

4 Affected Environment, Environmental Consequences, and Mitigation

4.10 Water Quality and Stormwater

4.10.1 Introduction

This section assesses the potential construction period and operational effects of the No Build Alternative and the Build Alternative on water quality, including surface water, groundwater, and stormwater conditions. This section also identifies mitigation measures that will be implemented to avoid or minimize the potential construction-related and operational effects of the Build Alternative relative to water quality resources, including the Cape Cod Sole Source Aquifer and the Plymouth/Carver Sole Source Aquifer.

4.10.2 Regulatory Context

Various federal and state regulatory programs govern stormwater management and water quality. The Federal Water Pollution Act Amendments of 1972,¹ also known as the Clean Water Act, is the primary federal law governing surface water quality protection in the United States. Sections of the Massachusetts Wetlands Protection Act Regulations,² and the state's 401 Water Quality Certification Regulations³ govern stormwater management in Massachusetts.

In addition to these regulatory programs, guidance documents that were used to support this assessment include the Massachusetts Stormwater Handbook and Stormwater Standards⁴ and the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas.⁵

¹ Federal Water Pollution Control Act ([Clean Water Act](#)) of 1972 (33 U.S. Code 1251-1376) as amended by the U.S. Clean Water Act (1977) and the Water Quality Act (1987); Sections 401 and 404 of the Clean Water Act (33 U.S. Code 1251-1376). <https://www.epa.gov/laws-regulations/summary-clean-water-act>

² Massachusetts Department of Environmental Protection. 2014. [Massachusetts Wetlands Protection Act Regulations](#) (310 Code of Massachusetts Regulations [CMR] 10.00). October. <https://www.mass.gov/regulations/310-CMR-1000-wetlands-protection-act-regulations>

³ Massachusetts Department of Environmental Protection. 2014. [Massachusetts 401 Water Quality Certification Regulations \(314 CMR 9.00\)](#). October. <https://www.mass.gov/regulations/314-CMR-9-401-water-quality-certification>

⁴ Massachusetts Department of Environmental Protection. 2008. [Massachusetts Stormwater Handbook and Stormwater Standards](#). February. <https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards#stormwater-handbook-volume-1->

⁵ Massachusetts Department of Environmental Protection. 2003. [Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas; A Guide for Planners, Designers, and Municipal Officials](#). May (reprint). <https://www.mass.gov/doc/complete-erosion-and-sedimentation-control-guidelines-a-guide-for-planners-designers-and/download>

4.10.3 Methodology and Study Area

4.10.3.1 Study Area

The Study Area for the water quality and stormwater assessment includes the Project Limits. The Study Area for the water quality and stormwater assessment also includes the areas of land that contribute flow to the Project Limits and ultimately the Cape Cod Canal. **Figure 4.10-1 through Figure 4.10-4** identify the watershed boundaries within each of the following Study Area quadrants: Sagamore North, Sagamore South, Bourne North, and Bourne South. The contributing stormwater catchment area is the same for existing and proposed conditions. They were delineated using a combination of topographic survey and record plans that define the existing closed drainage system. The contributing stormwater catchment area depicts the study area that was delineated and included in the site-specific hydrologic model for comparison of existing and proposed conditions. Areas outside of the project limits that will not change due to the proposed construction were not included in the hydrologic study.

4.10.3.2 Assessment Methodologies

The design flood frequency for stormwater conveyance design elements was selected in accordance with Massachusetts Department of Transportation (MassDOT) and Federal Highway Administration guidelines. The hydrology of the Study Area was analyzed in HydroCAD software using the Soil Conservation Service (SCS) Technical Release No. 20⁶ and SCS Technical Release No. 55.⁷ Proposed stormwater control measures (SCM) were analyzed using the Dynamic Storage Indication Method.⁸ The Type III 24-hour storm was used for stormwater runoff calculations. The precipitation depths were estimated using National Oceanic and Atmospheric Administration Atlas 14.⁹ The proposed storm drainage collection system was designed using the Rational Method. Bentley® StormCAD software was used to perform the hydraulic analysis for the storm drainage system.

The Massachusetts Climate Resilience Design Standards Tool, which recommends a planning horizon of 2070¹⁰ and a return period associated with a 100-year (1% annual chance) storm event, was used to inform rainfall projections for design of the proposed stormwater management system. Predictions show that by 2070, the 100-year (or 1% probability) storm event will result in 9.8 inches of rainfall in 24 hours for the Sagamore Bridge watersheds and 9.9 inches of rainfall in 24 hours for the Bourne Bridge watersheds. These rainfall depths were used to assess the vulnerability of the stormwater management system and to design sustainable infrastructure.

⁶ Natural Resources Conservation Service. n.d. [TR-20: Project Formulation – Hydrology](https://hydrocad.net/tr-20.htm). <https://hydrocad.net/tr-20.htm>

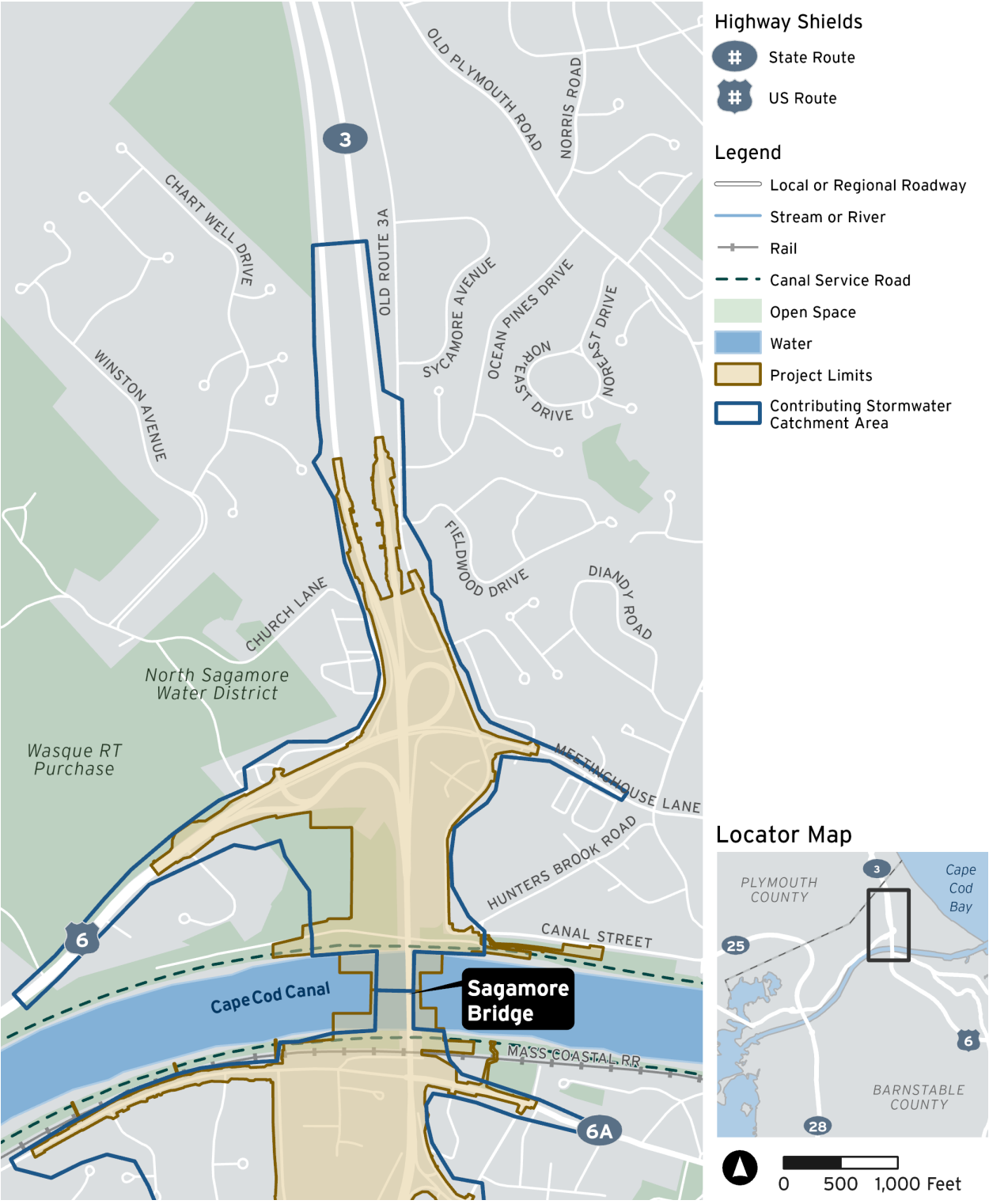
⁷ Natural Resources Conservation Service. n.d. [TR-55: Urban Hydrology for Small Watersheds](https://www.hydrocad.net/tr-55.htm). <https://www.hydrocad.net/tr-55.htm>

⁸ Natural Resources Conservation Service. n.d. [Using the Dynamic Storage-Indication Method](https://hydrocad.net/dsi.htm). <https://hydrocad.net/dsi.htm>

⁹ NOAA, National Weather Service. n.d. [Hydrometeorological Design Studies Center: NOAA Atlas 14 Point Precipitation Frequency Estimates](https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html). https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html

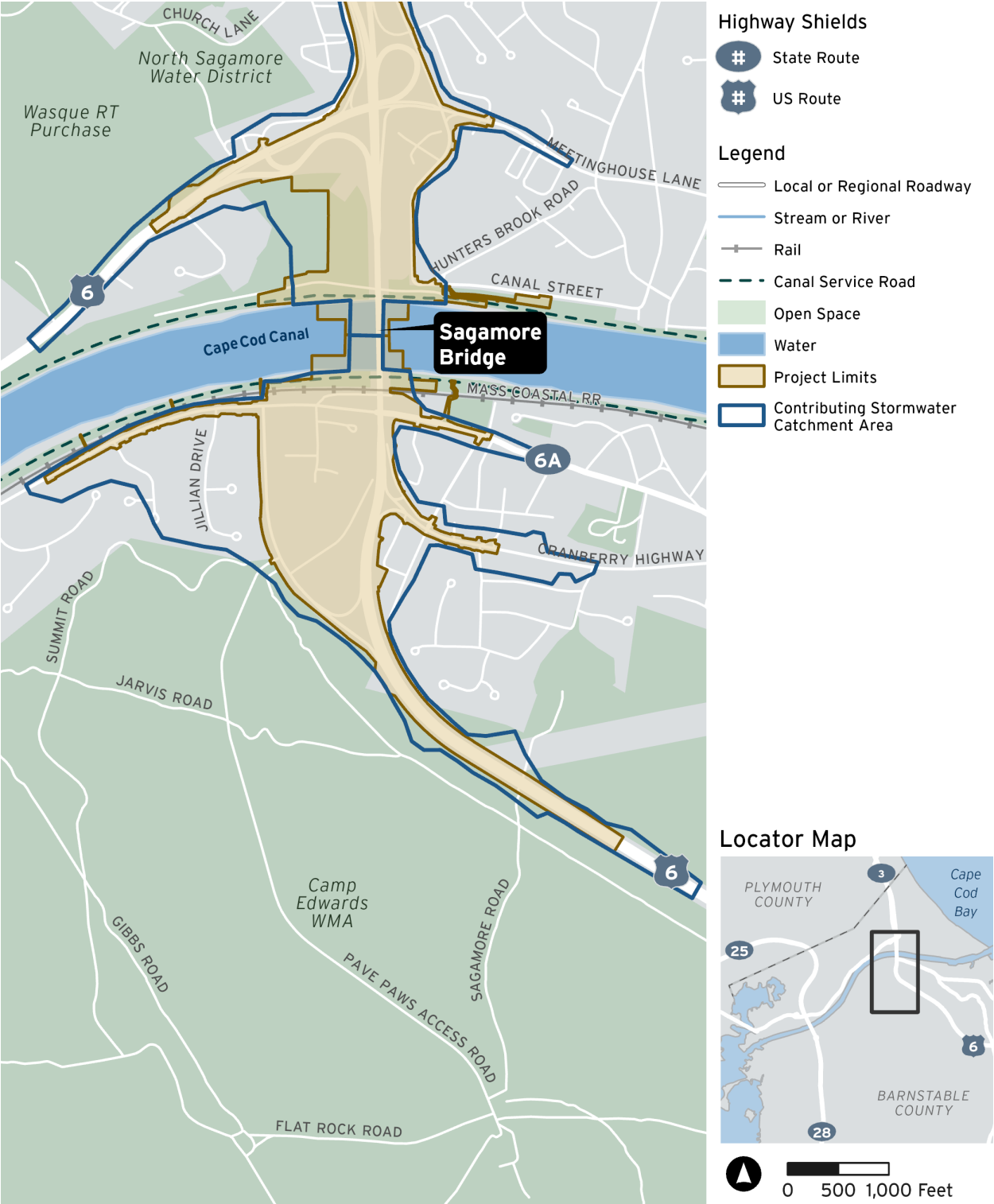
¹⁰ A future date to which a project can be designed, which allows the project to incorporate anticipated climate conditions.

Figure 4.10-1. Contributing Stormwater Catchment Area (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2026

Figure 4.10-2. Contributing Stormwater Catchment Area (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2026

Figure 4.10-3. Contributing Stormwater Catchment Area (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2026

Figure 4.10-4. Contributing Stormwater Catchment Area (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2026

4.10.4 Affected Environment

4.10.4.1 Drinking Water Supplies

The Study Area lies within two sole source aquifers, as designated by the U.S. Environmental Protection Agency (EPA). The Cape Cod Sole Source Aquifer encompasses the entire Study Area south of Cape Cod Canal. The Plymouth/Carver Sole Source Aquifer encompasses the entire Study Area north of Cape Cod Canal. The designation ensures that no commitment for federal financial assistance may be provided for any project that the EPA determines may contaminate the aquifer through its recharge area to create a significant hazard to public health.¹¹ The EPA defines a sole source aquifer as one that supplies at least 50% of the drinking water consumed in the area overlying the aquifer. EPA guidelines also require that these areas have no alternative drinking water sources(s) that could physically, legally, and economically supply water to all who depend on the aquifer for drinking water.¹²

Figure 4.10-5 illustrates the extent of the two sole source aquifers within the Study Area.

There are two Wellhead Protection Areas within the Bourne North quadrant:

- An interim wellhead protection area for Sandy's Restaurant
- A Zone II wellhead protection area for the Buzzards Bay Water District

As stated in 310 Code of Massachusetts Regulations (CMR) 22.02, a Zone II is:

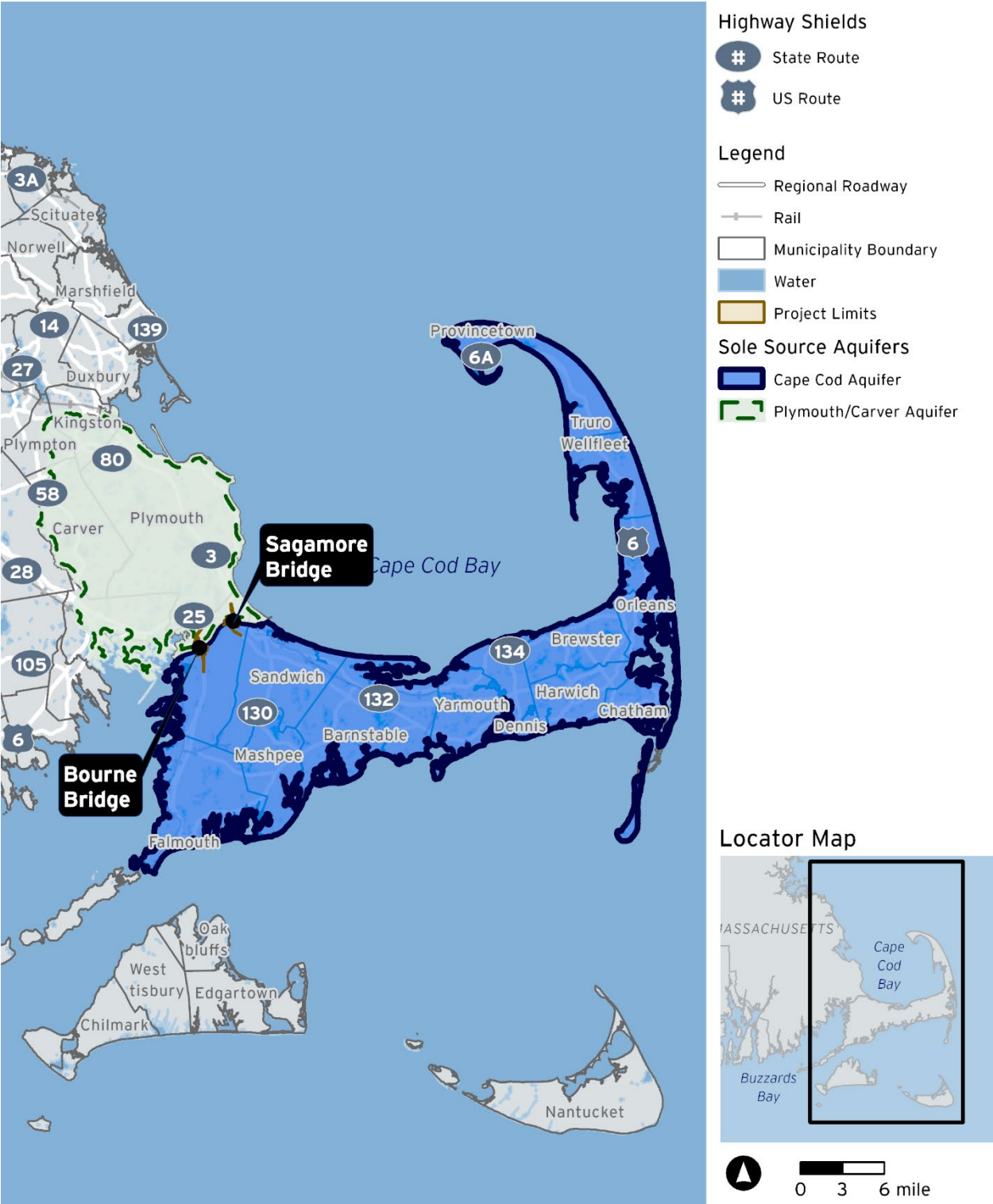
“That area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone IIs shall extend up gradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock, or a recharge boundary).”¹³

¹¹ U.S. Environmental Protection Agency, Region 1. 2008. [Sole Source Aquifer Program](https://www3.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html).
https://www3.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html

¹² U.S. Environmental Protection Agency, Region 1. 2008. [Sole Source Aquifer Program](https://www3.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html).
https://www3.epa.gov/region1/eco/drinkwater/pc_solesource_aquifer.html

¹³ Executive Office of Technology Services and Security. 2024. [MassGIS Data: MassDEP Wellhead Protection Areas \(Zone II, Zone I, IWPA\)](https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-iwpa). April. <https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-iwpa>

Figure 4.10-5. Sole Source Aquifers



Source: Massachusetts Department of Transportation, 2024

In the absence of an approved Zone II, the Massachusetts Department of Environmental Protection (MassDEP) has adopted the interim wellhead protection area as the primary, protected recharge area for public water supply¹⁴ groundwater sources.¹⁵ **Figure 4.10-6 through Figure 4.10-9** illustrate the groundwater depth contours, flow direction, and location of public and private wells. The groundwater contours on the north side of the canal were developed by the U.S. Geological Survey as part of the Water-Resources Investigations Report 90-4204, Plate 1.¹⁶ The groundwater contours on the south side of the canal were developed by the U.S. Army Corps of Engineers as part of the Impact Area Groundwater Study Program at Joint Base Cape Cod.¹⁷

There is an impervious shoulder that consists of hot mix asphalt, which is buried approximately 4 feet deep, in all pervious medians and shoulders within the wellhead protection area. It prevents stormwater from infiltrating to the groundwater. Snow melt or runoff from large storms that is not captured by the catch basin inlets in the roadway is collected in a subdrain system and conveyed to Cape Cod Canal.

¹⁴ A system for the provision of public water for human consumption through pipes or other constructed conveyances if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days of the year.

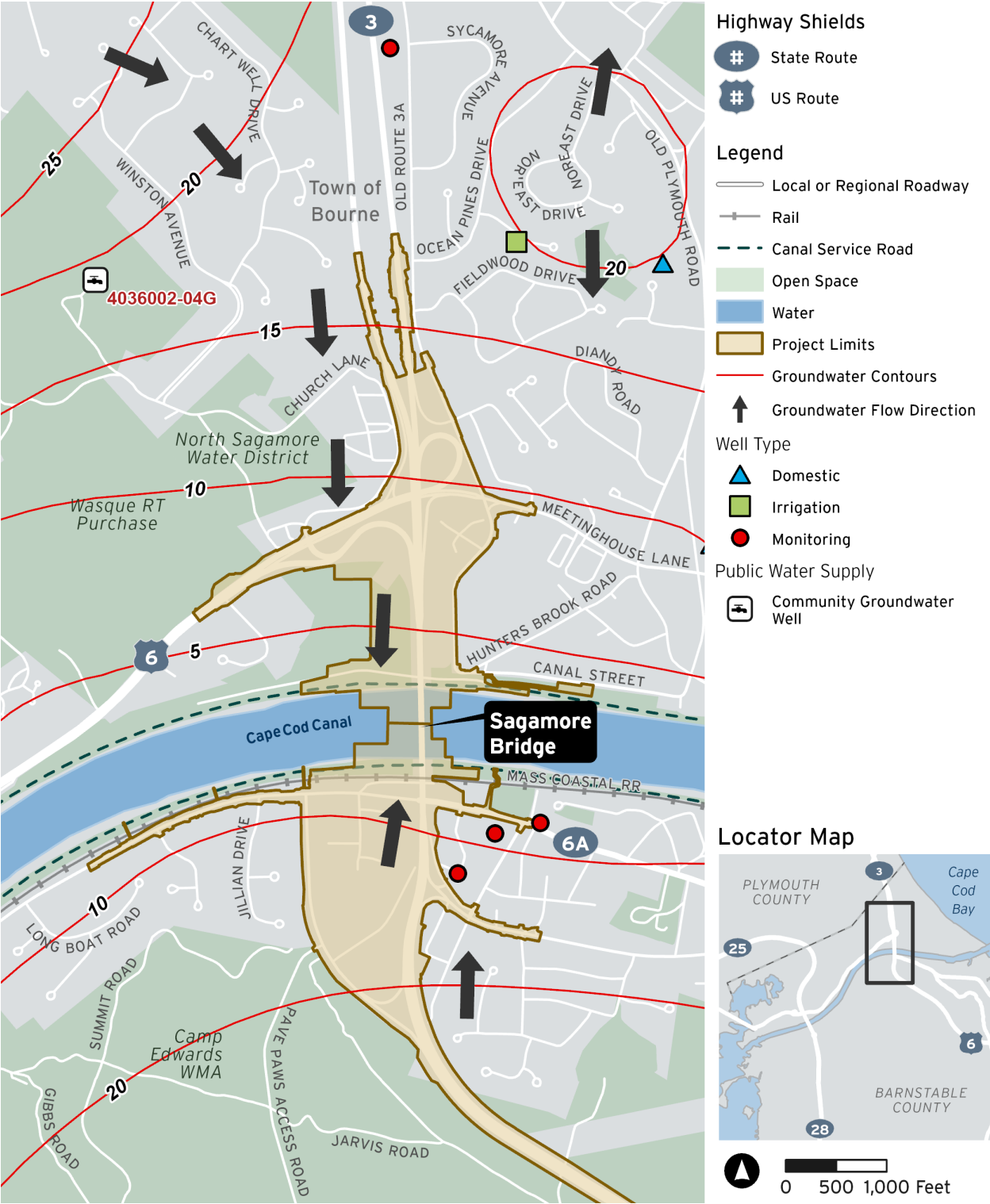
Source: 310 CMR 22.02, <https://www.mass.gov/info-details/determining-if-a-water-system-is-public-or-private>

¹⁵ Executive Office of Technology Services and Security. 2024. [MassGIS Data: MassDEP Wellhead Protection Areas \(Zone II, Zone I, IWPA\)](https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-iwpa). April. <https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-iwpa>

¹⁶ Bruce P. Hanson and Wayne W. Lapham. Geohydrology and Simulated Ground-Water Flow, Plymouth-Carver Aquifer, Southeastern Massachusetts. U.S. Geological Survey Water-Resources Investigations Report 90-4204. 1992. <https://pubs.usgs.gov/wri/wri904204/pdfs/wri904204.PDF>

¹⁷ U.S. Army Corps of Engineers, New England District. Impact Area Groundwater Study Program T Range Soil & Groundwater Investigation Report, Camp Edwards Massachusetts Military Reservation, Cape Cod Massachusetts. June 4, 2007. <https://archive.epa.gov/region1/mmr/web/pdf/269651.pdf>

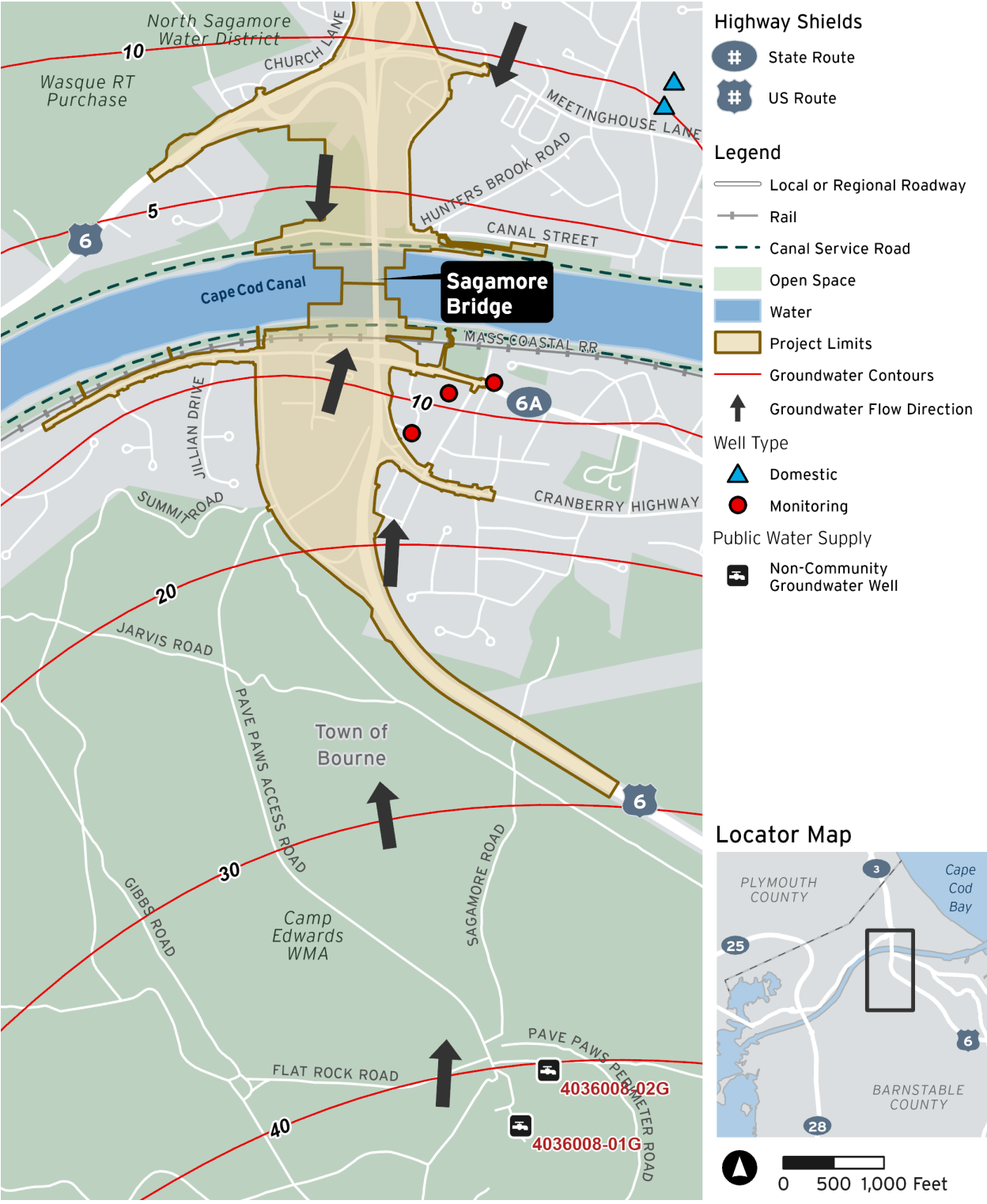
Figure 4.10-6. Groundwater Hydrology (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2026

Note: Groundwater elevations shown are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

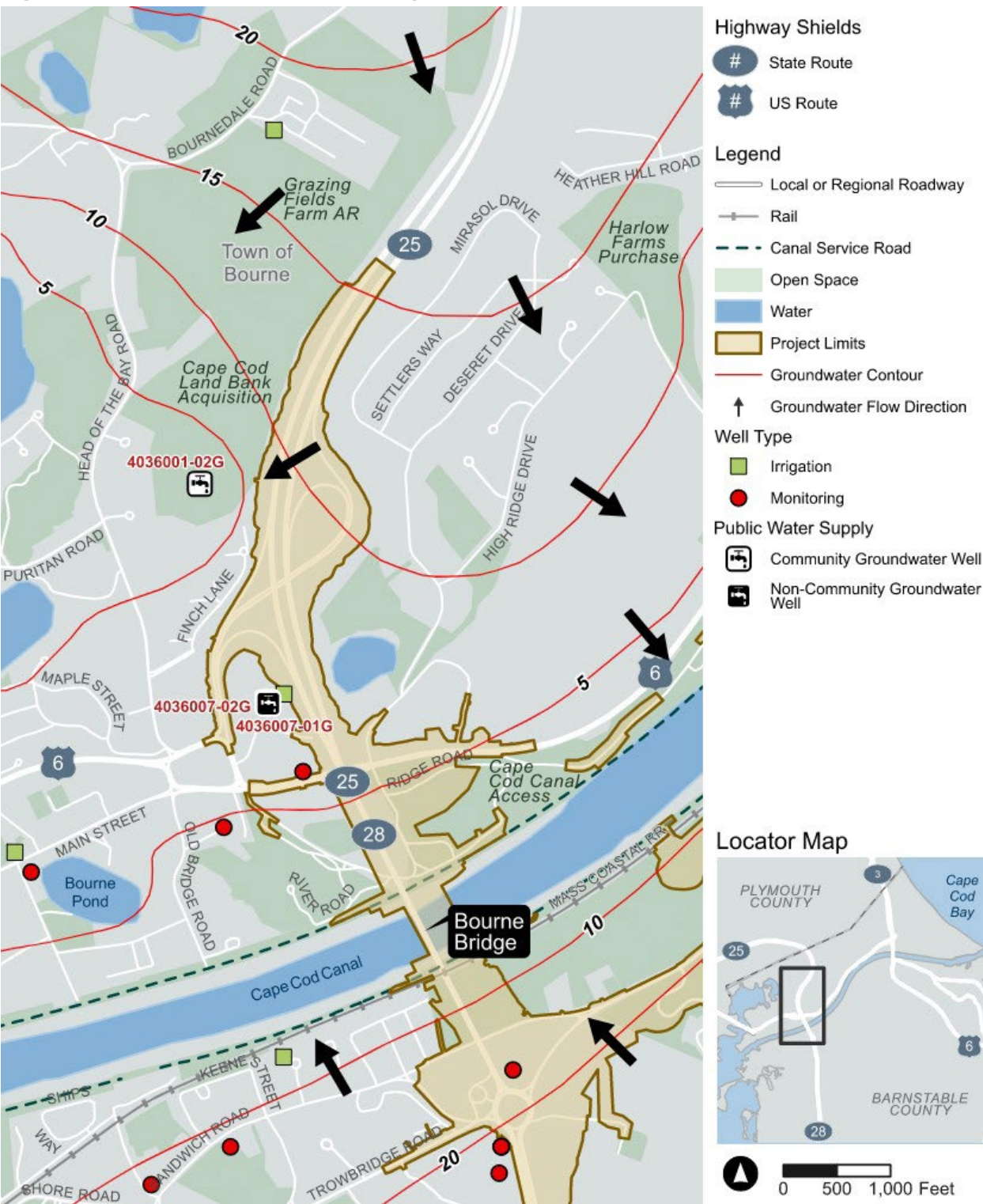
Figure 4.10-7. Groundwater Hydrology (Sagamore South Quadrant)



Source: Massachusetts Department of Transportation, 2026

Note: Groundwater elevations shown are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

Figure 4.10-8. Groundwater Hydrology (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2026

Note: Groundwater elevations shown are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

Figure 4.10-9. Groundwater Hydrology (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, [2026](#)

Note: Groundwater elevations shown are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

4.10.4.2 Study Area Watersheds

The Study Area also lies within three major watersheds: South Coastal, Cape Cod, and Buzzards Bay. Stormwater runoff within the Study Area flows to Cape Cod Canal with a portion captured by catch basins or similar structures and conveyed through underground pipes that discharge along the bank of the canal. Stormwater runoff within the Study Area is also captured and conveyed via pipe network to low lying areas and existing stormwater basins where it recharges to the groundwater, which is part of the Cape Cod and Plymouth/Carver sole source aquifers. **Figure 4.10-10** illustrates the three major watersheds within the Study Area.

All developed land covers convey natural and human-made materials including sediment, nutrients, metals, salts, organic chemicals, litter, and bacteria that are either deposited on surfaces by wind, air pollution fallout, and rain or generated by land-use activities. Roadways and other impervious urban areas can convey naturally deposited materials, materials of their construction, and materials that are tracked on or deposited by vehicular traffic, as well as other sources. Roadways and parking lots may also receive de-icing chemicals and/or winter maintenance sands applied to maintain safe operating conditions. The U.S. Geological Survey, in cooperation with MassDOT, has characterized, quantified, and interpreted the quality of runoff from highways and bridges in Massachusetts.¹⁸

4.10.4.3 Snow and Ice Management

MassDOT conducts snow and ice management that is consistent with the practices outlined in the MassDOT Snow and Ice Control Program Environmental Status and Planning Report, formerly known as the Snow and Ice Control Generic Environmental Impact Report.

Cape Cod is a Reduced Salt Zone due to its sandy soils and sole source aquifer. [MassDOT has continually updated and improved its snow and ice management practices, as documented in the 2022 Environmental Status and Planning Report¹⁹ for the statewide Snow and Ice Control Program.](#)

[MassDOT's current strategy emphasizes best practices, such as anti-icing with liquid deicers, pre-wetting of salt, use of road weather information systems, and calibrating application equipment to optimize material use. These methods have resulted in substantial reductions in salt usage on a per lane-mile basis while improving effectiveness compared to prior Reduced Salt Zone treatments that included sand.](#)

[Consistent with these advancements, MassDOT is actively phasing out the routine use of sand in Reduced Salt Zones. While limited use of sand may still occur under certain conditions or in specific locations during this transition, MassDOT's aim is to minimize and ultimately replace sand with more effective and environmentally preferable practices. Sand use is being reduced due to its limited deicing](#)

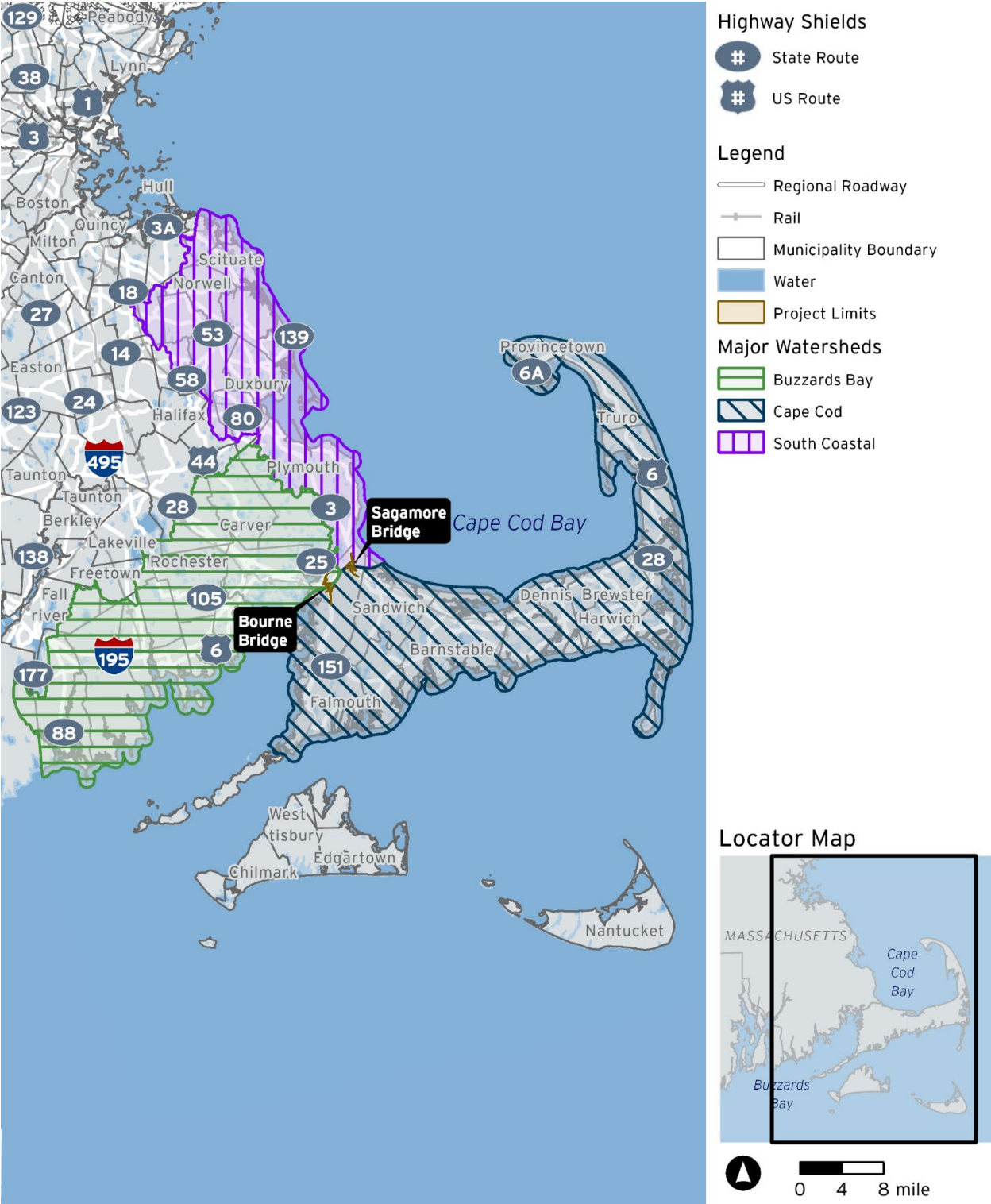
¹⁸ U.S. Geological Survey Scientific Investigations Report 2009–5269 (<https://doi.org/10.3133/sir20095269>), U.S. Geological Survey Scientific Investigations Report 2018–5033 (<https://doi.org/10.3133/sir20185033>).

¹⁹ [Massachusetts Department of Transportation. 2022. EEA #11202 MassDOT Snow and Ice Control Program 2022 Environmental Status and Planning Report Executive Summary. \[https://walkmass.org/wp-content/uploads/2023/01/2022-12-21_MassDOT-2022-Snow-Ice-ESPR_Executive-Summary.pdf\]\(https://walkmass.org/wp-content/uploads/2023/01/2022-12-21_MassDOT-2022-Snow-Ice-ESPR_Executive-Summary.pdf\)](#)

[effectiveness and associated environmental impacts, including air quality concerns and sedimentation of receiving waters.](#)

MassDOT updates the Snow and Ice Control Program report annually [with updates to topics such as winter severity and material usage and](#) revamps it every five years. The report details best management practices employed by MassDOT's snow and ice program to limit the environmental repercussions from its winter roadway maintenance to the extent possible. MassDOT also works with individual well owners to alleviate concerns related to salinity and participates in discussions with water authorities that have an interest in the snow and ice management practices. All proposed infiltration basins for the Cape Cod Bridges Program would be located outside of the Zone II areas, which contribute to wellhead protection areas via groundwater flow.

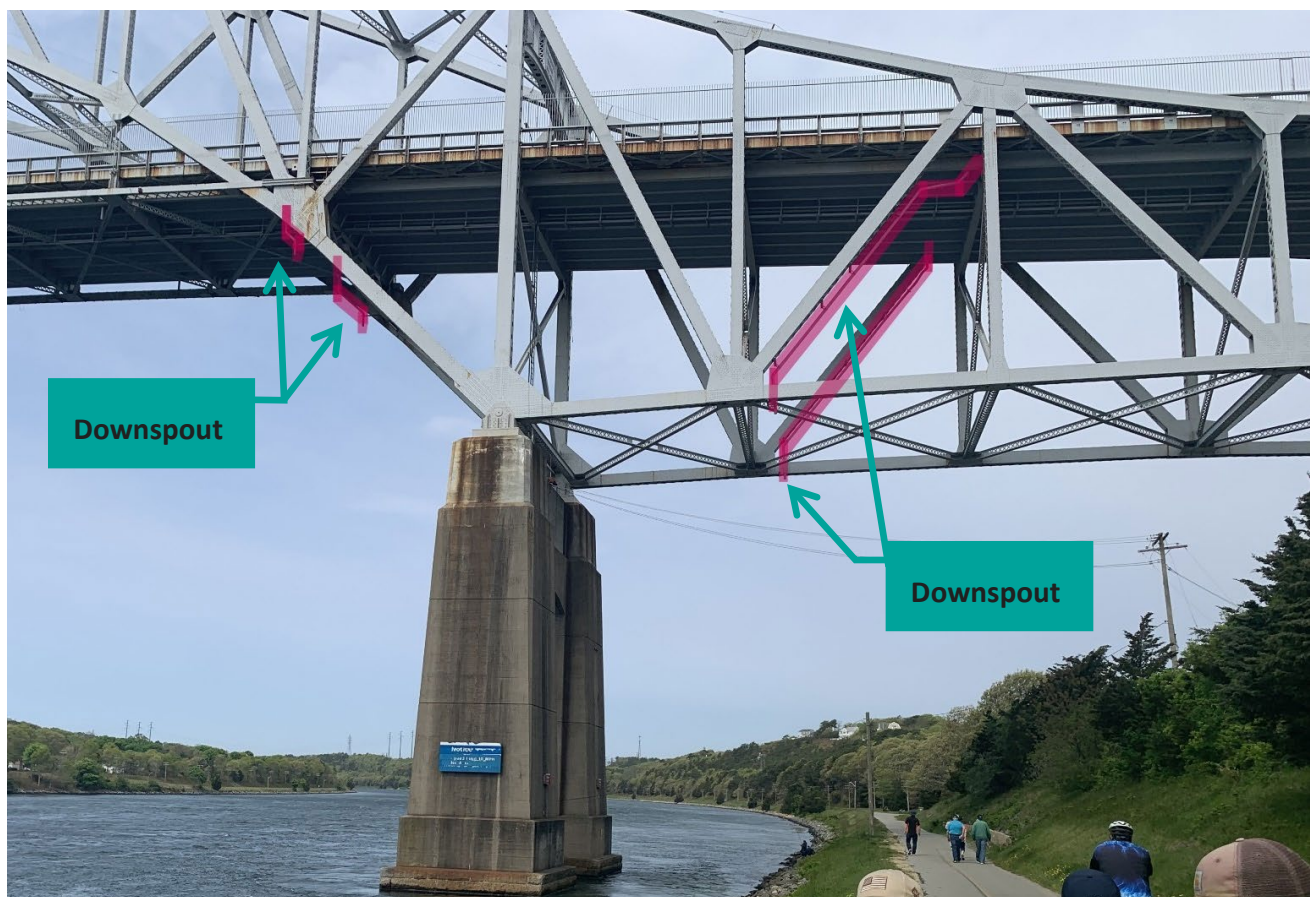
Figure 4.10-10. Major Watersheds Relevant to the Study Area



Source: Massachusetts Department of Transportation, 2024

Newer stormwater management systems typically have in-line treatment devices or practices to reduce the pollutants in the stormwater prior to discharge to wetlands or waterways. The majority of the existing pipe networks discharging to the Cape Cod Canal in the Study Area were constructed before MassDEP issued the Stormwater Policy in 1996 that established Stormwater Management Standards and provide a minimal level of treatment of pollutants prior to discharge. The exception is the Sagamore North Study Area, which includes stormwater treatment basins. At the Sagamore and Bourne Bridges, stormwater runoff discharges directly to Cape Cod Canal and land beneath the bridge approaches through bridge deck scuppers, which are connected to downspouts. [Exhibit 4.10-1](#) illustrates downspouts originating from the Sagamore Bridge deck and ending at the bottom of the bridge truss where water discharges to the ground below. [Exhibit 4.10-2](#) and [Exhibit 4.10-3](#) illustrate two of the existing stormwater treatment basins at the Sagamore North quadrant. [Exhibit 4.10-4](#) through [Exhibit 4.10-6](#) illustrate pipe outfalls to the canal for the Bourne North and Bourne South quadrants.

Exhibit 4.10-1. Downspouts (Sagamore Bridge)



Source: Massachusetts Department of Transportation, 2023

Exhibit 4.10-2. Stormwater Basin at Canal Street and Commerce Way (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2023

Exhibit 4.10-3. Stormwater Basin at State Route 3 North Off-Ramp (Sagamore North Quadrant)



Source: Massachusetts Department of Transportation, 2023

Exhibit 4.10-4. Pipe Outfall Location at Cape Cod Canal (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2023

Exhibit 4.10-5. Twin 43-inch by 68-inch Elliptical Pipe Outfalls (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2023

Exhibit 4.10-6. 24-Inch Pipe Outfall at Cape Cod Canal (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2023

4.10.5 No Build Alternative

The No Build Alternative would include maintenance of existing facilities as well as recently completed and near-term projects included in the Cape Cod Region's FFY [2026-2030](#) Transportation Improvement Program. For the No Build Alternative, most of the existing impervious surface area along roadways in the Study Area would remain untreated, which has the potential for long-term adverse effects to surface water and groundwater quality within the Study Area. The projected increase in traffic volumes for the No Build Alternative could increase the pollutants deposited on roadways, leading to higher potential pollutant load in stormwater runoff.

4.10.6 Build Alternative

The Program team has coordinated with the EPA Region 1 Source Water Protection Coordinator and Buzzards Bay, Bourne, and North Sagamore Water Districts. Their feedback supported the assessment methodology and stormwater mitigation approach for the Program. EPA Region 1 would conduct a Sole Source Aquifer Review of the Program prior to construction.

4.10.6.1 Construction Impacts

During construction, stormwater runoff has the potential to affect infrastructure by flooding travel lanes or adjacent properties. The contractor will be required to maintain adequate provisions for stormwater management during construction to prevent safety and maintenance issues by maintaining the drainage system during interim conditions, keeping catch basin inlet grates free of debris and sediment, and installing temporary features as necessary to prevent flooding after storm events.

Stormwater runoff during construction can affect water quality by transporting sediment and other construction pollutants to Cape Cod Canal in the absence of best management practices. Because the Build Alternative would disturb greater than 1 acre of land, including discharges of stormwater to Waters of the United States, coverage under the EPA's 2022 National Pollutant Discharge Elimination System Construction General Permit would be required. The permit requires development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) to minimize erosion, sediment, and other construction-related stormwater pollutants.

Also, because the Build Alternative is subject to Wetlands jurisdiction, a construction period erosion, sedimentation, and pollution prevention plan (CP4) must be submitted to the Bourne Conservation Commission and MassDEP.

MassDOT's Contract Specifications require the contractor(s) to prepare and implement a combined SWPPP/CP4 in accordance with National Pollutant Discharge Elimination System permitting requirements and the CP4 requirements of Massachusetts Stormwater Standard 8. The SWPPP/CP4 will describe best management practices, installation methods, and inspection requirements for temporary and permanent erosion and pollution prevention and sediment control practices.

[Section 4.10.7.1](#) discusses the mitigation measures that will be implemented to avoid or minimize the potential for adverse impacts to groundwater, surface water, and stormwater runoff during construction.

4.10.6.2 Operational Impacts

As illustrated in [Table 4.10-1](#), the Build Alternative would result in an increase of approximately 52.3 acres of new impervious surface area [within the Project limits](#) compared to existing conditions.

Table 4.10-1 Build Alternative Impervious Area

Study Area Quadrant	Existing Impervious Area (acres)	Proposed Impervious Area (acres)	Impervious Area Increase (acres)	Impervious Area Increase	Treated Impervious Area (acres)
Sagamore North	25.3	34.8	9.5	38%	30.8
Sagamore South	19.8	34.2	14.4	72%	23.1
Bourne North	23.8	38.2	14.4	61%	29.0
Bourne South	21.8	35.8	14.0	64%	30.7
Total	90.7	143.0	52.3	—	113.6

Source: Massachusetts Department of Transportation, [2025](#)

The Build Alternative has the potential to affect water quality by changing the land cover and ultimately the hydrology of the site. Increased impervious surface without associated stormwater treatment could lead to increased surface runoff, higher peak flows during storm events, higher pollutant loads, and reduced groundwater recharge.

For the Build Alternative, new collection and conveyance systems would be constructed for the proposed bridges and approach roadways. Stormwater detention and recharge, and improved water quality, would be provided through installation of low-impact SCMs, as discussed in [Section 4.10.7.2](#). The proposed SCMs for the Build Alternative would improve the treatment and quality of the runoff that is eventually discharged to Cape Cod Canal and the Plymouth/Carver and Cape Cod sole source aquifers.

The stormwater management system for the Build Alternative would be designed to comply with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations and the 401 Water Quality Certification Regulations. Refer to **Appendix 4.10, Water Quality and Stormwater Technical Report**, for details assessing compliance of the Build Alternative with the Massachusetts Stormwater Management Standards.

4.10.7 Mitigation

4.10.7.1 Construction Impacts

Mitigation measures that will be implemented to avoid or minimize the potential for adverse impacts to groundwater, surface water, and stormwater runoff during construction will be specified in the SWPPP. The SWPPP will be prepared in accordance with the EPA's National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities, effective February 17, 2022. The SWPPP will include construction period best management practices that will be implemented to meet the Order of Conditions issued by the Bourne Conservation Commission under the Massachusetts Wetlands Protection Act (310 CMR 10.00). The minimum practices required in the SWPPP will include the following:

- Installation of sediment controls along the top of the bank of Cape Cod Canal and inland wetland resource areas, such as silt fence and/or compost filter tubes
- Stabilized construction exits to prevent sediment tracking from the work area onto public ways
- Site-specific construction phasing plans to minimize the extent of the disturbance at any one time
- Soil stockpile protection including temporary erosion measures and perimeter controls
- Dust suppression including watering
- Good housekeeping pollution prevention measures, including secondary containment
- Maintenance requirements
- Temporary and permanent stabilization requirements
- Recordkeeping/inspection requirements

4.10.7.2 Operational Impacts

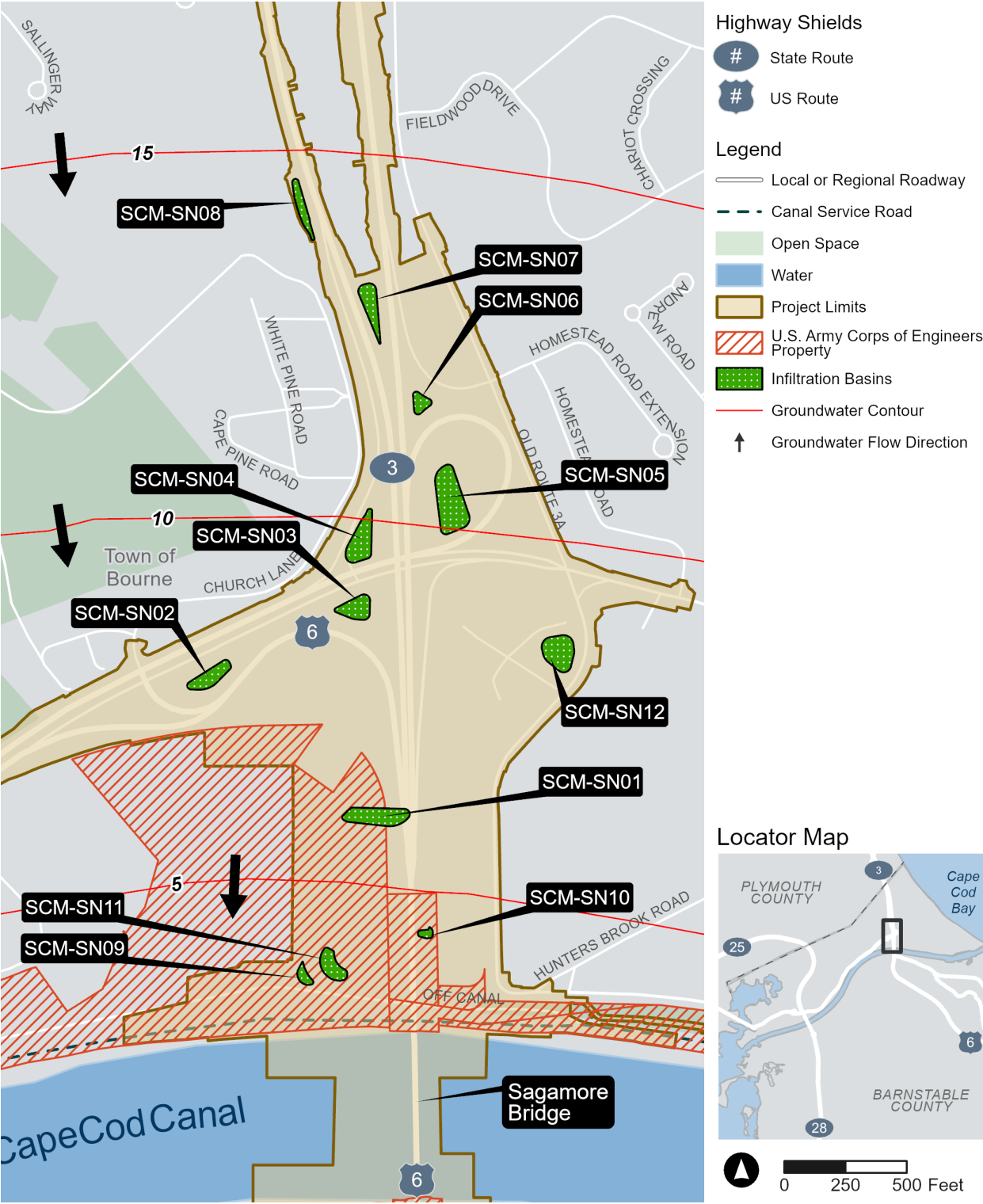
This section discusses mitigation measures that will be implemented to avoid and minimize the potential for adverse operational effects of the Build Alternative on groundwater, surface water, and stormwater runoff. The proposed stormwater management system for the Build Alternative will be designed to comply with the Massachusetts Stormwater Management Standards, as enforced through the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and the 401 Water Quality Certification Regulations (314 CMR 9.00). The general stormwater treatment methodology prioritizes the use of low-impact, green infrastructure, such as rain gardens and infiltration basins, to meet the required targets for peak rate attenuation, recharge, and water quality treatment including total suspended solids, Nitrogen, Phosphorus, Metals, and Pathogens removal for the Build Alternative. The following sections describe each SCM, including its intended use for the Build Alternative.

Figure 4.10-11 through Figure 4.10-14 illustrate the potential locations of SCMs within the Study Area.

Infiltration Basin

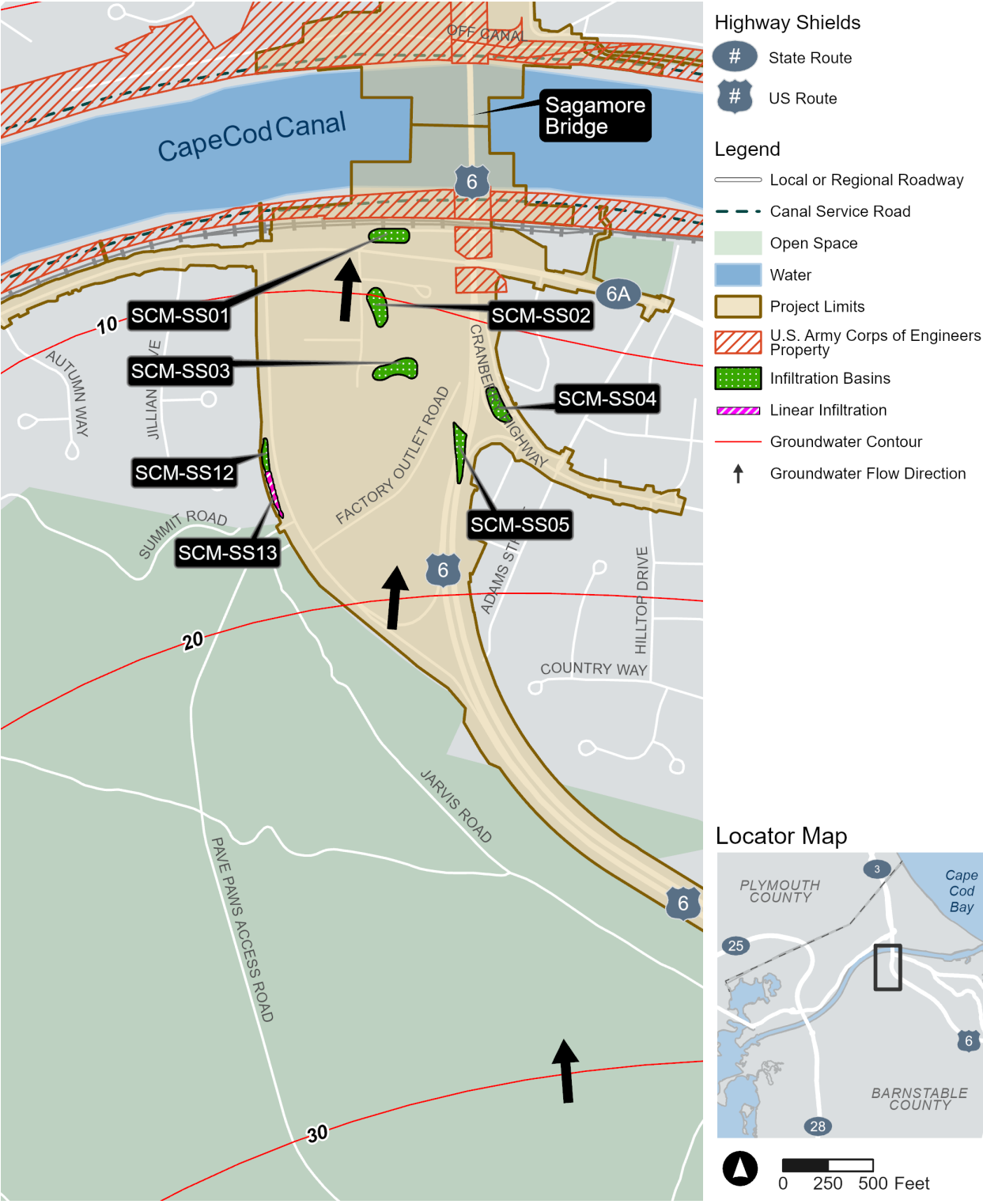
Infiltration basins will be used to treat stormwater runoff from the proposed bridges and approach roadway systems. Each basin will be designed to hold the required recharge volume, allowing stormwater to filter through the subsurface, which removes pollutants, prior to reaching groundwater. Runoff from larger storm events will discharge through an outlet control structure, enter a collector pipe, and eventually discharge either to Cape Cod Canal via pipe outfall or to the groundwater via infiltration through the soils. Linear infiltration will be used as a retrofit technique to transform existing conveyance swales and ditches into stormwater treatment practices. Linear infiltration will also be used when physical constraints preclude the use of infiltration basins. Infiltration is considered a goal of many Low Impact Development techniques. **Exhibit 4.10-7** illustrates a typical infiltration basin with sediment forebay.

Figure 4.10-11. Potential Stormwater Control Measures (Sagamore North Quadrant)



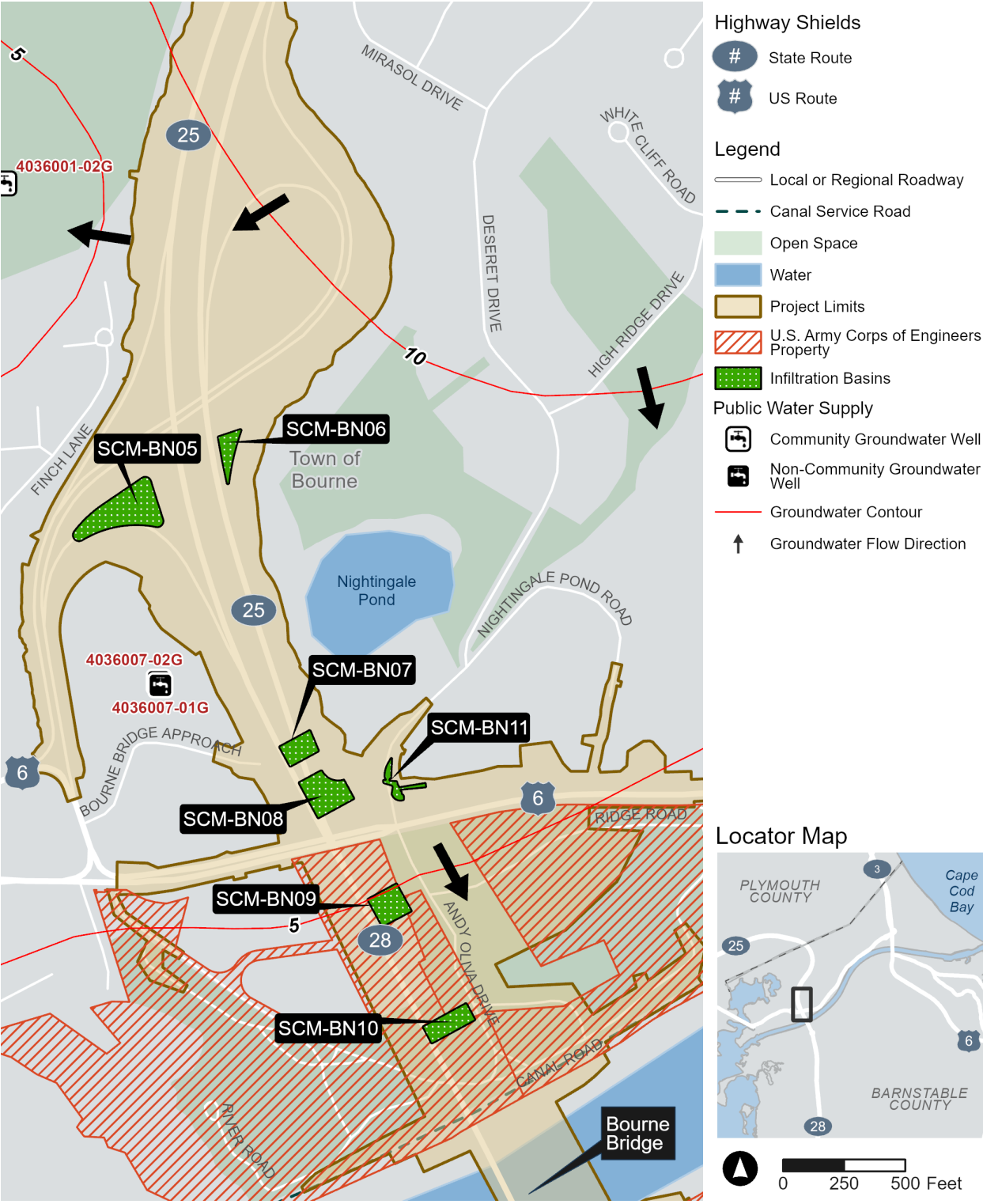
Source: Massachusetts Department of Transportation, 2026

Figure 4.10-12. Potential Stormwater Control Measures (Sagamore South Quadrant)



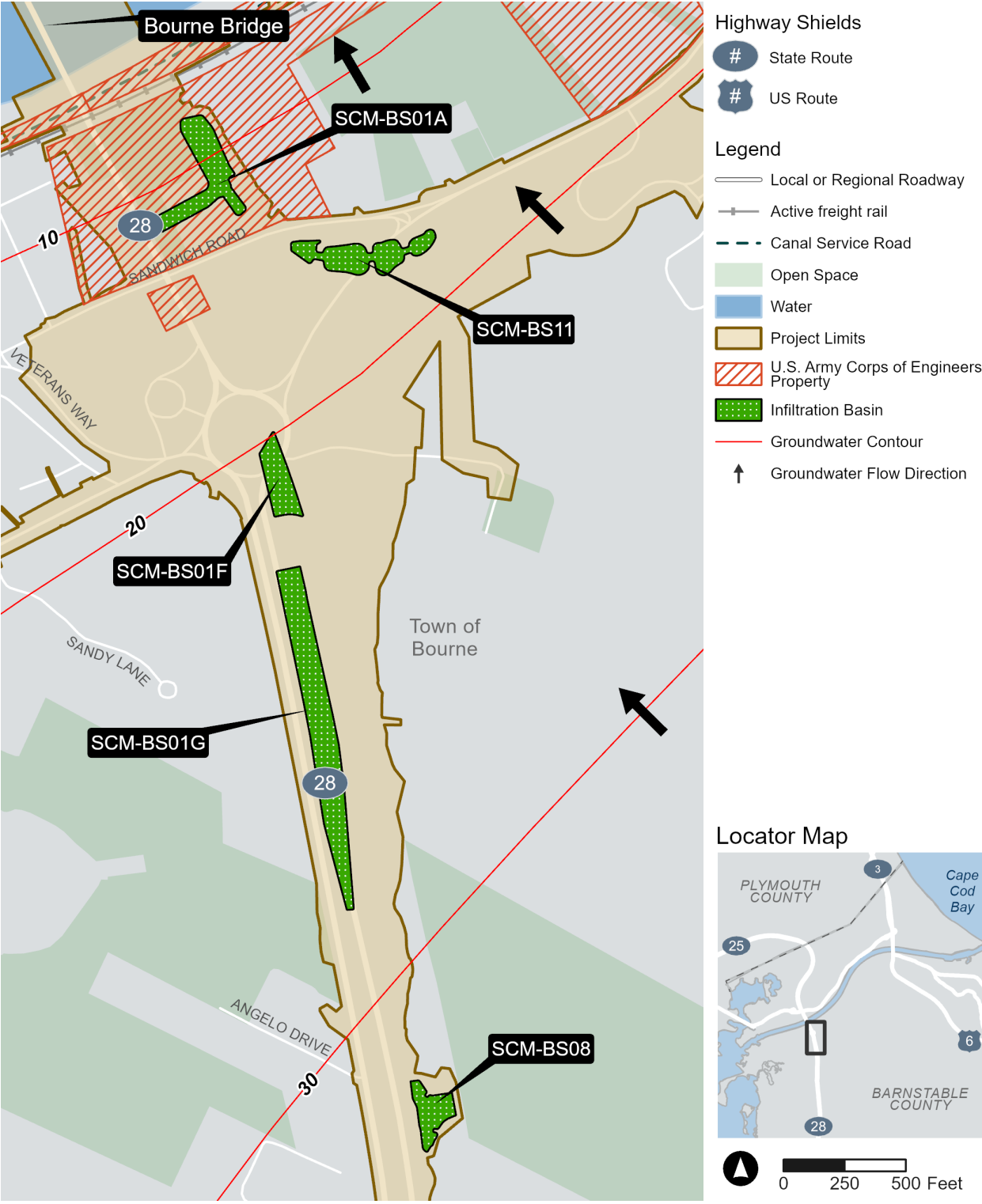
Source: Massachusetts Department of Transportation, 2026

Figure 4.10-13. Potential Stormwater Control Measures (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2026

Figure 4.10-14. Potential Stormwater Control Measures (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2026

Exhibit 4.10-7. Typical Infiltration Basin with Sediment Forebay



Source: Massachusetts Department of Transportation, September 2013