4 Affected Environment, Environmental Consequences, and Mitigation

4.14 Noise and Vibration

4.14.1 Introduction

This section assesses the future highway traffic noise impacts of both the Build Alternative and the No Build Alternative on sensitive receptors, allowing for a comparison of projected noise conditions with and without the proposed improvements. Noise abatement was evaluated for locations where highway traffic noise impacts are identified. This section also evaluates the potential construction noise and vibration impacts associated with the Build Alternative. The analysis considers short-term noise generated by construction equipment and activities, as well as the potential for ground-borne vibration to affect nearby sensitive receptors. The impacts would be minimized through use of established best-practice mitigation measures. Details supporting these findings are provided in the following sections, which describe the analytical methods used, the predicted noise and vibration impacts, and the mitigation measures proposed to minimize those impacts.

4.14.1.1 Resource Definition

- Noise is generally defined as sound that is undesirable because it interferes with speech, causes sleep disturbance, or is otherwise annoying (unwanted sound). The individual human response to noise is subject to considerable variability because there are many emotional and physical factors that contribute to the differences in reaction to noise.
- Vibration is an oscillatory motion, which can be described in terms of displacement, velocity, or acceleration. Displacement refers to the distance an object has moved from its equilibrium position during vibration. Velocity represents the speed at which the object is moving during vibration. Acceleration describes the rate at which the velocity of a vibrating object changes over time. Construction activity can generate varying degrees of ground-borne vibration, depending on the equipment and methods employed, distance between source and receptor, duration, and subsurface conditions.
- Sensitive receptors are defined as land uses that are considered sensitive to noise and vibration impacts. Examples of noise-sensitive receptors include residences, schools, hospitals, libraries, places of worship, hotels, television and recording studios, and passive recreation areas. Vibration-sensitive receptors are generally the same as noise-sensitive receivers but may also include buildings in poor structural condition, and businesses, such as research facilities and laboratories that use vibration-sensitive equipment.

4.14.1.2 Regulatory Context

The Cape Cod Bridges Program is classified as a Type I project[1] in accordance with the following:

- Federal Highway Administration's (FHWA) Noise Regulations (23 Code of Federal Regulations [CFR] 772) — Procedures for Abatement of Highway Traffic Noise and Construction Noise[2]
- Massachusetts Department of Transportation's (MassDOT) Noise Abatement Policies (effective July 13, 2011)[3]

FHWA Noise Regulation 23 CFR 772 and MassDOT's Noise Abatement Policies require that traffic noise levels associated with Type I projects are calculated, the results are compared to the noise abatement criteria, and, if noise impacts are identified, noise mitigation measures are evaluated to reduce noise impacts in a study area. Type 1 projects also require analysis of construction noise and abatement measures and prediction of noise impacts on undeveloped lands to inform local officials on land use compatible planning.

No FHWA regulations are specific to construction-related vibration. MassDOT derived guidance for the assessment of construction-related vibration effects from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual.[4]

4.14.1.3 Methodology and Study Area

Noise Study Areas

The Project Limits have been refined since publication of the Draft Environmental Impact Statement. The Noise Study Areas extend approximately 500 feet beyond the refined Project Limits of the Build Alternative at Sagamore and Bourne Bridges. Within each Noise Study Area, Common Noise Environments (CNE) were delineated, which are groups of receptors (e.g., homes, businesses, parks, schools) that are exposed to similar noise sources and levels. Factors considered in the identification of CNEs included traffic volumes, topographic features, and secondary noise sources, such as interchanges, cross-roads, and intersections.

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[1] A Type I project is a project that involves (1) The construction of a highway on new location; (2) The physical alteration of an existing highway where there is either a substantial horizontal alteration or a substantial vertical alteration; (3) The addition of a through traffic lane(s); (4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; (5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; (6) Restriping existing pavement for the purpose of adding a through traffic lane or an auxiliary lane; or, (7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

[2] Federal Highway Administration. 2011. Procedures for Abatement of Highway Traffic Noise and Construction Noise. July. https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772

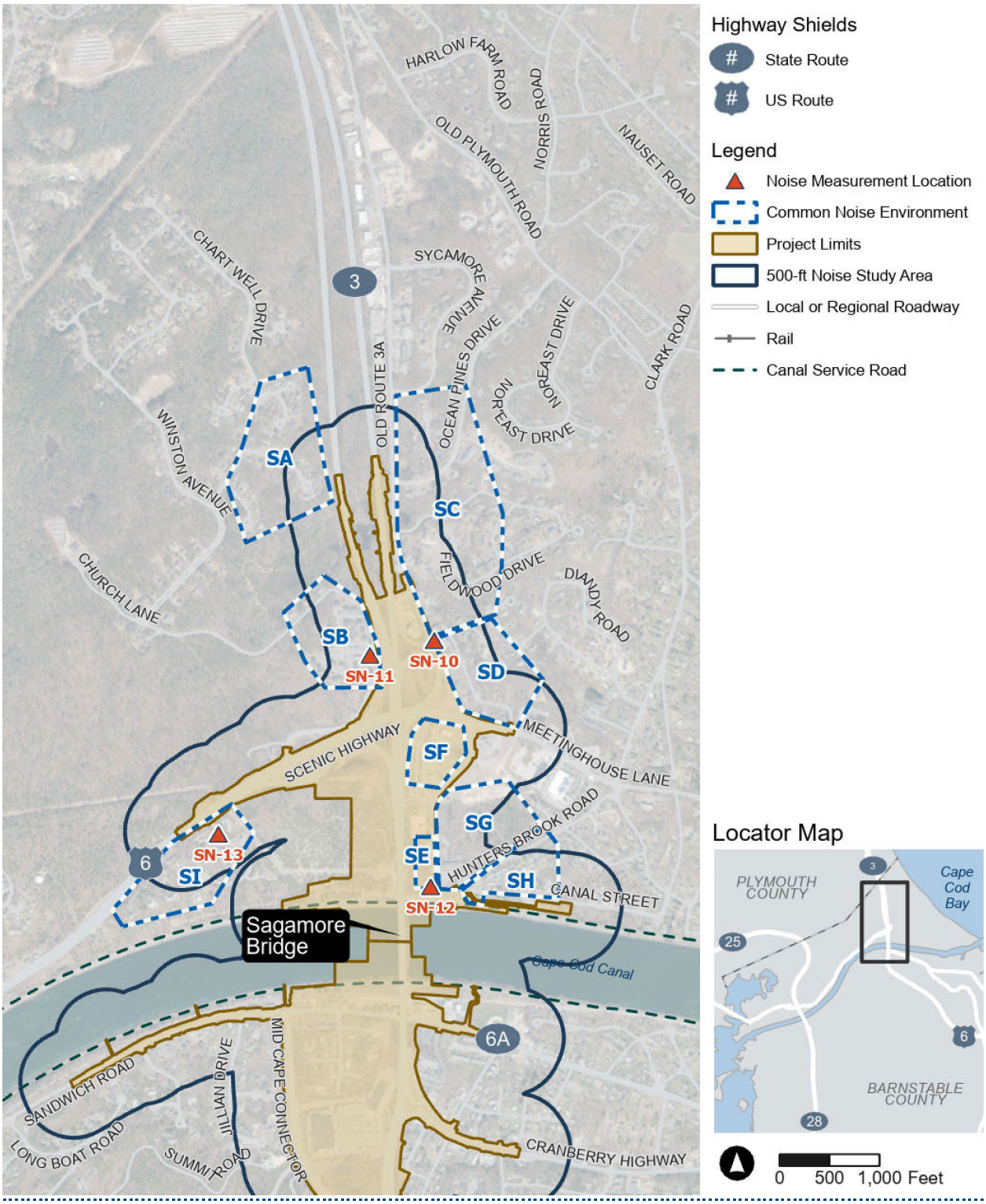
[3] Massachusetts Department of Transportation. 2011. Type I and Type II Noise Abatement Policies and Procedures. July. https://studylib.net/doc/13043513/massachusetts-department-of-transportation-type-i-and-typ...

[4] Federal Transit Administration. 2018. Transit Noise and Vibration Impact Assessment Manual. September. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf

Noise-sensitive land uses within the Noise Study Areas were grouped into a total of 34 CNEs and included primarily single- and multi-family residential developments. Other noise-sensitive land uses that were identified within the Noise Study Areas include parks and recreation areas, and schools, restaurants, and hotels with exterior use areas.

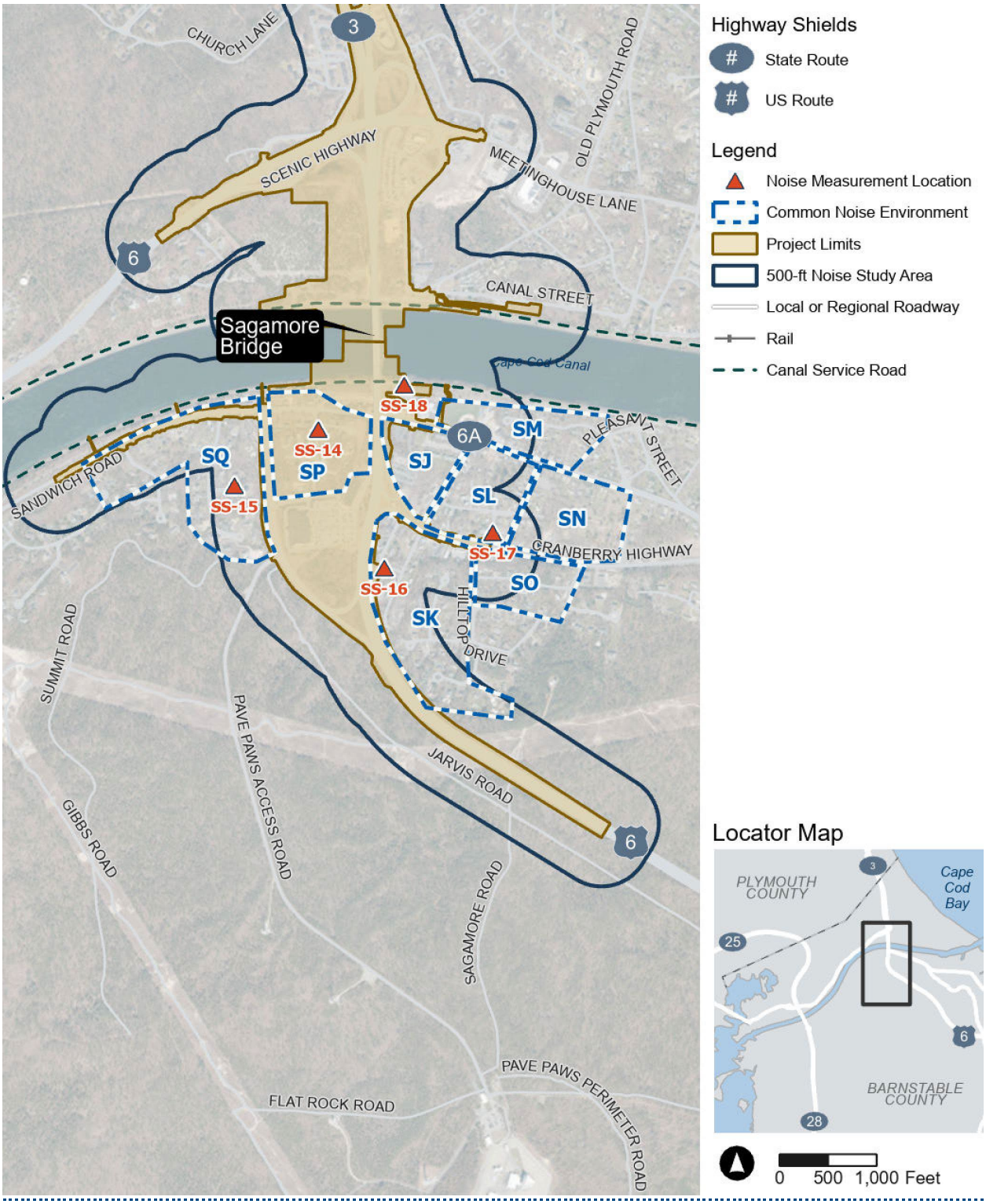
Figure 4.14-1 through Figure 4.14-4 illustrate the boundaries of the identified CNEs within the Noise Study Areas. These figures also provide the locations of 18 noise measurement sites where MassDOT conducted a noise measurement program to document existing ambient noise levels. The measurement sites are represented by orange triangles on the figures. **Appendix 4.14, Noise and Vibration Technical Report**, provides detailed descriptions of each CNE, including noise-sensitive land use within those boundaries, and additional details related to the noise measurement program.

Figure 4.14-1 Common Noise Environment Boundaries and Noise Measurement Locations (Sagamore North Quadrant)



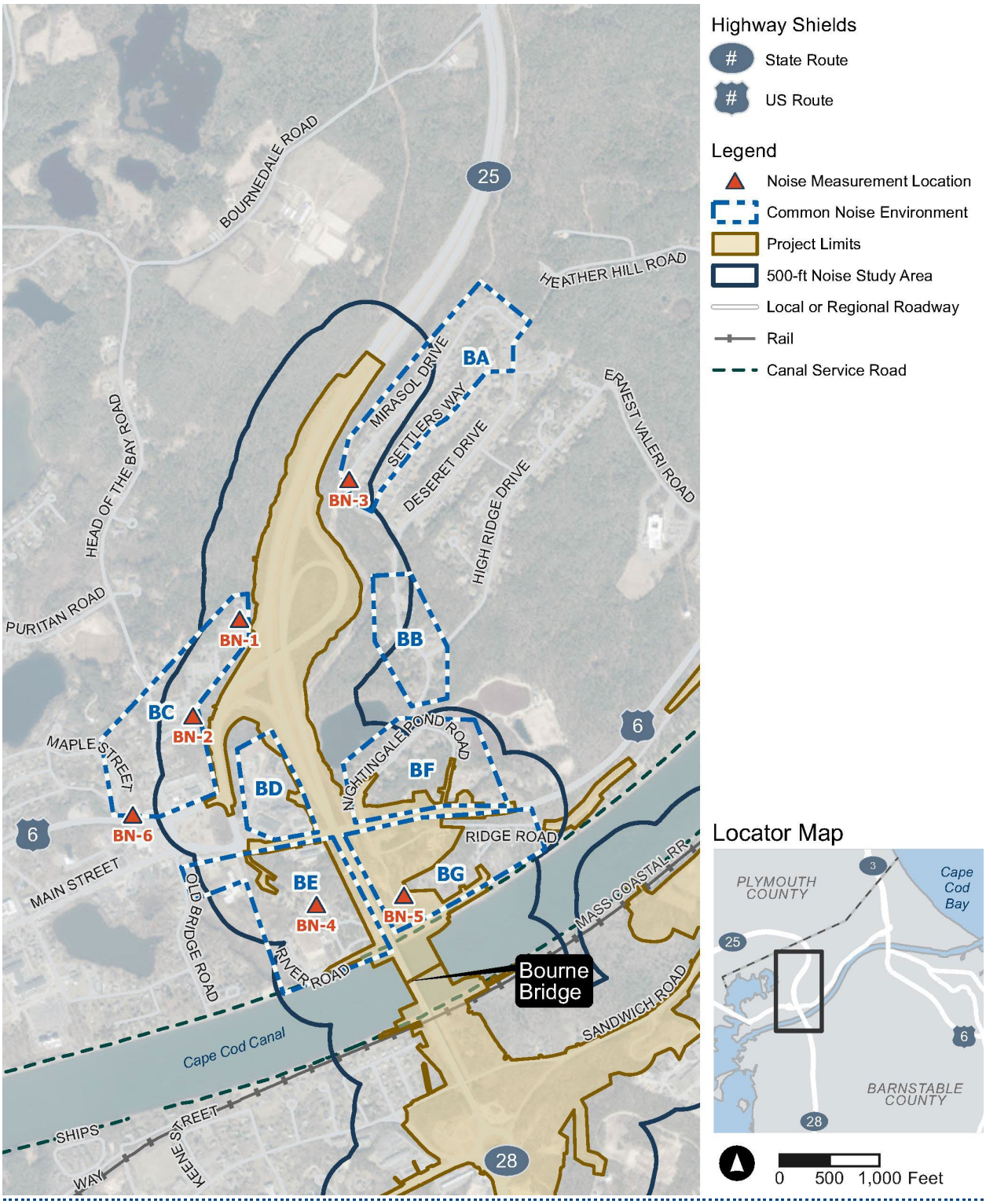
Source: Massachusetts Department of Transportation, 2025

Figure 4.14-2. Common Noise Environment Boundaries and Noise Measurement Locations (Sagamore South Quadrant)



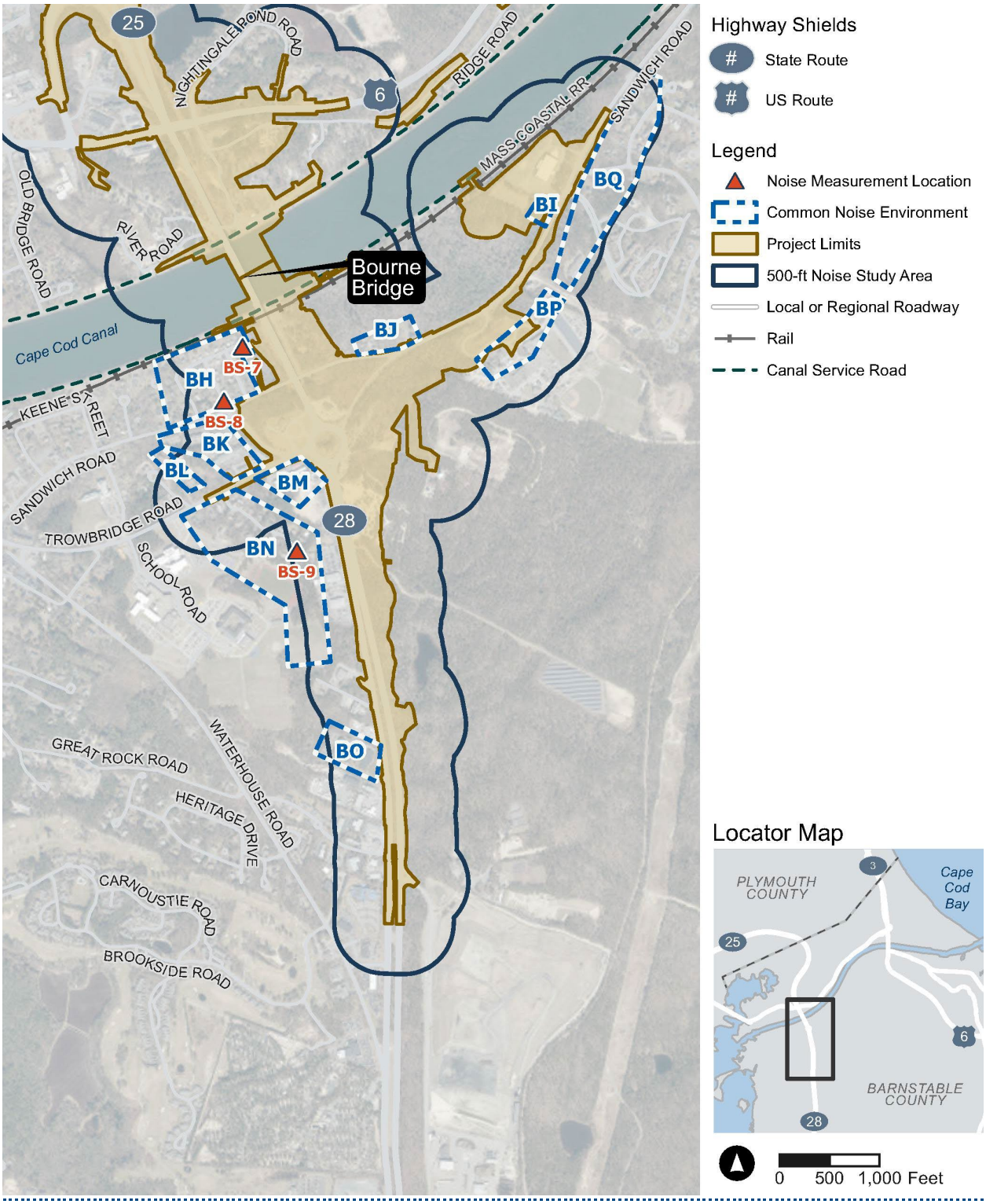
Source: Massachusetts Department of Transportation, 2025

Figure 4.14-3. Common Noise Environment Boundaries and Noise Measurement Locations (Bourne North Quadrant)



Source: Massachusetts Department of Transportation, 2025

Figure 4.14-4. Common Noise Environment Boundaries and Noise Measurement Locations (Bourne South Quadrant)



Source: Massachusetts Department of Transportation, 2025

Operational Traffic Noise Methodology

The operational traffic noise analysis involved monitoring existing noise conditions to validate the project-specific noise model and modeling existing 2019 and future 2050 No Build Alternative and Build Alternative noise conditions with the FHWA-approved computerized Traffic Noise Model, version 2.5 (TNM). MassDOT conducted the noise analysis using traffic data that was representative of the Loudest Traffic Hour (LTH), which was identified as the AM traffic peak hour for all Noise Study Areas except the Sagamore North quadrant where the LTH was identified as the PM peak traffic hour. MassDOT used existing 2019 Fall AM and PM peak-hour traffic data to evaluate existing noise levels within the Noise Study Areas. MassDOT used future 2050 Fall AM and PM peak-hour traffic data to evaluate No Build Alternative and Build Alternative noise levels. Traffic noise impacts were assessed for different categories of noise-sensitive land use using the FHWA Noise Abatement Criteria (NAC), as presented in **Table 4.14-1**.

Table 4.14-1. Federal Highway Administration Noise Abatement Criteria

Activity Category	Leq(h)[a]	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B[b]	67 (Exterior)	Residential
C[b]	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[b]	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F[c]	—	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G[c]	—	Undeveloped lands that are not permitted (without building permits)

Source: FHWA, "Procedures for Abatement of Highway Traffic Noise and Construction Noise" (23 Code of Federal Regulations 772, as amended 75 FR 39820, July 13, 2010; Effective date July 13, 2011). https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772

[a] Hourly Equivalent A-weighted Sound Level (dBA)

[b] Includes undeveloped lands permitted for this category

[c] "—" indicates no Noise Abatement Criteria value established by the Federal Highway Administration and Massachusetts Department of Transportation

Traffic noise impact occurs when the predicted future Design Year noise levels approach (within 1 dBA) or exceed the FHWA NAC levels presented in **Table 4.14-1**, or when future Design Year predicted noise levels substantially exceed the existing noise levels. MassDOT defines "substantially exceed" as a 10 dB increase in Design Year noise levels, relative to existing noise levels.

When traffic noise impacts are identified, noise abatement must be considered and evaluated for feasibility and reasonableness. For this traffic noise study, MassDOT evaluated noise abatement in the form of noise barriers (**Section 4.14.5.1**). Refer to **Appendix 4.14, Noise and Vibration Technical Report,** for additional details on operational traffic noise methodology.

Construction Noise and Vibration Methodology

MassDOT conducted a construction noise analysis to determine potential impacted receptors, describe potential ranges in construction noise levels, and identify measures to be included in project plans and specifications.

MassDOT derived guidance for the assessment of construction-related vibration effects from the FTA's guidance manual. A quantitative construction vibration assessment was conducted to identify distances within which there would be a potential for vibration-induced structural damage and annoyance from heavy construction activities.

Refer to **Appendix 4.14, Noise and Vibration Technical Report,** for additional details on the construction noise and vibration analysis methodology.

4.14.2 Affected Environment

Based on short-term noise measurements conducted in May 2023, the dominant source of noise in the Noise Study Areas was vehicular traffic from automobiles and trucks on State Route 3, U.S. Route 6, State Route 25, and other major arterials.

According to FHWA and MassDOT policies, the accuracy of the noise prediction model must be verified on a project-by-project basis. Therefore, noise model validation was conducted to compare field-measured noise levels to predicted noise levels using the FHWA TNM with field-documented traffic volumes, speeds, and vehicle types, as well as existing horizontal and vertical roadway geometries. At all 18 measurement sites, the differences between measured and predicted noise levels were within the +/-3 dB(A) tolerance allowed by FHWA. Therefore, the existing noise model is considered validated, and existing condition year 2019 LTH volumes and vehicle types were used to predict existing noise levels at additional receptors in the Noise Study Areas.

Table 4.14-2 and **Table 4.14-3** summarize 2019 existing condition noise levels and the number of receptors predicted to approach or exceed the Activity Categories B and C NAC of 67 dBA Leq and the Activity E Category NAC of 72 dBA Leq within the Sagamore North quadrant and Sagamore South quadrant. **Table 4.14-4** and **Table 4.14-5** summarize the 2019 existing condition noise levels and number of receptors predicted to approach or exceed the Activity Categories B and C NAC of 67 dBA Leq and the Activity E Category NAC of 72 dBA Leq within the Bourne North quadrant and Bourne South quadrant.

In the Sagamore North quadrant for the 2019 existing conditions (**Table 4.14-2**), four single-family residential dwelling units within CNEs SC and SD approach or exceed the FHWA Category B NAC. No Activity Categories C, D, or E land uses approach or exceed the respective NAC thresholds for the 2019 existing condition in the Sagamore North quadrant.

Table 4.14-2. 2019 Existing: Loudest Traffic Hour Noise Levels (Sagamore North Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	FHWA Activity Category	2019 Existing Condition Approach or Exceed Noise Abatement Criteria
SA	State Route 3 Southbound	44–60	B	0
SB	State Route 3 Southbound	51–65	B	0
SC	State Route 3 Northbound	49–67	B	3
SD	State Route 3 Northbound	46–68	B	1
SE	U.S. Route 6 Northbound	60–61	B	0
SF	U.S. Route 6 Northbound	61–63	C	0
			E	0
SG	U.S. Route 6 Northbound	55–60	B	0
	Canal Street			
SH	U.S. Route 6 Northbound	49–60	B	0
	Canal Street		C	0
SI	Scenic Highway	52–65	B	0

Source: Massachusetts Department of Transportation, 2024

Note: Refer to **Figure 4.14-1** for Common Noise Environment locations.

In the Sagamore South quadrant for the 2019 existing conditions (**Table 4.14-3**), 37 residential dwelling units approach or exceed the FHWA Category B NAC. Existing noise levels also approach or exceed the FHWA Activity Category C NAC at Keith Field on the field behind home plate in the catcher's position. To determine the number of equivalent receptors predicted to experience noise levels that approach or exceed the FHWA Category C NAC at Keith Field, a schedule of events on the Bourne Recreation website was reviewed.[5] The calendar for booking usage of Keith Field shows that, on average, there is either one game or practice at the field per day. Behind home plate, a maximum of three people per day (i.e., the batter, catcher, and potentially one umpire if the field is being used for a game) for a total of approximately three hours would experience noise levels that approach or exceed the FHWA

[5] https://bournema.myrec.com/info/facilities/details.aspx?FacilityID=14558

Category C NAC. No Activity Category E land uses approach or exceed the respective NAC thresholds for the 2019 existing conditions in the Sagamore South quadrant.

Table 4.14-3. 2019 Existing: Loudest Traffic Hour Noise Levels (Sagamore South Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	FHWA Activity Category	2019 Existing Condition Approach or Exceed Noise Abatement Criteria
SJ	Sandwich Road	54–68	B	20
SK	U.S. Route 6 Northbound	53–71	B	6
SL	Sandwich Road	51–67	B	2
	Cranberry Highway		E	0
SM	Sandwich Road	48–67	B	7
			C	3
SN	Sandwich Road Cranberry Highway	49–65	B C E	0 0 0
SO	Cranberry Highway	50–64	B	0
SP	U.S. Route 6 Southbound	53–61	B	0
	Mid-Cape Connector			
	Sandwich Road			
SQ	Mid-Cape Connector	49–69	B	2
	Sandwich Road			

Source: Massachusetts Department of Transportation, 2024

Note: Refer to **Figure 4.14-2** for Common Noise Environment locations.

In the Bourne North quadrant for the 2019 existing conditions (**Table 4.14-4**), there are no residential dwelling units that approach or exceed the FHWA Category B NAC. No Activity Categories C, D, or E land uses approach or exceed the respective NAC thresholds for the 2019 existing condition in the Bourne North quadrant.

Table 4.14-4. 2019 Existing: Loudest Traffic Hour Noise Levels (Bourne North Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Noise Level Ranges Leq	FHWA Activity Category	2019 Existing Condition Approach or Exceed Noise Abatement Criteria
BA	State Route 25 Northbound	45–63	B	0
BB	State Route 25 Northbound and northbound/southbound on-ramps	52–55	B	0
BC	State Route 25 Southbound	48–65	B	0
			E	
BD	State Route 25 Southbound	60–65	E	0
BE	State Route 28 Southbound	53–63	B	0
			C	
			E	
BF	State Route 28 Northbound	53–65	B	0
	U.S. Route 6/Main Street			
BG	State Route 28 Northbound	53–62	C	0
	U.S. Route 6/Main Street			

Source: Massachusetts Department of Transportation, 2024

Note: Refer to **Figure 4.14-3** for Common Noise Environment locations.

In the Bourne South quadrant for the 2019 existing conditions (**Table 4.14-5**), two residences approach or exceed the FHWA Category B NAC. One bench on the north side of the Bourne Manor Extended Care facility approaches or exceeds the FHWA Activity Category C NAC for the 2019 existing condition. No FHWA Activity Categories D or E land uses approach or exceed the respective NAC thresholds for the 2019 existing condition in the Bourne South quadrant.

Table 4.14-5. 2019 Existing: Loudest Traffic Hour Noise Levels (Bourne South Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Noise Level Ranges Leq	Federal Highway Administration Activity Category	2019 Existing Condition Approach or Exceed Noise Abatement Criteria
BH	State Route 28 Southbound	52–60	B	0
BI	State Route 28 Northbound	57–58	C	0
BJ	Sandwich Road	59–64	B	0
BK	Veterans Way	42–64	B	0

Common Noise Environment	Adjacent Roadways	2019 Existing Noise Level Ranges Leq	Federal Highway Administration Activity Category	2019 Existing Condition Approach or Exceed Noise Abatement Criteria
	Sandwich Road		C	0
	Trowbridge Road		E	0
BL	Sandwich Road	51–53	B	0
	Trowbridge Road			
BM	State Route 28 Southbound	52–64	E	0
	Trowbridge Road			
BN	State Route 28 Southbound	46–60	B	0
	Trowbridge Road		C	0
BO	State Route 28 Southbound	54–67	C	1
BP	Sandwich Road	27–53	C	0
BQ	Sandwich Road	53–68	B	2

Source: Massachusetts Department of Transportation, 2024

Note: Refer to **Figure 4.14-4** for Common Noise Environment locations.

4.14.3 No Build Alternative

This section presents the operational traffic noise effects of the future 2050 No Build Alternative on noise-sensitive receptors within the Noise Study Area quadrants. Future 2050 traffic noise levels for the No Build Alternative were predicted using the FHWA TNM 2.5 with Design Year 2050 LTH traffic volumes, vehicle types, and posted speeds included within **Appendix 4.2, Traffic Engineering Technical Report.** Existing roadway geometry was used for the No Build Alternative models.

Undeveloped lands with issued building permits for future development were identified through coordination with the Town of Bourne and included in the 2050 No Build Alternative noise models. One permitted development was identified within the Sagamore North quadrant (Cape View Way), and two permitted developments were identified within the Bourne North quadrant (328 Main Street and 340 Main Street).

No construction activities would occur for the No Build Alternative. Therefore, no construction-related noise or vibration would be generated.

4.14.3.1 Operational Traffic Noise Effects

Table 4.14-6 and **Table 4.14-7** summarize the 2050 No Build Alternative noise levels and number of receptors predicted to approach or exceed the Activity Categories B and C NAC of 67 dBA Leq and the Activity E Category NAC of 72 dBA Leq within the Sagamore North and Sagamore South quadrants,

respectively. **Table 4.14-8** and **Table 4.14-9** summarize the 2050 No Build Alternative noise levels and number of receptors predicted to approach or exceed the Activity Categories B and C NAC of 67 dBA Leq and the Activity E Category NAC of 72 dBA Leq within the Bourne North and Bourne South quadrants, respectively.

For the 2050 No Build Alternative in the Sagamore North quadrant (**Table 4.14-6**), seven residential dwelling units within CNEs SB, SC, and SD would approach or exceed the Activity Category B NAC for the 2050 No Build Alternative. In addition, one permitted development (Cape View Way) was identified and includes a plan for 42 residential apartment units (FHWA Activity Category B) on five parcels north of Meetinghouse Lane. A building permit was issued for this development on September 24, 2024, and construction is underway. Due to the development's distance from the State Route 3/U.S. Route 6 mainline travel lanes and Meetinghouse Lane, noise levels would not approach or exceed the Activity Category B NAC for the 2050 No Build Alternative at this development. No Activity Categories C, D, or E land uses would approach or exceed the respective NAC thresholds for the 2050 No Build Alternative in the Sagamore North quadrant.

In the Sagamore South quadrant for the 2050 No Build Alternative (**Table 4.14-7**), 47 residential dwelling units would approach or exceed the FHWA Category B NAC within CNEs SJ, SK, SL, SM, SN, and SQ. The 2050 No Build Alternative noise levels would approach or exceed the FHWA Activity Category C NAC at the Sagamore Cemetery along Sandwich Road and Ben Abbey Road and at Keith Field on the field behind home plate in the catcher's position. To determine the number of equivalent receptors predicted to experience noise levels that approach or exceed the FHWA Category C NAC at Keith Field, a schedule of events on the Bourne Recreation website was reviewed.[6] The calendar for booking usage of Keith Field shows that, on average, there is either one game or practice at the field per day. Behind home plate, a maximum of three people per day (i.e., the batter, catcher, and potentially one umpire if the field is being used for a game) for a total of approximately three hours would experience noise levels that approach or exceed the FHWA Category C NAC. No Activity Category E land uses would approach or exceed the respective NAC thresholds for the 2050 No Build Alternative in the Sagamore South quadrant.

For the 2050 No Build Alternative in the Bourne North quadrant (**Table 4.14-8**), two residential dwelling units would approach or exceed the FHWA Category B NAC within CNE BF along U.S. Route 6/ Main Street westbound. In addition, two permitted future development (328 Main Street and 340 Main Street) were identified that include plans for seven townhouse apartments at 328 Main Street and 24 townhome style residences at 340 Main Street (FHWA Activity Category B) along U.S. Route 6/ Main Street behind and west of Bourne Bridge and behind the Sav-On gas station. A building permit was issued for this development on March 5, 2022, and construction is anticipated to commence in winter 2025. A building permit was issued for 328 Main Street on April 8, 2025, and foundation walls and the roof have been constructed to date. Under the 2050 No Build Alternative, noise levels are predicted to approach or exceed Activity Category B NAC at all seven townhomes at 328 Main Street. Noise levels are not predicted to approach or exceed the Activity Category B NAC for the 2050 No Build

[6] https://bournema.myrec.com/info/facilities/details.aspx?FacilityID=14558

Alternative at the permitted development at 340 Main Street due to their distance from U.S. Route 6/ Main Street and the Bourne Bridge mainline travel lanes. No Activity Categories C, D, or E land uses would approach or exceed the respective NAC thresholds for the 2050 No Build Alternative in the Bourne North quadrant.

In the Bourne South quadrant for the 2050 No Build Alternative (**Table 4.14-9**), two residences within CNE BQ would approach or exceed the FHWA Category B NAC. One bench on the north side of the Bourne Manor Extended Care facility would approach or exceed the FHWA Activity Category C NAC for the 2050 No Build Alternative. No FHWA Activity Categories D or E land uses would approach or exceed the respective NAC thresholds for the 2050 No Build Alternative in the Bourne South quadrant.

Table 4.14-6. 2050 No Build Alternative: Loudest Traffic Hour Noise Levels (Sagamore North Quadrant)

Common Noise Environment	Adjacent Roadways	2050 No Build Alternative Noise Level Ranges Leq	FHWA Activity Category	2050 No Build Alternative Approach or Exceed Noise Abatement Criteria
SA	State Route 3 Southbound	45–61	B	0
SB	State Route 3 Southbound	52–67	B	2
SC	State Route 3 Northbound	51–69	B	3
SD	State Route 3 Northbound	47–69	B	2
SE	U.S. Route 6 Northbound	61–62	B	0
SF	U.S. Route 6 Northbound	61–65	C	0
			E	0
SG	U.S. Route 6 Northbound	56–61	B	0
	Canal Street			
SH	U.S. Route 6 Northbound	49–61	B	0
	Canal Street		C	0
SI	Scenic Highway	53–65	B	0
Permitted Development – Cape View Way[a]	Meetinghouse Lane	49–52	B	0

[a] Cape View Way is a proposed residential development (FHWA Activity Category B) that received a building permit on September 24, 2024, to construct 42 residential dwelling units. The development is now complete, according to the Town of Bourne Planning Department.

Note: Refer to **Figure 4.14-1** for Common Noise Environment locations.

Table 4.14-7. 2050 No Build Alternative: Loudest Traffic Hour Noise Levels (Sagamore South Quadrant)

Common Noise Environment	Adjacent Roadways	2050 No Build Alternative Noise Level Ranges Leq	FHWA Activity Category	2050 No Build Alternative Approach or Exceed Noise Abatement Criteria
SJ	Sandwich Road	55–69	B	20
SK	U.S. Route 6 Northbound	54–72	B	8
SL	Sandwich Road	52–68	B	4
	Cranberry Highway		E	0
SM	Sandwich Road	50–69	B	8
			C	3
SN	Sandwich Road Cranberry Highway	51–67	B	3
			C	1
			E	0
SO	Cranberry Highway	51–65	B	0
SP	U.S. Route 6 Southbound	54–63	B	0
	Mid-Cape Connector			
	Sandwich Road			
SQ	Mid-Cape Connector	51–70	B	4
	Sandwich Road			

Note: Refer to **Figure 4.14-2** for Common Noise Environment locations.

Table 4.14-8. 2050 No Build Alternative: Loudest Traffic Hour Noise Levels (Bourne North Quadrant)

Common Noise Environment	Adjacent Roadways	2050 No Build Alternative Noise Level Ranges Leq	FHWA Activity Category	2050 No Build Alternative Approach or Exceed Noise Abatement Criteria
BA	State Route 25 Northbound	46–63	B	0
BB	State Route 25 Northbound and northbound/southbound on-ramps	53–56	B	0
BC	State Route 25 Southbound	49–65	B	0
			E	
BD	State Route 25 Southbound	61–66	E	0
BE	State Route 28 Southbound	54–65	B	0
			C	
			E	
BF	State Route 28 Northbound	54–66	B	2
	U.S. Route 6/Main Street			
BG	State Route 28 Northbound	54–63	C	0
	U.S. Route 6/Main Street			
Permitted Development – 340 Main Street[a]	State Route 28 Northbound	58–65	B	0
	U.S. Route 6/Main Street			
Permitted Development – 328 Main Street[b]	State Route 28 Northbound	72-72	B	7
	U.S. Route 6/Main Street			

[a] 340 Main Street is a part of a mixed-use development, where Phase I has been completed and includes six second-story apartment units above first floor commercial property. Phase II includes construction of 24 rental townhome style units behind the commercial property. Phase II building permit was issued on March 5, 2022.

[b] 328 Main Street is a multifamily residential development that includes the construction of seven townhouse apartments. The building permit was issued on April 8, 2025.

Note: Refer to **Figure 4.14-3** for Common Noise Environment locations.

Table 4.14-9. 2050 No Build Alternative: Loudest Traffic Hour Noise Levels (Bourne South Quadrant)

Common Noise Environment	Adjacent Roadways	2050 No Build Alternative Level Ranges Leq	Federal Highway Administration Activity Category	2050 No Build Alternative Approach or Exceed Noise Abatement Criteria
BH	State Route 28 Southbound	53–60	B	0
BI	State Route 28 Northbound	59–60	C	0
BJ	Sandwich Road	60–65	B	0
BK	Veterans Way	42–63	B	0
	Sandwich Road		C	0
	Trowbridge Road		E	0
BL	Sandwich Road	52–55	B	0
	Trowbridge Road			
BM	State Route 28 Southbound	53–65	E	0
	Trowbridge Road			
BN	State Route 28 Southbound	47–61	B	0
	Trowbridge Road		C	
BO	State Route 28 Southbound	54–67	C	1
BP	Sandwich Road	28–55	C	0
BQ	Sandwich Road	53–68	B	2

Note: Refer to **Figure 4.14-4** for Common Noise Environment locations.

4.14.4 Build Alternative

4.14.4.1 Operational Traffic Noise Effects

Future 2050 traffic noise levels for the Build Alternative were predicted using the FHWA TNM 2.5 with Design Year 2050 LTH traffic volumes, vehicle types, and posted speeds included within **Appendix 4.2, Traffic Engineering Technical Report.** Proposed roadway design data (including horizontal and vertical geometries) were used as input components for the 2050 Build Alternative models.

Table 4.14-10, **Table 4.14-11**, **Table 4.14-12**, and **Table 4.14-13** summarize the 2050 Build Alternative noise levels and number of receptors predicted to approach or exceed Activity Categories B and C NAC (67 dBA Leq) and the Activity Category E NAC (72 dBA Leq) within the Sagamore North, Sagamore South, Bourne North, and Bourne South quadrants, respectively.

For the 2050 Build Alternative in the Sagamore North quadrant (**Table 4.14-10**), nine residential dwelling units are within CNEs SB, SC, and SD that would approach or exceed the Activity Category B NAC. The 2050 Build Alternative noise levels are not predicted to approach or exceed the Activity Category B NAC at the proposed Cape View Way permitted development. No Activity Categories C, D, or E land uses would approach or exceed the respective NAC thresholds for the 2050 Build Alternative in the Sagamore North quadrant (**Table 4.14-10**). In addition, no substantial noise increases are predicted within the Sagamore North quadrant.

Table 4.14-10. 2050 Build Alternative: Loudest Traffic Hour Noise Levels (Sagamore North Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
SA	State Route 3 Southbound	44–60	47–61	B	0	0
SB	State Route 3 Southbound	51–65	52–67	B	3	0
SC	State Route 3 Northbound	49–67	51–68	B	3	0
SD	State Route 3 Northbound	46–68	48–67	B	2	0
SE	U.S. Route 6 Northbound	60–61	63–63	B	0	0
SF	U.S. Route 6 Northbound	61–63	58–65	C	0	0
				E	0	0

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
SG	U.S. Route 6 Northbound Canal Street	55–60	58–62	B	0	0
SH	U.S. Route 6 Northbound	49–60	50–62	B	0	0
	Canal Street			C	0	0
SI	Scenic Highway	52–65	55–67	B	1	0
Permitted Development – Cape View Way[b]	Meetinghouse Lane	N/A	50–52	B	0	0

[a] A substantial noise increase is defined by MassDOT as a 10 dBA (A-weighted decibels) increase in Build Alternative Design Year noise levels, relative to the existing condition noise levels.

[b] Cape View Way is a proposed residential development (FHWA Category B) that received a building permit on September 24, 2024, for construction of 42 residential dwelling units. The 2019 existing noise levels are not reported for permitted developments because they do not yet exist.

Note: Refer to **Figure 4.14-1** for the Common Noise Environment locations.

Within the Sagamore South quadrant (**Table 4.14-11**), 45 residential dwelling units would approach or exceed the FHWA Category B NAC within CNEs SJ, SK, SL, SM, SN, and SQ. No Activity Category C, D, or E land uses would approach or exceed the respective NAC thresholds for the 2050 Build Alternative in the Sagamore South quadrant. In addition, no substantial noise increases are predicted within the Sagamore South quadrant.

Table 4.14-11. 2050 Build Alternative: Loudest Traffic Hour Noise Levels (Sagamore South Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
SJ	Sandwich Road	54–68	56–67	B	20	0
SK	U.S. Route 6 Northbound	53–71	56–68	B	5	0
SL	Sandwich Road	51–67	54–67	B	5	0
	Cranberry Highway			E	0	0
SM	Sandwich Road	48–67	51–67	B	7	0
				C	0	0
SN	Sandwich Road	49–65	53–66	B	1	0
	Cranberry Highway			C E	0 0	0 0
SO	Cranberry Highway	50–64	53–69	B	1	0
SP	U.S. Route 6 Southbound	53–61	60–64	B	0	0
	Mid-Cape Connector					
	Sandwich Road					
SQ	Mid-Cape Connector	49–69	53–71	B	6	0
	Sandwich Road					

[a] A substantial noise increase is defined by MassDOT as a 10 dBA (A-weighted decibels) increase in Build Alternative Design Year noise levels, relative to the existing condition noise levels.

Note: Refer to **Figure 4.14-2** for Common Noise Environment locations.

For the 2050 Build Alternative in the Bourne North quadrant, there would be a total of nine residential dwelling units that would approach or exceed the FHWA Category B NAC. Within CNE BC, there is one single-family residence along Head of the Bay Road, one single-family residence along U.S. Route 6/ Main Street westbound within CNE BF, and seven townhomes along U.S. Route 6 within the permitted development parcel at 328 Main Street. No impacts are predicted at the permitted development at

340 Main Street for the 2050 Build Alternative. No Activity Category C, D, or E land uses would approach or exceed the respective NAC thresholds for the 2050 Build Alternative in the Bourne North quadrant. In addition, no substantial noise increases are predicted within the Bourne North quadrant. **Table 4.14-12** summarizes the predicted ranges in 2019 existing conditions and 2050 Build Alternative noise levels as well as the number of impacted equivalent dwelling units within each CNE in the Bourne North quadrant.

Table 4.14-12. 2050 Build Alternative: Loudest Traffic Hour Noise Levels (Bourne North Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
BA	State Route 25 Northbound	45–63	46–64	B	0	0
BB	State Route 25 Northbound and northbound/ southbound on-ramps	52–55	52–56	B	0	0
BC	State Route 25 Southbound	48–65	48–66	B	1	0
				E	0	0
BD	State Route 25 Southbound	60–65	59–64	E	0	0
BE	State Route 28 Southbound	53–63	55–64	B	0	0
				C	0	0
				E	0	0
BF	State Route 28 Northbound	53–65	55–67	B	1	0
	U.S. Route 6/ Main Street					
BG	State Route 28 Northbound	53–62	57–64	C	0	0
	U.S. Route 6/ Main Street					
Permitted Development –	State Route 28 Northbound	N/A	58–63	B	0	0

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
340 Main Street[b]	U.S. Route 6/ Main Street					
Permitted Development – 328 Main Street[c]	State Route 28 Northbound	N/A	67–68	B	7	0
	U.S. Route 6/ Main Street					

[a] A substantial noise increase is defined by MassDOT as a 10 dBA (A-weighted decibels) increase in Build Alternative Design Year noise levels, relative to the existing condition noise levels.

[b] The permitted development at 340 Main Street is a part of a mixed-use development, where Phase I has been completed and includes six second-story apartment units above first floor commercial property. Phase II includes construction of 24 rental townhome-style units behind the commercial property. The Phase II building permit was issued on March 5, 2022. Since the development does not exist for the 2019 existing condition, reported sound levels for the 2019 existing conditions are not available.

[c] 328 Main Street is a multifamily residential development that includes construction of seven townhouse apartments. The building permit was issued on April 8, 2025.

Note: Refer to **Figure 4.14-3** for the Common Noise Environment locations.

In the Bourne South quadrant for the 2050 Build Alternative (**Table 4.14-13**), one residential dwelling unit would approach or exceed the FHWA Category B NAC within CNE BQ along Sandwich Road. In addition, one bench on the north side of the Bourne Manor Extended Care facility would approach or exceed the FHWA Activity Category C NAC for the 2050 Build Alternative. No FHWA Activity Categories D or E land uses would approach or exceed the respective NAC thresholds for the 2050 Build Alternative in the Bourne South quadrant. In addition, no substantial noise increases are predicted within the Bourne South quadrant.

Table 4.14-13. 2050 Build Alternative: Loudest Traffic Hour Noise Levels (Bourne South Quadrant)

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
BH	State Route 28 Southbound	52–60	52–59	B	0	0
BI[b]	State Route 28 Northbound	57–58	61	C	0	0

Common Noise Environment	Adjacent Roadways	2019 Existing Condition Noise Level Ranges Leq	2050 Build Alternative Noise Level Ranges Leq	Federal Highway Administration Activity Category	2050 Build Alternative Approach or Exceed Noise Abatement Criteria	Substantial Increase[a]
BJ	Sandwich Road	59–64	56–58	B	0	0
BK	Veterans Way	42–64	41–61	B	0	0
	Sandwich Road			C	0	0
	Trowbridge Road			E	0	0
BL	Sandwich Road	51–53	52–56	B	0	0
	Trowbridge Road					
BM	State Route 28 Southbound	52–64	53–61	E	0	0
	Trowbridge Road					
BN	State Route 28 Southbound	46–60	47–59	B	0	0
	Trowbridge Road			C		
BO	State Route 28 Southbound	54–67	55–66	C	1	0
BP[c]	Sandwich Road	27–53	30–57	C	0	0
BQ	Sandwich Road	51–65	54–66	B	1	0

[a] A substantial noise increase is defined by MassDOT as a 10 dBA (A-weighted decibels) increase in Build Alternative Design Year noise levels, relative to the existing condition noise levels.

[b] Bourne Recreation Area would be relocated for the 2050 Build Alternative. Noise levels are predicted to increase under the 2050 Build Alternative due to the relocated area closer to Sandwich Road.

[c] CNE BP represents both exterior and interior use at the Upper Cape Cod Regional Technical High School. The minimum predicted noise level under the 2050 Build Alternative is representative of an estimated interior noise level based on a building attenuation value of 25 dBA for a light-frame building with storm windows based on Federal Highway Administration guidance.

Note: Refer to **Figure 4.14-4** for the Common Noise Environment locations.

4.14.4.2 Construction Noise Effects

Table 4.14-14, Table 4.14-15, Table 4.14-16, and **Table 4.14-17** summarize the predicted ranges in construction-period noise levels (Leq and Lmax) and number of receptors predicted to experience construction noise levels that exceed MassDOT's construction noise lot line limits within the Sagamore North, Sagamore South, Bourne North, and Bourne South quadrants, respectively. **Figure 4.14-1,**

Figure 4.14-2, Figure 4.14-3, and Figure 4.14-4 provide location maps for the CNEs where construction impacts were evaluated. **Section 4.14.5.2** outlines the measures that will be incorporated to mitigate construction period noise impacts.

Within the Sagamore North quadrant, during daytime, evening, and nighttime hours, 44, 134, and 156 noise-sensitive sites, respectively, are predicted to experience construction noise levels that exceed one or more of MassDOT's construction noise limits. There are no commercial or industrial land uses predicted to experience construction noise levels that exceed MassDOT's limits. Due to construction activities along the main span, some CNEs within the Sagamore South quadrant closest to the main span may also experience construction noise levels that exceed MassDOT's limits, particularly during the evening and nighttime hours when noise limits are lowest.

Table 4.14-14 summarizes the predicted ranges in construction noise levels within each CNE in the Sagamore North quadrant and the number of sites anticipated to experience construction noise levels that exceed MassDOT's construction noise limits during each period of the day.

Table 4.14-14. Summary of Predicted Construction Noise Levels and Impacts (Sagamore North Quadrant)

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	Number of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	Number of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	Number of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
SA	Noise-Sensitive	54–64	54–71	0/0	2/0	4/0
SB	Noise-Sensitive	61–74	62–80	27/0	42/0	43/0
SC	Noise-Sensitive	56–72	56–74	1/0	21/0	32/0
SD	Noise-Sensitive	65–81	63–90	10/0	25/4	25/4
SE	Noise-Sensitive	69–69	75–75	0/0	1/0	1/0
SF	Commercial	76–78	81–85	0/-	-/-	-/-
SG	Noise-Sensitive	64–71	68–77	2/0	18/0	18/0
SH	Noise-Sensitive	60–64	63–70	0/0	12/0	21/0
	Noise-Sensitive[a]	64–64	71–72	0/0	2/0	N/A
SI	Noise-Sensitive	54–75	54–85	3/0	6/3	7/3
Permitted Development – Cape View Way	Noise-Sensitive	65–71	72–78	1/0	5/0	5/0

[a] Pool associated with Ship's Way single-family residential complex. Nighttime noise criteria are not applicable due to the site's hours of use. The pool would also not be impacted during off-season hours when it is closed.

Within the Sagamore South quadrant, during daytime, evening, and nighttime hours, 24, 116, and 144 noise-sensitive sites, respectively, are predicted to experience construction noise levels that exceed one or more of MassDOT's construction noise limits. There are no commercial or industrial land use predicted to experience construction noise levels that exceed MassDOT's limits. Due to construction activities along the main span, some CNEs within the Sagamore North quadrant closest to the main span may also experience construction noise levels that exceed MassDOT's limits, particularly during the evening and nighttime hours when the noise limits are lowest.

Table 4.14-15 summarizes the predicted ranges in construction noise levels within each CNE in the Sagamore South quadrant and the number of sites anticipated to experience construction noise levels that exceed MassDOT's construction noise limits during each period of the day.

Table 4.14-15. Summary of Predicted Construction Noise Levels and Impacts (Sagamore South Quadrant)

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	No. of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	No. of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	No. of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
SJ	Noise-Sensitive	63–68	69–74	0/0	25/0	25/0
SK	Noise-Sensitive	58–75	64–89	9/0	37/12	47/12
SL	Noise-Sensitive	58–72	62–82	4/0	26/3	36/3
	Commercial	71–71	81–81	0/-	-/-	-/-
SM	Noise-Sensitive	55–60	59–65	0/0	0/0	0/0
	Noise-Sensitive[a]	61–65	66–72	0/0	1/0	N/A
SN	Noise-Sensitive	54–58	58–61	0/0	0/0	0/0
	Noise-Sensitive[b]	54–54	57–57	0/0	N/A	N/A
	Commercial	57–57	60–60	0/-	-/-	-/-
SO	Noise-Sensitive	53–64	56–71	0/0	2/0	6/0
SP	Noise-Sensitive	67–77	69–87	10/0	16/2	16/2
SQ	Noise-Sensitive	54–81	56–91	1/1	9/1	14/1

[a] Noise-sensitive land use associated with Bridgeview Montessori School Playground and Keith Field (baseball field, tennis, and pickleball courts). Evening and nighttime noise criteria are not applicable at the school, while nighttime noise criteria

are not applicable at Keith Field. Also, Kieth Field is only expected to experience construction noise impacts during spring, summer and fall seasons when the fields would be in use.

[b] Noise-sensitive land use associated with the Sagamore Cemetery.

Within the Bourne North quadrant, during daytime, evening, and nighttime hours, 49, 196, and 207 noise-sensitive sites, respectively, are predicted to experience construction noise levels that exceed one or more of MassDOT's construction noise limits. There are no commercial or industrial land use predicted to experience construction noise levels that exceed MassDOT's limits. Due to construction activities along the main span, some CNEs within the Bourne South quadrant closest to the main span may also experience construction noise levels that exceed MassDOT's limits, particularly during the evening and nighttime hours when noise limits are lowest.

Table 4.14-16 summarizes the predicted ranges in construction noise levels within each CNE in the Bourne North quadrant and the number of sites anticipated to experience construction noise levels that exceed MassDOT's construction noise limits during each period of the day.

Table 4.14-16. Summary of Predicted Construction Noise Levels and Impacts: Bourne North Quadrant

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	No. of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	No. of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	No. of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
BA	Noise-Sensitive	52–65	56–71	0/0	16/0	26/0
BB	Noise-Sensitive	63–66	65–69	0/0	15/0	15/0
BC	Noise-Sensitive	62–72	69–83	17/0	127/13	128/13
	Commercial	65–65	74–74	0/-	-/-	-/-
BD	Commercial	73–75	74–77	0/-	-/-	-/-
BE	Noise-Sensitive	62–72	66–73	1/0	2/0	2/0
	Noise-Sensitive[a]	66–95	65–98	1/1	1/1	1/1
	Commercial	73–73	74–74	0/-	-/-	-/-
BF	Noise-Sensitive	66–84	72–96	10/1	15/7	15/7

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	No. of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	No. of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	No. of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
BG	Noise-Sensitive[a]	65–96	69–97	1/ 1	1/1	1/1
Permitted Developments 328 and 340 Main Street	Noise-Sensitive	70–76	70–79	19/0	19/0	19/0

[a] Noise-sensitive land use associated with Bourne Scenic Park. Daytime, evening, and nighttime noise criteria apply to the campsites, while only daytime and evening criteria apply to the pool and playground areas based on their hours of use. Also, the pool would not be impacted during the off-season when it is closed.

Within the Bourne South quadrant, during daytime, evening, and nighttime hours, 77, 122, and 121 noise-sensitive sites, respectively, are predicted to experience construction noise levels that exceed one or more of MassDOT's construction noise limits. There are no commercial or industrial land use predicted to experience construction noise levels that exceed MassDOT's limits. Due to construction activities along the main span, some CNEs within the Bourne South quadrant closest to the main span may also experience construction noise levels that exceed MassDOT's limits, particularly during the evening and nighttime hours when noise limits are lowest.

Table 4.14-17 summarizes the predicted ranges in construction noise levels within each CNE in the Bourne South quadrant and the number of sites anticipated to experience construction noise levels that exceed MassDOT's construction noise limits during each period of the day.

Table 4.14-17. Summary of Predicted Construction Noise Levels and Impacts: Bourne South Quadrant

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	No. of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	No. of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	No. of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
BH	Noise-Sensitive	67–75	69–83	31/0	45/6	45/6
BI	Noise-Sensitive[a]	58–62	58–62	0/0	0/0	N/A

Common Noise Environment	Land Use	Predicted Construction Noise Level Range Leq	Predicted Construction Noise Level Range Lmax	No. of Impacted Receptors Daytime (7:00 am to 6:00 pm) Leq/Lmax	No. of Impacted Receptors Evening (6:00 pm to 10:00 pm) Leq/Lmax	No. of Impacted Receptors Night (10:00 pm to 7:00 am) Leq/Lmax
BJ	Noise-Sensitive	72–76	82–87	3/0	3/3	3/3
BK	Noise-Sensitive	68–73	76–84	12/0	48/24	48/24
	Noise-Sensitive[b]	75-77	76-79	1/0	1/0	1/0
	Commercial	75–84	77-87	2/-	-/-	-/-
BL	Noise-Sensitive	66–72	70–75	1/0	3/0	3/0
BM	Commercial	82–84	83–86	5/-	-/-	-/-
BN	Noise-Sensitive	71–85	70–88	20/0	20/4	20/4
	Noise-Sensitive[c]	66–71	66–72	1/0	1/0	N/A
BO	Noise-Sensitive[d]	63–70	64–71	0/0	1/0	1/0
BP	Noise-Sensitive[e]	63–82	63–85	1/0	N/A	N/A
BQ	Noise-Sensitive	52–60	48–57	0/0	0/0	0/0

[a] The analysis assumes the existing Bourne Recreation Area would be closed during construction and relocated. Therefore, the analysis reflects noise-sensitive land use associated with the relocated Bourne Recreation Area. Nighttime noise criteria are not applicable based on the assumed hours of operation of the land use.

[b] Noise-sensitive land use associated with the Quality Inn Hotel. Daytime, evening, and nighttime criteria apply to this land use.

[c] Noise-sensitive land use associated with the Bourne Intermediate School, Bourne Middle School, and Bourne High School. Daytime and evening criteria apply based on hours of operation. It is assumed there are evening sports activities at Bourne High School.

[d] Noise-sensitive land use associated with the Bourne Manor Extended Care facility. Daytime, evening, and nighttime criteria apply.

[e] Noise-sensitive land use associated with the Upper Cape Cod Regional Technical High School. Daytime criteria apply.

4.14.4.3 Construction Vibration Effects

During construction, the highest vibration levels would typically result from pile driving, drilling activities (e.g., caisson drilling), and vibratory roller/compactor use. Assuming most buildings proximate to proposed construction activities would be non-engineered timber and masonry buildings, structural damage has the potential to occur for these types of structures if they are within approximately 22 feet of vibratory pile driving. If the contractor chooses to use an impact pile driver, the extent of vibration-induced structural damage would increase. When vibratory pile driving occurs beyond 22 feet, there would be no potential for structural damage to non-engineered timber and masonry buildings. The potential for structural damage to non-engineered timber and masonry structures from drilling activities would occur within approximately 15 feet, and the potential for structural damage from activities requiring vibratory rollers/compactors would occur within approximately 26 feet.

Conservatively, construction-induced vibration may be considered "frequent" in nature. Therefore, MassDOT used the applicable annoyance threshold of 72 dBA for FTA Land Use Category 2 to evaluate potential vibration annoyance at nearby residences. The applicable annoyance threshold of 75 dBA for FTA Land Use Category 3 was used to evaluate potential vibration annoyance at nearby institutional land uses (e.g., schools, churches, parks). Based on the annoyance assessment prescribed within the FTA manual, should a vibratory pile driver be used, the annoyance threshold would be exceeded at any residential (FTA Land Use Category 2) structures within approximately 125 feet and any institutional structures within approximately 100 feet. Use of impact pile drivers would extend the distance a potential annoyance is experienced.

During construction activities that would require drilling, the annoyance threshold would be exceeded at any residential (FTA Land Use Category 2) structures within 79 feet and any institutional structures within 63 feet. Vibratory rollers/compactors would cause vibration-induced annoyance when they are located within 135 feet of residences and 108 feet of institutional uses.

While these distances offer some guidance on vibration exposure based on receptor-to-source activity distances, other factors also influence groundborne vibration impacts, including subsurface conditions, vibration frequency, and contractor means/methods. MassDOT's Contract Specification will include provisions for pre-construction surveys, vibration monitoring, adherence to vibration limit thresholds, and equipment restrictions, as necessary. **Section 4.14.5.3** provides additional information on construction vibration mitigation measures.

4.14.5 Mitigation

4.14.5.1 Operational Traffic Noise Effects

Noise abatement is any measure used to reduce highway traffic noise levels. In general, FHWA-approved abatement measures include traffic management, alteration of horizontal and vertical alignment, property acquisition for buffer zones, noise insulation (for Category D impacts only), and noise barriers. Noise barriers were the only form of abatement considered.

As required by FHWA and MassDOT's highway traffic noise assessment policy, noise barriers were only evaluated in areas where design year traffic noise levels were predicted to approach (i.e., within 1 dBA) or exceed the FHWA NAC for each activity category. All noise barriers were evaluated for feasibility and reasonableness in accordance with MassDOT's highway traffic noise assessment policy.

The feasibility of an abatement measure usually relates to a combination of acoustic and engineering factors. Acoustic factors include the amount of noise reduction achieved by the barrier, while engineering factors consider safety, impacts on drainage and utilities, maintenance of the abatement measure, and access to adjacent properties. Reasonableness considers the combination of social, economic, and environmental factors in the evaluation of a noise abatement measure and implies that good judgment and common sense were used in making a decision about barrier construction. Three primary reasonableness factors that must be achieved in determining if noise abatement is reasonable include cost effectiveness, achieving a noise reduction design goal, and gaining the support of property owners and residents for the abatement measures.[7]

According to MassDOT Noise Policy, noise barrier cost is determined by multiplying the square footage of the proposed noise barrier (as modeled by the FHWA TNM) by a unit cost per square foot. Pursuant to 23 CFR 772.13(d)(2)(ii), state highway agencies will reevaluate noise abatement costs on a regular interval, not to exceed five years. In 2021, MassDOT submitted an updated unit cost to FHWA of $60 per square foot. MassDOT considers a noise barrier to be cost effective if the cost is less than or equal to the Cost Effectiveness Index, which was increased to $10,080 per decibel of noise reduction per residential dwelling unit benefited in 2021 when MassDOT submitted a revised unit cost to FHWA.[8]

Table 4.14-18 summarizes the noise barrier evaluation results by Study Area quadrant and CNE. **Figure 4.14-5** and **Figure 4.14-6** provide the locations of all modeled and evaluated noise barriers at the Sagamore Bridge and Bourne Bridge, respectively.

Table 4.14-18. Noise Barrier Evaluation Summary Table

Noise Barrier ID and Location	Barrier SB Sagamore North Quadrant	Barrier SJ Sagamore South Quadrant	Barrier SK Sagamore South Quadrant	Barrier BF Bourne North Quadrant	Barrier BQ Bourne South Quadrant
Average Noise Reduction (dBA)	8	9	7	10	6
Length (feet)	1,072	380	1,200	442	1,369
Height (feet)	25	12	25	25	14
Surface Area (square feet)	26,776	4,562	29,994	11,044	19,154

[7] FHWA, "Procedures for Abatement of Highway Traffic Noise and Construction Noise" (23 Code of Federal Regulations 772, as amended 75 FR 39820, July 13, 2010; Effective date July 13, 2011). https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772

[8] MassDOT defines a benefited receptor as one that achieves a noise level reduction of at least 5 dBA with a noise abatement measure. A benefited receptor does not have to be one that is impacted.

Noise Barrier ID and Location	Barrier SB Sagamore North Quadrant	Barrier SJ Sagamore South Quadrant	Barrier SK Sagamore South Quadrant	Barrier BF Bourne North Quadrant	Barrier BQ Bourne South Quadrant
Total Cost[a]	$1,606,560	$273,720	$1,799,640	$662,640	$1,149,240
Number of Impacted and Benefited Receptors	3	20	4	1	1
Number of Not Impacted and Benefited Receptors[b]	13	0	5	0	8
Total Benefited	16	20	9	1	9
Massachusetts Department of Transportation Cost-Effectiveness Index[c]	$13,277	$1,524	$29,551	$69,752	$19,952
Barrier Status	Feasible and Not Reasonable	Feasible and Not Reasonable	Feasible and Not Reasonable	Feasible and Not Reasonable	Feasible and Not Reasonable

[a] Total cost calculated based on a unit cost of $60 per square foot, in accordance with the Massachusetts Department of Transportation's 2021 cost update, submitted to the Federal Highway Administration, pursuant to 23 Code of Federal Regulations 772.13(d)(2)(ii).

[b] A benefited receptor is a receptor in the Noise Study Area that attains at least a 5 decibel (dB) noise reduction or greater with a noise abatement measure. A benefited receptor does not have to be an impacted receptor.

[c] An index that is based on cost, the average noise level reduction provided by a noise barrier, and the number of receptors that achieve a 5 dB or more reduction in noise levels. The Cost-Effectiveness Index is one of several criteria used to determine the reasonableness[9] of noise abatement.

[d] Barrier SJ was determined to be not reasonable based on the combination of environmental impacts this abatement measure would impose on the Canal View Apartments, which is eligible for listing on the National Register of Historic Places.

dBA = A-weighted decibel

One noise barrier (Barrier SJ), at the Canal View Apartments within the Sagamore South quadrant was determined to meet MassDOT's acoustic feasibility criterion as well as the Noise Reduction Design Goal and Cost Effectiveness Index. The Canal View Apartments (South Sagamore Area) is eligible for listing on the National Register of Historic Places. A noise barrier approximately 380 feet in length was analyzed for 20 impacted residential dwelling units (FHWA Activity Category B). The noise barrier was modeled along the eastbound edge of pavement on Sandwich Road at various uniform heights ranging from a minimum height of 10 feet to a maximum height of 25 feet. At a height of 12 feet, the modeled

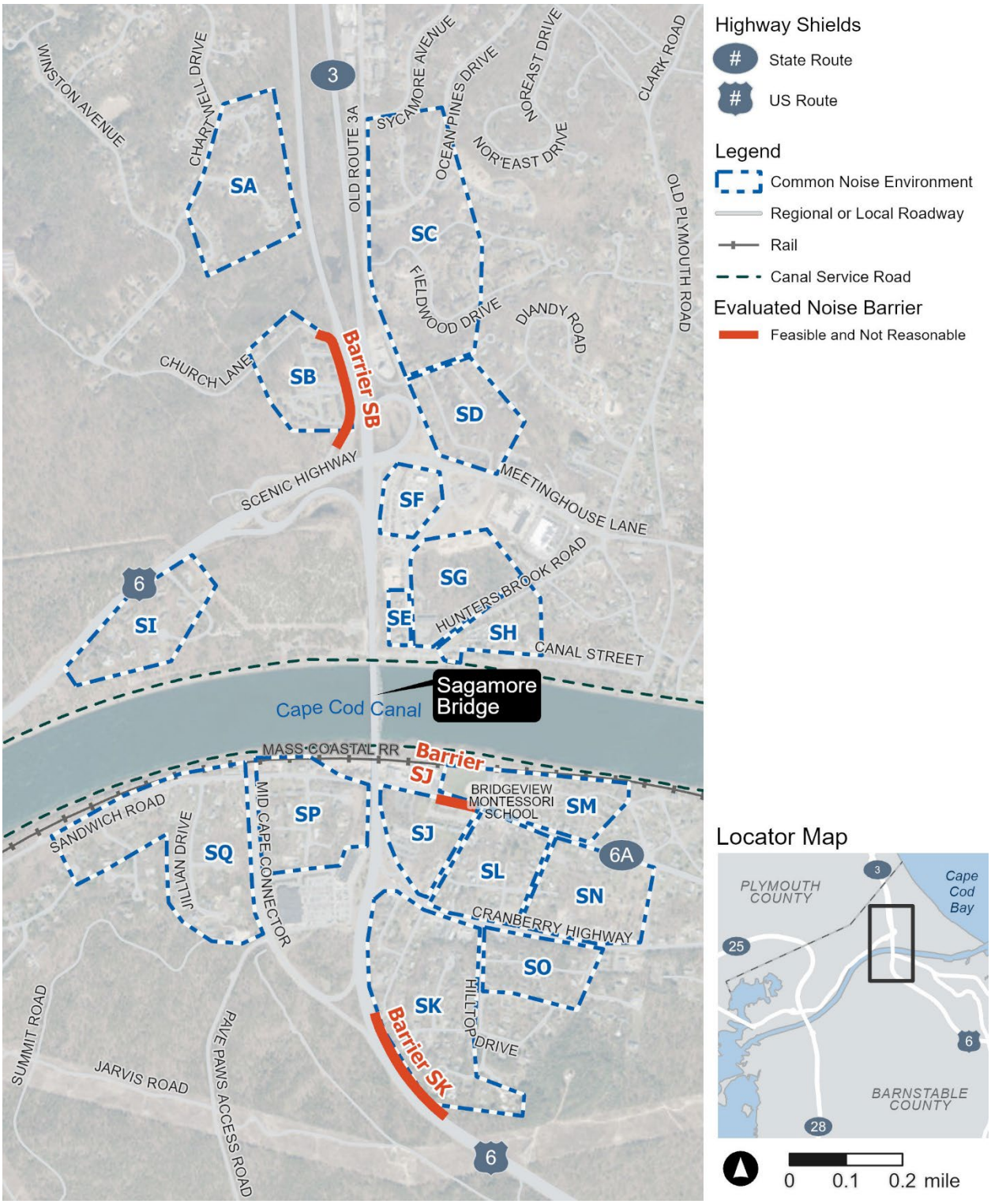
[9] The combination of social, economic, and acoustical factors considered in the evaluation of proposed noise abatement measures. Reasonableness implies that good judgment and common sense have been applied in arriving at a decision on the construction or installation of proposed noise abatement measures.

noise barrier would provide a 5 dBA reduction (benefit) to all 20 impacted first-row residential dwelling units and would reduce noise levels by 10 dB at 10 first-row residential dwelling units, thereby achieving MassDOT's acoustic feasibility goal and noise reduction design goal, respectively. The barrier would also achieve a weighted average insertion loss of approximately 9 dBA and would benefit 20 residential dwelling units. Using MassDOT's 2021 updated unit cost of $60 per square foot, the total barrier cost would be $273,720, yielding a Cost Effectiveness Index of $1,524, which would be below MassDOT's 2021 updated Cost Effectiveness Index of $10,080 per decibel of noise reduction (insertion loss) per residential dwelling unit benefited.

23 CFR 772.5 defines reasonableness, specific to noise abatement, as "The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure." Given the Canal View Apartments eligibility for listing on the National Register of Historic Places, the installation of a noise barrier at location CNE SJ would likely result in an Adverse Effect under Section 106 of the National Historic Preservation Act, necessitating Individual evaluation under Section 4(f) of the U.S. Department of Transportation Act for the "use" of a historic resource. The installation of a noise barrier at this location would also require the removal of 10 or more mature shade trees that currently provide the only buffer between the apartments and Sandwich Road. MassDOT recognizes the environmental and aesthetic benefits provided by these shade trees. Further, a noise barrier would be a visual obstruction for some residents of the Canal View Apartments and impede views of the Cape Cod Canal, which is a defining attribute of the property. In consideration of this location's existing noise level range (54–68 dBA) and the 2050 Build Alternative noise level range (56–67 dBA), the likely adverse effect to and use of a historic property under Section 106 and Section 4(f), and the environmental conditions described above, MassDOT has determined construction of noise barrier SJ is not reasonable due to environmental impacts.

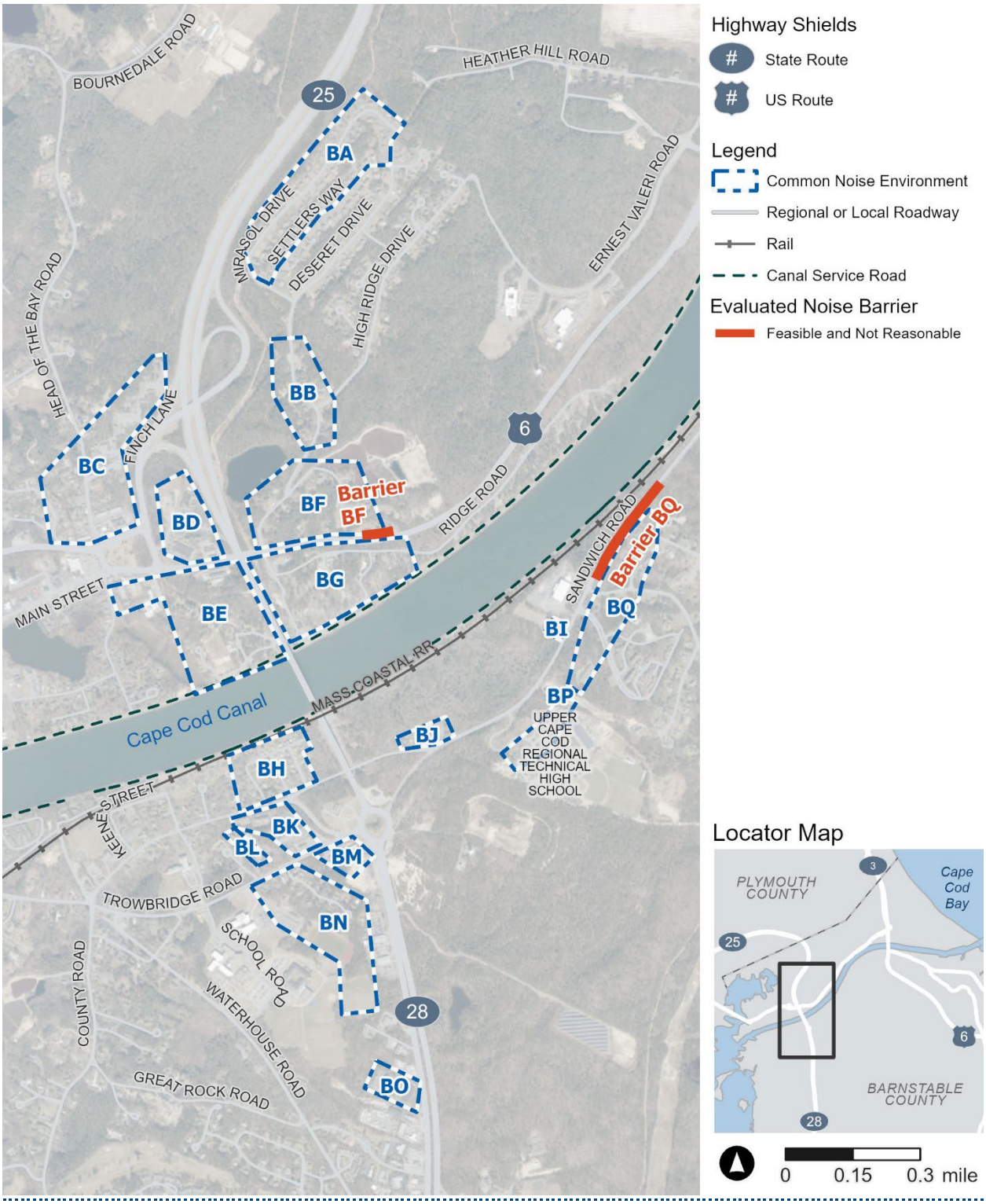
Appendix 4.14, Noise and Vibration Technical Report, provides further details regarding additional noise barriers that were evaluated as part of this noise analysis and other areas of impact where noise barriers were not evaluated due to engineering constraints.

Figure 4.14-5. Common Noise Environment Boundaries and Evaluated Noise Barrier Locations (Sagamore Bridge)



Source: Massachusetts Department of Transportation, 2025

Figure 4.14-6. Common Noise Environment Boundaries and Evaluated Noise Barrier Locations (Bourne Bridge)



Source: Massachusetts Department of Transportation, 2025

4.14.5.2 Construction Noise Effects

MassDOT will include special provisions for noise control during construction. The special provision will require the contractor to submit a Noise Control Plan for MassDOT's approval prior to beginning construction. The Noise Control Plan will describe the procedure for predicting construction noise levels prior to performing construction activities, including identification of noise reduction measures required to meet the noise level limitations and minimize nuisance noise conditions. MassDOT and the Contractor will establish a clear system for receiving and tracking comments, complaints, and questions from the public and project stakeholders during construction. This system will include a dedicated project hotline, managed by the contractor, and a dedicated email address managed by MassDOT's Public Affairs staff. Information on these communication channels will be provided in construction notices, on the Program website, and through posted signage at the job sites. Both channels will be activated prior to the start of major construction. All inquiries received through the hotline or email will be logged, responded to, and tracked through resolution.

The contractor will be required to use all reasonable efforts to minimize the impacts of construction noise on noise-sensitive receptors as part of the required Noise Control Plan. Example noise control measures may include:

- Scheduling the loudest construction activities during daytime hours near residential neighborhoods.
- Ensuring that all construction equipment is in good working order and equipped with mufflers and other noise-reducing features.
- Limiting the frequency and duration of equipment idling on the construction sites.
- Conducting noise monitoring to document compliance with recommended construction noise limits outlined in the Noise Control Plan. For measured noise levels that exceed or approach construction noise limits in the Noise Control Plan, the contractor will implement corrective action in coordination with local communities.
- Routing construction-related truck traffic along roads that would cause the least disturbance to residents.
- Using noise control measures, such as temporary noise barriers/curtain systems and portable enclosures for small equipment (i.e., jackhammers and concrete saws), where feasible.
- Implementing an active and responsive public outreach program during construction to coordinate construction activities and schedules and work with local communities to address concerns.

4.14.5.3 Construction Vibration Effects

MassDOT's contract specifications will include special provisions for vibration control during construction. The special provision will require the contractor to submit a Vibration Control and Mitigation Plan for MassDOT's approval prior to beginning construction. The Vibration Control and Mitigation Plan will describe the procedure for predicting vibration levels prior to performing construction activities, provide results of a pre-construction buildings survey (identifying structures of

concern), identify vibration reduction measures required to meet established vibration limits set forth to preclude structural damage and minimize vibration-induced annoyance, and provide a third-party compliance monitoring plan. An acoustical engineer or vibration specialist will develop the Vibration Control and Mitigation Plan, which the contractor will implement.

The contractor will be required to use all reasonable efforts to minimize the impacts of construction vibration as part of the required Vibration Control and Mitigation Plan. Example vibration control measures may include:

- Establishing construction vibration structural damage response actions and stop-work levels.
- Sequencing operations to reduce total vibration levels by separating significant vibration-inducing activities.
- Limiting vibration-inducing activities to daytime hours, where feasible.
- Selecting alternative means and methods, where conditions permit.