

2020 REGIONAL TRANSPORTATION PLAN

Technical Appendix G: Congestion Management Plan



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Technical Appendix G: Congestion Management Plan

INTRODUCTION

Any urban area with a population over 200,000 is considered a Transportation Management Area, which subjects it to additional planning requirements under the U.S. DOT's Surface Transportation Program. The Cape Cod Region has been designated as a Transportation Management Area (TMA) following the 2000 Census. Under the federal statutes that define the MPO processes and requirements, these conditions make the establishment of a Congestion Management Program (CMP) a requirement of the Cape Cod Metropolitan Planning Organization (MPO).

Federal legislation that contains requirements for transportation plans, programs and projects includes the current legislation: *Moving Ahead for Progress in the 21st Century* (MAP-21) and the outgoing legislation: *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU) as well as the *Clean Air Act Amendments of 1990*.

Significant Legislative Elements

The CMP shall be developed, established, and implemented as part of the metropolitan planning process in accordance with 23 CFR 450.320(c). The statute includes the following requirements:

- Methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of congestion, identify and evaluate alternative actions, provide information supporting the implementation of actions, and evaluate the efficiency and effectiveness of implemented actions.
- 2. Definition of parameters for measuring the extent of congestion and for supporting the evaluation of the effectiveness of congestion-reduction and mobility-enhancement strategies for the movement of people and goods. Since levels of acceptable system performance may vary among local communities, performance measures and service thresholds should be tailored to the specific needs of the area and established cooperatively by the State, affected MPO(s), and local officials in consultation with the operators of major modes of transportation in the coverage area.
- 3. Establishment of a program for data collection and system performance monitoring to define the extent and duration of congestion, to help determine the causes of

congestion, and to evaluate the efficiency and effectiveness of implemented actions. To the extent possible, existing data sources should be used, as well as appropriate application of the real-time system performance monitoring capabilities available through Intelligent Transportation Systems (ITS) technologies.

- 4. Identification and evaluation of the anticipated performance and expected benefits of appropriate traditional and nontraditional congestion management strategies that will contribute to the more efficient use of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, should be appropriately considered for each area:
 - Transportation demand management measures, including growth management and congestion pricing;
 - Traffic operational improvements;
 - Public transportation improvements;
 - ITS technologies; and,
 - Where necessary, additional system capacity.
- 5. Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy (or combination of strategies) proposed for implementation.
- Implementation of a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures. The results of this evaluation shall be provided to decision makers to provide guidance on the selection of effective strategies for future implementation.

CONGESTION MANAGEMENT PLAN PROCESS

The CMP follows the federal guidance for an objectives-driven, performance-based approach consisting of the following eight actions:

- Develop Regional Objectives
- Define CMP Network
- Develop Multimodal Performance Measures
- Collect Data/Monitor System Performance
- Analyze Congestion Problems and Needs
- Identify and Assess Strategies
- Program and Implement Strategies

• Evaluate Strategy Effectiveness ¹

CONGESTION MANAGEMENT BACKGROUND

The Congestion Management Program is a collaboration of other ongoing regional efforts including the Regional Transportation Plan, Transportation Improvement Plan (TIP) and the Unified Planning Work Program (UPWP). The goals and objectives developed for the RTP are echoed in the CMP as well. As part of these on-going documents, congestion management is continually monitored, evaluated and measured within the regional transportation system. Our annual traffic count program monitors traffic volumes and travel patterns within the region, while our annual studies conducted as part of the UPWP evaluate existing congestion roadway links and recommend alternative strategies to mitigate regional congestion. As part of these on-going documents, congestion management is continually monitored, evaluated and measured within the regional transportation system.

The CMP is also intended to be a planning tool to help reduce mobile source emissions and improve regional air quality. To support this planning tool, monitoring of transportation system performance is an ongoing activity for the Cape Cod region.

"Congestion" is defined as travel time or delay in excess of that normally incurred under light or free-flow travel conditions. There are two primary types identified for congestion and a successful congestion management program should address both types of congestion. The two types of congestion are:

1. <u>Recurring congestion</u> that tends to be concentrated into short time periods, such as "rush hours" and is caused from excessive traffic volumes resulting in reduced speed and flow rate within the system, and

 <u>Non-recurring congestion</u> caused from unforeseen incidents (road accidents, weather events, construction work zones) which affect the driver behavior to a considerable extent.
 With regard to the Cape Cod region, there are several factors that attribute to recurring congestion:

- Natural geometry of the region as it is surrounded by water and uniquely shaped with only two regional roadways.
- Vehicular access to the region is limited by two antiquated bridge structures across the Cape Cod Canal.
- Limited presence of multi-modal options connecting Cape Cod to the urban areas of Massachusetts (i.e. commuter rail and ferry routes).

¹ Congestion Management Process: A Guidebook. Federal Highway Administration. April 2011. Report No. FHWA_HEP_11_011.

- The Cape Cod region is home to an established community of secondary summer homes and is a vacation destination, which greatly increases traffic volumes and congestion periods.
- Access to the highly-seasonal islands of Nantucket and Martha's Vineyard is provided from Cape Cod via ferry routes and airline connections.

However, the Cape Cod region also has some strengths that present unique opportunities for the management of congestion:

- The region has an established and active public transit authority (Cape Cod Regional Transit Authority (CCRTA)), consisting of seven (7) fixed route transit bus routes, dial-a-ride (DART) or paratransit service, seasonal trolley service and the Hyannis Transportation Center.
- A seasonal commuter passenger rail service, known as the CapeFlyer, was established in 2013 in collaboration with MassDOT, the Massachusetts Bay Transportation Authority (MBTA) and the CCRTA, and provides passenger rail service between Boston and Cape Cod. The service runs on the weekends, beginning Friday evenings between Memorial Day weekend and Labor Day weekend.
- The region has an established network of multi-use paths and rail trails, including the Cape Cod Rail Trail, Cape Cod Canal Path and the Shining Sea Bikeway with several expansion routes planned for the future. In addition, the region's municipalities have a growing interest in bicycle accommodation for on road facilities.

Critical to the concept of congestion management is the understanding that the acceptable system performance may vary by type of transportation modes and systems, geographic location, season, and/or time of day. The philosophy of the Cape Cod RTP and CMP is not to build to accommodate the peak season demand, but to provide adequate transportation for year-round travel and to provide and promote alternatives to the automobile. This philosophy is different from the majority of the regions in Massachusetts and across the nation. The philosophy of the CMP places much more emphasis on management of traffic and providing alternatives to the automobile for transportation rather than accommodating traffic demand.

CONGESTION MANAGEMENT NETWORK

The Congestion Management Network for the Cape Cod region was developed based on its unique attributes of its landscape and seasonal nature. The Cape Cod region includes 15 towns with an average population of 200,000 year-round residents, which spikes to approximately 500,000 during the summer peak season. Due to the unique geography of the Cape Cod landscape, the region is mainly served by two main linear corridors, Route 6 and Route 28, that provide a regional connection to all 15 towns. The network for the congestion management focuses on these two

main arterial roadways which handle the majority of the regional vehicular trips, experience reoccurring congestion and have a known crash history. Both corridors currently provide transit service and have the greatest potential for an improved multi-modal environment. As shown in Figure 1, Route 28 and Route 6 are the two main arteries that serve the Cape Cod region and coincide with other multi-modal facilities in the region.



FIGURE 1. Cape Cod Regional Roadways

Route 6

On Cape Cod, Route 6 is the major transportation corridor, particularly for those traveling long distances. From where it enters Barnstable County in Buzzards Bay until its end in Provincetown, it provides a primarily limited-access high-speed means of traveling along the spine of the Cape for commercial traffic and is under the jurisdiction of MassDOT. The Route 6 corridor in the Outer Cape does not have limited access and consists of a four-lane cross section with commercial curb cuts. This portion of Route 6 also contains segments of the Claire Saltonstall Bikeway, or State Bicycle Route 1, but with limited pedestrian and bicycle accommodations. The CCRTA runs transit service on Route 6 on the Outer Cape via the Flex Route from Harwich to Provincetown. Within the Mid-Cape, Route 6 carries a summer ADT count of approximately 65,000 and within the Outer Cape, Route 6 carries a summer ADT of approximately 24,000. The posted speed limit on Route 6 is

55 miles per hour (mph) within the four-lane divided highway section from Sagamore Bridge to Exit 9, 50 mph on the two-lane divided highway section from Exit 9 to the Orleans Rotary and 40 mph on the Outer Cape portion.

During peak travel periods in the summer it is not unusual for westbound traffic to be stopped for several miles east of the Sagamore Bridge or at various bottleneck points. The two most notable bottlenecks on Route 6 are at the Sagamore Bridge and the section of Route 6 in Dennis where is changes from a four-lane cross section to a two-lane cross section. A third bottleneck is on Route 6 in Wellfleet where the cross section again changes from four lanes to two lanes. Recently, MassDOT has installed "Go Time' signs on Route 6, providing real-time traffic travel times to major points, such as Hyannis, Provincetown and the Sagamore Bridge.

Route 28

Route 28 runs for almost sixty-five miles after crossing the Cape Cod Canal and passing through villages adjacent to Buzzards Bay/Nantucket Sound/the Atlantic Ocean from Bourne to Orleans Center. Route 28 is a regional roadway, but it does not provide direct inter-regional travel options in most cases. The cross section of Route 28 varies greatly throughout the Cape. However, there are three primary sections to Route 28, which are identifiable by their roadways characteristics, and all three sections are under the jurisdiction of MassDOT. Most notably is a section within the towns of Bourne and Falmouth that is classified as a limited-access highway with high travel speeds and carries a summer ADT of approximately 38,000. MassDOT has recently installed Go Time' signs on this portion of Route 28, providing real-time traffic travel times to major points, such as Woods Hole and the Bourne Bridge. The urban major arterial section of Route 28 which spans from Falmouth to Orleans has varying travel speeds with varying levels of pedestrian and bicycle accommodations. Route 28 within the Mid-Cape carries a summer ADT of approximately 31,000. The CCRTA runs two transit bus lines, the Sealine and the H2O line along Route 28 from Falmouth to Orleans.

Traffic flow along the corridor is generally heavy during the summer, with gridlock occurring in many locations. However, the level of traffic varies greatly along the corridor. Much of the Route 28 corridor is congested during summer peak hours. Some sections, such as in Hyannis and Falmouth, can experience congestion year-round. One of the most notable regional bottleneck areas on Route 28 is at the Bourne Bridge and the Bourne Rotary.

REGIONAL GOALS AND OBJECTIVES

The congestion management goals and objectives are in concert with the goals developed as part of the Cape Cod Region RTP. Specially, the following three goals are the focus for the CMP:

Goal 1: Improve Safety

• Objective: Reduce crashes on Route 28 and Route 6 for all modes of travel.

Goal 2: Increase Multi-modal Accommodations

• Objective: Increase multi-modal options for non-motorists along Route 28 and Route 6 to reduce single occupancy vehicles and reduce congestion.

Goal 3: Reduce Congestion

• Objective: Aim to reduce congestion at specific bottleneck intersections on Route 28 and Route 6 on Cape Cod.

MULTI-MODAL PERFORMANCE MEASURES

The following multi-modal performance measures have been identified as part of the congestion management process and mirror the vision that has been developed for the RTP.

Traffic Volumes

Traffic volumes are at the core of the data collection process, especially for a seasonal area such as Cape Cod. Traffic volumes are collected during the summer peak season on area roadways and intersections and reveal our most heavily traveled corridors. Traffic volume data reveals peak days and time periods, as well as where congestion points may occur. Many of the other safety performance measures listed below are dependent on traffic volumes (i.e. crash rates, volume to capacity ratio).

Volume to Capacity (v/c) Ratios

This measurement is a ratio of the traffic volume of a roadway to its capacity. Capacity is defined as the hourly rate at which vehicles can reasonably be expected to proceed through an intersection under normal conditions. A v/c ratio at or above 1.0 is an indicator that the intersection operates at or over its intended capacity.

Vehicle Occupancy

Vehicle occupancy is a measurement of how many people are riding in one vehicle at a time at a certain location. Ride share and carpool services have grown in recent years which reduces single occupant vehicles on roadways and lessens congestion.

Number of Crashes (all modes)

The total number of crashes directly relate to problem areas with safety issues based on the frequency. Crash data for the Cape Cod region is inventoried on an annual basis to identify the worst intersections in our region based on several different factors, including the total number.

Transit Ridership

The number of transit riders is regularly collected by transit agencies and indicate how well the transit route is performing from a location and service perspective.

Park n Ride Lot Usage

Park n Ride lots provide people with the opportunity to carpool or take alternative transportation, such as bus service or bicycling. Parking counts at the three (3) Park n Ride lots on Cape Cod are performed regularly throughout the course of a year. Park n Rides are used frequently by area residents to commute to Boston and/or Logan Airport.

Walkability Rating

Walkability rating refers to the sidewalk condition, connectivity and comfortability for the pedestrian. Sidewalks along the Route 6 and Route 28 corridors will be rated based on these parameters.

Transportation Demand Management

Transportation Demand Management (TDM) measures assist in reducing congestion on areas roadways by encouraging alternate modes of travel, such as carpooling, walking, bicycling, and transit service. Employers may also provide benefits to help reduce off-site vehicle trips throughout the workday. TDM measures are encouraged for private development projects on Cape Cod through Development of Regional Impact (DRI) permitting through the Cape Cod Commission.

DATA COLLECTION AND SYSTEM PERFORMANCE MONITORING

A multitude of data collection processes are performed annually for the Cape Cod region and will be analyzed as part of the CMP process. The data collected in the monitoring process will be continually compared to the measures developed to define congestion. The comparison will be used to identify congested areas and trigger an investigation into the nature of the demand problems. These demand issues are expected to include regional traffic flows, local traffic generators, geometric problems, and access problems. The annual traffic studies pursued by the Cape Cod MPO staff will be guided by the CMP and target areas for further study.

The following programs are currently underway and will continue an annual basis. These existing programs are anticipated to provide the bulk of the data for the CMP.

Traffic Volumes

The Cape Cod Commission, funded by MassDOT, has been collecting traffic data since 1984. This data includes traffic volumes on key roadway segments around Cape Cod and turning movement counts collected at key intersections. The traffic counting program is established in a systematic way to provide historic data at key locations as resources allow. Counts are also made to support traffic studies and, in areas of concern, to identify congested situations. Development of the annual traffic counting program is done in consultation with the Cape Cod Joint Transportation Committee. The principal product of this effort is the annual traffic counting report.

The traffic counting program will continue to provide data for the CMP. Examination of changes in traffic volume will be done and trends will guide further investigation of traffic problems as part of the CMP. As the traffic counting program is defined each spring, counts to investigate suspected or identified congestion areas will be included. In addition, counts will be programmed to monitor congestion in areas where CMP initiatives are in place.

Measures of seasonal as well as year-round congestion need to be developed through the traffic counting program in addition to monitoring of the travel times as well as transit usage. Development of relative conditions and trends between seasonal demand and winter demand periods must also occur to help determine appropriate strategies for addressing congestion

Recurring congestion often occurs during "rush hours" in the off-season, however, during the peak summer season volumes are found to generally be consistently high throughout the day on Route 28 and Route 6, as shown in Figure 2.



In addition, during the summer peak season there are the well-known weekend congestion periods on Route 6 and at the Cape Cod Canal bridges, most notably on Friday afternoons and Saturday mornings for visitors arriving to the Cape and on Sundays with visitors leaving the Cape. Additionally, most weekly rental homes turn over on Saturdays, so this change-over period also adds to the congestion period. Unfortunately, the traffic woes and congestion periods have become the norm to most roadway users and motorists plan accordingly around the congestion.

The traffic counting program is the base data source for developing trends in traffic growth and potential for growth in traffic congestion. The following information is from the *Cape Cod 2018 Traffic Counting Report* to be published in early 2019. The full report and access to mapped traffic counts are available at:

www.capecodcommission.org/counts

The Massachusetts Department of Transportation (MassDOT) maintains seven permanent counter locations on or near Cape Cod on some of the more heavily trafficked roads. The following table displays those locations with their ten-year growth, ten-year average annual growth, and one-year growth rate (2017-2018).

PERMANENT TRAFFIC COUNTING STATION	10 YEAR TOTAL GROWTH	10 YEAR AVERAGE ANNUAL GROWTH RATE	ONE YEAR GROWTH RATE 2017- 2018
#15: Rt 6 E of Rt 149 (Ex. 5)	-2.25	-0.23	-6.76
#20: Rt 3 N of Bourne TL	6.31	0.61	n/a
#707: Bourne Bridge	-0.55	-0.06	3.56
#708: Sagamore Bridge	8.56	0.82	-1.66
#709: Rt 28 E of Higgins Crowell	-6.85	-0.71	n/a
#7322: Rt 28 S of Otis Rotary	0.40	0.04	n/a
#7351: Rt 28 W of Old Post Rd	-3.70	-0.38	n/a

TABLE 1.Growth Rates - Permanent Counting Stations and Bridge Crossings

It is important to note that growth is based on summer traffic volumes, not off-season values.

REGION*	NUMBER OF COMPARISONS**	10-YEAR TOTAL GROWTH (%)	10-YEAR ANNUAL AVERAGE GROWTH RATE (%)	ONE-YEAR GROWTH RATE 2017-2018 (%)		
Upper Cape	168	5.59	0.54	3.85		
Mid-Cape	152	2.70	0.26	1.26		
Lower Cape	120	3.65	0.35	1.84		
Outer Cape	81	8.80	0.84	4.66		
All Roads	518	4.54	0.44	2.92		
*Upper = Bourne, Sandwich, Falmouth, Mashpee Mid = Barnstable, Yarmouth, Dennis						

TABLE 2.Cape Cod Summer Traffic Growth (2008-2018)

Lower = Harwich, Chatham, Brewster, Orleans | Outer = Eastham, Wellfleet, Truro, Provincetown

** Corresponds to ten-year analysis only

The Cape Cod Center for Sustainability traffic congestion indicator is based on average annual daily bridge crossings over the Sagamore and Bourne bridges. While there are many possible indicators of congestion, bridge traffic is easy to measure, provides data on long-term trends, and has significant implications for traffic Cape wide, as many who bring their cars across the bridge use them for virtually all local or regional trips.

Bridge crossings have been rising steadily for most of the past 32 years. Traffic data have been collected at permanent count stations at both bridges since 1972. Carrying roughly twice as many vehicles today as in 1972, the story of traffic over the bridges is the story of traffic on Cape Cod.

As shown in the figure below, both summer and annual average daily traffic (ADT) over the bridges showed an overall upward trend from the early 1970's through the early 2000's, reaching a maximum in 2002. Traffic volumes, on average, dropped from 2002 to 2007 before trending slightly upward in recent years. This figure has not been updated since 2012 because traffic counters have not been able to supply consistent data throughout the year. Seasonal traffic trends over the bridges have also changed considerably over the years. Since 1972, traffic has tended to be more spread out over 12 months as opposed to concentrated during the summer months. As shown in the following figure this trend, along with the overall increase in traffic, has resulted in 2011 traffic volumes throughout almost the entire year in excess of 1972 traffic volumes in the summer. There were a variety of ten months of available data for 2018, these counts are displayed below to show the traffic volume trends along with 2011 for comparison.



FIGURE 3. Combined Average Daily Traffic over Bourne and Sagamore Bridges

The following figure compares the total monthly vehicle traffic in both directions on the Bourne and Sagamore Bridges in 2018. The Sagamore Bridge was consistently crossed more each month. In the summer months, both bridges received increased traffic and the difference in usage between the bridges increased. Incomplete data for northbound traffic on the Bourne Bridge occurred in March while incomplete data for the northbound traffic on the Sagamore Bridge occurred in July.



FIGURE 4. Historic Monthly ADT Changes at the Cape Cod Canal Bridges

The different usage of the two bridges shows a similar trend when examining directional volumes, as shown by the following figure. More vehicles cross the Sagamore Bridge than the Bourne Bridge each month, except in April 2018 where a major construction project was performed on the Sagamore Bridge and reduced travel lanes to one per direction. The access to and from the Canal roadways to the bridges varies in each crossing direction.





A MassDOT remote counting station located on Route 28 in the town of Barnstable shows useful insight into traffic trends on Route 28 during the summer and in the off-season. The figure below shows the hourly volumes during a typical summer day and an off-season day at the location of Route 28 west of Putnam Avenue. The data shows that traffic volumes on Route 28 do not have a distinct peak hour, as you would typically see on a typical arterial roadway during commuter peak hours. Instead, traffic peaks in the morning and traffic volumes remain steady throughout the day until the typical evening peak period.



FIGURE 6. Hourly Summer Data at MassDOT Permanent Counting Station on Route 28

The graph below shows the monthly volumes that were counted by Cape Cod Commission permanent counting stations in 2018. The intersection at Route 28 and Lumbert Mill Road in Barnstable showed the highest volumes of the three locations in each month. The location in Harwich shows traffic volumes closer to the amount shown Route 28 and Lumbert Mill Road in the July and August. The intersection in Harwich, Route 124 at Queen Anne Road showed a larger increase in volume during the summer months. The intersection at Route 28 and Lumbert Mill Road showed more consistent volumes year-round.





Volume to Capacity Ratios

The thresholds for the Level of Service (LOS) and volume to capacity ratios are shown in the following table below.

SYMBOL	V/C RATIO THRESHOLD	LEVEL OF SERVICE (LOS)
٠	0.8	C or Better
•	0.9	D
•	1.0	E
•	>1.0	F

TABLE 3. Volume to Capacity Thresholds

LOS and v/c calculations were performed as part of the CMP for locations on Route 28 and Route 6 that were recently counted during the 2018 summer peak season. The traffic volumes used represent a consistent summer weekday 4-5 p.m. peak hour on a roadway section.

Roadway LOS only shows part of the congestion picture. In many cases traffic congestion bottlenecks occur at intersections. Intersection analyses are more complicated and performed on a case-by-case basis. Such locations are often identified through public input and consultations with local traffic officials such as CCJTC members.

The following table summarizes congested roadway locations along Route 28 and Route 6 that are rated LOS E/F.

TOWN	ROUTE	ORIENT	ROAD	LOS	VC_Ratio
Bourne	Rt 6 Scenic	under	Bourne Bridge	E/F	0.89
Bourne	Rt 6	0	Bour/Sand TL	E/F	1.14
Sandwich	Rt 6	Btwn	Exits 2 & 3	E/F	1.00
Sandwich	Rt 6	Btwn	Exits 3&4	E/F	0.92
Sandwich	Rt 6	@	Sand/Barn TL	E/F	0.89
Falmouth	Rt 28	S of	Braeside Rd	E/F	1.32
Falmouth	Rt 28	W of	Davisville Rd	E/F	1.15
Falmouth	Rt 28	@	Falm/Mash TL	E/F	1.16
Falmouth	Rt 28	W of	Fresh Pond Rd	E/F	1.51
Falmouth	Rt 28	N of	Jones Rd (W end)	E/F	1.51
Falmouth	Rt 28	E of	King St	E/F	1.12
Falmouth	Rt 28	N of	Lakeview Av	E/F	1.02
Falmouth	Rt 28	E of	Maravista Ext	E/F	1.10
Falmouth	Rt 28	W of	Post Office Rd	E/F	1.20
Falmouth	Rt 28	E of	Sandwich Rd	E/F	0.95
Falmouth	Rt 28	W of	Shore Rd	E/F	0.79
Falmouth	Rt 28	E of	Spring Bars Rd	E/F	1.08
Mashpee	Rt 28	E of	Donnas Ln	E/F	1.48
Mashpee	Rt 28	Eof	Industrial Way	E/F	1.32
Mashpee	Rt 28	@	Mash/Barn TL	E/F	1.56
Mashpee	Rt 28	E of	Mashpee Rotary	E/F	1.63
Mashpee	Rt 28	W of	Mashpee Rotary	E/F	1.16
Mashpee	Rt 28	W of	Orchard Rd & Ashers Path	E/F	1.71
Barnstable	Rt 28	E of	Airport Rotary	E/F	1.80
Barnstable	Rt 28	W of	Anchor Ln	E/F	1.47
Barnstable	Rt 28	@	Barn/Yarm TL	E/F	1.22
Barnstable	Rt 28	E of	Barnstable Intermediate E Entrance	E/F	1.34

TABLE 4.2018 Congested Locations on Route 28 and Route 6

TOWN	ROUTE	ORIENT	ROAD	LOS	VC_Ratio
Barnstable	Rt 28	W of	Barnstable Intermediate E Entrance	E/F	1.27
Barnstable	Rt 28	W of	Bearses Way	E/F	1.33
Barnstable	Rt 28	Eof	Bearses Way	E/F	0.90
Barnstable	Rt 28	W of	Lumbert Mill Rd	E/F	1.40
Barnstable	Rt 28	W of	Old Stage Rd	E/F	2.02
Barnstable	Rt 28	W of	Pitchers Way	E/F	1.35
Barnstable	Rt 28	Eof	Putnam Av	E/F	2.36
Barnstable	Rt 28	W of	Putnam Av	E/F	1.68
Barnstable	Rt 28	W of	Rt 132	E/F	1.19
Barnstable	Rt 28	W of	Santuit-Newtown Rd	E/F	1.44
Barnstable	Rt 28	W of	West Main St	E/F	1.63
Barnstable	Rt 28	W of	Yarmouth Rd	E/F	1.91
Barnstable	Rt 6	@	Barn/Yarm TL	E/F	0.84
Yarmouth	Rt 28	Eof	Baxter Ave	E/F	1.85
Yarmouth	Rt 28	Eof	East Main St (Hyannis)	E/F	2.09
Yarmouth	Rt 28	W of	Forest Rd	E/F	1.01
Yarmouth	Rt 28	W of	Long Pond Dr	E/F	0.99
Yarmouth	Rt 28	E of	North Main St	E/F	1.10
Yarmouth	Rt 28	W of	Old Main St (S Yarmouth)	E/F	1.19
Yarmouth	Rt 28	E of	Seaview Av	E/F	1.20
Yarmouth	Rt 28	E of	South Sea Av	E/F	1.10
Yarmouth	Rt 28	W of	Town Brook Rd	E/F	1.59
Yarmouth	Rt 28	W of	West Yarmouth Rd	E/F	1.28
Yarmouth	Rt 28	E of	Wood Rd	E/F	1.20
Yarmouth	Rt 6	Btwn	Exits 7 & 8	E/F	0.92
Yarmouth	Rt 6	@	Yarm/Denn TL	E/F	0.97
Dennis	Rt 28	@	Denn/Harw TL	E/F	0.77
Dennis	Rt 28	Eof	School St	E/F	0.97
Dennis	Rt 28	W of	School St	E/F	1.15
Dennis	Rt 28	W of	Sea St	E/F	0.78

TOWN	ROUTE	ROUTE ORIENT ROAD		LOS	VC_Ratio
Dennis	Rt 28	W of	Woodbine Dr	Woodbine Dr E/F	
Dennis	Rt 6	0	Denn/Harw TL	Denn/Harw TL E/F	
Harwich	Rt 28	W of	Bank St	E/F	0.87
Harwich	Rt 28	Eof	Belmont Rd	E/F	0.90
Harwich	Rt 28	W of	Belmont Rd	E/F	0.77
Harwich	Rt 28	@	Harw/Chat TL (N end)	E/F	0.78
Harwich	Rt 28	@	Harw/Chat TL (W end)	E/F	0.74
Harwich	Rt 28	Eof	Sisson Rd (Rt 39)	E/F	0.73
Harwich	Rt 28	W of	Sisson Rd (Rt 39)	E/F	0.99
Harwich	Rt 6	Btwn	Exits 10 & 11	E/F	1.17
Brewster	Rt 6	@	Brew/Orle TL	E/F	0.84
Chatham	Rt 28	Eof	Barn Hill Rd	E/F	1.15
Chatham	Rt 28	N of	Crowell Rd (N end)	E/F	0.81
Chatham	Rt 28	W of	Crowell Rd (S end)	E/F	1.21
Chatham	Rt 28	Eof	Crowell Rd (S end)	E/F	0.85
Chatham	Rt 28	Eof	Heritage Ln E/F		1.23
Chatham	Rt 28	Eof	Rt 137	E/F	1.03
Chatham	Rt 28	W of	Stage Harbor Rd	E/F	0.82
Chatham	Rt 28	N of	Stoney Hill Rd	E/F	0.67
Orleans	Rt 28	S of	Main St	E/F	0.79
Orleans	Rt 28	N of	Rt 39	E/F	1.06
Orleans	Rt 28	S of	Rt 6A	E/F	0.88
Orleans	Rt 6	W of	Orle/East Rotary	E/F	0.70
Eastham	Rt 6	@	East/Well TL	E/F	1.51
Eastham	Rt 6	S of	Hemenway Rd	E/F	0.83
Eastham	Rt 6	N of	Orle/East Rot	E/F	0.89
Wellfleet	Rt 6	S of	Lecount Hollow Rd	E/F	1.61
Wellfleet	Rt 6	S of	Long Pond Rd	E/F	1.37
Wellfleet	Rt 6	S of	Main St	E/F	1.54
Wellfleet	Rt 6	N of	Springbrook Rd	E/F	1.22

TOWN	ROUTE	ORIENT	ROAD	LOS	VC_Ratio
Wellfleet	Rt 6	@	Well/Trur TL	E/F	1.13
Wellfleet	Rt 6	N of	Wellfleet Drive In	E/F	1.55
Truro	Rt 6	S of	Castle Rd	E/F	1.20
Truro	Rt 6	S of	Rt 6A	E/F	1.37
Truro	Rt 6	@	Trur/Prov TL	E/F	0.59
Truro	Rt 6	N of	Truro Central School	E/F	1.37
Truro	Rt 6	S of	Union Field Rd	E/F	1.13

As seen in the above summary table, the majority of Route 28 in the Upper Cape and Mid-Cape sections (Falmouth to Dennis) has a v/c ratio over 1.0 and indicates a congested corridor in the summer. Route 6 is also identified as having a v/c ratio of over 1.0 in the area near the Cape Cod Canal bridges in the towns of Bourne and Sandwich and also in the Outer Cape areas of Wellfleet and Truro, where Route 6 is a two-lane undivided roadway.

In addition, MassDOT has recently completed released a draft report of their Cape Cod Canal Transportation Study. The study analyzed the major intersections and interchanges in the vicinity of the Cape Cod Canal and the Sagamore and Bourne Bridges, which are sources of reoccurring congestion on a year-round basis. As part of the MassDOT study, a set of preferred alternatives have been identified to significantly reduce congestion and improve the reliability across the Canal. The following locations have been identified as bottleneck locations for improvement:

- Belmont Circle
- Bourne Rotary Interchange
- Route 6 Westbound at Exit 1C
- Bourne and Sagamore Bridge Approaches

Vehicle Occupancy

Vehicle occupancy counts are conducted at key locations in the CMP. The following table presents data from recent occupancy counts performed in 2016-2018 along Route 6 and Route 28. A more robust occupancy counting program is planned in the future to build out this dataset.

TABLE 5.

Vehicle Occupancy Data

			RIGHT LANE SAMPLE	RIGHT LANE	LEFT LANE SAMPLE	LEFT LANE
TOWN	LOCATION	DATE	VOLUME	OCCUPANCY	VOLUME	OCCUPANCY
Bourne	Rt 6 SB S of Sagamore Br	06/01/2016	696	1.29	615	1.26
Bourne	Rt 6 NB S of Sagamore Br	06/07/2017	521	1.37	476	1.36
Bourne	Rt 28 SB N of Bourne Br	06/01/2016	327	1.34	324	1.24
Bourne	Rt 6 NB S of Sagamore Br	06/01/2016	1309	1.32	1104	1.26
Bourne	Rt 28 NB N of Bourne Br	06/01/2017	790	1.31	586	1.16
Bourne	Rt 6 SB S of Sagamore Br	08/24/2016	333	1.54	328	1.49
Bourne	Rt 28 SB N of Bourne Br	08/25/2016	636	1.62	602	1.49
Bourne	Rt 6 NB S of Sagamore Br	08/25/2016	418	1.42	415	1.36
Bourne	Rt 28 NB N of Bourne Br	08/25/2016	1090	1.52	640	1.40
Yarmouth	Rt 6 EB @ Rest Area	06/06/2017	663	1.39	363	1.25
Yarmouth	Rt 6 WB @ Rest Area (Bass River)	06/06/2017	551	1.29	710	1.28
Bourne	Rt 6 SB S of Sagamore Br	06/07/2017	721	1.25	637	1.27
Bourne	Rt 28 NB N of Bourne Br	08/25/2017	534	1.51	168	1.35
Bourne	Rt 6 SB S of Sagamore Br	08/25/2017	298	1.37	255	1.28
Bourne	Rt 6 NB S of Sagamore Br	08/25/2017	575	1.53	272	1.51
Bourne	Rt 28 SB N of Bourne Br	08/25/2017	218	1.17	306	1.21

			RIGHT LANE SAMPLE	RIGHT LANE	LEFT LANE SAMPLE	LEFT LANE
TOWN	LOCATION	DATE	VOLUME	OCCUPANCY	VOLUME	OCCUPANCY
Mashpee	Rt 28 WB W of Steeple St	10/11/2017	237	1.27	NA	NA
Mashpee	Rt 28 EB W of Steeple St	10/11/2017	440	1.27	NA	NA
Yarmouth	Rt 6 EB @ Rest Area	06/01/2018	350	1.42	271	1.49
Barnstabl e	Rt 28 EB E of Old Stage Rd	07/26/2018	453	1.43	363	1.47

Number of crashes (all modes)

The Cape Cod Commission has recently identified the region's Top 50 high crash locations. The data used for this endeavor, including crashes that occurred from 2012-2016, are the most recent available from the Massachusetts Department and Transportation (MassDOT) and local police departments from Barnstable County. Through the analysis of our data, a series of top crash location lists have been generated, including crash rank, crash rate and Equivalent Property Damage Only (EPDO). A future task will be to identify the top pedestrian and bicycle crash areas. The following table summarizes the top crash locations by rank that are located on either Route 28 or Route 6 within Barnstable County.

Rank			Crash		Crash	EPDO
Crashes	Town	Location	Count	EPDO	Rate	Rate
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
6	Falmouth	Route 28 (East Falmouth Highway) at Old Meeting House Road/Davisville Road	104	216	3.7	7.6
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
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
18	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	52	165	1.5	4.6
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
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
31	Falmouth	Route 28 (Main Street) at Scranton Avenue	43	79	1.8	3.4
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
40	Yarmouth	Route 28 at Higgins Crowell Road/Berry Avenue	38	82	1.3	2.8
44	Wellfleet	Route 6 at Main Street	38	66	1.6	2.7
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
50	Barnstable	Route 28 (Falmouth Road) at Bell Tower Mall	35	75	0.7	1.4

TABLE 6.Top Crash Locations (2012-2016)

As seen in the above table out of the top 50 locations, approximately half of those crashes occurred on Route 28. It should be noted that this top crash analysis is limited to intersection specific crashes and does not include the limited-access highway portion of Route 6.

Transit Usage

Ridership data is collected routinely by the mobile data computers linked to the fare boxes on the entire fixed route CCRTA system. The ridership on the demand response services (DART) is also recorded by the CCRTA. This data will be studied by the Cape Cod Commission in the future and development of detailed transit use and patterns of travel will be incorporated into the CMP.

The Sealine and H2O service routes generally follow the Route 28 corridor: Whereas the Flex service route generally follows the Route 6 corridor on the Outer Cape. A summary of transit usage from 2018 by service route is summarized in Table 7.

SERVICE ROUTES	FY18	FY17
DART (Demand Response)	169,015	177,749
SeaLine	165,746	161,095
WHOOSH	14,073	17,753
Villager	45,524	48,077
Hyannis Loop	23,309	16,677
H20 Line	151,673	162,416
Provincetown/Truro Shuttle	82,933	87,726
Flex	87,346	89,255
Hyannis Shuttle	8,651	3,367
Bourne Line	10,928	13,457
Sandwich Line	23,961	24,944
CapeFLYER (Rail)	13,781	13,555

TABLE 7.CCRTA Ridership Data (2018)

As seen in the above table, excluding the DART service, the Sealine, H20 and the Flex service routes are the busiest transits lines and are serviced on the congested corridors of Route 28 and Route 6. Improvements focused on the Route 28 and Route 6 corridors to reduce congestion and improve pedestrian connections would help continue to grow transit ridership for these routes.

Park-and-Ride Usage

Data collected at the three Park-and-Ride locations are organized in Figures 8, 10 and 12 to show the capacity and average occupancy for each of the lots from 2014-2018. In addition, a recent aerial image from Google Earth on October 5, 2018 is included as figures below for each lot and shows the parking lots at the Barnstable and Sagamore Park n Ride facilities nearing capacity. The data was collected in various samples during the summer months and shows inconsistent trends when comparing the data.

The results show that the Barnstable lot is regularly nearing capacity. During two observations (in May 2017 and December 2018), the lot was observed to be over capacity with illegal vehicles parked. The Sagamore Lot has not been observed to exceed capacity in the last 15 years. The average occupancy does show that the Harwich lot averages fewer than 50 percent capacity for each year despite the removal of commuter bus service.



FIGURE 8. Barnstable Park n Ride Lot On Route 132



FIGURE 9. Barnstable Park n Ride usage



FIGURE 10. Sagamore Park n Ride Lot at the Sagamore Bridge



FIGURE 11. Sagamore Park n Ride Usage



FIGURE 12. Harwich Park n Ride Lot On Route 124





Walkability

To date, several healthy transportation studies have been performed related to pedestrian connectivity. The following figure summarizes the existing sidewalk network on Cape Cod. Based on this figure, approximately 47% of the Route 28 corridor does not currently have a sidewalk on it. Additional inventory efforts related to walkability on Route 28 and Route 6 will be performed as part of data collection efforts in the Summer 2019. Additionally, a future study will help to identify gaps in the pedestrian network at high ridership stops that do not contain amenities consistent with the transit stop buildout.



FIGURE 14. Sidewalk Network

Transportation Demand Management

Transportation Demand Management (TDM) measures are encouraged for private development projects on Cape Cod through a Development of Regional Impact (DRI) permit issued by the Cape Cod Commission. The current Regional Policy Plan (RPP) encourages all DRI projects at a minimum to implement best practices for TDM such as, carpool parking spaces, bicycle storage or posting of transit schedules. Larger sites are recommended to implement a site-specific TDM plan that could include a trip reduction monitoring program, subsidized transit passes or an on-site transportation. In addition, the RPP encourages growth to be focused in centers of activity and areas supported by adequate infrastructure to promote a multi-modal transportation system.

ANALYZE PROBLEMS AND NEEDS

Based on our data collection efforts previously summarized in the last section and based on previous and on-going studies that have been performed as part of the UPWP, the following problem areas have been identified for the Route 28 and Route 6 corridors:

- Park n Ride lot capacity exceeded (Barnstable)
- Cape Cod Canal Area bottleneck locations
- Route 28 and Route 6 bottleneck intersections

- Route 28 high crash locations
- Pedestrian gaps on Route 28 and Route 6 in the Outer Cape
- Bicycle multi-use path connectivity
- Increased transit service and expansion routes

IDENTIFICATION AND ASSESSMENT OF STRATEGIES

As part of the development of future regional documents such as the RTP and TIP, the following CMP strategies should be considered for the basis of future studies or have funding dedicated to address CMP strategies and problem areas. These seven strategies will aim to reduce congestion, improve safety and increase multi-modal opportunities.

Congestion Management Strategies

- Management and expansion of park n rides
 - Identify areas for expansion at existing park n ride lots
 - Recommend management upgrades for park n rides (fee structure)
 - Implement Canal study recommendation for a new Park n Ride lot in Sandwich
- Geometric improvements for certain bottleneck intersections
 - Improvements to allow for additional capacity or safety enhancements to reduce crashes and congestion in the Canal Area and other key location on the CMP network. Example may be additional turn lanes.
- Bicycle and pedestrian improvements
 - Improvements to pedestrian and bicycle infrastructure can help to encourage a higher proportion of people to walk or bike for their transportation needs, thus reducing automobile congestion.
 - Implement Vision 88
 - Address missing gaps in sidewalk network
 - ADA ramps/transition plans
 - Safety enhancements (RRFBs, crosswalk striping signage)
 - Promote multi-use paths
- Optimization of signal timings
 - Modify signal timings to allow for optimal flow through congested intersections.
 Recommend additional timing plans for some seasonal congested intersections.
 - Recommend adaptive signal technology.
- Increased transit service (including rail and inter-city bus)
 - Promote for additional transit services including year-round commuter rail and bus expansion for routes and service times. Note: CCRTA recently modified theSealine

route to serve Falmouth Hospital and Falmouth District Court, which are major destinations that were previously unserved.

- Leverage transit technology
 - Recommend potential transit signal technological improvements as part of intersection redesign projects on main transit corridors to all transit vehicles for an improved performance. Examples could be transit signal priority or queue jump or on-time performance information report to customers via mobile devices.
- Access Management
 - Promote smart development with appropriate access management to minimize congestion points and improve safety.
 - Promote TDM measures to offset single occupancy vehicles to sites to reduce congestion.

PROGRAM AND IMPLEMENTATION STRATEGIES

The results of the CMP will include the generation of studies to address issues that exceed the criteria developed to define transportation congestion for the region. These studies will produce recommendations that will be included in the RTP and TIP processes to be considered for construction or implementation. The table below summaries which improvement strategies could apply to the study area roadways.

	CORRIDOR		
IMPROVEMENT STRATEGIES	ROUTE 6 (MID-CAPE HIGHWAY) & CANAL AREA	ROUTE 6 (OUTER CAPE)	ROUTE 28
Management & Expansion of Park n Ride	Х		
Geometric Improvements	Х	Х	Х
Bicycle & Pedestrian	Х	Х	Х
Signal Timing Optimization	Х	Х	Х
Increased Transit Service	Х	Х	Х
Leverage Transit Technology	Х	Х	Х
Access Management		Х	X

TABLE 8.	Potential Improvement Strategies for Congested Corridors on C	Cape Cod
	· · · · · · · · · · · · · · · · · · ·	

Recommendations for location specific actions/studies

Recommendations to the MPO to address issues that exceed the criteria developed to define transportation congestion for the region will generally come from studies conducted by the Cape Cod Commission transportation staff. Recommendations may also be developed by the towns and the CCRTA. All recommended projects and strategies will be evaluated by the Commission and the Cape Cod Joint Transportation Committee using the MassDOT evaluation criteria and with the RTP goals. Based on these evaluations, the CMP projects will be considered by the MPO for inclusion in the RTP and compete for funding within the TIP.

Recommendations for regional actions/studies

Some congestion problems will need to be addressed on a corridor-wide or system basis or require significant investments, such as the Canal Area improvements. Studies or remedial actions will be recommended to the MPO for their consideration and potential inclusion in the TIP or the UPWP. Projects with regional significance may become an initiative of the Statewide Transportation Program. These proposed projects may require a more extensive evaluation with regard to conformity with the Massachusetts State Implementation Plan (SIP). These projects may also become Transportation Control Measures (TCMs) and included as such in the SIP submitted to EPA.

EVALUATION OF STRATEGY EFFECTIVENESS

The CMP is an ongoing program that documents the region's mobility concerns. The CMP contains the most recent performance monitoring information for the regional transportation system. The information and general analysis of the system, using the criteria defined in the CMP and RTP processes, will provide the basis for the Cape Cod Commission Transportation staff and the Cape Cod Joint Transportation Committee to make recommendations. These recommendations will be made to the Cape Cod MPO as congestion reducing and mobility enhancing actions to be considered in the MPO planning and programming processes. The following evaluation will be used as part of the CMP to evaluate effectiveness.

• The UPWP performance measure task will be expanded to include additional analysis to support evaluation of multi-modal measures in the CMP.

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