



Cape Cod Bridges Program

Bourne, Massachusetts

Appendix 4.9 Wetlands and Floodplains Technical Report

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ACEC	Area of Critical Environmental Concern
ANRAD	Abbreviated Notice of Resource Area Delineation
BLSF	Bordering Land Subject to Flooding
BVW	Bordering Vegetated Wetland
CB	Coastal Bank
CMR	Code of Massachusetts Regulations
CWA	U.S. Clean Water Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
HTL	High Tide Line
ILFP	In-Lieu Fee Program
lf	linear feet
LSCSF	Land Subject to Coastal Storm Flowage
LSTA	Land Subject to Tidal Action
LUO	Land Under Ocean
LUW	Land Under Water Bodies and Waterways

Acronym/Abbreviation	Definition
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MA WPA	Massachusetts Wetlands Protection Act
MHW	Mean High Water
MRER/EA	Major Rehabilitation Evaluation Report and Environmental Assessment
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
ORAD	Order of Resource Area Delineation
PRM	Permittee-responsible mitigation
Program	Cape Cod Bridges Program
RPW	Relatively Permanent Water
sf	square feet
SOP	Compensatory Mitigation Standard Operating Procedures
SUP	shared-use path
USACE	U.S. Army Corps of Engineers
USC	United States Code
VW	vegetated wetland
WOTUS	Waters of the United States

1 Introduction

This technical report has been prepared in support of the Draft Environmental Impact Statement for the Cape Cod Bridges Program (Program), in accordance with the following federal and state statutes, regulations, and guidance:

- National Environmental Policy Act (NEPA) of 1969, as amended, 42 United States Code (USC) 4321 et seq.
- *Efficient Environmental Reviews for Project Decisionmaking and One Federal Decision*, 23 USC 139.
- Federal Highway Administration's (FHWA) regulations implementing NEPA, *Environmental Impact and Related Procedures* (23 Code of Federal Regulations [CFR] 771), and corresponding guidance, Technical Advisory (T 6640.8A): *Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (October 30, 1987).
- Location and Hydraulic Design of Encroachments on Flood Plains, 23 CFR 650
- Executive Order 13112, Invasive Species

2 Summary of Findings

This technical report explains in detail the assessment of estimated construction-term impacts on wetland and floodplain resources resulting from implementation of the Build Alternative for the Program. Construction term impacts, both temporary and permanent, are considered those that represent quantifiable alterations to state and federal resource areas. All references to temporary and permanent impacts referenced herein are related to the construction term. Once the highway approaches and bridges are constructed, operation-term impacts would be limited to the maintenance of project components, and no impacts to resources areas are anticipated. Inland and coastal wetland resources would be temporarily and permanently impacted. Temporary and permanent impacts to state and federal inland resource areas associated with the interchange approaches would be restored in-kind, and compensation provided for permanent impacts. Temporary impacts to state and federal coastal resource areas in Cape Cod Canal would be restored. Compensation for net permanent impacts to federal and state coastal resource areas would be coordinated with the U.S. Army Corps of Engineers (USACE) and Massachusetts Department of Environmental Protection (MassDEP) and presented in the Final Environmental Impact Statement.

3 Proposed Action and Alternatives

3.1 Purpose and Need

In partnership with the FHWA and the New England District of the 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 Bourne and Sagamore Bridges (also known as the Cape Cod Canal highway 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:

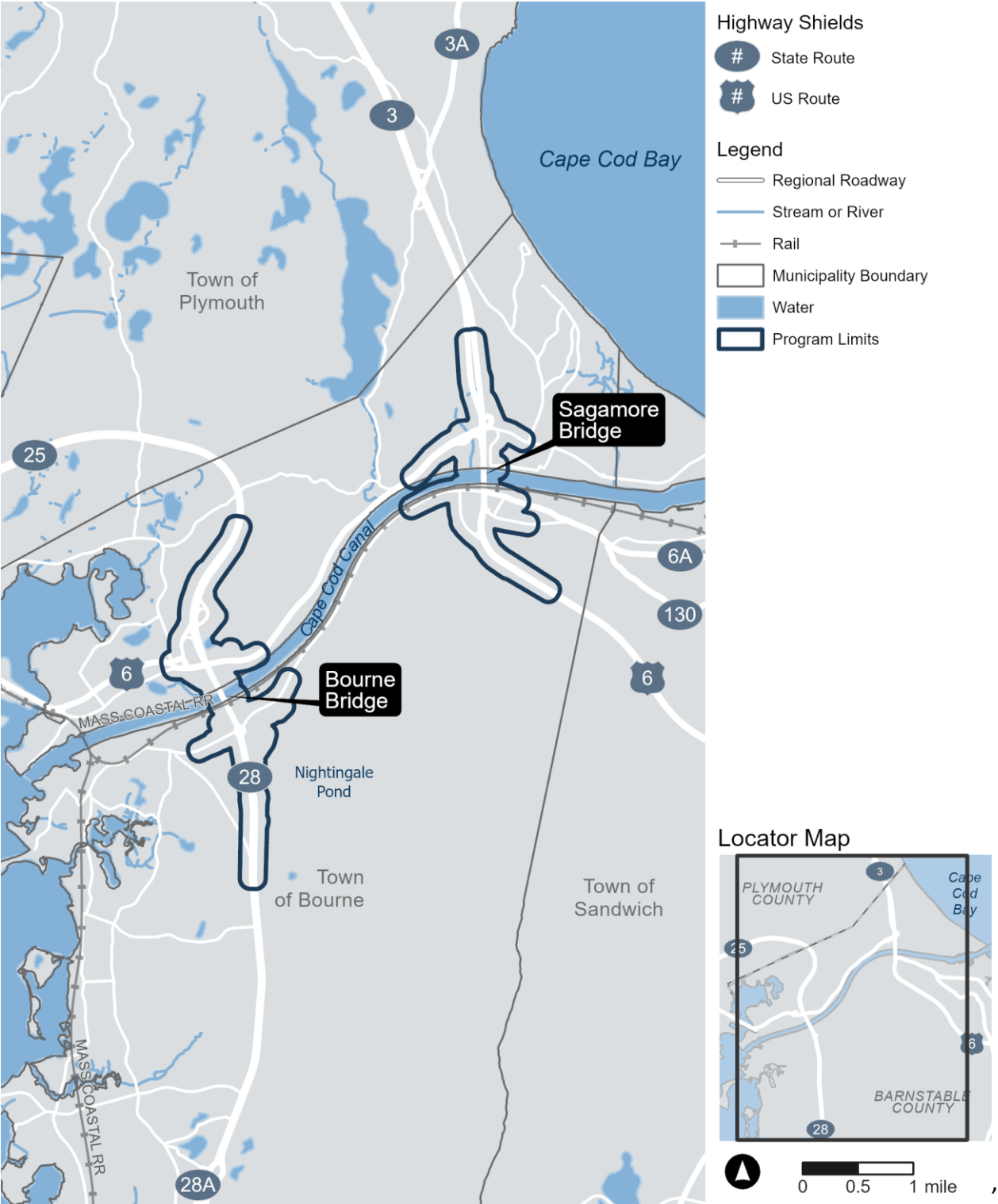
- Address the deteriorating structural condition and escalating maintenance demands of the Bourne and Sagamore Bridges.
- Address the substandard design elements of the Bourne and Sagamore Bridges, the immediate mainline approaches, and their adjacent interchanges and intersections.
- Improve vehicular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

Figure 3-1 shows two distinct project limits for the Program.

3.2 Study Area

The Project Study Area for the wetlands and floodplain analysis includes the Project Limits where physical work would occur within a construction zone as well as a 500-foot buffer from the construction zone. The 500-foot buffer represents areas beyond the physical work zone that may contain natural resources and associated buffer zones that could potentially be indirectly impacted during construction.

Figure 3-1. Program Limits



Source: Massachusetts Department of Transportation, 2024

3.3 Build Alternative

The Program's Build Alternative would incorporate the USACE's Major Rehabilitation Evaluation Report and Environmental Assessment'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 Program proposes to replace the Bourne and Sagamore 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 the Bourne Bridge and Sagamore 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. At both canal crossings, the Program 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 3-1 presents a description of the Program elements/design parameters of the recommended Build Alternative: Replacement Highway Bridges Built to Modern Design Standards.

Table 3-1. Description of Design Parameters of the Recommended Build Alternative

Program Element/ Program Design Parameter	Description
Highway Bridges	Both the Bourne and Sagamore 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).
Bridge Highway Cross- Section and Shared-Use Path (SUP)	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 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.

Program Element/ Program Design Parameter	Description
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 Bourne Bridge and Sagamore Bridge. At the Bourne crossing, both main spans would be located east of the existing Bourne Bridge toward Cape Cod Bay. At the Sagamore crossing, both main spans would be located west of the existing Sagamore Bridge toward Buzzards Bay.
Bridge Type	The replacement bridges would be twin tied-arch bridges with delta frames supporting an approximate 700-foot mainline span.
Interchange Approach Network: Sagamore North	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.

Program Element/ Program Design Parameter	Description
Interchange Approach Network: Sagamore South	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	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	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.

3.4 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 Route 3/Route 6 corridor at Sagamore Bridge and the Route 25/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 Commonwealth of Massachusetts-sponsored and local transportation improvements projects in and near the Program as indicated in the Federal Fiscal Year 2025-2029 Transportation Improvement Program for the Cape Cod Metropolitan Planning Organization. [Table 3-2](#) identifies the Transportation Improvement Program projects within and near the Program to be incorporated in the No Build Alternative.

Table 3-2. 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
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

Project Number	Year	Transportation Project	Project Description	Status
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
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

Project Number	Year	Transportation Project	Project Description	Status
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 3-2** includes only those projects in the Study Areas 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 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 Methods for Effect Evaluations

4.1 Regulatory Context for Wetland and Floodplain Resources

The Project Study Area, including the Bourne and Sagamore interchange approaches and Cape Cod Canal, contains wetland and floodplain resources subject to jurisdiction under the following acts and order:

- Federal Water Pollution Control Act of 1972 (33 USC 1251-1376), as amended by U.S. Clean Water Act (1977) and U.S. Water Quality Act (1987), Section 401 and Section 404
- Rivers and Harbors Act of 1899 (33 USC 403), Section 10
- Massachusetts Wetlands Protection Act (MA WPA; Massachusetts General Laws [MGL] Chapter 131 Section 40) and its implementing regulations (310 Code of Massachusetts Regulations [CMR] 10.00)
- Executive Order 13112 Invasive Species

The USACE New England District issues a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act (CWA). The federal CWA regulates the discharge of dredge or fill materials into Waters of the United (WOTUS) which include, but are not limited to, navigable waters and tidal wetlands, and which also include many non-tidal wetlands and other waterbodies. WOTUS are subject to federal jurisdiction under the CWA, of which Section 404 requires authorization from the USACE for the discharge of dredged or fill material into WOTUS, including wetlands. Navigable WOTUS are also subject to federal jurisdiction under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403). Any work in or over, or outside the limits of the navigable WOTUS that would affect the navigable water requires authorization from the USACE. In Massachusetts, the MassDEP administers Section 401 of the Clean Water Act through the Massachusetts Surface Water Quality Standards (314 CMR 4.00) and 401 Water Quality Certification regulations (314 CMR 9.00) to ensure compliance with state water quality standards for any activity impacting WOTUS within Massachusetts.

At the state level, coastal and inland wetlands are subject to protection under the MA WPA and its regulations (310 CMR 10.00), which is administered by municipal conservation commissions. Freshwater resources subject to protection include banks, freshwater wetland, marsh, or swamp bordering on any creek, river, stream, pond, or lake; land under any listed water body, land subject to flooding; and riverfront area. Coastal resources subject to protection include coastal banks (CB), salt marsh, coastal beach, coastal dune, land under ocean (LUO), land subject to tidal action (LSTA), rocky intertidal shore (RIS), land containing shellfish, banks underlying an anadromous fish run, and land subject to coastal storm flowage (LSCSF).

The floodplain is defined as any land area susceptible to being inundated by floodwaters from any source. The Federal Emergency Management Agency (FEMA) identifies the 100-year floodplain as the boundary of the flood that has a 1% chance of being equaled or exceeded in any given year (also known as the base flood). FEMA identifies the 500-year floodplain as the boundary of flood that has a

0.2% chance of being equaled or exceeded in any given year. The 100-year floodplain is considered LSCSF and Bordering Land Subject to Flooding (BLSF) under the MA WPA.

In Massachusetts, an Area of Critical Environmental Concern (ACEC) designation is a formal state designation of a significant ecological area. A designated ACEC receives special recognition because of the quality, uniqueness, and significance of its natural and cultural resources. The ACEC regulations (301 CMR 12.00) require agencies under the Executive Office of Energy and Environmental Affairs review projects subject to their jurisdiction to avoid and minimize adverse effects to ACEC resources.

Vernal Pools are areas typically filled with water in the autumn or winter due to rainfall and rising groundwater and remain ponded through the spring and into summer. Vernal pools provide habitat for amphibians, such as wood frogs, salamanders, and fairy shrimp. They are regulated under the MA WPA and Section 401 of the Clean Water Act.

4.2 Methodology

Wetlands, WOTUS, floodplains, vernal pools, and ACECs within the Study Area were identified using a range of data sources including the following:

- GIS Mapping
- Field wetland delineations (2020, 2021 and 2024)
- Vernal pool surveys (May 2020)
- FEMA Flood Insurance Rate Maps (FIRM)
- Coastal Zone Management Mapping
- USACE Major Rehabilitation Evaluation Environmental Assessment

Wetlands in the Project Study Area were delineated June 12 through September 18, 2020, and on February 10, 2021. Vernal pool surveys were conducted within the Project Study Area between May 13 and May 15, 2020. An Abbreviated Notice of Resource Area Delineation (ANRAD; HNTB 2021) was submitted to the Bourne Conservation Commission on December 6, 2021, and revised information was submitted on April 22, 2022 (HNTB 2022) (Appendix A). The Bourne Conservation Commission issued an Order of Resource Area Delineation (ORAD) on May 6, 2022, which was valid until May 6, 2025. The Permit Extension Act signed by Governor Healey on November 20, 2024, extends the permit for a 2-year period until May 6, 2027. Since the time of the delineation and issuance of the ORAD, further field investigations were performed in October and November 2024 to delineate and document the resource areas associated with the Cape Cod Canal, and a review of the stormwater pipe network connections was conducted. The field investigations resulted in the delineation of the resource areas within the Cape Cod Canal, and review of the pipe network connections resulted in updates to several inland state resource area qualifications. Prior to May 6, 2027, a request for an Amended ORAD and 3-year extension will be filed with the Bourne Conservation Commission to include the Cape Cod Canal, reflect the recent field investigations, and extend the ORAD (if necessary). The resource areas described herein reflect the updated delineation effort.

5 Affected Environment

5.1 State Inland Resource Areas

State inland jurisdictional resource areas were identified and approved in the ORAD. The resource areas were further qualified by additional investigations. There were a number of areas identified in the field, but many of them did not qualify under the MA WPA as jurisdictional areas due to their size and/or because they are human-made stormwater management features constructed in uplands. The ANRAD also included WOTUS. The state and federal resource areas were also confirmed based on field investigations, pipe network, and surface connections to Cape Cod Canal. Those discussed herein include only those with the potential to be affected.

In the Study Area, the following inland resource areas were identified in the Sagamore North, Bourne North, and South interchange approaches: BLSF, bordering vegetated wetland (BVW), and land under water bodies and waterways (LUW). In addition, there are 100-foot buffer zones from the edges of both bank and BVW. These resources are defined in [Table 5-1](#) and depicted in [Figure 5-1 through Figure 5-3](#). No inland wetland resource areas were identified in the Sagamore South interchange approach area.

Table 5-1. Definitions of State Inland Wetland Resources

Resource	Definition
Bank	The portion of the land surface which normally abuts and confines a water body (stream lake or pond)
Bordering Land Subject to Flooding (BLSF)	An area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds, or lakes. It extends from the banks of these waterways and water bodies; where a BVW occurs, it extends from said wetland.
Bordering Vegetated Wetland (BVW)	Freshwater wetlands which border on creeks, rivers, streams, ponds, and lakes, including wet meadows, marshes, swamps, and bogs. These wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants.
Land Under Water Bodies and Waterways (LUW)	The bottom of, or land underneath, any creek, river, stream, pond, or lake.

Highway Shields

- # State Route
- # US Route

Legend

- Local or Regional Roadway
- Rail
- Open Space
- Water
- Project Limits
- Wetlands and Floodplains Study Area
- Bordering Vegetated Wetlands (BVW) / Vegetated Wetlands (VW)

Additional Resources

- Certified Vernal Pool (CVP)

Locator Map

PLYMOUTH COUNTY

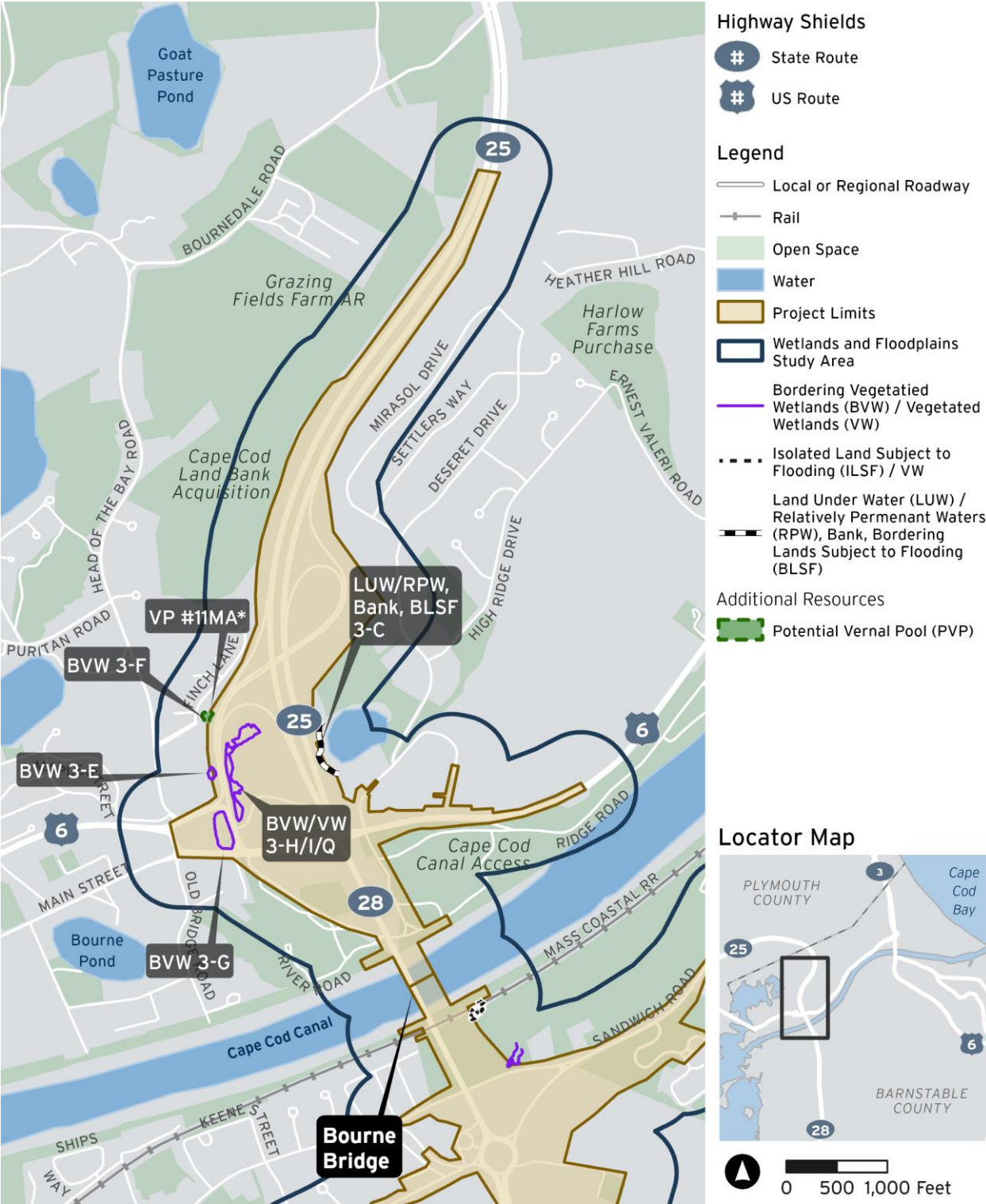
BARNSTABLE COUNTY

Cape Cod Bay

0 500 1,000 Feet

Cape Cod Bridges Program DEIS – Appendix 4.9, Wetlands and Floodplains Technical Report

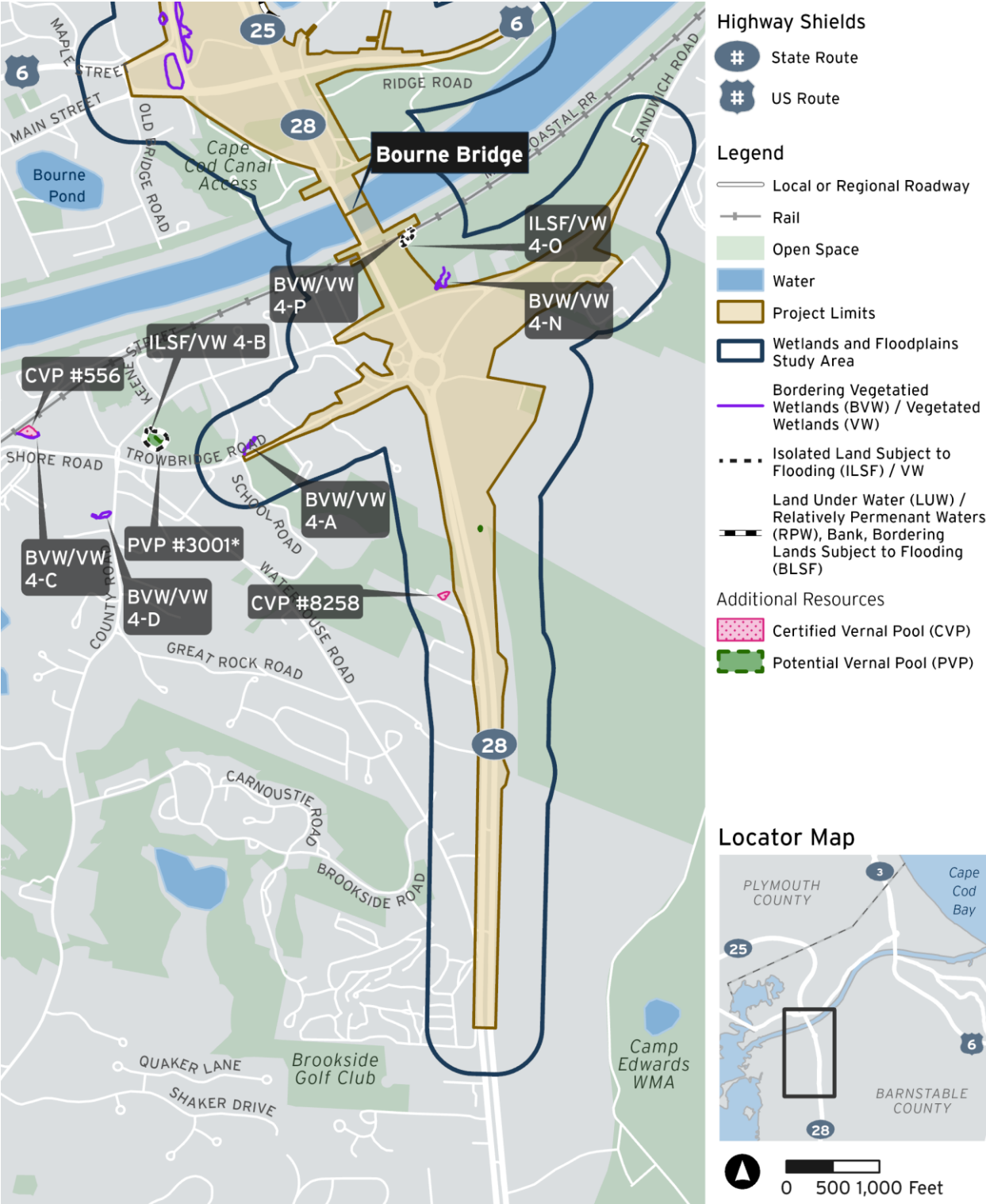
Figure 5-2. State and Federal Inland Wetlands (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Note: Vernal Pool certification criteria not met.

Figure 5-3. State and Federal Inland Wetlands (Bourne South Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Note: Vernal Pool certification criteria not met.

Of those wetland areas identified, three, all of which are located within the Bourne North quadrant interchange approach, would be impacted. **Table 5-2** lists these three wetland areas.

Table 5-2. State Inland Wetlands (Bourne North Quadrant Interchange Approach)

Figure No.	Wetland ID ^[1]	State Resource Area Type	Location	Description
Figure 5-2	Series 3-E	Bordering Vegetated Wetland (BVW)	Northeast of CVS parking lot on west side of State Route 25 eastbound off-ramp to U.S. Route 6/State Route 28; connected to 3-H/I/Q via culvert under State Route 25 ramps; eventually flows to Cape Cod Canal	Sparsely vegetated forested wetland dominated by alder buckthorn (<i>Frangula alnus</i>), red maple (<i>Acer rubrum</i>), and sensitive fern (<i>Onoclea sensibilis</i>).
Figure 5-2	Series 3-H/I/Q	BVW	East side of U.S. Route 6/State Route 28 southbound ramp to State Route 25; connected to wetland resource 3-G via culvert under U.S. Route 6/State Route 28 ramp; eventually flows to the Cape Cod Canal via culvert	Dominant vegetation includes arrowwood (<i>Viburnum dentatum</i>), red maple, gray birch (<i>Betula populifolia</i>), steeplebush (<i>Spiraea tomentosa</i>), and small cranberry (<i>Vaccinium oxycoccos</i>).
Figure 5-2	Series 3-C	BVW Land Under Water (LUW) Bank Bordering Land Subject to Flooding (BLSF)	Nightingale Pond; east of State Route 25 northbound	Dominant vegetation on edge of pond includes black gum (<i>Nyssa sylvatica</i>), sweet pepperbush (<i>Clethra alnifolia</i>), and highbush blueberry (<i>Vaccinium corymbosum</i>).

^[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD) (HNTB 2021, 2022) and additional field investigations.

Associated with wetland flag Series 3-C, the FEMA Flood Insurance Rate Study and Map, revised effective date of July 6, 2021, shows a Zone A flood zone (i.e., 1% annual chance flood hazard or BLSF) with no Base Flood Elevation associated with Nightingale Pond. Considering there is no FEMA Base Flood Elevation, the MA WPA regulations require a hydrologic analysis to determine the elevation of BLSF in accordance with 310 CMR 10.57(2)(a)3. The elevation of BLSF was calculated using a design storm of 7.5 inches of precipitation in 24 hours as set forth in the National Oceanic and Atmospheric Administration's 14 Precipitation-Frequency Atlas of the United States. The model calculates the peak elevations within the flooded area representing the elevation of BLSF or the 1% annual chance flood hazard. The analysis determined the BLSF elevation to be 14.5 feet North American Vertical Datum of

1988 (NAVD88). The model also calculates the 10% annual chance flood hazard area using a design storm of 5 inches of precipitation in 24 hours. The analysis determined the 10% annual chance flood elevation to be 9.3 feet NAVD88.

5.1.1 Vernal Pools

Vernal pools are confined basin depressions, which, in most years, hold water for a minimum of two continuous months during the spring and/or summer, are free of adult fish populations, and provide specialized and critical breeding habitat for frogs, salamanders, and invertebrates. Although vernal pools are not an area subject to protection under the MA WPA they are designated as an Outstanding Resource Water pursuant to the Massachusetts Surface Water Quality Standards and subject to regulation under Section 401 of the CWA through the Water Quality Certification regulations (314 CMR 9.00).

Vernal pools in the Study Area are described in the Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment (Stantec 2020). Five vernal pools were identified in the Wetlands and Floodplains Study Areas (refer to [Figure 5-1](#), [Figure 5-2](#), [Figure 5-3](#), and [Table 5-3](#)).

Table 5-3. Summary of Spring 2020 Vernal Pool Surveys

Figure No.	Survey Area/Wetland ID ^[1]	Vernal Pool ID ^[2]	Vernal Pool ID ^[3]	Comments
Figure 5-1	Sagamore North Quadrant/BVW 1-E	05DN	Certified #555	Within 100 feet of proposed work
Figure 5-2	Bourne North Quadrant/BVW 3-F	11MA	None	Does not meet biological criteria for certification
Figure 5-3	Bourne South Quadrant/ILSF 4-B	03MA	Potential #3001	Does not meet biological criteria for certification
Figure 5-3	Bourne South Quadrant/IVW 4W	05MA	None	Does not meet biological criteria for certification
Figure 5-3	Bourne South Quadrant/BVW	07MA	Certified #8258	Within 100 feet of proposed work

BVW = Bordering Vegetated Wetlands, ILSF = Isolated Land Subject to Flooding

^[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD) (HNTB 2021, 2022) and additional field investigations.

^[2] As identified in Stantec (2020).

^[3] As identified by the Massachusetts Department of Fish and Wildlife Natural Heritage and Endangered Species Program.

5.2 State Coastal Resource Areas

State coastal resource areas that were identified within the Sagamore and Bourne Bridge Study Areas include LUO, CB, RIS, LSTA, Banks of or Land Under the Ocean Underlying an Anadromous/

Catadromous Fish Run, Land Containing Shellfish, and LSCSF. These resources are defined in [Table 5-4](#) and their locations are depicted in [Figure 5-4 through Figure 5-7](#) and described in [Table 5-6](#). These state coastal resources are associated with the Cape Cod Canal, which connects Cape Cod Bay to Buzzards Bay.

Water elevations within the Cape Cod Canal were obtained from the USACE Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation Report (USACE 2022). Elevations in the USACE report were based on mean sea level datum and converted to NAVD88 to establish the state jurisdictional limits. Water elevations pertinent to state jurisdictional limits are presented in [Table 5-5](#). Variations in the values presented in [Table 5-5](#) result from differences in the timing and amplitude of the tides in Buzzards Bay and Cape Cod Bay – Buzzards Bay tide range is approximately 6 feet compared to Cape Cod Bay’s range of approximately 10 feet, and the high and low tides precede that of Cape Cod Bay by about 3 hours.

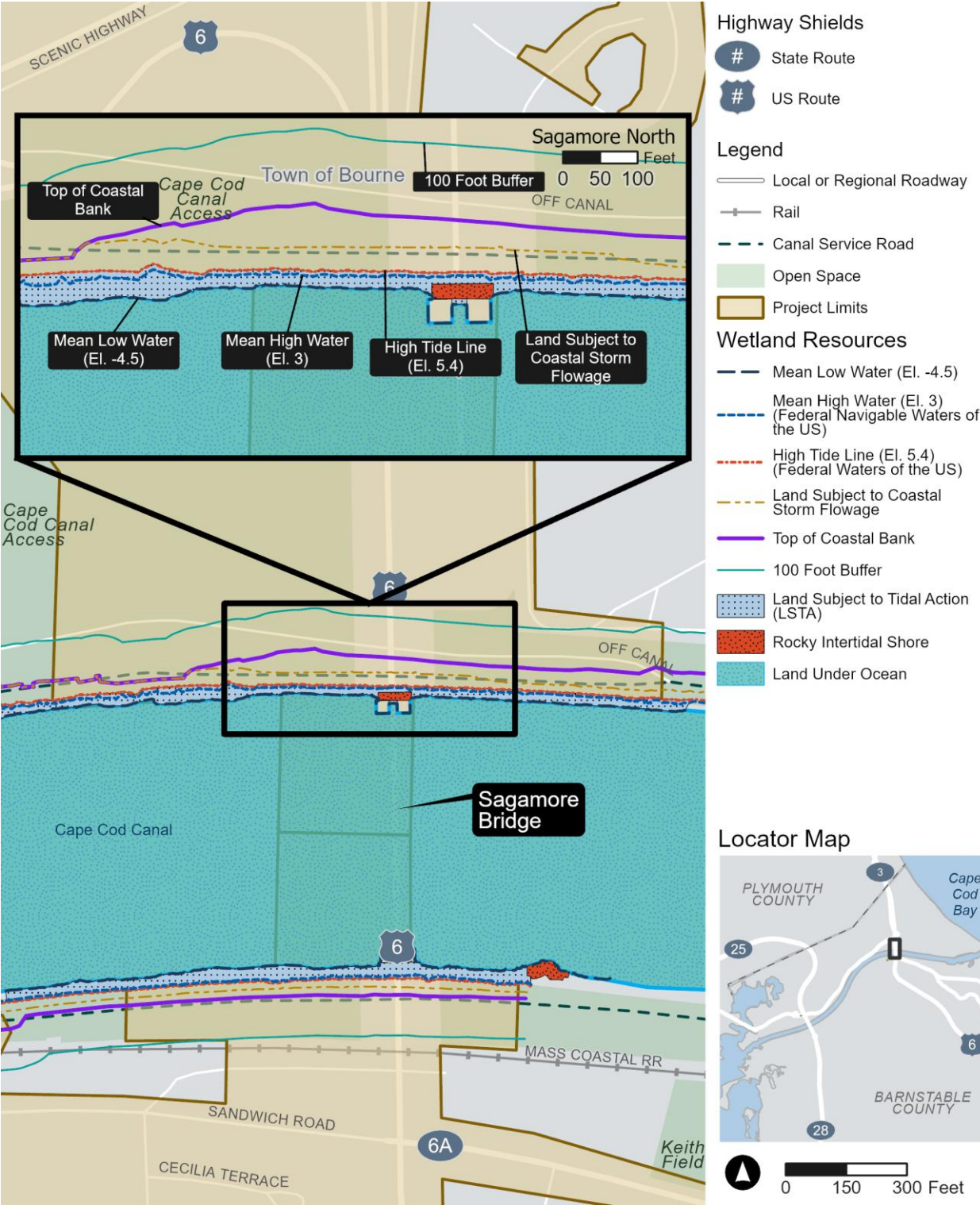
Table 5-4. Definitions of State Coastal Resource Areas

Resource	Definition
Land Under the Ocean	Land extending from the mean low water line seaward to the boundary of the municipality's jurisdiction, and includes land under estuaries.
Coastal Bank	The seaward face or side of any elevated landform, other than a coastal dune, which lies at the landward edge of a coastal beach, land subject to tidal action, or other wetland.
Rocky Intertidal Shore	Naturally occurring rocky areas, such as bedrock or boulder-strewn areas between the mean high water line and the mean low water line.
Land Containing Shellfish	Land under the ocean, tidal flats, rocky intertidal shores, salt marshes, and land under salt ponds when any such land contains shellfish.
Land Subject to Tidal Action	Land subject to the periodic rise and fall of a coastal water body, including spring tides.
Banks of or Land Under the Ocean Underlying an Anadromous/ Catadromous Fish Run	Area within estuaries, ponds, streams, creeks, rivers, lakes, or coastal waters, which is a spawning or feeding ground or passageway for anadromous or catadromous fish and which is identified by the Division of Marine Fisheries or has been mapped on the Coastal Atlas of the Coastal Zone Management Program.
Land Subject to Coastal Storm Flowage	Land subject to inundation caused by coastal storms up to and including that caused by the 100-year storm surge of record or storm of record.

Table 5-5. Cape Cod Canal Water Elevations in Feet (Based on NAVD88)

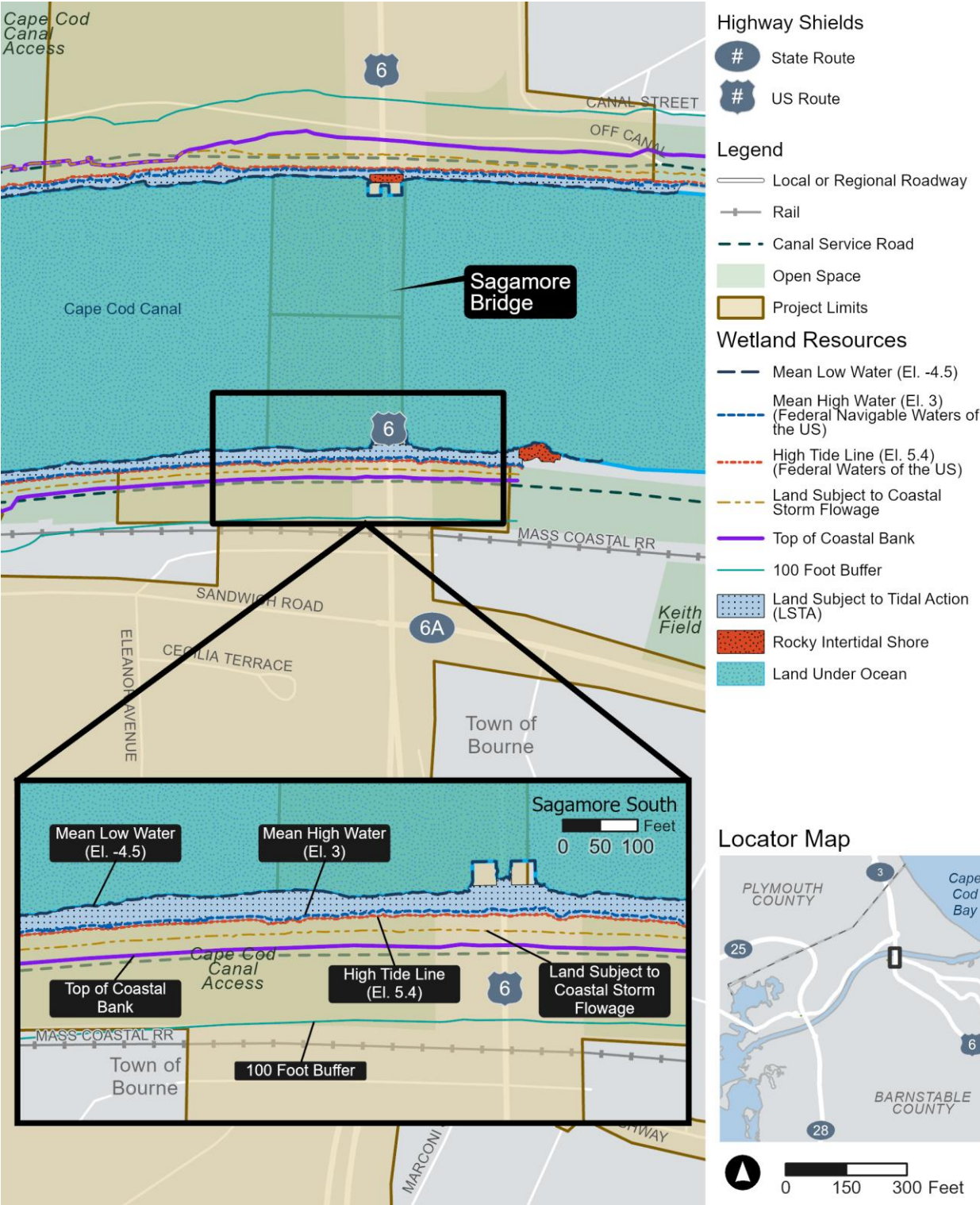
Location	High Tide Line	Mean High Water	Mean Low Water
Sagamore Bridge	5.4	3.0	-4.5
Bourne Bridge	2.9	1.5	-3.0

Figure 5-4. State and Federal Coastal Resource Areas (Sagamore North Quadrant)



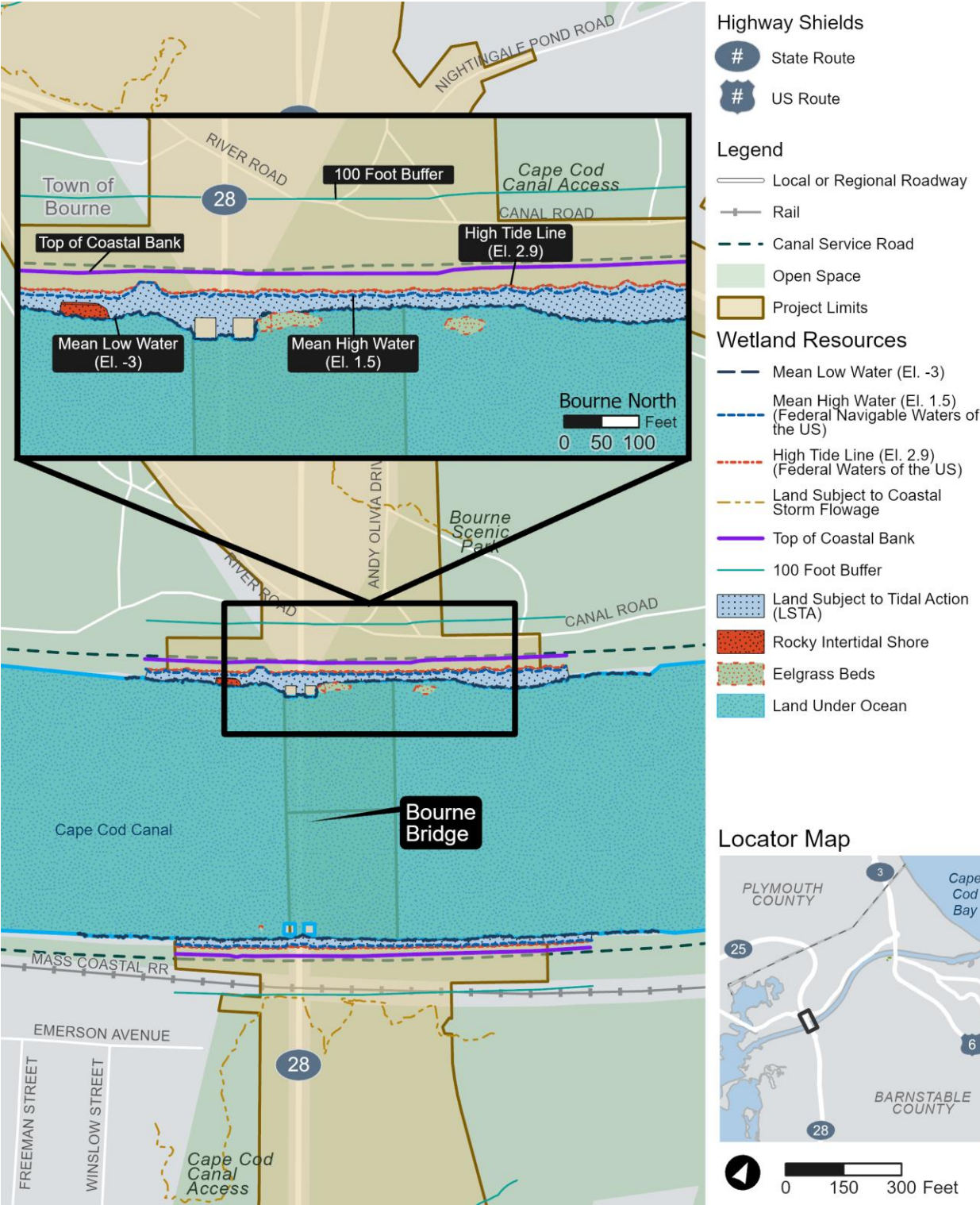
Source: Massachusetts Department of Transportation, 2025

Figure 5-5. State and Federal Coastal Resource Areas (Sagamore South Quadrant)



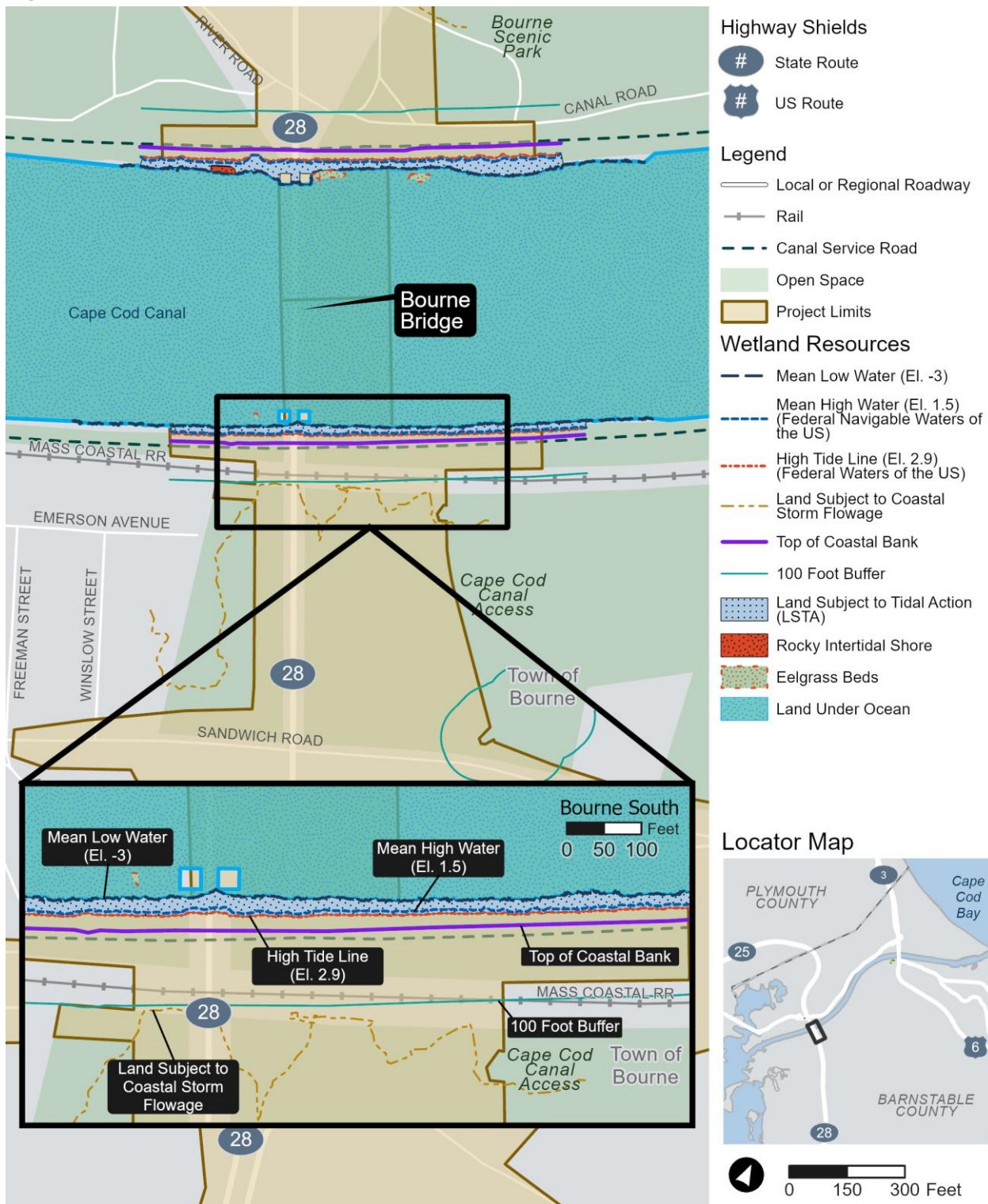
Source: Massachusetts Department of Transportation, 2025

Figure 5-6. State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Figure 5-7. State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Table 5-6. State Coastal Resource Areas

Resource Area Type	Location	How Determined
Land Under Ocean	Within Cape Cod Canal	Below Mean Low Water elevation based on U.S. Army Corps of Engineers (2022)
Coastal Bank	Along north and south shorelines of entire length of Cape Cod Canal; 100-foot buffer applies	Massachusetts Department of Environmental Protection Wetlands Program Policy 92-1 Coastal Banks
Rocky Intertidal Shore	1,652 square feet at Sagamore North Approach and 1,167 square feet at Bourne North Approach	Based on field observations between Mean High Water and Mean Low Water
Land Subject to Tidal Action	Within the Cape Cod Canal	Between Mean Low Water and High Tide Line (including spring tides) based on U.S. Army Corps of Engineers (2022)
Banks of or Land Under the Ocean Underlying an Anadromous/ Catadromous Fish Run	Along north and south shorelines of entire length of Cape Cod Canal	As mapped by the Massachusetts Department of Fish and Game Division of Marine Fisheries
Land Containing Shellfish	Within Cape Cod Canal	As mapped by the Massachusetts Department of Fish and Game Division of Marine Fisheries
Land Subject to Coastal Storm Flowage or 1% annual chance flood hazard	Elevation 14 feet North American Vertical Datum of 1988 (NAVD88) at Sagamore Bridge, elevation 16 feet NAVD88 west of Bourne Bridge, and elevation 15 feet NAVD88 east of Bourne Bridge	Based on Federal Emergency Management Agency Flood Insurance Study and Rate Map and elevation verified by survey

Canal resource areas are depicted in [Exhibit 5-1 through Exhibit 5-8](#).

The Cape Cod Canal Project Study Area was reviewed for the presence/absence of other state coastal resources (i.e., coastal beach, coastal dune, barrier beach, salt marsh, and land under salt ponds). These coastal resources were not observed.

Exhibit 5-1. Banks of Cape Cod Canal Adjacent to Sagamore North Quadrant Bridge Piers, Looking East



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-2. Banks of Cape Cod Canal Adjacent to Sagamore North Quadrant Bridge Piers, Looking South



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-3. Banks of Cape Cod Canal Adjacent to Sagamore South Quadrant Bridge Piers, Looking East



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-4. Banks of Cape Cod Canal Adjacent to Sagamore South Quadrant Bridge Piers, Looking East-Northeast



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-5. Banks of Cape Cod Canal Adjacent to Bourne North Quadrant Bridge Piers, Looking East



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-6. Banks of Cape Cod Canal Adjacent to Bourne North Quadrant Bridge Piers, Looking South



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-7. Banks of Cape Cod Canal Adjacent to Bourne South Quadrant Bridge Piers, Looking East



Source: Massachusetts Department of Transportation, 2024

Exhibit 5-8. Banks of Cape Cod Canal Adjacent to Bourne South Quadrant Bridge Piers, Looking East (closeup view)



Source: Massachusetts Department of Transportation, 2024

5.3 Waters of the United States

The Program is currently proceeding under the presumption that aquatic resources that meet the CWA definition of wetlands and any Relatively Permanent Water (RPW) with a High Tide Line (HTL), Mean High Water (MHW) mark, or Ordinary High Water (OHW) mark are subject to USACE jurisdiction pursuant to the CWA and/or Section 10 of the Rivers and Harbors Act of 1899. The terms WOTUS and federal are used interchangeably to refer to these aquatic resources.

5.3.1 Inland WOTUS

Inland WOTUS were identified in the Sagamore North quadrant, Bourne North quadrant, and Bourne South quadrant interchange approaches. [Figure 5-1](#) through [Figure 5-3](#) depict these wetland resources. Of those wetland resources identified, three, all of which are within the Bourne North quadrant interchange approach ([Figure 5-2](#)), would be impacted. [Table 5-7](#) identifies these three WOTUS.

Table 5-7. Federal Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)

Figure No.	Wetland ID ^[1]	Resource Area Type	Location	Description
Figure 5-2	Series 3-E	Vegetated Wetland	Northeast of CVS parking lot on west side of State Route 25 eastbound off-ramp to U.S. Route 6/State Route 28; connected to 3-H/I/Q via culvert under State Route 25 ramps; eventually flows to Cape Cod Canal.	Sparsely vegetated forested wetland dominated by alder buckthorn, red maple, and sensitive fern.
Figure 5-2	Series 3-H/I/Q	Vegetated Wetland.	East side of U.S. Route 6/State Route 28 southbound ramp to State Route 25; connected to wetland resource 3-G via culvert under U.S. Route 6/State Route 28 ramp; eventually flows to the Cape Cod Canal via culvert	Dominant vegetation includes arrowwood, red maple, gray birch, steplebush, and small cranberry
Figure 5-2	Series 3-C	Vegetated Wetland and Relatively Permanent Water	Nightingale Pond; east of State Route 25 northbound	Dominant vegetation on edge of pond includes black gum, sweet pepperbush, and highbush blueberry

Note: Only those wetlands are listed where impacts are proposed.

^[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD) (HNTB 2021, 2022) and additional field investigations.

5.3.2 Coastal (Tidal) Waters of the United States

Coastal WOTUS are those waters that are subject to the ebb and flow of the tide. Cape Cod Canal is a tidal Navigable WOTUS. Coastal WOTUS identified within the Wetlands and Floodplains Study Areas at both bridge locations are depicted in [Figure 5-4 through Figure 5-7](#). Water elevations pertinent to federal jurisdictional limits are presented in [Table 5-5](#) and were obtained from the USACE MRER/EA (USACE 2022). The Bourne Bridge North quadrant includes two eelgrass beds totaling 2,345 square feet that are located east of the existing piers. The Bourne Bridge South quadrant includes one 100 square foot eelgrass bed that is located west of the existing piers along with isolated eelgrass sprigs further west. The Sagamore Bridge Study Area does not include areas vegetated with eelgrass.

5.4 Floodplains

FEMA FIRM panels (25001C0316K, 25001C0318K, 25001C0311K, 250010C4K, 25001C0501J, and 25001C0502J), identify the 1% annual chance flood hazard (i.e., 100-year floodplain) boundary within the Study Areas. The limits of the FEMA-delineated floodplain within the Study Areas are illustrated in [Figure 5-8](#) and [Figure 5-9](#).

The FEMA Flood Insurance Study and Map, with a revised effective date of July 6, 2021, shows the Cape Cod Canal as Zone AE, 1% annual chance flood hazard ranging between elevation 16 feet NAVD88 to the west of the Bourne Bridge to elevation 15 feet NAVD88 to the east of the Bourne Bridge. At the Sagamore Bridge location the 1% annual chance flood hazard is elevation 14 feet NAVD88.

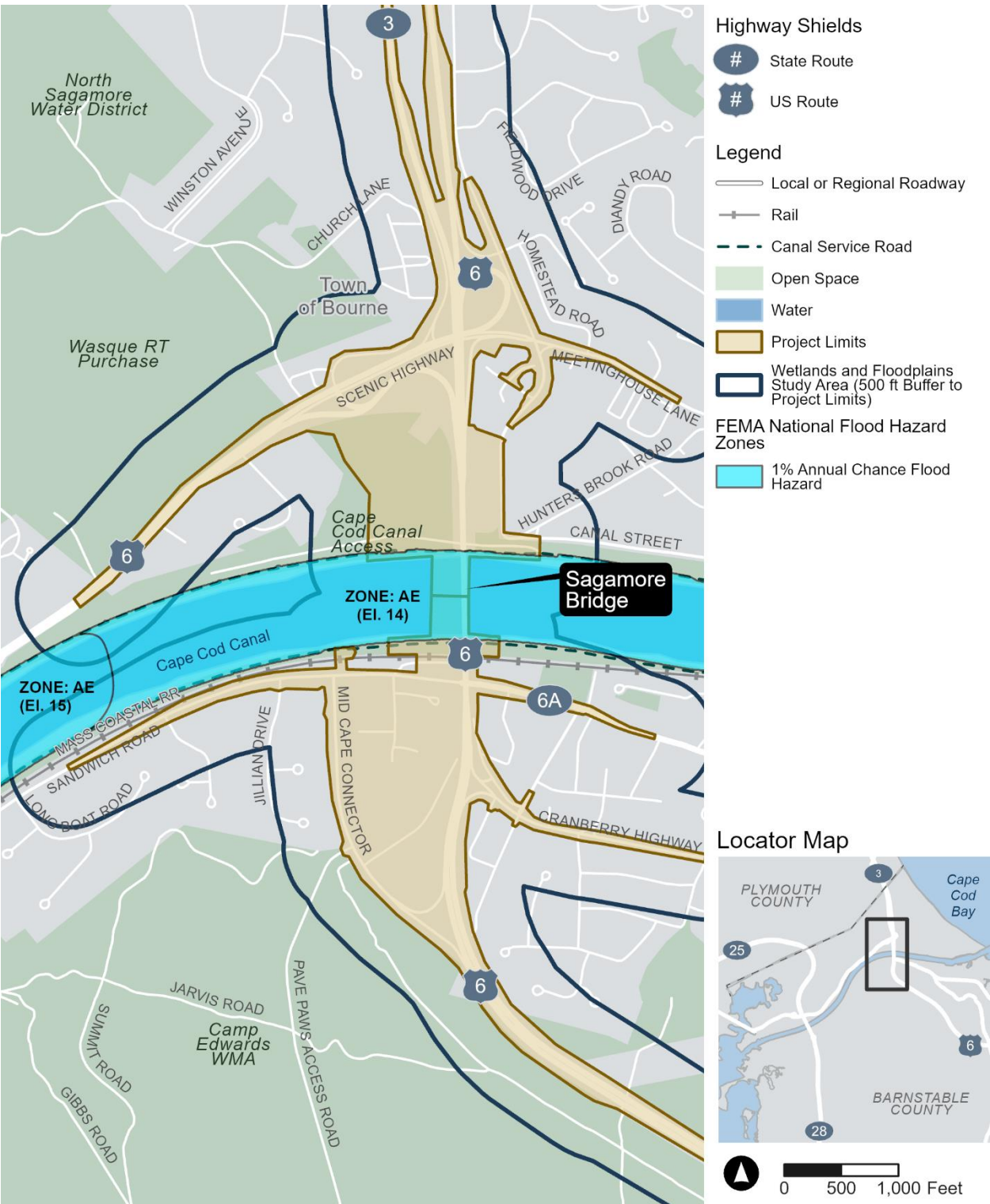
At the Bourne Bridge North Interchange Approach, Zone AE extends beyond the banks of Cape Cod Canal into Belmont Circle. At the Bourne Bridge South Interchange Approach, the flood zone extends into the adjacent properties on either side of the bridge. At the Sagamore North Interchange Approach, Zone AE is located along the landward edge of the existing pedestrian path, and at Sagamore South Approach, Zone AE is confined to the banks of Cape Cod Canal.

Zone A flood zone (i.e., 1% annual chance flood hazard) with no Base Flood Elevation is associated with Nightingale Pond which is in the Bourne North quadrant. Considering no Base Flood Elevation is provided, a hydrologic analysis was conducted to determine it. The elevation of BLSF was calculated using a design storm of 7.5 inches of precipitation in 24 hours as set forth in the National Oceanic and Atmospheric Administration's 14 Precipitation-Frequency Atlas of the United States. The analysis determined the Base Flood Elevation to be 14.5 feet NAVD88.

5.5 Areas of Critical Environmental Concern

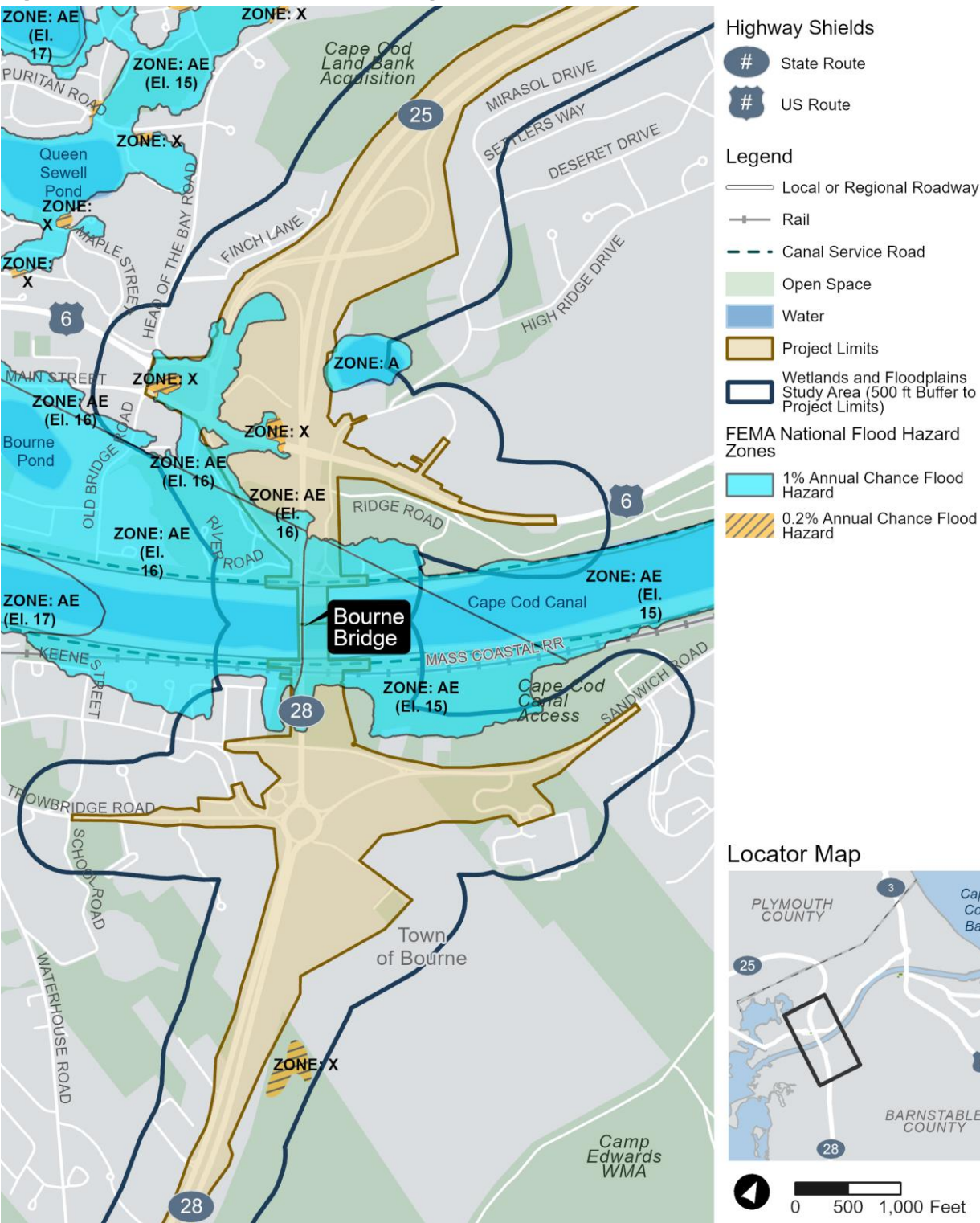
The Herring River Watershed is a mapped Area of Critical Environmental Concern (ACEC) that occurs within the Sagamore North Interchange Approach ([Figure 5-10](#)). The ACEC is mapped on the west side of State Route 3 and includes BVW series 1-J. At the southern end of the Bourne South Interchange Approach, the Project Limits overlap with the Bourne Back River ACEC ([Figure 5-11](#)). The wetlands within the ACEC are considered Outstanding Resource Waters, which are regulated under Clean Water Act Section 401.

Figure 5-8. Floodplains (Sagamore Bridge)



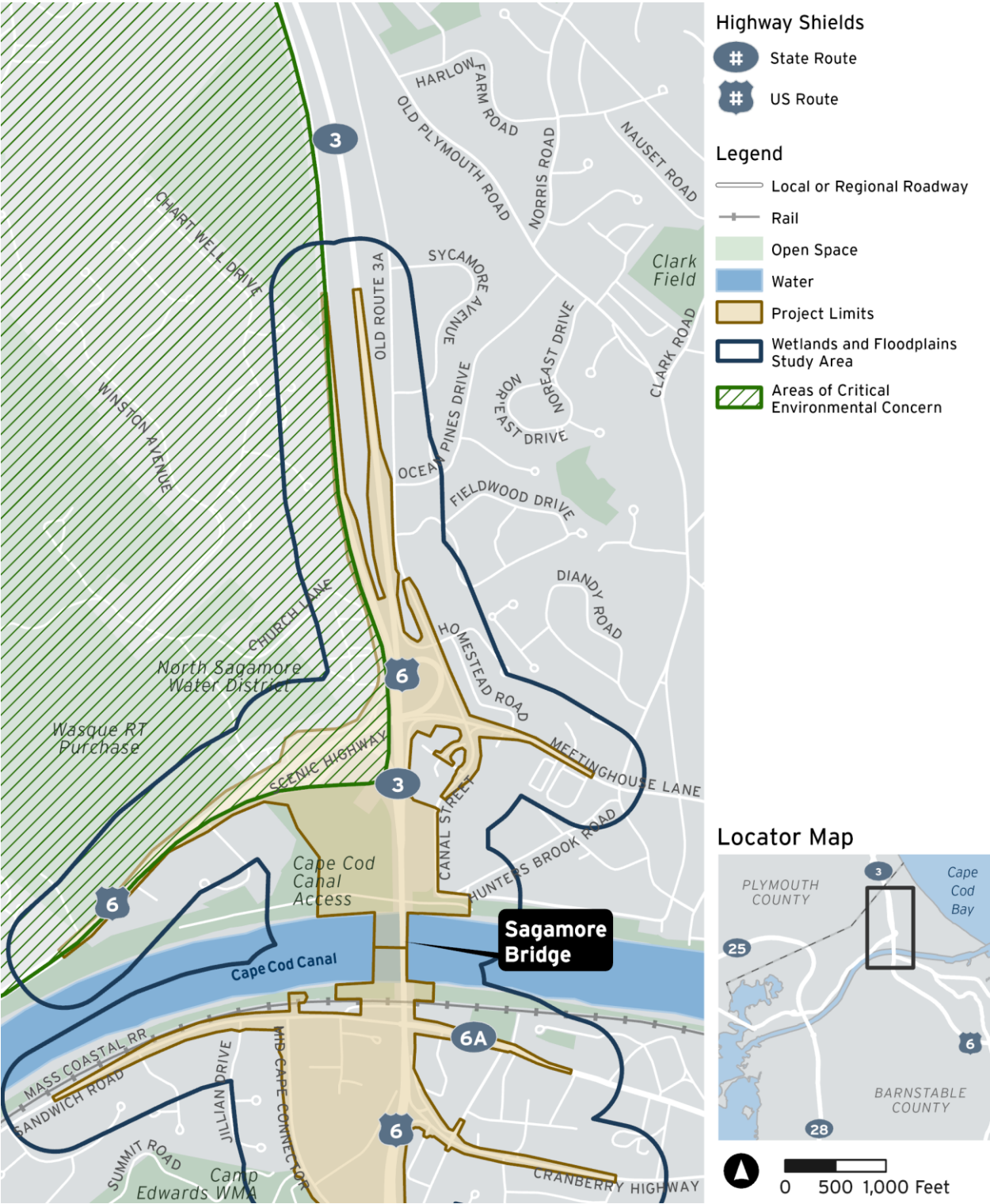
Source: Massachusetts Department of Transportation, 2025

Figure 5-9. Floodplains (Bourne Bridge)



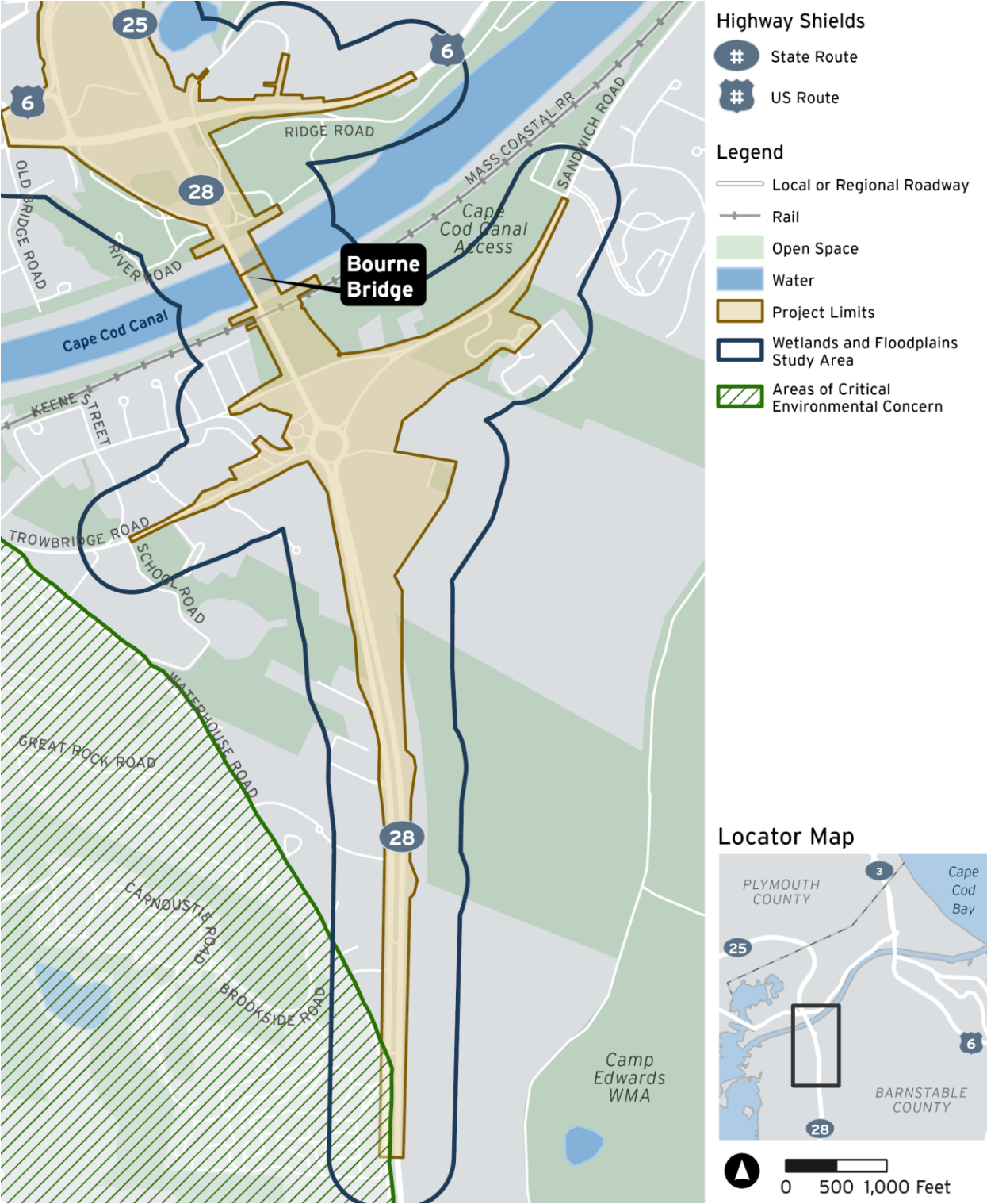
Source: Massachusetts Department of Transportation, 2025

Figure 5-10. Areas of Critical Environmental Concern (Sagamore North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Figure 5-11. Areas of Critical Environmental Concern (Bourne South Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

6 No Build Alternative

For the No Build Alternative, the Sagamore and Bourne Bridges would not be replaced. The USACE would continue to conduct maintenance activities at both bridges. These activities would not result in permanent impacts to state or federal wetland resource areas. Effects would be similar to those that occurred during prior maintenance activities for which the USACE analyzed pursuant to NEPA.

7 Build Alternative

7.1 Construction-Term Impact Assessment

The Build Alternative would result in temporary and permanent impacts to both state and federal resources and in both inland and coastal areas. Temporary construction-term alterations would include filling, excavating, and installing structures. Permanent alterations would result from project components, including new bridge piers, riprap pier protection, and retaining walls. Dredging would also be required to provide marine vessels access to support construction activities during low tide cycles.

Organized by the location of the construction activities, the following subsections discuss resource area impacts, design considerations to avoid impacts, measures to avoid and minimize impacts, and mitigation for unavoidable impacts. The Sagamore and Bourne interchange approaches would also occupy the 100-foot buffer zone to state wetlands. The occupation of the buffer zone would include temporary construction work zones, permanent highway ramps, shared-use paths (SUP), landscaping, and mitigation areas.

7.1.1 Potential Impacts to State and Federal Inland Wetland Resource Areas

The Bourne North Interchange Approach would include roadway widening, additional lanes, and/or accommodations for a SUP in three locations that would affect state and federal wetlands. In each location, retaining walls would be constructed to minimize the extent of fill in jurisdictional resources. The temporary alteration at Nightingale Pond would allow for an 11.5-foot-wide work zone to construct a retaining wall. For post-construction, this 11.5-foot-wide work zone would be narrowed to a 10-foot-wide grass surface access path for future maintenance purposes during operations. The 10-foot-wide path would be considered a permanent impact. Unavoidable impacts to wetlands are presented in [Figure 7-1](#) and [Figure 7-2](#) and described in [Table 7-1](#).

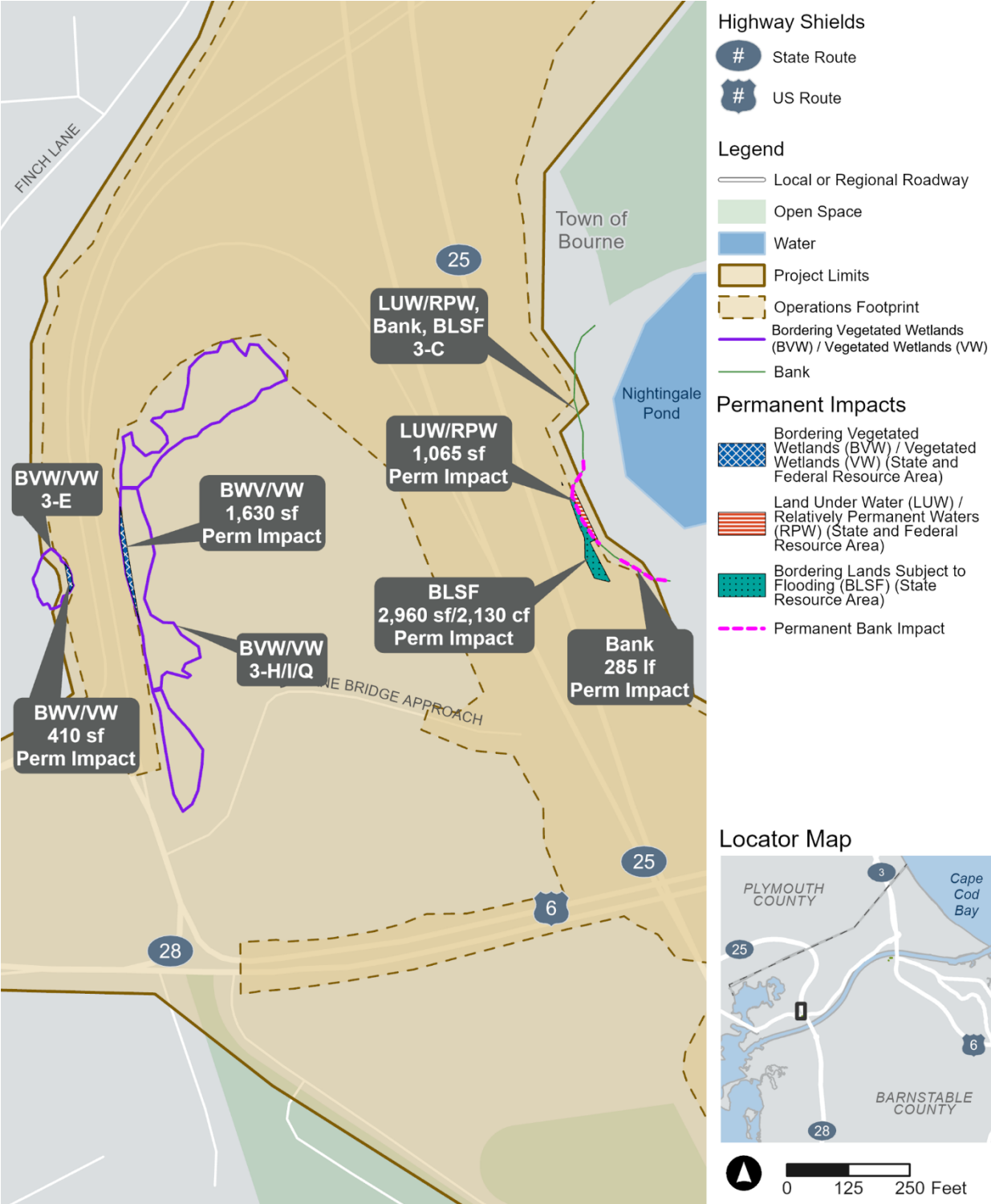
Construction in the Bourne South quadrant, Sagamore North quadrant, and Sagamore South quadrant interchange approaches would not result in impacts to inland wetland resources. However, part of this work would occur proximal to two vernal pools ([Table 7-2](#)), one in the Bourne South quadrant (Vernal Pool #8258) and one in the Sagamore North quadrant (Vernal Pool #555) interchange approaches. Work is proposed within 75 feet of Vernal Pool #555, but the work would be separated by a roadway. Vernal Pool #8258 is located along the driveway of a car wash, north of Angelo Drive. Approximately 1,150 square feet of the existing driveway within 100 feet of the vernal pool would be repaved.

Figure 7-1. Potential Temporary Impacts to State Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Figure 7-2. Potential Permanent Impacts to State and Federal Inland Wetland Resource Areas (Bourne North Quadrant Interchange Approach)



Source: Massachusetts Department of Transportation, 2025

Table 7-1. Potential Impacts State and Federal Inland Wetland Resource Areas

Resource^[1]	Temporary Impacts	Permanent Impacts	Reason for Impact
Bordering Vegetated Wetland (BVW) 3-E VW 3-E ^[2]	—	410 square feet (<0.01 acre)	Fill for widening State Route 25 east- and westbound off-ramps to U.S. Route 6/State Route 28 and add second travel lane
BVW 3-H/I/Q VW 3-H/I/Q ^[2]	—	1,630 square feet (0.03 acre)	Fill for widening State Route 25 east- and west-bound on-ramps from U.S. Route 6/State Route 28 and accommodate SUP
Land Under Water (LUW) 3-C <i>Relatively Permanent Water (RPW) 3-H/Q/I^[2]</i>	2,675 square feet (0.06 acre)	1,065 square feet (0.02 acre)	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound
Bank 3-C	70 linear feet	285 linear feet	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound
Bordering Land Subject to Flooding (BLSF) 3-C	8,660 square feet	2,960 square feet 2,130 cubic feet	Fill for new westbound on-ramp to State Route 25 from U.S. Route 6 and add auxiliary lane on State Route 25 westbound

^[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD) (HNTB 2021, 2022) and additional field investigations.

^[2] Identified as Waters of the United States.

Table 7-2. Potential Work for Bourne North Quadrant and Sagamore North Quadrant Interchange Approaches Proximate to Vernal Pools

Survey Area/Wetland ID^[1]	Vernal Pool ID^[2]	Vernal Pool ID^[3]	Work Within 100 Feet of Resource	Comment
Sagamore North/BVW 1-E	05DN	Certified #555	Roadway widening for extension of acceleration lane within 75 feet of Vernal Pool	Work to occur along State Route 3 northbound and separated by State Road
Bourne South/BVW	07MA	Certified #8258	Work limited to repaving 1,150 square feet of existing driveway	Work to occur approximately 70 feet from Vernal Pool

^[1] As identified in the Abbreviated Notice of Resource Area Delineation (ANRAD) (HNTB 2021, 2022) and additional field investigations.

^[2] As identified in Stantec (2020).

^[3] As identified by Massachusetts Department of Fish and Wildlife Natural Heritage and Endangered Species Program.

7.1.2 Potential Impacts to State and Federal Coastal Resource Areas

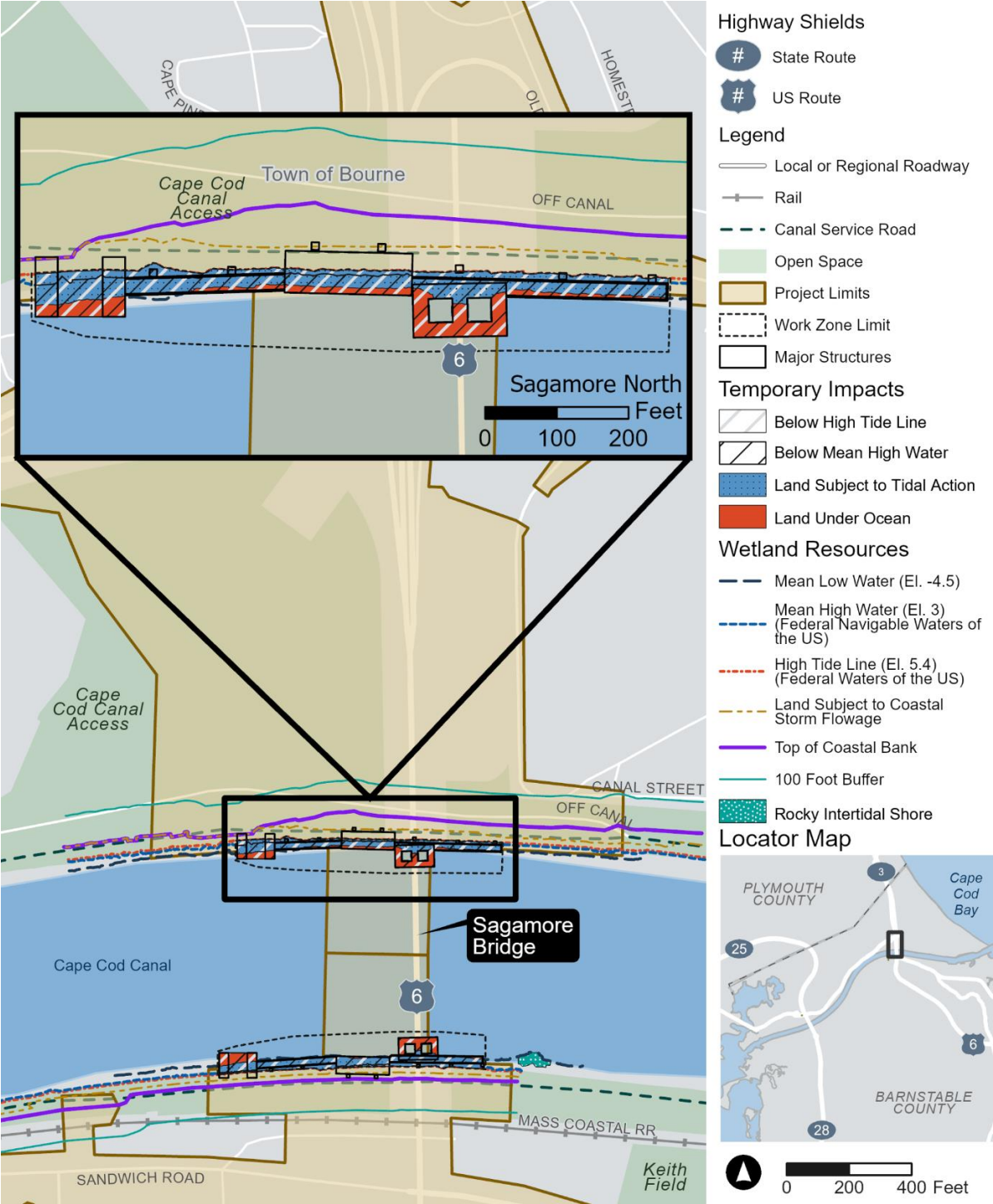
Replacing the Bourne and Sagamore bridges would remove eight piers from below MHW and construct eight new piers in Cape Cod Canal. Each bridge would be supported by four new piers to accommodate both the north- and south-bound decks over the Cape Cod Canal. Each pier would be partially located within the riprap banks of the canal shoreline and partially below MHW and HTL.

Temporary structures would include barge docks, cofferdams surrounding the work areas for pier removal and installation; and bulkheads to create level work area platforms on two sides of each pier cofferdam, pile-supported work trestles to facilitate work from above the water surface, and bollards and pile-supported dolphins to accommodate work barges. The existing riprap along the shoreline would be temporarily removed to accommodate the sheet pile installations. Excavation would occur to remove the existing piers to a minimum of two feet below the mudline and to install the new piers. Dredging would also be required to facilitate marine vessel access to the temporary work structures. Potential temporary impacts to state and federal coastal resources are shown in [Figure 7-3 through Figure 7-10](#), which are represented on two sets of figures due to the overlap of the trestles and other structures.

Most of the temporary occupations of water sheet below the MHW and HTL would extend to the limit of the navigational channel boundary. For temporary alterations to resource areas, the proposed bridge pier construction along the north and south sides of the canal at the Sagamore and Bourne Bridges would occupy an in-water work zone that varies between approximately 80,000 and 90,000 square feet at each set of piers, this is the area expected to be needed by the design-build contractor to stage, access, and construct the new piers and demolish the existing piers. Following construction, all temporary structures would be removed.

Permanent structures would include the new bridge piers and their foundations and riprap protection. The eelgrass beds within the Bourne North and Bourne South quadrants would be permanently impacted by the proposed pier protection riprap. Potential permanent impacts to state and federal coastal resources are shown in [Figure 7-11 through Figure 7-14](#).

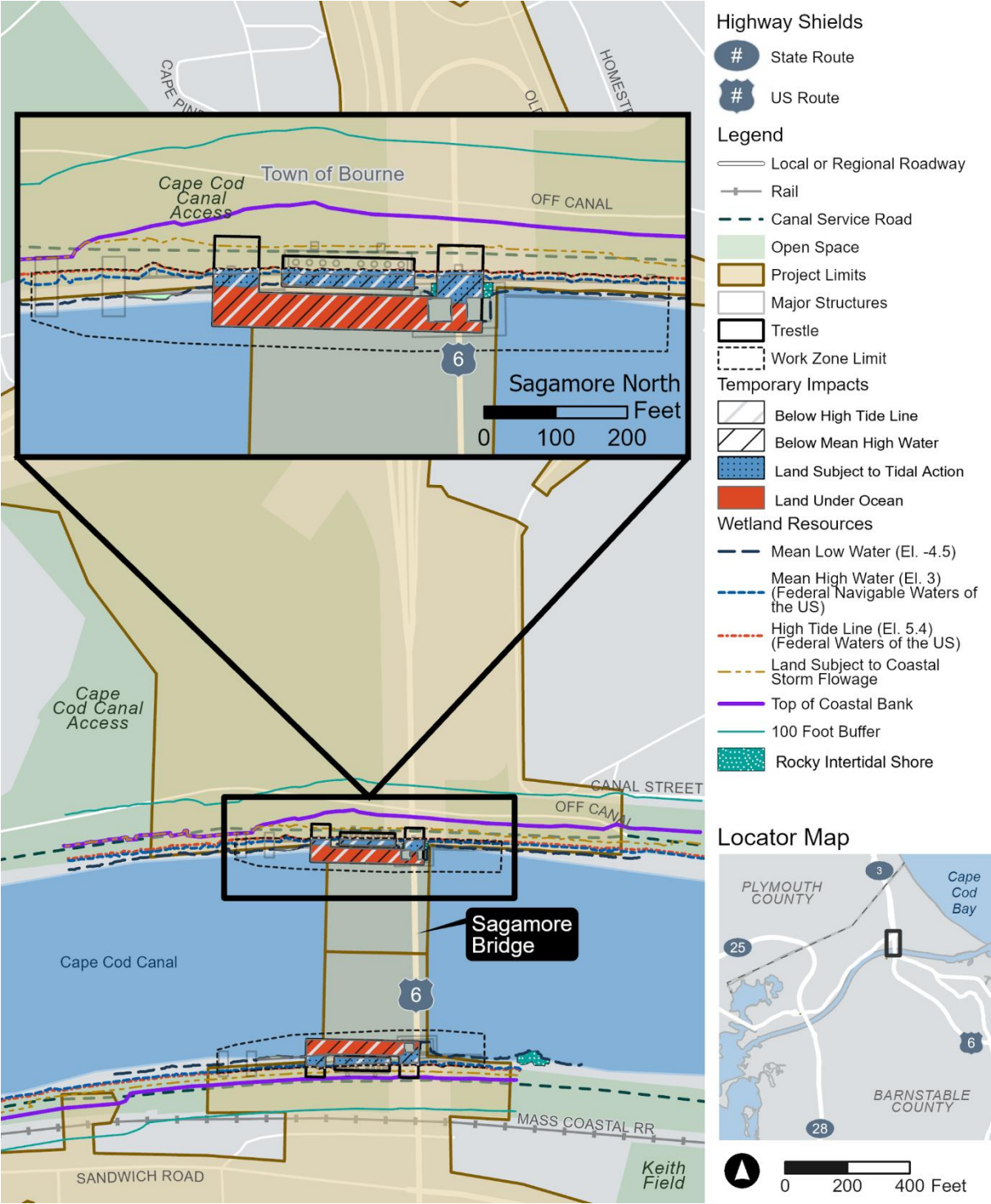
Figure 7-3. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

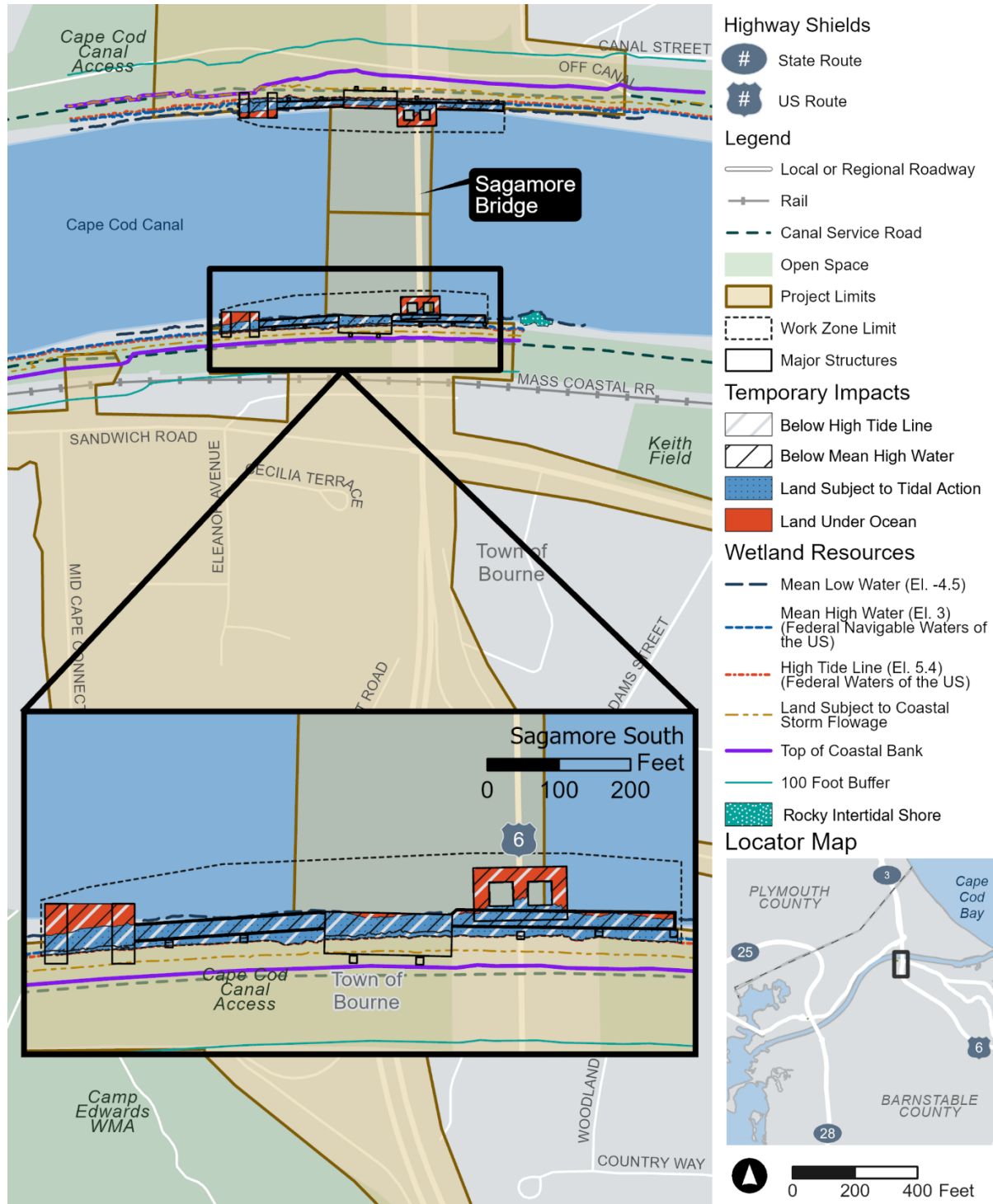
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging will be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 7-4. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

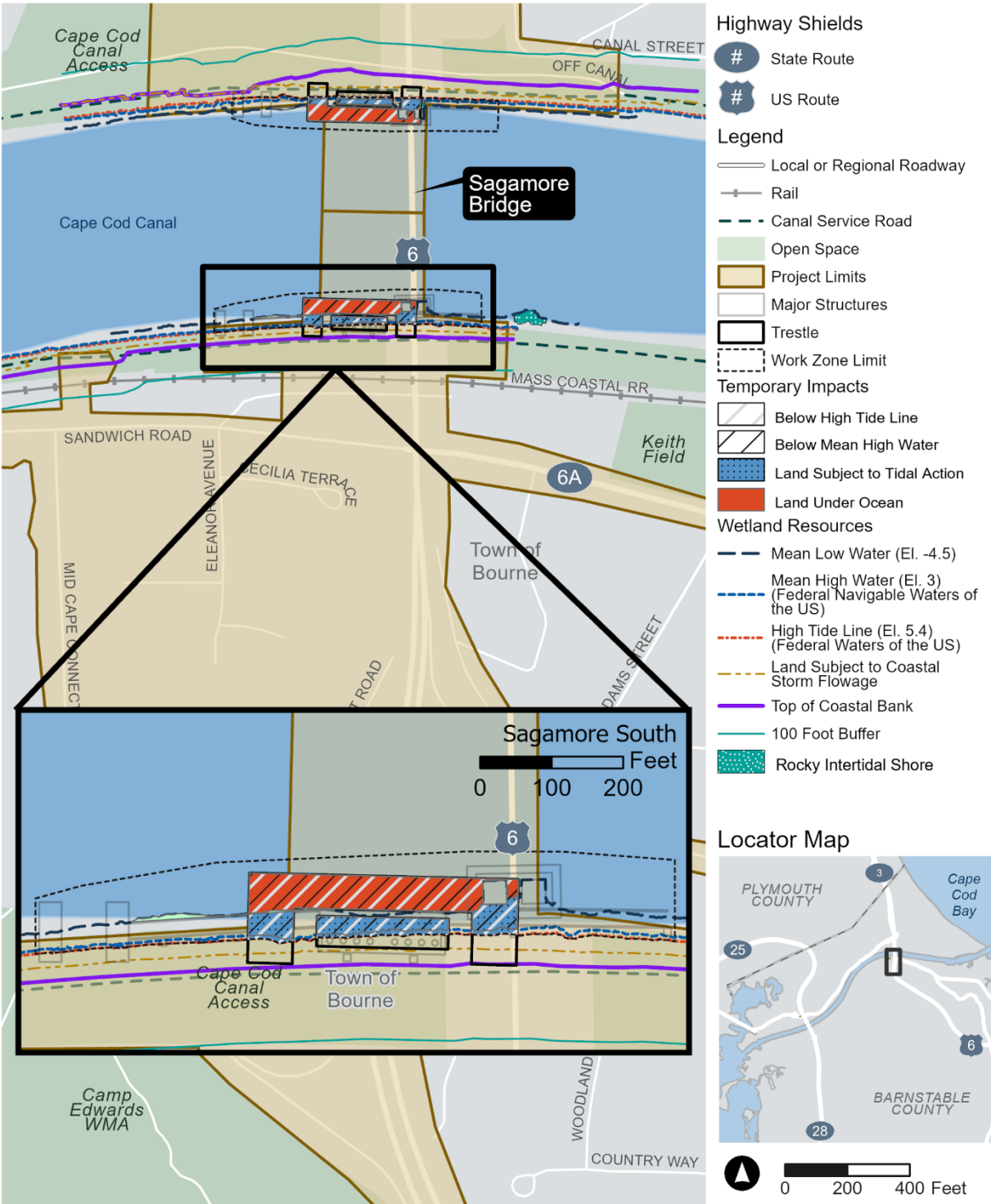
Figure 7-5. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2025

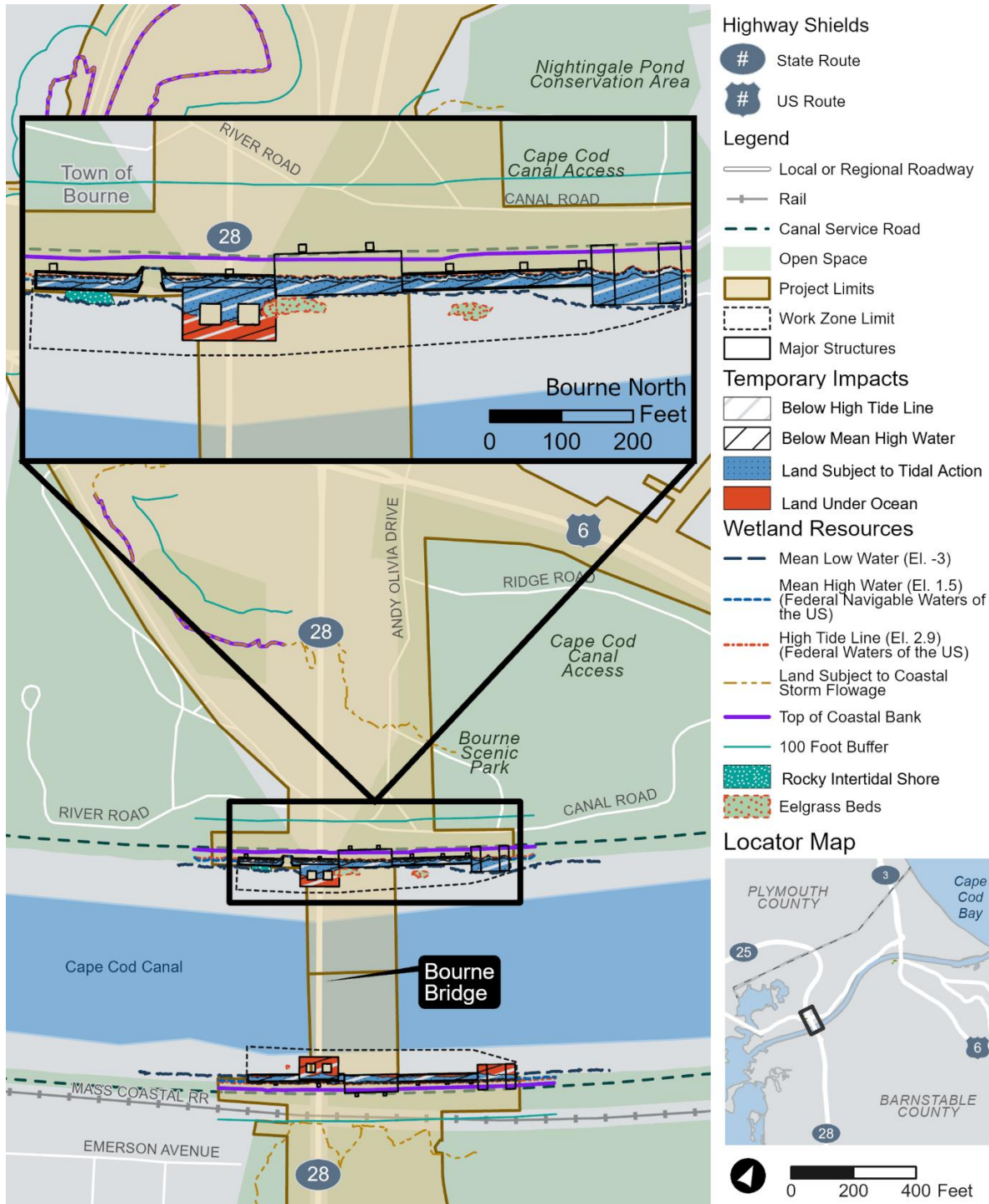
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging will be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 7-6. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2025

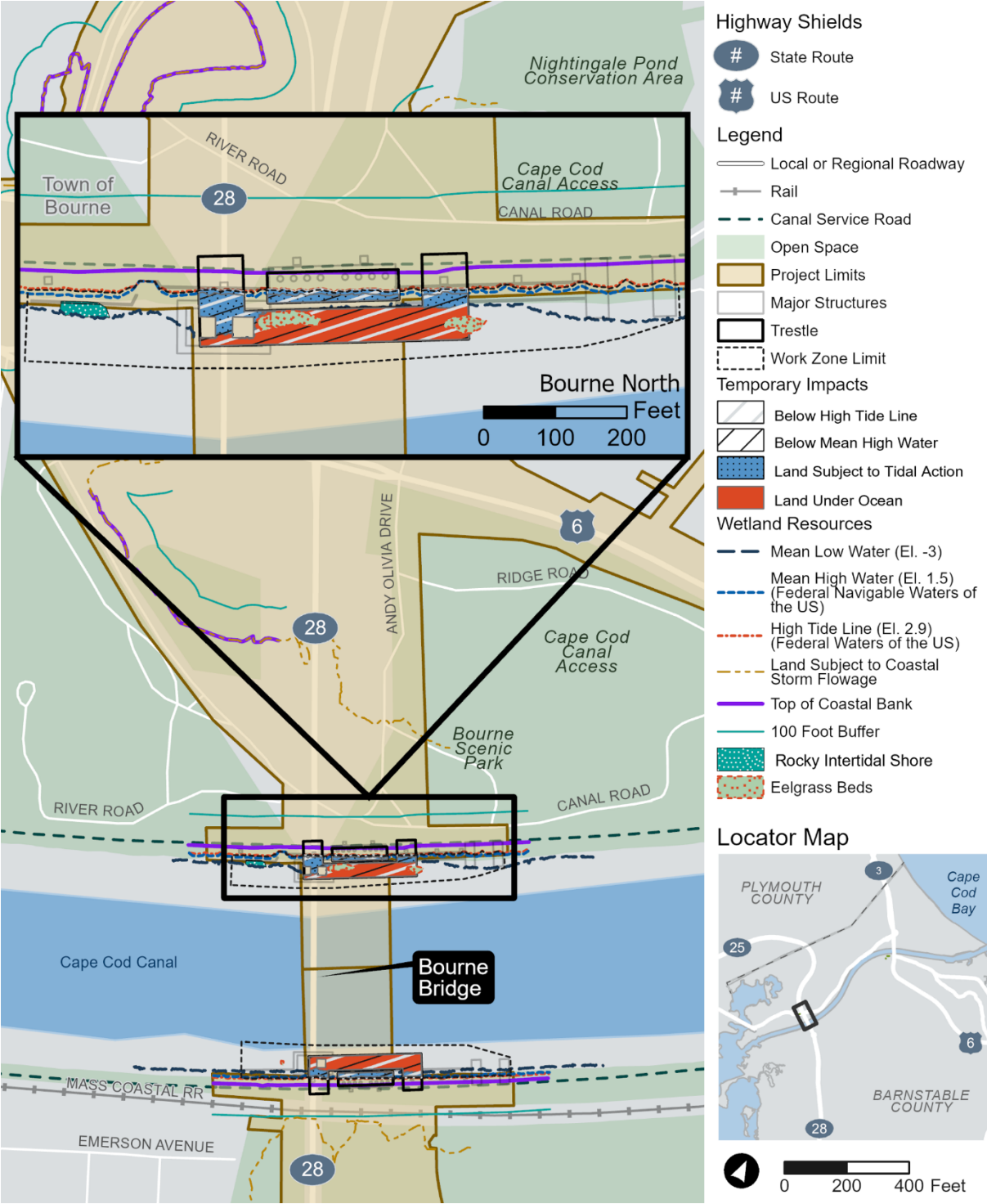
Figure 7-7. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

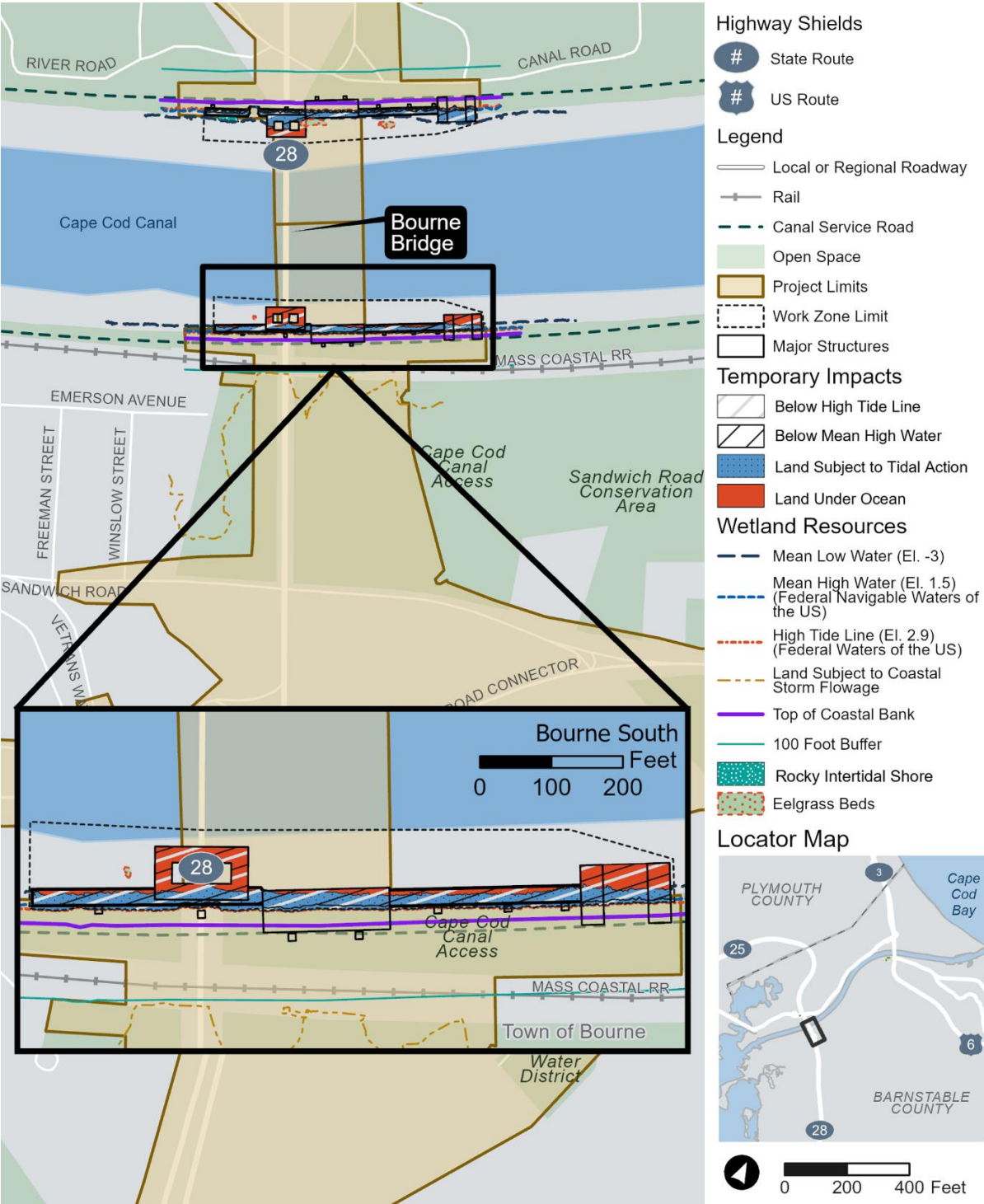
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging will be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 7-8. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

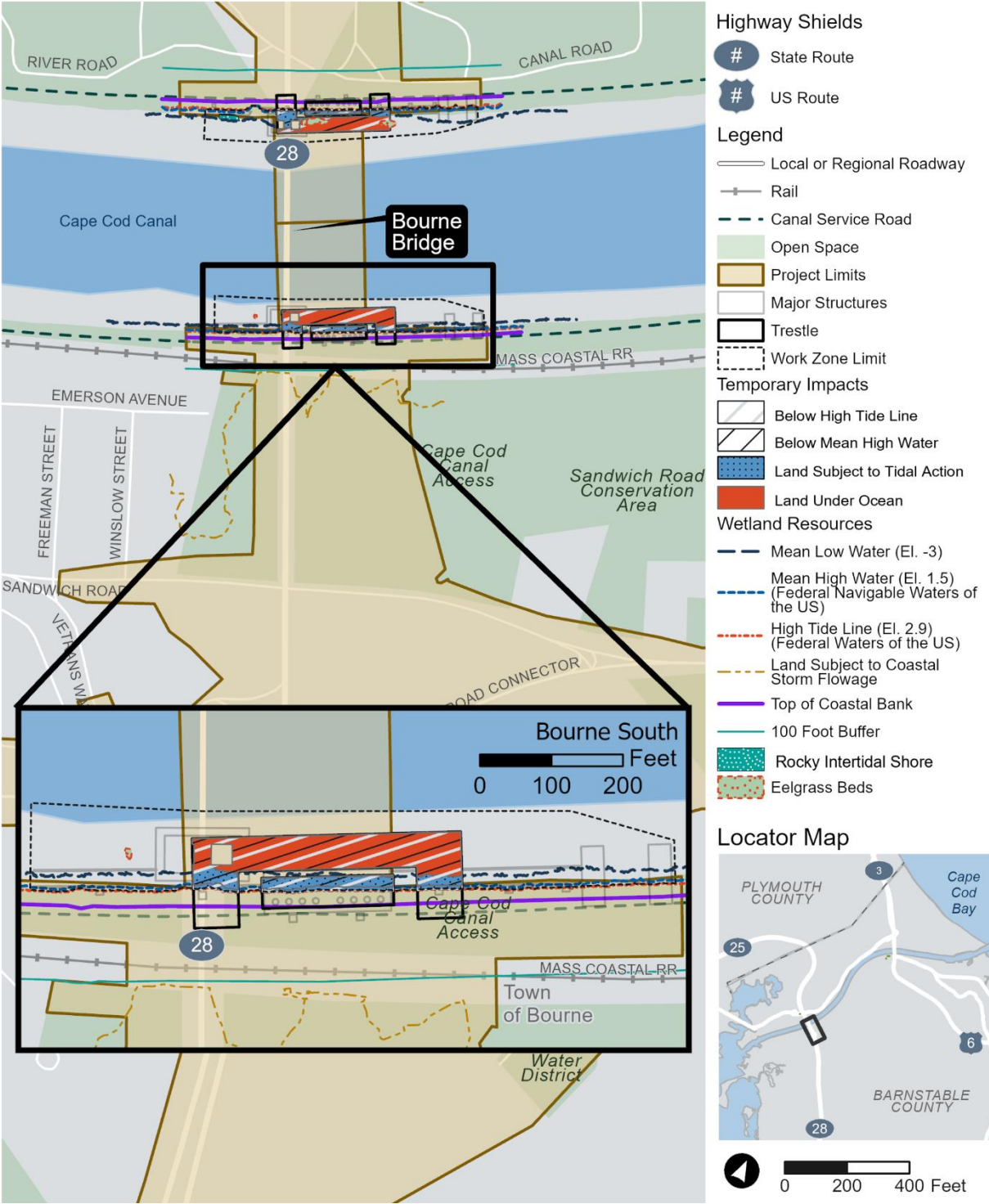
Figure 7-9. Potential Temporary Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

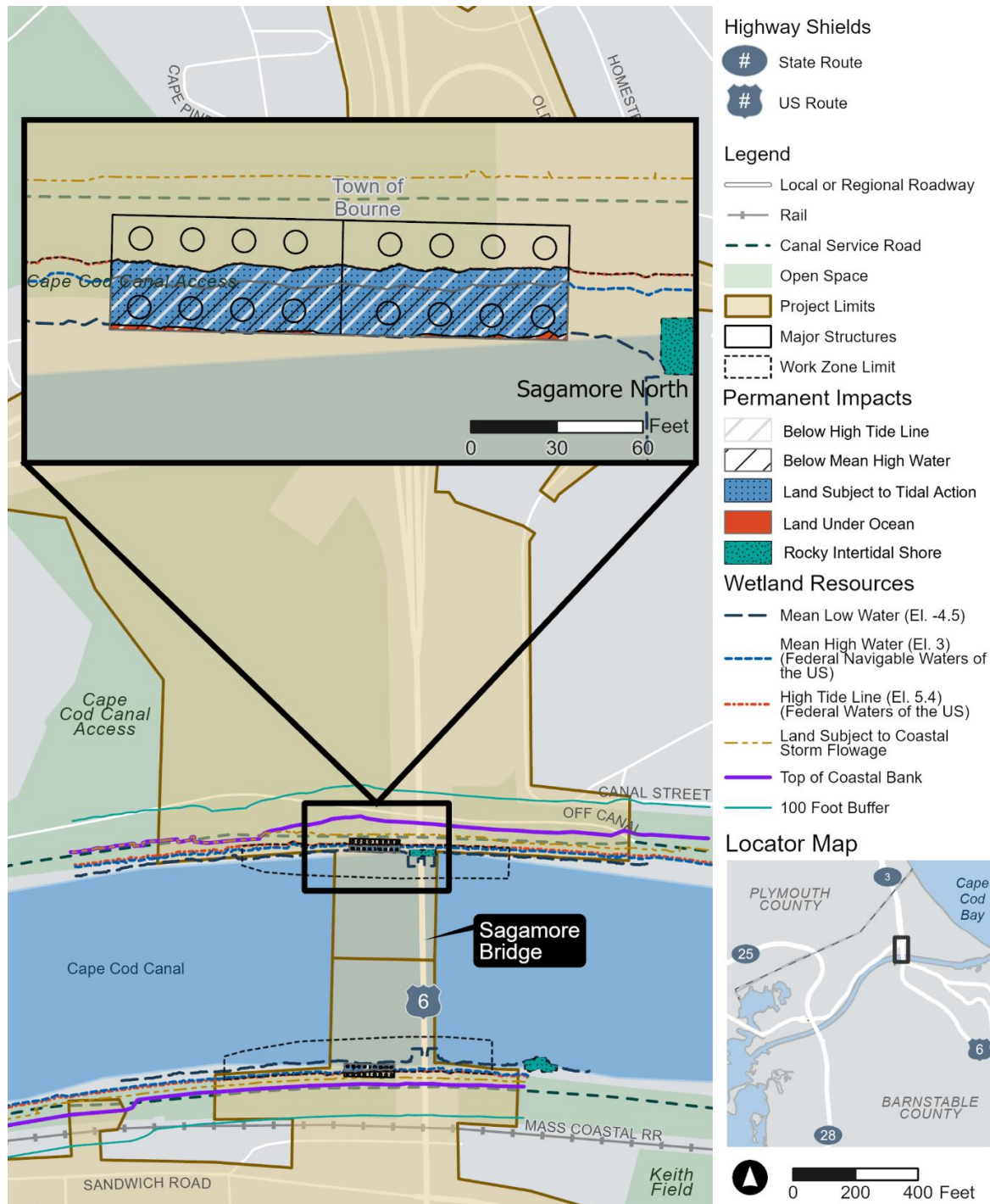
Note: Approximately 69,800 square feet/19,500 cubic yards of dredging will be required within the work zone. For visual clarity, impacts to Coastal Bank areas are not depicted in this figure.

Figure 7-10. Potential Temporary Trestle Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

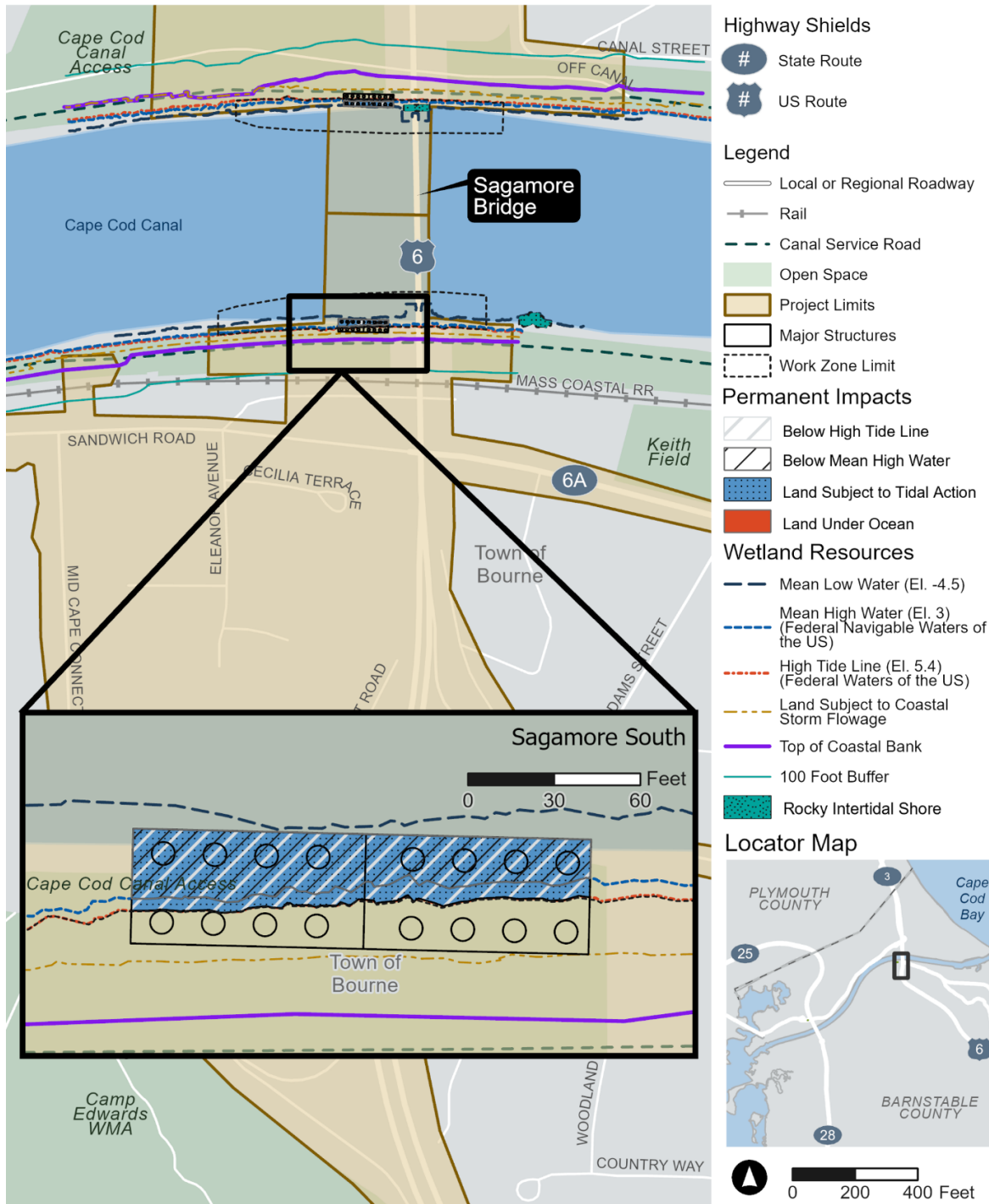
Figure 7-11. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection will occur below high tide line. Additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging will be required. The footprint for both will be developed during design advancement.

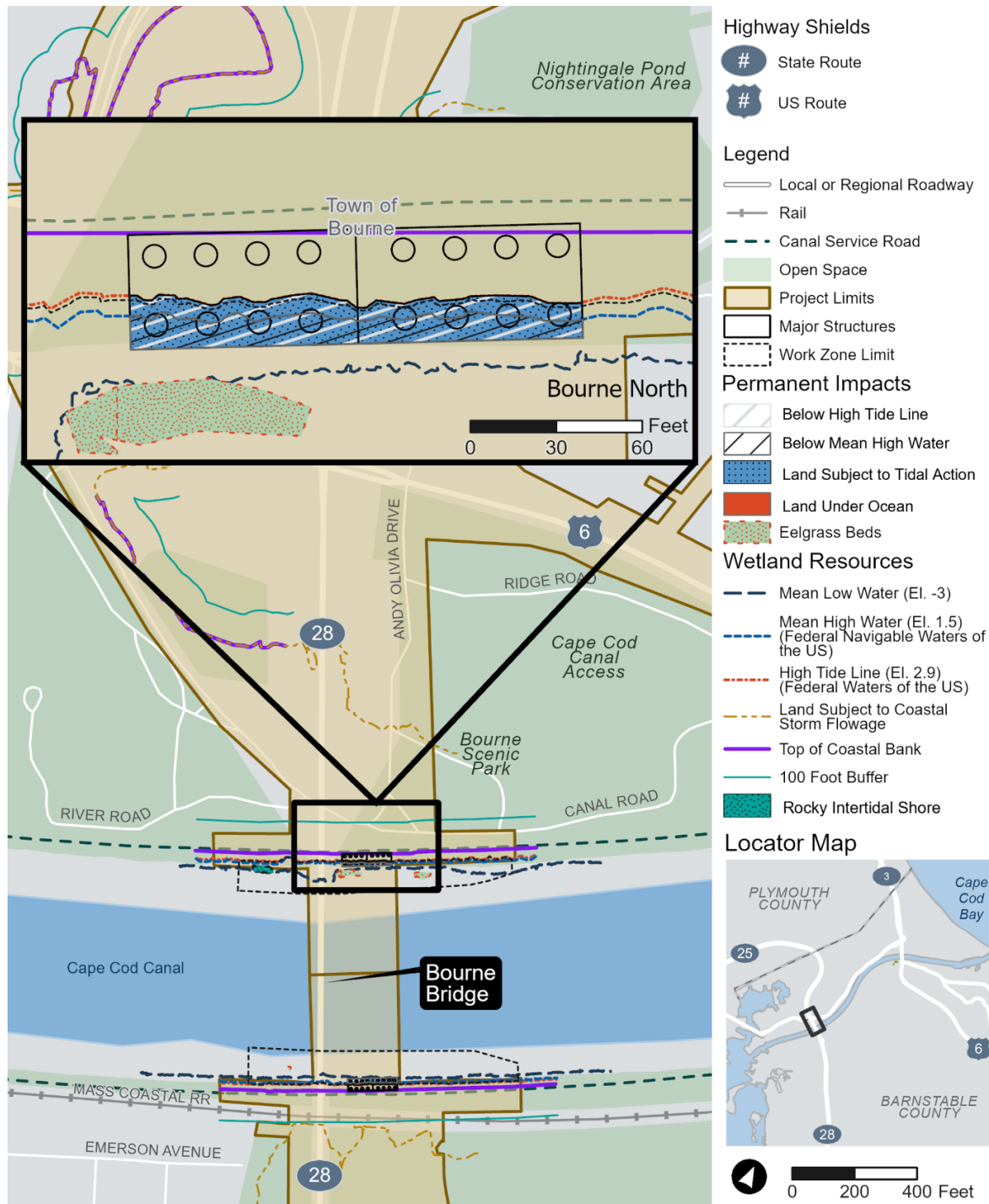
Figure 7-12. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection will occur below the high tide line, additionally, 34,000 sf/7,000 cubic yards of post-construction dredging will be required. The footprint for both will be developed during design advancement.

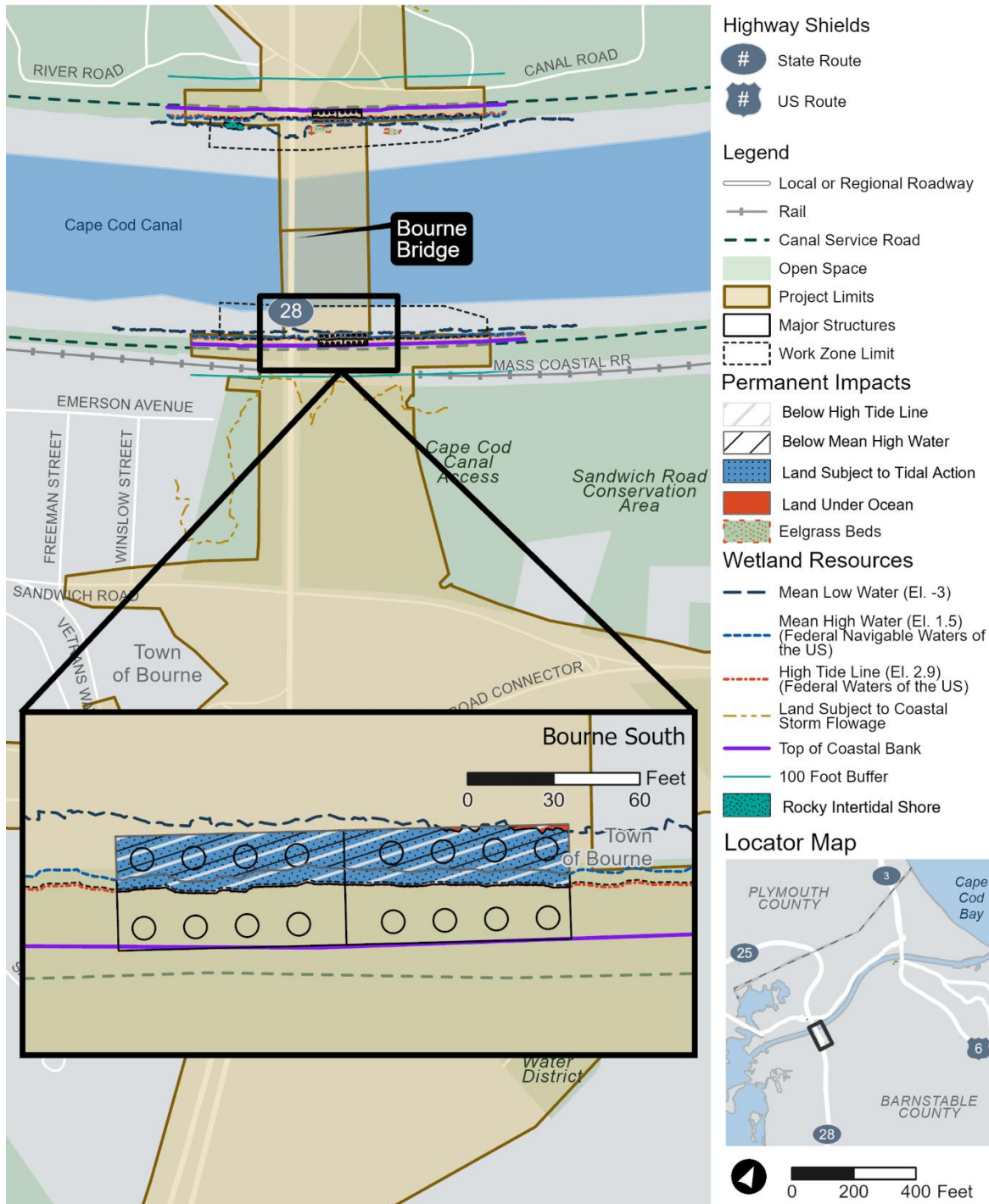
Figure 7-13. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of riprap for pier protection will occur below high tide level. Additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging will be required. The footprint for both will be developed during design advancement.

Figure 7-14. Potential Permanent Impacts to State and Federal Coastal Resource Areas (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Note: Approximately 24,000 square feet of rip rap for pier protection will occur below high tide line, additionally, 34,000 square feet/7,000 cubic yards of post-construction dredging will be required. The footprint for both will be developed during design advancement.

Table 7-3 and **Table 7-4** summarize the proposed temporary and permanent impacts to state and federal coastal resources for the Sagamore and Bourne bridges. **Table 7-5 through Table 7-8** provide detailed assessments of these impacts by proposed activity for each bridge quadrant.

Note: The following is provided in support of the information presented in **Table 7-3** through **Table 7-8**:

- Quantities are provided below HTL as an estimate based on the current level of design. Future permit applications will include dredge quantities below MHW based on regulatory requirements.
- LSCSF impacts are calculated for permanent impacts or losses only.
- The temporary and permanent impacts to resource areas presented herein are preliminary and subject to change as the design advances.
- The Build Alternative would result in temporary impacts to Coastal Bank, which occurs along the width of the Project Limits at both bridges.
- The Build Alternative would result in impacts to Land Containing Shellfish and Land Under the Ocean underlying an Anadromous/Catadromous Fish Run, both of which are regulated under the Massachusetts Wetlands Protection Act and its implementing regulations. Impacts to Land Containing Shellfish are calculated by summing impacts to LUO and RIS. Impacts to Land Under the Ocean underlying an Anadromous/Catadromous Fish Run are calculated by summing impacts to LSTA and LUO. Because these impact values are calculated from a subset of resource area impacts already reflected in the tables, they are not listed separately.
- MassDOT is coordinating the design of the bridge pier protection system with the USACE. As design advances, MassDOT will finalize the area of protection and quantities of riprap, which will be included in the Final Environmental Impact Statement and federal and state permit applications.

Table 7-3. Potential Impacts to State and Federal Coastal Resource Areas (Sagamore Bridge)

Resource Area		Temporary Impacts	Permanent Impacts	Reason for Impact
Federal	WOTUS	121,675 square feet (sf) (2.79 acres)	54,035 sf (1.24 acre)	• Temporary: cofferdams, bulkheads, shoreline sheeting, trestles, bollards, docks, and dolphins • Permanent: new bridge piers and riprap pier protection
	WOTUS – (Excavation/ Dredge)	51,000/139,600 sf (1.17/3.20 acres) 28,000/39,000 cubic yards	Refer to note [1]	• Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal
State	Land Under Ocean	68,799 sf	38,523 sf	• Temporary: cofferdams, bulkheads, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap pier protection
	Coastal Bank	1,299 linear feet	420 linear feet	• Temporary: cofferdams, shoreline sheeting, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection
	Rocky Intertidal Shore	Refer to note [1]	1,652 sf	• Temporary: cofferdams and work trestle piles • Permanent: piers and riprap pier protection
	Land Subject to Tidal Action	52,876 sf	17,112 sf	• Temporary: cofferdams, shoreline sheet piles, bulkhead, work trestle piles, bollards, docks, dolphins, and excavation/dredge • Permanent: piers and riprap pier protection
	Land Subject to Coastal Storm Flowage	—	6,900 sf	• Temporary: cofferdams, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection

[1] The Massachusetts Department of Transportation (MassDOT) is coordinating the design of the bridge pier protection system with the U.S. Army Corps of Engineers. As design advances, MassDOT will finalize the area of protection and quantities of riprap, which will be included in the Final Environmental Impact Statement and federal and state permit applications.

Table 7-4. Potential Impacts to State and Federal Coastal Resource Areas (Bourne Bridge)

Resource Area		Temporary Impacts	Permanent Impacts	Reason for Impact
Federal	WOTUS	119,730 square feet (sf) (2.75 acres)	53,510 sf (1.23 acres)	• Temporary: cofferdams, bulkheads, shoreline sheeting, trestle, bollards, docks, and dolphins • Permanent: new bridge piers and riprap pier protection (Includes 2,445 sf impact to eelgrass beds)
	WOTUS - dredge	51,000/139,600 sf (1.17/3.20 acres) 28,000/39,000 cubic yards	Refer to note [1]	• Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal
State	Land Under Ocean	71,296 sf	38,445 sf	• Temporary: cofferdams, bulkheads, work trestle piles, bollards, docks, dolphins and excavation/dredge • Permanent: piers and riprap pier protection
	Coastal Bank	1,300 linear feet	440 linear feet	• Temporary: cofferdams, shoreline sheeting, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection
	Rocky Intertidal Shore	1,167 sf	Refer to note [1]	• Temporary: bulkheads and excavation/dredge • Permanent: piers and riprap pier protection
	Land Subject to Tidal Action	47,267 sf	15,118 sf	• Temporary: cofferdams, shoreline sheet piles, bulkhead, work trestle piles, bollards, docks, dolphins and excavation/dredge • Permanent: piers and riprap
	Land Subject to Coastal Storm Flowage	—	9,000 sf	• Temporary: cofferdams, work trestle piles, bollards, and docks • Permanent: piers and riprap pier protection

^[1] The Massachusetts Department of Transportation (MassDOT) is coordinating the design of the bridge pier protection system with the U.S. Army Corps of Engineers. As design advances, MassDOT will finalize the area of protection and quantities of riprap, which will be included in the Final Environmental Impact Statement and federal and state permit applications.

Table 7-5. Detailed Potential Impacts to State and Federal Coastal Resource Areas (Sagamore North Quadrant)

Activity	Federal Impacts Below High Tide Line	State Impacts	Excavation/Dredge Below High Tide Line
Sagamore North: Temporary Impacts			
Cofferdams, shoreline sheeting, bulkheads, docks and excavation/dredge	55,260 square feet (sf) (1.27 acres)	31,604 sf Land Under Ocean (LUO) 856 linear feet (lf) Coastal Bank (CB) 23,656 sf Land Subject to Tidal Action (LSTA)	
Trestle and dolphins	5,425 sf (0.12 acre)	5,425 sf LUO	-
Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal			25,500/69,800 sf (0.59/1.60 acres)/ 14,000/19,500 cubic yards
Sagamore North: Permanent Impacts			
New bridge piers	3,771 sf (0.09 acre)	123 sf LUO 160 lf CB 3,629 sf Land Subject to Coastal Storm Flowage (LSTA) 2,648 sf LSCSF	
Riprap pier protection	24,000 sf (0.55 acre)	19,200 sf LUO 1,652 sf Rocky Intertidal Shore 4,800 sf LSTA	

Table 7-6. Detailed Potential Impacts to State and Federal Coastal Resources (Sagamore South Quadrant)

Activity	Federal Impacts Below High Tide Line	State Impacts	Excavation/Dredge Below High Tide Line
Sagamore South: Temporary Impacts			
Cofferdams shoreline sheeting, bulkheads, docks, and excavation/dredge	55,565 square feet (sf) (1.28 acres)	26,345 sf LUO 863 linear feet Coastal Bank 29,220 sf Land Subject to Tidal Action (LSTA)	
Trestle and dolphins	5,425 sf (0.12 acre)	5,425 sf LUO	
Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal			25,500/69,800 sf (0.59/1.60 acres) / 14,000/19,500 cubic yards
Sagamore South: Permanent Impacts			
New bridge piers	2,264 sf (0.52 acre)	LSTA 3,883 sf LSCSF 2,517 sf	-
Riprap pier protection	24,000 sf (0.55 acre)	19,200 sf LUO 4,800 sf LSTA	-

Table 7-7. Detailed Potential Impacts to State and Federal Coastal Resources (Bourne North Quadrant)

Activity	Federal Below High Tide Line	State Impacts	Excavation/Dredge Below High Tide Line
Bourne North: Temporary Impacts			
Cofferdams, shoreline sheeting, bulkheads, docks, and excavation/dredge	54,190 square feet (sf) (1.24 acres)	24,427 sf Land Under Ocean (LUO) 875 linear feet (lf) Coastal Bank (CB) 1,167 sf Rocky Intertidal Shore 28,596 sf Land Subject to Tidal Action (LSTA)	
Trestle and dolphins	5,425 sf (0.12 acre)	5,425 sf LUO	
Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal			25,500/69,800 sf (0.59/1.60 acre) / 14,000/19,500 cubic yards
Bourne North: Permanent Impacts			
New bridge piers	2,181 sf (0.05 acre)	160 lf CB 2,448 sf LSTA 3,952 sf LSCSF	
Riprap pier protection	24,000 sf (0.55 acre) ^[1]	19,200 sf LUO 4,800 sf LSTA	

^[1] Includes eelgrass bed impact of 2,345 square feet.

Table 7-8. Detailed Potential Impacts to State and Federal Coastal Resources (Bourne South Quadrant)

Activity	Federal Impacts Below High Tide Line	State Impacts	Excavation/Dredge Below High Tide Line
Bourne South: Temporary Impacts			
Cofferdams, shoreline sheeting, bulkheads, docks, and excavation/dredge	54,690 square feet (sf) (1.26 acres)	36,019 sf Land Under Ocean (LUO) 867 linear feet (lf) Coastal Bank (CB) 18,671 sf Land Subject to Tidal Action (LSTA)	
Trestle and dolphins	5,425 sf (0.12 acre)	5,425 sf LUO	
Excavation within cofferdams and dredge for navigation access to temporary structures and riprap/structure removal			25,500/69,800 sf (0.59/1.60 acres) / 14,000/19,500 cubic yards
Bourne South: Permanent Impacts			
New bridge piers	3,329 sf (0.08 acre)	45 sf LUO 160 lf CB 3,070 sf LSTA 3,285 sf LSCSF	
Riprap pier protection	24,000 sf (0.55 acre) ^[1]	19,200 sf LUO 4,800 sf LSTA	

^[1] Includes eelgrass bed impact of 100 square feet.

7.1.3 Indirect Effects

Indirect effects are those effects which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include related effects on air and water and other natural systems, including ecosystems. There are no indirect effects to inland or coastal resources that would result in changes to the functions and values in terms of the overall wetland hydrology, or fragmentation. The project impacts would not result in isolated fragments of wetlands or waterways. Potential indirect effects include the unintended introduction of invasive plant species.

7.1.4 Floodplains

Construction of the westbound ramp from U.S. Route 6 to State Route 25 and auxiliary lane on State Route 25 would result in temporary impacts (8,660 sf) and permanent impacts (2,960 sf; 2,130 cubic feet) to the floodplains associated with Nightingale Pond (3-C). The new piers at both Sagamore and Bourne bridges would result in 15,900 sf of permanent impacts to the floodplain associated with riprap placement for pier protection in Cape Cod Canal.

7.1.5 Areas of Critical Environmental Concern

Within the Sagamore North Approach Interchange, Series 1-J BVW is mapped within the Herring River Watershed ACEC. There are no permanent or temporary impacts proposed within wetland 1-J. At its closest location, the existing pavement edge along State Route 3 southbound is approximately 28 feet from the edge of the wetland, separated by a forested 2:1 slope. The roadway would be widened at this location, and the edge of the new roadway would be approximately 18 feet from the wetland. Although pavement widening of approximately 10 feet would occur within the ACEC, it would be located within the existing roadway shoulder of MassDOT's right-of-way. The widening and introduction of pavement within this area is a continuation of the use of an existing transportation corridor, and it would not result in impacts to the wetlands, the sole source aquifer, or threatened and endangered species. Therefore, it is not expected to adversely affect protected resources associated with the ACEC. Construction-term impacts may occur; however, the implementation of erosion prevention and sediment controls will minimize impacts to the resource area.

Within the Bourne South Approach Interchange Area, the Bourne Back River ACEC is mapped on the west side of the State Route 28 southbound travel lane and extending 15 feet east into the median. The Project Work Limit is approximately 1,200 feet north of the ACEC limit within State Route 28 southbound. Therefore, no temporary or permanent impacts are proposed within the Bourne Back River ACEC.

7.2 Operation-Term Impact Assessment

Once the highway approaches and bridges are constructed, operation-term impacts would be limited to the maintenance of project components including the stormwater management system. The stormwater management system would be maintained in accordance with the project specific

Operations and Maintenance Plan, details of which are presented in **Section 4.10, Water Quality and Stormwater**.

7.3 Summary

Construction of the Bourne North quadrant interchange approach would result in temporary and permanent impacts to inland wetland resources. Construction of both bridges would result in temporary and permanent impacts to coastal wetland resources. Indirect impacts resulting from construction may include the unintended introduction of invasive plant species. Operation-term impacts would be limited to the maintenance of project components including the stormwater management system.

8 Mitigation Measures

8.1 Requirements And Guidance

8.1.1 State Resources

For any impacts that are unable to be avoided or minimized, the MA WPA regulations contain performance standards for each resource area, intended to ensure protection of their functions and values. The performance standards require that projects first seek to avoid and minimize impacts to wetland resource areas, and where impacts are unavoidable, ensure no adverse effects on the interests protected by the WPA such as flood control, water quality, and wildlife habitat. Refer to **Attachment 2, Build Alternative: Conformance with Performance Standards of the Massachusetts Wetlands Protection Act** for a discussion of the Program's conformance with performance standards of the MA WPA regulations.

8.1.2 Federal Resources

After practicable measures have been taken to avoid and minimize impacts to WOTUS, Section 404(b)(1) of the federal CWA requires compensation for unavoidable, permanent impacts to WOTUS. The USACE New England District has Compensatory Mitigation Standard Operating Procedures (SOP, dated April 26, 2024), which provide guidance for developing mitigation plans for, among other resources, vegetated wetlands, RPW, and submerged aquatic vegetation. According to the SOP, the use of mitigation banks and/or In-Lieu Fee Program (ILFP) mitigation is preferred over permittee-responsible mitigation (PRM) unless the permittee demonstrates PRM is more ecologically appropriate.

There are no USACE-approved wetland mitigation banks in Massachusetts. However, the Massachusetts Department of Fish and Game (DFG) has a USACE-approved ILFP. Because PRM compensation would be required for impacts to state wetland resources, as discussed in **Section 8.2** compensation for permanent impacts would be provided through PRM in the form of vegetated wetland and RPW creation within the project area along with participation in DFG's ILFP.

8.2 Compensation for Impacts to Inland Wetlands

Proposed compensation for permanent impacts to inland resources is summarized in **Table 8-1**. Inland resources impacted include state-regulated BVW, Bank, LUW, and BLSF and federally regulated VW and RPW. Details for the compensatory wetlands would be included in the final compensatory mitigation plan to be prepared in conjunction with the permit applications to federal and state agencies, which the design-build contractor, on behalf of MassDOT, would be responsible for updating to account for final impacts to habitat types (e.g., forested, emergent), permit conditions, and design changes, as applicable.

Success of the proposed PRM compensation areas would be documented through completion of annual monitoring reports developed in accordance with the USACE SOP and MassDEP Guidelines.

Table 8-1. Proposed Compensation for Permanent Impacts to Inland Resources

Wetland Series ID ^[1]	State Resource		Federal Resource		Impact to Compensation (Creation) Ratio
	Impact Type and Extent	Compensation	Impact Type and Extent	Compensation ^[2]	
3-E	Bordering Vegetated Wetland (BVW) 410 square feet (sf)	BVW 615 sf	Vegetated Wetland (VW) 410 sf	VW/615 sf	1:1.5
3-H/I/Q	BVW 1,630 sf	BVW 2,445 sf	VW 1,630 sf	VW/2,445 sf	1:1.5
3-C (Nightingale Pond)	Bank 285 linear feet (lf)	Bank 325 lf	N/A	N/A	1:1.1
	Land Under Water (LUW) 1,065 sf	LUW: 2,590 sf	RPW 2,590 sf	N/A	1:2.4
	Bordering Land Subject to Flooding (BLSF) 2,130 cubic feet (cf)/2,960 sf	BLSF 3,210 sf/5,430 cf	N/A	N/A	1:2.5

^[1] As identified in the ANRAD (HNTB 2021, 2022) and additional field investigations.

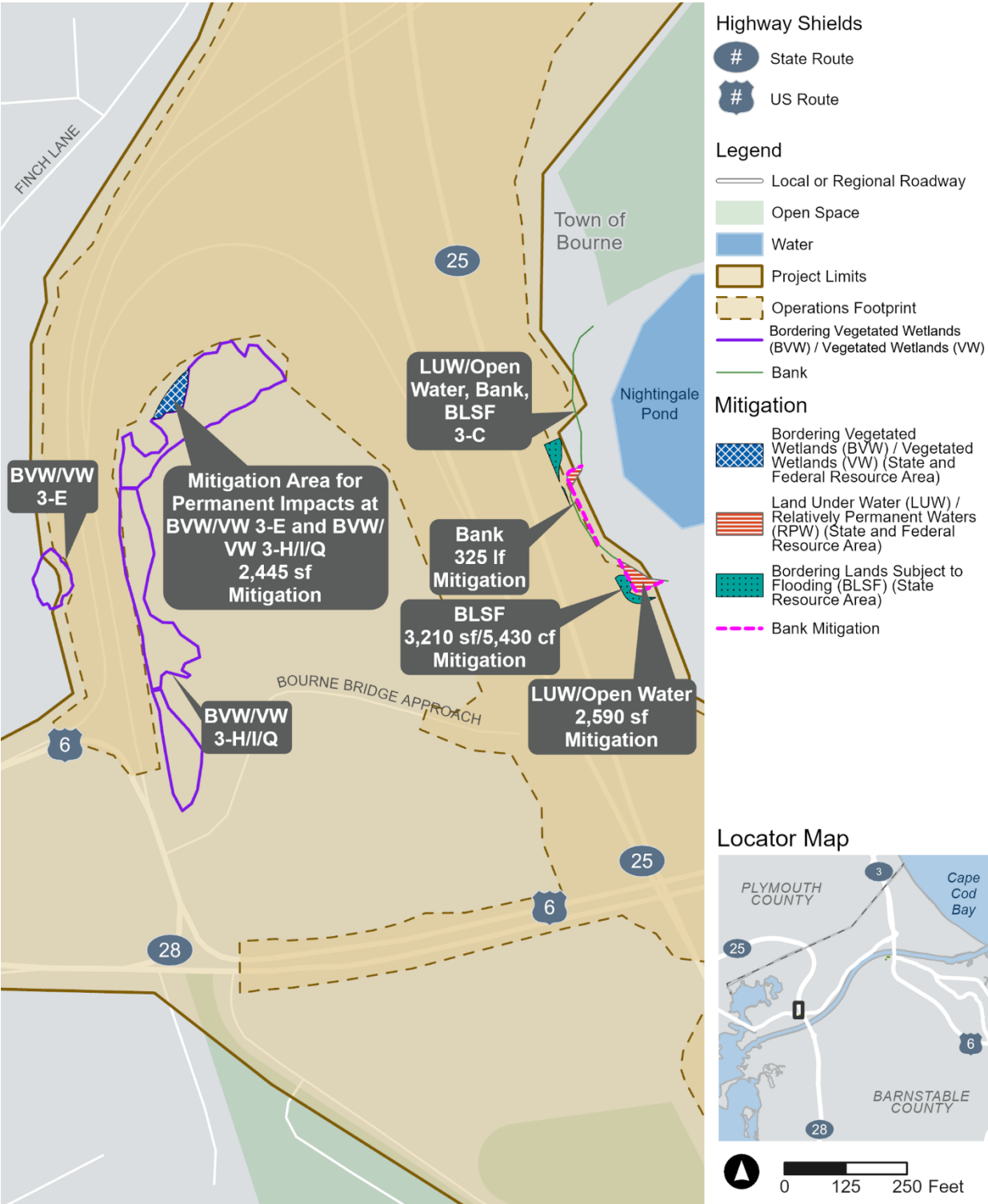
^[2] In addition to the creation of vegetated wetland, credits would be purchased through the Massachusetts Department of Fish and Wildlife In-Lieu Fee Program.

Permanent impacts to vegetated wetlands would be compensated through the creation of vegetated wetlands adjacent to Series 3-H/I/Q. Locating the proposed compensation site adjacent to Series 3-H/I/Q would allow the functions impacted by the permanent alterations to be compensated appropriately. For BVW, the 1:1.5 ratio of impact to compensation is proposed, which exceeds the performance standards (310 CMR 10.55(4)(b)(1)) of 1:1. The USACE SOP includes a recommended

impact to compensation ratio of 1:4 for permanent impacts to forested wetlands, which would be met through both wetland creation and purchasing credits from the DFG ILFP. The general location of the wetland creation area is depicted on [Figure 8-1](#).

Permanent impacts to state resource areas of Bank and LUW and federal RPW at Nightingale Pond would be compensated through the creation of Bank along the limit of the permanent impact area and expansion of Nightingale Pond to the north and south of the proposed permanent impact area. The compensation area would be graded to approximate that of the permanent impact area. The surface layer of the subaqueous soils within the impact area would be removed prior to filling and used as the surface layer in the compensation area. The general location of the Bank, LUW, and RPW compensation is depicted on [Figure 8-1](#).

Figure 8-1. Potential On-Site Compensation for State and Federal Inland Wetland Resource Areas



Impacts to BLSF would be mitigated by providing compensatory flood storage on a foot-by-foot basis at each elevation. **Table 8-2** demonstrates the excavation required to compensate for the corresponding fill at each elevation.

Table 8-2. Compensatory Flood Storage Analysis for Nightingale Pond

Elevation (feet)	Incremental Volume of Fill (cubic feet) (between each elevation)	Incremental Volume of Excavation (cubic feet) (between each elevation)
6		
	170	260
7		
	240	250
8		
	40	290
9		
	20	360
10		
	40	480
11		
	80	690
12		
	240	730
13		
	630	1,240
14		
	670	1,130
14.5		
Total Volume	2,130	5,430
Total Area	2,960	3,210

Temporary impacts to Bank and LUW would result from the construction of the compensation area at Nightingale Pond. Prior to disturbance, the temporary impact areas would be photographed to document existing ground conditions and surveyed to confirm pre-construction elevations or baseline conditions. Vegetation within the impact area would be re-established through the application of a wetland seed mix and/or plant plugs and trees and shrubs as applicable, which are native to southeast

Massachusetts and Cape Cod. Soil within the restoration area would be similar to preconstruction soils (e.g., depth of surface layer, organic matter content, texture).

8.3 Compensation for Impacts to Coastal Resources

8.3.1 Permanent Impacts

The removal of the existing bridge piers will result in the restoration of approximately 8,000 sf of Navigable WOTUS and of LUO. Compensation for net impacts to federal and state resource areas will be coordinated with the USACE and MassDEP and presented in the Final Environmental Impact Statement.

8.3.2 Temporary Impacts

Temporary impacts to state and federal coastal resource areas will be compensated through in-kind restoration and natural reestablishment.

8.4 Mitigation for Construction-Term Impacts

Construction effects or impacts to wetland resources from construction-related pollutants, stormwater runoff, and dewatering activities may impact resource areas. The potential impacts would be minimized through the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP), required pursuant to the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities. The SWPPP would include best management practices to prevent erosion, minimize sediment transport, and other associated construction-term potential pollution sources. Construction-term impacts are associated with all Program activities for inland and coastal resource areas within the Study Areas.

For conformance with Executive Order 13112 (Invasive Species), the contract will include specifications for the management and disposal of soil and plant material and the prevention of the spread of invasive species via equipment.

9 Regulatory Compliance

The Program will require federal and state permits for temporary and permanent impacts to inland and coastal resource areas. The following addresses regulatory compliance with respect to state and federal requirements:

9.1 Massachusetts Wetlands Protection Act Order of Conditions

The MA WPA regulations (310 CMR 10.00) include performance standards to be met when state-regulated resource areas are altered. For the project, this includes temporary and permanent alterations to Bank, LUW, BVW, BLSF, LUO, rocky intertidal shore, CB, LSTA, and LSCSF. How the proposed Project would meet these performance standards is explained in **Attachment 2, Build**

Alternative: Conformance with Performance Standards of the Massachusetts Wetlands Protection Act.

9.2 Water Quality Certification (Clean Water Act Section 401)

The Massachusetts Water Quality regulations (314 CMR 9.00) include performance standards to be met for dredging and the discharge of dredged or fill material. A Major Dredge Project Certification for more than 5,000 cubic yards will be required. In addition, because the project would result in the loss of more than 5,000 sf of LUW for the discharge of dredged or fill material, a Major Project Certification for Fill/Excavation will be required. The following information demonstrates conformance with the criteria outlined in 314 CMR 9.06 Criteria for the Evaluation of Applications for the Discharge of Dredged or Fill Material and 314 CMR 9.07 Criteria for the Evaluation of Applications for Dredging and Dredged Material Management.

The following address conformance with 9.06: Criteria for the Evaluation of Applications for Discharge of Dredged or Fill Material:

- *Standard 9.06 (1)*

No discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.

- *Response*

An alternatives analysis of this water-dependent project selected a Build Alternative considering a range of both in-water and terrestrial interests, including navigational clearances, structural integrity of the bridge, the location of the existing Canal service road, and construction impacts. Additionally, alternatives were reviewed in relation to their performance at meeting screening criteria related to operations, connectivity, geometrics safety, constructability, multi-modal connections, utility impacts, environmental impacts (including avoidance of wetland resources), and right-of-way impacts.

- *Standard 9.06 (2)*

No discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will avoid and minimize potential adverse impacts to the bordering or isolated vegetated wetlands, land under water or ocean, or the intertidal zone. However, no such project may be permitted which will have any adverse effect on specified habitat sites of Rare Species.

- *Response*

The Program has been designed in accordance with Clean Water Act 404(b)(1) guidelines, to avoid and minimize impacts as practicable and to provide mitigation for the unavoidable impacts.

The Project Limits do not include areas mapped as Estimated Habitat of Rare Wildlife by the Massachusetts Wildlife's Natural Heritage and Endangered Species Program (NHESP).

- *Standard 9.06 (3)*

Except as otherwise provided in 314 CMR 9.06(3), no discharge of dredged or fill material shall be permitted to Outstanding Resource Waters. The discharge of dredged or fill material to an Outstanding Resource Water in association with an activity listed in 314 CMR 9.06(3)(a) Effective 10/through (k) may be permitted without requiring the applicant to obtain a variance in accordance with 314 CMR 9.08 provided that the Department determines that the discharge of dredged or fill material may be permitted in accordance with 314 CMR 9.06(1), (2), (4), (5), and (7), and is not identified in 314 CMR 9.06(4) as a discharge of dredged or fill material that requires a variance.

- *Response*

The Program does not involve a discharge of dredged or fill material to Outstanding Resource Waters.

- *Standard 9.06 (4)*

The discharge of dredged or fill material into wetlands or waters of the Commonwealth within 400 feet of the high water mark of a Class A surface water (exclusive of tributaries) requires a variance issued by the Department pursuant to 314 CMR 9.08 unless the discharge of dredged or fill material is associated with an activity conducted by a public water system under 310 CMR 22.00: Drinking Water or by a public agency or authority for the maintenance or repair of existing public roads or railways. The discharge of dredged or fill material to a vernal pool certified by the Division of Fisheries and Wildlife requires a variance pursuant to 314 CMR 9.08.

- *Response*

The Program does not involve the discharge of dredged or fill material into wetlands or waters of the Commonwealth within 400 feet of the high water mark of a Class A surface water. The Program does not involve the discharge of dredged or fill material to a vernal pool certified by the Division of Fisheries and Wildlife.

- *Standard 9.06 (5)*

No discharge of dredged or fill material is permitted for the impoundment or detention of stormwater for purposes of controlling sedimentation or other pollutant attenuation. Discharge of dredged or fill material may be permitted to manage stormwater for flood control purposes only where there is no practicable alternative and provided that best management practices are implemented to prevent sedimentation or other pollution. No discharge of dredged or fill material is permitted for the impoundment or detention of stormwater in Outstanding Resource Waters for any purpose.

– *Response*

The Program does not involve the discharge of dredged or fill material for the impoundment or detention of stormwater for purposes of controlling sedimentation or other pollutant attenuation (refer to **Section 4.10, Water Quality and Stormwater Management**).

The Program does not involve a discharge of dredged or fill material to Outstanding Resource Waters.

• *Standard 9.06 (6)(a)*

Except as otherwise provided in 314 CMR 9.06, stormwater discharges shall be provided with best management practices to attenuate pollutants and to provide a setback from the receiving water or wetlands in accordance with the Stormwater Management Standards as further defined and specified in the Massachusetts Stormwater Handbook.

– *Response*

The project has been designed in accordance with the Stormwater Management Standards as further defined and specified in the Massachusetts Stormwater Handbook (refer to **Section 4.10, Water Quality and Stormwater Management**).

The following addresses Project conformance with 9.07: Criteria for the Evaluation of Applications for Dredging and Dredged Material Management

• *Standard 9.07 (1)(a)*

No dredging shall be permitted unless appropriate and practicable steps have been taken which would first avoid, and if avoidance is not possible, then minimize, or if neither avoidance or minimization are possible, then mitigate, potential adverse impacts to land under water or ocean, intertidal zone, and special aquatic sites. No dredging shall be permitted if there is a practicable alternative that would have less impact on the aquatic ecosystem. However, no such dredging may be permitted, which would have any adverse effect on specified habitat sites of Rare Species unless the work is subject to a Conservation and Management Permit or Determination of No Take issued by the Division of Fisheries and Wildlife.

– *Response*

The Program has been designed in accordance with CWA 404(b)(1) guidelines, to avoid and minimize impacts as practicable and to provide mitigation for the unavoidable impacts (refer to **Attachment 2, Build Alternative: Conformance with Performance Standards of the Massachusetts Wetlands Protection Act**).

The Project Limits do not include areas mapped as Estimated Habitat of Rare Wildlife by the Massachusetts Wildlife's Natural Heritage and Endangered Species Program (NHESP).

An alternatives analysis of this water dependent project selected a Build Alternative considering a range of both in-water and terrestrial interests, including navigational clearances, structural integrity of the bridge, the location of the existing Canal service road, and construction impacts. Additionally, alternatives were reviewed in relation to their performance at meeting screening

criteria related to operations, connectivity, geometrics safety, constructability, multi-modal connections, utility impacts, environmental impacts (including avoidance of wetland resources), and right-of way impacts.

The Program does not involve a discharge of dredged or fill material to Outstanding Resource Waters.

Cape Cod Canal has undergone recent maintenance dredging. Testing of the dredged material found that the material was appropriate for beach nourishment and the dredged material has been used for beach nourishment at Town Beach in Sandwich.

- *Standard 9.07 (2)*

Sampling and Analysis Requirements. The applicant shall submit the results of all relevant sampling with the application unless an alternative schedule is specifically authorized by the Department in writing.

- *Response*

The Project will comply with all sampling requirements.

- *Standard 9.07 (3)*

Dredging Performance Standards. Dredging shall be planned and conducted to minimize short-term, long-term, impacts on the aquatic ecosystem and to provide protection to human health.

- *Response*

The project will plan and conduct dredging to minimize short-term, long-term, impacts on the aquatic ecosystem and to provide protection to human health.

9.3 Section 404 of the Clean Water Act

The Build Alternative would require a Section 404 permit for the placement of fill material in WOTUS. These impacts are evaluated under the Section 404 (b)(1) Guidelines, the intent of which is to avoid unnecessary filling of waters and wetlands. The Section 404 (b)(1) Guidelines (40 CFR § 230) which state:

- Except as provided under section 404(b)(2) of the CWA, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences, the intent of which is to avoid unnecessary filling of waters and wetlands (40 CFR § 230.10(a)). An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered (40 CFR § 230.10(a)(2)). Where the activity associated with a discharge which is proposed for a special aquatic site (as defined in subpart E) does not require access or proximity to or siting within the special aquatic site in

question to fulfill its basic purpose (i.e., is not “water dependent”), practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise. In addition, where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise (40 CFR § 230.10(a)(3)).

- Except as provided under Section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem (40 CFR § 230.10(d)).

9.3.1 Alternatives

An alternatives analysis of this water dependent project selected a Build Alternative considering a range of both in-water and terrestrial interests, including navigational clearances, structural integrity of the bridge, the location of the existing Canal service road, and construction impacts. Additionally, alternatives were reviewed in relation to their performance at meeting screening criteria related to operations, connectivity, geometrics safety, constructability, multi-modal connections, utility impacts, environmental impacts (including avoidance of wetland resources), and right-of way impacts. For further discussion regarding the Alternatives Analysis, refer to **Chapter 3, Proposed Action and Alternatives**.

9.3.2 Minimization

The Program has been designed to minimize adverse impacts as appropriate and practicable (refer to **Attachment 2, Build Alternative: Conformance with Performance Standards of the Massachusetts Wetlands Protection Act**).

9.4 23 CFR 650 Subpart A (Floodplain)

23 CFR Part 650 Subpart A – Location and Hydraulic Design of Encroachments on Flood Plains prescribes FHWA policies and procedures for the location and hydraulic design of highway encroachments on flood plains, including direct Federal highway projects administered by the FHWA. Conformance with applicable requirements of Subpart A is provided in **Table 9-1**.

Table 9-1. 23 CFO Part 650 Subpart A Conformance

Performance Standard	Conformance
Sec. 650.111 Location hydraulic studies	
a) National Flood Insurance Program (NFIP) maps or information developed by the highway agency, if NFIP maps are not available, shall be used to determine whether a highway location alternative will include an encroachment.	National Flood Insurance Program maps were used to determine the presence of an encroachment.

Performance Standard	Conformance
b) Location studies shall include evaluation and discussion of the practicability of alternatives to any longitudinal encroachments.	An alternatives analysis is included in Chapter 3 .
c) Location studies shall include discussion of the following items, commensurate with the significance of the risk or environmental impact, for all alternatives containing encroachments and for those actions which would support based floodplain development: (1) The risks associated with implementation of the action, (2) The impacts on natural and beneficial flood-plain values, (3) The support of probable incompatible flood-plain development, (4) The measures to minimize flood-plain impacts associated with the action, and (5) The measures to restore and preserve the natural and beneficial flood-plain values impacted by the action.	The Draft Environmental Impact Statement includes a discussion of these items regarding encroachment. The Program does not support floodplain development.
d) Location studies shall include evaluation and discussion of the practicability of alternatives to any significant encroachments or any support of incompatible flood-plain development	The Program will not result in a significant encroachment and does not support incompatible floodplain development.
e) The studies required by Sec. 650.111 (c) and (d) shall be summarized in environmental review documents prepared pursuant to 23 CFR Part 771	The Program's Draft Environmental Impact Statement provides a summary.
f) Local, State, and Federal water resources and flood-plain management agencies should be consulted to determine if the proposed highway action is consistent with existing watershed and flood-plain management programs and to obtain current information on development and proposed actions in the affected watersheds	The Program will comply with the Massachusetts Wetlands Protection Act and is implementing regulations that regulate natural and beneficial floodplain values.

Performance Standard	Conformance
Sec. 650.113 Only practicable alternative finding a) A proposed action which includes a significant encroachment shall not be approved unless the FHWA finds that the proposed significant encroachment is the only practicable alternative. This finding shall be included in the final environmental document (final environmental impact statement or finding of no significant impact) and shall be supported by the following information: (1) The reasons why the proposed action must be located in the flood plain, (2) The alternatives considered and why they were not practicable, and (3) A statement indicating whether the action conforms to applicable State or local flood-plain protection standards.	The proposed action is not considered a significant encroachment. This standard is not applicable to the Program.

10 References

- HNTB Corporation (HNTB). 2021. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts. HNTB Corporation, Boston, Massachusetts. December.
- HNTB. 2022. Abbreviated Notice of Resource Area Delineation (ANRAD), MassDOT Cape Cod Canal Area Transportation Improvements Program, Project No. 608020, Bourne, Massachusetts. HNTB Corporation, Boston, Massachusetts. April.
- Massachusetts Division of Fisheries and Wildlife (MassWildlife). 2009. Guidelines for the Certification of Vernal Pool Habitat (updated 2020). Massachusetts Division of Fisheries and Wildlife. Westborough, Massachusetts. March.
- Stantec Consulting Services Inc. (Stantec). 2020. Bourne and Sagamore Bridge Improvement Projects – Rare, Threatened, and Endangered Species Habitat Assessment, MassDOT Project # 14-33419, Barnstable County, Massachusetts. Stantec Consulting Services Inc., Boston, Massachusetts. December.
- U.S. Army Corps of Engineers (USACE). 2022. Environmental Assessment and Finding of No Significant Impact for Major Rehabilitation Evaluation, Cape Cod Canal Highway Bridges, Massachusetts. New England District, Concord, Massachusetts. March.

11 Attachments

- Attachment 1. Abbreviated Notice of Resource Area Delineation
- Attachment 2. Build Alternative: Conformance with Performance Standards of the Massachusetts Wetlands Protection Act