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
MEPA	Massachusetts Environmental Policy Act
MRER/EA	Major Rehabilitation Evaluation Report/Environmental Assessment
NB	northbound
O-D	origin-destination
Program	Cape Cod Bridges Program
SB	southbound
SUP	share-use path
USACE	U.S. Army Corps of Engineers
WB	westbound

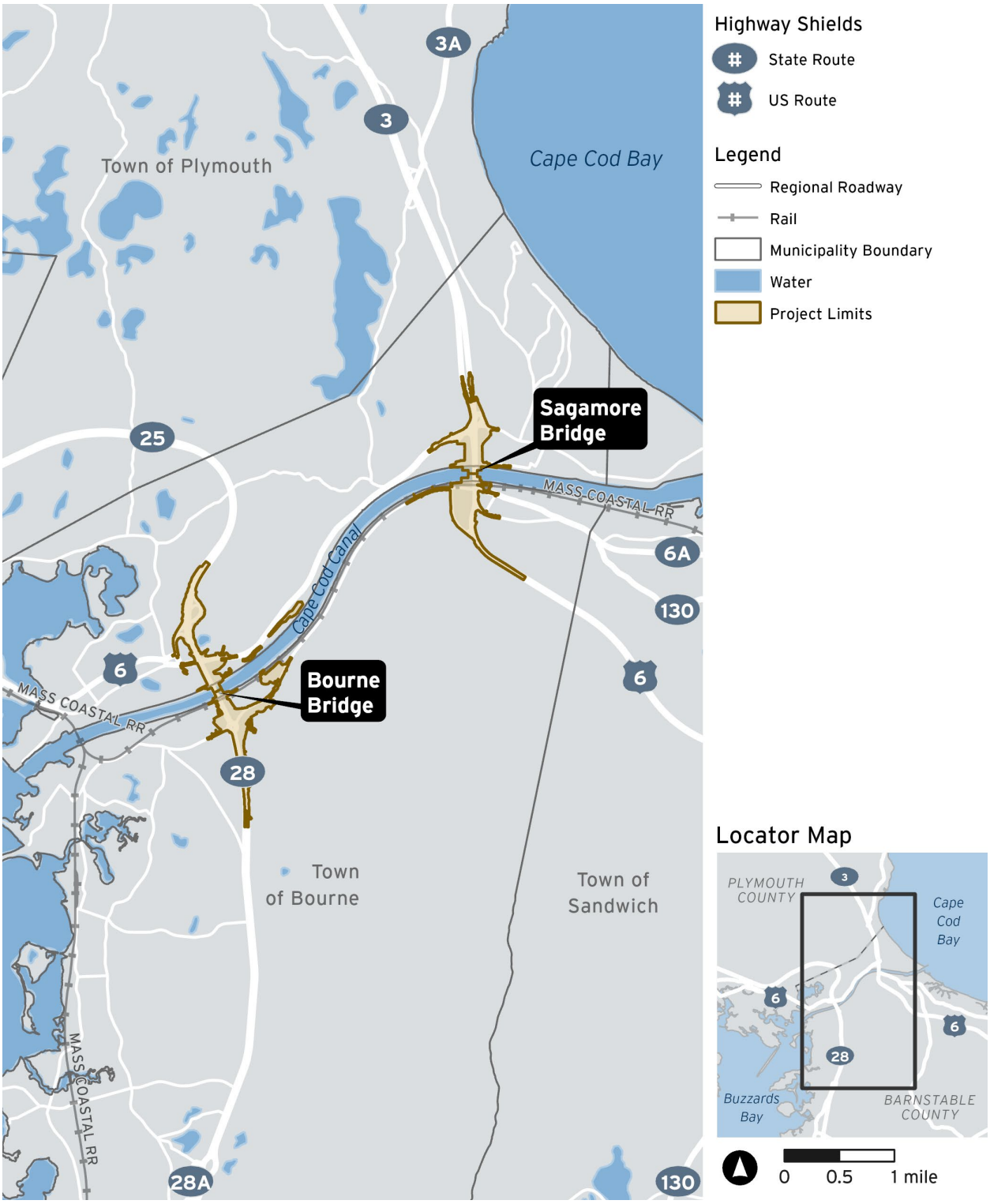
1 Introduction

This Traffic Engineering Technical Report supplements the discussion of traffic operations provided in the Final Environmental Impact Report (FEIR) and Final Environmental Impact Statement (FEIS) for the Cape Cod Bridges Program (Program), in accordance with the state and federal requirements of the Massachusetts Environmental Policy Act (MEPA; 301 CMR 11.00) and the National Environmental Policy Act (NEPA; 42 U.S.C. § 4321 et seq.).

The Program, led by Massachusetts Department of Transportation (MassDOT) in partnership with Federal Highway Administration (FHWA) and U.S. Army Corps of Engineers (USACE), proposes replacing the Sagamore and Bourne Bridges and reconfiguring their approach highway networks in Bourne, Massachusetts. The Project Limits are presented in **Figure 1-1.**

The purpose of this report is to evaluate the Program's potential effects on local and regional traffic operations. The analysis assesses 2019 Base Year conditions, and forecasts 2050 No-Build and Build conditions to understand existing traffic performance and future operations with and without the proposed improvements.

Figure 1-1. Program Project Limits



Source: Massachusetts Department of Transportation, 2026

2 Purpose and Need

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.

The needs for the Program to:

- 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.

The Sagamore and Bourne Bridges, both serving traffic since 1935, have deteriorated over time and are now beyond their functional service lives. Both bridges require frequent and costly maintenance by USACE due to their age, heavy traffic demands, and setting within the corrosive saltwater environment of Cape Cod Canal. Routine maintenance activities require lane closures, which typically restrict traffic to one lane in each direction for extended periods of time. These lane closures result in heavy backups for travelers waiting to cross the bridges, with traffic queues extending for several miles along the highway approaches and local roadways.

Both bridges are classified as functionally obsolete as they do not meet current MassDOT bridge and highway design standards for travel lane widths, median barrier separation, shoulder widths, and roadway grades. The 10-foot-wide travel lanes on the bridges are narrower than the standard 12-foot-wide lanes typically used on highways. The bridges lack physical separation between opposing traffic lanes and shoulders to provide emergency vehicle access and refuge for vehicle breakdowns or crashes. The roadway grades along the approaches to the bridges, up to 6% in some sections, are steeper than the 4% to 5% maximum grade typical for limited access highways. On State Route 3 heading south toward the Sagamore Bridge, the roadway narrows from two lanes to one, creating slowdowns and queuing. At the Bourne Rotary, located at grade on the southern end of the Bourne Bridge, high traffic volumes entering from multiple directions often result in delays and safety concerns.

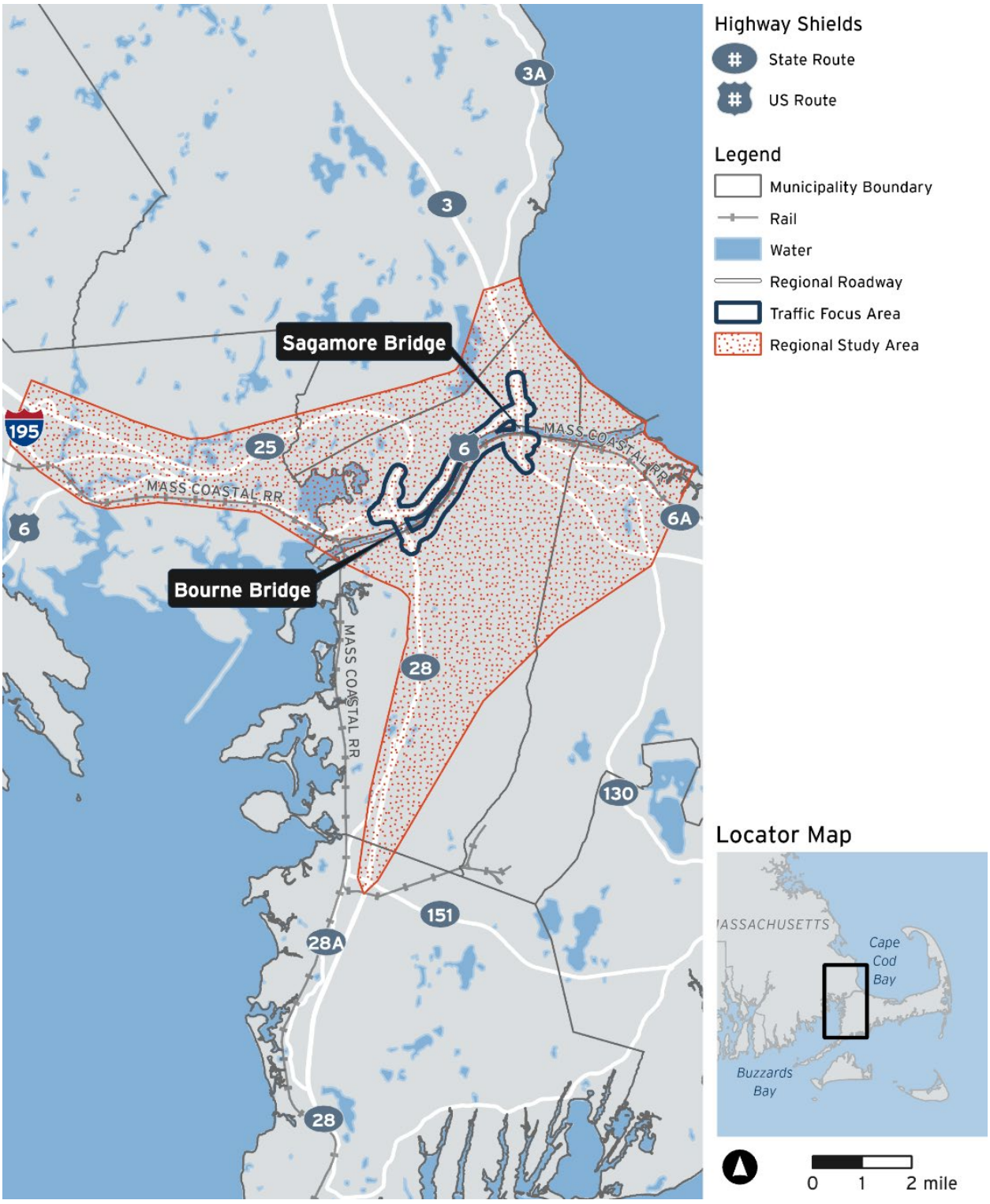
High traffic volumes on the bridges during peak travel periods, combined with narrow travel lanes, no shoulders, steep grades, and the absence of auxiliary lanes, contribute to poor traffic operations, recurring congestion, and high crash rates. Between 2017 and 2019, the most common types of crashes on the bridges were rear-end and same-direction side-swipe collisions, often associated with backups, narrow lanes, and sudden lane changes.

Both bridges have a narrow single raised sidewalk directly beside traffic with no barrier and steep grades that do not meet current accessibility standards. They also lack dedicated bicycle accommodation, and their sidewalks do not connect to nearby pedestrian or bicycle facilities.

3 Study Area

The Study Area includes a Traffic Focus Area for evaluating operations within an approximate two -mile radius of the Sagamore and Bourne Bridges. A broader regional Study Area is also used to assess potential operational effects on major roadways, interchanges, and intersections extending beyond the Focus Area, including locations in Plymouth, Wareham, Bourne, Sandwich, and Falmouth. **Figure 3-1** illustrates the Traffic Focus Area and Regional Study Area used to evaluate potential operational effects.

Figure 3-1. Study Area



Source: Massachusetts Department of Transportation, 2026

The Traffic Focus Area includes 15 intersections, and the Regional Study Area includes an additional 25 intersections. All intersections are listed in **Table 3-1**.

Table 3-1 Study Area Intersections

Quadrant	Intersection ID	Intersection	Study Area
Bourne North	1	Maple Springs Rd/Route 25 NB On-Ramp	Regional
	2	Maple Springs Rd/Route 25 SB Off-Ramp	Regional
	3	Glen Charlie Road/Route 25 NB Off-Ramp	Regional
	4	Glen Charlie Road/Route 25 SB On-Ramp	Regional
	5	Buzzards Bay Rotary	Regional
	6	Belmont Circle	Focus
	7	Scenic Highway (Route 6)/Main Street (Route 6)/Nightingale Road/Andy Oliva Drive	Focus
Bourne South	8	Sandwich Road/Trowbridge Road/County Road/Shore Road	Regional
	9	Trowbridge Road/Veterans Way	Focus
	10	Sandwich Road/Veterans Way	Focus
	11	Bourne Rotary	Focus
	12	Sandwich Road/Sandwich Road	Focus
	13	Sandwich Road/Upper Cape Cod Technical School Driveway	Focus
	14	Sandwich Road/Harbor Lights Road	Regional
	15	Sandwich Road/Jefferson Road (Tech Drive)	Regional
	16	Sandwich Road/Jarvis Road	Regional
	17	Nathan Ellis Highway (Route 151)/Route 28 NB Ramps	Regional
	18	Nathan Ellis Highway (Route 151)/Route 28 SB Ramps	Regional
Sagamore North	19	Herring Pond Road/State Road	Regional
	20	Herring Pond Road/Route 3 NB Ramps	Regional
	21	Herring Pond Road/Route 3 SB Ramps	Regional
	22	Scenic Highway (Route 6)/Church Lane/Route 6 SB On-Ramp	Focus
	23	Scenic Highway (Route 6) & Route 3 SB Off-Ramp	Focus
	24	Meetinghouse Lane/State Road/Scenic Highway	Focus
	25	State Road/Route 3 NB On-Ramp	Focus
	26	Sandwich Road/Mid-Cape Connector	Focus

Quadrant	Intersection ID	Intersection	Study Area
Sagamore South	27	Mid-Cape Connector/Factory Outlet Way	Focus
	28	Cranberry Highway/Adams Street	Focus
	29	Sandwich Road/Adams Street	Focus
	30	Cranberry Highway/Sandwich Road/Regency Drive	Regional
	31	Old King's Highway (Route 6A)/Main Street (Route 130)/Tupper Road	Regional
	32	Old King's Highway (Route 6A)/Tupper Road	Regional
	33	Water Street (Route 130)/Beale Avenue	Regional
	34	Main Street/Beale Avenue	Regional
	35	Old King's Highway (Route 6A)/Main Street/Old Main Street	Regional
	36	Forestdale Road (Route 130)/Route 6 EB Ramps	Regional
	37	Water Street (Route 130)/Route 6 WB Ramps	Regional
	38	Quaker Meeting House Road/Route 6 EB Ramps	Regional
	39	Quaker Meeting House Road/Route 6 WB Ramps	Regional
	40	Route 130/Cotuit Road	Regional

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 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. 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 2026-2030 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, 2026-2030 in the No Build Alternative

Project Number	Year	Transportation Project	Project Description	Status (as of October 2025)
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)	Completed
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	Completed
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	Underway

[1] The Cape Cod Metropolitan Planning Organization's Transportation Improvement Program was endorsed on May 19, 2025, and amended on November 17, 2025.

Project Number	Year	Transportation Project	Project Description	Status (as of October 2025)
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
613864	—	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

Project Number	Year	Transportation Project	Project Description	Status (as of October 2025)
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	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	Underway
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	—	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	Not Programmed
612063	2030	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

Project Number	Year	Transportation Project	Project Description	Status (as of October 2025)
613199	—	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	Not 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

Source: Cape Cod Transportation Improvement Program for FFY 2026-2030[2]

Notes:

— No date available.

Table 4-1 includes only those projects in the Federal Fiscal Year (FFY) 2026-2030 Transportation Improvement Program (TIP) within the Study Areas that are part of the No Build Alternative.

The No-Build Alternative represents the "Fix as Fails" Base Condition of USACE's Major Rehabilitation Evaluation Report and Environmental Assessment (MRER/EA). In the No-Build Alternative, 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 USACE's operations and maintenance program could correct the deficiencies and restore and sustain reliability. 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.

[2] https://www.capecodcommission.org/resource-library/file/?url=/dept/commission/team/tr/Transportation%20Plans/TIP/FY2026-2030%20TIP/Endorsement%20Files/Cape_Cod_2026-2030_Transportation_Improvement_Program%20-%20Adjusted%20Dec%2015%202025.pdf

- 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 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 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. Cape Cod Bridges Program Preferred Alternative

Program Element/ Program Design Parameter	Description
Highway Bridges	Replacement of both highway bridges with new bridges with four through-traffic lanes and two auxiliary lanes (in-kind bridge replacement updated to comply with federal and state highway and design safety standards).
Highway Bridge Cross-Section and Shared-Use Path	Each replacement highway bridge span would provide two 12-foot-wide through-traffic lanes (one in each direction), one 12-foot-wide entrance/exit (auxiliary) lane, a 6-foot-wide median shoulder, and a 12-foot-wide exterior shoulder. Each crossing location would include one bidirectional pedestrian and bicycle shared-use path, separated from vehicular traffic by the shoulder and barrier. The usable width of the shared-use path 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.

Program Element/ Program Design Parameter	Description
Bridge Vertical and Horizontal Clearances	The replacement bridges would maintain the existing vertical clearance of 135 feet above mean high water and account for 3.3 feet of fluctuations in relative sea level, thereby providing a vertical clearance of 138.3 feet above mean high water. The replacement bridges would provide a minimum 500 feet of horizontal channel width consistent with the authorized navigational channel width and existing conditions.
Main Span Length and Bridge Pier Location	The replacement bridges would have a main span length of approximately 720 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 bridge (Sagamore and Bourne) would have two separate decks (twin structures).
Mainline Alignment	The mainline alignment locations at both bridges would be offline inboard. Both main spans of the replacement highway bridges would be outside the footprint of the existing bridge, 7 feet apart and parallel to each other (offline), and on the side of Cape Cod Canal between the existing bridges (inboard). The replacement main spans at the Sagamore crossing be west of existing Sagamore Bridge toward Buzzards Bay. The replacement main spans at the Bourne crossing would be east of existing Bourne Bridge toward Cape Cod Bay.
Bridge Type	The replacement bridges would be steel twin network tied-arch bridges with delta frames supporting a 720-foot mainline span.
Interchange Approach Network	Interchange approach improvements at each bridge would be as follows: • Sagamore Bridge Crossing: Direct connection to State Road in the Sagamore North quadrant and Westbound On-Ramp Under U.S. Route 6 with Sandwich Road Extension in the Sagamore South quadrant • Bourne Bridge Crossing: Directional Interchange in the Bourne North quadrant and a Diamond Interchange in the Bourne South quadrant
Interchange Approach Network: Sagamore North Quadrant	The selected interchange approach option for the Sagamore North quadrant is: Direct Connection to State Road (Option SN-8A). Option SN-8A would provide a single exit point from a relocated U.S. Route 6/State Route 3. It would remove the Sagamore Bridge northbound off-ramp connection to Scenic Highway/Meetinghouse Lane eastbound, and instead it would connect to State Road, north of Scenic Highway/ Meetinghouse Lane. The remaining ramp connections would remain similar to existing conditions with geometric adjustments to meet the new mainline location. A double roundabout would replace the signalized intersection of Scenic Highway/Meetinghouse Lane/State Road/Canal Street. Signalized intersections along Scenic Highway would be modified for new lane

Program Element/ Program Design Parameter	Description
	configurations. The intersection of State Road at State Route 3 northbound on-ramp would be modified to accommodate the addition of the new State Route 3 northbound off-ramp with installation of a traffic signal. Option SN-8A would provide a shared-use path on the U.S. Route 6 eastbound main span that would provide connections to the south side of Scenic Highway, Canal Street, and Canal Service Road. This option would provide shared-use paths along the southern side of Scenic Highway and Meetinghouse Lane, as well as along the eastern side of State Road to Homestead Avenue and Canal Street to Bourne Park and Ride.
Interchange Approach Network: Sagamore South Quadrant	The selected interchange approach option for the Sagamore South quadrant is: Westbound On-Ramp Under U.S. Route 6 with Sandwich Road Extension (Option SS-3.1A). Option SS-3.1A would include Cranberry Highway Extension and would relocate the westbound on-ramp so it would share the same entrance point as the eastbound on-ramp off Mid-Cape Connector. Modifications to lane arrangements at the intersections of Mid-Cape Connector with Sandwich Road and Cranberry Highway Extension would accommodate the revised traffic patterns resulting from the extension of Cranberry Highway and the relocation of access to U.S. Route 6 (Scenic Highway) eastbound, including modifications to the existing traffic signals. There would be a connection from Cranberry Highway to Sandwich Road east of the new mainline bridge (Sandwich Road Connector). A roundabout would be provided at the intersection of the U.S. Route 6 westbound off-ramp with Cranberry Highway. An additional roundabout would be provided along Cranberry Highway providing access to Market Basket (Factory Outlet Road). There would be an access driveway to the former Christmas Tree Shops area. Option SS-3.1A would include a shared-use path on the U.S. Route 6 eastbound main span that would provide connections to Factory Outlet Road, Sandwich Road, and Canal Service Road. Pedestrian and bicycle improvements would also be included on Cranberry Highway. This option would add a new connection through Cranberry Highway Extension to Mid-Cape Connector.
Interchange Approach Network: Bourne North Quadrant	The selected interchange approach option for the Bourne North quadrant crossing is: Directional Interchange (BN-14.4b). Option BN-14.4b would provide a combination of direct-connection ramps between State Route 25 and U.S. Route 6 (Scenic Highway). The ramp connecting State Route 25 eastbound to Scenic Highway would be a flyover ramp passing over Nightingale Road and merging with the on-ramp from Belmont Circle before meeting up with State Route 25 mainline. The ramp connecting Scenic Highway eastbound to State Route 25 eastbound would be a

Program Element/ Program Design Parameter	Description
	flyover ramp passing over Scenic Highway, allowing vehicles to bypass Belmont Circle and eliminating the need for an additional traffic signal. This ramp would use one of the travel lanes on Scenic Highway and be a free-flowing movement to reduce congestion. The existing interchange ramp over the State Route 25 bridge would be relocated to widen the bridge and allow for this new southbound to eastbound ramp movement. The existing southbound off-ramp would be revised to be an option lane, improving the geometry and decision sight distance for drivers. The intersection control at Scenic Highway/Nightingale Road/Andy Oliva Drive would be provided by a single-lane roundabout. The new flyover ramp over Scenic Highway would provide a shared-use path and grade-separated crossing for pedestrians and bicyclists. The Scenic Highway Lane configuration would be reduced from four lanes to three lanes, which would provide additional space for multimodal accommodations. It would provide one continuous 12-foot-wide shared-use path along the south side of Scenic Highway connecting to Belmont Circle and a 6-foot-wide sidewalk along the north side of Scenic Highway.
Interchange Approach Network: Bourne South Quadrant	The selected interchange approach option for the Bourne South quadrant is: Diamond Interchange (BS-2). Option BS-2 would eliminate Bourne Rotary and replace it with a grade-separated diamond interchange, which would allow through movements on State Route 28 to bypass intersections with the non-mainline roadways. The two intersections within the diamond interchange would be a single-lane dogbone roundabout). Changes to the Trowbridge Road and Sandwich Road underpass in this option would consist of a roundabout at a relocated Upper Cape Cod Regional Technical High School driveway entrance. Option BS-2's shared-use path improvements would include providing connections to Trowbridge Road, Canal Service Road, and Bourne Recreation Area.

Since the publication of the DEIS, intersection control types were evaluated for each of the intersections proposed to be modified by the Build Alternative. **Table 4-3** includes an explanation of the control type selected for each intersection in the Sagamore North and Sagamore South quadrants. **Table 4-4** includes an explanation of the control type selected for each intersection in the Bourne North and Bourne South quadrants.

Table 4-3. Intersection Control Summary: Sagamore

Quadrant	Intersection	Viable Control Strategies	Primary Reason Other Controls Not Viable	Selected Preferred Control Strategy and Justification
Sagamore North	Scenic Highway/Church Lane/Route 6 Eastbound On-Ramp	Roundabout, Traffic Signal	• TWSC – intersection operates over capacity • AWSC – intersection operates over capacity • U-turn, Jughandle and DLT intersections have ROW impacts and proximity of the Scenic Highway/Southbound Off-Ramp limits the ability to provide the required geometric modifications.	**Traffic Signal**: Maintains existing traffic control. Profile grade on Scenic Highway is 6% through the intersection. Providing a flatter grade for a roundabout would require steeping the profile to 7% and extensive reconstruction of Scenic Highway.
Sagamore North	Scenic Highway/ Route 3 Southbound Off-Ramp	Roundabout, Traffic Signal	• TWSC – intersection operates over capacity • AWSC – intersection operates over capacity • Since there are no left turns on Scenic Highway, U-turn, Jughandle and DLT intersections are not applicable for this intersection.	**Traffic Signal**: Maintains existing traffic control. Provides opportunity to manage queuing between the nearby signal at Church Lane/Eastbound On-Ramp. Larger footprint of a roundabout would have additional grading impacts compared to signal.
Sagamore North	Scenic Highway/ State Road/ Meetinghouse Lane/ Canal Street	Roundabout, Traffic Signal	• TWSC – intersection operates over capacity • AWSC – intersection operates over capacity • U-turn, Jughandle and DLT intersections have significant ROW impacts	**Roundabout**: Roundabouts provide better operations with shorter queues compared to installation of traffic signals.

Quadrant	Intersection	Viable Control Strategies	Primary Reason Other Controls Not Viable	Selected Preferred Control Strategy and Justification
Sagamore North	State Road/Route 3 Northbound Ramps	Roundabout, Traffic Signal	• TWSC – intersection operates over capacity • AWSC – intersection operates over capacity • U-turn, Jughandle and DLT intersections have significant ROW impacts	**Traffic Signal**: Traffic signal does not reduce ramp lengths or impact maintenance depot.
Sagamore South	Sandwich Road/ Mid-Cape Connector	Roundabout, Traffic Signal	• TWSC –intersection operates over capacity • AWSC –intersection operates over capacity • U-turn, Jughandle and DLT intersections have significant ROW impacts	**Traffic Signal**: Maintains existing traffic control. Larger footprint of a roundabout and profile changes would have additional grading and property impacts compared to signal.
Sagamore South	Sandwich Road/ Sandwich Road Connector	Roundabout, Traffic Signal	• TWSC –intersection operates over capacity • AWSC –intersection operates over capacity • U-turn, Jughandle and DLT intersections have significant ROW impacts	**Traffic Signal**: Larger footprint of a roundabout and profile changes would have additional grading impacts and impacts to the use of the commercial building compared to signal. Provides opportunity with coordination to manage WB queues at the adjacent signal at Mid-Cape Connector.
Sagamore South	Mid-Cape Connector/Cranberry Highway Extension	Roundabout, Traffic Signal	• TWSC –intersection operates over capacity • AWSC –intersection operates over capacity • U-turn, Jughandle and DLT intersections are geometrically constrained by adjacent intersections	**Traffic Signal**: Maintains existing traffic control and allows for signalized SUP crossing. Profile changes for roundabout would have more grading/ROW impacts compared to signal.

Quadrant	Intersection	Viable Control Strategies	Primary Reason Other Controls Not Viable	Selected Preferred Control Strategy and Justification
Sagamore South	Cranberry Highway Extension/Market Basket East Driveway	Roundabout, Traffic Signal	• TWSC –intersection operates over capacity • AWSC –intersection operates over capacity • U-turn, Jughandle and DLT intersections are geometrically constrained by adjacent intersections	**Roundabout**: Roundabout preferred over traffic signal for safety and shorter queues.
Sagamore South	Cranberry Highway/ Route 6 Westbound Off-Ramp/Sandwich Road Connector	Roundabout, Traffic Signal	• TWSC –intersection operates over capacity • AWSC –intersection operates over capacity • Ability to make left turns at adjacent intersections negates effectiveness of U-turn, Jughandle and DLT intersections	**Roundabout**: Roundabout preferred over traffic signal for safety and shorter queues.
Sagamore South	Cranberry Highway/ Adams Street	Stop Control, Roundabout	• Ability to make left turns at adjacent intersections negates effectiveness of U-turn, Jughandle and DLT intersections • Traffic Signal – does not meet volume warrants	**Stop Control**: Maintains existing two way stop control. No ROW impacts with Stop Control.

Table 4-4. Intersection Control Summary: Bourne

Quadrant	Intersection	Viable Control Strategies	Primary Reason Other Controls Not Viable	Selected Preferred Control Strategy and Justification
Bourne North	Scenic Highway/ Nightingale Road/Andy Oliva Drive	Roundabout	• TWSC – removing existing Traffic Signal would eliminate pedestrian crossing. • AWSC – volumes do not meet MUTCD criteria for multiway stop. • Traffic Signal – does not meet volume warrants. • U-Turn, Jughandle and DLT 3 intersections have abutter impacts the intersection has left turn volumes to justify impacts.	**Roundabout**: Only viable control strategy as a traffic signal is not warranted and stop-control is not feasible from operational or safety perspective.
Bourne South	Trowbridge Road/ Southbound Off-Ramp/ Frontage Road	Roundabout, Traffic Signal	• TWSC – intersection operates over capacity. • AWSC – intersection operates over capacity. • U-Turn, Jughandle and DLT intersections have significant ROW impacts.	**Roundabout**: Only viable control strategy considering system of diamond interchange and proximity to NB Ramps. Roundabout preferred over Traffic Signal for safety and operations.
Bourne South	Trowbridge Road/ Northbound Ramps	Roundabout	• TWSC – intersection operates over capacity. • AWSC – intersection operates over capacity. • Traffic Signal – does not meet volume warrants. • U-Turn, Jughandle and DLT intersections have significant ROW impacts.	**Roundabout**: Only viable control strategy as a traffic signal is not warranted and stop-control is not feasible from operational or safety perspective.
Bourne South	Frontage Road/ Southbound On-Ramp	No Control, Roundabout	The rest of the controls are not viable for this type of intersection.	**No Control**: Minimal conflicts; therefore, does not require intersection control.

Quadrant	Intersection	Viable Control Strategies	Primary Reason Other Controls Not Viable	Selected Preferred Control Strategy and Justification
Bourne South	Trowbridge Road/Sandwich Road/Technical High School	Roundabout	• TWSC – intersection operates over capacity. • AWSC – intersection operates over capacity. • Traffic Signal – does not meet volume warrants. • U-Turn, Jughandle and DLT intersections have significant ROW impacts.	**Roundabout**: Only viable control strategy as a traffic signal is not warranted and stop-control is not feasible from operational or safety perspective.
Bourne South	Trowbridge Road/Veterans Way	Stop Control	ICE not required for intersections with minor streets with less than 1,000 ADT. Alternative intersection control not considered.	**Stop Control**: Maintaining existing intersection control.
Bourne South	Sandwich Road/Veterans Way	Stop Control	ICE not required for intersections with minor streets with less than 1,000 ADT. Alternative intersection control not considered.	**Stop Control**: Maintaining existing intersection control.

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 fall and summer 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.

In addition to the regular evaluation of the permanent count stations on the bridges, additional traffic counts were collected at the Study Area intersections and along key roadway segments in April 2024 and August 2024 to review any significant volume changes and potential traffic pattern shifts. Following the assessment of newly collected data, it was determined that the 2024 volumes were in

line with the 2019 Base Year traffic volumes and the expected background growth between the two years.

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, the Program team 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. This document focuses on analysis for the Fall Weekday PM peak hour.
- MassDOT also analyzed the Summer Saturday Midday period to understand potential peak-season operations. Summer Saturday Midday represents the peak period for total canal crossings in both directions, including on-Cape and off-Cape traffic. However, traffic operations analysis conducted for this time period was not used as the basis for the development of the 2050 Build Alternative. Traffic analysis for the Summer Saturday Midday period can be found in the attachments to this document.
- MassDOT analyzed traffic operations using the following software applications in accordance with applicable Highway Capacity Manual[3] and FHWA standards:[4]
  - 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.

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

[3] 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

[4] 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

conditions and LOS F representing conditions in which vehicle demand generally exceeds roadway capacity.

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 on a network-wide basis to understand overall conditions within the Traffic Focus Area transportation network. MassDOT recorded traffic operations in VISSIM for No-Build Alternative and Build Alternative conditions 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.

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 and the results of the traffic analysis for the Study Area.

6.1 Synchro Analysis

Attachment 1 Table A-1 summarizes the results of the existing LOS, capacity, and queue analyses performed in Synchro for all study intersections during the Fall Weekday PM peak hour. **Attachment 1, Figure A-3** provides a graphical representation of the LOS ratings for each study intersection.

The following study intersections are expected to operate at or above capacity (LOS E or LOS F) during the Fall Weekday PM peak hour:

- Intersection # 8: Sandwich Road at Trowbridge Road, County Road, and Shore Road (LOS F)
- Intersection # 12: Sandwich Road at Sandwich Road (LOS F)
- Intersection # 13: Sandwich Road at Upper Cape Cod Technical School (LOS F)
- Intersection # 17: Nathan Ellis Highway (Route 151) at Route 28 NB Ramps (LOS F)
- Intersection # 18: Nathan Ellis Highway (Route 151) at Route 28 SB Ramps (LOS F)
- Intersection # 19: Herring Pond Road at State Road (LOS F)
- Intersection # 21: Herring Pond Road at Route 3 SB Ramps (LOS E)
- Intersection # 24: Meetinghouse Lane at State Road/Canal Street (LOS E)
- Intersection # 30: Cranberry Highway at Sandwich Road and Regency Drive (LOS F)
- Intersection # 31: Old King's Highway (Route 6A) at Main Street (Route 130) & Tupper Road (LOS E)
- Intersection # 32: Old King's Highway (Route 6A) at Tupper Road (LOS E)
- Intersection # 36: Forestdale Road (Route 130) at Route 6 EB Ramps (LOS E)
- Intersection # 39: Quaker Meeting House Road at Route 6 WB Ramps (LOS E)

6.2 Sidra Analysis

Attachment 1, Table A-1 summarizes the results of the existing LOS, capacity, and queue analyses performed in SIDRA for all study intersections during the Fall Weekday PM peak hour. **Attachment 1, Figure A-3** provides a graphical representation of the LOS ratings for each study intersection. The following locations are expected to operate above capacity (LOS F) during the Fall Weekday PM peak hour:

- Intersection # 6: Belmont Circle
- Intersection # 11: Bourne Rotary

6.3 Highway Capacity Software 7 Analysis

Attachment 1, Figure A-4 provides a graphical representation of the LOS and density results of the freeway segments and merging/diverging segments within the Regional Study Area.

Most freeway and merge/diverge segments operate at LOS C or better during the Fall Weekday PM peak hour. In general, sections closer to the bridges operate at or above capacity (LOS E or LOS F). During the Fall Weekday PM peak hour, the following segments operate at or above capacity:

- Bourne Bridge SB (LOS E)
- Bourne Bridge NB (LOS E)
- Route 3 SB north of Exit 1A (LOS E)
- Sagamore Bridge WB (LOS F)

6.4 VISSIM 11 Analysis

6.4.1 Processed Volumes

Table 6-1 summarizes the overall number of vehicles processed by the 2019 Base Year Fall Weekday 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. This is 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. 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

6.4.2 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 2** includes the 2050 No-Build Alternative traffic volume flow maps. **Attachment 3** includes the 2050 Build Alternative traffic volume flow maps. Discussion in this report focuses on intersections and roadways in the Focus Area; for results of the analysis of the overall Study Area see **Attachments 2 and 3**.

7.1 2050 No-Build Synchro Analysis

Attachment 2, Table B-1 summarizes the results of the LOS, capacity, and queue analyses performed in Synchro for all study intersections during the Fall Weekday PM peak hour. **Attachment 2, Figure B-3** provides a graphical representation of the LOS ratings for each study intersection.

The following study intersections are expected to operate at declined LOS E or F compared to the 2019 Base Year Condition during the Fall Weekday PM peak hour:

- Intersection # 20: Herring Pond Road at Route 3 northbound (NB) Ramps (LOS F)
- Intersection # 21: Herring Pond Road at Route 3 southbound (SB) Ramps (LOS F)
- Intersection # 23: Scenic Highway (U.S. Route 6) at State Route 3 SB Off-Ramp (LOS E)
- Intersection # 31: Old King's Highway (Route 6A) at Main Street (Route 130) & Tupper Road (LOS F)
- Intersection # 32: Old King's Highway (Route 6A) at Tupper Road (LOS F)
- Intersection # 37: Water Street (Route 130) at Route 6 westbound (WB) Ramps (LOS F)
- Intersection # 38: Forestdale Road (Route 130) at Route 6 EB Ramps (LOS F)

7.2 2050 No-Build Sidra Analysis

Belmont Circle and Bourne Rotary are expected to operate at LOS F under the 2050 No-Build Condition. **Attachment 2, Table B-1** summarizes the results of the LOS, capacity, and queue analyses performed in SIDRA for all study rotaries during the Fall Weekday PM peak hour. **Attachment 2, Figure B-3** provides a graphical representation of the LOS ratings for each study rotary.

7.3 2050 No-Build Highway Capacity Software 7 Analysis

Attachment 2, Figure B-4 provides a graphical representation of the LOS and density results of the freeway segments and merging/diverging segments within the Regional Study Area.

Most freeway and weave/merge/diverge sections operate at LOS C or better during the Fall Weekday PM peak hour. The following segments worsened to LOS E or LOS F compared to the 2019 Base Year Condition:

- Route 25 EB North of Exit 10 (LOS E)
- Bourne Bridge NB (LOS F)
- Route 3 NB Exit 1A Diverge (LOS F)
- U.S. Route 6 WB Exit 55 Merge (LOS F)
- U.S. Route 6 WB Exit 55 Diverge (LOS E)
- U.S. Route 6 WB South of Exit 55 (LOS E)
- U.S. Route 6 WB Exit 59 Merge (LOS F)
- U.S. Route 6 WB Exit 61 Diverge (LOS F)

7.4 2050 Build Synchro Analysis

Attachment 3, Table C-1 summarizes the results of the LOS, capacity, and queue analyses performed in Synchro for all study intersections during the Fall Weekday PM peak hour. **Attachment 3, Figure C-3** provides a graphical representation of the LOS ratings for each study intersection.

For the 2050 Build Condition, all study intersections within the Traffic Focus Area are expected to operate between LOS A-D.

7.5 2050 Build Sidra Analysis

Under the 2050 Build Condition, Belmont Circle continues to operate at LOS F but does see reduced delays and shorter queues as compared to the No-Build Condition. Note: Bourne Rotary is replaced with a grade separated diamond interchange in the Build Condition. The new and modified roundabouts proposed under the Build Condition include:

- Scenic Highway (Route 6)/Main Street (Route 6)/Nightingale Road/Andy Oliva Drive
- Trowbridge Road/Route 25 SB Ramps
- Sandwich Road/Trowbridge Road/Route 28 NB Ramps
- Sandwich Road/Upper Cape Cod Technical School Driveway
- Meetinghouse Lane/State Road/Scenic Highway
- Meetinghouse Lane/Canal Street
- Cranberry Highway Extension/Market Basket

- Cranberry Highway/Sandwich Road Connector

These locations are expected to operate between LOS A-D. Refer to **Attachment 3, Table C-1** which summarizes the results of the LOS, capacity, and queue analyses performed for the Fall Weekday PM peak hour. **Attachment 3, Figure C-3** provides a graphical representation of the LOS ratings of each study rotary.

7.6 2050 Build Highway Capacity Software 7 Analysis

Attachment 3, Figures C-4 provides a graphical representation of the LOS and density results of the freeway segments and merging/diverging segments within the Regional Study Area.

Most freeway and weave/merge/diverge sections operate at LOS C or better during the Fall Weekday PM peak hour. The following locations worsened to LOS E or LOS F compared to the No-Build Condition:

- Route 25 EB North of Exit 10 (LOS F)
- Route 3 SB North of Exit 1A (LOS E)
- U.S. Route 6 WB south of Exit 55 (LOS F)
- U.S. Route 6 WB Exit 59 Diverge (LOS F)
- U.S. Route 6 WB Exit 61 Merge (LOS F)
- Route 3 SB North of Exit 1A

Under No-Build Conditions, the Route 3 SB North of Exit 1A segment straddles the threshold between LOS D and LOS E. While the LOS worsens from LOS D to LOS E in the Build Condition, the segment density only worsens by a minimal amount (3.5 cars per mile per lane).

7.7 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 in the Fall Weekday PM peak hour are presented in **Attachment 2, Figure B-5** for the 2050 No-Build Alternative and **Attachment 3, Figure C-5** for the 2050 Build Alternative.

7.7.1 Processed Vehicles

Table 7-1 depicts the total number of vehicles processed by the 2050 No-Build Alternative and 2050 Build Alternative 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	13,922	84.4%

The data presented indicates that the 2050 Build Alternative model processes more vehicles than the 2050 No-Build Alternative model. This suggests the 2050 Build Alternative network can more efficiently 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.

7.7.2 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 1.8 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	1.8

7.7.3 Travel Times

7.7.3.1 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 (2,126 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	2,126

7.7.3.2 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

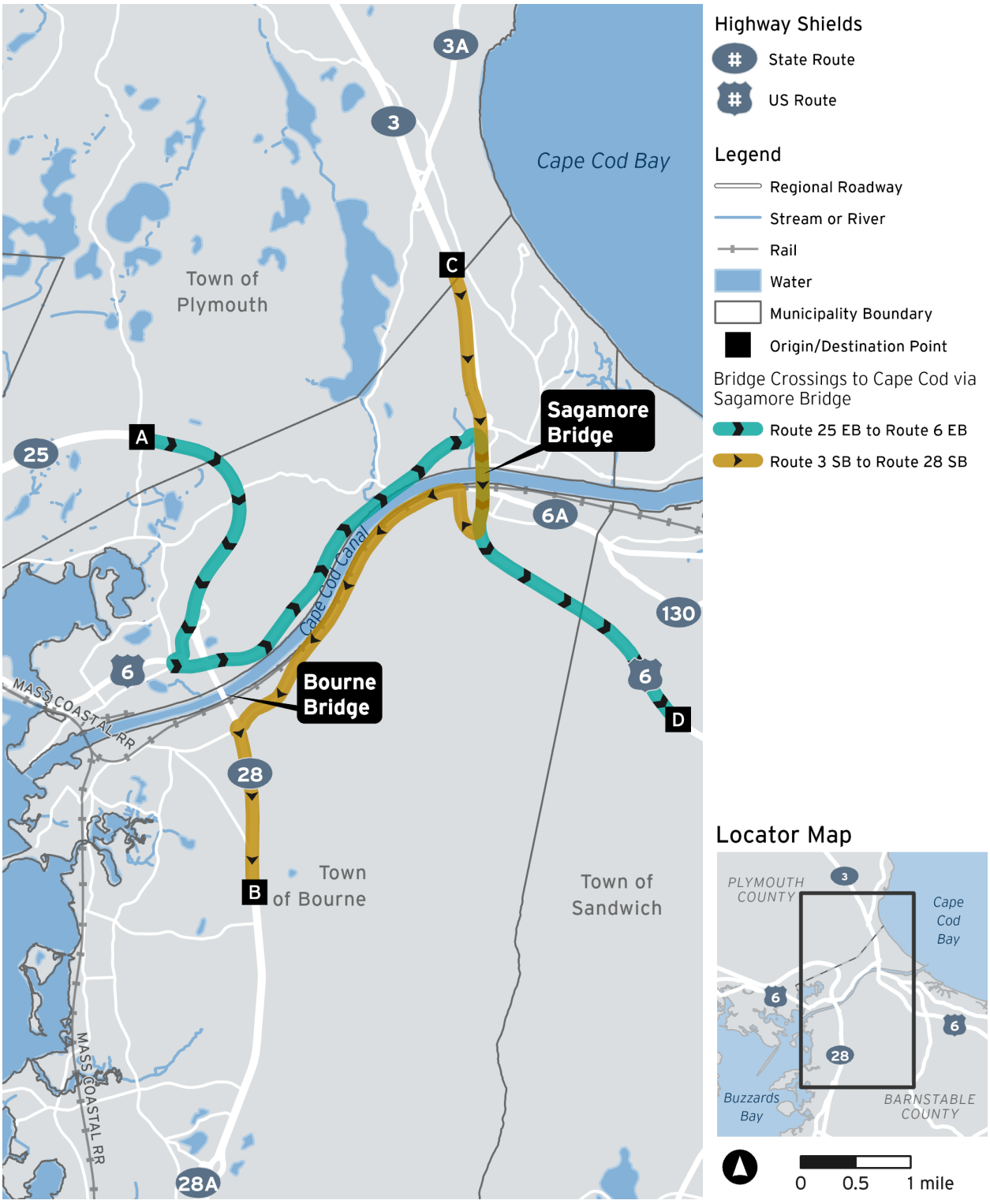
The State Route 25 EB to State Route 3 NB travel route is projected to be a major O-D route in the 2050 Design Year and is also discussed in the **Diagonal Bridge Crossings** section. **Figure 7-1** depicts the diagonal bridge crossings entering Cape Cod via Sagamore Bridge. **Figure 7-2** depicts the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

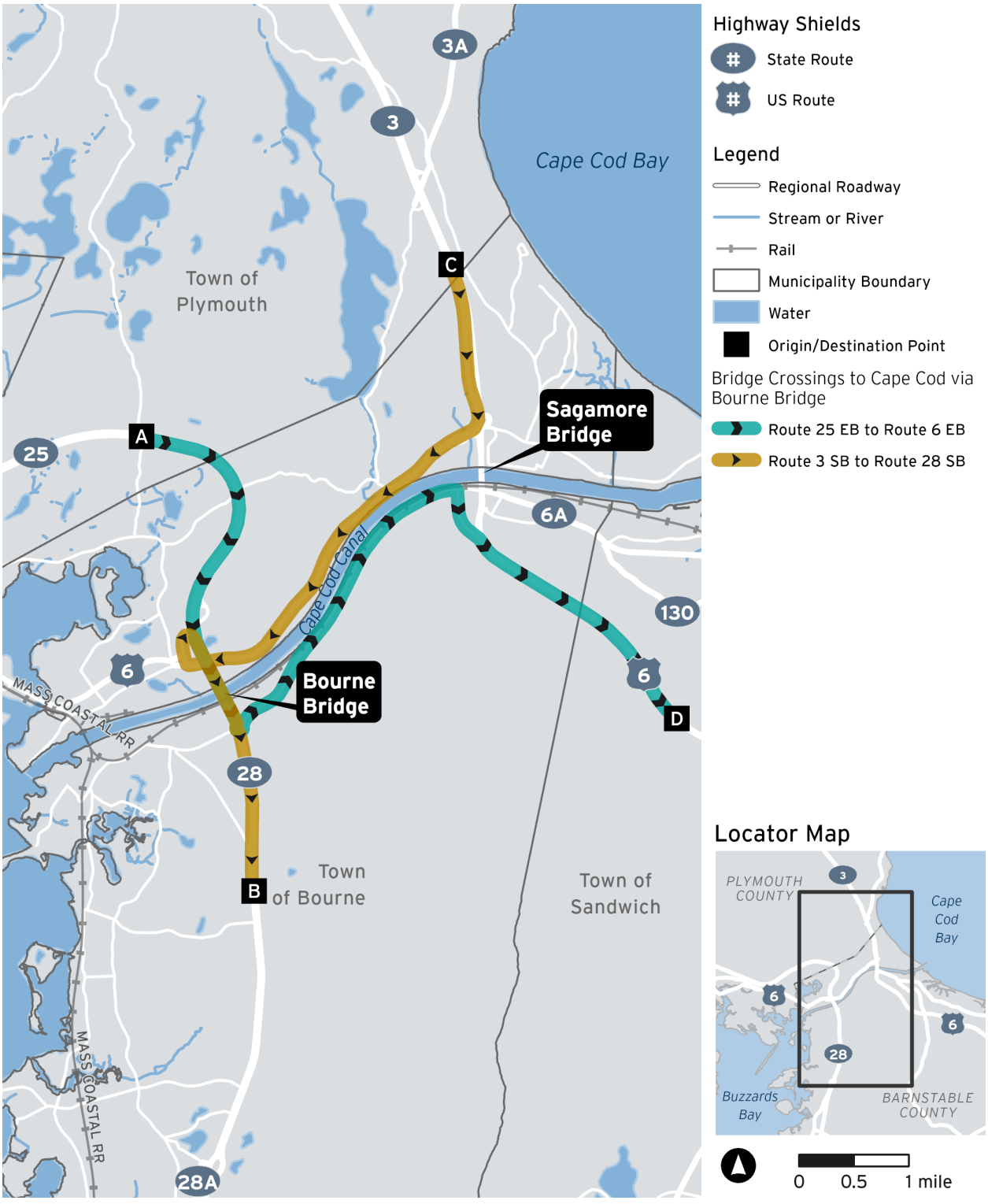
Figure 7-4 and **Figure 7-5** depict through-bridge crossings entering and exiting Cape Cod.

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



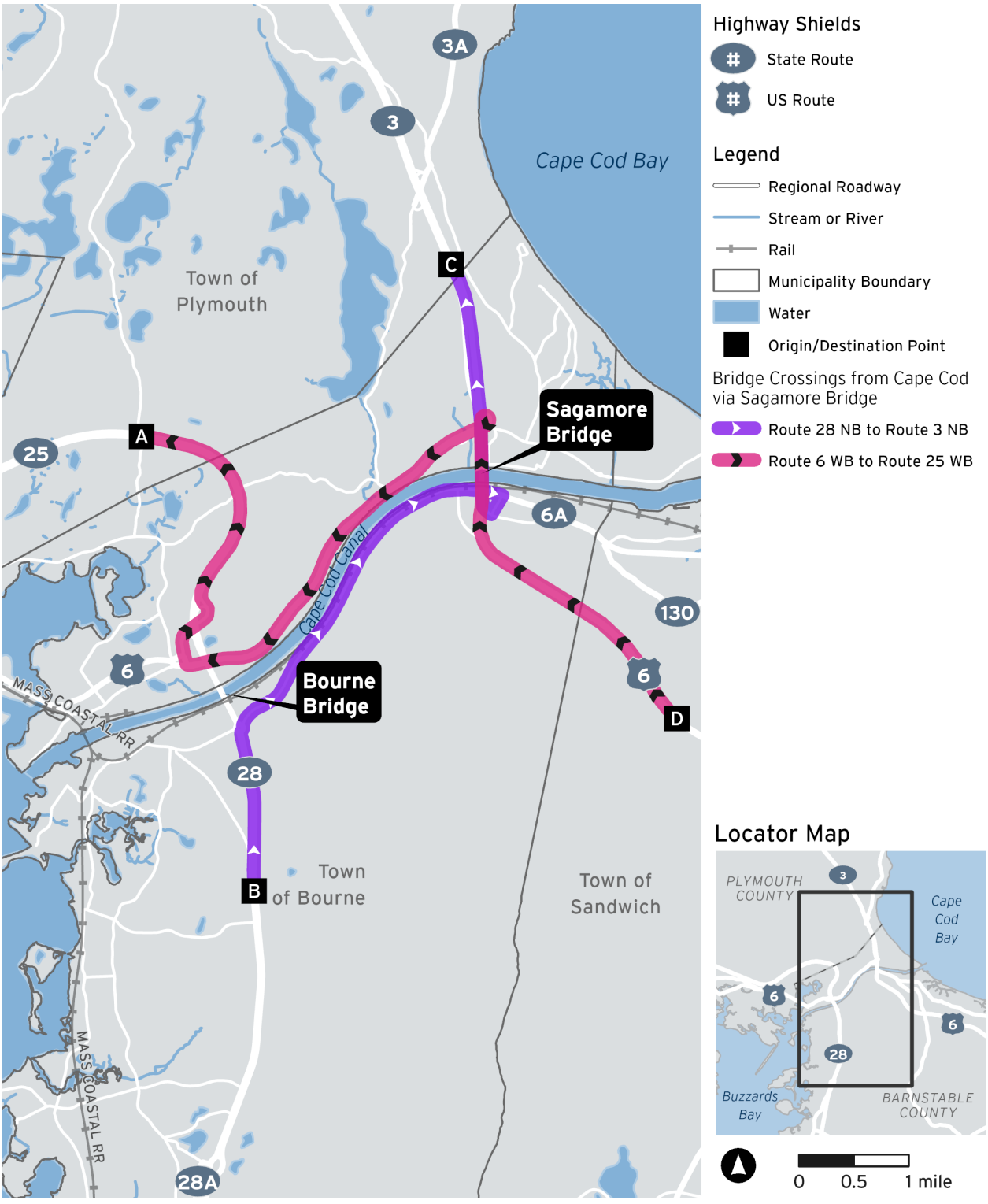
Source: Massachusetts Department of Transportation, 2024

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



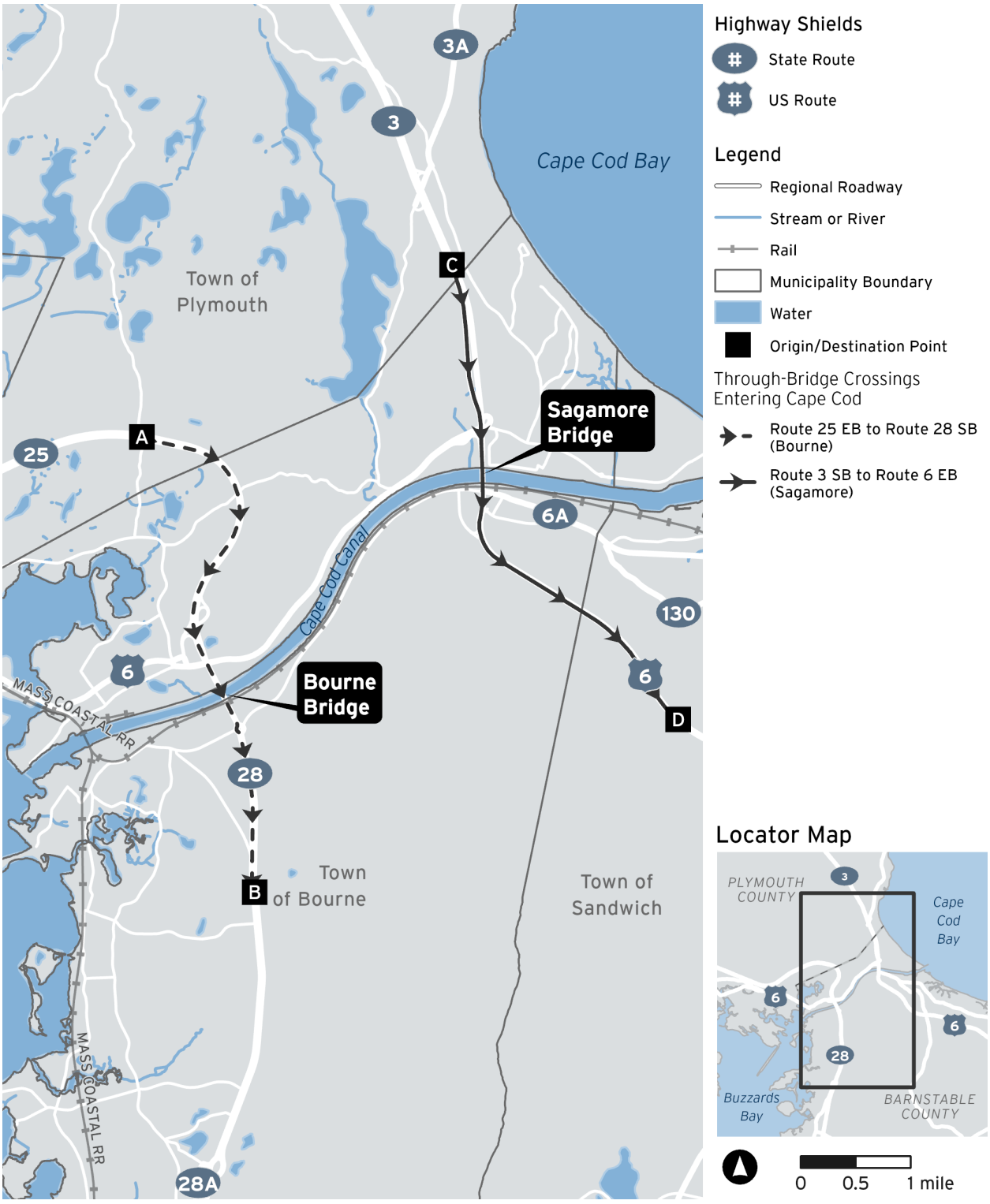
Source: Massachusetts Department of Transportation, 2024

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



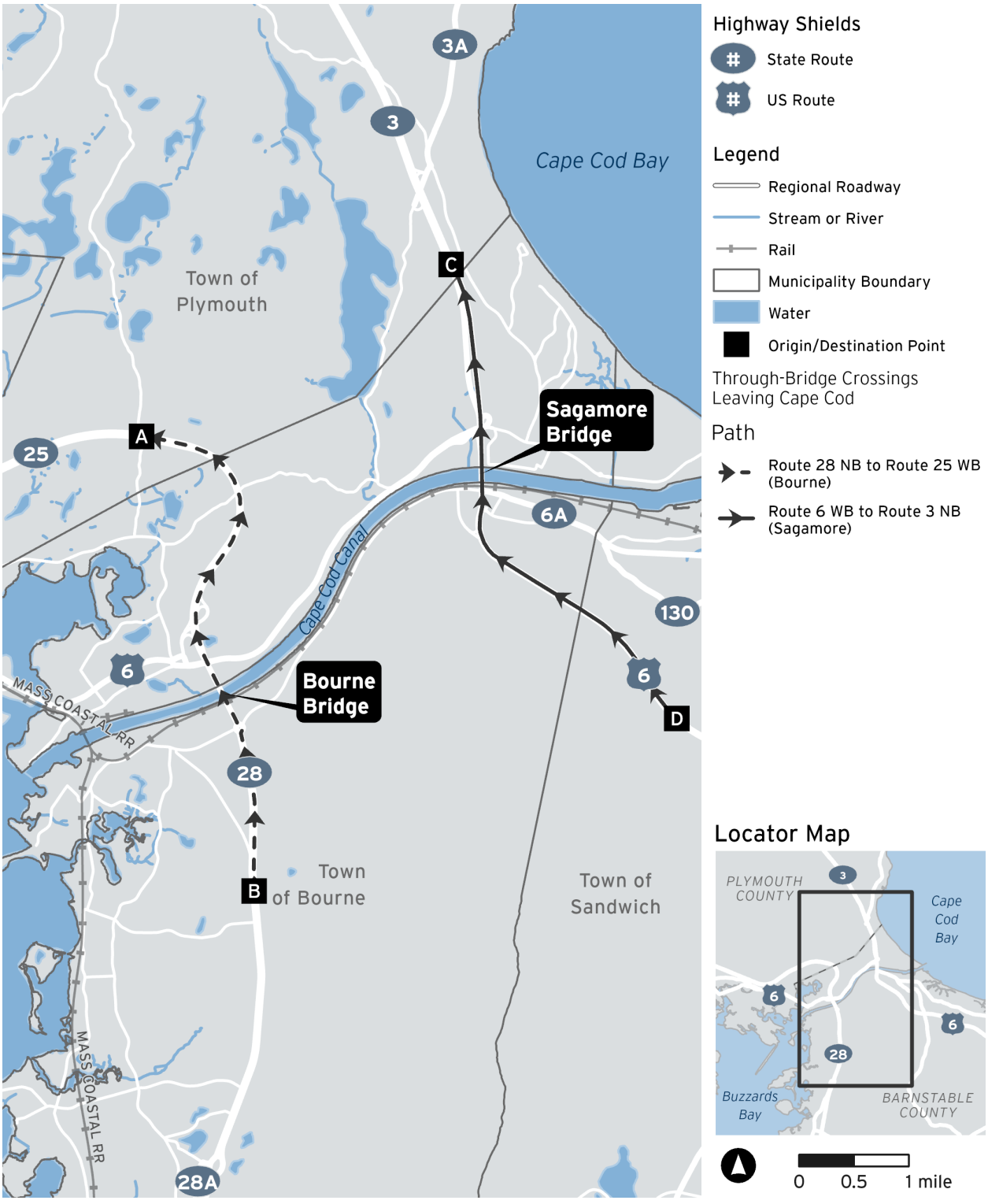
Source: Massachusetts Department of Transportation, 2024

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 20.6 minutes. The travel time recorded along the preferred route of Scenic Highway under the 2050 Build Alternative is approximately 11.3 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	20.6	12.1
Scenic Highway	24.2	11.3

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 the 2050 Build Alternative. The 2050 Build Alternative travel time along Sandwich Road (11.6 minutes) is more efficient than that recorded under the 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	11.6

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 (10.7 minutes) is more efficient than that recorded under the 2050 No-Build Alternative (19.1 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 (21.5 minutes) than that recorded under the 2050 Build Alternative (23.4 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	19.1	10.7
Sandwich Road	21.5	23.4

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 12.0 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	12.0

Through-Bridge Crossings

Bourne Bridge

According to **Table 7-8**, 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 7-8 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	11.4	5.4
Northbound	14.5	6.1

Sagamore Bridge

Similarly, according to **Table 7-9**, 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 7-9 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	10.4	4.6
Northbound	8.5	4.8

8 Glossary of Terms

Table 8-1 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 within a traffic stream. LOS is represented using letter grades “A” through “F”, with LOS A representing very low delays and free-flow conditions and LOS F representing conditions in which vehicle demand generally exceeds roadway capacity.
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 forms when traffic demand exceeds the available capacity at a point on the roadway.

9 Attachments

Attachment 1 – 2019 Base Year Conditions

Attachment 2 – 2050 Design Year No-Build Alternative Conditions

Attachment 3 – 2050 Design Year Build Alternative Conditions