CAPE COD COMMISSION

2024 REGIONAL TRANSPORTATION PLAN

Technical Appendix G: Congestion Management Plan

FINAL JULY 2023

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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 2010 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).

Since the last CMP there has major changes to the federal legislation that contains requirements for transportation plans, programs, and projects. At the time of the previous CMP, the current legislation was *Moving Ahead for Progress in the 21st Century* (MAP-21) and the outgoing legislation was the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU) as well as the *Clean Air Act Amendments of 1990*. Since then, MAP-21 has been replaced by the *Fixing America's Surface Transportation Act* (FAST Act) which has since been replaced with current legislation of the *Bipartisan Infrastructure Law* (BIL).

Significant Legislative Elements

The CMP shall be developed, established, and implemented as part of the metropolitan planning process in accordance with 23 CFR 450.322(d). The statute includes the following requirements:

1. 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.

6. 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.

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 more than 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. Recurring congestion 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
2. Non-recurring congestion caused from unforeseen incidents (road accidents, weather events, construction work zones) which affect the driver behavior to a considerable extent.

Regarding 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 that are subject to frequent maintenance activities.
- 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.
- The CCRTA is piloting a service that provides an app based, on-demand service called SmartDART that is a door-to-door, ride-hail service using the SmartDART App which is similar to Uber and Lyft. This service is currently only available in Yarmouth and Barnstable.
- 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 Cape Cod region has GO Time Intelligent Transportation signs which are able to display average travel times to locations by anonymously tracking Bluetooth technology carried by drivers, measuring speeds and travel times. These intelligent transportation systems are helpful in reducing the amount of congestion on major routes. Motorists can see the current travel times to popular destinations from their current position allowing for them to seek alternative routes if need be.
- The region has an established network of multi-use paths and rail trails, including the Cape Cod Rail Trail, the Old Colony Rail Trail, Cape Cod Canal Path, and the Shining Sea Bikeway with several expansion routes planned. 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 is different from many of the regions in Massachusetts and across the nation. The Cape Cod 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 over 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 many 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. Also included in the network are Scenic Highway, Sandwich Road and the sections of Route 25 and Route 3 that are in Barnstable County. These roadways are important to the Network as traffic that moves through the region to Route 28 and Route 6 utilize these roadways.

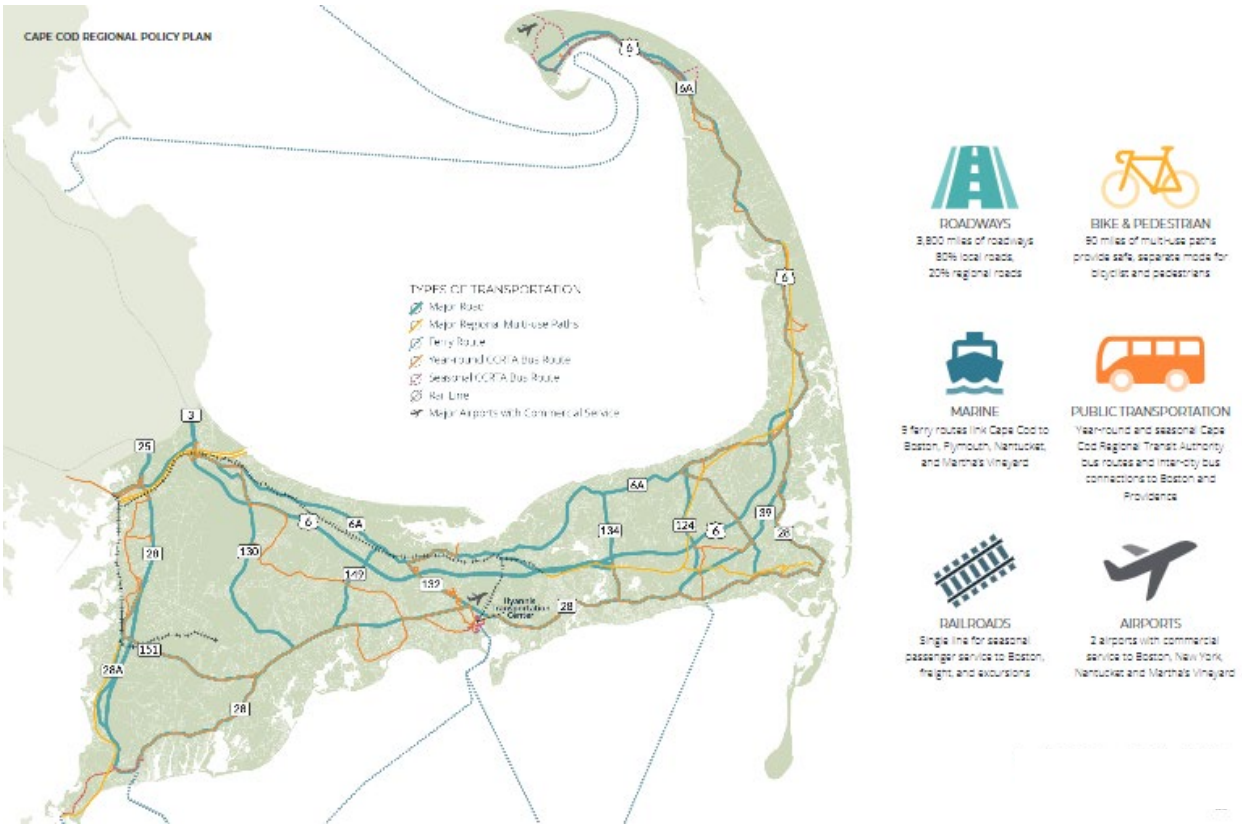

FIGURE 1. Cape Cod Regional Roadways

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. MassDOT has installed "Go Time Intelligent Transportation" signs on Route 6, which provide 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. For the purposes of the CMP, there are two primary sections to Route 28, which are identifiable by their roadway characteristics. Both sections are under the jurisdiction of MassDOT. Most notably is the 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 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 other notable section is the urban major arterial section of Route 28 which spans from Falmouth to Orleans. This section has varying travel speeds and changing 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).

Travel Time Reliability and Planning Time Index

On Cape Cod, like other high traffic regions, travel times can vary greatly from day to day and therefore it is useful to have a measure of expected total travel times. To measure Travel Time Reliability (TTR), Planning Time Index (PTI) can be utilized to calculate the extent of this unexpected delay. The PTI represents the total travel time that should be planned for a trip when an adequate buffer time is included. TTR is significant to many transportation system users as it can better quantify the benefits of traffic management and operation activities than simple averages.

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.

RITIS Bottleneck Ranking Data

Regional Integrated Transportation Information System (RITIS) is a data-driven platform for transportation analysis, monitoring, and data visualization. MassDOT is using RITIS data for tracking congestion patterns and bottlenecks on roadways. This system is useful to the Cape Cod Commission for seeing real-time and past roadway congestion events as well as to develop a bottleneck ranking list for the region.

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 and Ride Lot Usage

Park and Ride lots provide people with the opportunity to carpool or take alternative transportation, such as bus service or bicycling. Parking counts at the three Park and Ride lots on Cape Cod are performed regularly throughout the course of a year. Park and 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.

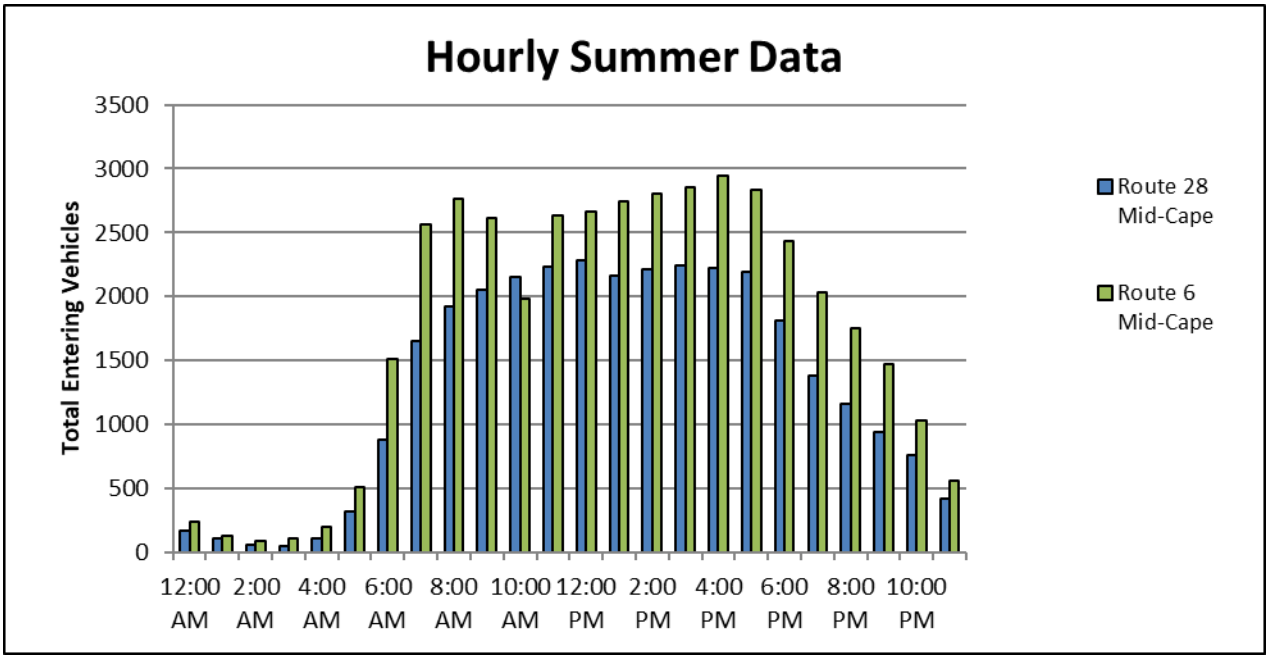

FIGURE 2. Route 6 and Route 28 Hourly summer volume data

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 2019 Traffic Counting Report* published in September 2022. 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 (2018-2019).

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

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)	-4.30	-0.44	n/a
#20: Rt 3 N of Bourne TL	6.26	0.60	0.63
#707: Bourne Bridge	-2.32	-0.24	-0.12
#708: Sagamore Bridge	12.11	1.14	9.03
#709: Rt 28 E of Higgins Crowell	-7.44	-0.77	n/a
#7322: Rt 28 S of Otis Rotary	6.44	0.62	n/a
#7351: Rt 28 W of Old Post Rd	0.25	0.02	7.89

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

MassDOT's permanent counting stations can be used to show a trend in road usage over time. Table 1 shows that, traffic volumes on Route 6 and Route 28 have decreased over the last ten years. Route 3 north of the Bourne/Plymouth town line has seen 6.26% growth since 2009. The Sagamore Bridge has seen 12.11% growth since 2009, while the Bourne Bridge has seen a negative growth of -2.32%. Due to equipment problems, not all stations were available for analysis. A new MassDOT counting station on Route 28 south of the Otis Rotary in Bourne became operational at the beginning of 2015 and is now included in growth calculations.

TABLE 2. Cape Cod Summer Traffic Growth (2009-2019)

REGION*	NUMBER OF COMPARISONS**	10-YEAR TOTAL GROWTH (%)	10-YEAR ANNUAL AVERAGE GROWTH RATE (%)	ONE-YEAR GROWTH RATE 2018-2019 (%)
Upper Cape	160	6.10	0.59	1.29
Mid-Cape	151	1.85	0.18	3.00
Lower Cape	108	2.42	0.23	4.07
Outer Cape	79	6.15	0.59	-4.52
All Roads	**498**	**3.99**	**0.39**	**2.15**

*Upper = Bourne, Sandwich, Falmouth, Mashpee | Mid = Barnstable, Yarmouth, Dennis
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 50 years. Traffic data has 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. Traffic volumes, on average, dropped from 2002 to 2007 before trending slightly upward in recent years. This figure is missing date from 2013 to 2019 due to traffic counters have not able to supply consistent data throughout those years. Since the COVID-19 Pandemic in 2020, there was a major dip in ADT over the Bourne and Sagamore Bridges as most of the country experienced lockdowns and or were placed in quarantine. In 2020, the ADT over the bridges was close to the same amount as in 1990 and 1991. Since the initial start of the pandemic, the ADT in this location has see a new maximum, in 2021, and has been leveling out to the same ADT range as the early 2000s and the 2010s. As ADT data becomes available for 2023, it will be interesting to see if there is a downward or upward trend developing after such massive extremes.

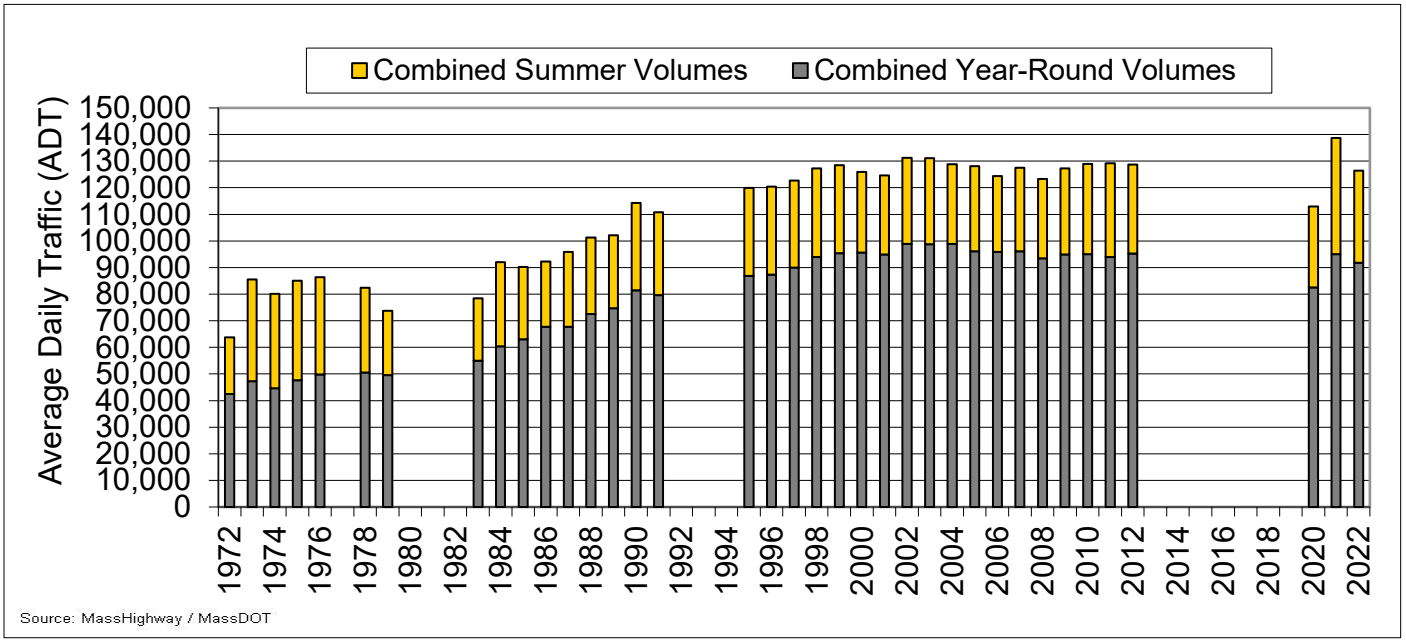

FIGURE 3. Combined Average Daily Traffic over Bourne and Sagamore Bridges

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. In the following figure this trend, ADT from 1972, 2011, 2018 and 2022 can be seen. In the past decade, ADT has been nearly double for every month when compared to 1972. 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. The 2022 ADT for each month is also displayed, as that is the latest yearly ADT data available for contrast.

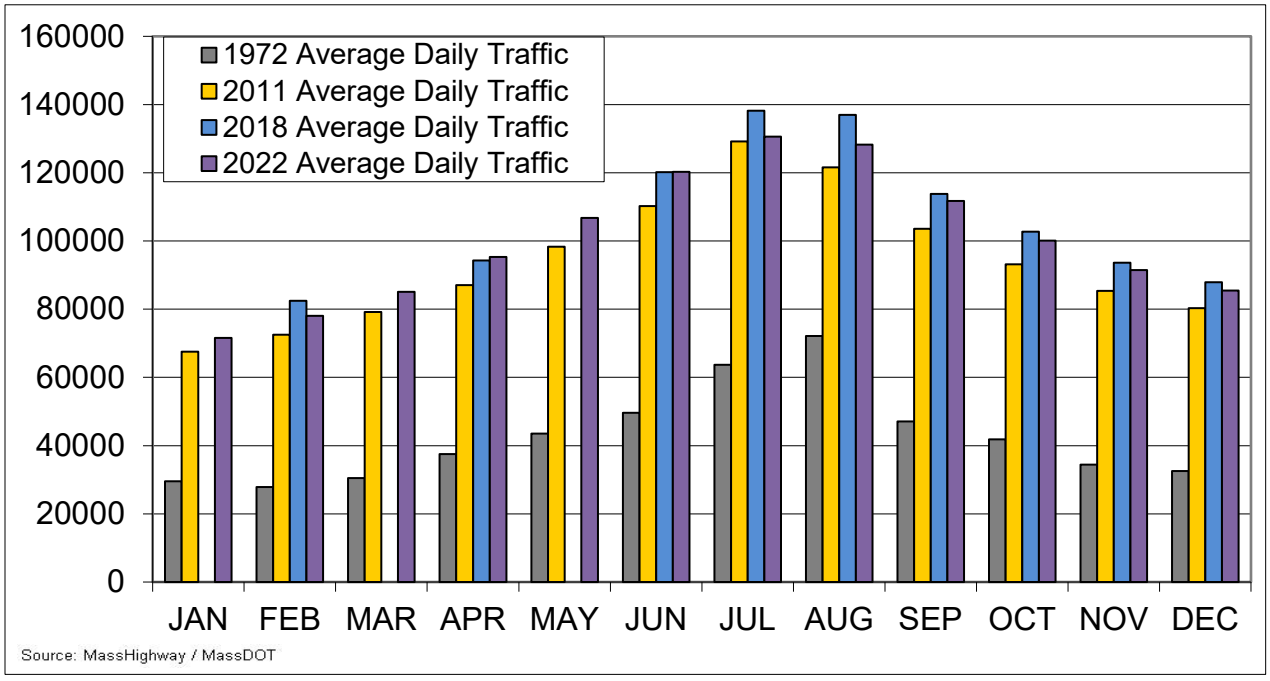

FIGURE 4. Historic Monthly ADT Changes at the Cape Cod Canal Bridges

The following figure compares the monthly directional ADT in both directions on the Bourne and Sagamore Bridges 2022. 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.

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. The larger number of users on the Sagamore could indicate that drivers tend to favor this bridge over the Bourne Bridge as a way of traveling to and from their Cape Cod destinations. The access to and from the Canal roadways to the bridges varies in each crossing direction.

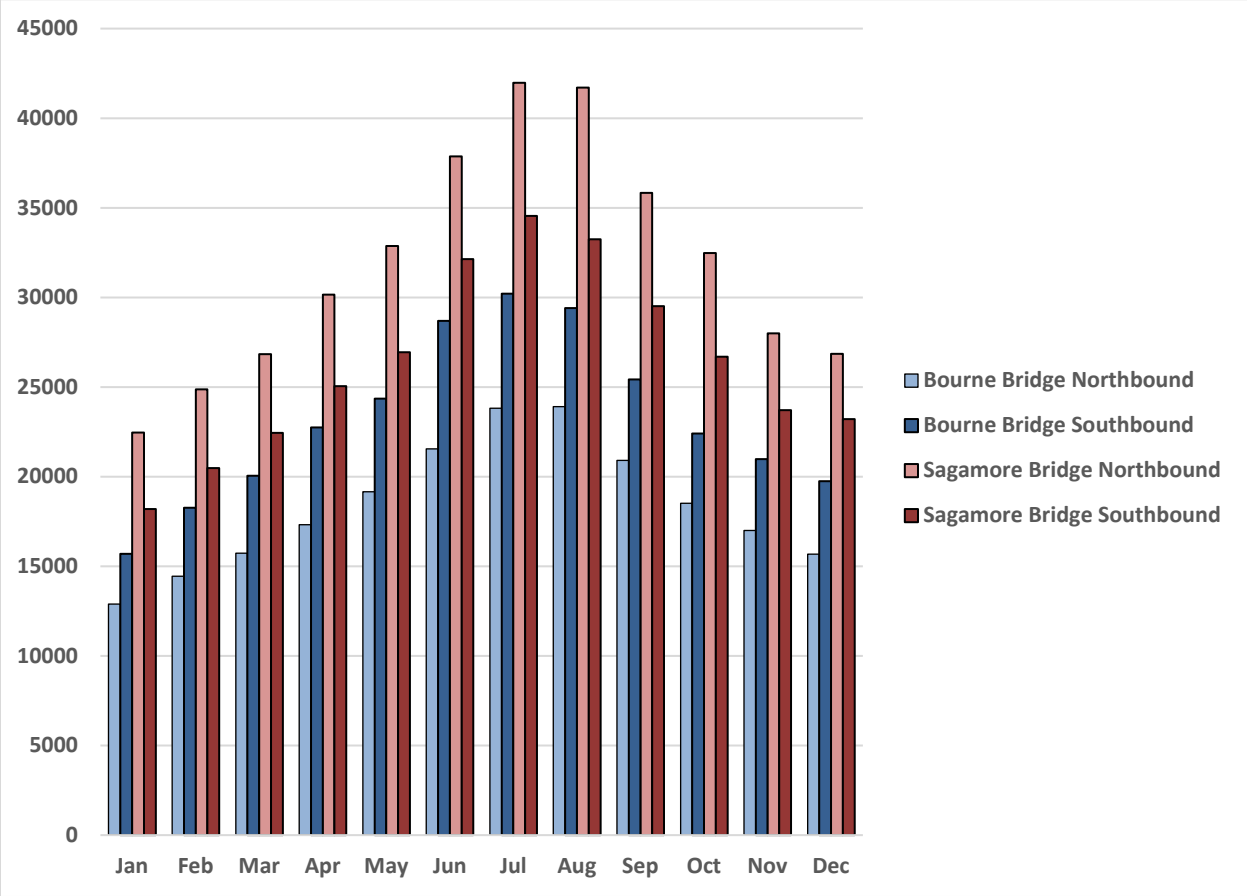

FIGURE 5. 2022 Monthly Directional Average Daily Traffic at the Cape Cod Canal Bridges

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 Old Post Road. 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.

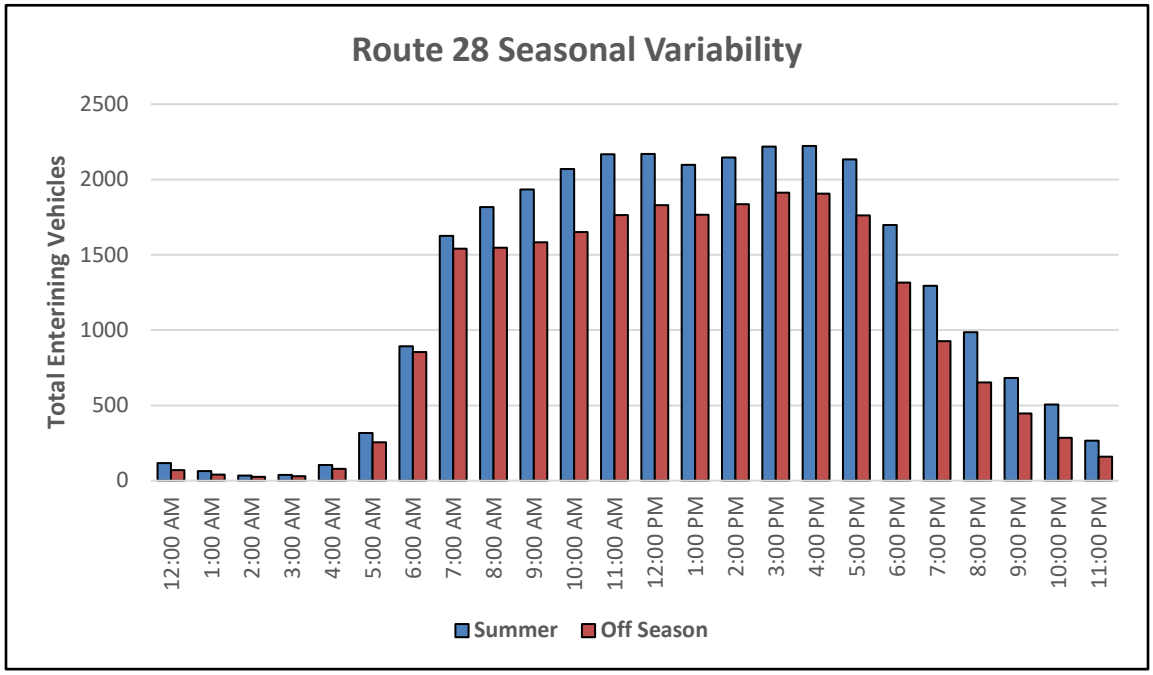

FIGURE 6. Hourly Summer Data at MassDOT Permanent Counting Station on Route 28

The graph below shows the monthly ADT volumes that were counted by Cape Cod Commission permanent counting stations in 2022. The intersection at Route 28 and Lumbert Mill Road in Barnstable showed the highest volumes of the two locations in each month. The remote counter in Harwich shows traffic volumes closer to the amount shown at Route 28 and Lumbert Mill Road in the months of 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.

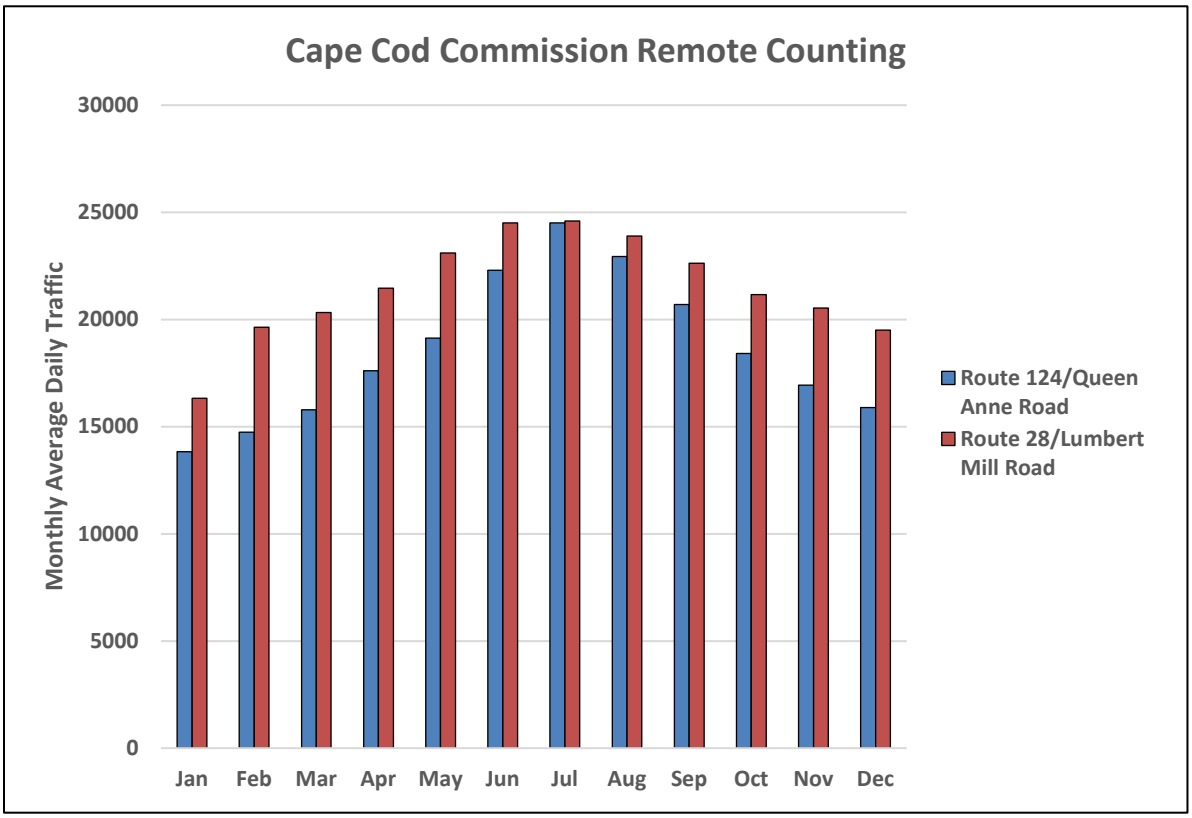

FIGURE 7. Monthly ADT at Cape Cod Commission Permanent Counting Stations

Travel Time Reliability and Planning Time Index

The Planning Time Index (PTI) data represents the total time that should be planned when an adequate buffer time is included. This includes the typical delay as well as unexpected delay and is computed as the 95th percentile travel time divided by the free-flow travel time. With the PTI calculated, more consistent and dependable travel times can be obtained. This in turn leads to having a more accurately represented Travel Time Reliability (TTR) based on worst days and not the average day. The PTI can be obtained for Route 28 and Route 6 on Cape Cod using RITIS data. RITIS (Regional Integrated Transportation Information System) is a real-time traffic monitoring system that provides information on traffic flow, congestion, and incident management. By providing this data, more accurate travel times and better prior-to-trip planning by roadways users can occur. For example, knowing that the PTI value for a trip is 2.50 means that for a 30-minute trip in light traffic, 75 minutes should be planned. Knowing where the high index areas are is essential for commuters, residents, and businesses in the Cape Cod region.

The following tables and figures display the PTI data from 2022 on Route 28 and Route 6.

TABLE 3. Planning Time Index – Index Value and Corresponding Color Threshold

Planning Time Index Value	Color Threshold
0 to 0.5	
0.5 to 1.1	
1.1 to 1.6	
1.6 to 2.1	
2.1 to 2.6	
2.6 to 4	

TABLE 4. Delta Planning Time Index – Index Value and Corresponding Color Threshold

Delta Planning Time Index Value	Color Threshold
< -1	
-1 to -0.5	
-0.5 to -0.1	
-0.1 to 0.1	
0.1 to 0.5	
0.5 to 1	
1 to > 2	

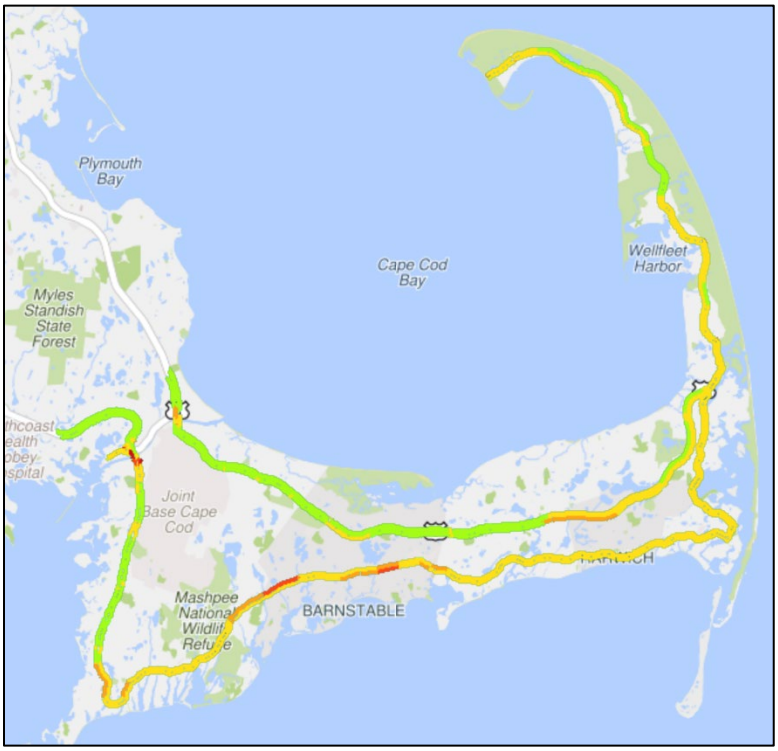

FIGURE 8. Planning Time Index 2022 AM Peak (6AM-10AM)

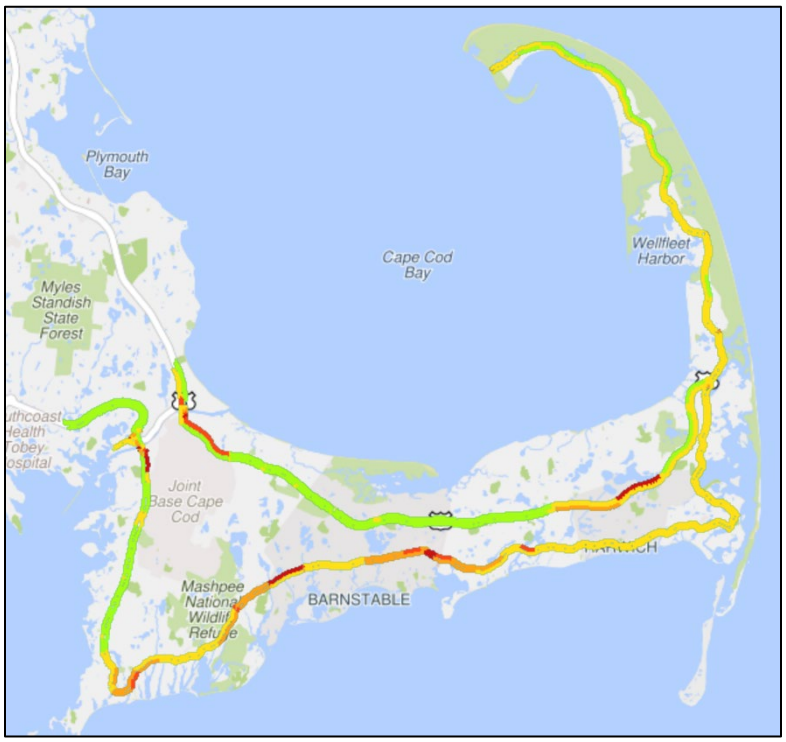

FIGURE 9. Planning Time Index 2022 PM Peak (4PM-8PM)

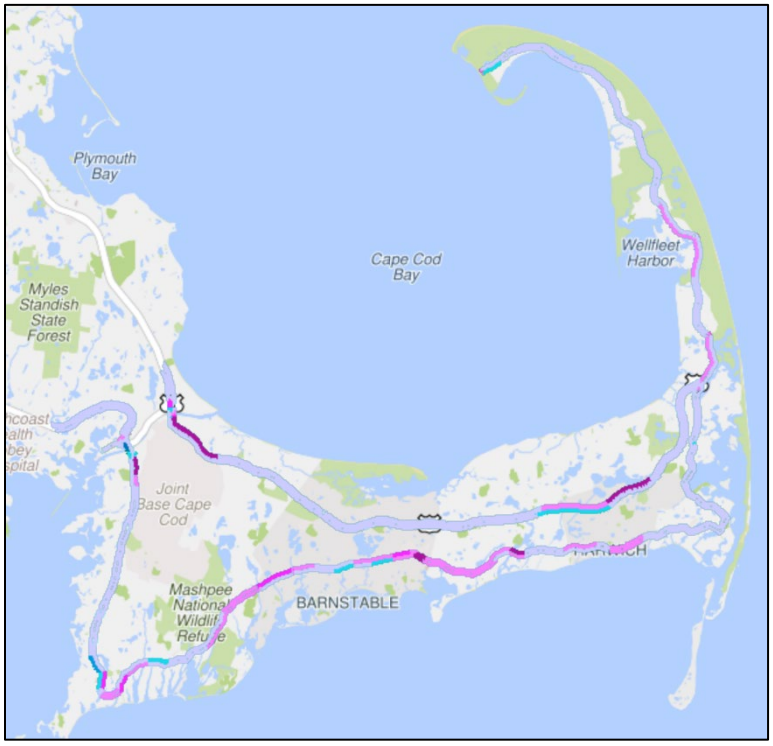

FIGURE 10. Delta Planning Time Index – AM vs PM

Figure 8 and Figure 9 show the Planning Time Index for the year of 2022 on Cape Cod for the regional corridors of Route 28 and Route 6. The AM peak traffic period shows that there are high index value points located on Route 28 at Bourne Rotary Circle (South), Route 28 around Route 130, and Route 28 around Pitcher's Way. Some of the same AM peak locations can also be seen to increase in index value in the PM peak period. Other locations emerge in the PM peak period as well such as Route 6 and Sandwich Road, Route 6 at Route 124 and Exit 82, and Route 28 at Yarmouth Road and Camp Street. The darker red in color corresponds to having a higher index value, these values are shown in Table 3.

Figure 10 shows the change between the AM peak travel period and the PM peak travel period. The darker purple in color corresponds to worsening conditions, an increase to the index value, these values are shown in Table 4. Overall, the areas with higher PTI values correspond to areas that are experiencing congestion and are noted bottlenecks within the region.

RITIS Bottleneck Ranking

The Bottleneck Rankings for Route 28 and Route 6 on Cape Cod can be obtained using RITIS data. RITIS (Regional Integrated Transportation Information System) is a real-time traffic monitoring system that provides information on traffic flow, congestion, and incident management. Using RITIS data, traffic patterns on Route 28 and Route 6 can be analyzed and locations where traffic flow is restricted causing delays and congestion can be identified. Bottlenecks are points in the roadway where traffic is forced to slow down due to various factors such as a high volume of vehicles,

merging or diverging lanes, or road construction. By ranking the bottlenecks on these two routes, we can identify the areas that require improvement and develop strategies to reduce congestion and improve travel times.

The following table is a summary of the top 50 bottleneck locations from 2022 on Route 28 and Route 6 ranked in order of total delay.

TABLE 5. 2022 Top 50 Bottlenecks on Route 28 and Route 6

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
US-6 W @ Sagamore Bridge	3.82	48 m	12 d 7 h 24 m	183,508	86,335,595
US-6 E @ US-6/MA-3	2.58	2 h 45 m	42 d 1 h 14 m	241,720	75,527,464
MA-28 N @ AIRPORT ROTARY	1.4	4 h 29 m	68 d 4 h 41 m	156,623	38,942,167
MA-28 N @ MA-130	2.35	1 h 9 m	17 d 15 h 50 m	84,203	27,680,545
MA-28 S @ SANDWICH RD	1.69	2 h 17 m	34 d 20 h 38 m	96,642	26,341,839
MA-28 N @ W MAIN ST (FALMOUTH)	2	2 h 9 m	32 d 18 h 53 m	100,466	26,025,478
MA-28 S @ YARMOUTH RD/CAMP ST	0.85	3 h	45 d 15 h 10 m	71,596	19,531,351
US-6 W @ MA-124/EXIT 10	1.33	1 h 23 m	21 d 3 h 36 m	107,669	18,434,291
MA-28 S @ PITCHERS WAY	1.83	1 h 16 m	19 d 9 h 52 m	56,691	12,420,855
MA-28 N @ MAIN ST (CENTERVILLE)	1.83	1 h	15 d 5 h 59 m	47,912	9,593,469
MA-28 N @ MAIN ST (SOUTH YARMOUTH)	0.94	1 h 12 m	18 d 8 h 49 m	35,152	8,945,068
MA-28 N @ PALMER AVE	1.25	1 h 12 m	18 d 9 h 25 m	40,930	8,693,451
MA-28 N @ FALMOUTH HEIGHTS RD	1.1	1 h 30 m	23 d 1 h 25 m	38,435	8,571,308

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
MA-28 S @ ACAPESKET RD	3.09	21 m	5 d 8 h 24 m	28,833	7,910,517
MA-28 S @ FALMOUTH HEIGHTS RD	1.06	1 h 10 m	17 d 20 h 42 m	28,788	7,369,927
MA-28 S @ MA-28/CONNERY AVE	1.52	48 m	12 d 9 h 11 m	36,420	6,413,932
MA-28 S @ MA-151/GREAT NECK RD/NATHAN ELLIS HWY	0.57	2 h 11 m	33 d 10 h 38 m	28,295	6,183,603
MA-28 S @ YARMOUTH RD	2.1	29 m	7 d 13 h	24,671	5,604,577
MA-28 S @ CENTRAL AVE	2.16	25 m	6 d 13 h 22 m	20,858	5,209,681
MA-28 S @ TOWN BROOK RD	1.77	25 m	6 d 9 h 7 m	18,565	4,775,930
MA-28 N @ ACAPESKET RD	1.48	33 m	8 d 10 h 15 m	20,277	4,740,604
MA-28 S @ MA-130	3.46	15 m	3 d 21 h 45 m	21,721	4,605,276
MA-28 N @ Old Stage Rd	1.49	29 m	7 d 11 h 52 m	16,218	4,189,317
MA-28 N @ YARMOUTH RD/CAMP ST	1.28	28 m	7 d 4 h 17 m	15,519	3,717,939
MA-28 N @ PITCHERS WAY	1.62	26 m	6 d 16 h 17 m	16,172	3,341,419
MA-28 S @ FOREST RD	3.43	10 m	2 d 17 h 31 m	13,672	2,866,745
US-6 W @ WILLOW ST/EXIT 7	2.42	4 m	1 d 2 h 54 m	6,542	2,617,689
MA-28 S @ OLD STAGE RD	1.43	12 m	3 d 5 h 42 m	8,067	2,444,168
MA-28 S @ US-6/HWY	0.46	33 m	8 d 13 h 38 m	6,806	2,212,194
US-6 E @ LAWRENCE RD/SCHOOL ST	3.81	7 m	2 d 8 m	12,239	2,138,554
US-6 E @ LECOUNT HOLLOW RD	3.58	6 m	1 d 17 h 14 m	11,536	2,096,413

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
MA-28 N @ TOWN BROOK RD	2.24	12 m	3 d 3 h 22 m	10,273	1,992,804
MA-28 N @ MA-149/COTUIT RD	0.09	3 h 40 m	55 d 23 h 19 m	6,422	1,893,403
US-6 W @ MA-149/MEETINGHOUSE WAY/EXIT 5	2.42	3 m	20 h 7 m	3,911	1,651,853
MA-28 S @ MAIN ST (CENTERVILLE)	1.38	9 m	2 d 12 h 14 m	5,962	1,600,235
MA-28 N @ MA-151/GREAT NECK RD/NATHAN ELLIS HWY	3.25	3 m	23 h 21 m	5,751	1,410,015
MA-28 S @ RED BROOK RD	4.05	4 m	1 d 1 h 7 m	6,941	1,404,075
US-6 W @ WEST RD	4.01	2 m	18 h 2 m	7,191	1,342,016
US-6 E @ MA-149/MEETINGHOUSE WAY/EXIT 5	2.23	2 m	16 h 37 m	2,868	1,282,695
MA-28 N @ YARMOUTH RD	1.93	7 m	1 d 22 h 8 m	6,116	1,253,961
US-6 E @ WEST RD	1.66	5 m	1 d 9 h 38 m	5,190	1,175,934
US-6 W @ UNION ST/EXIT 8	1.52	4 m	1 d 1 h 50 m	3,367	1,175,134
US-6 W @ MA-130/WATER ST/EXIT 2	3.03	2 m	16 h 5 m	2,675	1,100,156
US-6 W @ MA-132/IYANNOUGH RD/EXIT 6	2.46	2 m	16 h 48 m	2,933	995,913
MA-28 S @ OSTERVILLE WEST BARNSTABLE RD	2.05	4 m	1 d 2 h 25 m	3,187	885,721
US-6 E @ NAUSET RD/SALT POND RD	0.17	1 h 11 m	18 d 4 h 10 m	4,191	846,487
MA-28 N @ N MAIN ST (FALMOUTH)	1.52	6 m	1 d 14 h 34 m	3,336	831,655

Head Location	Average Max Length (miles)	Average Daily Duration	Total Duration	Congestion	Total Delay
US-6 E @ NAUSET RD/WAMPUM LN	2.7	3 m	22 h 26 m	3,989	827,031
MA-28 S @ CHATHAM RD	2.1	11 m	2 d 19 h	9,156	744,091

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 2018-2020, is the most recent available from the Massachusetts Department and Transportation (MassDOT) and local police departments from Barnstable County. Through the analysis of that 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.

TABLE 6. Top Crash Locations (2018-2020)

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
4	Barnstable	Route 28 (Falmouth Road) at Osterville-West Barnstable Road	55	375	2.418	16.489
6	Yarmouth	Route 28 at East Main Street	46	226	2.053	10.088
9	Barnstable	Route 28 (Falmouth Road) and Pitchers Way	41	281	1.915	13.126
12	Barnstable	Route 28 (Falmouth Road) at Old Stage Road/Camp Opechee Road	36	256	1.189	8.458
14	Yarmouth	Route 28 at Old Main Street/North Main Street	34	214	2.003	12.609
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
20	Falmouth	Route 28 (Falmouth Road) at Trotting Park Road	25	85	1.932	6.569
22	Falmouth	Route 28 (Teaticket Highway) at Falmouth Mall	25	179	1.661	11.890

Rank Crashes	Town	Location	Crash Count	EPDO	Crash Rate	EPDO Rate
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
27	Wellfleet	Route 6 at Main Street	23	123	1.570	8.396
28	Barnstable	Route 28 (Iyannough Road) at Mary Dunn Way/Engine House Road	23	143	1.010	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
33	Mashpee	Route 28 (Falmouth Road) at Orchard Road/Asher's Path	22	242	1.245	13.697
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
42	Barnstable	Route 28 (Iyannough Road) at Spring Street	19	99	0.912	4.750
44	Falmouth	Route 28 at Scranton Avenue	19	39	1.348	2.767
48	Barnstable	Route 28 (Falmouth Road) at Lumbert Mill Road	18	178	0.735	7.270

As seen in the above table out of the top 50 locations, approximately half of the locations were 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 2017 to 2022 by service route is summarized in Table 7.

TABLE 7. CCRTA Ridership Data (2017-2022)

SERVICE ROUTES	FY17	FY18	FY19	FY20	FY21	FY22
DART (Demand Response)	177,749	169,015	172,339	179,718	99,208	121,527
SeaLine	161,095	165,746	170,468	143,648	121,258	126,201
WHOOSH	17,753	14,073	13,628	21,563	5,245	4,780
Villager	48,077	45,524	42,900	28,473	18,190	22,600
Hyannis Loop	16,677	23,309	25,340	17,982	11,413	13,019
H20 Line	162,416	151,673	145,483	130,334	106,951	114,434
Provincetown/Truro Shuttle	87,726	82,933	82,056	134,641	28,863	34,527
Flex	89,255	87,346	82,385	85,532	71,580	86,274
Hyannis Shuttle	3,367	8,651	10,540	8,167	4,477	5,206
Bourne Line	13,457	10,928	12,826	13,093	12,481	17,228
Sandwich Line	24,944	23,961	24,545	20,454	12,964	16,939
CapeFLYER (Rail)	13,555	13,781	14,568	2,823	7,037	9,473
SmartDART	-	-	-	-	-	8,717

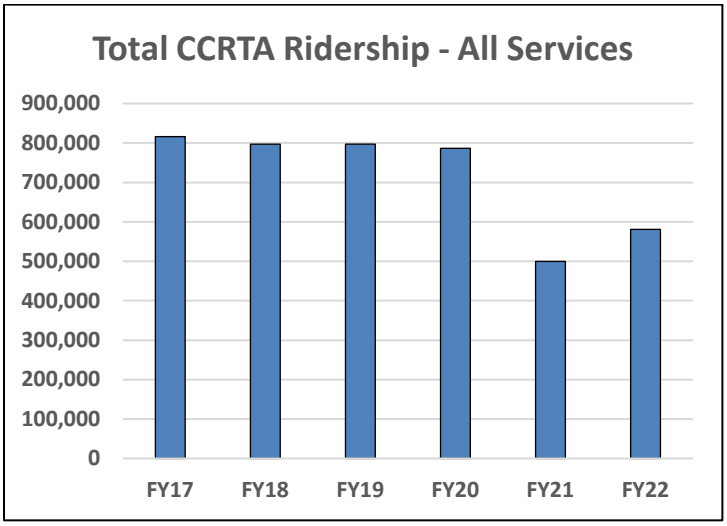

FIGURE 11. Total Ridership Across All CCRTA Services (FY17-FY22)

As seen in the above table, excluding the DART service, the Sealine, H20 and the Flex service routes are consistently 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. The SmartDART service offered by the CCRTA was started in FY21, however data is only currently available from FY22. Figure 11 shows the total ridership across all the CCRTA services from FY17 to FY22. The large change in data from FY20 to FY21 is due to the Covid-19 Pandemic. This data is useful to monitor as it can help inform public policy decisions related to transportation infrastructure investments and planning for future pandemics or other crises that may impact transportation systems.

Park-and-Ride Usage

Data collected at the three Park-and-Ride locations are organized in Figures 13, 15 and 17 to show the capacity and average occupancy for each of the lots from 2014-2022. In addition, a recent aerial image from Google Earth from February 2023 is included as figures below for each lot and shows the parking lots at the Barnstable and Sagamore Park and Ride facilities. 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 several observations, the Barnstable lot was observed to be over capacity with illegal vehicles parked. A MassDOT Highway project is in the preliminary design phase and includes the expansion of parking capacity at the existing park and ride facility on Route 132. The project is also anticipated to include electric vehicle parking spaces and upgrades to bus shelters. The Sagamore Lot has not been observed to

exceed capacity in the last 15 years except for in 2021. However, this may be a statistical anomaly due to the Covid-19 Pandemic. 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 12. Barnstable Park and Ride Lot On Route 132

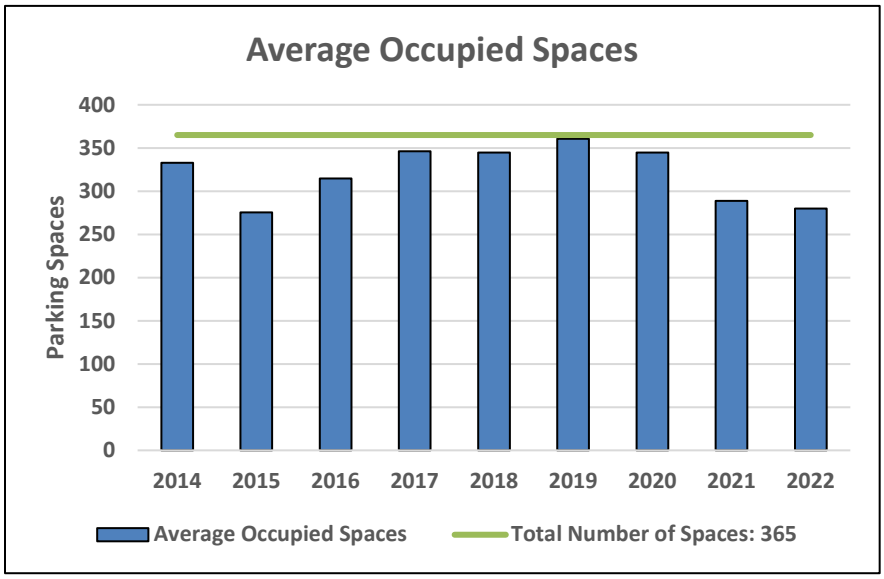

FIGURE 13. Barnstable Park and Ride usage

FIGURE 14. Sagamore Park and Ride Lot at the Sagamore Bridge

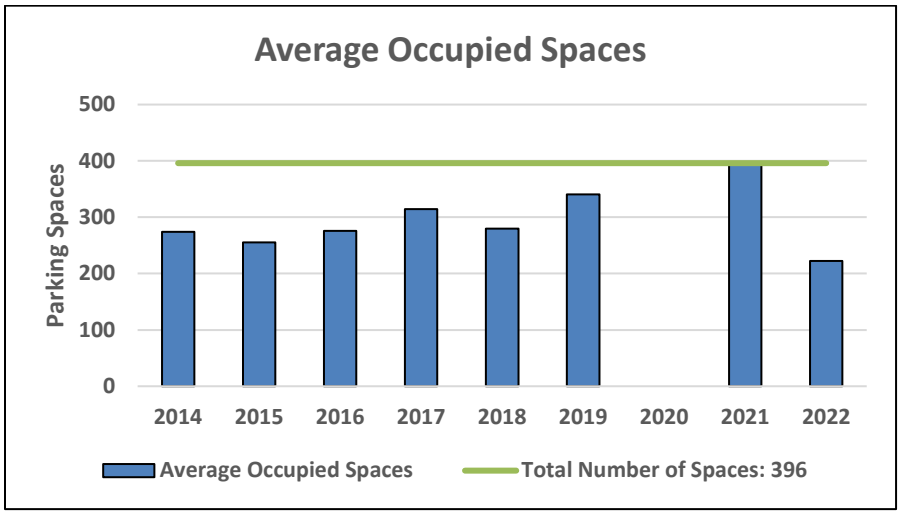

FIGURE 15. Sagamore Park and Ride Usage

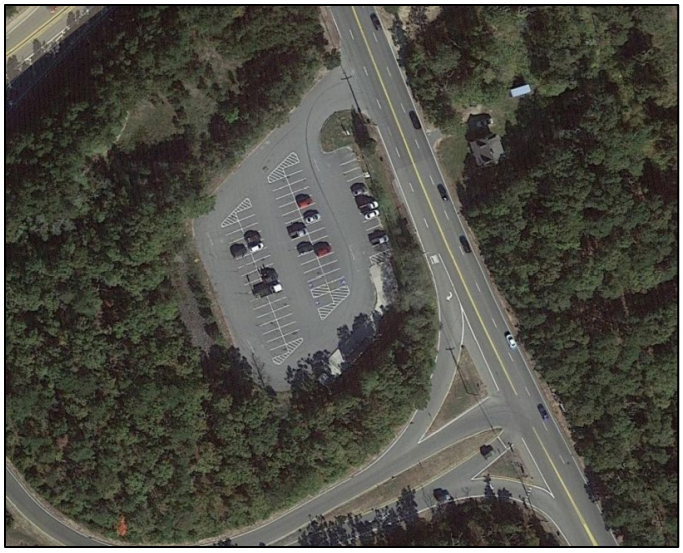

FIGURE 16. Harwich Park and Ride Lot On Route 124

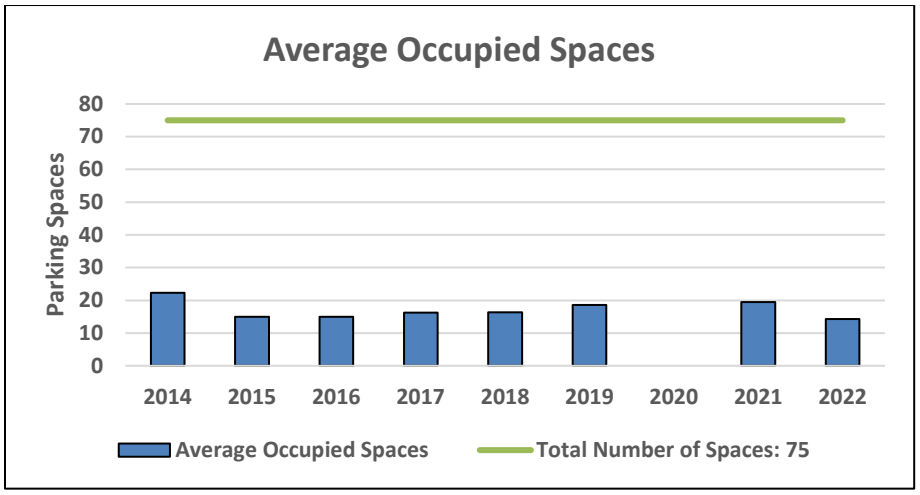

FIGURE 17. Harwich Park and Ride Usage

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 were performed as part of data collection efforts in the summer of 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 18. Sidewalk Network

The following figure shows the results of ArcGIS data from Cape Cod on roads that are considered walkable in 2021. There are different levels of walkability, this map shows only shows if the roads are considered walkable. As can be seen, there are several gaps on the Outer Cape and gaps due to the major corridors in the region, Route 28 and Route 6.

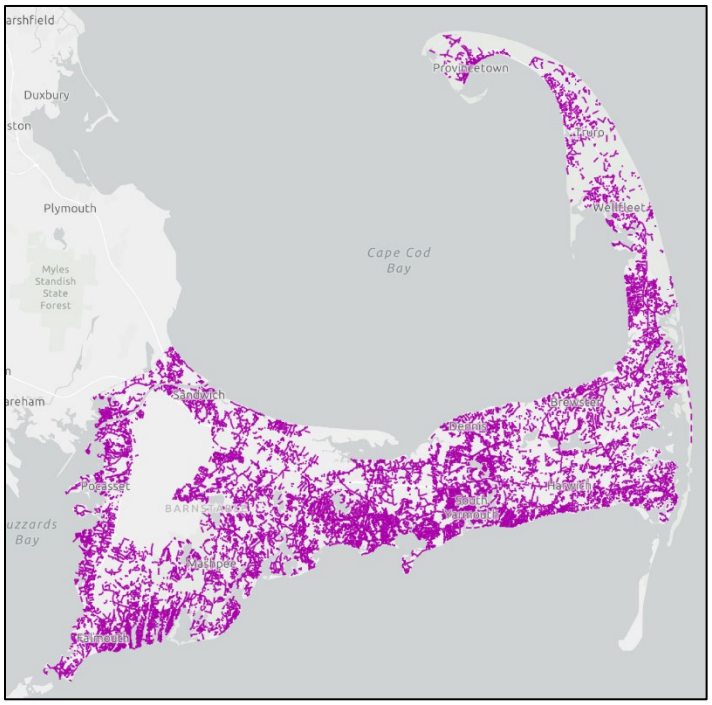

FIGURE 19. Walkable Roads on Cape Cod

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 on 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 and 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 and rides
    - Identify areas for expansion at existing park and ride lots.
    - Recommend management upgrades for park and rides (fee structure).
    - Implement Canal study recommendation for a new park and ride lot in Sandwich.
    - Monitor expansion and improvement of the Route 132 Barnstable Park and Ride.
- 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 the Sealine 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 giving transit signal priority, queue jumping, or on-time performance information reporting 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 a 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.

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

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

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 State Transportation Improvement Program (STIP). These proposed projects may require a more extensive evaluation regarding 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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