

4 Affected Environment, Environmental Consequences, and Mitigation

4.1 Introduction

This chapter describes the existing social, economic, and environmental conditions that may be affected by the alternatives retained for detailed study in this [Final](#) Environmental Impact Statement. It also presents the expected beneficial and adverse social, economic, and environmental effects of the alternatives, including measures to avoid, minimize, and mitigate adverse effects, where applicable.

The analysis in this chapter covers a range of environmental resources and topics, as listed in [Table 4.1-1](#). Each section identifies a resource-specific study area or study areas to define the geographic extents of the assessment. As indicated in [Table 4.1-1](#), sections of this chapter reference technical reports that present additional details on the methodologies, analyses, and findings related to the subject matter.

Table 4.1-1. Environmental Resources and Topics Assessed in Chapter 4

Chapter Section	Environmental Resources and Topics	Appendix
4.2	Transportation, Traffic, and Safety	4.2, Traffic Engineering Technical Report
4.3	Pedestrian and Bicycle Facilities	None
4.4	Maritime Transportation, Traffic, and Safety	4.4, Maritime Transportation, Traffic, and Safety
4.5	Socioeconomics	4.5, Socioeconomics Technical Report
4.6	Land Use, Zoning, and Community Cohesion	4.6, Land Use, Zoning, and Community Cohesion Technical Report
4.7	Community Facilities	None
4.8	Property Acquisition, Displacement, and Relocation	None
4.9	Wetlands and Floodplains	4.9, Wetlands and Floodplains Technical Report
4.10	Water Quality and Stormwater	4.10, Water Quality and Stormwater Technical Report
4.11	Threatened, Endangered, and Protected Species and Habitats	4.11, Threatened, Endangered, and Protected Species and Habitats Material
4.12	Coastal Zone Consistency	None
4.13	Air Quality	4.13, Air Quality Technical Report
4.14	Noise and Vibration	4.14, Noise and Vibration Technical Report
4.15	Visual Resources	4.15, Visual Impact Assessment
4.16	Cultural Resources	4.16, Cultural Resources Technical Report
4.17	Public Parks, Recreational Facilities, and Open Space	None

Chapter Section	Environmental Resources and Topics	Appendix
4.18	Solid and Hazardous Waste Material Management	4.18, Solid and Hazardous Waste Material Management Technical Report
4.19	Utilities and Services	None
4.20	Public Health	None
4.21	Adaptation and Resiliency	None
4.22	Indirect Effects	4.22, Assessment of Induced Demand and Induced Development

As indicated in [Section 3.4.4, Summary of the Preferred Alternative Refinements](#), following the publication of the Draft Environmental Impact Statement, MassDOT refined the Preferred Alternative in response to public and agency comments, further development of preliminary design, and additional coordination with agencies and community stakeholders. Additionally, MassDOT revised the Project Limits, defined as the construction and operational footprints of the Sagamore and Bourne Bridge Projects, to incorporate further development of preliminary design and mitigation measures proposed in compliance with Section 4(f) of the U.S. Department of Transportation Act of 1966 (Section 4(f)).

[Table 4.1-2](#) summarizes the Preferred Alternative's revised environmental impacts reported in the Final Environmental Impact Statement compared to those reported in the Draft Environmental Impact Statement. These revisions reflect changes resulting from interchange approach network refinements, and pedestrian and bicycle improvements, and further development of preliminary design. [Table 4.1-2](#) also identifies environmental impacts associated with proposed improvements to recreational resources that are being implemented as mitigation measures for impacts to Section 4(f) properties. References to the applicable sections within **Chapter 4** are provided for additional detailed information.

Table 4.1-2. Summary of the Preferred Alternative Revised Environmental Effects

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect^[1]	Change	Reason for Change
4.2, Transportation, Traffic and Safety	Transportation (Commuter Parking)	Permanent loss of 17 parking spaces within MassDOT's Bourne Park and Ride Lot	Permanent loss of 12 parking spaces within MassDOT's Bourne Park and Ride Lot	Decrease of 5 parking spaces permanently lost	Revised grading between Scenic Highway and the north end of the park and ride lot has reduced the overall area of impact.
	Transportation (Rail Operations)	Periodic service disruptions to freight and seasonal passenger rail services along the Cape Main Line during construction	Periodic service disruptions to freight and seasonal passenger rail services along the Cape Main Line during construction	No Change	N/A
	Transportation (Rail Transit Facilities)	Relocation of Bourne Train Station on the Cape Main Line	Relocation of Bourne Train Station on the Cape Main Line	No Change	N/A
	Traffic Operations	The 2050 Build Alternative would reduce total vehicle hours traveled in the Traffic Focus Area during the fall PM peak hour by 22% compared to the 2050 No Build Alternative	The 2050 Build Alternative would reduce total vehicle hours traveled in the Traffic Focus Area during the fall PM peak hour by 26% compared to the 2050 No Build Alternative	The 2050 Build Alternative would reduce total vehicle hours traveled in the Traffic Focus Area by 4% compared to the 2050 No Build Alternative	Intersection control design refinements have been incorporated to improve traffic flow and enhance overall intersection efficiency.

¹ All quantifiable effects and impacts listed are approximate.

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[2]	Change	Reason for Change
	Traffic Safety	Predicted crash reductions of up to 48% on the Sagamore and Bourne Bridges	Predicted crash reductions of up to 48% on the Sagamore and Bourne Bridges	No Change	N/A
4.3, Pedestrian and Bicycle Facilities	Pedestrian and bicycle facilities	Temporary closures of sections of Canal Service Road, Scenic Highway, and Sandwich Road during construction	Temporary closures of sections of Canal Service Road, Scenic Highway, and Sandwich Road during construction	Minor changes	Design refinements
4.4, Maritime Transportation, Traffic, and Safety	Cape Cod Canal	Temporary construction equipment and/or vessel encroachment into the 480-foot federal navigation channel	Temporary construction equipment and/or vessel encroachment into the 480-foot federal navigation channel	No Change	N/A
		Six short-term, full closures of the Canal during Construction	Six short-term, full closures of Cape Cod Canal during construction	No Change	N/A
4.5, Socioeconomics	Households and Businesses within Cape Cod and Islands.	- Net increase in economic output, jobs, and labor income in the permanent condition - Increase in noise levels generated by construction vehicles and construction equipment. - Construction-induced vibration annoyance	- Net increase in economic output, jobs, and labor income in the permanent condition - Increase in noise levels generated by construction vehicles and construction equipment. - Construction-induced vibration annoyance	No Change	N/A

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[1]	Change	Reason for Change
4.6, Land Use, Zoning, and Community Cohesion	Land Alteration	306.39	328.10 acres	+21.71 acres	New sidewalk and shared-use path installation and addition of Section 4(f) mitigation areas
	Impervious Area	50.84 acres	52.29 acres	+1.45 acres	New sidewalk and shared-use path installation
	Tree Clearing	132.14 acres	146.77 acres	+14.63 acres	Addition of Section 4(f) mitigation areas
4.7, Community Facilities	Community facilities	Potential temporary and permanent impacts to community facilities. Property impacts not reported.	Four temporary easements, two permanent easements, and two partial, permanent acquisitions from properties containing community facilities.	Updated discussion of direct impacts	Design refinements
4.8, Property Acquisition, Displacement, and Relocation	Full Property Acquisitions	28	30	+2 properties	Design refinements
	Partial Property Acquisitions	34	59	+25 properties	Design refinements
	Property Easements	114	143	+29 easements	Design refinements
	Residential Displacements	14	17	+3	Property owner interviews
	Commercial Displacements	3	7	+5	Property owner interviews

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[1]	Change	Reason for Change
4.9, Wetlands and Floodplains	Federal Vegetated Wetlands ²	2,040 sf	6,350 sf	+4,310 sf	Design refinements
	Tidal Navigable Waters of the United States	450,950 sf	166,300 sf	-284,650 sf	Design refinements: Installation of riprap pier protection system Elimination of double counting
	Floodplain	2,130 cubic feet	2,130 cubic feet	No change	N/A
4.10, Water Quality and Stormwater	New Impervious Area	50.9 acres	52.3 acres	+1.4 acres	New sidewalk and shared-use path installation
4.11, Threatened, Endangered, and Protected Species and Habitats	Zone of Marine Disturbance	7.88 acres	9.28 acres	1.41 acres	Design refinements: installation of riprap pier protection system
	Natural Heritage Endangered Species Program Priority Habitat	10.65 acres	7.36 acres	-3.29 acres	Reduced Project Limits to edges of Priority Habitat

² Includes Isolated Vegetated Wetlands. No Wetlands Protection Act variance needed.

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[2]	Change	Reason for Change
4.12, Coastal Zone Consistency	Coastal zone resources	Potential permanent and temporary effects to wetlands and floodplain, federal and state-protected species and habitats, protected areas, water supply areas, and public recreation areas (refer to Sections 4.9, 4.10, 4.11, and 4.17)	Potential permanent and temporary effects to wetlands and floodplain, federal and state-protected species and habitats, protected areas, water supply areas, and public recreation areas (refer to Sections 4.9, 4.10, 4.11, and 4.17)	No Change	N/A
4.13, Air Quality	Localized Carbon Monoxide (CO) emissions	The 2050 Build Alternative would decrease total vehicle hours traveled in the Traffic Focus Area by 22% during the fall PM peak hour compared to the 2050 No Build Alternative	The 2050 Build Alternative would decrease total vehicle hours traveled in the Traffic Focus Area by 26% during the fall PM peak hour compared to the 2050 No Build Alternative	An additional 4% decrease in total vehicle hours traveled is expected to further reduce localized CO emissions.	Updated traffic modeling incorporating preferred intersection control types.
	Mesoscale regional emissions	The 2050 Build Alternative is expected to decrease daily VMT and VHT compared to the 2050 No Build Alternative, leading to reduced daily emissions of CO, nitrogen oxide, and particulates (PM10 and PM2.5).	The 2050 Build Alternative is expected to decrease daily vehicle miles traveled and vehicle hours traveled compared to the 2050 No Build Alternative, leading to reduced daily emissions of CO, nitrogen oxide, and particulates (PM10 and PM2.5).	No change	N/A

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[1]	Change	Reason for Change
	Mobile-Source Air Toxics (MSAT)	Low potential MSAT effects because design year traffic is projected to be less than 140,000 to 150,000 annual average daily traffic	Low potential MSAT effects because design year traffic is projected to be less than 140,000 to 150,000 annual average daily traffic	No change	N/A
	Construction Period Air Quality	Qualitative assessment of short-term increases in air pollutants during construction from ground disturbance, demolition, and equipment emissions	Additional pollutant emissions from construction related diesel truck trips and marine vessel activity	Annual emissions are below EPA <i>de minimis</i> emission threshold rates for each criteria pollutant	Quantitative assessment of projected annual pollutant emissions from construction-related diesel truck and marine vessel trips conducted for the FEIS
4.14, Noise and Vibration	Highway Traffic Noise	A total of 57 noise sensitive receptors would be impacted by projected traffic noise levels under the 2050 Build Alternative: • Sagamore North: 9 • Sagamore South: 45 • Bourne North: 2 • Bourne South: 1	A total of 57 noise sensitive receptors would be impacted by projected traffic noise levels under the 2050 Build Alternative: • Sagamore North: 9 • Sagamore South: 45 • Bourne North: 9 • Bourne South: 2	8 additional noise sensitive receptors would be impacted by projected traffic noise levels under the 2050 Build Alternative	New development in Bourne North since DEIS publication and extension of the Project Limits in Bourne South

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[1]	Change	Reason for Change
	Construction Noise	Qualitative assessment of construction noise emissions levels based on equipment type at standard referenced distances	Construction noise levels at noise-sensitive sites exceeding one or more of MassDOT's construction noise limits (daytime/evening/nighttime): • Sagamore North: 44/134/156 • Sagamore South: 24/116/144 • Bourne North: 49/196/207 • Bourne South: 77/122/121	Program wide: 194/568/628	Construction noise quantitative analysis conducted for the FEIS
	Construction vibration	Potential for structural damage and exceedances of Federal Transit Administration (FTA) land-use category annoyance thresholds during construction based on the distance between vibration generating construction activities and nearby receptors	Potential for structural damage and exceedances of Federal Transit Administration (FTA) land-use category annoyance thresholds during based on the distance between vibration generating construction activities and nearby receptors	Distances established for vibration annoyance	Additional analysis conducted for FEIS

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect^[2]	Change	Reason for Change
<u>4.15, Visual Resources</u>	<u>Visual Inventory Locations</u>	<u>Changes:</u> • <u>4 beneficial</u> • <u>11 neutral</u> • <u>2 adverse</u> • <u>17 locations</u>	<u>Changes:</u> • <u>5 beneficial</u> • <u>13 neutral</u> • <u>2 adverse</u> • <u>21 locations</u>	<u>+1 beneficial and +2 neutral changes</u>	<u>Design refinements; addition of Section 4(f) mitigation areas</u>
<u>4.16, Cultural Resources</u>	<u>National Register-eligible Sagamore and Bourne Bridges</u>	<u>Permanent loss of bridges through demolition</u>	<u>Permanent loss of bridges through demolition</u>	<u>No change</u>	<u>N/A</u>
<u>4.17, Public Parks, Recreational Facilities, and Open Space</u>	<u>Sagamore Recreation Area</u>	• <u>Temporary occupancy of 0.53 acres</u> • <u>Direct use of 0.51 acres</u>	• <u>Temporary occupancy of 0.88 acres</u> • <u>Direct use of 0.49 acres</u>	<u>+ 0.35 acres for temporary occupancy and - 0.02 acres for direct use</u>	<u>Design refinements</u>
	<u>Keith Field Recreation Area</u>	<u>Direct use of 0.37 acres</u>	• <u>Temporary occupancy of 0.09 acres</u> • <u>Direct use of 0.12 acres</u>	• <u>+ 0.09 acres for temporary occupancy</u> • <u>- 0.25 acres for direct use</u>	<u>Design refinements</u>
	<u>Bourne Scenic Park</u>	• <u>Temporary occupancy of 14.7 acres</u> • <u>Direct use of 5.7 acres</u>	• <u>Temporary occupancy of 28.5 acres</u> • <u>Direct use of 6.3 acres</u>	• <u>+ 13.8 acres for temporary occupancy</u> • <u>+ 0.6 acres for direct use</u>	<u>Design refinements</u>
	<u>Bourne Recreation Area</u>	<u>Direct use of 4.1 acres</u>	<u>Direct use of 4.1 acres</u>	<u>No change</u>	<u>N/A</u>

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect^[1]	Change	Reason for Change
	Gallo Ice Arena	• Temporary occupancy of 2.3 acres • Direct use of 3.75 acres	• Temporary occupancy of 2.3 acres • Direct use of 3.83 acres	+ 0.08 acres for direct use	Design refinements
4.18, Solid and Hazardous Waste Material Management	Demolition waste, including steel, rebar, and concrete	• Sagamore Bridge: 75,830 tons • Bourne Bridge: 103,255 tons	• Sagamore Bridge: 75,830 tons • Bourne Bridge: 103,255 tons	No change	N/A
	Excavated material	• Sagamore Bridge: 1,149,000 cubic yards • Bourne Bridge: 1,051,000 cubic yards	• Sagamore Bridge: 1,149,000 cubic yards • Bourne Bridge: 1,051,000 cubic yards	No Change	N/A
	Fill material	• Sagamore Bridge: 376,000 cubic yards • Bourne Bridge: 595,000 cubic yards	• Sagamore Bridge: 376,000 cubic yards • Bourne Bridge: 595,000 cubic yards	No Change	N/A
4.19, Utilities and Services	Water, sewer/septic, gas, electrical and telecommunications services	• Permanent relocation and replacement of certain utilities • Temporary effects during construction	• Permanent relocation and replacement of certain utilities • Temporary effects during construction	No Change	N/A

FEIS Section	Environmental Resource or Topic	DEIS Effect	FEIS Effect ^[2]	Change	Reason for Change
4.20, Public Health	Health-related effects	The Build Alternative would generate temporary construction noise and vibration. Best Management Practices (BMPs) would be implemented to avoid or minimize public disturbance. Hazardous materials, air quality, and water quality considerations would be managed through regulatory compliance and BMPs.	The Build Alternative would generate temporary construction noise and vibration. Best Management Practices (BMPs) would be implemented to avoid or minimize public disturbance. Hazardous materials, air quality, and water quality considerations would be managed through regulatory compliance and BMPs.	No Change	N/A
4.21, Adaptation and Resiliency	Sea level/storm surge	- Potential for submerged or partially submerged outfalls and infiltration basins in the permanent condition - Potential for flooding of roadways, evaluation routes, and shared-use paths in the permanent condition	- Potential for submerged or partially submerged outfalls and infiltration basins in the permanent condition - Potential for flooding of roadways, evaluation routes, and shared-use paths in the permanent condition	No Change	N/A
	Winter weather	Potential for winter weather icing on the bridges in the permanent condition	Potential for winter weather icing on the bridges in the permanent condition	No Change	N/A
4.22, Indirect Effects	Environmental effects	Potential introduction of invasive plant species	Potential introduction of invasive plant species	No Change	N/A