2 Program Purpose and Need

2.1 Introduction

This chapter defines the purpose and need for the Cape Cod Bridges Program (the Program). The “Purpose” statement (**Section 2.2**) concisely establishes the fundamental reasons why the Federal Highway Administration is undertaking the Program, which is expressed as a desired transportation outcome. The “Need” statement (**Section 2.3**) identifies transportation-related problems that the Program is intended to address or improve. In addition to providing the justification for undertaking the proposed action, the purpose and need is used to identify and determine a range of reasonable alternatives that are evaluated in this Draft Environmental Impact Statement, establish criteria to compare those alternatives, and ultimately select an alternative that advances into project development. The Massachusetts Department of Transportation (MassDOT) established other goals beyond the desired transportation outcomes stated in the Program’s purpose. These goals—related to social, economic, and environmental outcomes—are distinct from the Program’s purpose and need. A list of the Program goals and related objectives is presented in **Chapter 3, Proposed Action and Alternatives, Table 3.5**.

Building upon the analyses and findings of the U.S. Army Corps of Engineers’ (USACE’s) and MassDOT’s foundational documents (presented in **Chapter 1, Introduction**), MassDOT developed the Program Purpose and Need Statement in coordination with the Federal Highway Administration, Cooperating Agencies, and the public. **Chapter 6, Agency Coordination and Public Involvement**, provides details of agency and public involvement in developing the Program’s purpose and need.

2.2 Purpose of the Program

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.

2.3 Need for the Program

The needs for the Program are as follows:

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

Sections 2.3.1 through 2.3.4 provide data supporting each of these identified transportation-related needs.

2.3.1 Address the Deteriorating Structural Condition and Escalating Maintenance Demands of Sagamore and Bourne Bridges

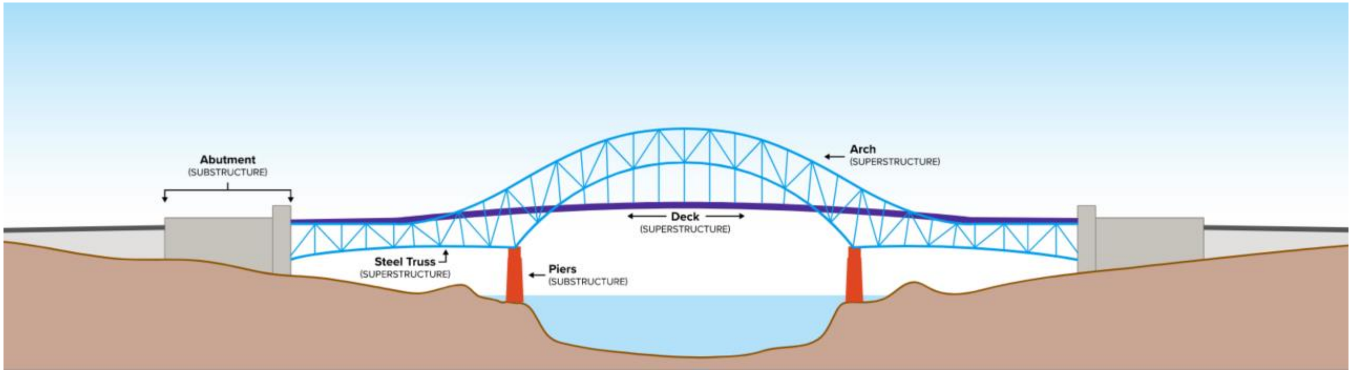
With original construction completed in 1935, Sagamore and Bourne Bridges have undergone a maintenance, repair, and rehabilitation program, including major rehabilitation between 1979 and 1982. The USACE conducts a regular cycle of inspections of both bridges in accordance with current National Bridge Inspection Standards. These routine inspections are conducted to characterize condition ratings for three main bridge components: the deck, superstructure, and substructure. The deck is the roadway portion of the bridge that supports vehicular and pedestrian traffic. The superstructure is the portion of the bridge above the substructure—including beams, arches, trusses, and other load-bearing elements—that support the bridge deck. The substructure is the portion of the bridge below the superstructure—including the piers, abutments, and foundations—that transfer the loads from the superstructure to the ground. A bridge is rated “structurally deficient” if its deck, superstructure, or substructure is rated in poor condition, which is a rating of 4 or below on the National Bridge Inspection Standards rating scale (**Table 2-1**). **Figure 2-1** identifies the main components of the existing Sagamore and Bourne Bridges.

Table 2-1. Bridge Condition: National Bridge Inspection Ratings and Good/Fair/Poor Classification

Number	Condition	Classification
9	Excellent	Good
8	Very Good	
7	Good	
6	Satisfactory	Fair
5	Fair	
4	Poor	Poor
3	Serious	
2	Critical	
1	Imminent Failure	
0	Fail	

Source: Federal Highway Administration (FHWA) Pavement and Bridge Condition Performance Measures final rule, January 2017

Figure 2-1. Main Components of the Existing Sagamore and Bourne Bridges



Source: Massachusetts Department of Transportation, 2024

Sagamore Bridge was not considered to be “structurally deficient” as of the latest available inspection conducted by the USACE in September 2021. The deck was in fair condition with an overall rating of 5. The superstructure and substructure were also in fair condition with overall ratings of 5. While Sagamore Bridge was not classified as “structurally deficient,” several gusset plates connecting the truss members within the superstructure exhibited advanced section loss and deformation due to corrosion. Severe deterioration or warping of gusset plates could lead to localized failures and, in extreme cases, a progressive collapse of the steel truss superstructure. **Exhibit 2-1** depicts the advanced deterioration of gusset plates based on the 2021 USACE Sagamore Bridge inspection.

Exhibit 2-1. Truss Joint Gusset Plate Deterioration (Sagamore Bridge)

Source: U.S. Army Corps of Engineers, 2021 (routine inspection of Sagamore Bridge)

Based on the latest information available from a routine inspection conducted by USACE in October 2022, Bourne Bridge was classified as “structurally deficient.” The superstructure was in poor condition with a rating of 4 due to the continuing deterioration of key structural elements, including gusset plates connecting the truss members, bridge bearings, and the concrete T-beams supporting the deck. The deck was in fair condition with a rating of 5 due to continuing deterioration in the abutment spans. The substructure was in good condition with a rating of 7, although delamination and spalling were noted in the bridge abutment walls, and the deck joints received a rating of 4. **Exhibit 2-2** depicts advanced deterioration of gusset plates based on the 2022 USACE Bourne Bridge inspection. **Exhibit 2-3** depicts advanced deterioration of concrete T-beams based on the 2022 USACE Bourne Bridge inspection.

Exhibit 2-2. Truss Joint Gusset Plate Deterioration (Bourne Bridge)

Source: U.S. Army Corps of Engineers, 2022 (routine inspection of Bourne Bridge)

Exhibit 2-3. Concrete T-Beam Deterioration (Bourne Bridge)

Source: U.S. Army Corps of Engineers, 2022 (routine inspection of Bourne Bridge)

While Bourne Bridge was found to be structurally deficient (as of the 2022 USACE inspection), this classification does not imply that the bridge is unsafe for public travel. However, the classification is an indication that the bridge requires maintenance, repair, and eventual rehabilitation or replacement to address deficiencies and concerns regarding deterioration in the long term.

The age of the bridges—combined with their heavy vehicular demands and the corrosive saltwater environment of Cape Cod Canal—creates an environment where frequent, costly, and escalating maintenance efforts are necessary to maintain the structures in a state of good repair. According to the USACE's March 2020 Major Rehabilitation Evaluation Report and Environmental Assessment for the Cape Cod Canal Highway Bridges, the cost to maintain Bourne Bridge between 1979 and 2017 was just over $41 million, while the cost to maintain Sagamore Bridge between 1981 and 2018 was just over $37 million.

All repair work on the superstructure and bridge deck requires that vehicular lanes be closed to facilitate contractor activities. Typically, these lane closures restrict travel to one lane in each direction. Historically, temporary lane closures last a minimum of nine months during repair contracts.[1] These lane closures for maintenance and repairs result in heavy backups for motorists waiting to cross the bridges, with queues commonly stretching several miles on the approach highways and local roadways. Lane restrictions and heavy traffic congestion during bridge maintenance repairs affect the ability for police, firefighters, and emergency medical responders to operate and respond to incidents safely and efficiently. The USACE schedules bridge maintenance work in off-peak travel seasons between Columbus Day and Memorial Day, when possible, to minimize impacts to the traveling public.

Based on criteria provided in the MassDOT Load and Resistance Factor Design bridge design specifications, Sagamore and Bourne Bridges are designated as "Critical and Essential Bridges," indicating that they must be operational following a natural disaster or other event. Because the bridges were built in the 1930s, they do not meet current seismic design standards. Given the age and underlying structural deficiencies of these bridges, they are vulnerable to damage from major seismic events or extreme weather-related events, such as hurricanes.

2.3.2 Address the Substandard Design Elements of Sagamore and Bourne Bridges, including their immediate Approaches and Interchanges

Sagamore and Bourne Bridges do not meet current MassDOT bridge and highway design standards for key characteristics, such as travel lane width, median barrier separation, shoulder width, and roadway profile grade. Each bridge provides four 10-foot-wide vehicular travel lanes (two lanes in each direction), which are 2 feet narrower than the 12-foot lane width standard for limited access highways.[2] The bridges lack physical separation between opposing travel lanes, which increases the risk of head-on collisions. In addition, they lack shoulder accommodations to allow vehicles to pull out

[1] U.S. Army Corps of Engineers. March 2020. Major Rehabilitation Evaluation Report and Environmental Assessment, Cape Cod Canal Highway Bridges, Bourne, Massachusetts.

[2] American Association of State Highway and Transportation Officials: A Policy on Geometric Design of Highways and Streets (2018)

of the travel lanes in emergency situations. In the event of traffic accidents or other incidents on the bridges, damaged or disabled vehicles block travel lanes until they can be removed, resulting in lengthy traffic delays and full bridge closure in one or both directions. Severe congestion and the lack of shoulder accommodations on the bridges pose public safety concerns due to delayed emergency response for police, fire, and paramedic services. The narrow travel lanes, lack of shoulders, and absence of separation between opposing travel lanes on the bridges result in frequent reports of sideswipe collisions between vehicles traveling in the same or opposite directions. As presented in **Section 2.3.3**, sideswipe collisions (opposite and same-side) and head-on crashes made up over 40% of the reported crashes between January 1, 2017, and December 31, 2019, which can be attributed to the lack of physical separation between opposing travel lanes and shoulders. The traffic safety features of Sagamore and Bourne Bridges—including their bridge railings, transitions, approach guardrails, and approach guardrail ends—do not conform to current MassDOT specifications.

Sagamore and Bourne Bridges connect to interchanges on the north and south sides of Cape Cod Canal. These interchanges are closely spaced and facilitate local and regional movement of traffic. Under current travel patterns, the right-most through travel lanes in each direction on the bridges are often used as acceleration and deceleration lanes to facilitate vehicles entering and exiting the bridges from the adjacent interchange ramps, increasing lane-changing maneuvers and reducing the efficiency of cross-canal traffic movement. In addition, the Bourne Rotary has historically been a major bottleneck in the Cape Cod Canal area roadway network due to heavy conflicting traffic flows. The proximity of interchanges and intersections at the end of each bridge and the lack of auxiliary lanes across the bridges and the adjoining roadways result in weaving and merging issues for motorists, which further increases congestion and queueing.

Exhibit 2-4. Steep Roadway Grade Approaching Sagamore Bridge

Source: Massachusetts Department of Transportation, 2024

Sagamore and Bourne Bridges and their approaches have steep roadway profile grades of up to 6%, which gradually flatten as the roadway crests at the mid crossing point of the canal. **Exhibit 2-4** illustrates the steep grades approaching Sagamore Bridge. At a 6% grade, the vertical profiles of the bridges and their approaches are steeper than the 4% to 5% maximum grade typical for limited-access highways. Because of the steep roadway profile grades of the bridges and their approaches, it is difficult for vehicles, especially large trucks, to maintain speed. This effect—combined with the narrow 10-foot-wide lanes and lack of auxiliary lanes on the bridges—causes all traffic immediately approaching and on the bridges to slow down in both directions and make abrupt lane changes.

Approaching Sagamore Bridge from the north, one of the two travel lanes along State Route 3 southbound is dropped to allow travelers from Scenic Highway to merge onto State Route 3 at Exit 1A, reinstating the second travel lane. This lane drop contributes to congestion and delays on State Route 3 southbound, especially during peak travel periods. Additionally, the geometry of U.S. Route 6 Exit 55 westbound (at Cranberry Highway) does not comply with current MassDOT highway design standards due to its short acceleration and deceleration lanes, and the steep grades approaching Sagamore Bridge.

2.3.3 Improve Vehicular Traffic Operations

The 1930s-era Sagamore and Bourne Bridges were designed and built to serve far lower traffic volumes than those served by the bridges today. Estimates of vehicle traffic volumes during design for new highway crossings of Cape Cod Canal in the early 1930s ranged from 1,200 vehicles per day to 4,700 vehicles per day, depending on the time of year.[3] According to MassDOT traffic count data for the 2019 base year condition, the average daily traffic for the fall (tourist off-season) and the summer (tourist peak-season) on Bourne Bridge was 46,380 and 57,870, respectively. The average daily traffic for the fall (tourist off-season) and the summer (tourist peak-season) on the Sagamore Bridge was 62,030 and 79,570, respectively.

Heavy traffic volumes, coupled with the geometrically deficient features of the bridges and their immediate approaches, contribute to poor traffic operations during peak travel periods and crash rates that are considerably higher than the statewide average for similar facilities. Level of Service (LOS) is a letter grade system used to describe operational conditions within a traffic stream and their perception by the traveling public (**Table 2-2**). A designation of LOS A, B, or C represents free-flowing conditions, and a designation of LOS D is generally considered marginally acceptable conditions. A designation of LOS E or F is generally considered unacceptable to most drivers, where operating conditions are near or at capacity with considerable delays. **Table 2-3** presents highway sections along Sagamore and Bourne Bridges and their mainline approaches that operate with considerable delays (LOS E/F) during the fall tourist off-season weekday peak morning and afternoon travel periods based on 2019 Existing Condition VISSIM traffic models.[4] Operating conditions and traffic delays on the bridges and their highway approaches are expected to worsen due to projected growth in annual visitor trips to the Cape Cod region and the continued trend of lower-wage Cape Cod workers living off Cape.

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[3] U.S. Army Corps of Engineers. March 2020. Major Rehabilitation Evaluation Report and Environmental Assessment, Cape Cod Canal Highway Bridges, Bourne, Massachusetts.

[4] VISSIM: microsimulation software used to analyze the roadway network including roadways of differing functional classifications.

Table 2-2. Level of Service Ratings

Letter	Definition
A	**Free-Flow Traffic** (No Delays)
B	**Light/Moderate Traffic** (No Delays)
C	**Steady Traffic** (Minimal Delays)
D	**Speeds Begin to Decline** (Minimal Delays)
E	**Traffic at Capacity** (Significant Delays)
F	**Heaviest Congestion** (Forced Flow)

Source: Highway Capacity Manual, 7th Edition, 2022

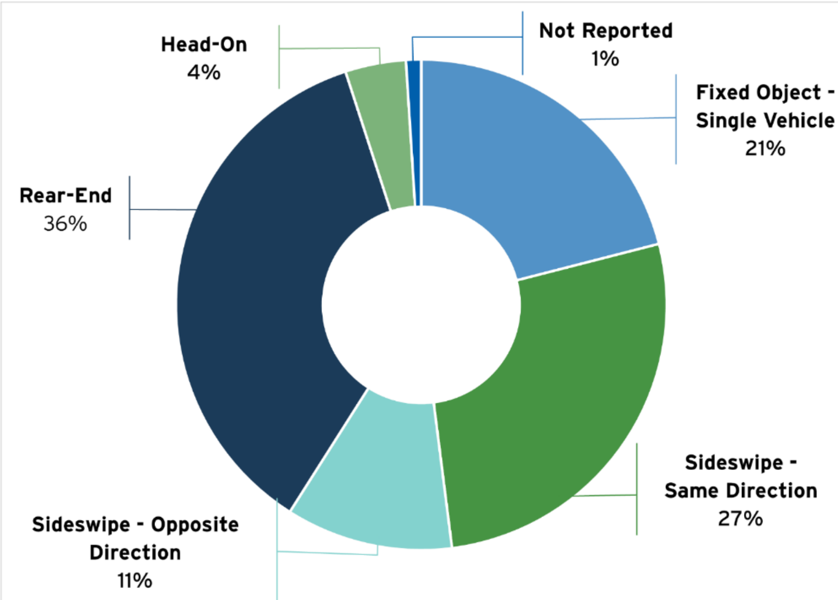
Table 2-3. Bridge and Mainline Approach Sections Operating Near or At Capacity for 2019 (Existing Condition) Fall Weekday Peak Hours

Highway Section	A.M. Peak Hour LOS	P.M. Peak Hour LOS
State Route 3 southbound approaching Sagamore Bridge	F	E
U.S. Route 6 westbound and eastbound on Sagamore Bridge	F	F
State Route 28 southbound on Bourne Bridge	F	F
State Route 28 and MacArthur Boulevard intersection northbound approaching the Bourne Rotary	D	F
State Route 25 approaching the exit for Belmont Circle (Exit 10)	E	F

Source: Massachusetts Department of Transportation. 2025. Cape Cod Bridges Program Environmental Impact Report, Appendix 4.2: Traffic Engineering Technical Report.

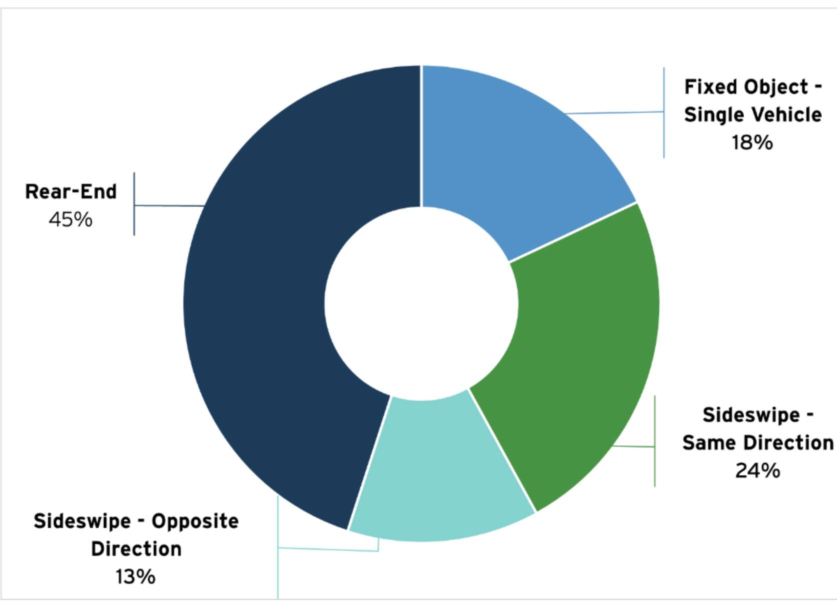
Sagamore and Bourne Bridges experienced a significantly higher crash rate than the MassDOT average crash rate for similar principal arterial roadways between January 1, 2017, and December 31, 2019. The MassDOT crash rate for a similar facility is 0.80 crashes per million vehicle miles traveled (MVMT). Bourne Bridge experienced a crash rate of approximately 1.8 crashes per MVMT or 120% higher than the Massachusetts average crash rate for a principal arterial roadway. Sagamore Bridge experienced a crash rate of approximately 2.6 crashes per MVMT or 228% higher than the Massachusetts average crash rate for a principal arterial roadway. Observed crashes by type during the 2017–2019 study period were partially attributed to existing traffic congestion and the narrow roadway cross-section of the existing bridges. There were 56 observed crashes on Sagamore Bridge and 45 observed crashes on Bourne Bridge during the 2017–2019 study period. **Figure 2-2** and **Figure 2-3** summarize the composition of observed crashes by type during the 2017–2019 study period.

Figure 2-2. Sagamore Bridge Crash Data Summary by Type (2017 through 2019)



Source: Massachusetts Department of Transportation, 2024

Figure 2-3. Bourne Bridge Crash Data Summary by Type (2017 through 2019)



Source: Massachusetts Department of Transportation, 2024

As illustrated in **Figure 2-2** and **Figure 2-3**, the most common crash type on the bridges is *Rear-End* (36% and 45% of crashes, respectively). Congestion along the bridges contributes to the high rate of rear-end crashes. The second most common crash type on each bridge is Sideswipe - Same Direction (27% and 24% of crashes, respectively). This crash type, along with the Fixed Object/Single Vehicle Crash type, can be partially attributed to the narrow 10-foot travel lanes on the bridges (**Exhibit 2-5**) and their lack of roadway shoulders. The Sideswipe - Opposite Direction and Head-On crash types can also be partially attributed to the lack of a median or separation of the direction of travel along each bridge.

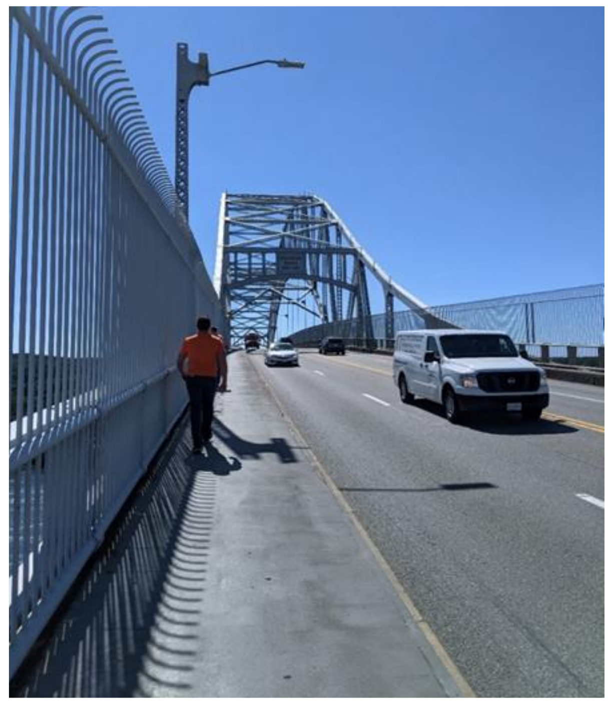
Within the past several years, other identified locations in the immediate area of the bridges with a history of high-crash rates include Belmont Circle, Bourne Rotary, and the intersection of Scenic Highway at Meetinghouse Lane. These high-crash locations identify crash clusters that rank within the top 5% of the Cape Cod Commission's planning region.

2.3.4 Improve Accommodations for Pedestrians and Bicyclists

The MassDOT Office of Transportation Planning's 2019 Cape Cod Canal Transportation Study recommended improving pedestrian and bicycle connections between local roadways and the Sagamore and Bourne Bridges.

Each bridge provides a narrow raised 6-foot-8-inch-wide sidewalk along one side that includes steep roadway profile grades of up to 6%, with no designated accommodations for bicycle travel. With the lack of roadway shoulders on the bridges, vehicles travel immediately next to the existing sidewalks. The proximity of vehicular traffic to sidewalks on the bridges creates unsafe and uncomfortable conditions for pedestrians. **Exhibit 2-5** illustrates the narrow width for pedestrian traffic on Sagamore Bridge.

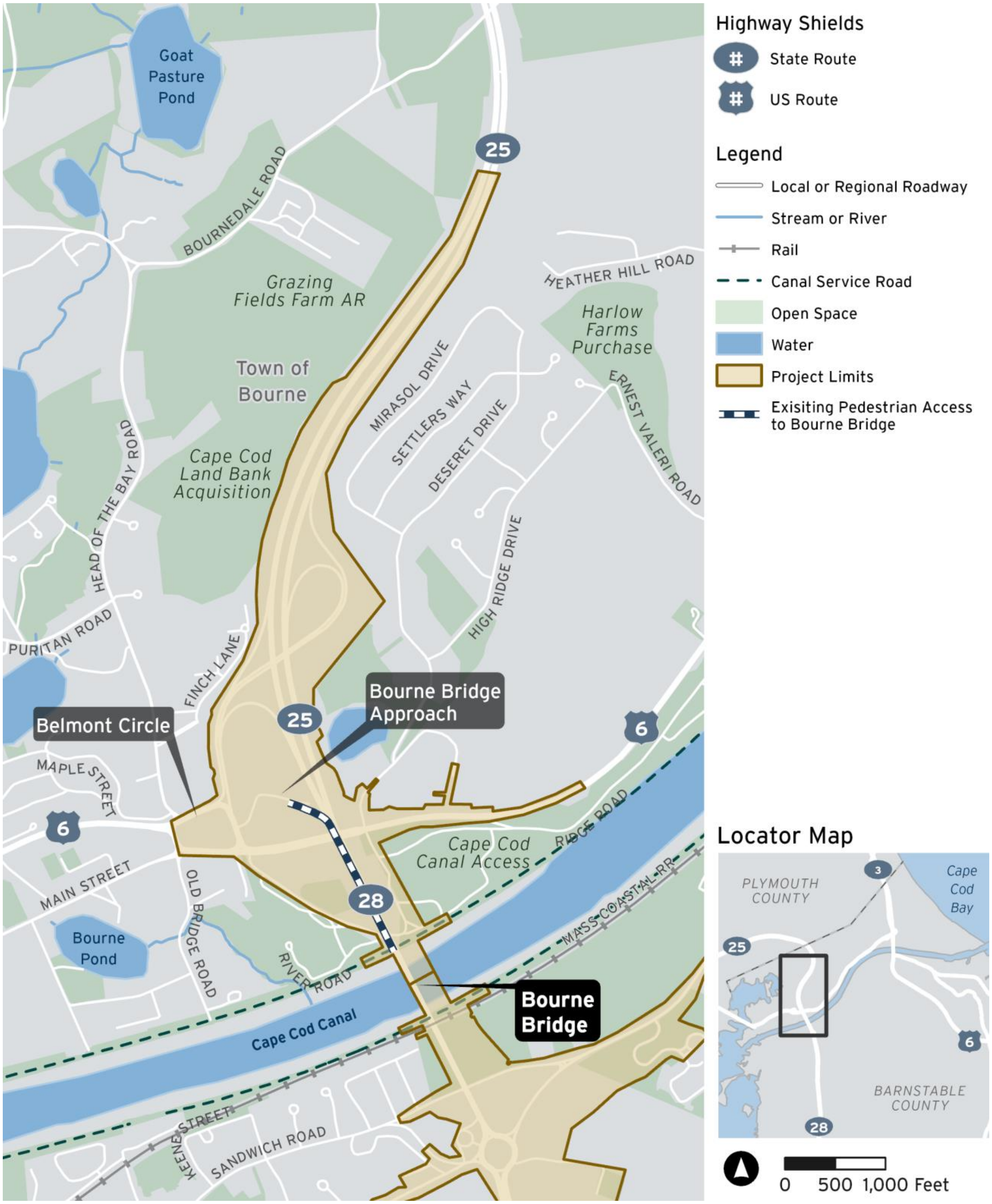
Exhibit 2-5. Pedestrians Crossing Sagamore Bridge



Source: Massachusetts Department of Transportation, September 2022

At the approaches to both bridges, existing gaps in the sidewalk network pose access limitations for pedestrians to cross Cape Cod Canal. The only pedestrian access to Bourne Bridge from the north is via an unmarked sidewalk at the end of the Bourne Bridge approach (**Figure 2-4**). To access the sidewalk at the southern end of Bourne Bridge, pedestrians need to enter Bourne Rotary, a high-volume traffic circle that lacks sidewalks. No designated pedestrian facilities connect the southern end of Sagamore Bridge to Cranberry Highway or Sandwich Road.

Figure 2-4.   Pedestrian Access to Bourne Bridge via Sidewalk at Bridge Approach Street



Source: Massachusetts Department of Transportation, 2024

There is also a lack of pedestrian and bicycle connections to the Cape Cod Canal service roads, which run below Sagamore and Bourne Bridges along both the north and south banks of Cape Cod Canal. These service roads, which the USACE owns and maintains as part of the Cape Cod Canal Federal Navigation Project, are open to the public and serve as a popular resource for walking, jogging, cycling, and access to saltwater fishing.