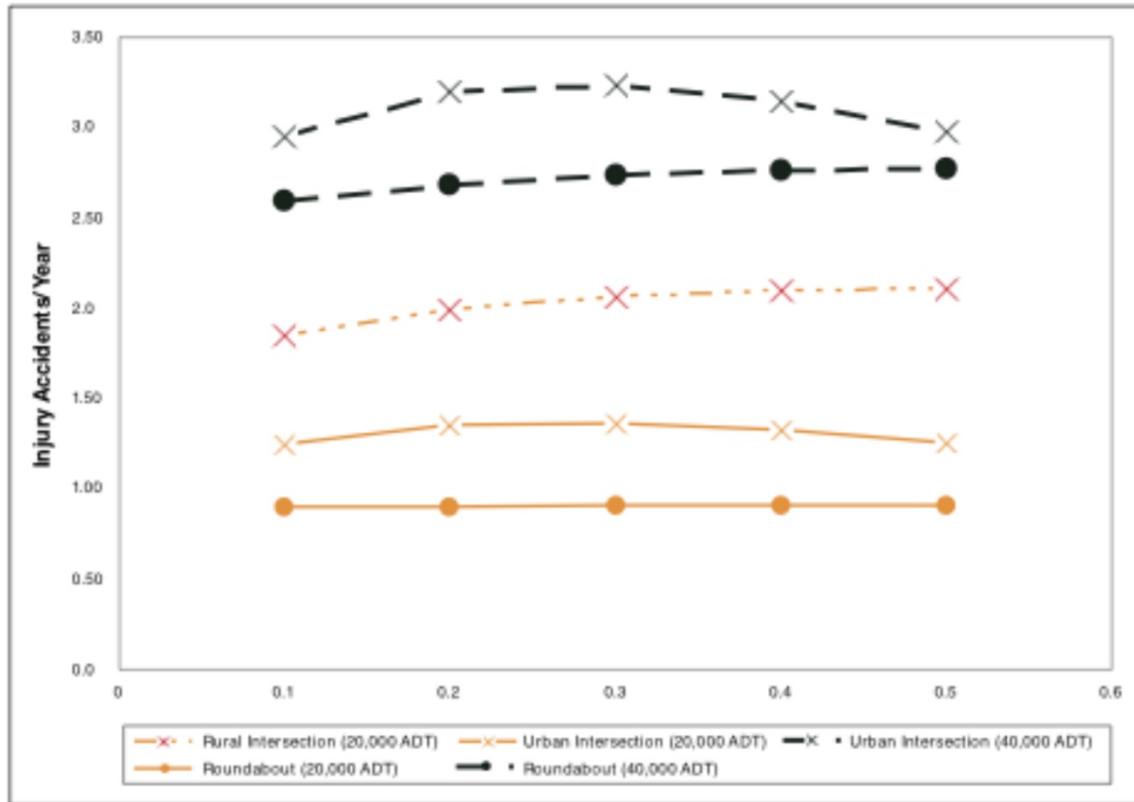
FIGURE 2. Comparison of Predicted Roundabout Injury Crashes with Rural 2-Way Stop - Controlled Intersections



(Source: FHWA)

The Roundabout guide also includes information to compare roundabouts to signalized intersections. The following figure shows that roundabouts have fewer injury accidents per year than signalized intersections, particularly in rural areas. At volumes greater than 50,000 vehicles per day (shown on the figure as “ADT” – average daily traffic), urban roundabout safety may be comparable to that of urban signalized intersections.

FIGURE 3. Comparison of Predicted Injury Crashes for Single-Lane and Double-Lane Roundabouts with Rural or Urban Signalized Intersections



(Source: FHWA)

Safety-Related Technology

Improved technology provides new options for the enforcement of traffic laws and speed control. The Insurance Institute for Highway Safety (IIHS) and the FHWA have favorable reviews of applications such as red-light enforcement and photo radar. These techniques should be coupled with education as well, since a goal is to improve safety by deterring unsafe driving. The greatest benefit of these techniques has been a “halo effect” whereby drivers are complying with traffic laws in un-monitored locations as well as those where the technology has been installed.

RED LIGHT ENFORCEMENT

According to IIHS, nationwide, drivers who run red lights are responsible for 260,000 crashes each year. Of these, approximately 750 are fatal. Motorists are more likely to be injured in crashes involving red light running than in other types of crashes: occupant injuries occurred in 45% of red light running crashes compared with 30% for other crash types. Enforcing red light laws by traditional means poses special difficulties for police, who in most cases must follow a violating vehicle through a red light to stop it. This poses a danger to motorists, pedestrians, as well as the officers. Red light running violations typically decrease by as much as 60% at intersections where cameras automatically enforce the law.

In areas where red light cameras have been installed as well as areas without cameras, most drivers have supported the use of red light cameras, 80% in cities with cameras and 76% in cities without.

OPTICOM SYSTEM

Many of the Cape's signalized intersections are equipped with the Opticom priority-based pre-emption system. Opticom includes infrared detection equipment installed adjacent to the signal heads. When an emergency vehicle (ambulance, fire engine, etc.) equipped with an Opticom infrared emitter approaches the intersection, the detector notifies the signal controller and a green phase is maintained for the emergency vehicle (other approaches are held under a red phase). Signal pre-emption is vital for emergency responders to safely and quickly travel to incident sites. Agencies responsible for intersection signal maintenance should also ensure continuous operation of the Opticom system. Upgrades to existing signals and new signal installations should be equipped with Opticom.

Coordination with Massachusetts' Strategic Highway Safety Plan

Building on the success of the 2006 "Strategic Highway Safety Plan" (SHSP), MassDOT released an update of the document in September 2013. The updated Massachusetts SHSP¹ is consistent with requirements outlined in the most recent Federal transportation legislation, Moving Ahead for Progress in the 21st Century (MAP-21). One requirement is to establish goals and performance measures. Goals in the Massachusetts SHSP include:

- Reduce motor vehicle fatalities and hospitalizations by 20 percent in the five-year period following adoption of the SHSP (Short-Term Goal);
- Halve the number of fatalities and serious injuries by 2030 (Interim Goal); and
- Move Toward Zero Deaths and eliminate fatalities and serious injuries on the roadways (Long-Term Goal).

The Massachusetts Strategic Highway Safety Plan update is organized to focus attention on the traffic safety problems exhibited by each emphasis area. An emphasis area is classified as Strategic, Proactive, or Emerging based on the number of fatalities, hospitalizations, or incapacitating injuries resulting from crashes related to the emphasis area.

¹ <http://www.massdot.state.ma.us/Portals/8/docs/traffic/shsp/shspSeptember2013.pdf>

STRATEGIC EMPHASIS AREAS

Each emphasis area listed here represents at least 10 percent of annual fatalities or severe injuries on Massachusetts roadways.²

- Impaired Driving
- Young Drivers
- Intersections
- Older Drivers
- Lane Departures
- Pedestrians
- Occupant Protection
- Motorcycles
- Speeding/Aggressive Driving

PROACTIVE EMPHASIS AREAS

Each of these emphasis areas represents less than 10 percent of annual fatalities or severe injuries on Massachusetts roadways. Strategies included within each emphasis area are designed to ensure fatalities and severe injuries for these areas are further reduced even though it may be more difficult in areas already experiencing very low crash rates.

- Bicycles
- At-Grade Crossings
- Truck/Bus-Involved Crashes
- Safety of Persons Working on Roadways

EMERGING EMPHASIS AREAS

These emphasis areas focus on continuously improving the data systems used to analyze traffic safety patterns and generate data on safety topics where the data currently are inconclusive.

- Data Systems
- Driver Inattention³

The safety goals, objectives, and performance measures of the Cape Cod RTP were developed to support the goals and performance measures of the Massachusetts SHSP.

² Severe injuries are based on injuries requiring hospitalizations or defined as incapacitating injuries by police reporting

³ <http://www.massdot.state.ma.us/Portals/8/docs/traffic/shsp/shspSeptember2013.pdf>

Policies & Strategies

In the interest of preserving the character of Cape Cod and achieving safer roads, non-traditional methods of improving safety must be explored. The following recommendations for improving safety will not substantially change the character of the roadways on Cape Cod. Recommendations consistent with the Massachusetts' *Strategic Highway Safety Plan's* (SHSP) "Emphasis Areas" are indicated with an asterisk.

- Consider Traffic Calming measures such as 4-way stop signs and roundabouts.*
- Improve striping maintenance and use of more reflective treatments.*
- Increase enforcement and police presence on rural roads such as 6A.*
- Investigate photo enforcement of red light running and speeding.*
- Make physical improvements that improve the safety and security of the transportation network a priority.*
- Continuously monitor the condition of the transportation system to ensure that it is safe to travel on all modes throughout Cape Cod.*
- Continue to identify the high priority safety locations throughout Cape Cod and then determine measures to increase safety at those locations.*
- Separate high and low speed travel modes, so that those traveling at slower speeds, such as bicycles and pedestrians, do not conflict with those traveling at higher speeds, such as rail and automobile traffic.*
- Encourage safe use of the transportation network through public awareness campaigns, promoting such things as seatbelts for motorists and helmet use for bicyclists.*

*Supports Massachusetts' Strategic Highway Improvement Program "Emphasis Areas"

Community Character/Safety Issues

The following recommendations are intended to preserve community character while addressing safety issues.

- Use alternative guardrail treatments, such as steel Corten or steel backed timber - all on wood posts, where guardrail is necessary.
- Consider roundabouts as an alternative to signalized intersections.
- Continue policies that disallow business logo signs on state highways in Barnstable County.
- Preserve all state owned/town owned land along roads and other transportation rights-of-way, for transportation uses and/or conservation.
- Prohibit pruning and clearing within state rights-of-way except for safety purposes, such as making sight distance improvements.
- Encourage ornamental signal posts and mast arms.
- Develop design guidelines for Cape Cod to document preferred treatments in design concepts and details.

- Encourage use of simulated brick crosswalks and other contrasting materials in order to provide drivers with better visual identification. Crosswalks should be considered for all projects to accommodate walking as a viable mode of travel.
- Promote “Share the Road” and other bicycle education programs.

ROADWAY SAFETY AUDITS

Since 2011 there have been twenty-one Road Safety Audits (RSAs) completed for locations throughout Cape Cod. The Audit process is overseen by MassDOT and brings together community officials and others in an intensive review of high-crash locations’ operational and geometric deficiencies. Each audit includes a review of traffic and crash information, an onsite field review.

It is important to note that the RSAs were borne directly from the U.S. DOT & MassDOT’s Highway Safety Improvement Program (HSIP). This program was formally created by the federal transportation legislation (SAFETEA-LU) and these efforts are intended to align the use of data to identify the most serious safety deficiencies responsible for fatal accidents and serious injuries. All RSAs can be located at www.capecodcommission.org/safety.

TABLE 5. List of Cape Cod Road Safety Audits from 2011 to 2019

TOWN	YEAR	LOCATION
Barnstable	2012	Route 28 at Osterville-West Barnstable Road
	2012	Route 28 (Iyannough Road) at Yarmouth Road
	2014	Route 132 (Iyannough Road) at Cape Cod Community College
	2015	Route 28 (Falmouth Road) at Strawberry Hill Road
	2019	Route 28 (Falmouth Road at Route 132 (Iyannough Road)- Airport Rotary
	2019	Route 6A at Mary Dunn Road/Indian Trail
Bourne	2012	Sandwich Road at Cranberry Highway
	2013	Route 28 between Bourne and Otis Rotary
Brewster	2011	Route 124 (Harwich Road) at Tubman Road
Dennis	2012	Analysis of High-Crash Locations in Dennisport*
Eastham	2012	Route 6 at Governor Prence Road
	2017	Route 6 at Nauset Road/Wampum Lane
Falmouth	2011	Sandwich Road: Carriage Shop Road to Hatchville Road
	2017	Route 28 Corridor
	2018	Route 151 Corridor
Harwich	2016	Route 39 (Orleans Road) at Pleasant Bay Road
	2014	Route 151 (Nathan Ellis HWY) at Old Barnstable Road
Mashpee	2016	Mashpee Wampanoag Tribe Road Safety Audit
	2018	Route 151 at Ninigret Avenue, Algonquin Avenue, and Job's Fishing Road
Wellfleet	2016	Route 6 at Main Street
	2012	Wellfleet Route 6 Safety Study*
Yarmouth	2011	Union Street/Station Avenue: Route 6 Ramps
	2013	Route 6A: Willow Street to Union Street

**denotes study was not an RSA, but rather a safety study. Safety studies offer similar recommendations as an RSA does.*

According to the Federal Highway Administration, an RSA is “the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.” RSA include a list of recommendations in a multitude of categories from Signage, Lighting, and Roadway Configuration. Below is an example list of what an RSA multidisciplinary team is observing when visiting the location.

FIGURE 4. Road Safety Audit Prompt List

GEOMETRIC DESIGN	
Issue	Comment
A. Speed – (Design Speed; Speed Limit & Zoning; Sight Distance; Overtaking)	
<p>Are there speed-related issues along the corridor? Please consider the following elements:</p> <ul style="list-style-type: none"> • Horizontal and vertical alignment; • Posted and advisory speeds • Driver compliance with speed limits • Approximate sight distance • Safe passing opportunities 	
B. Road alignment and cross section	
<p>With respect to the roadway alignment and cross-section please consider the appropriateness of the following elements:</p> <ul style="list-style-type: none"> • Functional class (Urban Principal Arterial) • Delineation of alignment; • Widths (lanes, shoulders, medians); • Sight distance for access points; • Cross-slopes • Curbs and gutters • Drainage features 	
C. Intersections	
<p>For intersections along the corridor please consider all potential safety issues. Some specific considerations should include the following:</p> <ul style="list-style-type: none"> • Intersections fit alignment (i.e. curvature) • Traffic control devices alert motorists as necessary • Sight distance and sight lines seem appropriate • Vehicles can safely slow/stop for turns • Conflict point management • Adequate spacing for various vehicle types • Capacity problems that result in safety problems 	
D. Auxiliary lanes	
<ul style="list-style-type: none"> • Do auxiliary lanes appear to be adequate? • Could the taper locations and alignments be causing safety deficiencies? • Are shoulder widths at merges causing safety deficiencies? 	

MULTIMODAL TRANSPORTATION SAFETY

Safety information is readily available for several modes of travel. The following sections provide safety issue details on several transportation modes. Bicyclist and Pedestrian safety are discussed in the RTP Technical Appendix “Bicycle/Pedestrian Safety Plan.”

Public Transit Safety

Public transit vehicles are generally considered to operate at a higher level of safety in comparison to private automobiles. Drivers are required to have higher qualifications and are subject to strict safety guidelines. The Cape Cod Regional Transit Authority tracks any incidents related to their vehicles and reports that are required. The latest data is available on request.

Air Travel Safety

The National Transportation Safety Board has assembled a database of safety incidents at Cape Cod airports (Hyannis, Falmouth, and Chatham). During the years 2012-2016, seven incidents were listed for these airports. These data are summarized in the following table:

TABLE 6. Hyannis Air Travel Safety Incidents

YEAR	FATAL	NON-FATAL	INCIDENT
2012	0	0	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	1	0

(Source: National Transportation Safety Board)

TABLE 7. Falmouth Air Travel Safety Incidents

YEAR	FATAL	NON-FATAL	INCIDENT
2012	1	1	0
2013	0	0	0
2014	0	1	0
2015	0	1	0
2016	0	0	0

(Source: National Transportation Safety Board)

TABLE 8. Chatham Air Travel Safety Incidents

YEAR	FATAL	NON-FATAL	INCIDENT
2012	0	0	0
2013	0	0	0
2014	0	1	0
2015	0	0	0
2016	0	1	0

(Source: National Transportation Safety Board)

Summary of General Transportation Safety Recommendations

- Work with state and local agencies to improve the accuracy and timeliness (e.g., within 12 months of the end of each year) of crash data
- Consider protected left turn phases into signalized intersections
- Maintain delineation through more frequent restriping and street cleaning
- Improve signage standards to include larger lettering
- Improve lighting level standards, in particular at intersections. Consider placing utilities underground and installing breakaway safety poles for lighting
- Consider extension of “all red” phases for signalized intersections
- Establish driver education programs for older drivers
- Provide education on other options for mobility
- Increase education for local young drivers
- Support additional enforcement and warnings during busy traffic season to reach out to young visitor drivers
- Develop and implement an advertising campaign and roadside signage reminding drivers that traffic and drunk driving laws are strictly enforced on Cape Cod.
- Provide better signage for visitors directing them to popular destinations
- Install signage explaining the rotary “rules of the road” and disseminate similar information to be included in visitor brochures and Cape-related websites
- Consider conversion of conventional intersections (signalized or unsignalized) which have high crash rates to roundabouts
- Promote the use of red-light cameras at high crash rate signalized intersections
- Support road designs which are estimated to reduce crashes and improve safety for all users

INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent Transportation Systems (ITS) are applications of advanced technology in the field of transportation, with the goals of increasing operation efficiency and capacity, improving safety, reducing environmental costs, and enhancing personal mobility. A policy of Cape Cod MPO is to advocate and endorse the consideration of Intelligent Transportation Systems solutions for transportation problems as a routine part of the transportation planning process. As a stakeholder in the Southeastern Massachusetts Regional ITS Architecture, the Cape Cod MPO is committed to continuing an active role in these ITS systems. This includes maintaining channels of communication between the Cape Cod Commission and other stakeholders, including but not limited to: the MassDOT; the Southeastern Regional Planning and Economic Development District (SRPEDD); the Old Colony Planning Council (OCPC), and the Cape Cod Regional Transit Authority (CCRTA). A regional ITS architecture is a framework that defines component systems and their interconnections. Successful ITS deployment requires an approach to planning, implementation, and operations that emphasizes collaboration between relevant entities and compatibility of individual systems. The regional architecture is a mechanism design to ensure this collaboration and compatibility occurs. Inputs into ITS systems can involve any variety of a range of collection devices, including:

- Loop detectors in the pavement and sophisticated ground level radar systems are able to collect real time traffic volume and speed data.
- Video equipment is often used to monitor the transportation system, which is useful in allowing system operators to immediately detect areas of congestion that may be forming. It is also used to detect incidents such as crashes and disabled vehicles, in turn accelerating emergency dispatch and the overall incident management process. Video surveillance is also a useful tool for security and incident management in transit vehicles and around stops and terminals.
- Automatic vehicle locators (AVL) on board transit vehicles, emergency response vehicles, and roadside assistance vehicles allow operators to know where vehicles are in real time that allows for more efficient dispatch and adjustment of traffic controls if necessary.
- Automated Fare Payment Systems that allow riders on transit systems to pay electronically using a "smart card" (prepaid balance) or in the future conventional credit/debit cards rather than cash.
- Transmitters onboard transit and emergency vehicles alike are used to pre-empt traffic signals ahead or to alert travelers at a transit stop that the vehicle is approaching.
- Remote weather stations and Doppler radar provide real time weather conditions occurring throughout the transportation network, and provide alerts regarding events such as icing or flooding that may be occurring. These are some of the technological applications that can be utilized for managing the regional transportation network. All of this information travels over both hard-wired and wireless communication systems to systems that manipulate the data and

distribute it to users of the transportation system. End users of ITS system and the output media include:

- Transit Operation Centers that monitor the transit system through video feed, radio communications, and AVL signals, allowing operators to make improved decisions regarding security, dispatch, and incident management.
- Traffic Operation Centers that monitor the roadway system through reports from systems like loop detection and video feed, allowing operators to make improved decisions regarding congestion management, incident management, security, and maintenance management.
- Traveler Information Services such as the national 511 System or SmarTraveler locally, which receive traffic data from traffic and transit operations centers and distribute it to users via hard line and wireless communications.
- Variable Message Signage that allows operators from traffic and transit operation centers to instantly relay messages to users on the system.
- Kiosks that receive information from transit operation centers and transit vehicles, relaying it to users of the transit system.

MassDOT owns and operates several permanent variable message signs and a large fleet of portable variable message signs throughout the Commonwealth. Permanent stations are used to alert drivers to major events affecting locations such as the Route 128 belt and Interstate 93, as well as the tunnels. Portable variable message sign trailers are located throughout the state and are able to be dispatched to locations wherever and whenever needed. Often they are used for a major local event, such as a road race or sidewalk carnival. They can also be dispatched for major unplanned events, such as a chemical spill that forces an extended closure of a highway. All variable message signs are controlled from the MassDOT Traffic Operations Center in South Boston. MassDOT is using automated vehicle locators on their snow removal and highway maintenance fleet, increasing the efficiency of dispatch of resources to where they are needed. Travelers are able to obtain real time traffic conditions for highways in the Commonwealth, including highway approaches to the Cape such as Routes 3 and 495 as well as the Cape Cod Canal bridges, through SmartRoutes phone and web links, and will soon be available through a statewide 511 system and MassDOT website.

CAPE COD COMMISSION'S LOCATION-SPECIFIC SAFETY STUDIES

The Cape Cod Commission has completed several safety-related studies. The following is a summary of the locations that were studied and highlights of recommended safety improvements. Full reports are available on the internet:

www.capecodcommission.org/safety

CONCLUSION

Safety is the highest priority goal of the Regional Transportation Plan. The Cape's transportation system should ensure that travelers and their possessions will arrive at their destinations unharmed and undamaged. Travelers should be educated regarding transportation regulations and traffic laws, and these must also be enforced to prevent the improper use of the transportation system. The importance of safety requires a spectrum of strategies including education, enforcement, and engineering.

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