Cape Cod Bridges Program
Bourne, Massachusetts

Appendix 4.2
Traffic Engineering Technical Report

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
CFR	Code of Federal Regulations
EB	eastbound
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
LOS	Level of Service
MassDOT	Massachusetts Department of Transportation
MRER/EA	Major Rehabilitation Evaluation Report/Environmental Assessment
NB	northbound
NEPA	National Environmental Policy Act
O-D	origin-destination
Program	Cape Cod Bridges Program
SB	southbound
SUP	share-use path
USACE	U.S. Army Corps of Engineers
WB	westbound

1 Introduction

This Traffic Engineering Technical Report has been prepared in support of the Draft Environmental Impact Statement for the Cape Cod Bridges Program (Program) in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended.

2 Purpose and Need

In partnership with the Federal Highway Administration (FHWA) and the New England District of the U.S. Army Corps of Engineers (USACE), the Massachusetts Department of Transportation (MassDOT) proposes advancing the Program in the town of Bourne, Barnstable County, Massachusetts.

The purpose of the Program is to improve cross-canal mobility and accessibility between Cape Cod and mainland Massachusetts for all road users and to address the increasing maintenance needs and functional obsolescence of the aging Sagamore and Bourne Bridges, which the USACE owns, operates, and maintains as part of the Cape Cod Canal Federal Navigation Project.

The needs for the Program are as follows:

- Address the deteriorating structural condition and escalating maintenance demands of the Sagamore and Bourne Bridges.
- Address the substandard design elements of the Sagamore and Bourne Bridges, the immediate mainline approaches, and their adjacent interchanges and intersections.
- Improve vehicular traffic operations.
- Improve accommodations for pedestrians and bicyclists.

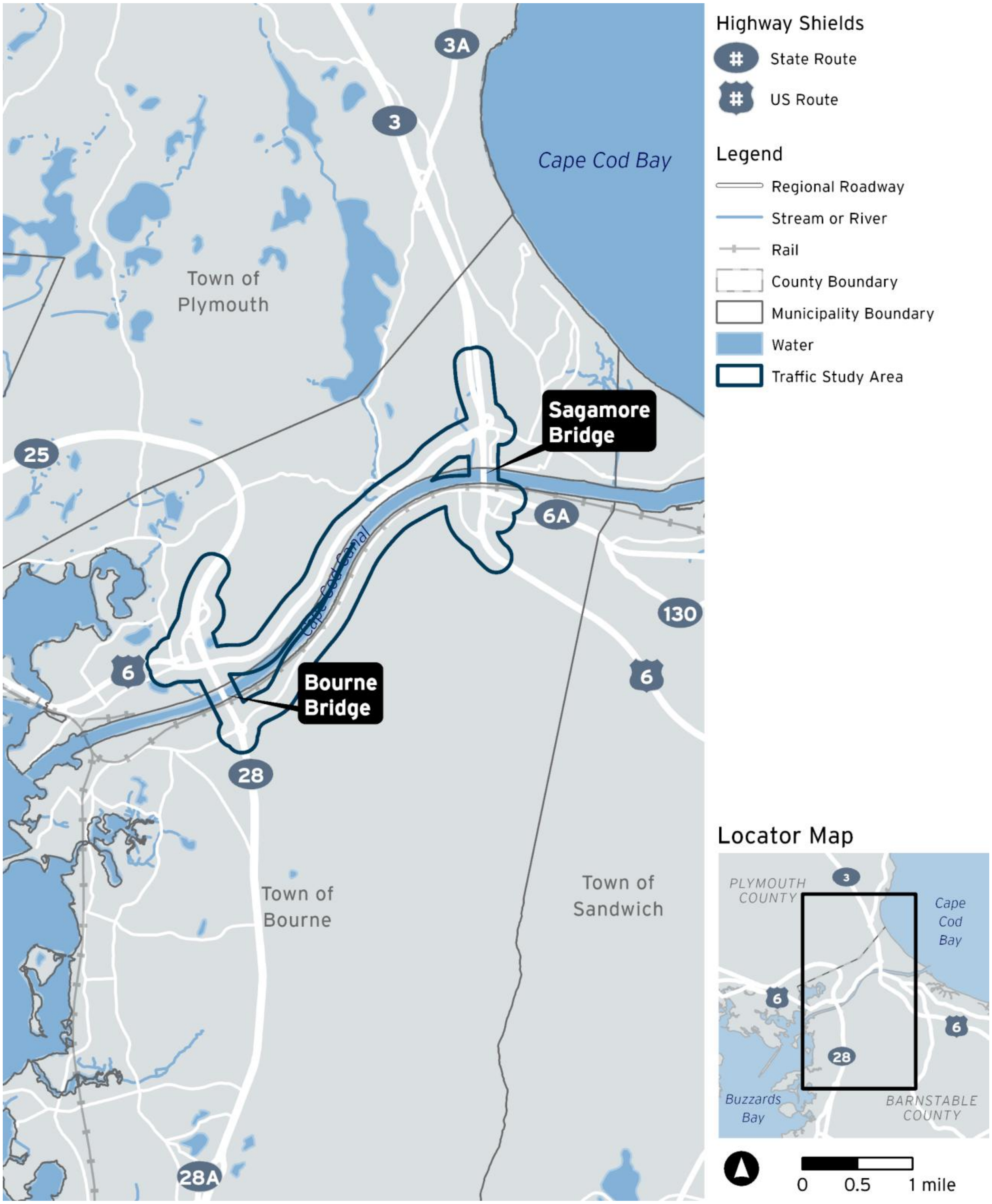
3 Study Area

The overall traffic Study Area includes major regional roadways, interchanges, and intersections within Plymouth, Wareham, Bourne, and Sandwich that are affected by traffic crossing Cape Cod Canal. The overall limits along State Route 3 begin at Interchange 3 (Herring Pond Road) north of Sagamore Bridge and extend to Interchange 61 (Quaker Meetinghouse Road) along U.S. Route 6 located southeast of Sagamore Bridge. The overall limits along State Route 25 begin at Interchange 3 (Maple Springs Road/Glen Charlie Road) northwest of Bourne Bridge and extend to the interchange between State Route 28 and State Route 151 located south of Bourne Bridge.

The Study Area (**Figure 3-1**) represents the area selected for detailed traffic operations analysis within the 2-mile area centered around Sagamore and Bourne Bridges. Critical roadways in the Study Area include the following:

- State Route 25
- State Route 28
- Main Street
- Buzzards Bay Bypass
- Scenic Highway
- Sandwich Road
- Trowbridge Road
- State Route 3
- U.S. Route 6
- State Road
- Cranberry Highway

Figure 3-1. Study Area



Source: Massachusetts Department of Transportation, 2024

4 Alternatives

4.1 No Build Alternative

The Sagamore and Bourne Bridges, as components of the Cape Cod Canal Federal Navigation Project, are federal assets that are managed by the USACE's New England District. The Commonwealth of Massachusetts owns the connecting major highway corridors at the bridges, which consist of the State Route 3/U.S. Route 6 corridor at Sagamore Bridge and the State Route 25/State Route 28 corridor at Bourne Bridge.

In the No Build Alternative, the Sagamore and Bourne Bridges would retain their current configuration of four 10-foot-wide travel lanes (two in each direction) with one 6-foot sidewalk and a 2-foot safety curb. The USACE would continue to own the Sagamore and Bourne Bridges and would implement a maintenance and repair program as needed to maintain bridge operations and public safety. MassDOT would continue to own, operate, and maintain the state highway interchange approach networks at the two bridges.

The No Build Alternative would include recently completed and proposed transportation improvements projects identified in the Federal Fiscal Year 2025-2029 Transportation Improvement Program for the Cape Cod Metropolitan Planning Organization.[1] **Table 4-1** identifies the Transportation Improvement Program projects within and near the Program to be incorporated in the No Build Alternative.

Table 4-1. Transportation Improvement Program Projects, 2025–2029

Project Number	Year	Transportation Project	Project Description	Status
606900	2020	Belmont Circle Traffic and Multimodal Improvements	Traffic and multimodal improvements at Belmont Circle at U.S. Route 6 and State Route 25 and State Route 28	Completed
608422	2022	Trail Improvements – Sandwich	Shared-use path on Service Road (State Route 130 to Chase Road)	Underway
610542	2023	Bourne Rotary Improvements	• Restriping Bourne Rotary to two lanes and adding a channelized right-turn lane from State Route 28 northbound to Sandwich Road eastbound • Adding signs at Bourne Rotary • Installing flashing beacons at the Bourne Rotary approaches	Underway

[1] The Transportation Improvement Program was endorsed on May 20, 2024, with subsequent amendments on November 18, 2024; December 16, 2024; February 24, 2025; and an adjustment on March 24, 2025

Project Number	Year	Transportation Project	Project Description	Status
613195	2024	Bridge Systematic Maintenance	Bridge deck replacement of the Quaker Meetinghouse Road Bridge over U.S. Route 6/Mid-Cape Highway as part of an overall bridge preservation strategy	Programmed
609262	2025	Bourne Rail Trail, Phase 1	First phase of four planned phases of the Bourne Rail Trail connection to the Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 1 is approximately one-half mile long within the existing right-of-way of the Old Colony Railroad (Woods Hole branch line) from the Canal Service Road to Monument Neck Road.	Programmed
610673	—	Bourne Rail Trail, Phase 2	Phase 2 of four planned phases of the Bourne Rail Trail connection to Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 2 is approximately 2 miles long from Monument Neck Road to Monk's Park/ Valley Bars Road.	Not Programmed
---	—	Bourne Rail Trail, Phase 3 and Phase 4A	Phase 3 and Phase 4A of four planned phases of the Bourne Rail Trail connection to Shining Sea Bikeway to the south in Falmouth	Not Programmed
607394/ 611998	—	Bourne Rail Trail, Phase 4B	Phase 4B of four planned phases of the Bourne Rail Trail connection to the Shining Sea Bikeway to the south in Falmouth and to the Cape Cod Canal path (Canal Service Road) in the town of Bourne; Phase 4B is approximately 1 mile long, extending the Shining Sea Bikeway from its current terminus in North Falmouth into the town of Bourne.	Not Programmed
606082	2025–2028	U.S. Route 6 Scenic Highway Median Installation	• Resurfacing • Safety improvements, including a raised center median and expanded shoulders to separate eastbound and westbound travel lanes • Drainage improvements • Traffic signal improvements at two intersections • Shared-use path	Programmed

Project Number	Year	Transportation Project	Project Description	Status
612053	2025	Bourne/Sandwich, Resurfacing and Related Work on U.S. Route 6	Improvements to pavement serviceability, condition, and roadway safety on U.S. Route 6 from Sagamore Bridge to the Sandwich town line (8.55 miles)	Programmed
613200	2026	Chase Road over U.S. Route 6 Bridge	Bridge deck replacement of Chase Road over U.S. Route 6 (Mid-Cape Highway) bridge structure in the town of Sandwich	Programmed
612063	2028	State Route 28 Resurfacing and Related Work	Improvements to pavement serviceability, condition, and roadway safety on MacArthur Boulevard (State Route 28) from Bourne Rotary to Otis Rotary	Programmed
613199	2028	U.S. Route 6 over State Route 130 Bridge	Bridge deck replacement of U.S. Route 6 (Mid-Cape Highway) bridge structure over State Route 130 in the town of Sandwich	Programmed
613271	—	Shared-use path, State Route 130 to Canal Service Road	Shared-use path from State Route 130 to Canal Service Road in the town of Sandwich	Not Programmed

Note: **Table 4-1** includes only those projects in the Study Area that are part of the No Build Alternative. It does not include Project S13144, the replacement of the Sagamore Bridge, which was added to the Federal Fiscal Year 2025-2029 Transportation Improvement Program as Amendment #2, December 9, 2024.

— No date available.

The No Build Alternative represents the "Fix as Fails" Base Condition of the USACE's Major Rehabilitation Evaluation Report and Environmental Assessment (MRER/EA). In the No Build Alternative, the USACE would implement an ongoing program of continued inspections and maintenance, and repair of both existing bridges as needed to maintain safety. No major rehabilitation efforts involving extensive repairs and replacement of major bridge components would occur. Structural components would be repaired, and critical elements would be replaced only when inspections indicate unsatisfactory reliability ratings. The MRER/EA indicates that both the Sagamore and Bourne Bridges are in deteriorated condition and well beyond the state in which actions and funding from the USACE's operations and maintenance program could correct the deficiencies and restore and sustain reliability. The USACE has indicated that as the bridges continue to age, routine maintenance and minor component replacement would result in an unacceptable structural condition. As a result, it is likely that lower vehicle weights, traffic volume restrictions, and speed limits would be required and posted to maintain continued bridge safety.

The No Build Alternative would not meet any of the Program's identified needs:

- It would not address the deteriorating structural condition and escalating maintenance demands of the existing bridges.

- It would not address the substandard design elements of the bridges, the immediate mainline approaches, and their adjacent interchanges and intersections.
- It would not improve vehicular traffic operations.
- It would not improve accommodations for pedestrians and bicyclists.

Per NEPA requirements, the No Build Alternative is included in the NEPA document as the base condition against which the Build Alternative is compared and evaluated.

4.2 Build Alternative

The Program's Build Alternative would incorporate the USACE's MRER/EA preferred alternative of replacing both highway bridges with new bridges, each with four through-travel lanes and two auxiliary lanes (in-kind bridge replacement that would be updated to comply with federal and state highway and design safety standards). The Build Alternative proposes to replace the Sagamore and Bourne Bridges with parallel, twin tied-arch bridge structures that would be supported on delta frames with an approximate 700-foot mainline span length. At both bridge crossings, the replacement mainline alignment locations would be offline and inboard of the existing bridges on the side of the canal between the bridges. The Build Alternative would reconfigure the highway interchange approach networks north and south of Cape Cod Canal to align with the replacement bridges. The replacement bridges and their interchange approaches would accommodate shared-use pedestrian and bicycle paths that would connect to the local roadway network on both sides of Cape Cod Canal in the town of Bourne.

Table 4-2 presents a description of the Program elements/design parameters of the recommended Build Alternative: Replacement Highway Bridges Built to Modern Design Standards.

Table 4-2. Description of Design Parameters of the Recommended Build Alternative

Program Element/ Program Design Parameter	Description
Highway Bridges	Both the Sagamore and Bourne Bridges would be replaced with new bridges, with each comprising four through-travel lanes and two auxiliary lanes (i.e., an in-kind bridge replacement that would comply with federal and state highway and design safety standards).

Program Element/ Program Design Parameter	Description
Bridge Highway Cross-Section and Shared-Use Path	Each replacement bridge would provide four 12-foot-wide through-traffic lanes (two in each direction), two 12-foot-wide entrance/exit (auxiliary) lanes, a 4-foot-wide left shoulder, and a 10-foot-wide right shoulder. Right and left barriers would be offset an additional 2 feet beyond the limits of the shoulders.
	Each crossing location would include one bidirectional pedestrian and bicycle shared-use path (SUP), separated from vehicular traffic by the shoulder and barrier. The usable width of the SUP would be 14 feet wide on the bridge main span, 20 feet wide on the interchange approaches, and 12 feet wide on the connecting roadways.
Bridge Clearances	The replacement bridges would maintain the existing vertical clearance of 135 feet above mean high water and account for 3 feet of fluctuations in relative sea level, for a total vertical clearance of 138 feet above mean high water. The replacement bridges would provide a minimum 500 feet of horizontal channel width to be consistent with existing conditions.
Main Span Length and Bridge Pier Location	The replacement bridges would have a main span length of approximately 700 feet, which would locate the bridge piers at the waterline adjacent to the service road (shoreline piers) into the riprap slope but above the low tide line.
Bridge Deck Configuration	Each replacement bridge would have two separate decks (twin structures).
Mainline Alignment	The mainline alignment locations at both crossings would be offline inboard: the main spans of each replacement bridge would be located outside the footprint of the existing bridge, approximately 10 feet apart and parallel to each other and on the side of the canal between the existing Sagamore Bridge and Bourne Bridge. At the Sagamore crossing, the replacement main spans would be west of the existing Sagamore Bridge toward Buzzards Bay. At the Bourne crossing, the replacement main spans would be east of the existing Bourne Bridge toward Cape Cod Bay.
Bridge Type	The replacement bridges would be twin tied-arch bridges with delta frames supporting an approximate 700-foot mainline span.

Program Element/ Program Design Parameter	Description
Interchange Approach Network: Sagamore North Quadrant	The Sagamore North interchange approach network would follow the “Direct Connection to State Road (Option SN-8A)” configuration. This design would provide a single exit point from a relocated U.S. Route 6/State Route 3 and eliminate the existing Sagamore Bridge northbound off-ramp connection to Scenic Highway/Meetinghouse Lane eastbound. Instead, the new connection would tie into State Road, north of Scenic Highway/Meetinghouse Lane. The remaining ramp connections would remain similar to existing conditions. Intersections along Scenic Highway and Meetinghouse Lane would be modified to accommodate new lane configurations. The intersection of State Road at State Route 3 northbound would also be reconfigured to support the addition of the new northbound off-ramp. The design includes a SUP on the U.S. Route 6 eastbound main span, providing connections to the south side of Scenic Highway, Canal Street, and Canal Service Road. Additional SUPs would be constructed along the southern side of Scenic Highway and Meetinghouse Lane, as well as along the eastern side of State Road to Homestead Avenue.
Interchange Approach Network: Sagamore South Quadrant	The Sagamore South interchange approach network would follow the “Westbound On-Ramp Under U.S. Route 6 with Sandwich Road Extension (Option SS-3.1A)” configuration. This design includes the Cranberry Highway Extension and relocates the westbound on-ramp to share the same entrance point as the eastbound on-ramp from the Mid-Cape Connector. The existing westbound ramp from Cranberry Highway to the Sagamore Bridge would be removed and replaced with a new westbound on-ramp connection from the Mid-Cape Connector. Lane arrangements at the intersections of the Mid-Cape Connector with Sandwich Road and Cranberry Highway Extension would be modified to accommodate revised traffic patterns resulting from the new Cranberry Highway Extension and changes to U.S. Route 6 access. A new connection from Cranberry Highway Extension to Sandwich Road would be provided east of the new mainline bridge structure, forming the Sandwich Road Extension. Access to Market Basket via Factory Outlet Road would be modified, and a new driveway would be added to serve the former Christmas Tree Shops property. A SUP would be constructed along the U.S. Route 6 eastbound main span, providing connections to Factory Outlet Road, Sandwich Road, and Canal Service Road. Additional bicycle and pedestrian improvements would be included along Cranberry Highway. A new connection would also be established through the Cranberry Highway Extension to the Mid-Cape Connector.

Program Element/ Program Design Parameter	Description
Interchange Approach Network: Bourne North Quadrant	The Bourne North interchange approach would follow the “Directional Interchange (Option BN-14.4b)” configuration. This design includes a combination of direct connection ramps between State Route 25 and U.S. Route 6. The ramp connecting State Route 25 eastbound to Scenic Highway would be a direct connection, providing access to Scenic Highway eastbound only. A new flyover ramp from Scenic Highway to State Route 25 would allow vehicles to bypass Belmont Circle, improving traffic flow without the need for additional intersection control. This ramp would repurpose one of the existing travel lanes on Scenic Highway and provide a free-flowing movement to reduce congestion. To accommodate this new southbound-to-eastbound movement, the existing State Route 28 bridge over State Route 25 would be relocated and widened. The existing southbound off-ramp would be reconfigured as an option lane, improving geometry and decision sight distance for drivers. Intersection control at U.S. Route 6/Nightingale Road/Andy Oliva Drive is being evaluated, with a single-lane roundabout previously considered. MassDOT continues to assess appropriate control types through the Intersection Control Evaluation (ICE) process. The design also includes a SUP and a grade-separated crossing for pedestrians and bicyclists via the new flyover ramp over Scenic Highway. U.S. Route 6 would be reduced from four lanes to three, creating space for multimodal accommodations. A continuous 12-foot-wide SUP would be provided along the south side of U.S. Route 6, connecting to Belmont Circle, with a 6-foot-wide sidewalk along the north side.
Interchange Approach Network: Bourne South Quadrant	The Bourne South interchange approach network would follow the “Diamond Interchange (Option BS-2)” configuration. This design would eliminate the existing Bourne Rotary and replace it with a grade-separated diamond interchange, allowing through movements on State Route 28 to bypass intersections with local roadways. Both intersections within the diamond interchange would include appropriate intersection controls to manage traffic flow and improve safety. Changes to the Trowbridge Road and Sandwich Road underpass would include a reconfigured entrance to Upper Cape Cod Regional Technical High School, relocated to improve access and circulation. The design would also provide SUP connections to Trowbridge Road, the Cape Cod Canal Service Road, and the Bourne Recreation Area, enhancing multimodal connectivity throughout the corridor.

5 Analysis Procedures

5.1 Travel Demand Modeling Methodology

Due to the COVID-19 pandemic, the collection of traffic counts between 2020 and 2022 were restricted because travel patterns shifted during this period. Therefore, a travel demand model was developed utilizing 2014 count data, 2019 count data at select locations, and INRIX origin-destination data.

MassDOT developed a travel demand model for the future 2050 design year based on demographic projections (population, households, and employment) for the Cape Cod communities (prepared by the UMass Donohue Institute for MassDOT's Office of Transportation Planning) and future growth projections specific to visitor trips. This demand model was used to develop the traffic volume projections for the 2050 No Build Alternative and 2050 Build Alternative scenarios.

5.2 Traffic Operations Analysis Methodology

- MassDOT chose the Fall Weekday PM period as the design time period in which to evaluate traffic operations. Through a review of the permanent count stations on the bridges, MassDOT determined that the Fall Weekday PM period represents the 85th percentile traffic volumes. This means that 85% of the year, traffic volumes within the Study Area are equal to or lower than the Fall Weekday PM period. It is standard practice to use this method to determine the design period.
- MassDOT also analyzed the Summer Saturday Midday period to understand potential peak-season operations. However, traffic operations analysis conducted for this time period was not used as the basis for the development of the 2050 Build Alternative.
- This document summarizes only the Fall Weekday PM period for the 2050 Build Alternative condition traffic analysis.
- MassDOT analyzed traffic operations using the following software applications in accordance with applicable Highway Capacity Manual[2] and FHWA standards:[3]
  - Synchro: analysis software used to analyze unsignalized and signalized intersections along the local and arterial roadways.
  - Sidra: analysis software used to analyze traffic circles along the local and arterial roadways.
  - Highway Capacity Software (HCS): analysis software used to analyze multilane freeway segments, weaving segments, and merge/diverge segments.
  - VISSIM: microsimulation software used to analyze the entire roadway network including roadways of differing functional classifications.

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[2] National Academies of Sciences, Engineering, and Medicine. 2016. Highway Capacity Manual 6th Edition: A Guide for Multimodal Mobility Analysis. https://doi.org/10.17226/24798

[3] Federal Highway Administration. 2019. Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software. https://ops.fhwa.dot.gov/publications/fhwahop18036/index.htm

5.3 Traffic Operations Analysis Performance Measures

Existing capacity analyses assign a qualitative level of service (LOS) letter grade to traffic facilities during various peak hours. The concept of LOS is defined as a qualitative measure based on quantitative model outputs that describe operational conditions within a traffic stream and their perception by the traveling public. LOS is identified based on average delay per vehicle (measured in seconds per vehicle) at local signalized and unsignalized intersections and based on densities on freeway sections and at merge-diverge points (measured in vehicles per mile per lane). LOS is represented using letter grades "A" through "F," with LOS A representing very low delays and free-flow conditions and LOS F representing unacceptable conditions for most drivers and conditions in which vehicle demand generally exceeds roadway capacity. LOS A, LOS B, and LOS C are generally considered acceptable conditions; LOS D is generally considered marginally acceptable conditions; and LOS E and LOS F are generally considered unacceptable to most drivers.

The levels of service for individual traffic movements at signalized and unsignalized intersections within the Study Area were determined based on criteria set forth in the Transportation Research Board's Highway Capacity Manual (HCM) 6th Edition. **Table 5-1** summarizes the delay criteria for each LOS letter grade at unsignalized and signalized intersections.

Table 5-1. Intersection Level of Service Criteria

LOS	Delay (seconds per vehicle)	
	Unsignalized	**Signalized**
A	≤10	≤10
B	>10 and ≤15	>10 and ≤20
C	>15 and ≤25	>20 and ≤35
D	>25 and ≤35	>35 and ≤55
E	>35 and ≤50	>55 and ≤80
F	>50	>80

Source: Highway Capacity Manual 6th Edition, Exhibits 19-8, 20-2, and 21-8

Table 5-2 summarizes the LOS criteria for traffic movements at traffic circles within the Study Area.

Table 5-2. Level of Service Criteria for Roundabouts

LOS	Delay (seconds per vehicle)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Source: Highway Capacity Manual 6th Edition, Exhibit 22-8

The levels of service for multilane highways and/or freeways are based on vehicle density per mile of roadway segment and are measured in passenger cars per mile per lane (pc/mi/ln). Levels of service for the Study Area freeway segments and freeway merges/diverges were calculated using HCS 7 software, which is based on the HCM, 6th Edition. **Table 5-3** summarizes the LOS criteria for freeway segments. **Table 5-4** summarizes the LOS criteria for freeway merging and diverging segments.

Table 5-3. Level of Service Criteria for Freeway Segments

LOS	Density (pc/mi/ln)
A	≤11
B	>11-18
C	>18-26
D	>26-35
E	>35-45
F	Demand exceeds capacity OR density > 45

Source: Highway Capacity Manual 6th Edition, Exhibit 12-15
pc/mi/ln = passenger cars per mile per lane

Table 5-4. Level of Service Criteria for Freeway Merges and Diverges

LOS	Density (pc/mi/ln)
A	≤10
B	>10-20
C	>20-28
D	>28-35
E	>35
F	Demand exceeds capacity

Source: Highway Capacity Manual 6th Edition, Exhibit 14-3
pc/mi/ln = passenger cars per mile per lane

MassDOT summarized traffic operations in VISSIM for the 2019 Base Year in terms of LOS as well as on a network-wide basis to understand overall conditions within the Study Area transportation network. MassDOT recorded traffic operations in VISSIM for No Build Alternative and Build Alternative conditions on a network-wide basis only. The network-wide evaluation metrics included the following:

- Processed Vehicles – the total number of vehicles that have entered the network and reached their destination before the end of the simulation.

- Average Delay per Vehicle – the Total Network Delay averaged over the total number of vehicles that have been processed and those that are still in the network at the end of the simulation. Delay is an estimate of the extra time that a driver spends traveling compared to free-flow conditions.
- Total Travel Time – serves as a crucial performance metric, offering a direct indication of system efficiency and user experience. Decreased travel times signify improved mobility, enhanced accessibility, and potentially reduced road user costs. Conversely, prolonged travel times can signal congestion, routing or infrastructure inefficiencies, and potential network bottlenecks. To assess the effectiveness of the analysis, travel-time evaluation was conducted in two facets:
  - Network-wide Assessment – This analysis focused on evaluating performance using network-wide travel-time data, providing a comprehensive insight into transportation system efficiency, congestion levels, and overall effectiveness.
  - Major O-D Evaluation – By measuring travel time between origin and destination (O-D) points, MassDOT assessed the efficiency of travel along major routes, which included total travel time of vehicles within or exiting the network.

The Major O-D Evaluation performance measure is compared only between the No Build Alternative and Build Alternative.

6 2019 Base Year Traffic Analysis

The 2019 Base Year traffic models include 2019 Base Year traffic volumes. **Attachment 1** includes the 2019 Base Year traffic volume flow maps.

6.1 Synchro Analysis

MassDOT built existing local intersection traffic models using Synchro 10. **Attachment 2, 2019 Base Year Traffic Analysis**, are the LOS tables that summarize the results of the existing capacity and queue analyses performed in Synchro for all six peak hours at all Study Area intersections. **Attachment 2, Figures B-1 and B-2**, provide a graphical representation of the intersection levels of service.

During the three fall peak hours (Weekday AM - 7:00 to 8:00, Weekday PM – 4:00 to 5:00, and Saturday Midday – 12:00 PM to 1:00 PM), most of the intersections analyzed operate at overall intersection LOS D or better. The following locations within the focus area operate at LOS E or LOS F during one or more of the fall peak hours:

- Sandwich Road/County Road at Trowbridge Road/Shore Road (Weekday PM – LOS F)
- Sandwich Road at Bourne Rotary Connector (Weekday AM and PM – LOS F; Saturday Midday – LOS E)
- Sandwich Road at Upper Cape Cod Technical School (Weekday PM – LOS F)
- Meetinghouse Lane at State Road/Canal Street (Weekday PM – LOS E)
- Cranberry Highway at Sandwich Road/Regency Drive (Weekday AM – LOS E; Weekday PM and Saturday Midday – LOS F)

During the three summer peak hours (Weekday AM - 7:00 to 8:00, Weekday PM – 4:00 to 5:00, and Saturday Midday – 12:00 PM to 1:00 PM), most of the intersections analyzed operate at overall intersection LOS D or better, with the following exceptions:

- Scenic Highway (U.S. Route 6) at Nightingale Road/Andy Olivia Drive (Weekday PM – LOS F)
- Sandwich Road/County Road at Trowbridge Road/Shore Road (Weekday PM – LOS F)
- Sandwich Road at Bourne Rotary Connector (All Peak Hours – LOS F)
- Meetinghouse Lane at State Road/Canal Street (Weekday PM – LOS E)
- Cranberry Highway at Sandwich Road/Regency Drive (Weekday AM and PM – LOS F)

6.2 Sidra Analysis

MassDOT analyzed unsignalized traffic circles and rotaries within the Study Area using Sidra 7 software. **Attachment 2, Tables B-1 and B-2**, are LOS tables that summarize the results of the Sidra analysis performed for all six peak hours. **Attachment 2, Figures B-1 and B-2**, are the graphical representation of the levels of service for each of these traffic circles are provided in, as well.

Bourne Rotary and Belmont Circle each operate at overall LOS F during all three peak hours (Weekday AM, Weekday PM, and Saturday Midday) analyzed for the fall and summer seasons. Buzzards Bay Rotary carries lower volumes than the other two traffic circles and operates at overall LOS A or LOS B during all six peak hours analyzed.

6.3 Highway Capacity Software 7 Analysis

MassDOT used HCS 7 software to calculate levels of service for the Study Area freeway segments and freeway merges/diverges. The HCS analysis was performed for all six analysis periods at the immediate key locations north and south of Bourne Bridge and Sagamore Bridge. MassDOT calibrated the capacity adjustment factors and safety adjustment factors to reflect the existing operation conditions, which are tabulated in **Attachment 2, Tables B-7** and **B-8. Attachment 2, Figures B-3** and **B-4**, provide graphical representations of the LOS and density results of the freeway segments and merging/diverging segments.

Most freeway and merge/diverge segments throughout the Study Area operate at LOS C or better during all six peak hours analyzed. In general, sections closer to each of the bridges operate at unacceptable LOS E or LOS F during one or more peak hours. The following locations operate at LOS E or LOS F during one or more peak hours, consistent with field observations:

- State Route 25 Southbound (SB) approaching Exit 10 (Belmont Circle) – (Fall Weekday AM and Fall/Summer Saturday Midday – LOS E; Summer Weekday PM – LOS F)
- Bourne Bridge SB – (Summer Weekday AM, Fall Weekday PM, and Fall Saturday Midday – LOS E; Fall Weekday AM, Summer Weekday PM, and Summer Saturday Midday – LOS F)
- Bourne Bridge Northbound (NB) – (Fall Weekday PM – LOS E; Summer Weekday PM – LOS F)
- State Route 25 SB Exit 10 merge – (Summer Weekday PM and Summer Saturday Midday – LOS F)

- State Route 3 SB approaching Exit 1A (Scenic Highway) – (Fall Weekday PM and Summer Saturday Midday – LOS E; Summer Weekday PM and Fall Saturday Midday – LOS F)
- Sagamore Bridge SB – (Fall/Summer Weekday AM and Fall Saturday Midday – LOS E; Summer Weekday PM and Summer Saturday Midday – LOS F)
- Sagamore Bridge NB – (Fall/Summer Weekday AM and Fall Saturday Midday – LOS E; Fall/Summer Weekday PM and Summer Saturday Midday – LOS F)
- U.S. Route 6 SB south of Sagamore Bridge – (Summer Saturday Midday – LOS E)
- U.S. Route 6 NB south of Sagamore Bridge – (Fall Weekday PM – LOS F)
- State Route 3 SB Diverge to Exit 1A – (Summer Weekday PM – LOS F)
- U.S. Route 6 NB Merge from Cranberry Highway – (Summer Weekday PM – LOS F)

6.4 VISSIM 11 Analysis

Existing conditions were modeled for each of the six peak hours previously identified using PTV's VISSIM traffic microsimulation software for all key intersections, rotaries and traffic circles, and freeway segments within a 2-mile radius of the Sagamore and Bourne Bridges. **Attachment 2, Tables B-4 through B-6**, present the VISSIM model results.

MassDOT calibrated models to match existing conditions, such as vehicle queueing and traffic volumes as well as travel-time information from INRIX. **Attachment 2, Table B-3**, presents a comparison of model outputs to real-world data. **Attachment 2, Table B-9**, presents the factors that MassDOT modified during the calibration process.

6.4.1 Level of Service

According to the VISSIM model simulations, congestion was observed along all major Study Area highways under all study peak periods. **Attachment 2, Tables B-4 through B-6**, present the model LOS results. **Attachment 2, Figures B-6 through B-8**, present graphical representations of the levels of service along the Study Area highways.

6.4.2 Processed Volumes

Processed volumes indicate the number of vehicles that were able to move through the Study Area in an hour, which is based on the demand and capacity. **Attachment 2, Table B-5**, provides a comparison between the VISSIM processed volumes and 2019 Base Year traffic volume flow maps. **Attachment 2, Table B-5**, highlights the locations in which the VISSIM model processes less than 80% of the expected volume based on 2019 Base Year traffic volume flow maps. Such differences could be expected in a microsimulation model of this size and could be attributed to the upward balancing of traffic volumes that are unable to be processed through congested intersections due to capacity constraints. **Table 6-1** summarizes the overall number of vehicles processed by the 2019 Base Year Fall PM VISSIM model, which serves as the design peak hour, as well as the percentage of vehicles processed compared to the vehicles input into the model. Overall, the VISSIM model processed slightly less than 80% of the expected volume.

Table 6-1. 2019 Base Year VISSIM Processed Vehicles

Alternative	Total Number of Processed Vehicles	Percentage of Processed Vehicles Compared to Vehicle Input
2019 Base Year	10,705	79.7

6.4.3 Travel Times

Table 6-2 provides a summary of the 2019 Base Year VISSIM model network travel-time results for the Fall Weekday PM peak hour. The network travel times are the summation of the travel times for all vehicles within the network.

Table 6-2. 2019 Base Year VISSIM Model Network Travel-Time Results

Metric	Fall Weekday PM Peak
Network Travel Times (vehicle-hours traveled)	2,397

7 2050 Design Year Traffic Analysis

MassDOT updated the existing conditions traffic models developed for the 2019 Base Year to include the projected 2050 Design Year traffic volumes. **Attachment 3** includes the 2050 No Build Alternative conditions traffic volume flow maps. **Attachment 4** includes the 2050 Build Alternative traffic volume flow map.

7.1 2050 Design Year Synchro Analysis

LOS tables summarizing the 2050 No Build Alternative and 2050 Build Alternative capacity and queue analyses performed in Synchro for Fall PM and Summer Saturday Midday at all Study Area intersections are provided in **Attachment 3, Table C-1**, for the 2050 No Build Alternative condition models, and **Attachment 4, Table D-1**, for the 2050 Build Alternative condition models. Graphical representations of the intersection levels of service are provided in **Attachment 3, Figure C-3**, for the 2050 No Build Alternative analysis and **Attachment 4, Figure D-3**, for the 2050 Build Alternative analysis.

During the Fall PM peak hour, most of the intersections analyzed operate at overall intersection LOS D or better. The following locations within the focus area operate at LOS E or F:

- Scenic Highway (U.S. Route 6) at Nightingale Road/Andy Olivia Drive (LOS E – 2050 No Build Alternative)
- Sandwich Road/County Road at Trowbridge Road/Shore Road (LOS F – 2050 No Build Alternative)

- Sandwich Road at Bourne Rotary Connector (LOS F – 2050 No Build and 2050 Build Alternatives)
- Sandwich Road at Upper Cape Cod Technical School (LOS F – 2050 No Build and 2050 Build Alternatives)
- Scenic Highway (U.S. Route 6) at State Route 3 SB Off-Ramp (LOS E – 2050 No Build Alternative)
- Meetinghouse Lane at State Road/Canal Street (LOS F – 2050 No Build Alternative)
- Cranberry Highway at Sandwich Road/Regency Drive (LOS F – 2050 No Build and 2050 Build Alternatives)

During the Summer Saturday Midday peak hour, most of the intersections analyzed operate at overall intersection LOS D or better, with the following exceptions:

- Scenic Highway (U.S. Route 6) at Nightingale Road/Andy Olivia Drive (LOS F – 2050 No Build Alternative)
- Sandwich Road/County Road at Trowbridge Road/Shore Road (LOS F – 2050 No Build Alternative)
- Sandwich Road at Bourne Rotary Connector (LOS E – 2050 Build Alternative; LOS F – 2050 No Build Alternative)
- Scenic Highway (U.S. Route 6) at Church Lane (LOS F – 2050 No Build Alternative)
- Scenic Highway (U.S. Route 6) at State Route 3 SB Off-Ramp (LOS E – 2050 No Build Alternative)
- Cranberry Highway at Sandwich Road/Regency Drive (LOS F – 2050 No Build Alternative)

Further design refinement will seek to improve estimated traffic operations at locations currently estimated to operate at LOS E or F.

7.2 2050 Design Year Sidra Analysis

LOS tables that summarize the results of the projected 2050 No Build Alternative and 2050 Build Alternative capacity and queue analyses performed in Sidra for Fall PM and Summer Saturday Midday peak hours, at all Study Area unsignalized traffic circles and rotaries can be found in **Attachment 3, Table C-1**, for the 2050 No Build Alternative analysis and **Attachment 4, Table D-1**, for the 2050 Build Alternative analysis. A graphical representation of the intersection levels of service is provided in **Attachment 3, Figure C-3**, for the 2050 No Build Alternative analysis and **Attachment 4, Figure D-3**, for the 2050 Build Alternative analysis.

Bourne Rotary, which was analyzed only under the 2050 No Build Alternative, and Belmont Circle each operate at overall LOS F during the peak hours analyzed for the fall and summer seasons. Heavy traffic volumes from all approaches combined with geometric constraints contribute to the poor levels of service at both intersections. Buzzards Bay Rotary carries lower volumes than the other two traffic circles and operates at overall LOS A or LOS B during Fall PM peak hour and LOS E or LOS F during the Summer Saturday Midday peak hour.

7.3 2050 Design Year Highway Capacity Software 7 Analysis

MassDOT performed HCS analysis for Fall PM and Summer Saturday Midday peak hours at the immediate key locations north and south of Bourne Bridge and Sagamore Bridge. A graphical representation of the LOS and density results of the freeway segments and merging-diverging segments is provided in **Attachment 3, Figure C-4**, for the 2050 No Build Alternative and **Attachment 4, Figure D-4**, for the 2050 Build Alternative.

Most freeway and weave/merge/diverge sections throughout the Study Area operate at LOS C or better during both analysis periods. The following locations within the focus area operate at LOS E or LOS F during Fall PM peak hour:

- State Route 25 SB north of Bourne Bridge (LOS F – 2050 Build Alternative)
- Bourne Bridge SB – (LOS E – 2050 No Build Alternative)
- Bourne Bridge NB – (LOS E – 2050 No Build Alternative)
- State Route 3 SB north of Sagamore Bridge – (LOS E – 2050 No Build and 2050 Build Alternatives)
- Sagamore Bridge Westbound (WB) – (LOS F – 2050 No Build Alternative)
- U.S. Route 6 WB south of Sagamore Bridge (LOS F – 2050 Build Alternative)

The following locations within the focus area operate at LOS E or LOS F during Summer Saturday peak hour:

- State Route 25 SB north of Bourne Bridge – (LOS E – 2050 No Build Alternative; LOS F – 2050 Build Alternative)
- Bourne Bridge SB – (LOS F – 2050 No Build Alternative)
- State Route 25 SB Exit 10 merge – (LOS F – 2050 No Build Alternative)
- State Route 28 SB merge – (LOS F – 2050 Build Alternative)
- State Route 3 SB north of Sagamore Bridge – (LOS E – 2050 No Build Alternative; LOS F – 2050 Build Alternative)
- Sagamore Bridge Eastbound (EB) – (LOS F – 2050 No Build Alternative)
- Sagamore Bridge WB – (LOS F – 2050 No Build Alternative)
- U.S. Route 6 EB south of Sagamore Bridge – (LOS F – 2050 Build Alternative)
- U.S. Route 6 WB south of Sagamore Bridge – (LOS E – 2050 No Build and 2050 Build Alternatives)

Fewer freeway and weave/merge/diverge sections are anticipated to operate at LOS E or F during either analysis period under the 2050 Build Alternative.

7.4 2050 Design Year VISSIM 11 Analysis

The 2050 No Build Alternative and Build Alternative conditions are compared in VISSIM on a network-wide basis to understand overall benefits to the Sagamore and Bourne Bridges area transportation network.

The VISSIM model predicted vehicle queues are presented in **Attachment 3, Figure C-5**, for the 2050 No Build Alternative and **Attachment 4, Figure D-6**, for the 2050 Build Alternative.

7.4.1 Processed Vehicles

Table 7-1 depicts the total number of vehicles processed by the 2050 No Build Alternative and 2050 Build Alternative conditions VISSIM models as well as the percentage of processed vehicles compared to the model vehicle input.

Table 7-1. 2050 Design Year VISSIM Processed Vehicles

Alternative	Total Number of Processed Vehicles	Percentage of Processed Vehicles Compared to Vehicle Input
2050 No Build Alternative	11,443	82.1%
2050 Build Alternative	12,402	85.9%

The data presented indicates that the 2050 Build Alternative conditions model processes more vehicles than the 2050 No Build Alternative conditions model. This suggests the 2050 Build Alternative condition network has a greater capacity to meet vehicle demands. Processed vehicles can also be a product of the number of vehicles input into the model. Relative to the vehicles input into each model, **Table 7-1** indicates that the 2050 Build Alternative also processes a greater percentage of the vehicles input into the model than the 2050 No Build Alternative.

7.4.2 Average Delay Per Vehicle Processed

Table 7-2 compares the average delay per vehicle processed (in minutes) of the 2050 No Build Alternative to the 2050 Build Alternative. The 2050 Build Alternative is estimated to reduce the average delay per vehicle processed from 4 minutes to 3.3 minutes. This metric indicates that vehicles in the 2050 Build Alternative model typically spend less time waiting or traveling slower than free-flow speed due to congestion than the 2050 No Build Alternative model.

Table 7-2. 2050 Design Year VISSIM Average Delay Per Vehicle (in minutes)

Alternative	Average Delay Per Vehicle (minutes)
2050 No Build Alternative	4.0
2050 Build Alternative	3.3

7.4.3 Travel Times

7.4.3.1 Total Network Travel Time

Table 7-3 compares the total network travel time for all vehicles that have processed through each network along with those vehicles active at the end of the simulation for the 2050 No Build Alternative and 2050 Build Alternative during the Fall Weekday PM peak hour. Despite processing more vehicles, the 2050 Build Alternative model recorded less total travel time (2,240 hours) in the network than the 2050 No Build Alternative (2,879 hours).

Table 7-3. 2050 Design Year VISSIM Travel Time (in hours)

Alternative	Total Network Travel Time (hours)
2050 No Build Alternative	2,879
2050 Build Alternative	2,240

7.4.3.2 Major Origin-Destination Evaluation

Travel time between O-D points along major routes within the Study Area was measured in VISSIM. The travel-time measurements presented in this technical report encompass both diagonal bridge crossings and through-bridge crossings.

Diagonal bridge crossings refer to vehicles entering the Study Area from either the Bourne Bridge or Sagamore Bridge side, using Scenic Highway or Sandwich Road, and exiting via the Sagamore Bridge or Bourne Bridge side. Major diagonal crossing O-D routes include the following:

- State Route 25 EB to U.S. Route 6 EB
- State Route 28 NB to State Route 3 NB
- State Route 3 SB to State Route 28 SB
- U.S. Route 6 WB to State Route 25 WB

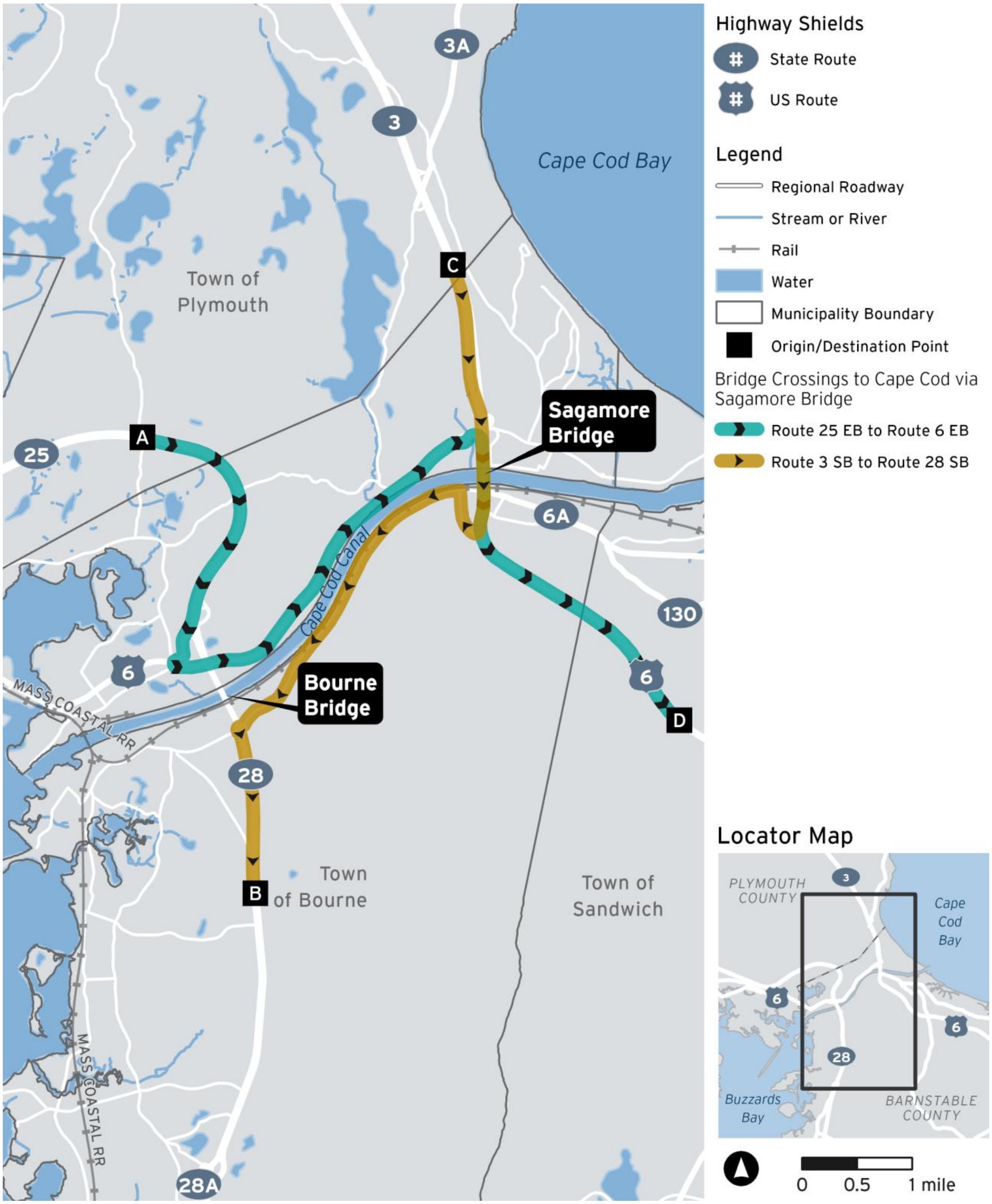
The State Route 25 EB to State Route 3 NB travel route is projected to be a major O-D route in the 2050 Design Year and is also discussed in the **Diagonal Bridge Crossings** section. **Figure 7-1** depicts the diagonal bridge crossings entering Cape Cod via Sagamore Bridge. **Figure 7-2** depicts the diagonal bridge crossings entering Cape Cod via Bourne Bridge. **Figure 7-3** depicts the diagonal bridge crossings exiting Cape Cod and should be noted are estimated to primarily use Sagamore Bridge.

Through-bridge crossings refer to direct passage through the Study Area along State Route 25/28 via Bourne Bridge or along State Route 3/U.S. Route 6 via Sagamore Bridge and are defined as follows:

- State Route 25 EB to State Route 28 SB
- State Route 28 NB to State Route 25 WB
- State Route 3 SB to U.S. Route 6 EB
- U.S. Route 6 WB to State Route 3 NB

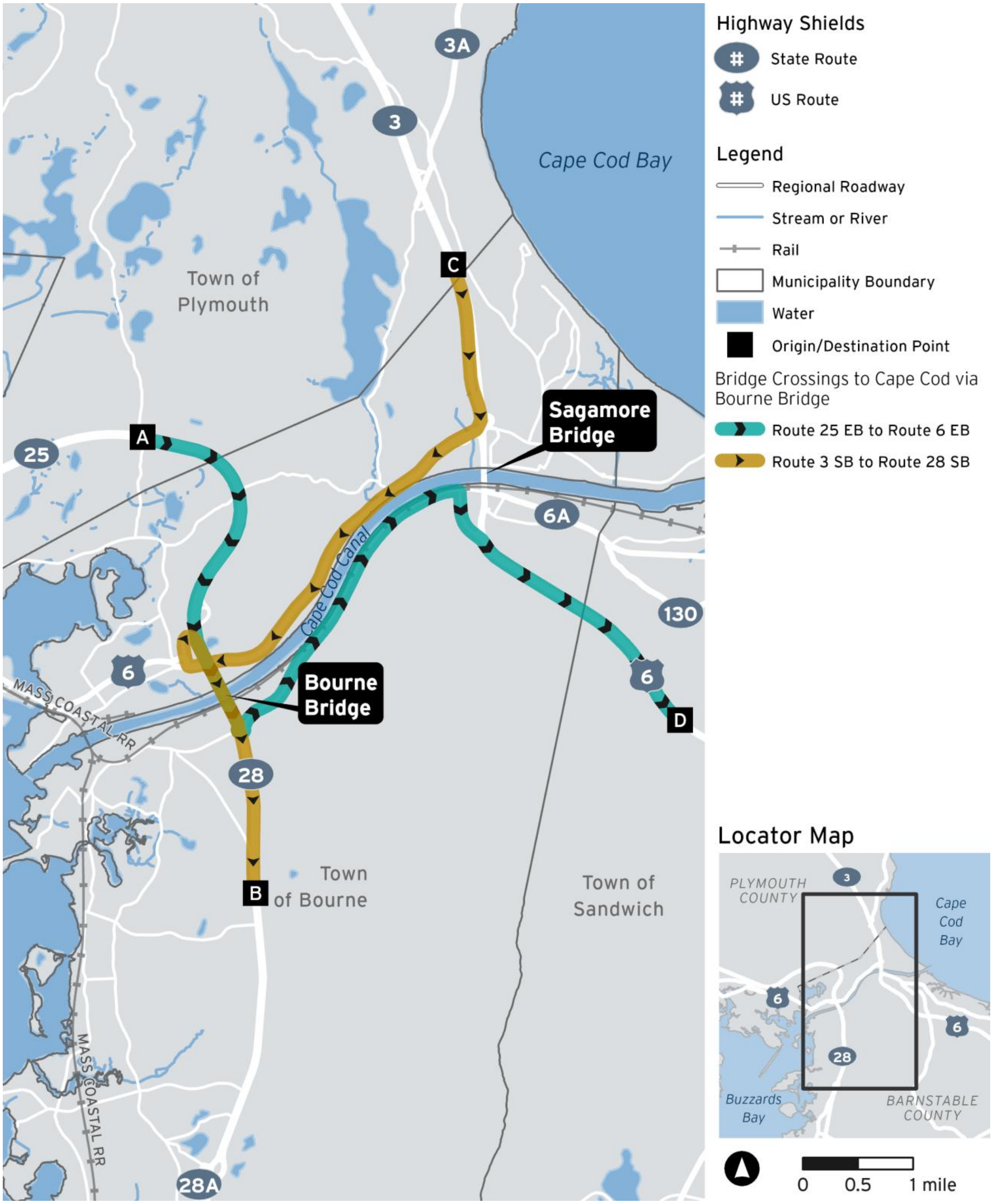
Figure 7-4 and **Figure 7-5** depict through-bridge crossings entering and exiting Cape Cod.

Figure 7-1. Diagonal Bridge Crossings from Mainland to Cape Cod via Sagamore Bridge



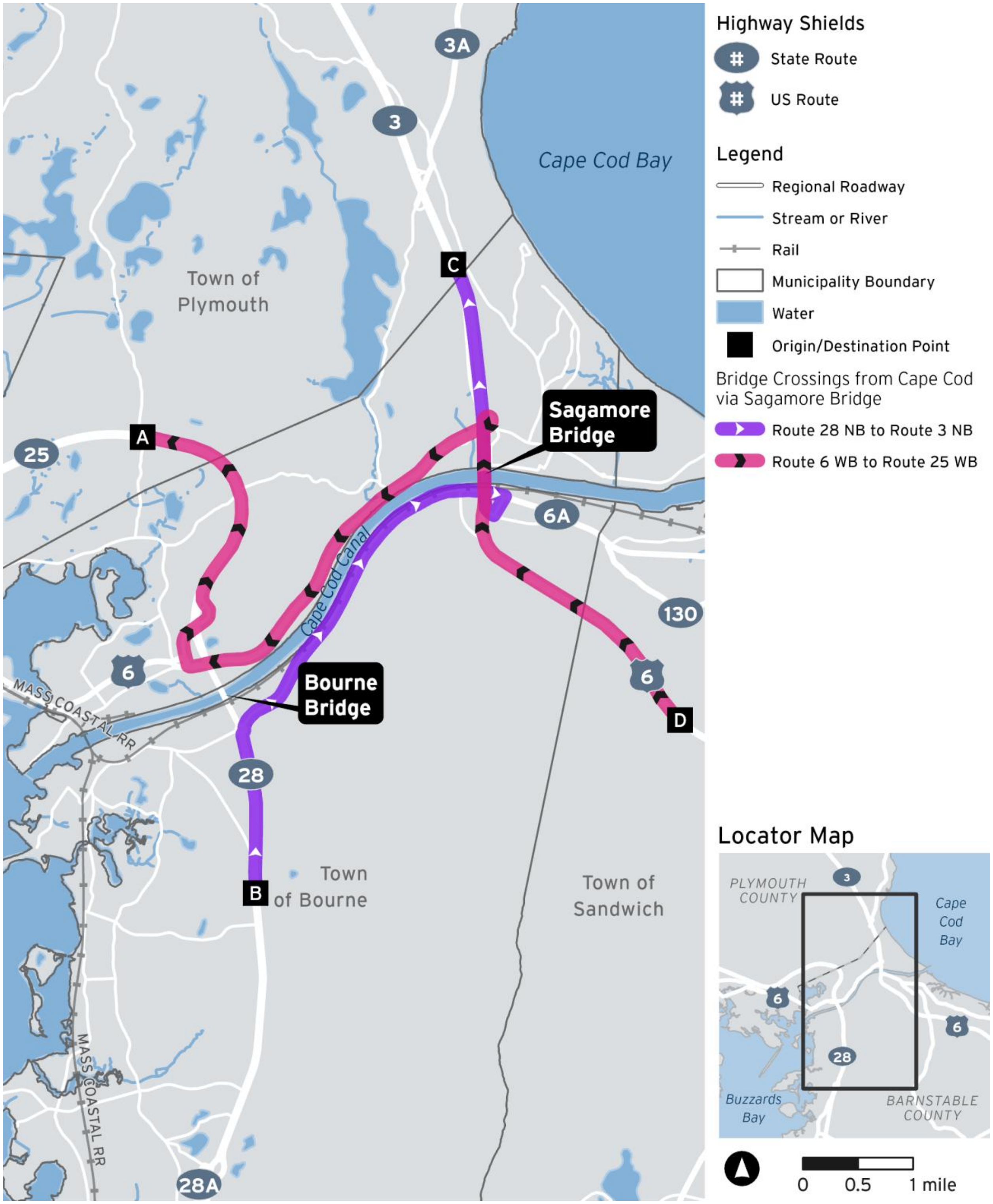
Source: Massachusetts Department of Transportation, 2024

Figure 7-2. Diagonal Bridge Crossings from Mainland to Cape Cod via Bourne Bridge



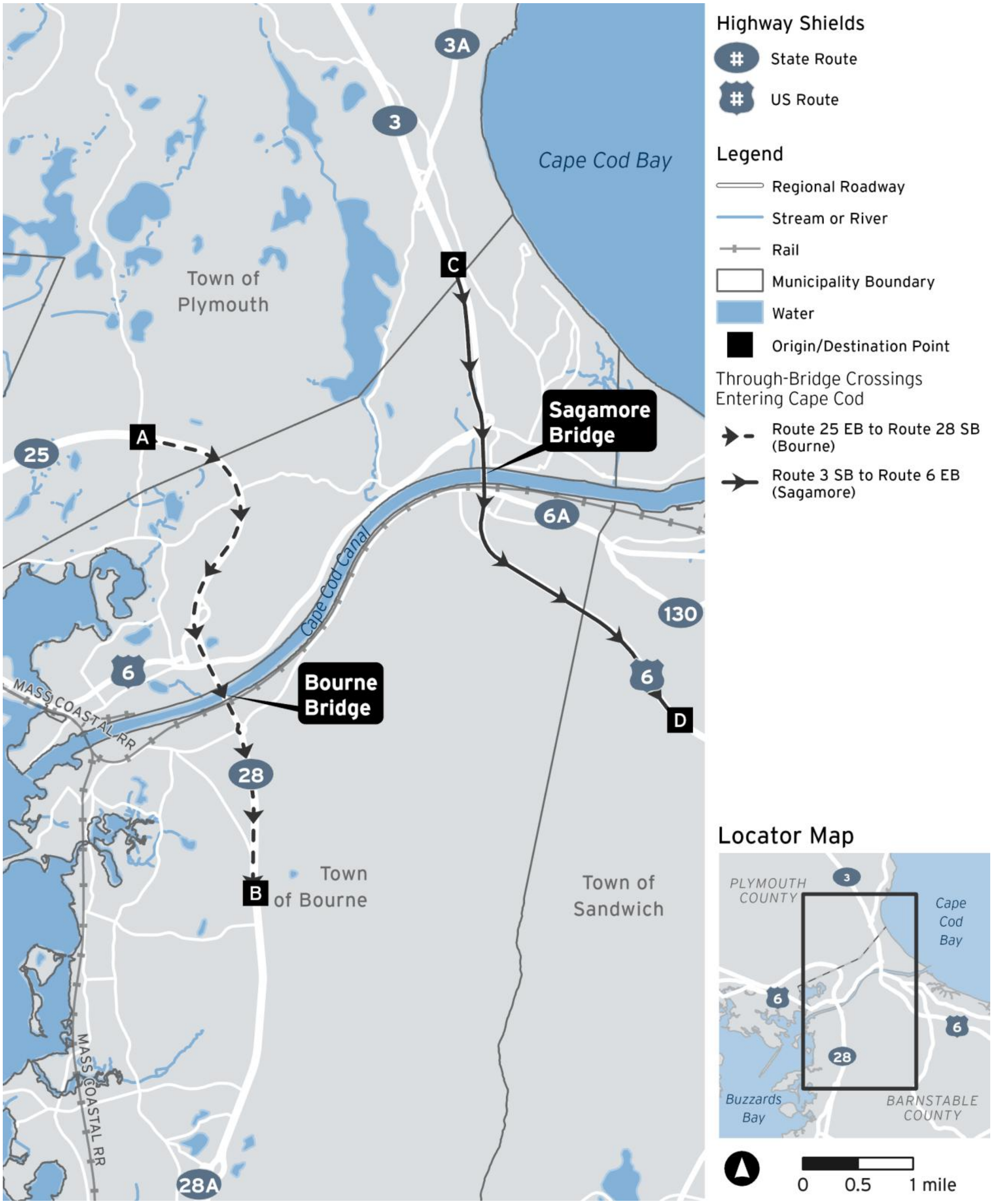
Source: Massachusetts Department of Transportation, 2024

Figure 7-3. Diagonal Bridge Crossings from Cape Cod to Mainland via Sagamore Bridge



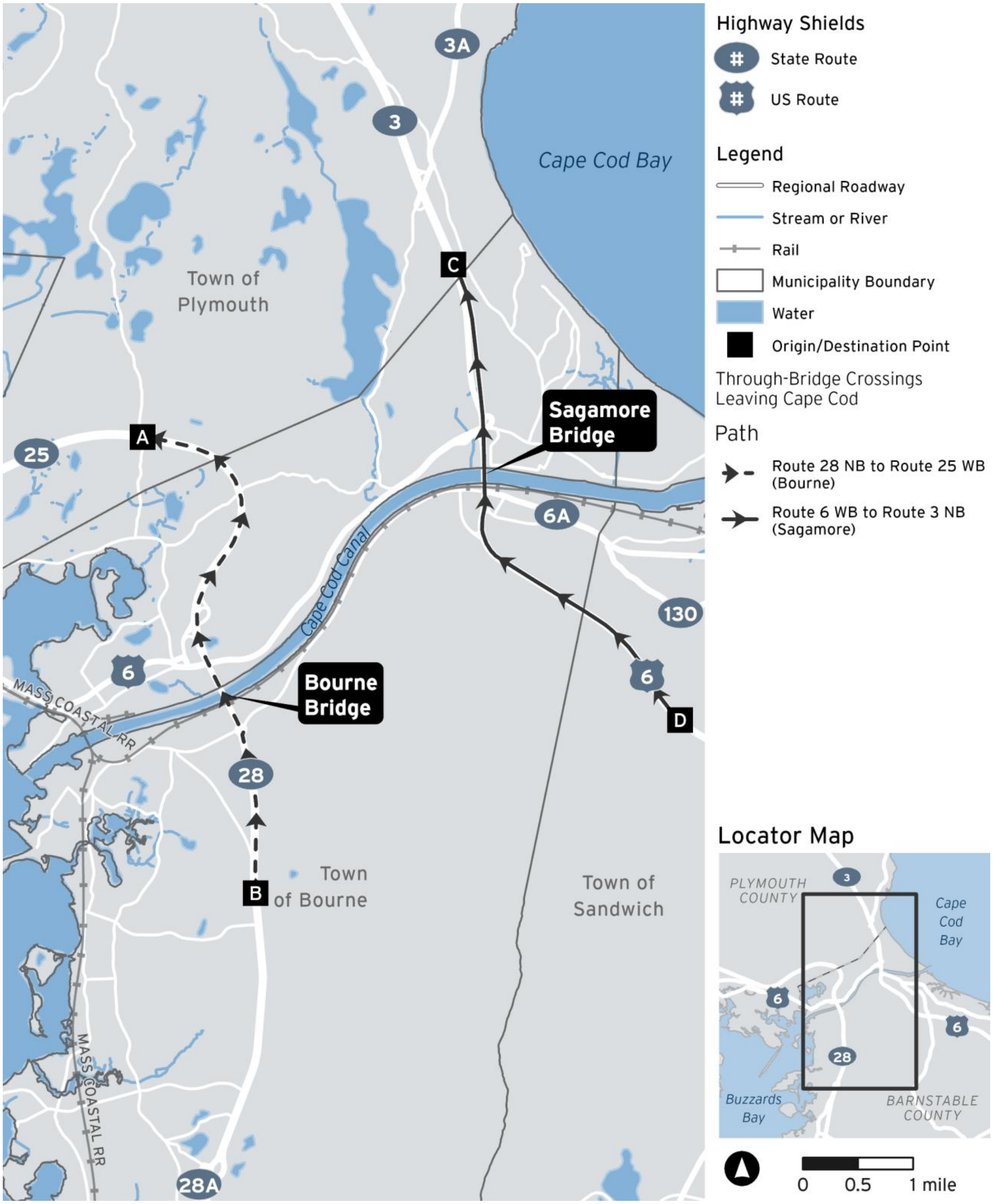
Source: Massachusetts Department of Transportation, 2024

Figure 7-4. Through-Bridge Crossings Entering Cape Cod



Source: Massachusetts Department of Transportation, 2024

Figure 7-5. Through-Bridge Crossings Exiting Cape Cod



Source: Massachusetts Department of Transportation, 2024

Diagonal Bridge Crossings

State Route 25 Eastbound to U.S. Route 6 Eastbound

According to the travel demand model O-D data, the primary access from State Route 25 EB to U.S. Route 6 EB is via Sandwich Road under the 2050 No Build Alternative but would shift to Scenic Highway under the 2050 Build Alternative. **Table 7-4** indicates that the travel time recorded along the route via Sandwich Road under the 2050 No Build Alternative is approximately 24.2 minutes. The travel time recorded along the preferred route of Scenic Highway under the 2050 Build Alternative is approximately 18.4 minutes (**Table 7-4**), offering a shorter duration trip than the 2050 No Build Alternative.

Table 7-4. State Route 25 Eastbound to U.S. Route 6 Eastbound Travel Time (in minutes)

Route	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Sandwich Road	24.2	14.9
Scenic Highway	20.6	18.4

State Route 28 Northbound to State Route 3 Northbound

Table 7-5 depicts the travel time from State Route 28 NB to State Route 3 NB via Sandwich Road. According to the O-D data, Sandwich Road is the primary route under both the 2050 No Build Alternative and 2050 Build Alternative. The 2050 Build Alternative travel time along Sandwich Road (12.6 minutes) is more efficient than that recorded under the 2050 No Build Alternative (15.9 minutes).

Table 7-5. State Route 28 Northbound to State Route 3 Northbound Travel Time (in minutes)

Route	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Sandwich Road	15.9	12.6

State Route 3 Southbound to State Route 28 Southbound

Table 7-6 depicts the travel time from State Route 3 SB to State Route 28 SB via Sandwich Road or Scenic Highway. According to the O-D data, both routes are used under both the 2050 No Build Alternative and the 2050 Build Alternative. The 2050 Build Alternative travel time along Scenic Highway (13 minutes) is more efficient than that recorded under the 2050 No Build Alternative (21.5 minutes) due to improvements in access between Scenic Highway and State Route 25. Via Sandwich Road, the 2050 No Build Alternative was recorded to have a slightly shorter travel time (19.1 minutes) than that recorded under the 2050 Build Alternative (20.2 minutes). This discrepancy can be attributed to the conceptual nature of the intersection configurations and any associated traffic signal timing along the route. As design refinements of intersection control, configuration, and any associated traffic signal timing continue, the travel time for the 2050 Build Alternative is expected to improve.

Table 7-6. State Route 3 Southbound to State Route 28 Southbound Travel Time (in minutes)

Route	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Scenic Highway	21.5	13.0
Sandwich Road	19.1	20.2

U.S. Route 6 Westbound to State Route 25 Westbound

Table 7-7 compares the travel time from U.S. Route 6 WB to State Route 25 WB via Scenic Highway for the 2050 No Build Alternative and the 2050 Build Alternative. According to the O-D data, Scenic Highway is the primary route. The travel time recorded in the models for this route via Scenic Highway under the 2050 Build Alternative is 11.7 minutes compared to the recorded time of 22.9 minutes under the 2050 No Build Alternative.

Table 7-7. U.S. Route 6 Westbound to State Route 25 Westbound Travel Time (in minutes)

Route	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Scenic Highway	22.9	11.7

State Route 25 Eastbound to State Route 3 Northbound

With improvements in access between State Route 25 and Scenic Highway, the travel time from State Route 25 EB to State Route 3 NB via Scenic Highway is recorded to improve from the 2050 No Build Alternative (19.6 minutes) to the 2050 Build Alternative (12.1 minutes) per **Table 7-8**.

Table 7-8. State Route 25 Eastbound to State Route 3 Northbound Travel Time (in minutes)

Route	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Scenic Highway	19.6	12.1

Through-Bridge Crossings

Bourne Bridge

According to **Table 7-9**, which depicts travel times in each direction between State Route 25 and State Route 28 over Bourne Bridge, the 2050 Build Alternative model offers more efficient travel times in each direction over Bourne Bridge than the 2050 No Build Alternative model.

Table 7-9. State Route 25 Eastbound to State Route 28 Southbound and State Route 28 Northbound to State Route 25 Westbound Travel Time (in minutes)

Bridge Direction	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Southbound	10.4	5.5
Northbound	14.5	6.4

Sagamore Bridge

Similarly, according to **Table 7-10**, which depicts travel times in each direction between State Route 3 and U.S. Route 6 over Sagamore Bridge, the 2050 Build Alternative model offers more efficient travel times in each direction over Sagamore Bridge than the 2050 No Build Alternative model.

Table 7-10. State Route 3 Southbound to U.S. Route 6 Eastbound and U.S. Route 6 Westbound to State Route 3 Northbound Travel Time (in Minutes)

Bridge Direction	2050 No Build Alternative (minutes)	2050 Build Alternative (minutes)
Southbound	11.4	4.7
Northbound	8.5	5.1

8 Summary of Findings

The 2050 Build Alternative traffic analysis estimates improvements to traffic operations compared to the 2050 No Build Alternative. Study area intersections as well as expressway mainline, and merging-diverging segments are expected to operate at improved levels of service during the Weekday Fall PM design peak hour analysis period. Critically, the 2050 Build Alternative is estimated to reduce vehicle delays and travel times compared to the 2050 No Build Alternative.

Overall, network travel time under the 2050 Build Alternative is estimated to decrease to 2,240 hours of total travel time compared to the 2,879 hours of total travel time estimated under the 2050 No Build Alternative. This indicates that vehicular mobility within the Study Area under the 2050 Build Alternative is anticipated to be more efficient than the 2050 No Build Alternative.

Travel times along all major O-D routes within the Study Area are estimated to improve under the 2050 Build Alternative compared to the 2050 No Build Alternative. This includes cross-canal diagonal bridge crossings as well as cross-canal through-bridge crossings. These estimated reductions in travel times along O-D routes reflect improved accessibility within the Study Area under the 2050 Build Alternative.

The 2050 Build Alternative, therefore, meets the purpose of the Program defined in **Section 2** to improve cross-canal mobility and accessibility between Cape Cod and mainland Massachusetts.

9 Glossary of Terms

Table 9-1. Glossary of Terms

Term	Definition
Capacity	Maximum traffic flow that can be accommodated on a given roadway facility.
Delay	An estimate of the extra time that a driver spends traveling compared to free-flow conditions.
Density	Number of vehicles per unit length of a road at a given time.
Level of Service	A qualitative measurement that describes the operating conditions of a roadway based on factors like travel time, speed, delay, maneuverability, and safety.
Performance Measures	Quantitative estimates on the performance of a transportation facility, service, program, system, scenario, or project with respect to policies, goals, and objectives.
Microsimulation	The modeling of individual vehicle movements on a second or subsecond basis for the purpose of assessing the traffic performance of highway and street systems, transit, and pedestrians.
Origin-Destination	The movement through a geographic space from an origin to a destination.
Queue	The line of vehicles that backs up behind a signal or stop sign, or behind motorists who are forced to yield to other traffic or pedestrian movements.

10 Attachments

Attachment 1 – 2019 Base Year Traffic Volume Flowmaps

Attachment 2 – 2019 Base Year Traffic Analysis

Attachment 3 – 2050 Design Year No Build Alternative Traffic Analysis

Attachment 4 – 2050 Design Year Build Alternative Traffic Analysis