CAPE COD
COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix C: Safety

FINAL JULY 2023

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Technical Appendix C: Safety

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

"*Improve safety for all modes*"

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 2022, 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:** The simplest method used in this report for establishing a high crash list is ranking intersections based on the largest number of crashes. The intersection with the greatest number of crashes receives the number one ranking.
- **Based on Equivalent Property Damage Only (EPDO):** The inclusion of severity information in the MassDOT data allows for the calculation of Equivalent Property Damage Only (EPDO). A list ranked by EPDO will bring more attention to locations where the crashes have produced injuries or fatalities. The formula for calculating EPDO is as follows:

  EPDO = 21 x (# fatal crashes + injury crashes) + damage only crashes

  While the EPDO method is useful in identifying intersections with the most severe crashes, it should be noted that not all crashes and their resultant injuries can be attributed to a road's

conditions or geometry. For example, a passenger's decision of whether to wear a seatbelt may determine whether an injury will be experienced. The intersection with the highest EPDO in this list is ranked number one.

- **Based on Crash Rate:** It is expected that a road with higher traffic volumes will experience more vehicle crashes. Using a crash rate helps to avoid highlighting intersections whose problems may be magnified by a large traffic volume. With this methodology, the number of crashes is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on crash rate, the top 100 intersections based on number of crashes were analyzed with the following formula:

  R = ([C/Y] x 1,000,000)/(V x 365)
  R = Crash Rate, C = Total Crashes, Y = # Years Analyzed, V = Daily Entering Volume

  While this method is good for reducing the influence of high-volume roads, it also has the capacity to rank a very low volume road with few crashes very highly. The intersection with the highest crash rate in this list is ranked number one.
- **Based on EPDO Rate:** This method uses the same theory as the crash rate, where there is an assumption that heavily traveled roads are expected to have higher EPDO designations, and it is not necessarily indicative of poor road conditions or geometric flaws. To create this list, the intersections' EPDO is compared to the number of vehicles entering, and the resultant figure is in terms of crashes per million entering vehicles. To be certain to capture the top fifty crash locations based on EPDO rate, the top 100 locations with the highest EPDO were analyzed with the following formula:

  EPDO Rate = ([EPDO/Y] x 1,000,000)/(V x 365)
  Y = # Years Analyzed, V = Daily Entering Volume

  The intersection with the highest EPDO rate in this list is ranked number one.

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 three years of data (2018-2020). 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 14,405 crash reports collected by the Massachusetts Registry of Motor Vehicles, 13,753 incidents were located by MassDOT. The incidents are mapped on the following figure and listed in ranking order in the following tables.

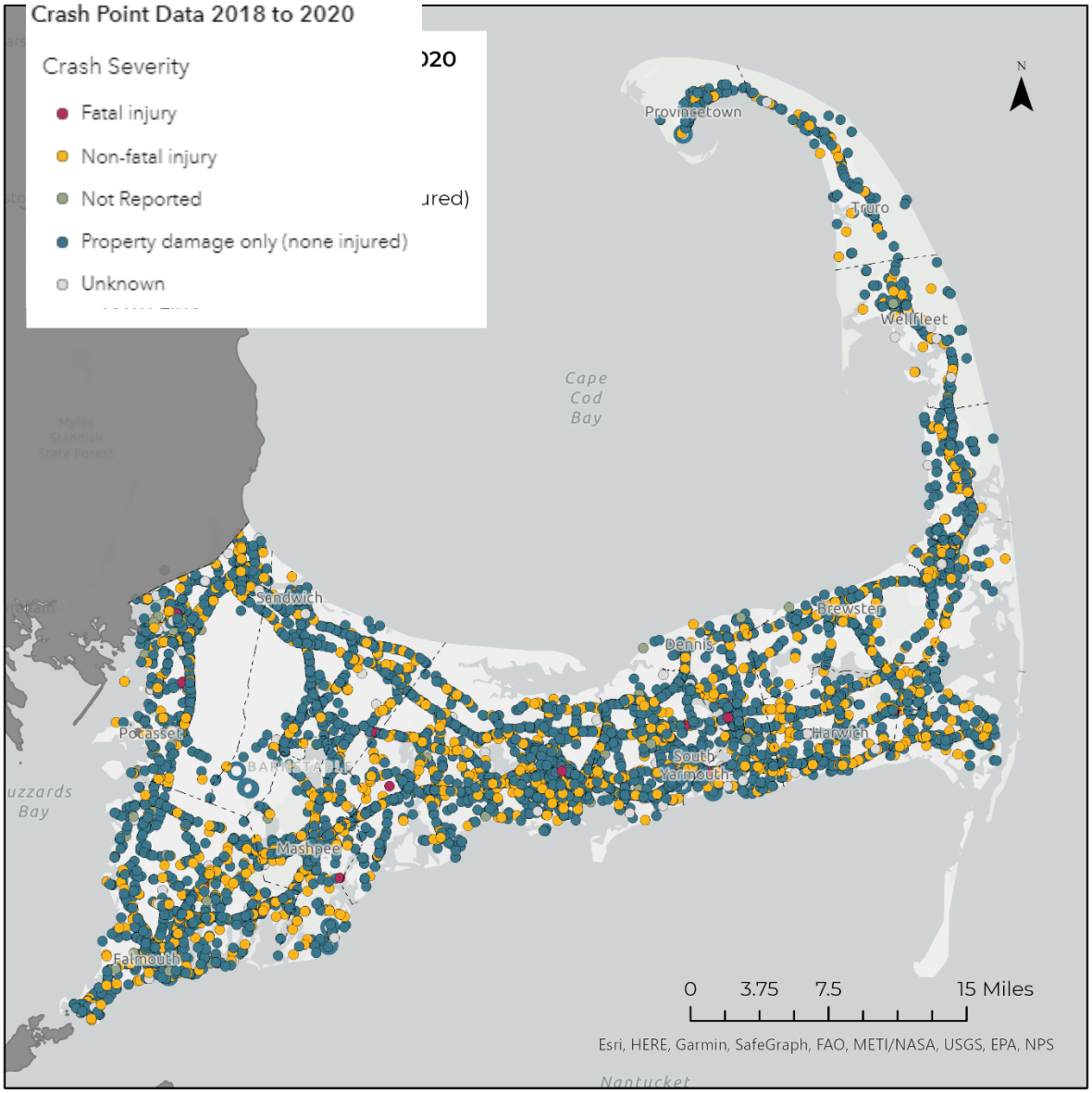


FIGURE 1. Cape Cod Located Crashes 2018-2020

(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	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
2	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
3	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
4	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
5	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
6	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
7	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
8	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
9	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
10	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
11	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
12	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
13	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
14	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
15	Barnstable	Route 132 at Cape Cod Mall	31	149	1.050	5.048
16	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	31	151	0.839	4.088
17	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
18	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
19	Barnstable	Route 132 (Iyannough Road) at Independence Drive	26	66	0.989	2.511
20	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
21	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
22	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
23	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
24	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
25	Barnstable	Route 28 at Bell Tower Mall	23	163	0.716	5.077
26	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
27	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
28	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Enginehouse Road	23	143	1.101	6.844
29	Barnstable	Route 28 (Falmouth Road) at Main Street	22	142	1.003	6.475
30	Barnstable	Route 28 (Falmouth Road) at Route 149	22	102	0.844	3.912
31	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
32	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
33	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
34	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
35	Eastham	Route 6 at Samoset Road/Depot Road	21	81	1.107	4.271
36	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
37	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
38	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	21	101	1.108	5.329
39	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
40	Harwich	Route 124 at Route 39/Main Street	20	59	1.600	4.719
41	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
42	Barnstable	Route 28 (Iyannough Road) at Spring Street	19	99	0.912	4.750
43	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall West Entrance	19	118	0.608	3.776
44	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
45	Harwich	Route 137 at Orleans Road	19	139	0.908	6.646
46	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
47	Yarmouth	Station Avenue at White's Path/Workshop Road	19	58	0.685	2.090
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
49	Falmouth	East Falmouth Highway/Teaticket Highway at Acapesket Road	18	178	0.975	9.640
50	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260

Source: MassDOT Crash Records 2018-2020

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) at Osterville-West Barnstable Road	55	375	2.418	16.489
2	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
3	Barnstable	Route 28 (Falmouth Road) and Bearses Way	60	339	2.070	11.694
4	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
5	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
6	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
7	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
8	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
9	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
10	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
11	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
12	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
13	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
14	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
15	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
16	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
17	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
18	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
19	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
20	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
21	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
22	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
23	Falmouth	East Falmouth Highway/Teaticket Highway at Acapesket Road	18	178	0.975	9.640
24	Barnstable	Route 28 at Bell Tower Mall	23	163	0.716	5.077
25	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
26	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
27	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260
28	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
29	Barnstable	Bearses Way at South Street	15	155	1.696	17.530
30	Mashpee	Route 151 at Market Street	14	154	0.727	7.995
31	Barnstable	Old Stage Road/Old Falmouth Road at Race Lane/Oak Street	11	151	1.114	15.293
32	Barnstable	Route 132 (Iyannough Road) at Phinneys Lane	31	151	0.839	4.088
33	Barnstable	Route 132 at Cape Cod Mall	31	149	1.050	5.048
34	Falmouth	Gifford Street at Dillingham Avenue	8	148	0.597	11.040
35	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
36	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
37	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Enginehouse Road	23	143	1.101	6.844
38	Barnstable	Route 28 (Falmouth Road) at Main Street	22	142	1.003	6.475
39	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
40	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
41	Harwich	Route 137 at Orleans Road	19	139	0.908	6.646
42	Barnstable	Route 28 (Falmouth Road) at Main Street/South County Road	15	135	0.739	6.654
43	Barnstable	Phinney's Lane at Old Strawberry Hill Road	16	135	1.648	13.906
44	Barnstable	Route 28 (Falmouth Road) at Santuit Newtown Road	14	134	0.660	6.317
45	Falmouth	Route 28 (Teaticket Highway) at Village Common Drive	10	130	0.626	8.132
46	Barnstable	Route 28 (Falmouth Road) at East Osterville Road	9	129	0.457	6.545
47	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
48	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
49	Barnstable	Route 132 (Iyannough Road) at Cape Cod Mall West Entrance	19	118	0.608	3.776
50	Barnstable	Route 132 at Shootflying Hill Road	17	117	0.614	4.222

Source: MassDOT Crash Records 2018-2020

TABLE 3. Top Locations based on Crash Rate

Rank Crash Rate	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
2	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
3	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
4	Barnstable	South Street at Pleasant Street	13	93	2.395	17.131
5	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
6	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
7	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
8	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
9	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
10	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
11	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
12	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
13	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
14	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
15	Barnstable	Stevens Street at Bassett Lane	16	96	1.818	10.910
16	Dennis	Route 134 (East-West Dennis Road) at Upper County Road	44	144	1.783	5.834
17	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
18	Barnstable	High School Road at South Street	15	155	1.696	17.530
19	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
20	Yarmouth	Forest Road at Old Town House Road	15	95	1.674	10.601
21	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
22	Barnstable	Phinney's Lane at Old Strawberry Hill Road	16	135	1.648	13.906
23	Dennis	Route 134 (East-West Dennis Road) at Theophilus F. Smith Road	39	139	1.638	5.836
24	Harwich	Route 124 at Route 39/Main Street	20	59	1.600	4.719
25	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
26	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
27	Dennis	Route 28 (Main Street at Sea Street	15	115	1.537	11.781
28	Dennis	Route 134 (East-West Dennis Road) at Patriot Square/Market Place	43	142	1.536	5.071
29	Barnstable	Barnstable Road at Center Street/Charles Street	14	54	1.526	5.886
30	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
31	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
32	Barnstable	High School Road at Main Street	14	74	1.431	7.566
33	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
34	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
35	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
36	Falmouth	Route 151 (Nathan Ellis Highway) at Route 28A (North Falmouth Highway	16	76	1.282	6.087
37	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
38	Barnstable	North Street at Stevens Street	14	113	1.255	10.129
39	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
40	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
41	Yarmouth	Route 28 (Main Street) at Old Main Street	16	14	1.234	1.080
42	Falmouth	Route 28 (Main Street) at Spring Bars Road/Dillingham Ave	15	55	1.222	4.480
43	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
44	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
45	Mashpee	Great Neck Road N at Old Barnstable Road	17	117	1.172	8.064
46	Bourne	Meetinghouse Lane at State Road/Canal Street	17	55	1.167	3.775
47	Yarmouth	Station Ave at Wood Road	15	115	1.165	8.930
48	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
49	Barnstable	Old Stage Road/Old Falmouth Road at Race Lane/Oak Street	11	151	1.114	15.293
50	Mashpee	Route 151 (Nathan Ellis Highway) at Ninigret Avenue	21	101	1.108	5.329

Source: MassDOT Crash Records 2018-2020

TABLE 4. Top Locations based on EPDO Rate

Rank EPDO Rate	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
1	Harwich	Route 39 (Orleans-Harwich Road) at Pleasant Bay Road	21	241	2.713	31.140
2	Falmouth	Spring Bars Road at Worcester Court	22	201	2.311	21.118
3	Barnstable	High School Road at South Street	15	155	1.696	17.530
4	Barnstable	South Street at Pleasant Street	13	93	2.395	17.131
5	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
6	Barnstable	Old Stage Road/Old Falmouth Road at Race Lane/Oak Street	11	151	1.114	15.293
7	Sandwich	Route 6A at Route 130/Tupper Road	20	160	1.904	15.234
8	Falmouth	Route 151 (Nathan Ellis Highway) at Sandwich Road	38	318	1.778	14.882
9	Barnstable	Phinney's Lane at Old Strawberry Hill Road	16	135	1.648	13.906
10	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
11	Barnstable	Route 28 at Yarmouth Road	72	372	2.649	13.685
12	Yarmouth	Higgins Crowell Road at Willow Street	22	242	1.215	13.363
13	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
14	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
15	Falmouth	Waquoit Highway at Metoxit Road	16	156	1.261	12.296
16	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890
17	Barnstable	Route 28 (Falmouth Road) at Strawberry Hill Road	26	206	1.494	11.834
18	Dennis	Route 28 (Main Street at Sea Street	15	115	1.537	11.781
19	Yarmouth	Buck Island Road at Higgins Crowell Road	19	179	1.241	11.695
20	Barnstable	Route 28 (Falmouth Road) at Bearses Way	60	339	2.070	11.694
21	Falmouth	Gifford Street at Dillingham Avenue	8	148	0.597	11.040
22	Barnstable	Stevens Street at Bassett Lane	16	96	1.818	10.910
23	Falmouth	Route 28 at Beagle Lane/Maravista Avenue	21	161	1.404	10.767
24	Yarmouth	Forest Road at Old Town House Road	15	95	1.674	10.601
25	Dennis	Route 134 (East-West Dennis Road) at Bob Crowell Road/Hemlock Lane	50	230	2.241	10.306
26	Barnstable	North Street at Stevens Street	14	113	1.255	10.129
27	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
28	Sandwich	Route 6A at Quaker Meetinghouse Road/Spring Hill Road	25	125	2.000	10.001
29	Bourne	Barlows Landing Road at County Road	8	108	0.732	9.889
30	Barnstable	Yarmouth Road atOld Yarmouth Road/Maher Road	11	111	0.963	9.717
31	Falmouth	Route 28 (East Falmouth Highway) at Old Barnstable Road/Acapesket Roa	18	178	0.975	9.640
32	Yarmouth	Station Ave at Wood Road	15	115	1.165	8.930
33	Falmouth	Jones Road at Gifford Street	23	143	1.434	8.913
34	Mashpee	Route 151 (Nathan Ellis Highway) at Job's Fishing Road	21	181	1.010	8.709
35	Barnstable	Route 132 (Iyannough Road) at Bearses Way	58	238	2.112	8.667
36	Falmouth	Route 28 at Shorewood/John Parker Road	24	184	1.106	8.478
37	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
38	Barnstable	Route 28 (Falmouth Road) at Phinney's Lane	28	208	1.134	8.424
39	Harwich	Route 124 (Pleasant Lake Ave) at Queen Anne Road	11	111	0.834	8.415
40	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
41	Falmouth	Route 28 (Teaticket Highway) at Village Common Drive	10	130	0.626	8.132
42	Mashpee	Great Neck Road N at Old Barnstable Road	17	117	1.172	8.064
43	Mashpee	Route 151 at Market Street	14	154	0.727	7.995
44	Mashpee	Route 151 (Nathan Ellis Highway) at Old Barnstable Road	34	193	1.367	7.760
45	Barnstable	High School Road at Main Street	14	74	1.431	7.566
46	Falmouth	Route 28 (Main Street) at Falmouth Schools Admin. Driveway	9	109	0.613	7.429
47	Falmouth	Route 28 at Fresh Pond Road	24	104	1.693	7.334
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270
49	Falmouth	Sandwich Road at Brick Kiln Road	22	102	1.567	7.266
50	Falmouth	Route 151 (Nathan Ellis Highway) at Currier Road	18	158	0.827	7.260

Source: MassDOT Crash Records 2018-2020

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 32% of Cape Cod's population as reported in the U.S Census Bureau (2020 estimates) was aged 65 or older (as compared to 17% 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 2020 estimates, 32% or 74,386 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 discussion topic at the outreach focus group meeting we held in the Outer Cape as part of the 2024 RTP development. Improved or new programs to connect seniors with routine and reliable transportation service to major destinations is needed.

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. Using hand held devices while driving is another distraction for younger drivers .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, hands free 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."

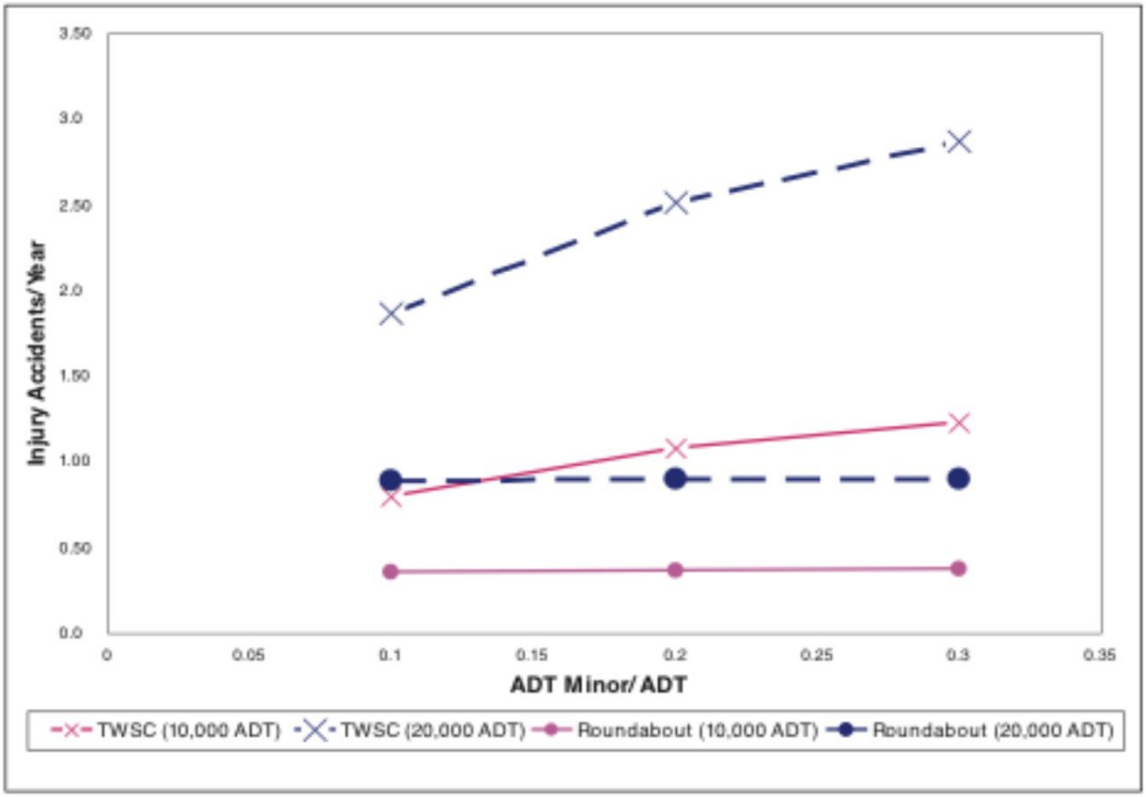
MODERN ROUNDABOUTS V. FOUR-WAY INTERSECTIONS

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. The National Cooperative Highway Research Program (NCHRP) Research Report 1043: *Guide for Roundabouts*, (2023) 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.

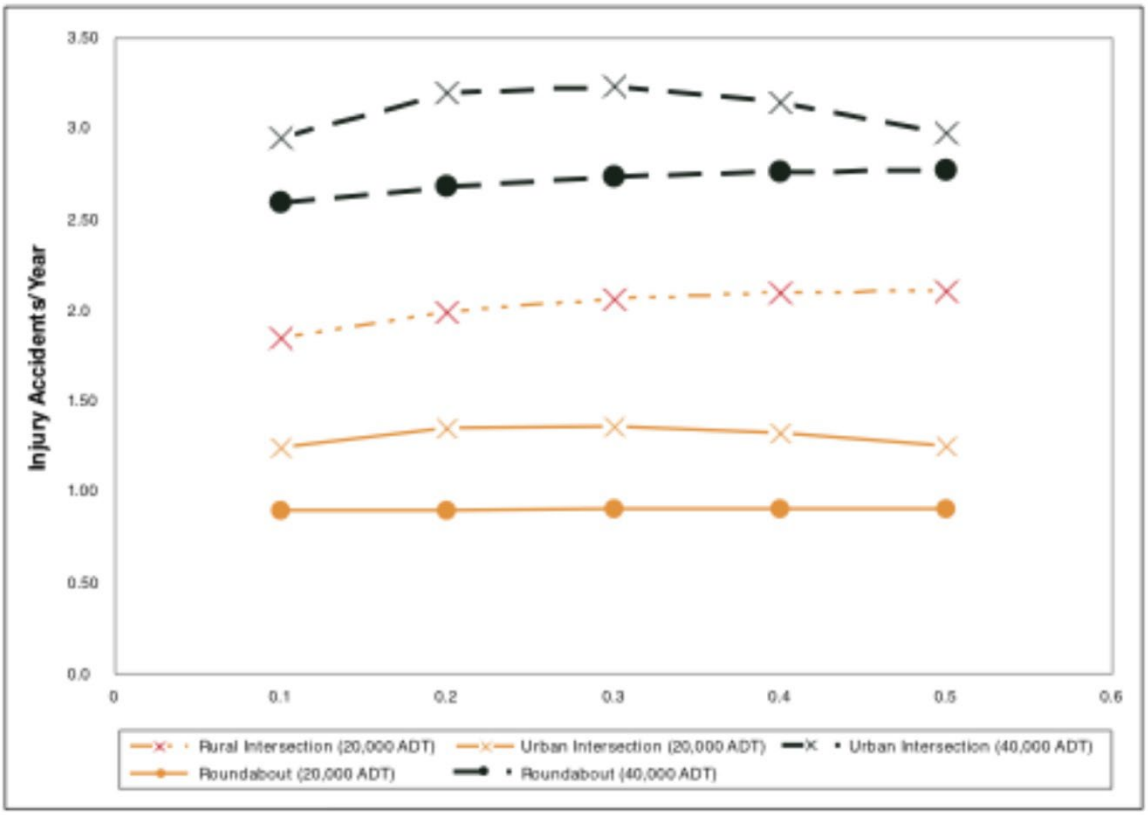
FIGURE 2. Comparison of Predicted Roundabout Injury Crashes with Rural 2-Way Stop - Controlled Intersections



(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.

EMERGENCY PRE-EMPTION SYSTEM

Many of the Cape's signalized intersections are equipped with an emergency traffic signal priority-based pre-emption system. The system includes infrared detection equipment installed adjacent to the signal heads. When an emergency vehicle (ambulance, fire engine, etc.) equipped with an 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 pre-emption system. Upgrades to existing signals and new signal installations should be equipped with an emergency pre-emption system.

Coordination with Massachusetts' Strategic Highway Safety Plan

Building on the success of the 2006 "Strategic Highway Safety Plan" (SHSP), MassDOT's most recent update was completed in 2022. The updated Massachusetts SHSP[1] identifies key safety needs and helps direct funding to improvements that reduce highway fatalities and serious injuries on all public roads. MassDOT developed the Massachusetts SHSP in a cooperative process with Federal, State, local, private, and public sector safety stakeholders. The SHSP is a data-driven, strategic plan that integrates the four E's: engineering, education, enforcement and emergency medical services (EMS) using the Safe System Approach.

The ultimate goal of the Massachusetts SHSP is to achieve zero roadway fatalities and serious injuries. The Massachusetts SHSP update is organized to focus on Vision Zero and the Safe System Approach.

SAFE SYSTEMS APPROACH

The Safe System Approach[2] has been embraced by the transportation community as an effective way to address and mitigate the risks inherent in our enormous and complex transportation system. It works by building and reinforcing multiple layers of protection to both prevent crashes from happening in the first place and minimize the harm caused to those involved when crashes do occur. It is a holistic and comprehensive approach that provides a guiding framework to make places safer for people.

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[1] https://www.mass.gov/doc/massachusetts-shsp-2023/download

[2] https://www.transportation.gov/NRSS/SafeSystem

This is a shift from a conventional safety approach because it focuses on both human mistakes and human vulnerability and designs a system with many redundancies in place to protect everyone.

U.S. DOT's National Roadway Safety Strategy and the Department's ongoing safety programs are working towards a future with zero roadway fatalities and serious injuries. In support of this approach, safety programs are focused on infrastructure, human behavior, responsible oversight of the vehicle and transportation industry, and emergency response.

PRINCIPLES OF THE SAFE SYSTEMS APPROACH

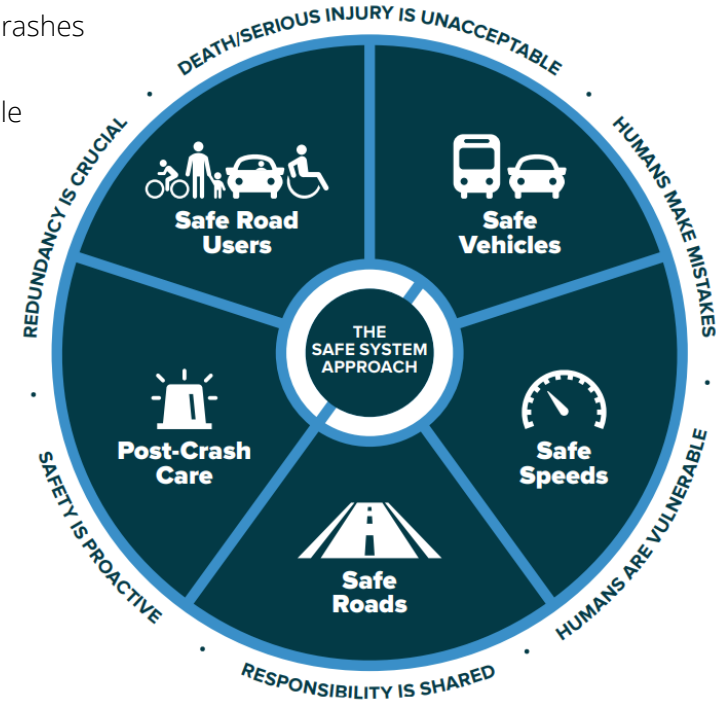
A Safe System Approach incorporates the following principles:

- Death and Serious Injuries are Unacceptable
    - A Safe System Approach prioritizes the elimination of crashes that result in death and serious injuries.
- Humans Make Mistakes
    - People will inevitably make mistakes and decisions that can lead or contribute to crashes, but the transportation system can be designed and operated to accommodate certain types and levels of human mistakes, and avoid death and serious injuries when a crash occurs.
- Humans are Vulnerable
    - Human bodies have physical limits for tolerating crash forces before death or serious injury occurs; therefore, it is critical to design and operate a transportation system that is human-centric and accommodates physical human vulnerabilities.
- Responsibility is Shared
    - All stakeholders—including government at all levels, industry, non-profit/advocacy, researchers, and the general public—are vital to preventing fatalities and serious injuries on our roadways.
- Safety is Proactive
    - Proactive tools should be used to identify and address safety issues in the transportation system, rather than waiting for crashes to occur and reacting afterwards.
- Redundancy is Crucial
    - Reducing risks requires that all parts of the transportation system be strengthened, so that if one part fails, the other parts still protect people.

OBJECTIVES OF A SAFE SYSTEM APPROACH

The Safe Systems Approach identifies five complementary objectives as listed below:

- Safer People[3]
    - Encourage safe, responsible driving and behavior by people who use our roads and create conditions that prioritize their ability to reach their destination unharmed.
- Safer Roads[4]
    - Design roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users.
- Safer Vehicles[5]
    - Expand the availability of vehicle systems and features that help to prevent crashes and minimize the impact of crashes on both occupants and non-occupants.
- Safer Speeds[6]
    - Promote safer speeds in all roadway environments through a combination of thoughtful, equitable, context-appropriate roadway design, appropriate speed-limit setting, targeted education, outreach campaigns, and enforcement.
- Post-Crash Care[7]
    - Enhance the survivability of crashes through expedient access to emergency medical care, while creating a safe working environment for vital first responders and preventing secondary crashes through robust traffic incident management practices.



[3] https://www.transportation.gov/NRSS/SaferPeople
[4] https://www.transportation.gov/NRSS/SaferRoads
[5] https://www.transportation.gov/NRSS/SaferVehicles
[6] https://www.transportation.gov/NRSS/SaferSpeeds
[7] https://www.transportation.gov/NRSS/PostCrashCare

SHSP Initiatives

To create safer roadways, the Commonwealth is pursuing the following six initiatives for coordinated multi agency and organization implementation.

- Implement Speed Management to Realize Safer Speeds
    - Evaluate and adjust operating speeds through roadway designs that are self-enforcing consistent with the new 2022 MassDOT speed management approach.
    - Develop and execute a procedure for target speed setting in all project types (e.g., roadway reconstruction, bridge, preservation, development, new roadways)
    - Amend Massachusetts regulations related to speed (expand the definition of a school zone, adjust speed limit setting, modify statutory speeds)
- Address Top-Risk Locations and Populations
    - Identify, initiate, and prioritize systemic projects involving top-risk locations
    - Identify, initiate, and prioritize systemic projects involving top-risk populations
    - Biannually update and disseminate information on locations and populations of top risk.
    - Evaluate effectiveness.
- Take an Active Role to Affect Change in Vehicle Design, Features, and Use
    - Identify opportunities for the state to champion safe vehicle designs and features to minimize injury severity with national, state, and local partners
- Accelerate Research and Adoption of Technology
    - Pursue research to test new approaches and identify new technologies for improving safety – including methods to screen and curb dangerous behaviors (e.g., drug impairment levels, testing tools)
    - Develop prospective pilots for automated enforcement for red light running, speed zones, and work zones.
    - Expand data linkages to improve our understanding of risks related to serious crashes and opportunities for intervention.
    - Evaluate and identify how roadway safety-related violation structure incentivizes or disincentivizes dangerous driving behavior and develop recommendations for changes.
- Double Down on What Works
    - Address top crash locations.
    - Expand the use of roadway pilots.
    - Expand internal state workforce training to engage the state workforce to raise awareness about the Safe System Approach and educate/train on how to implement it in their work.
    - Expand external trainings the state provides to amplify safety, Safe System, and best practices.

    - Expand resources to municipalities.
    - Get more safety equipment into the hands of road users (e.g., bicycle lights, car seats).
    - Expand data-driven targeted enforcement and high visibility police presence.
    - Improve accessibility and linkage of relevant safety-related data to professionals and the public.
    - Increase maintenance and operations.
    - Increase Road Safety Audits.
    - Provide a safe work environment for workers on roadways through increased training, education, awareness of incident management, and cutting-edge approaches.
    - Implement proven safety countermeasures in all roadway projects.
    - Develop, utilize, and provide guidance resources for effective selection and evaluation of improvements under both state and local jurisdictions.
    - Improve post-crash care through improving cell service coverage, implementing new trauma triage guidelines, increasing services for those involved in crashes, and increasing data linkages.
- Implement New Approaches to Public Education and Awareness
    - Develop new approaches, test to find what works, and implement a new type of comprehensive campaign that will have an impact on social norming/behavioral change on speeding, occupant protection, impairment, distraction, and seatbelts.
    - Develop an educational opportunity when individuals interact with the Registry of Motor Vehicles (RMV) to renew or obtain a license or ID so they can learn about safety advances including roadway design, multimodal mobility, signs, and signals.
    - Improve driver education and training for those under 18 and expand driver education for parent(s)/guardian(s) of those new drivers.
    - Improve driver education for new drivers over 18 years of age and provide refreshers for drivers transferring a license from another state.
    - Establish a state plan to communicate safety – including how we want media to talk about crashes.

Community Character/Safety Issues

The following recommendations are intended to preserve community character on Cape Cod 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 the Vulnerable Road Users law and other bicycle education programs.
- Right-size complete streets improvements to roadway projects to community character is not significantly changed with expansion of multimodal improvements.

ROADWAY SAFETY AUDITS

Since 2011 there have been 35 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, and 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 2023

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
	2021	Hyannis West End Rotary (West Main Street, Main Street, Scudder Avenue)
	2021	Route 28 at Santuit-Newtown Road
	2023	Route 28 at Pitcher's Way, Lincoln Road, and Barnstable Intermediate School
	2023	Route 132 (East of Bearses Way to West of Airport Rotary)
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*
	2020	Route 134 High Crash Locations
Eastham	2012	Route 6 at Governor Prence Road
	2017	Route 6 at Nauset Road/Wampum Lane
	2019	Eastham/Orleans Rotary and Route 6 at Van Dale Avenue
Falmouth	2011	Sandwich Road: Carriage Shop Road to Hatchville Road
	2017	Route 28 Corridor
	2018	Route 151 Corridor
	2021	Davis Straits (Route 28) Between the 13 Davis Straits and 80 Davis Straits
	2023	West Falmouth Route 28A between Old Dock Lane and Chapoquoit Road
Harwich	2016	Route 39 (Orleans Road) at Pleasant Bay Road
Mashpee	2014	Route 151 (Nathan Ellis HWY) at Old Barnstable Road
	2016	Mashpee Wampanoag Tribe Road Safety Audit
	2018	Route 151 at Ninigret Avenue, Algonquin Avenue, and Job's Fishing Road
	2019	Mashpee Rotary
Orleans	2019	Eastham/Orleans Rotary and Route 6 at Van Dale Avenue

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
	2016	Main Street (Route 28) at North Main Street and Old Main Street
	2019	Route 28 Between Iyannough Road and Parkers River Bridge

**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	
Are there speed-related issues along the corridor? Please consider the following elements: • 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	
With respect to the roadway alignment and cross-section please consider the appropriateness of the following elements: • 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	
For intersections along the corridor please consider all potential safety issues. Some specific considerations should include the following: • 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	
• 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 prepared its Public Transportation Agency Safety Plan (PTASP) in December 2022 which outlines its safety training program, establishes safety performance targets, a safety management policy and safety performance monitoring. CCRTA has established the safety targets below by reviewing historic safety data, with the goal of operating to maximum safety, proactively addressing hazards as they are identified. The Cape Cod MPO adopted the transit safety performance targets for the Cape Cod region in March 2023.

TABLE 6. Cape Cod Transit Safety Performance Targets

MODE OF TRANSIT SERVICE	FATALITIES (TOTAL)	FATALITIES (PER 100K VRM)	INJURIES (TOTAL)	INJURIES (PER 100K VRM)	SAFETY EVENTS (TOTAL)	SAFETY EVENTS (PER 100K VRM)	SYSTEM RELIABILITY (MMBF2)
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles
Paratransit	0	0.00	4	0.1	8	0.2	150,000 miles
Human Service Transportation/ Demand Taxi	0	0.00	6	0.5	12	1.0	100,000 miles
Fixed Route Bus	0	0.00	8	0.6	16	1.2	20,000 miles

[1] Vehicle Revenue Miles

[2] Mean Miles Between Failures

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
- Advocate for adaptive traffic signal technology for main corridors
- 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 can 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. Full reports are available on the Cape Cod Commission's website: www.capecodcommission.org/safety

- Non-Motorist Crash Analysis (2023) - Ongoing
- Before and After Crash Analysis Report (2022)
- Route 6 Safety Analysis Report (2022)
- Route 6 Safety Study: Ramp and Shoulder Design (2019)
- Route 6 Stormwater and Vegetation Management Plan and Maps (2016)
- Route 6 Hydroplaning Crash Analysis and Alternatives Development (2014)

CONCLUSION

Safety continues to be 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, engineering, and emergency response.

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