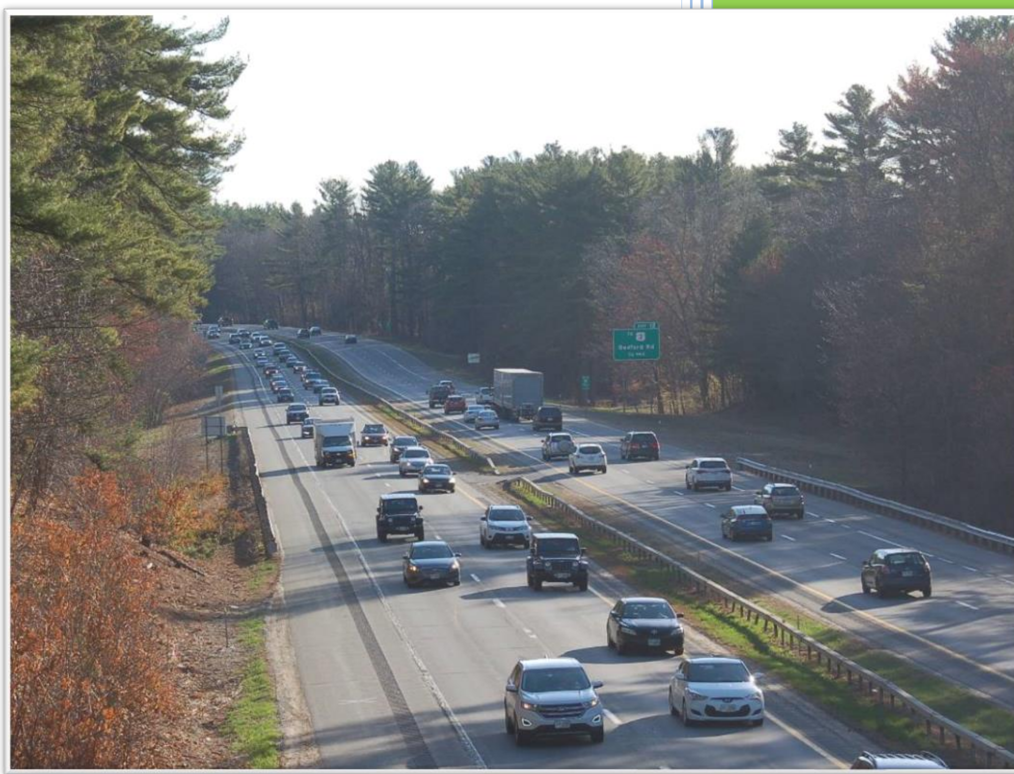
Prepared For:

F.E. Everett Turnpike Widening Project

Nashua, Merrimack and Bedford, NH

DRAFT Environmental Study



Prepared By:

McFarland Johnson
53 Regional Drive • Concord, NH 03301

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1 INTRODUCTION

The F.E. Everett Turnpike (F.E.E.T.) begins at the state border with Massachusetts, where it is a continuation of US Route 3, and continues north 39.5 miles to Exit 14 in Concord, NH, including portions of Interstates 93 and 293. It serves as a regional commuting route, an important local route for nearby communities, and an important link for New England-wide travel. Segments of this important corridor have become routinely congested with traffic in recent years, causing delays and safety concerns that are expected to continue or get worse. This project seeks to address those problems. This environmental study (ES) has been prepared to document the project's environmental effects, commitments, and permit requirements. The following is a discussion of the project background, the environmental requirements, and the project Purpose and Need Statement. Figure 1.1-1 shows the project location and Figures 1.1-2, 1.1-3 and 1.1-4 show the turnpike segments under consideration for this project.

1.1 PROJECT BACKGROUND

Traffic congestion on the F.E.E.T. has been studied for several years. In 2010, the New Hampshire Department of Transportation (NHDOT) prepared the F.E. Everett Turnpike Widening Feasibility Report, which studied the feasibility of widening the three two-lane segments along the turnpike from the Massachusetts/New Hampshire state line to the I-293 interchange in Bedford. This study looked at project need, design considerations, and costs. Levels of service along the three two-lane segments were determined to be D and E in 2009 and were predicted to be F in 2030. It was also concluded that safety would be improved with the widening; that five bridges would need rehabilitation or replacement "in the near future"; and that superelevation deficiencies existed. At the time there was no funding for the widening and the project was not in the State's Ten-Year Transportation Improvement Plan (TYP).

The project first appeared in the 2015-2024 TYP, where it was programmed for construction in Federal Fiscal Years 2022-2024. That plan was formally adopted in 2014. The project is currently in the Draft 2019-2028 TYP and programmed for construction from Federal Fiscal Year 2021 to 2023. In 2016, NHDOT contracted with a consulting team to develop preliminary design plans and environmental documents. The environmental documentation process and preliminary design are scheduled to be completed in 2018. If the current schedule holds, final design, environmental permitting, and right-of-way acquisition will continue through 2021, followed by construction starting in 2022.

1.2 LEAD FEDERAL AGENCY

The National Environmental Policy Act of 1969 (NEPA) (42 USC 55) requires full disclosure of potentially significant environmental impacts associated with federal actions. Federal actions include federally funded or approved projects. This project is expected to be funded solely by State turnpike revenue, with no financial assistance or design approvals anticipated from the Federal Highway Administration

(FHWA). Therefore, the FHWA is not the lead federal agency and the project is not subject to that agency's NEPA requirements (23 CFR 771).

The issuance of a permit under Section 404 of the Clean Water Act constitutes a federal action that is subject to the requirements of NEPA. The U.S. Army Corps of Engineers has adopted its own NEPA-implementing regulations (23 CFR 325 Appendix B) and will make a NEPA determination for proposed work within their areas of jurisdiction (Waters of the U.S.) through the Section 404 permitting process. The Army Corps may require the applicant to provide appropriate information for their NEPA review; however, the applicant is not required to provide a NEPA document to the Corps.

Section 106 of the National Historic Preservation Act requires consideration of historic resources for any undertaking that is carried out, licensed, permitted, approved, or assisted by a federal agency. When more than one federal agency is involved, one agency is designated as the lead federal agency. This project will require a Section 404 permit from the Army Corps and a National Pollution Discharge Elimination System (NPDES) permit from the U.S. Environmental Protection Agency (EPA). It has been decided that the Army Corps will serve as the lead federal agency under Section 106. As the lead federal agency, the Army Corps must consider the effects, if any, of proposed undertakings on historic resources within their permit area (23 CFR 325 Appendix C).

For non-federally funded projects such as this, the NHDOT has an internal policy of completing an environmental review that is similar to the NEPA process to ensure that all applicable State and Federal regulations are appropriately addressed. This environmental document has therefore been prepared in consideration of NEPA and the Council on Environmental Quality (CEQ) laws and regulations, including the following:

- 42 USC 55, *National Environmental Policy Act*
- 40 CFR 1500-1508, CEQ's *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*
- 23 CFR 771, *Environmental Impact and Related Procedures*, which prescribes policies and procedures for implementing NEPA on FHWA projects

The following document provides an initial assessment of the existing transportation, social, economic, environmental, and cultural resources, and potential impacts (positive or negative) that the proposed project will have upon those resources. This initial assessment will be made available to the public for comment and all comments will be reviewed and considered.

1.3 Purpose and Need Statement

Purpose

The purpose of the F.E. Everett Turnpike Widening Project is to improve transportation efficiency and reduce safety problems associated with turnpike congestion in Nashua, Merrimack, and Bedford for all users of the turnpike while being sensitive to the needs of local communities, residents, and natural and cultural resources.

Need

The F.E.E.T. is a principal north-south arterial highway within the State of New Hampshire and is part of the New Hampshire Turnpike System. The F.E.E.T. begins at the state border with Massachusetts, where it is a continuation of US Route 3, and continues north 39.5 miles to Exit 14 in Concord, NH. It includes portions of Interstates 93 and 293 and provides a vital link for north/south travel.

The F.E.E.T. carries a mix of traffic including trucks, cars, and buses, as well as commercial traffic vital to the region's economy. The F.E.E.T. corridor serves as a regional commuting route for residents of New Hampshire and Massachusetts as well as an important local route for the communities of Nashua, Merrimack, Bedford, and other surrounding municipalities. It also serves as an important link for New England-wide travel to population centers such as Nashua, Manchester, and Concord, as well as to tourist destinations such as the New Hampshire Lakes Region, White Mountains, and ski areas. As one of the main arterials in the New Hampshire highway system, it is important to maintain the mobility of people, goods and services through this corridor.

Capacity

Since the F.E.E.T. was constructed in the 1950s and 1960s, many segments and interchanges have been widened and improved. Currently, between the Massachusetts border and the I-293 interchange, all but three segments have at least three lanes in each direction. These three segments are two lanes in each direction.

Traffic volumes on the F.E.E.T. have grown substantially in recent years, resulting in frequent congestion and poor Levels of Service (LOS) on several road segments. (Level of Service is a measure of how well or poorly a roadway handles traffic volumes. LOS A represents free-flow conditions with no backups or delays, and LOS F represents extreme congestion with major delays.) In the three roadway segments with two lanes in each direction, traffic volumes increased between 25% and 40% from 2009 to 2015[1]. In the 2010 feasibility report[2], the 2009 LOS ranged between D and E, and the 2030 LOS was forecasted to be LOS F on all three segments. A LOS of F is frequently encountered along these turnpike roadway segments.

Traffic volumes are expected to continue to increase. An updated traffic analysis completed for this project determined the existing (2016) design hour traffic volumes (DHV is the 30th highest hourly volume for the design year) based on actual traffic counts and future volumes based on a regional traffic

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[1] Annual average daily traffic reported on NHDOT Bureau of Traffic website: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/F.E.E.T..pdf

[2] *F.E. Everett Turnpike Widening Feasibility Report*, NHDOT 2010.

model. The 2016 DHV exceeded the theoretical capacity for the highway, reflecting existing levels of congestion and delays. By 2024, traffic is expected to increase by 10.4%, so congestion and delays, as well as the potential for crashes, will continue to increase if the roadway remains in its current configuration.

Regional and Local Planning

The project corridor lies within three municipalities (Nashua, Merrimack, and Bedford) and traverses two regional planning organizations (Nashua Regional Planning Commission and Southern New Hampshire Planning Commission).

The Nashua Regional Planning Commission's (NRPC) *Nashua Region Metropolitan Transportation Plan, 2015-2040*[3] identifies the F.E.E.T. as the primary north/south arterial in the region. The Plan states that the turnpike's lane reductions lead to "recurring congestion associated with bottleneck conditions" causing congestion and compromising safety. NRPC staff indicate that the congestion on the turnpike increases congestion on other roads within the region.

The Southern New Hampshire Planning Commission's (SNHPC) 2015 regional plan, *Moving Southern NH Forward*[4], identifies the F.E.E.T. as a critical regional and statewide link. A future no-build analysis conducted by SNHPC indicated that the F.E.E.T. in Manchester and Bedford would be over capacity by 2035, and that capacity improvements would improve north-south highway travel. SNHPC staff added that the current two-lane sections are a safety concern.

The City of Nashua's master plan, *Nashua 2000 Master Plan*[5], supports safety improvements and reducing congestion on roadways. The City currently shifts workers' Friday schedules to avoid traffic congestion. Merrimack's 2013 Master Plan[6] identifies peak hour traffic congestion at Exit 11 (Merrimack), and states that approximately 26 percent of crashes reported in Merrimack occurred on the F.E.E.T. and its ramps. In interviews conducted for this project (see Land Use section of Chapter 3), town planners expressed concern with current levels of capacity and gridlock. Bedford planners also expressed concerns with safety and congestion along the existing F.E.E.T. corridor.

In recognition of these safety concerns, congestion, and deficiencies, the project has been included in the State's most recent *Ten-Year Transportation Improvement Plan 2017-2026*[7] for construction in years 2022 to 2024.

[3] The Regional Plan is published on the web at http://www.nashuarpc.org/web-apps/documents/?data=7&ccm_order_by=year_end&ccm_order_dir=desc

[4] Available on line at http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf

[5] http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf

[6] http://www.merrimacknh.gov/community-development/pages/2013-master-plan

[7] https://www.nh.gov/dot/org/projectdevelopment/planning/typ/documents/ApprovalTYP-CompleteBook6.24.16.pdf

Safety

Crash data was provided by the NHDOT for the years 2006 through 2016. Of the crashes reported, the majority occurred during dry roadway conditions and were located near on-ramps and off-ramps, particularly at Exits 11 and 12 (in Merrimack) and the I-293 interchange (in Bedford). In addition, there are several locations that were not specifically located at ramp intersections where it appears that the geometry of the mainline segment, coupled with congested traffic conditions, are contributing factors to the higher incidence of crashes. Vehicle crashes cause property damage as well as injuries to drivers. As traffic volumes increase on the F.E.E.T., the geometric deficiencies will become more problematic and crashes will likely increase.

Infrastructure

There are certain deficiencies in the current infrastructure that pose safety concerns. For example, there are segments where the turnpike's alignment, profile and superelevation were designed and constructed for a 55 mph design speed, whereas the proposed design would accommodate a speed of 70 mph.

Bridges associated with the F.E.E.T. also have structural and capacity deficiencies that need to be addressed. Specifically, the F.E.E.T. over Pennichuck Brook Bridges' substructures have concrete spalling and the steel girders exhibit section loss. The Baboosic Lake Road Bridge over the F.E.E.T. exhibits heaving, spalling and other concrete-related problems and is on the State's "Red List"[8], which indicates one or more components of the bridge is in poor condition or the bridge requires weight limit restrictions. The twin culverts carrying the F.E.E.T. over Baboosic Brook are generally considered to be in good condition, but are hydraulically undersized.

[8] See the NHDOT 2016 State Owned Red List Bridges dated December 31, 2016. https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents/2016-12-31bridge_state_red_list.pdf

2 ALTERNATIVES

This chapter provides a description of the project alternatives that were considered and developed to meet the project Purpose and Need as defined in Chapter 1. Below the alternatives are addressed by major project components, specifically the mainline turnpike (including the interchanges), Pennichuck Brook, Naticook Brook, and Baboosic Brook. For each major project component, an Engineering Report (available separately) has been prepared which describes in more detail the existing conditions, alternatives considered, and considerations in selecting the recommended alternative.

2.1 MAINLINE TURNPIKE

The No-Build Alternative would maintain a typical section similar to the existing typical section, which has two 12’ lanes in each direction with a 10’ shoulder on the right and a 4’ shoulder on the left. The median in these two-lane sections is either grassed with a box beam guardrail or paved with concrete barriers, providing protection from errant vehicles.

In determining possible alternatives for consideration, some thought was given to relocating the roadway or diverting traffic to other adjacent routes. However, these possibilities were clearly undesirable. If the traffic was relocated to another alignment on an existing route or in some other nearby location the substantial residential and commercial development and other land uses adjacent to the turnpike would experience severe impacts. The scale and magnitude of the modifications would be much greater and more costly than on-alignment alternatives and cause substantial impacts within Bedford, Merrimack, and Nashua, as well as the other adjacent municipalities. Consequently, the social, environmental, and economic costs would far outweigh the benefits.

Therefore, only one overall alternative was seriously considered: widening the existing two-lane sections, making the entire corridor at least three lanes in each direction. Based on a traffic analysis of the corridor it was determined that a three-lane section would accommodate the future traffic volumes predicted in 2044. This change would result in additional roadway capacity that would be sufficient to carry the volume of traffic expected in the future. In 2024, the year construction was originally (at the start of this study) expected to be completed, the widened roadway would operate between LOS B and D in both directions throughout the project area, depending on where a motorist is within the corridor. In 2044 most of the proposed roadway would still be operating between LOS B and D, with a few selected ramp areas operating at LOS E or even F, still well above the level predicted if no changes are implemented.

It should be noted that these predictions do not include improvements that may be obtained due to vehicle to vehicle (V2V) communication or other autonomous vehicle adaptations. This kind of technology could greatly improve traffic flow. It could reduce the need for additional lane capacity in the future. However, at this time it does not appear that V2V technology can provide enough benefits to eliminate the need for the third lane altogether.

The turnpike mainline typical section, which currently provides two 12' travel lanes with 10' shoulders on the right side and 4' shoulders on the left, would change to three 12' travel lanes in each direction with 11' shoulders on both the right and left sides of the roadway. A two-foot wide concrete median barrier would also be installed between the northbound and southbound barrels, providing much safer separation between opposing vehicle travel than the current box beam guardrail. A major benefit of this project would be that the roadway from Nashua to Manchester would now be a uniform three-lane section, providing consistent driver expectation throughout this 12-mile length. The overall project as proposed is shown in Figures 2.1-1 through 2.1-6.

The current roadway, built in the early 1950s, would also be improved in a number of ways. The roadway, although originally designed for high speed traffic, is no longer up to current standards. This project would improve the superelevation (the banking of the roadway through curved sections) by bringing it to current standards for a 70 mph design speed. Clear zones (the distance to obstructions or non-traversable slopes) would be checked and if necessary either increased or protection such as guardrail would be provided. As mentioned above, a concrete median barrier would be installed within the median, making the likelihood of a head-on crash remote. Guardrail would also be added where needed on the outside of both the northbound and southbound roadways. Each of these improvements would make the turnpike safer than in its current configuration.

As mentioned above, the horizontal alignment of the roadway would remain largely unchanged and all widening would occur to the outside. However, near the bridges over Pennichuck Brook, the alignment would be moved 19' to the east to facilitate construction, minimizing environmental impacts as well as the overall time needed to build the project. There are also minor revisions to the alignment near the bridge over the Souhegan River, where a subtle reduction in the amount of curvature is proposed to eliminate the need for superelevation. Other horizontal alignment changes were evaluated within the corridor, but none were deemed necessary or prudent to carry on to further design evaluation. The vertical alignment of the roadway meets current standards and the grades are generally gentle, rising consistently as vehicles move northward. The only change proposed to the vertical alignment is in the vicinity of Baboosic Brook just north of Wire Road, where the turnpike would be elevated approximately 3 feet to accommodate a larger bridge opening needed to pass the 100-year storm event.

At each interchange, only minor modifications are envisioned. Ramps at Exits 10, 11, and 12 and I-293 would be modified to connect to the widened highway, but would remain essentially the same. Only minor revisions would be needed to bring the ramps to current standards. No changes are envisioned at any of the existing intersections at the ramp terminals other than adjusting the traffic signal timings where needed.

As part of the widening, improvements to the existing drainage systems would also be included in the form of increased treatment of stormwater runoff. These changes are discussed in more detail in Chapter 4, but in summary, approximately 16 additional treatment basins have been added throughout the entire corridor, two existing basins will be modified, and treatment swales will be added, providing overall benefits for the receiving waters that eventually drain to the Merrimack River.

There would be right-of-way (ROW) acquisitions for most of the proposed treatment basins and relatively small slivers of land in a few other locations for treatment areas and drainage. All other drainage changes would occur within the existing ROW, which was established many years ago, resulting in a project that provides substantial benefits with only minor impacts to adjacent property owners.

Widening of the roadway requires that some of the cross roads and associated overpass bridges be modified to accommodate the wider turnpike. This is the case at Baboosic Lake Road and Wire Road. These crossings are discussed in more detail below, but it is noted here that both of these roads would be slightly widened to accommodate an 11' lane and a 5' wide shoulder in each direction to accommodate bicycle traffic. In addition, since it is near the school and municipal complex, Baboosic Lake Road would include a 6' sidewalk on both sides of the roadway to accommodate pedestrians. Each of these two roadways would accommodate a design speed of 30 mph, which is the current posted speed limit.

2.2 Pennichuck Brook

Existing Conditions - Approach Roadway

The approach roadways for the northbound and southbound structures are constructed on causeways which extend into Pennichuck Brook. The bridges span the Pennichuck Brook and the Nashua/Merrimack town line. The existing causeways are approximately 75 feet wide, and sit approximately 12' above the surveyed ordinary high water (OHW) line. Any widening or relocation of the F.E.E.T. would require a substantial amount of approach roadway reconstruction, with slope line impacts extending into Pennichuck Brook. The impacts to Pennichuck Brook due to approach roadway widening for all alternatives considered are summarized in Chapter 4.

Existing Conditions - Bridge

The existing structures carrying the F.E.E.T. over Pennichuck Brook are separate bridge superstructures, one northbound and one southbound bridge. Both the northbound and southbound bridges are approximately 35'-10" wide, with two 12' lanes, 3' shoulders and 2'-11" curbs.

The northbound and southbound bridges were constructed in 1954, and are single span painted steel multi-girder structures supporting a reinforced concrete deck. The structures span 87' and are supported by reinforced concrete stub abutments founded on a single row of steel H-piles, with the piles alternating between vertical and battered piles. A rehabilitation was performed in 1980 that included deck joint replacement at the south abutment and bearing replacement.

The NHDOT Bridge Inspection Reports (dated 5/19/2016) noted that the Federal Sufficiency Rating[9] of both structures is 45.2% with a National Bridge Inspection (NBI) status of functionally obsolete. The

[9] The Federal Sufficiency Rating is essentially an overall rating of a bridge's fitness for the duty that it performs. The rating is based on four separate factors which are derived from over 20 National Bridge Inspection data fields to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a

bridge inspection reports noted the following regarding the condition of the deck, superstructure and substructure:

- The reinforced concrete bridge decks are noted as "satisfactory" with condition ratings[10] of 6. The inspection reports note the 6.5" thick reinforced concrete decks exhibit light spalling and cracking on the underside. Minor cracking is noted in the asphalt overlay.
- The steel superstructures are noted as "fair" with condition ratings of 5. The steel girders exhibit section loss to the flanges, webs, bearings, and crossframes at the south abutment, likely attributed to the failed deck joint.
- The substructures are noted as "fair" with condition ratings of 5. There are widespread locations of cracking and spalling with exposed rebar to the girder seats and exposed abutment faces.

Bridge Alternatives Description

During the outset of the engineering study phase, multiple replacement/rehabilitation alternatives were identified, evaluated and summarized for the Engineering Report prepared for the project. A summary of the alternatives which were identified and initially evaluated are provided in Tables 2.2-1 and 2.2-2 and are summarized below:

- Alternative 1 – Complete bridge replacement with 14' alignment shift to the east over 3 construction seasons.
- Alternative 2 - Complete bridge replacement with 14' alignment shift to the east over 2 construction seasons utilizing a temporary bridge. This alternative was eliminated from consideration due to the environmental impacts associated with constructing a temporary causeway and bridge required to maintain traffic.
- Alternative 3 – Complete bridge replacement maintaining F.E.E.T. alignment over 3 construction seasons.
- Alternative 4 – Complete bridge replacement maintaining F.E.E.T. alignment over 2 construction seasons utilizing two temporary bridges. This alternative was eliminated from consideration due to the environmental impacts associated with constructing two temporary causeways with temporary bridges required to maintain traffic.
- Alternative 5 – Existing bridge rehabilitation over 3 construction seasons. This alternative was eliminated from consideration due to the life-cycle cost associated with rehabilitating the existing structure and the extensive structural modifications that would be required to widen the existing abutments.

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percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.

[10] The condition rating is an official rating from zero to ten that evaluates bridge components relative to new condition, with ten representing a brand new structure.

Table 2.2-1. F.E.E.T. over Pennichuck Brook initial decision matrix: alternatives removed from consideration

CONSIDERATION	ALTERNATIVE 2 14' ROADWAY SHIFT 1.5:1 Side Slopes	ALTERNATIVE 4 MAINTAIN F.E.E.T CL	ALTERNATIVE 5 EXISTING BRIDGE REHABILITATION	ALTERNATIVE 6 ABC CONSTRUCTION	ALTERNATIVE 7 REMOVE CAUSEWAYS
Description	Temporary causeway and bridge, and part of new bridge, constructed to east; then western half constructed	Two temp causeways and bridges constructed, both east and west; existing bridges then replaced with permanent bridge	Phased construction, no temporary bridges	Prefab units used. First stage closes and replaces one barrel, requiring one lane of traffic in each direction. Second stage has two lanes in each direction.	Same as Alternative 1 but removes entire 415-foot combined length of causeways
Estimated Construction Duration	2 Construction Seasons	2 Construction Seasons	3 Construction Seasons	1 Construction Season	3 Construction Seasons
Estimated Permanent Impacts Below OHW		41,100 SF (2:1 side slopes) 26,900 SF (1.5:1 side slopes)	41,100 SF (2:1 side slopes) 26,900 SF (1.5:1 side slopes)	41,100 SF (2:1 side slopes) 26,900 SF (1.5:1 side slopes)	Gain of 69,000 SF below OHW by removing causeways
Vegetated Slope	No, unless 2:1 slopes	No, unless 2:1 slopes	No, unless 2:1 slopes	No, unless 2:1 slopes	N/A
Estimated Temporary Impacts Below OHW	32,300 SF (1.5:1 side slopes)	57,700 SF (1.5:1 side slopes)	N/A	Minimal	23,600 SF (1.5:1 side slopes)
Environmental Mitigation Cost[1]	--	--	--	--	--
Estimated Construction Cost[2]	**$6.0M**	**$7.1M**	**$5.1M**	**$5.4M**	**$23.4M**
DECISION	**Removed from Consideration**	**Removed from Consideration**	**Removed from Consideration**	**Removed from Consideration**	**Removed from Consideration**

Note:

1. Alternative eliminated prior to calculating environmental mitigation cost.

2. Estimated construction costs include the following items: bridge, roadway, cofferdam, retaining wall, temporary bridge & causeway, dredging & environmental mitigation

Table 2.2-2. F.E.E.T. over Pennichuck Brook final alternatives decision matrix

CONSIDERATION	ALTERNATIVE 1 14' ROADWAY SHIFT			ALTERNATIVE 1B NET-ZERO	ALTERNATIVE 3 MAINTAIN FEET CL			ALTERNATIVE 8 19' ROADWAY SHIFT EAST
	2:1 Side Slopes	**1.5:1 Side Slopes**	**Retaining Walls**	**Retaining Walls**	**2:1 Side Slopes**	**1.5:1 Side Slopes**	**Retaining Walls**	**2:1 Side Slopes**
Description	Centerline shifted 14 feet east. New bridge constructed in 3 phases: 1. Construct 2 lanes of new bridge east of existing bridge 2. Replace existing SB bridge with new bridge 3. Replace existing NB bridge with new bridge				Temporary causeway and bridge constructed to west, then NB bridge replaced, then SB replaced			Centerline shifted 19 feet east. New bridge constructed in 3 phases (Similar to Alternative 1)
Estimated Construction Duration	3 Construction Seasons			3 Construction Seasons	3 Construction Seasons			3 Construction Seasons
Estimated Permanent Impacts Below OHW	40,700 SF	23,800 SF	15, 612 SF	0 SF (net)	41,100 SF	26,900 SF	0 SF	24,700 SF (2:1 Side Slopes)
Vegetated Slope	Yes	No	Partial	Partial	Yes	No	Partial	Yes
Estimated Temporary Impacts Below OHW	Minimal			Minimal	23,600 SF (1.5:1 side slopes)			Minimal
Environmental Mitigation Cost	$0.53M	$0.55M	$0.4M	$0.48	$0.53M	$0.57M	$0.27M	$0.28 M
Estimated Construction Cost[1]	**$4.8M**	**$4.8M**	**$5.4M**	**$5.7M**	**$5.9M**	**$6.0M**	**$6.8M**	**$4.5M**
DECISION	**Removed from Consideration**			**Removed from Consideration**	**Removed from Consideration**			**Recommended Alternative**

Note:

1. Estimated construction costs include the following items: bridge, cofferdams, retaining walls, temporary bridge & environmental mitigation

- Alternative 6 – Complete bridge replacement maintaining F.E.E.T. alignment over 1 construction season. This alternative was eliminated from consideration due to the major impacts to traffic required to replace the bridge in one construction season.
- Alternative 7 - Complete bridge replacement with 14’ alignment shift to the east over 3 construction phases with complete removal of both approach causeways. This alternative was eliminated from consideration due to the considerable costs required to remove the existing causeways and replace them with a bridge structure.
- Alternative 8 – Complete bridge replacement with 19’ alignment shift to the east over 3 construction seasons.

Three alternatives were not eliminated from consideration at the early stages of the project and were therefore advanced for further evaluation. These were Alternative 1, Alternative 3 and Alternative 8, described in more detail below.

Alternative 1 – Complete Bridge Replacement Over 3 Construction Seasons With 14’ Alignment Shift to the East

Alternative 1 is a three-phase complete bridge replacement that would result in a 14’ shift of the F.E.E.T. centerline to the east. The 14’ shift is required to allow construction of the new bridge while avoiding the construction of a temporary causeway or temporary bridge.

The existing substructure consists of reinforced concrete stub abutments supported by a single row of steel H-piles, with the piles alternating between vertical and battered piles. To minimize construction impacts to the existing F.E.E.T. and Pennichuck Brook, the proposed abutments would be located behind the existing abutments. The existing abutments would be removed to 1’ below proposed grade. Locating the proposed abutments behind the existing abutments results in a total structure span length of approximately 100 feet. The proposed abutments would be integral abutment systems supported by a single row of vertical steel H-piles, which will avoid the existing piles that will be left in place. (In an integral abutment bridge, the superstructure [bridge beams and deck] is directly connected to the substructure [abutments].) The proposed bridge span (100’) and the depth to bedrock (45’) are within the design criteria limits for an integral abutment system. The use of an integral abutment system would reduce the temporary earth support system costs by minimizing the depth of excavation required. Integral abutments would also eliminate the deck joint, reducing maintenance and extending the service life of the structure.

The proposed superstructure would be a simple span structure with an out-to-out width of 123’-8”. The 100-year flood elevation is 179.5’. Therefore, the minimum bottom of beam elevation would be 180.5’ which satisfies the 1’ minimum freeboard above the 100-year flood elevation requirement per the NHDOT Bridge Design Manual. The proposed superstructure would be a multi-beam system with an approximate structure depth of 6’-0”. With this structure depth, the proposed profile of the new bridge will be approximately 3’above the 100-year flood elevation.

Approach roadway side slopes of 2:1 and 1.5:1 were evaluated, along with the use of retaining walls to further minimize environmental impacts. The option with 2:1 side slopes would allow vegetated slopes but would have greater impacts to Pennichuck Brook. The option with 1.5:1 side slopes would not have vegetated slopes but would reduce impacts to the brook. The option with retaining walls would have the least impact to the brook but would be substantially more expensive and would require more ongoing maintenance than the other options.

No impacts outside of the existing ROW are anticipated.

Alternative 1 would have greater environmental impact to the brook and the side slopes than Alternative 8 and would have higher costs, without other advantages. It was therefore removed from consideration.

Alternative 1B – Complete Bridge Replacement over 3 Construction Seasons with 14' Alignment Shift to the East and No Net Impact to the Brook

This alternative was developed to consider an alternative with no net increase in aquatic resource impacts. It would be similar to Alternative 1 but the bridges would be lengthened, creating a larger opening over the brook, and retaining walls would be extended along the entire remaining causeway, minimizing fill in the water along the causeway. There would still be impacts to the brook to widen the causeway, but the new fill would be offset by an equal amount of restoration under the lengthened bridge.

Alternative 1B would result in no net impacts to surface waters but would cost substantially more, would require substantially more ongoing maintenance, and would result in less vegetated slope than other alternatives. It was therefore removed from consideration.

Alternative 3 – Complete Bridge Replacement Over 3 Construction Seasons Maintaining F.E.E.T. Alignment

Alternative 3 is a three-phase structure replacement that would maintain the existing F.E.E.T. centerline by constructing a temporary causeway and temporary bridge to the west of the existing F.E.E.T.

The proposed substructure for this Alternative would be similar to the substructure layout detailed in Alternative 1, with the proposed abutments behind the existing abutments. The resulting span length of this alternative is approximately 100 feet. The corresponding freeboard for this alternative is similar to that of Alternative 1.

No impacts outside of the existing ROW are anticipated. Side slopes of 2:1 and 1.5:1 were evaluated, along with the use of retaining walls to further minimize environmental impacts. Because of the proposed temporary causeway or bridge, all of these options would result in more temporary impacts than other alternatives, without other benefits. Therefore, Alternative 3 was removed from consideration.

Alternative 8 – Complete Bridge Replacement Over 3 Construction Seasons with a 19' Alignment Shift to the East

Alternative 8 is a three-phase complete bridge replacement that would result in a 19' shift of the F.E.E.T. centerline to the east. The 19' shift would allow construction of the new bridge while eliminating impacts to Pennichuck Brook below ordinary high water along the west approaches. All impacts to Pennichuck Brook would be along the northbound (east) approach roadways.

The proposed foundations would be integral abutments founded on driven steel H-piles behind the existing abutments, similar to Alternatives 1 and 3. The proposed span length would also be approximately 100', similar to Alternatives 1 and 3, providing approximately 3' of freeboard between the low chord (the lowest point of the underside of the bridge) and the 100-year flood elevation.

No impacts outside of the existing ROW are anticipated.

Alternatives Conclusion

The impacts to Pennichuck Brook due to the required bridge and approach roadway widening are summarized in Table 2.2-2. Alternative 8 (complete bridge replacement over 3 construction seasons with a 19' alignment shift to the east, as shown on Figures 2.2-1 and 4.5-10) was evaluated and determined to be the recommended alternative. This alternative would have the lowest cost, would maintain 2 lanes of traffic during all phases of construction, and would have environmental impacts that are comparable to (or lower than) the other alternatives under consideration. In addition, this alternative would avoid impacts to the western side of the approach roadways below ordinary high water. Because of these factors, Alternative 8 was selected as the recommended alternative. More detail regarding the alternatives considered, as well as the recommended alternative, is included in the Engineering Report (available separately).

2.3 F.E.E.T. OVER GREELEY STREET

The bridge carrying the F.E.E.T. over Greeley Street in Merrimack at Exit 11 was designed and constructed in 1993 and has not undergone rehabilitation. Its Federal Sufficiency Rating is 84%. It was designed to accommodate the additional lanes associated with the F.E.E.T. widening, so the bridge does not require replacement or rehabilitation based on geometry. The F.E.E.T. project will include a bridge rehabilitation at this location to perform bridge maintenance and upgrade the outdated bridge rail. The proposed bridge rehabilitation and repair items identified for the structure include bridge deck patching, new membrane and pavement overlay, replacement of the existing aluminum exterior bridge rail with steel bridge rail, replacement of the existing median guardrail with a concrete median barrier, removal of deteriorating korolath in the joints, new compression seal joints, abutment repairs, and other repairs.

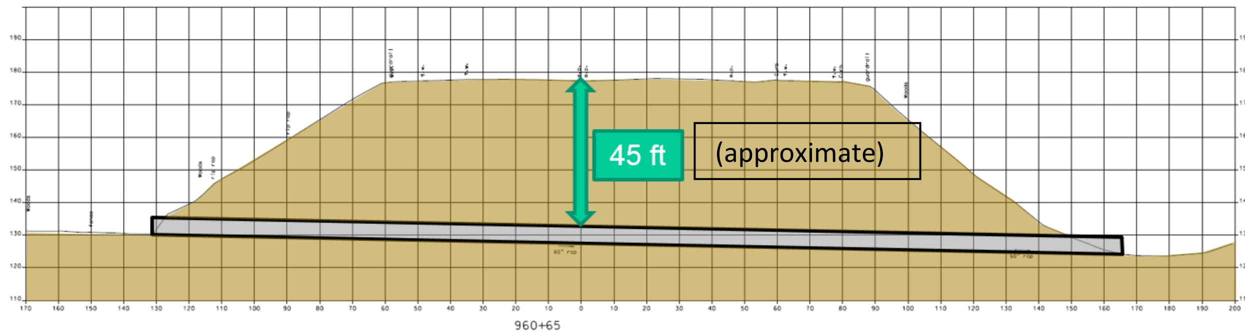
2.4 NATICOOK BROOK

Naticook Brook is carried by a 60" reinforced concrete culvert which crosses under the F.E.E.T. just north of Exit 11 in Merrimack. Based on the August 2014 Central Turnpike Culvert Inspection Report prepared by Stantec, the culvert had a barrel condition rating of 4 with an estimated remaining life of 5 years. A preliminary hydrologic and hydraulic assessment was conducted in accordance with NHDOT standards, the United States Army Corps of Engineers' (ACOE) Nationwide Permit requirements for aquatic organism passage (AOP), and the New Hampshire Stream Crossing Guidelines (2009). Refer to the *Engineering Report* for details regarding the methodology.

The Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Hillsborough County, New Hampshire (September 2009) was utilized to determine peak flows. The study reach of Naticook Brook in the vicinity of the turnpike crossing was updated based on the 2012 Merrimack River Watershed Light Detection and Ranging (LiDAR) elevation dataset.

The existing crossing consists of a 280' long, 60" reinforced concrete pipe with a corrugated metal pipe end section on the downstream end and a reinforced concrete pipe (RCP) inlet with mortar rubble masonry (MRM) wingwalls on its upstream end that carries Naticook Brook through the F.E. Everett Turnpike embankment. The culvert contains a ductile iron sewer pipe that the town of Merrimack received a permit to install in the 1980s to carry the sewer line under the turnpike. The turnpike roadway is located approximately 45' above the top of the culvert, as illustrated below.

Naticook Brook Existing Cross Section



A simulation of the updated hydrologic model indicated that the existing culvert is undersized, with the 50-year water surface elevation located approximately 2.8' above the pipe crown which is equivalent to a HW/D ratio of 1.6.

According to the *NHDOT Drainage Design for Highways Manual* (April 1998), culverts (structures with a span < 10') must pass the design storm with an acceptable headwater to depth ratio (HW/D). The design storm for culvert crossings under federally funded (Tier 1) roads is the 50-year storm event and the required HW/D ratio is 1.0 for culvert diameters greater than 48 inches.

In addition, the proposed structure should be designed in accordance with Army Corps of Engineers standards and the NH stream crossing guidelines. According to the New Hampshire Code of Administrative Rules (Env-Wt 900), Naticook Brook is classified as a Tier 3 stream, and as such replacement options are limited to a span structure (bridge) or an open-bottomed culvert (three-sided structure).

Several design alternatives were evaluated for the proposed crossing:

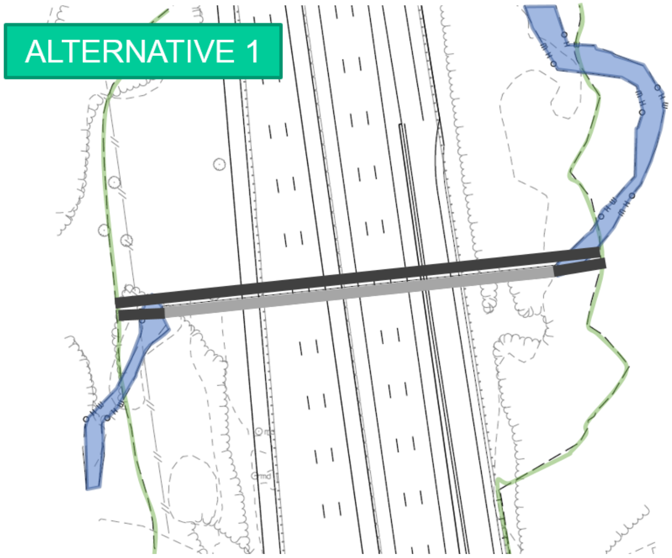
- <u>Alternative 1:</u> Trenchless installation of a supplemental 60" RCP and rehabilitation of the existing 60" RCP
- <u>Alternative 2:</u> 90" RCP, buried 2' in streambed
    - Alternative 2A – Open Cut Installation
    - Alternative 2B – Trenchless Installation
- <u>Alternative 3</u>: 20' span by 5' rise concrete three-sided structure with a native streambed

Alternative 1

This replacement alternative involves the trenchless installation of an additional 60"-inch RCP adjacent to the existing pipe, which would be rehabilitated in place. This alternative would limit the disturbance to the turnpike and provide additional capacity to meet the NHDOT hydraulic design standards for culverts. The HEC-RAS analysis for this alternative indicated that the proposed culverts would pass the 50-year event with approximately 0.6' of freeboard (below the pipe crowns), equivalent to a HW/D ratio of 0.8.

Alternative 1 would retain the existing culvert and would require that the supplemental culvert be installed following the same alignment, as illustrated below. In its existing condition, Naticook Brook approaches the existing culvert at a skew and extending the culvert would require stream channel relocation to align it with the new inlet and outlet of the culvert (see the figure below). Further, due to the size of the proposed culverts it is not feasible to provide a natural substrate bottom.

Naticook Brook Alternative 1



Alternative 2

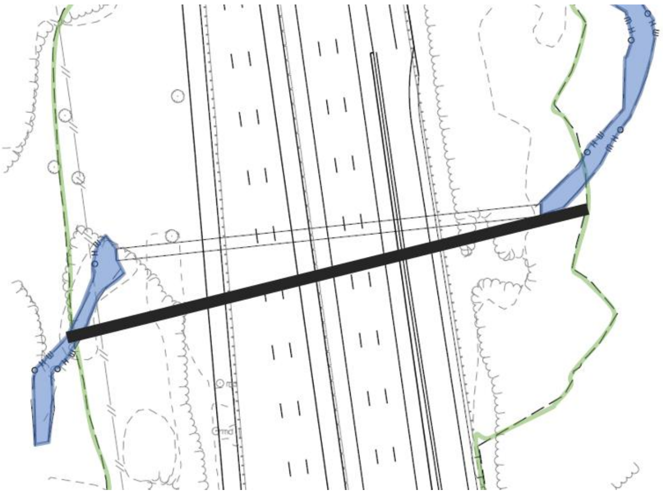
The second replacement alternative consists of a 90” RCP, buried 2’ and designed to match the existing channel bed upstream and downstream of the culvert but on a new alignment, as illustrated below. This alternative represents a compromise, which meets the intent of the stream crossing guidelines by providing a natural channel bottom, but is sized to comply with NHDOT hydraulic design standards for culverts. The HEC-RAS analysis for this alternative indicated that the proposed culvert will pass the 50-year event with approximately 0.3’ of freeboard (below the pipe crown), equivalent to a HW/D ratio of 0.9. Alternative 2 considers two installation methodologies, open cut installation (Alternative 2A) and installation using trenchless technologies (Alternative 2B).

Unlike Alternative 1, this alternative would not retain the existing pipe and as a result this alternative would allow the pipe to be installed at a skew to better align with the natural stream channel and would ultimately require less extensive and invasive stream channel relocation.

Two installation methods were evaluated for construction of this alternative. The first, Alternative 2A, evaluated installing the culvert using conventional open cut, which impacts the turnpike above. To maintain 2 lanes of traffic in each direction, extensive traffic control measures would be required, and cofferdams would be needed to limit the extents of the open cut and maintain traffic. Constructing the culvert in this manner is difficult and costly, with an extended construction duration when compared to Alternative 2B, described below.

Alternative 2B investigated installing the pipe using trenchless methods. This would effectively eliminate long-term traffic impacts to the turnpike above and result in a much lower cost than Alternative 2A (See Summary of Construction Costs below), while providing the overall benefits of installing the 90” RCP.

Naticook Brook Alternatives 2A, 2B and 3



Alternative 3

The Alternative 3 replacement option consists of a 20’ span by 5’ rise concrete three-sided structure, sized to match the bankfull channel width upstream and downstream of the culvert. This alternative assumes strict compliance with the NH stream crossing guidelines, and as a result is sized to meet the NHDOT criteria for bridge hydraulics. The HEC-RAS analysis for this alternative indicated that the proposed concrete three-sided structure would pass the 50-year event with approximately 1.5’ of freeboard (equivalent to a HW/D ratio of 0.7). In addition, this structure would also meet the NH hydraulic standards for bridges (span equal to or greater than 10’) by conveying the 100-year storm event with a freeboard of approximately 1.2’. The results of the hydraulic model indicate that the proposed concrete three-sided structure would meet standards for both culverts and bridges carrying a Tier 1 roadway. In addition, existing water surface elevations and velocities would be reduced at the pipe inlet with the installation of this structure.

Like Alternative 2, this structure could be installed to better match the alignment of the existing stream (see illustration above) and would require less stream channel relocation than Alternative 1. Further, the three-sided structure would allow for a native stream bed to meet the NH stream crossing guidelines as noted above.

Constructing this structure would require an open cut, which would have extensive impacts to the turnpike above, requiring cofferdams to retain 2 lanes of traffic in each direction coupled with several phases of complex traffic control. Finally, the resulting structure would be classified as a bridge, and as a result the lifecycle maintenance costs would be substantially higher than the culvert alternatives.

The alternatives analysis is summarized in Table 2.4-1 below.

Naticook Brook Culvert Replacement – Conclusion and Recommendation

Based on the considerations listed above, Alternative 2A or 2B, installation of a new 90" culvert on a new alignment, provides the most cost effective feasible compromise between hydraulic and environmental needs. However, Alternative 2A would have substantially greater traffic impacts and construction costs than Alternative 2B, but could be considered if traffic impacts and construction costs could be minimized.

Table 2.4-1. Naticook Brook culvert replacement – summary of alternatives

	ALTERNATIVE 1 **NEW 60" RCP CULVERT** **TRENCHLESS TECHNOLOGY**	**ALTERNATIVE 2A** **NEW 90" RCP** **OPEN CUT**	**ALTERNATIVE 2B** **NEW 90" RCP** **TRENCHLESS TECHNOLOGY**	**ALTERNATIVE 3** **NEW 5'-0" X 20'-0" THREE SIDED STRUCTURE** **OPEN CUT**
Estimated Construction Duration	2 Months	5 Months	2 Months	7 Months
Roadway Impacts	Minor	Major	Minor	Major
Traffic Impacts	Minor/None	Major	Minor/None	Major
Constructability	Lowest Difficulty	High Difficulty	Moderate Difficulty	High Difficulty
Construction Cost	**$2.1M**	**$4.6M**	**$2.2M**	**$8.2M**

2.5 F.E.E.T. OVER SOUHEGAN RIVER

The bridge over the Souhegan River in Merrimack was reconstructed in 2011/2012 to facilitate a six-lane turnpike. According to record plans and survey of the bridge and adjacent approaches these were constructed with a normal crown section, which does not meet the 70 mph design speed superelevation requirements. The project proposes to flatten the curves immediately adjacent to the bridge to accommodate a normal crown section which would meet the design criteria for 70 mph. No changes are proposed to the bridge structure itself.

2.6 BABOOSIC LAKE ROAD OVER THE F.E.E.T.

Existing Conditions

Baboosic Lake Road is an east-west local thoroughfare which serves as a primary access road from residential areas of Merrimack, NH to U.S. Route 3. The northeast approach is bordered by the American Legion, a daycare center and the Town of Merrimack Police Department. The southeast approach is bordered by an elementary school, high school, Town Offices, courthouse, and local business. The northwest and southwest approach roadways are bordered by local residences. Relocation of the existing alignment will likely have impacts to these adjacent properties.

The existing bridge was constructed in 1954 and is a 4-span continuous painted steel multi-girder superstructure supporting a reinforced concrete deck. The 2017 NBIS Inspection Report notes that the Federal Sufficiency Rating is 48% with an NBI status of structurally deficient and is on the State's Red List. The structure carrying Baboosic Lake Road over the F.E.E.T. carries approximately 9,700 vehicles per day (vpd), and the volume is expected to increase to approximately 14,350 vpd in 2044.

Design Considerations

Key design considerations included:

- Number of spans: A comparison evaluation was done to determine the cost difference between a simple span (assuming a 145' simple span structure) and a 2-span continuous structure with a pier constructed in the median of the reconstructed F.E.E.T. Costs were determined to be comparable. The simple span structure would eliminate construction activities in the median of the existing F.E.E.T., which would allow for a shorter construction duration while reducing traffic impacts to the F.E.E.T.; excluding the pier would eliminate a substructure item which is exposed to salt spray from nearby vehicles, thereby reducing future maintenance activities; and a simple span structure removes a permanent traffic hazard, providing a safer corridor. Because of these factors, the decision was made to advance the alternatives as simple span structures.
- Span Length: Per discussion with the Department, it was determined that abutment systems and alternatives would be developed with abutments located within the clear zone. The benefits of locating the abutments within the clear zone are reduced span length, which reduces overall bridge cost due to a shallower overall structure depth, as well as reducing approach roadway

impacts including ROW impacts on Baboosic Lake Road. A 145’ span length was conservatively used to estimate the conceptual bridge project costs regardless of abutment type.

- Proposed Bridge Width: The existing structure is approximately 35’-6” wide, with two 12’-0” lanes, 2’-0” shoulders and a 4’-8” wide sidewalk. The proposed structure width will be increased to 47’-0” wide, with two 11’-0” lanes, 5’-0” shoulders, two 6’-0” wide sidewalks and 1’-6” curbs.

Initial Alternatives

During the engineering study phase, multiple bridge replacement alternatives were identified for consideration and summarized within the Engineering Report. Rehabilitation of the existing structure was not considered to be a viable alternative because the widened F.E.E.T. cross section conflicts with two of the existing bridge piers. In addition, the existing vertical clearance beneath the Baboosic Lake Road Bridge is substandard (15’-6”) already and would be reduced further with a widened F.E.E.T. mainline.

A summary of the alternatives which were eliminated from consideration in the early stages of the evaluation process are summarized below:

Alternative 1 – Full bridge closure with offsite detour: This alternative was eliminated from consideration because the traffic impacts due to the closure were determined to be unacceptable. The anticipated detour length for this structure is approximately 5 miles end-to-end. Due to the proximity of an elementary school, high school, Town Hall, court, and a police station on the east approach, the impact to these establishments was determined to be unacceptable.

Alternative 6 – New bridge constructed to the south: This Alternative was eliminated from consideration due to the permanent ROW impacts to adjacent properties, including the Mastricola Upper Elementary School and two local businesses. Utilities along the west approach would require relocation.

Alternative 7 – Re-use of Prowse Bridge steel superstructure: This Alternative was eliminated from consideration because using the Prowse Bridge (an existing historic structure carrying Ash Street/Pillsbury Road over I-93 that is scheduled for replacement) would result in a substantial increase in the road profile, and thereby increase the ROW impacts. The constructability of re-using the existing steel would be challenging and add substantial cost and complexity to the project.

Alternatives Studied in More Detail

Three alternatives were not eliminated from consideration and were advanced for further evaluation. These are alternatives 2, 3C and alternative 4B, and are summarized below:

Alternative 2 – (Phased Construction): Alternative 2 would be a phased construction alternative which maintains one-way alternating traffic while the new structure is constructed.

Alternatives 3A, 3B, and 3C – (Temporary bridge constructed to the north): Alternatives 3A, 3B, and 3C consist of constructing a temporary bridge to the north of the existing bridge and diverting traffic to the temporary bridge while a new structure is built along the alignment of the existing bridge. The three alternatives would have different bridge span lengths.

Alternatives 4A and 4B – (New bridge constructed to the north): Alternatives 4A and 4B consist of constructing a new permanent bridge to the north of the existing bridge. Traffic would be maintained on the existing bridge while the new structure and approach roadways are built. The two alternatives have different span lengths.

Key evaluation criteria are summarized below:

- Based on traffic control, it was determined that Alternatives 3C and 4B are preferable. Through coordination with local officials, reducing traffic to 1 lane with alternating one-way traffic was determined to be unfeasible for this site. The substandard roadway approach geometry with a temporary bridge for Alternative 3C is a temporary condition and can be mitigated with a temporary reduction in the design speed.
- Based on ROW impacts, Alternative 2 was determined to be preferable, but the impacts associated with Alternative 3C would be temporary impacts and would not require any property acquisitions. Property acquisitions are required with Alternative 4B, and this alternative was therefore determined to have high impact.
- Based on utility impacts, the coordination and effort required for Alternative 2 are substantially less than those of Alternative 3C and Alternative 4B.
- Based on environmental impacts, there were few differences between Alternatives 2, 3C and 4B.

Alternative 5 – Temporary bridge constructed to the south: This alternative consists of constructing a temporary bridge to the south of the existing bridge and diverting traffic to the temporary bridge while a new structure is built along the alignment of the existing bridge. Utilities along the west approach would require relocation.

Recommended Alternative

Alternative 5 with an on-alignment bridge replacement and a temporary bridge constructed to the south was evaluated and determined to be the recommended alternative (Figures 2.6-1 and 2.6-2). The traffic impacts with Alternative 3C which uses phased construction which requires 1 lane of alternating traffic, were determined to be unfeasible through coordination with local officials. The ROW impacts and property acquisition required with Alternative 4B were determined to be unfeasible and was therefore eliminated from consideration. The utility impacts and coordination required with Alternative 3C were determined to be too large and was therefore also eliminated from consideration.

2.7 WIRE ROAD OVER THE F.E.E.T.

Existing Conditions

Wire Road is a north-south local thoroughfare which serves as a primary access road from residential areas of Merrimack, NH to U.S. Route 3. Baboosic Brook borders Wire Road east of the road along the northbound or east side of the turnpike. The existing bridge was constructed in 1954, and is a 4-span continuous painted steel multi-girder superstructure supporting a reinforced concrete deck. The total bridge length is 174'.

The 2016 NBIS Inspection Report notes that the Federal Sufficiency Rating is 64% with an NBI status of functionally obsolete. The bridge inspection reports noted various issues regarding the condition of the deck, superstructure and substructure. The structure carrying Baboosic Lake Road over the F.E.E.T. carries approximately 4,400 vehicles per day (vpd), and the volume is expected to increase to approximately 6,512 vpd in 2035. Refer to the *Engineering Report* for more details.

Design Considerations

Key design considerations included:

Span Configuration: A comparison evaluation was done to determine the cost difference between a simple span (assuming a 170' simple span structure) and a 2-span continuous structure with a pier constructed in the median of the reconstructed F.E.E.T. A simple span structure would eliminate construction activities in the median of the existing F.E.E.T., which would allow for a shorter construction duration while reducing traffic impacts to the F.E.E.T. Excluding the pier would eliminate a substructure item which is exposed to salt spray from nearby vehicles, thereby reducing future maintenance activities. A simple span structure removes a permanent traffic hazard, providing a safer corridor. Because of these factors, the decision was made to advance the alternatives as simple span structures.

*Abutment Type and Span Length: A*butment types were evaluated and developed which allow for construction of the abutments outside of and within the roadway clear zone. Per discussion with the NHDOT, it was determined that abutment systems and alternatives would be developed with abutments located within the clear zone. The benefits of locating the abutments within the clear zone are reduced span length, which reduces overall bridge cost, and a shallower overall structure depth, which reduces approach roadway impacts including ROW impacts on Wire Road.

Bridge Width: The existing structure is approximately 30'-5" wide, with two 11-0"' lanes, 1'-0" shoulders and 3'-3" safety curbs. The proposed structure width will be increased to 35'-0" wide to include two 11'-0" lanes, 5'-0" shoulders, and 1'-6" curbs. No sidewalks are provided on the existing bridge and none would be provided on the new bridge.

Bridge Alternatives

During the engineering study phase, multiple bridge replacement alternatives were identified for consideration and summarized for the Engineering Report. Rehabilitation of the existing structure was not considered a viable alternative because the widened F.E.E.T. cross section would require removal of the existing piers due to the increased roadway width. The existing F.E.E.T. vertical clearance beneath Wire Road is substandard (15’-9”), and would be reduced further with a widened F.E.E.T. mainline.

Several of the bridge alternatives developed were eliminated from consideration in the early stages of the evaluation process due to multiple factors. A summary of the eliminated alternatives and corresponding reasoning is summarized below:

Alternative 2 – Phased Construction: Alternative 2 would consist of replacing the bridge on its current alignment using phased construction. This alternative was eliminated from consideration because the use of phased construction for 2 construction seasons was determined to be unreasonable when discussed with local officials.

Alternative 3 –Complete bridge replacement maintaining traffic with a temporary bridge constructed to the north: Alternative 3 consists of constructing a temporary bridge to the north of the existing bridge and diverting traffic to the temporary bridge while a new structure is built along the alignment of the existing bridge. This Alternative was eliminated from consideration because the temporary environmental impacts to Baboosic Brook along the southeast approach are prohibitive, since the temporary approach roadway toe-of-slope would encroach on Baboosic Brook. An extensive retaining wall(s) or diversion structure(s) would need to be constructed to avoid impacting the brook, raising the cost considerably.

Alternative 5 – Complete bridge replacement maintaining traffic with a temporary bridge constructed to the south: Alternative 5 consists of constructing a temporary bridge to the south of the existing bridge, and diverting traffic to the temporary bridge while a new structure is built along the alignment of the existing bridge. This Alternative was eliminated from consideration because the temporary impacts to wetlands along the west side of Wire Road and the turnpike southbound are prohibitive and would require extensive retaining wall(s) or water diversion structures. Utilities along the west approach would also require relocation.

Alternative 6 – Complete bridge replacement to the south. Traffic maintained on the existing bridge: Alternative 6 consists of constructing an entire new bridge to the south of the existing bridge. Traffic would be maintained on the existing bridge while the new structure is built. This Alternative was eliminated from consideration because the temporary impacts to wetlands along the west side of Wire Road and the turnpike southbound are prohibitive and would require extensive retaining wall(s) or water diversion structure(s). Utilities along west approach would also require relocation.

Alternatives Studied in More Detail

Three alternatives were not eliminated and were advanced for further evaluation. These are Alternative 1, Alternative 4 and Alternative 7, and are summarized below.

Alternative 1 – Full bridge closure with signed detour. ABC methods to be utilized for a reduced closure duration: Alternative 1 would construct a new bridge along the existing Wire Road alignment. The existing bridge would be closed and traffic diverted to a signed detour. The bridge would be replaced using Accelerated Bridge Construction (ABC) techniques to minimize the closure duration.

Alternative 4 - Complete bridge replacement with approximately a 45' alignment shift to the north: Alternative 4 would construct a new bridge on a new alignment approximately 45' to the north of the existing bridge alignment. This bridge alternative would be constructed in one construction season and would have minimal impacts to local traffic. The new bridge structure would be slightly skewed in relation to the turnpike in order to limit the amount of approach roadway work required.

Alternative 7 – Hybrid Phased Construction - Complete bridge replacement with approximately a 25' alignment shift to the north: Alternative 7 would be a hybrid-phased construction alternative which maintains one-way alternating traffic on the existing bridge while the entire new bridge is constructed. Due to the configuration of the existing abutments, a phased construction replacement would require an approximate 25' shift of the alignment to the north. One lane of traffic would be maintained by removing a portion of the existing structure and placing temporary signals on each approach to provide alternating one-way traffic.

Key evaluation criteria are summarized below:

- Based on traffic control, it was determined that Alternative 1 was the preferred traffic control method. Through discussions with the local officials, it was determined that a bridge closure was not feasible and that one lane of traffic would need to be maintained during construction providing alternating one-way traffic.
- The right of way impacts for Alternative 4 are substantially higher than Alternatives 1 and 7. There is little difference between Alternatives 1 and 7 with regard to ROW.
- All alternatives require coordination and relocation (temporary and permanent) of the utilities. Therefore, all alternatives can be considered equally with regard to the utility impacts.
- Based on environmental impacts, Alternative 1 had the smallest overall level of impacts and was therefore preferable.

Recommended Alternative

Alternative 7 was evaluated and determined to be the recommended alternative (Figure 2.7-1). The traffic impacts associated with a full bridge closure were determined through conversations with local officials to be unfeasible. The environmental impacts and associated costs with the alignment shift of Alternative 4 were determined to be too large. The environmental impacts associated with Alternative 7 are smaller and can be mitigated with the construction of a wall along the northeast approach, which will limit impacts to Baboosic Brook. The bridge costs associated with this alternative were comparable to all other bridge costs when compared to the other replacement alternatives.

2.8 BABOOSIC BROOK

Existing Conditions – Culvert

The existing culvert is a twin-cell reinforced concrete box culvert. Both cells of the box culvert are 100’-6” in length and have a width of 15’ and a rise of 14’. The culvert has a condition rating and classification of 7 (good), and the culvert has a Federal Sufficiency Rating of 78% with an NBI status of Not Deficient.

Existing Hydraulic Conditions

The F.E.E.T. is classified as a secondary Interstate, and the State of New Hampshire has classified this highway as a Class I, which is considered to be a part of the primary state highway system. The NHDOT Bridge Design Manual requires that an adequate vertical freeboard height of 1 foot be provided at a minimum between the water surface elevation for the 100-year design flood event and the low chord of the structure. The existing culvert was analyzed with the HEC-RAS hydraulic modeling software to determine whether it meets the NHDOT freeboard requirement of 1’-0” minimum.

Based on the hydraulic analysis results, the Q100 elevation is above the top of the culvert, so the existing structure does not satisfy the freeboard requirement. In fact, FEMA floodplain mapping indicates the turnpike itself is inundated during the 100-year flood; although there is no historical record of the turnpike being inundated at this location. Therefore, retaining the existing structure and extending the culvert to accommodate the widened F.E.E.T. was removed from consideration for further evaluation.

Bridge Alternatives Description

During the initial phases of the type selection study, several alternatives were developed which were eliminated from consideration based on the initial results of the hydraulic analysis. A summary of the alternatives eliminated from consideration and the reasons they were eliminated is summarized below:

- Alternative 1 – Rehabilitation and extension of existing structure. This alternative was eliminated from consideration because it would perpetuate the inadequate hydraulic conveyance that is provided by the existing culvert.
- Alternative 2– Single cell culvert replacement. This alternative was eliminated from consideration due to the inadequate hydraulic conveyance that would be provided by the replacement culvert.
- Alternative 3– Multi-cell culvert replacement. This alternative was eliminated from consideration due to the inadequate hydraulic conveyance that would be provided by the replacement culverts.

This bridge is part of a series of bridges to be replaced along the downstream reach of Baboosic Brook by the NHDOT and the Town of Merrimack. The current FEMA flood elevations at the F.E.E.T. are controlled by the backwater conditions of the downstream structure over Baboosic Brook. The next structure downstream of the F.E.E.T. bridge over the Baboosic is the McGaw Bridge Road over Baboosic Brook, which replaced a 23-foot span, jack arch bridge with a 40-foot clear span bridge. Downstream of McGaw Bridge Road is the US Route 3 Bridge over the Baboosic Brook that is a 20-foot span concrete arch culvert which is currently proposed to be replaced with an 87-foot clear span bridge. The backwater conditions at this structure currently govern the flood elevations at both McGaw Bridge Road and the F.E.E.T. The US Route 3 bridge is scheduled to be replaced in 2023, which is currently expected to occur before the F.E.E.T. culvert replacement. Replacement of the US Route 3 structure will remove the backwater condition at the F.E.E.T., thereby changing the flood elevations at the structure and upstream reach.

The recently replaced (2016) McGaw Bridge Road Bridge downstream of the F.E.E.T. has an elevation at the structure (155.5’+/-) which is higher than the streambed elevation at the F.E.E.T. (153.8’). This elevation difference of 1.7’ is a primary reason the F.E.E.T. structure is shown as overtopping during a 100-year storm event. In order to increase the hydraulic conveyance, the profile elevation of the F.E.E.T. roadway would have to increase. Because providing a wider bridge does not provide an increase in hydraulic conveyance area, several alternatives were developed which raised the profile of the F.E.E.T. roadway to increase the hydraulic opening. A description of the alternatives and the reasons for their elimination from consideration are provided below:

- Alternative 4a – 90’ bridge span with full height abutments. This alternative was eliminated from consideration based on the results of the hydraulic analysis, which indicated that a longer span structure would not provide much additional hydraulic benefit compared to a 66’ structure.
- Alternative 4b - 90’ bridge span with integral abutments and sloping embankment. This alternative was eliminated from consideration based on the results of the hydraulic analysis, which indicated that a longer span structure would not provide much additional hydraulic benefit compared to a 66’ structure.
- Alternative 5a – 60’ bridge span with full height abutments. This alternative was eliminated due to the impacts required to construct a full height abutment with footing adjacent to the existing culvert and Baboosic Brook.
- Alternative 5b - 60’ bridge span with integral abutments and sloping embankment. This alternative was eliminated due to the integral abutment height required due with the sloping embankment.
- Alternative 6 – 66’ bridge span with sloping embankment. This alternative provided additional sloping embankment in order to accommodate wildlife passage, while also providing additional hydraulic area.

Three alternatives were developed based upon the preliminary hydraulic results developed for Alternative 6. These alternatives were developed in conjunction with the highway design to balance the hydraulic requirements of the structure and minimize the impacts to the alignment and profile of the F.E.E.T. The additional alternatives developed are summarized in Table 2.8-1 and described below.

Alternative 6A – On-line F.E.E.T. alignment with no profile increase

Alternative 6A would maintain the approximate existing alignment and profile and a 66' bridge span would be constructed. This alternative does not meet freeboard requirements and therefore was eliminated from consideration.

Alternative 6B – On-line F.E.E.T. alignment with profile increase

Alternative 6B would maintain the approximate existing alignment and a 66' bridge span would be constructed. The F.E.E.T. profile would be increased as needed to provide the minimum required freeboard.

Alternative 6C – 16' F.E.E.T. alignment shift to the west with a profile increase

Alternative 6C would construct a 66' bridge span. The F.E.E.T. alignment would be shifted 16' to the west and profiled would be increased as needed to provide the minimum required freeboard. Shifting the alignment would make reconstruction of the highway and construction of the new bridge easier than maintaining traffic on the existing alignment.

The final hydraulic analysis was performed for Alternative 6, and the results were used to determine what (if any) profile increase was required for the proposed F.E.E.T. Alternative 6A, with no profile increase, would not provide any freeboard; the inside top of the structure would be below the flood elevation. Alternatives 6B and 6C would have a profile increase of 3.1' and would provide 2.4' of freeboard.

Alternatives Conclusion

Alternative 6B was evaluated and determined to be the recommended alternative (Figures 2.8-1 and 4.5-12). Maintaining the approximate same roadway profile was determined to not be feasible because freeboard requirements would not be met. Alternative 6B would be approximately $2 million less than Alternative 6C. Based on this lower cost and the comparable hydraulic freeboard provided, Alternative 6B was recommended for further study. More detailed information regarding this structure is included in the Engineering Report (available separately).

Table 2.8-1. F.E.E.T. over Baboosic Brook final alternatives decision matrix

CONSIDERATION	ALTERNATIVE 6a – ON-LINE, NO PROFILE INCREASE	ALTERNATIVE 6b – ON-LINE WITH PROFILE INCREASE	ALTERNATIVE 6c – 16'ALIGNMENT SHIFT PROFILE INCREASE
Low Chord Elevation	168.65	171.75	171.75
Alignment Shift	None – Online	None – Online	16' West
F.E.E.T. Over Baboosic Brook Structure Span	66'	66'	66'
Profile Increase	0'	3.1'	3.1'
FEMA Q_{100} Freeboard Provided	**Q_{100} = -0.79'**	**Q_{100} = 2.31'**	**Q_{100} = 2.31'**
Natural Stream Bottom	Yes	Yes	Yes
Meets 1.2 x Bank Full Width (58.5')	Yes	Yes	Yes
Estimated Cost	**Total = $12.0M**	**Total = $13.1M**	**Total = $15.1M**
Decision	Eliminated from Consideration	**Recommended Alternative**	Eliminated from Consideration

2.9 STORMWATER TREATMENT

In order to comply with the *General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems* (2017), appropriate water quality measures were evaluated. The quantity and placement of stormwater best management practices (BMPs) is based on calculations that each BMP location would treat 4-8 acres of pavement area. Where geometric and ROW constraints preclude the construction of BMPs, vegetated treatment swales (VTS) were evaluated. It is estimated that BMPs and VTS could be provided as follows:

- Segment 1 (Southern) - 4 BMP locations plus 1 VTS
- Segment 2 (Middle) – 10 BMP locations plus 2 existing BMP modifications, plus 18 VTS in 6 different locations
- Segment 3 (Northern) - 2 BMP locations

The goal of the preliminary analysis of BMP placement was to capture stormwater runoff from all mainline highway pavement for treatment via existing or proposed BMPs located adjacent to the roadway.

Six areas were identified where treatment may not be possible due to roadway geometry (sag curve low points), environmentally sensitive areas, or archaeologically sensitive areas as follows:

- 814+00 to 822+00 – Pennichuck Brook crossing
- 942+00 to 975+00 – Naticook Brook crossing and archaeologically sensitive site
- 1011+00 to 1015+00 – Souhegan River crossing
- 1130+00 to 1136+00 – Roadway geometry
- 1338+00 to 1348+00 – Roadway geometry
- Archaeologically sensitive site

Proposed BMPs have been generally been assumed to be wet extended detention basins with sediment forebays. The water quality treatment volume (defined as the first inch of runoff and called WQV) was based on contributing highway length times the proposed 120’ wide pavement section. The BMPs are proposed with 4:1 slopes within the BMP where space allows, otherwise 3:1 slopes were used. Generally, BMPs would have a 10’ overall depth consisting of:

- 0 to 4 feet as permanent pool, sized to provide 50-100% WQV
- 4 to 5 feet as extended detention, sized to provide the remaining WQV

- 5 to 10 feet as detention, sized to provide the 50-year storm detention/retention volume using only the WQV orifice outlet (1.5” to 4”).

The standard BMP footprint varies by location but ranges from 115’ x 225’ up to 200’ x 550’. The preliminary footprints of all BMPs are indicated as rectangles, but the detention basins will be shaped to fit the existing topography, environmental constraints and available ROW.

Proposed vegetated treatment swales are designed to treat the water quality flow (defined as the resultant peak flow rate from the first inch of runoff and called WQF). Generally, a VTS has the following characteristics:

- Minimum length of at least 200 feet
- Maximum bottom width of 8 feet
- Longitudinal slope of between 0.5% and 2%
- Maximum flow depth of 4 inches at the WQF
- Minimum hydraulic residence time of 10 minutes during the WQF

2.10 Recommended Alternative

The recommended alternative consists of the following components:

- Widen the two-lane segments to three lanes in each direction with a 10’ outside shoulder, three 12’ travel lanes, and an 11’ inside shoulder. Follow the existing highway centerline with only slight variations, except at Pennichuck Brook.
- At Pennichuck Brook, shift the alignment 19 feet to the east in order to allow two lanes to remain open to traffic in both directions during construction of the new bridges and to minimize impacts to the brook.
- At the F.E.E.T. over Greeley Street, implement miscellaneous bridge rehabilitation measures.
- At Naticook Brook construct a new 90” diameter culvert with a natural stream bottom on new alignment to improve aquatic habitat and stream hydrology and avoid removing the extensive existing roadway fill.
- At the F.E.E.T. over the Souhegan River, modify the alignment and profile to achieve a superelevation that meets current guidelines.
- At Baboosic Lake Road over the turnpike, construct a temporary bridge on the south side of the existing road to keep two lanes open during construction. The proposed new bridge would have shoulders and sidewalks on both sides to accommodate bicyclists and pedestrians.

- At Wire Road over the turnpike, implement phased construction to keep one lane open in each direction during construction and construct a new two-lane bridge.
- At Baboosic Brook, raise the highway profile by approximately 3.1 feet and replace the existing twin box culverts with a new, 66' wide bridge that will accommodate the design storm event. The new structure will span the brook's bankfull width and provide shelves for wildlife crossing.
- Construct approximately 16 extended detention basins, modify 2 existing gravel wetlands, and construct approximately 19 treatment swales to treat as much stormwater runoff from existing and proposed roadway pavement as practicable.

2.11 Overall Project Cost Estimate

The overall project construction is currently estimated to be $114M. This cost does not include utilities or ROW. The cost is broken down by segment in Table 2.11-1 below.

Table 2.11-1. Project cost summary

PROJECT COST SUMMARY					
	SOUTH	**MIDDLE**	**NORTH**	**BABOOSIC LAKE ROAD BRIDGE**	**WIRE RD BRIDGE**
CONTRACT COST ESTIMATE	$ 21,110,000	$ 56,760,000	$ 11,960,000	$ 5,660,000	$ 4,390,000
CONTINGENCIES	$ 1,660,000	$ 5,060,000	$ 1,190,000	$ 210,000	$ 210,000
CONSTRUCTION ENGINEERING	$ 1,270,000	$ 3,410,000	$ 720,000	$ 340,000	$ 260,000
TOTAL	**$ 24,040,000**	**$ 65,230,000**	**$ 13,870,000**	**$ 6,210,000**	**$ 4,860,000**
TOTAL PROJECT COST	**$114,210,000**				

3 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter provides a detailed summary of the existing (baseline) conditions in the study area. The resources addressed include those specified in FHWA's National Environmental Policy Act (NEPA) guidelines, "Guidance for Preparing and Processing Environmental and Section 4(f) Documents" (T6640.8A). The "study area" is defined in general terms as the areas within and adjacent to the ROW, including areas where work is proposed outside the ROW, along the three segments being considered for widening. The "project area" refers to the broader general vicinity of the project, i.e., the turnpike and surrounding land use through Nashua, Merrimack, and Bedford, NH.

3.2 TRAFFIC AND TRANSPORTATION

3.2.1 Roadway Network Overview

The F. E. Everett Turnpike (F.E.E.T.), named for New Hampshire's first Highway Commissioner, was constructed during the early 1950s. The turnpike serves as a principal north-south arterial highway within the State and is part of the New Hampshire Turnpike System. The F.E.E.T. begins at the state border with Massachusetts where it is a continuation of Massachusetts State Route 3 and continues north 39.5 miles to Exit 14 in Concord, NH. It includes portions of Interstates 93 and 293 and provides a vital link for north/south travel.

The F.E.E.T. carries a mix of traffic including trucks, cars and buses, as well as commercial traffic vital to the region's economy. The F.E.E.T. corridor serves as a regional commuting route for residents of New Hampshire and Massachusetts as well as an important local route for the communities of Nashua, Merrimack, Bedford, and surrounding communities. It also serves as an important link for New England-wide travel to tourist destinations such as the New Hampshire Lakes Region, White Mountains, and ski areas. The project is composed of three segments in Nashua, Merrimack and Bedford.

Since the F.E.E.T. was constructed in the 1950s and 1960s, many segments and interchanges have been widened and improved. Currently, between the Massachusetts border and the I-293 interchange, all but three segments have at least three lanes in each direction. These three segments are two lanes in each direction. There are several interchanges associated with the three two-lane segments:

- Exit 8 at Somerset Parkway, a four-way interchange at the eastern terminus of the Parkway. The Parkway connects the F.E.E.T. with NH Route 101A and local roads.

- Exit 10 at Industrial Drive, a four-way interchange connecting the F.E.E.T. with US Route 3 to the east and Continental Boulevard to the west. In this area are a major outlet mall and large employers such as Fidelity and Anheuser-Busch.

- Exit 11 at Greeley Street, a four-way interchange connecting the F.E.E.T. with US Route 3 to the east and Amherst Road, businesses, and residential neighborhoods to the west.
- Exit 12 at Bedford Road, which has an off-ramp on the northbound side and an on-ramp on the southbound side. Bedford Road connects with US Route 3 to the east and local roads to the west. Dense residential development dominates this area.
- The Bedford tolls and Airport Access Road interchange, a four-way interchange connecting the turnpike with Manchester-Boston Regional Airport to the east.
- The I-293 interchange, a full four-way interchange at the northern terminus of the project. The F.E.E.T. passes through this interchange and continues north as I-293. I-293 and NH Route 101 continue as one highway to the east, while Route 101 continues to the west and I-293 continues northward.

3.2.2 Traffic Volumes and Levels of Service

Traffic volumes on the F.E.E.T. have grown substantially in recent years, resulting in frequent congestion and poor Levels of Service (LOS) on several road segments. Table 3.2-1 lists 2016 traffic volumes for both northbound and southbound project freeway segments.

Table 3.2-1. Freeway Peak Hour Traffic Volumes (2016)

	NORTHBOUND		SOUTHBOUND	
	AM	PM	AM	PM
Turnpike north of Raymond Wieczorek Dr.	2,975	3,779	3,730	3,064
Turnpike between Exits 12 & 13	2,579	3,691	3,565	2,774
Turnpike between Exits 11 & 12	2,879	4,212	4,512	3,139
Turnpike between Exits 8 & 10	10	3,122	3,645	3,425
Turnpike south of Exit 8	4,043	4,578	4,362	4,326

A traffic microsimulation model was developed for this project to model the performance of the turnpike and intersections at Exits 8, 10, 11, and 12 during the baseline year (2016) and two future years (2024 and 2044). The microsimulation model is calibrated to weekday AM and PM peak design hour conditions and is developed in the TransModeler software program. The model includes detailed information on roadway classification, speeds, geometrics, intersection controls, signal timings, and traffic volumes. The model is informed by vehicle origin/destination data collected by monitoring passing Bluetooth devices and counting traffic at intersections. Baseline, 2024, and 2044 traffic conditions are summarized in Section 4.2 of this Environmental Study.

The 2016 design hour traffic volumes (DHV is the 30th highest hourly volume for the design year), based on actual traffic counts, exceeded the theoretical capacity for the highway, reflecting existing levels of congestion and delays.

Level of Service (LOS) is a measure of how well or poorly a roadway handles traffic volumes. LOS A represents free-flow conditions with no backups or delays, and LOS F represents extreme congestion with major delays. In the three roadway segments with two lanes in each direction, traffic volumes increased between 25% and 40% from 2009 to 2015. In 2015, Average Daily Traffic volumes ranged from 46,600 to over 76,000 vehicles per day[11]. In the 2010 feasibility report[12], the 2009 Level of Service ranged between D and E. Observed traffic volumes from 2015 have already approached or exceeded the expected 2030 traffic volumes, and a Level of Service of F is frequently encountered along these turnpike roadway segments.

The traffic microsimulation model prepared for this study showed that the 2016 DHV exceeded the theoretical capacity for the highway. The 2016 PM peak hour levels of service were D between Exits 8 and 10, F on the Exit 11 northbound off-ramp, E between Exits 11 and 12, and D between Exits 12 and 13. During the AM peak hour, the worst segments were between Exits 12 and 13 (F), the Exit 12 southbound on-ramp (F), between Exits 11 and 12 (E), and the Exit 11 southbound off-ramp (E). By 2024, traffic is expected to increase by 10.4%, so congestion and delays will continue to increase if the roadway remains in its current configuration.

3.2.3 Crashes

Crash data was provided by the NHDOT for the years 2006 through 2016. Of the crashes reported, the majority occurred during dry roadway conditions and were located near on-ramps and off-ramps. Ramps with relatively high numbers of crashes included:

- Exit 12 Northbound Off-Ramp
- Exit 12 Southbound On-Ramp
- Exit 11 Northbound On/Off-Ramp
- I-293/F.E. Everett Turnpike Northbound On/Off-Ramp Weave

[11] Annual average daily traffic reported on NHDOT Bureau of Traffic website: https://www.nh.gov/dot/org/operations/traffic/tvr/routes/documents/feet.pdf

[12] *F.E. Everett Turnpike Widening Feasibility Report*, NHDOT 2010.

In addition, there are several crash locations that were not specifically located at ramp intersections where it appears that the geometry of the mainline segment, coupled with congested traffic conditions, are contributing factors to the higher incidence of crashes. These include:

- Northbound mainline lane drop at Exit 11
- Narrow shoulders on the bridge over Pennichuck Brook

Vehicle crashes cause property damage as well as injuries to drivers.

3.2.4 Infrastructure Deficiencies

There are certain deficiencies in the current infrastructure that pose safety concerns.

Based on preliminary survey data, the roadway superelevation (i.e., roadway banking in curved sections) along several of the curves does not meet current guidelines. In at least one area, the roadway profile was designed for a lower design speed than current posted speed limit.

Bridges associated with the F.E.E.T. also have structural and capacity deficiencies that need to be addressed, as described below. Additionally, there are several culverts along the corridor that will require lengthening.

- F.E.E.T. over Pennichuck Brook (Bridges 106/042 and 107/042): The 2016 NHDOT Bridge Inspection Report noted the Federal Sufficiency Rating[13] of both structures was 45.2%. The substructure condition and steel superstructure condition were both noted as “5” (Fair). The substructure had widespread locations of concrete spalling and the steel girders exhibited section loss to various components. The National Bridge Inventory status of the bridge was “functionally obsolete” (i.e., no longer functionally adequate for its task, in this case presumably due to substandard geometry such as limited shoulder widths).

- Baboosic Lake Road over F.E.E.T. (Bridge 107/131): The 2016 NHDOT Bridge Inspection Report noted that the Sufficiency Rating of this structure was 49% with a status of “structurally deficient” (i.e., one or more structural defects require attention). The substructure and deck condition were rated as “4” (Poor) due to heaving, spalling and other concrete-related problems. This bridge is also on the State’s Red List[14], which indicates one or more components of the bridge is in poor condition or the bridge requires weight limit restrictions.

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[13] The Sufficiency Rating is essentially an overall rating of a bridge's fitness for the duty that it performs. The rating is based on four separate factors which are derived from over 20 National Bridge Inspection data fields to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.

[14] See the NHDOT *2016 State Owned Red List Bridges* dated December 31, 2016. https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents/2016-12-31bridge_state_red_list.pdf

- Wire Road over F.E.E.T. (Bridge 114/140): The 2016 NHDOT Bridge Inspection Report noted that the Sufficiency Rating of this structure was 64% with a status of "functionally obsolete". The substructure and deck condition were rated as "5" (Fair). The superstructure was determined to be in satisfactory condition but exhibited collision damage and rust. This bridge is not on the State's Red List.

- F.E.E.T. over Baboosic Brook (Bridge 116/140): The 2016 NHDOT Bridge Inspection Report noted that the Sufficiency Rating of this structure was 77.7% with a status of "not deficient". The structure is classified as a culvert with an overall condition rating of "7" (Good), and it is not on the State's Red List. This structure is hydraulically undersized.

3.2.5 Local and Regional Planning

The project corridor lies within three municipalities (Nashua, Merrimack, and Bedford) and traverses two regional planning organizations.

The Nashua Regional Planning Commission's (NRPC) *Nashua Region Metropolitan Transportation Plan, 2015-2040*[15] identifies the F.E.E.T. as the primary north/south arterial in the region. The Plan states that the turnpike's lane reductions lead to "recurring congestion associated with bottleneck conditions", causing congestion and compromising safety. The Regional Plan specifically identified the segments between Exits 8 and 10 and between Exits 11 and 13 as having the most congestion. Exit 11 has more congestion than Exit 10.

Three of the objectives outlined in the NRPC Metropolitan Transportation Plan are:

- Manage travel demand and reduce peak hour travel time;

- Increase safety for all transportation system users; and

- Increase connectivity and decrease transportation-related emissions for the region.

More than 85 percent of the NRPC region's employers are located within one-quarter mile of the two major transportation corridors, the F.E. Everett Turnpike and Route 101A.

NRPC staff noted that the parallel Daniel Webster Highway gets overloaded when there is an accident or congestion on the F.E.E.T. Congestion has reportedly contributed to increasing "road rage" within the project area. They also noted specific safety concerns, including the lack of a concrete median barrier and problematic curvature.

The Southern New Hampshire Planning Commission's (SNHPC) 2015 regional plan, *Moving Southern NH Forward*[16], identifies the F.E.E.T. as a critical link in the region and statewide. A future no-build analysis

[15] The Regional Plan is published on the web at http://www.nashuarpc.org/web-apps/documents/?data=7&ccm_order_by=year_end&ccm_order_dir=desc

[16] Available on line at http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf

conducted by SNHPC indicated that the F.E.E.T. in Manchester and Bedford would be over capacity by 2035, and that capacity improvements would improve north-south highway travel. SNHPC staff added that the current two-lane sections are a safety concern.

The City of Nashua's master plan, *Nashua 2000 Master Plan*[17], supports safety improvements and reducing congestion on roadways. The City currently shifts workers' Friday schedules to avoid traffic congestion. Merrimack's 2013 Master Plan[18] identifies peak hour traffic congestion at Exit 11, and states that approximately 26 percent of crashes reported in Merrimack occurred on the F.E.E.T. and its ramps. Town planners are concerned with current levels of capacity and gridlock. Bedford planners also expressed concerns with safety and congestion along the existing F.E.E.T. corridor.

In recognition of these safety concerns, congestion, and deficiencies, the project has been included in the State's most recent *Ten-Year Transportation Improvement Plan 2017-2026*[19] for construction in years 2022 to 2024.

3.2.6 Transportation Demand Management

Transportation Demand Management (TDM) encompasses a variety of strategies that are designed to change personal travel behavior to reduce the demand for automobile use and the need for highway capacity expansion. TDM measures focus on providing incentives (or disincentives) to drivers who drive alone to encourage them to change their travel behavior to ride-share or use another mode of travel. This is accomplished through measures that reduce the number or length of drive-alone trips or that move trips out of times of peak roadway congestion. Examples of this include actively promoting ridesharing or providing and expanding alternative modes of transportation such as HOV lanes, park-and-ride facilities, bus services, and rail service. TDM measures that may currently be in practice along the F.E.E.T. corridor are described below.

Employer-Based Measures

TDM strategies are very effective in changing commuting behavior if they are implemented through employers. These programs encourage the use of transit, ride-sharing, or alternative travel modes.

Much of the work-related travel along the F.E.E.T. corridor is to workplaces in Nashua, or even further south in Massachusetts. These include employers along the I-95 (Route 128) and I-495 circumferential highways around Boston and even closer to the center of Boston itself. Employer-based TDM measures that would impact the F.E.E.T. corridor in New Hampshire would need to be implemented largely in Massachusetts.

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[17] http://www.snhpc.org/pdf/SNHPCRegionCompPlan2015.pdf

[18] http://www.merrimacknh.gov/community-development/pages/2013-master-plan

[19] https://www.nh.gov/dot/org/projectdevelopment/planning/typ/documents/ApprovalTYP-CompleteBook6.24.16.pdf

Implementation of employer-based TDM programs is frequently facilitated through ride-share brokerages or transportation management associations (TMAs). TMAs are groups that band together to address specific transportation issues in their area by implementing TDM measures for member employers. These are typically public/private partnerships that design, market, and implement programs that support commuting alternatives and administer incentives to employees who use the alternatives. These organizations also collaborate with state and local governments, public agencies, and transit operators to increase the availability of transportation alternatives. The Nashua Regional Planning Commission serves as a TMA for the greater Nashua region, and Massachusetts has a number of TMAs that provide a range of services to many New Hampshire residents who work in and around Boston.

Congestion Pricing

Congestion pricing is a TDM strategy that provides a financial disincentive to solo travel during peak periods of travel. Congestion pricing involves charging a premium price for use of a transportation facility during periods of congestion. Congestion pricing raises revenues that could be used to provide improved transit services as well as other needed improvements. However, it negatively affects low income and disadvantaged groups disproportionately and causes diversion on to local roads and streets that already have minimal excess capacity. In addition, commercial interests are normally skeptical of such pricing schemes as they feel it negatively impacts their businesses.

Congestion pricing is not currently implemented on the F.E.E.T.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) are often used in support of Transportation Demand Management (TDM). ITS can enhance communication between the user and the infrastructure providing the TDM measure. For instance, the NHDOT Traffic Management Center is already promoting the use of the 511 Travel Information Number as well as some other ride-sharing alternatives that are available to the public. Park and ride lots can also be enhanced as part of a coordinated effort to publicize the ride-sharing system. Many ride-sharing options are already publicized or available through the efforts of the Department of Transportation. As described below in the TSM section of this document, the NHDOT has already implemented many ITS measures that support TDM elements through its Transportation Management Center.

3.2.7 Transportation Systems Management

Transportation Systems Management (TSM) refers to short range, moderate cost measures aimed at reducing congestion and enhancing safety on the existing transportation system or roadway network. Generally, these measures involve little or no ROW impacts. On a project like this one, such measures might include adding ramp metering, modifying traffic signal timing or phasing, improving acceleration and deceleration lanes, and restriping of existing pavement markings. In addition, Intelligent Transportation System (ITS) technology, such as variable message boards and emergency communications, can be considered.

In general, TSM improvements cannot address the long-term safety and capacity needs of a highway, but can provide some short-term relief in advance of the ultimate solution. Descriptions of some TSM elements that could provide improved traffic flow are described below.

Geometry Improvements

Some improvements to traffic flow can often be realized by geometric improvements along the roadway. Steep grades or sharp horizontal curves can sometimes be improved providing conditions that reduce traffic congestion due to large vehicles. Trucks and other slow-moving vehicles, when combined with heavy volumes, can cause traffic backups that remain long after the initial delay. The turnpike from Nashua to Manchester has relatively gentle grades in most locations with only a few curves along its length. In the vicinity of the Souhegan River Bridge, the highway does not meet the 70 mph design speed superelevation requirements, and the project would flatten the curves to accommodate a normal crown section which would meet the design criteria for 70 mph.

Ramp Metering

The primary objective of any freeway control technique is to improve the safety and efficiency of mainline freeway operations by reducing the factors that increase freeway congestion. One method of freeway traffic control is freeway entrance ramp metering, commonly known as ramp metering. Ramp metering controls the access of vehicles on to the mainline, so that the vehicles entering upstream of the merge area are approximately proportional to the vehicles exiting downstream of the area. The purpose is to regulate freeway demand so that demand does not exceed highway capacity.

It has been shown in some cases that ramp metering can result in lower travel times, fewer crashes, and higher total travel. However, it can also cause substantial queues at metered entrance ramps because of a lack of alternative routes. If there is inadequate storage area, such queuing may extend onto local roadways and interfere with non-freeway traffic. Ramp metering is not currently in use anywhere in New Hampshire.

Shoulder Lane Use

The use of shoulders, or breakdown lanes, as travel lanes has been in existence in the United States for many years. Typically, opening shoulder lanes for travel during peak hours is primarily viewed as a temporary solution to peak period congestion until the permanent solutions are constructed. Using shoulders during construction is somewhat common within New Hampshire, but the use of shoulders as travel lanes during peak periods is not common, and is not currently practiced in the F.E.E.T. corridor.

Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) are applications of information processing, communications, control, and electronics to improve the efficiency and/or safety of a surface transportation system. While ITS technology may not eliminate the need to expand the physical infrastructure, it can make an important contribution on how efficiently the infrastructure is utilized. ITS are typically considered to be Transportation System Management (TSM) improvements, but they can also serve as Transportation Demand Management (TDM) strategies to address the needs of the corridor.

New Hampshire is, on its own and in concert with other states, developing and utilizing Intelligent Transportation Systems technologies. The F.E.E.T. corridor from Nashua to Manchester has been designated as one of the locations within the state where ITS is being implemented as part of an overall strategy organized through the state's Transportation Management Center. Responsible for Transportation Systems Management and Operations, the Center is implementing all ITS elements on the state's major highways, including the entire turnpike system. These include items like Recurring Traffic Management, Road and Weather Coordination, Emergency Operations, Security Management, Special Event Management, Service Patrol Management, and the 511 Traveler Information program. These ITS strategies are already helping to maintain traffic flow along the F.E.E.T. These strategies will continue to be used on this corridor in concert with any alternative that is selected for implementation.

3.3 Air Quality

FHWA's technical advisory on environmental documents, while not technically required for this project, requires consideration of air quality effects as part of NEPA compliance. This may include compliance with transportation conformity requirements under the Clean Air Act, emissions analysis to determine compliance with national standards, mobile source air toxics, and greenhouse gas emissions.

EPA designates "nonattainment areas" where air quality conditions exceed the National Ambient Air Quality Standards (NAAQS) for particular pollutants. When nonattainment areas come into compliance they may be redesignated as "maintenance areas". States are required to prepare a State Implementation Plan or SIP for nonattainment and maintenance areas. The SIP includes specific actions for achieving compliance with the NAAQS for each pollutant. The project area is designated as a maintenance area for ozone. The cities of Manchester and Nashua are designated as maintenance areas for carbon monoxide. A SIP has been prepared for compliance with the Clean Air Act.

Section 176(c) of the Clean Air Act prohibits Federal agencies from funding or approving activities that do not conform to an applicable SIP for achieving compliance with the NAAQS. A conformity determination may involve analysis of both regional and project level air quality effects.

The project is included in the latest Statewide Transportation Improvement Program plan (amended February 5, 2018) and is listed as a regionally significant project. In accordance with 40 CFR 93, the FHWA includes a finding of regional transportation conformity through the STIP. Therefore, a regional analysis outside of that completed for the STIP conformity determination is not necessary.

Project-level conformity must demonstrate that a project will not violate the NAAQS for six criteria air pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide). To determine whether a project may result in any local exceedances of the NAAQS, a microscale analysis must be completed to determine pollutant concentrations. This analysis generally focuses on carbon monoxide (CO) and particulate matter, the constituents that can be addressed at the project level. Under the Clean Air Act, this analysis is required for projects that are located in nonattainment or maintenance areas.

To demonstrate project-level conformity, a microscale analysis was completed for the three most congested intersections during the period of highest traffic volumes, specifically the 2044 Build Alternative. The intersections are:

- Exit 11 Northbound off and on ramp with Greeley Street
- Exit 12 Northbound off ramp with Bedford Road
- Exit 12 Southbound on ramp intersection with Back River Road and Bedford Road

Methods and results are reported in Chapter 4. Because the results were all well below the NAAQS, no analysis of existing conditions or other design years or alternatives was completed.

In addition to the six criteria pollutants, consideration must be given to Mobile Source Air Toxics (MSAT), which are seven hazardous air pollutants from mobile sources: acrolein, benzene, 1,3-butadiene, diesel particulate matter, formaldehyde, naphthalene, and polycyclic organic matter. MSATs are addressed in Chapter 4.

FHWA has not issued guidance addressing greenhouse gas emissions in NEPA reviews. Greenhouse gas emissions are to be considered depending on the significance or degree of controversy of the issue for the action. Greenhouse gas emissions are addressed in Chapter 4.

3.4 NOISE

3.4.1 Introduction

This section documents the results of a traffic noise analysis conducted for the F.E.E.T. improvement project. This analysis was prepared according to federal noise regulations, 23 CFR 772 (*Procedures for Abatement of Highway Traffic and Construction Noise*), and the *New Hampshire Department of Transportation Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I & II Highway Projects* (2016). Under the guidelines, Type I projects are defined as those involving the construction of new highways and/or the alteration of existing highways (e.g., realignment or addition of travel lanes). The alternatives addressed in this analysis are those that are considered Type I.

3.4.2 Methodology

The noise analysis included the following steps, in accordance with Federal Highway Administration (FHWA) and NHDOT policy:

1. Identification of existing activities and developed lands along the proposed alignment that may be impacted by highway noise.
2. Measurement of existing noise levels in the project area.
3. Determination of existing and future traffic noise levels for the project area, based on the field measurement data and the FHWA Traffic Noise Prediction Model (TNM 2.5).
4. Determination of existing and future traffic noise impacts. Impacts occur when traffic noise levels approach (within 1 decibel) or exceed the FHWA Noise Abatement Criteria, or when the predicted future traffic noise levels exceed the existing noise levels by 15 decibels or more.
5. Evaluation of traffic noise abatement measures at impacted locations.
6. Construction noise.

3.4.2.1 Criteria for Determining Impacts

Traffic Noise Terminology

Traffic noise levels are expressed in terms of the A-weighted sound level in decibels (dBA). The A-weighting scale approximates the frequency response of the human ear. Generally, when sound levels exceed the mid-60 dBA range, an outdoor conversation with a person approximately one meter (three feet) away becomes difficult to hear. A 10-decibel increase in sound levels is typically judged by the listener to be twice as loud as the original sound. Conversely, a 10-decibel reduction is typically perceived as half as loud. A doubling of traffic volumes will increase the sound level by approximately 3 dB, which is considered to be the smallest change to the A-weighted sound level that people, without specifically listening for a change, can notice.

Because most environmental noise fluctuates from moment to moment, it is customary to condense sound-level data from measurement periods into a single level called the equivalent sound level (L_{eq}). The L_{eq} is the value of a steady sound level that contains the same amount of energy as the actual time-varying sound evaluated over the same period. Typically, the A-weighted L_{eq} for traffic-noise analysis is evaluated during a one-hour period when the traffic volume and noise levels are at a daily high. The notation for this is L_{Aeq1h}.

The term insertion loss (IL) is used to describe the reduction in the L_{eq} at a location after the construction of a noise barrier. For example, if a new noise barrier reduced the L_{eq} at a residence from 75 dBA to 65 dBA, the insertion loss would be 10 dBA.

Noise Abatement Criteria (NAC) and Determination of Impact

23 CFR 772 identifies Noise Abatement Criteria (NAC) for various land uses (See Table 3.4-1). The NAC defines thresholds which, when approached or exceeded, indicate when noise abatement must be considered. By NHDOT policy, “approach” is defined as within 1 dBA of the NAC. Thus, impacts were determined to occur at properties where exterior sound levels were 66 dBA or higher for Activity Category B and C, and 71 dBA or higher for Activity Category E.

Noise impacts also occur, and consideration of abatement measures is also required, when the predicted future traffic noise is substantially higher than the existing noise levels. NHDOT policy defines “substantial” as an increase of 15 dB or more.

In determining traffic noise impacts and abatement measures, the primary consideration is given to exterior areas where a lowered noise level will be beneficial to “frequent human use” areas. Areas of “frequent human use” in residential areas are evidenced by the presence of patio furniture, picnic equipment, play equipment, gardens, etc. An entire residential lot is not necessarily defined as an area of “frequent human use”; only part of the property may be so defined. Locations where “lowered noise levels will be beneficial” do not normally include areas such as parking lots, athletic fields, or farm property (other than the house lot). Field reviews are conducted to identify areas where frequent human use occurs and a lowered noise level would be of benefit.

3.4.2.2 Existing Land Use and Noise Analysis Locations

Existing land use in the project area was identified by reviewing maps and aerial photography and conducting field investigations.

Noise Analysis Locations (NAL) are areas that represent logical groupings of receptors for the purposes of noise prediction and abatement analysis. The groupings can be based on a number of factors, including land use characteristics, the proximity of individual houses or structures to existing and proposed roadways, the terrain, and the location of the area. *Receptors* are individual sites or properties (e.g., a residence or playground). For this project, receptor locations for each NAL were selected to include the range of receptors that could be impacted or benefitted by the project. *Noise Measurement Sites* (NMS) are specific receptors at which existing noise levels are measured in the field. One Noise Measurement Site was established within each NAL (except Z, which was comparable to Y). The Land Use/Activity Category of each receptor was confirmed in the field.

Based on field review, 26 Noise Analysis Locations were initially established. Two locations were later determined to have only commercial land use with no exterior areas of frequent human use and were eliminated from analysis. One additional NAL (Z) was identified after the initial analysis was completed. An additional apartment complex at Exit 11 received Planning Board approval shortly before this Environmental Study was completed and was addressed but not formally analyzed. The boundaries for each of the remaining 25 Noise Analysis Locations are shown on Figures 3.4.2-1 and 3.4.2-2. As discussed in the following section, existing noise levels were measured at a minimum of one receptor per Noise Analysis Location (except Z, which was comparable to NAL Y). A description of each location is summarized in Table 3.4-2.

Table 3.4-1 Noise Abatement Criteria

Activity Category	L_{Aeq1h}*	Description of Activity
A	57 (Ext.)	Land 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	67 (Ext.)	Residential.
C	67 (Ext.)	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 (Int.)	Auditoriums, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, television studios.
E	72 (Ext.)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	-	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	-	Undeveloped lands that are not permitted.

* Hourly A-weighted sound level in decibels (dBA). Ext. = Exterior; Int. = Interior.

Table 3.4-2. Noise Analysis Locations

Noise Analysis Locations	Description	Activity Category	Approximate Number of Receptors	Noise Measurement Sites
A	Residential area along southbound/west side of F.E.E.T., northwest of Interchange 8.	B	45	R1
B	Residential area along southbound/west side of F.E.E.T., between Interchange 8 and Interchange 10.	B	10	R2
C	Residential area along southbound/west side of F.E.E.T., between Interchange 10 and Interchange 11.	B	40	R3
D	Residential area along southbound/west side of F.E.E.T., southwest of Interchange 11.	B	80	R4
E	Multi-unit residential area along northbound/east side of F.E.E.T., between Interchange 10 and Interchange 11.	B	40	R5
F	Multi-unit residential area along northbound/east side of F.E.E.T., southeast of Interchange 11.	B	100	R6
G	Residential area along northbound/east F.E.E.T., northeast of Interchange 11.	B	15	R7
H	Multi-unit residential area along northbound/east side of F.E.E.T., northeast of Interchange 11.	B	85	R8
I	Residential and Multi-unit residential area along northbound/east side of F.E.E.T., between Interchange 11 and Baboosic Lake Road.	B	45	R9
J	Multi-unit residential area along southbound/west side of F.E.E.T., between Interchange 11 and Baboosic Lake Road.	B	30	R10
K	Mastricola Elementary and Merrimack High Schools and vicinity along northbound/east side of F.E.E.T., south of Baboosic Lake Road.	B, C	2 schools plus 60 residences	R11

Noise Analysis Locations	Description	Activity Category	Approximate Number of Receptors	Noise Measurement Sites
L	Residential area along southbound/west side of F.E.E.T., along the north and south sides of Baboosic Lake Road.	B	25	R12
M	Residential area along northbound/east side of F.E.E.T., south of Wire Road.	B	20	R13
N	Residential area along northbound/east side of F.E.E.T., north of Wire Road.	B	25	R14
O	Residential area along southbound/west side of F.E.E.T., south of Wire Road.	B	25	R15
P	Residential area along southbound/west side of F.E.E.T., north of Wire Road.	B	15	R16
Q	Residential area along southbound/west side of F.E.E.T., southwest of Interchange 12.	B	35	R17
R	Residential area along northbound/east side of F.E.E.T., southeast of Interchange 12.	B	15	R18
S	Residential area along southbound/west side of F.E.E.T., northwest of Interchange 12.	B	35	R19
T	Residential area and church recreation area along northbound/east side of F.E.E.T., northeast of Interchange 12.	B	10	R20
U	Multi-unit residential area along northbound/east side of F.E.E.T., between Interchange 12 and Interchange 13.	B	100	R21
V	Multi-unit residential area along northbound/east side of F.E.E.T., southeast of Interchange 13.	B	75	R22
W	Commercial development northwest of Bedford tolls; no residential receptors	E	0	None
X	Residential area along southbound/west side of F.E.E.T., southwest of Interstate 293.	B	30	R25

Noise Analysis Locations	Description	Activity Category	Approximate Number of Receptors	Noise Measurement Sites
Y	Residential area along northbound/east side of F.E.E.T., southeast of Interstate 293.	B	3	R26
Z	Residential area along northbound/east side of FEET, southeast of Route 3 (South River road)	B	1	None

Note: Noise Measurement Sites R23 and R24 are not included because they were found to be commercial with no exterior land use and were eliminated from consideration.

3.4.2.3 Noise Measurement Procedures

Field noise measurement data were collected at the Noise Measurement Sites on August 15-17, 2016. A 3M SoundPro DL-2 sound level meter was used to measure sound levels at each measurement site over one 15-minute period. One measurement was taken at each site. Measurements were taken during daytime hours, including some AM and PM peak traffic hour periods. Vehicle classification counts were taken during each measurement period to record the volume of cars, medium trucks, heavy trucks, buses, and motorcycles for that 15-minute period.

3.4.2.4 Traffic Analysis

The noise analysis uses peak traffic volumes, when traffic volumes are at or near their highest levels and noise conditions are most likely to be at their highest levels, to determine noise levels in the project area. Traffic is broken down into autos/light trucks, medium trucks, heavy trucks and motorcycles.

3.4.2.5 Prediction of Noise Levels

The FHWA traffic noise prediction model, TNM 2.5, was used to predict traffic noise levels expected to occur with implementation of the proposed project. Peak-hour traffic projections were developed for existing (2016) and Design Year (2044) conditions, for both the No Build and one Build Alternative, including vehicle-mix information.

As a first step in the prediction process, the noise model was set up and run using the traffic volumes and classifications recorded during the 15-minute measurement periods. The noise levels predicted by the model were then compared to the measured noise levels. The measured noise levels and modeled noise levels were found to be within 1-3 decibels of each other at all measurement sites. This variation is considered acceptable and indicates that the overall model setup in terms of input variables (roadway and receiver geometry, traffic volumes, traffic mix and speeds, etc.) produces results that reflect actual conditions.

The year 2016 peak hour traffic volumes were then modeled, with the existing roadway configuration, to establish a baseline L_{Aeq1h}. Year 2044 (Design Year) noise levels for the No-Build and Build conditions were then predicted using the model. The predicted Year 2044 noise levels were compared to the Noise

Abatement Criteria and the 2016 modeled baseline L_{Aeq1h} (not to the 2016 measured noise levels) to determine the noise impacts associated with the project.

3.4.2.6 Noise Impact Analysis

Noise levels in the project area were evaluated in accordance with the noise impact analysis methodology described above. The existing and predicted noise levels were calculated for the receptors within each Noise Analysis Location that could be impacted by project noise. The calculated noise levels were compared to the appropriate Noise Abatement Criteria. The abatement analysis (Chapter 4) considered the receptors at each location which could benefit from noise abatement. Future noise levels and impacts along with an analysis of abatement measures are in Chapter 4.

3.4.2.7 Existing Noise Levels and Impacts

The highest noise levels modeled at each Noise Analysis Location for 2016 conditions are listed in Table 3.4-3. Noise levels approach or exceed the NAC (i.e., are 66 dBA or above) at 16 of the 25 Noise Analysis Locations. Future year noise levels, impacts, and potential abatement measures are addressed in Chapter 4.

3.5 WATER RESOURCES

Water resources present in the study area include groundwater, public water supplies, river, lakes, streams, ponds, associated floodplains, and wetlands. The following section provides a summary of these resources and the applicable state and federal regulations.

3.5.1 Groundwater

Groundwater aquifers are mapped through most of the study area, and groundwater is used locally to provide private and public drinking water sources as well as commercial and industrial water supplies. In recent years, per- and polyfluoroalkyl substances (PFAS) have been found in groundwater in portions of the project area. In recent years, per- and polyfluoroalkyl substances (PFAS) have been found in groundwater in portions of the project area. The NH Department of Environmental Services (NHDES) has identified Per- and polyfluoroalkyl substances (PFAS) as emerging contaminants and have developed Ambient Groundwater Quality Standards (AGQS) for two PFAS compounds, Perfluorooctanoic acid (PFOA) and Perfluorooctane Sulfonate (PFOS). NHDES will be setting Maximum Contaminant Levels (MCL's) for drinking water standards for PFOA, PFOS, Perfluorononanoic acid (PFNA) and Perfluorohexane sulfonic acid (PFHxS) by January 1, 2019. Groundwater that has the potential to have PFAS-impacted groundwater above AGQSs may be subject to management through a Groundwater Management Plan (GMP).

The NH Groundwater Protection Act (RSA 485-C) was passed in 1991, to protect and preserve valuable groundwater resources. The Act allows the New Hampshire Department of Environmental Services (DES) to regulate large groundwater withdrawals and commercial discharges of wastewater, establishes best management practices (BMPs) that must be employed by activities that are considered potential contamination sources, creates four classes of groundwater, establishes groundwater quality standards, and enables local municipal boards and water suppliers to actively manage activities that have the potential to contaminate groundwater.

Table 3.4-3. Modeled 2016 noise levels and impacts

NOISE ANALYSIS LOCATION	HIGHEST MODELED Leq IN NAL (2016)	IMPACT Y/N
A	67	N
B	69	Y
C	65	N
D	70	Y
E	71	Y
F	66	Y
G	72	Y
H	57	N
I	64	N
J	72	Y
K	67	Y
L	65	N
M	62	N
N	73	Y
O	70	Y
P	62	N
Q	72	Y
R	68	Y
S	72	Y
T	72	Y
U	67	Y
V	60	N
X	72	Y
Y	67	Y
Z	67*	Y

* Assumed comparable to NAL Y

3.5.1.1 Aquifers

Stratified Drift Aquifers

The F.E.E.T. is roughly parallel and to the west of the Merrimack River. Stratified drift aquifers associated with the Merrimack River and other major river systems along the project corridor underlay the majority of the study area (Figures 3.5.1-1 and 3.5.1-2). Stratified drift aquifers are typically composed of unconsolidated sand and gravel deposits, left behind by the melt waters from the deglaciation of the Merrimack River Valley. These aquifers provide an important source of groundwater for commercial, industrial, domestic, and public water supplies. Aquifer transmissivity quantifies the ability of an aquifer to transmit water horizontally.

The majority of the southern segment is underlain by a stratified drift aquifer with a transmissivity value of less than 2,000 feet squared per day. (Transmissivity is the rate at which water moves horizontally through an aquifer, and higher values generally indicate greater water availability.) There are two areas surrounding the Pennichuck Brook impoundment that have higher aquifer transmissivity. Near the southern end of the study area the aquifer has a transmissivity between 2,000 and 4,000 feet squared per day. At the location of the crossing of the F.E.E.T. over Pennichuck Brook the transmissivity of the aquifer increases to greater than 4,000 feet squared per day.

The southern half of the middle segment, from Exit 11 north to Baboosic Lake Road, is underlain by a stratified drift aquifer with a transmissivity value of less than 2,000 feet squared per day. The northern half of the middle segment is also underlain by an aquifer with a transmissivity value of less than 2,000 feet squared per day. Transmissivity increases in the vicinity of Baboosic Brook, north of Wire Road, and Dumpling Brook, near the northern end of the middle segment. Transmissivity in these areas ranges from 2,000 to over 4,000 feet squared per day.

Except for the areas surrounding the US Route 3 overpass/shopping center in Bedford, and the I-293 Interchange, the northern segment is underlain by a stratified drift aquifer with a transmissivity value of less than 2,000 feet squared per day.

Groundwater Classification Areas

The four classes of groundwater established by the NH Groundwater Protection Act include GAA, GA1, GA2, and GB; these classifications are described below:

- **Class GAA** is the most protected class. Groundwater in this class is within the wellhead protection area for wells which presently are used or well sites which have been identified for future use as drinking water supply for public water systems. GAA areas require an inventory of potential contamination sources within the wellhead protection area, and a management program.
- **Class GA1** is assigned to groundwater in a defined zone of high value for present or future drinking water supply. GA1 areas require an inventory of potential contaminant sources within the contributing area of this class in addition to a management program.
- **Class GA2** is assigned to groundwater within aquifers identified as highly productive for potential use as a public water supply. Zones of stratified drift with a saturated thickness greater than 20 feet, and a transmissivity greater than 1,000 feet squared per day are designated as class GA2. Zones of bedrock with average well yields greater than 50 gallons per minute are also designated as class GA2. GA2 areas have no land use restrictions and no

active management until the local community initiates reclassification to the GAA or GA1 class.

- **Class GB** shall be assigned to all groundwater not assigned to a higher class.

The entire southern segment is located within a GA2 Classification Area.

The majority of the middle segment is underlain by a GA2 Groundwater Classification Area, with the exception of the area surrounding Naticook Brook, north of Exit 11; the area between Baboosic Lake Road and Wire Road; and in the vicinity of Exit 12. These areas do not contain any higher Groundwater Classification Areas and are therefore classified as GB.

The northern segment does not contain any higher Groundwater Classification Areas and is therefore classified as GB.

Groundwater classifications of GA2 and GB do not have any land use restrictions or active management associated with them. There are no areas of groundwater classified as GA1 or GAA in the vicinity of the proposed project.

3.5.1.2 Public Drinking Water Systems

The New Hampshire Safe Drinking Water Act (RSA 485), regulates water systems according to the type and size of the population they serve. As defined in RSA 485, a Public Water Supply consists of a "piped water system for human consumption, serving 15 or more services or 25 or more people for at least 60 days per year." Public water systems can be classified into two groups.

1. **Community Wells:** 15 services used by year-round residents, or serves at least 25 year-round residents (includes municipal wells, apartments/condominiums, mobile home parks, and single-family home developments); and

2. **Non-Community Wells:** All non-residential public systems: Non-transient and Transient.

   Non-transient – 25 services, or serves 25 or more of the same people, for at least 6 months per year (includes schools, daycares, year-round office buildings, and commercial or industrial businesses with permanent employees).

   Transient – 15 services, or 25 different people, for more than 2 months (includes restaurants, motels, ski areas, campgrounds).

There are 12 Public Water Supply Wells located within 1 mile of the proposed project. Table 3.5-1 summarizes the wells located in the vicinity of the project.

Table 3.5-1. Public Water Supply Wells within One Mile of the Study Area.

Well ID Number	Town	System Name	Activity Status	System Type	Approximate Distance from Project (ft)
1621010-002	Nashua	PENNICHUCK WATER WORKS	Active	Community	4,700
1536010-001	Merrimack	ANHEUSER-BUSCH INC	Inactive	Non-transient, non-community	4,900
1531010-008	Merrimack	MERRIMACK VILLAGE DIST	Active	Community	3,400
1531010-005	Merrimack	MERRIMACK VILLAGE DIST	Active	Community	2,200
1531010-004	Merrimack	MERRIMACK VILLAGE DIST	Active	Community	2,100
0198010-001	Bedford	OLDE ROAD II	Active	Transient, non-community	5,000
0197030-001	Bedford	CAMP KETTLEFORD	Active	Transient, non-community	4,500
0196290-001	Bedford	EXPERT SERVER GROUP	Inactive	Non-transient, non-community	1,900
0192010-004	Bedford	BEDFORD WATER	Active	Community	4,600
0196150-001	Bedford	ALLSTATE INSURANCE CO	Inactive	Non-transient, non-community	85
0195020-001	Bedford	KELLOGG CHRISTIAN SCHOOL	Active	Non-transient, non-community	2,700
0195050-001	Bedford	PETER WOODBURY SCHOOL	Inactive	Non-transient, non-community	3,400

The largest community water supply well within a mile of the project area is the Pennichuck Water Works well located along Pennichuck Brook, approximately 4,700 feet down gradient from the project area in the southern segment. Pennichuck Brook serves as the public water supply for the greater Nashua area. The entire study area is located within the Source Water Protection Area (SWPA) made up of portions of the Pennichuck Brook and Merrimack River watersheds. The F.E.E.T. crosses over the impoundment on Pennichuck Brook known as Bowers Pond. There are two community wells located southeast of the study area, downstream from a series of dams. One of these wells is located on Harris Pond, and the other is located on Supply Pond. An additional community well is located north of these two wells along the Merrimack River. These three Public Water Supply Wells have associated Water Supply Intake Protection Areas. Anheuser-Busch Inc. has a non-transient, non-community well located along the Merrimack River, roughly 4,900 feet from the southern end of the middle segment.

Three community wells owned by the Merrimack Village District Water Works are located within a mile of the proposed project. The first is located upgradient from the project area, approximately 3,400 feet west of the southern end of the middle segment. There is a Wellhead Protection Area (WHPA) associated with this well (see Section 3.5.1.3). The remaining two wells are located adjacent to one another, approximately 2,100-2,200 feet east of the project area, south of Exit 12. These wells are currently inactive and do not have an associated WHPA.

The Old Road II and Camp Kettleford wells are two transient, non-community wells located roughly 5,000 feet southeast and 4,500 feet southwest of the southern end of the northern segment respectively. Bedford Water has a community well located approximately 4,600 feet southwest of the southern end of the northern segment, in the vicinity of the Camp Kettleford well. This well has an associated WHPA. The Allstate Insurance well is an inactive, non-transient, non-community well located directly adjacent to the F.E. Everett Turnpike in Bedford. This well is located approximately 85 feet east of the project area. The remaining wells include the Kellogg Christian School and the Peter Woodbury School. These are located upgradient/west of the southern segment of the project at a distance of 2,700 and 3,400 feet respectively. The Kellogg Christian School well has an associated WHPA.

The Town of Merrimack is replacing some of the private water supplies in the project area with public water lines because of PFAS contamination.

3.5.1.3 Wellhead Protection Areas

The NHDES has developed a Wellhead Protection Program for the purpose of protecting wells that serve as public water supplies. The New Hampshire Groundwater Protection Act (RSA 485-C) defines a Wellhead Protection Area (WHPA) as “the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach the water well or wellfield.” The wellhead protection program commits public water suppliers to regular inspections within the delineated WHPA to ensure that best management practices are being followed. Community and non-transient, non-community public water systems have delineated WHPAs, while transient systems and private domestic wells do not.

The proposed project area does not contain any WHPAs. There is a large WHPA in Merrimack located west of the F.E. Everett Turnpike between the southern and middle segments. This WHPA is associated with the Merrimack Village District Water Works community wells. This area is approximately 2,300 feet from the northern end of the southern segment, and 700 feet west of the southern end of the middle segment.

There is a small WHPA associated with the Kellogg School well, located approximately 1,600 feet west of the F.E. Everett Turnpike, south of the Interstate 293 interchange in Bedford. There is a cluster of three WHPAs associated with the Bedford Water community wells in Bedford located approximately 4,200 feet southwest of the southern end of the northern segment of the proposed project. There are no additional WHPAs in the vicinity of the project area.

3.5.2 Surface Waters

The following sections describe the surface water resources located within the study area including watersheds, lakes and ponds, rivers and streams, applicable state and federal regulatory programs, and water quality.

Surface water resources within the study area consist of rivers, streams lakes, and ponds. Surface waters are regulated in New Hampshire under the federal Clean Water Act (33 U.S.C. 1251 – 1376), the New Hampshire Dredge and Fill Law (NH RSA 482-A), and other programs discussed further below. State surface water resource regulations are administered by the New Hampshire Department of Environmental Services, Water Division. Surface water classifications referenced below are based on the U.S. Fish and Wildlife Service publication *Classification of Wetlands and Deepwater Habitats of the United States* by Cowardin et al. (1979).

3.5.2.1 Watersheds

There are four larger watersheds in the study area, and several smaller watersheds associated with some of the smaller perennial and intermittent streams. All of these are sub-watersheds of the Merrimack River watershed. The watershed areas are shown on Figure 3.5.2-1. The four larger watersheds include Pennichuck Brook, Naticook Brook, Souhegan River, and Baboosic Brook.

Throughout the southern segment the study area is located within the Pennichuck Brook watershed, a sub-watershed of the Merrimack River. The middle segment passes through the watersheds of Naticook Brook, the Souhegan River, Baboosic Brook, and Dumpling Brook, along with several smaller sub-watersheds. The northern segment includes areas draining to Patten Brook and directly to the Merrimack River.

3.5.2.2 Lakes and Ponds

There is one impounded stream in the study area. There are also several wetlands with areas of open water, discussed further in Section 3.5.4. Figures 3.5.2-2 and 3.5.2-3 show the locations of surface waters located throughout the proposed project corridor.

Pennichuck Brook (S-1)

Pennichuck Brook, identified as S-1 on project mapping, is a tributary of the Merrimack River that flows through the southern segment of the project. At the location of the F.E.E.T. crossing, Pennichuck Brook is a lacustrine system that has been artificially created by a series of dams downstream. The impoundment has a Cowardin Classification of L1UBHh. The watershed size at the location of the F.E.E.T. crossing is approximately 26.9 square miles. Pennichuck Brook originates from Silver Lake in Hollis, NH and flows northeast. It flows through Dunklee Pond and continues through Pennichuck Pond. Several tributaries flow into Pennichuck Brook including Muddy Brook, which also empties into Pennichuck Pond, and Witches Brook. Pennichuck Brook then flows under NH Route 101A, before turning east flowing into a series of impoundments created by dams including Holts Pond, Bowers Pond, Harris Pond, and Supply Pond, before reaching the confluence with the Merrimack River. Several of these impoundments including Bowers Pond, Harris Pond, and Supply Pond are used as drinking water reservoirs for the Greater Nashua area. The F.E.E.T. crosses over the Pennichuck Brook in the area also known as Bowers Pond where it forms the boundary between Nashua, NH to the south and Merrimack, NH to the north. The Bowers Pond impoundment on Pennichuck Brook is approximately 79.2 acres.

3.5.2.3 Rivers and Streams

There are several perennial and intermittent streams within the study area (Table 3.5-2). Ordinary high water (OHW) and top of bank (TOB) were delineated for surface waters based on hydrologic, topographic, and vegetative characteristics, and other indicators.

Streams can be classified by size based on a hierarchy of tributaries, known as the Strahler stream order system. First order streams are the smallest tributaries at the headwaters located in the upper reaches of a watershed. The stream order increases when two streams of the same order meet. For example, a second order stream begins at the confluence of two first order streams, and a third order stream begins at the confluence of two second order streams.

Unnamed Stream (S-2)

Stream S-2 is an unnamed stream, possibly perennial, located between the southern and middle segments of the proposed project, south of Exit 11. At the location of the crossing the stream is a first order stream with a watershed size of 0.28 mi^2 (181 acres). The stream appears to originate from a pond approximately 1,000 feet west of the F.E. Everett Turnpike, and flows to the east. The stream appears to be a relatively low gradient stream with associated palustrine forested floodplain adjacent to the channel. This stream has a Cowardin Classification of R3UB5H.

Naticook Brook (S-3)

Naticook Brook is a perennial stream located near the southern end of the middle project segment. The stream originates southwest of the study area at the outlet of Naticook Lake in Merrimack, NH. It flows to the northeast for approximately 3.5 miles through Greens Pond and continues underneath the F.E.E.T. At the location of this crossing the stream flows through a 60” RCP culvert. The existing outlet is slightly perched during low-flow conditions. East of the study area the brook flows into Horseshoe Pond and the associated wetland complex in that area, before draining into the Merrimack River. At the location of the crossing with the F.E.E.T. Naticook Brook is a 2nd order stream and has a watershed size of approximately 3.2 mi^2 (2,028 acres). The stream has a Cowardin Classification of R3UB1H.

Table 3.5-2. F.E. Everett Turnpike Widening - Stream Crossing Summary

Town	Waterbody Name	Regime	Watershed Size (acres)	NH Stream Crossing Guidelines Tier	Impairments [2016 303(d) List]	Use Description	TMDL* Completed
Nashua/Merrimack	Pennichuck Brook	Perennial	15,320	3	Iron	Aquatic Life	No
Merrimack	Unnamed	Perennial	181	1			
Merrimack	Naticook Brook	Perennial	2,028	3			
Merrimack	Souhegan River	Perennial	109,422	3	Aluminum Oxygen, Dissolved pH	Aquatic Life	No
Merrimack	Unnamed	Intermittent	64	1			
Merrimack	Unnamed	Perennial	219	2			
Merrimack	Baboosic Brook	Perennial	30,982	3	Benthic-Macroinvertebrate Bioassessments Oxygen, Dissolved	Aquatic Life	No
Merrimack	Unnamed	Intermittent	N/A	N/A			
Merrimack	Dumpling Brook	Perennial	299	2			
Bedford	Patten Brook	Perennial	1,830	3	Aluminum	Aquatic Life	No
Bedford	Unnamed	Intermittent	102	1			
Bedford	Unnamed	Intermittent	19	1			

* TMDL is the Total Maximum Daily Load of pollutants designated for some impaired waterways.

Souhegan River (S-4)

The Souhegan River begins southwest of the study area in New Ipswich, NH, at the confluence of the South Branch of the Souhegan and the West Branch of the Souhegan. The Souhegan River flows northeast/east for approximately 34 miles before reaching the Merrimack River. The watershed is approximately 171.0 mi^2 (109,422 acres) at the location of the crossing. This crossing is spanned by a bridge. It flows through the middle segment of the project, and is a 5th order stream at this location. The Souhegan River has a Cowardin Classification of R3RB1H.

Unnamed Tributaries to Baboosic Brook (S-5 and S-6)

An unnamed intermittent stream (S-5) is located in the middle project segment west of the Wire Road overpass in Merrimack, NH. This stream flows from south to north underneath the F.E.E.T., through a 24" RCP culvert, and then flows northeast, parallel to the southbound lanes of the roadway, before reaching the confluence with an unnamed stream (S-6). The watershed size of this stream is approximately 0.1 mi^2 (64 acres). This stream has a Cowardin Classification of R4SB5J.

Stream S-6 is an unnamed perennial stream located in the northwest quadrant of the Wire Road crossing over the F.E.E.T. This stream is a small tributary to Baboosic Brook. Stream S-6 flows from the northwest, and is joined by S-5, just before flowing under the F.E.E.T. through an RCP culvert with a 30" inlet and a 36" outlet, before discharging into Baboosic Brook. The approximate watershed size is 0.3 mi^2 (219 acres). This stream has a Cowardin Classification of R4SB4J.

Baboosic Brook (S-7)

Baboosic Brook originates from Baboosic Lake, located west of the study area, on the border between the towns of Merrimack, NH and Amherst, NH. The stream flows for approximately 12.7 miles, before draining into the Souhegan River, just west of the confluence with the Merrimack River. Baboosic Brook flows underneath the F.E.E.T. in the middle project segment through twin 15' box culverts, north of the Wire Road overpass in Merrimack. At this location it is a 4th order stream, with a watershed size of approximately 48.4 mi^2 (30,982 acres) and a Cowardin Classification of R2UB2H. The river flows from north to south through the study area. Intermittent Stream 2 flows into Baboosic Brook inside the study area, near the southeast quadrant of the Wire Road Bridge over the F.E.E.T.

Dumpling Brook and Tributary (S-9 and S-8)

Dumpling Brook (S-9) flows from northwest to the southeast through the northern end of the middle segment of the project. This perennial stream originates west of the study area in an area with a high density of residential development with forest interspersed. It flows for approximately 1.6 miles, and crosses underneath the F.E.E.T. through a 36" RCP culvert before reaching the Merrimack River. The watershed is approximately 0.5 mi^2 (299 acres). Stream S-8 is a small unnamed intermittent stream flows from west to east and joins Dumpling Brook just outside the study area. This stream does not continue on the west side of the F.E. Everett Turnpike and receives most of its flow from existing drainage. Watershed mapping does not delineate a separate watershed for this area, rather it is included as part of the Dumpling Brook Watershed.

Patten Brook (S-10)

Patten Brook is located in the northern project segment, just south of the I-293 interchange. The stream originates west of the study area from a small pond located on a golf course. Several smaller tributaries feed this pond. The stream flows east for approximately 1.7 miles, crossing US Route 3 and the F.E.E.T., before reaching the Merrimack River south of the I-293 bridge. The existing structure underneath the F.E.E.T. crossing consists of a 72” RCP culvert. At the location of the F.E.E.T. crossing, this is a 3rd order stream with a watershed size of approximately 2.9 mi^2 (1,830 acres). On the upstream side of the F.E.E.T. this stream has a Cowardin Classification of R3RB1H, and on the downstream end it is classified as R3UB1H. A small intermittent channel enters this stream within the study area east of the turnpike.

Unnamed Stream (S-11) in I-293 Interchange

Intermittent stream S-11 is located just north of I-293, at the interchange. The stream flows from the west underneath the F.E.E.T. through a 24” RCP culvert, then turns to the north and flows underneath the exit ramp, and continues to a small pond, before draining into the Merrimack River. The stream has a relatively small watershed size of only 0.2 mi^2 (102 acres) at the F.E.E.T. crossing. At the location of the crossing it is a 2nd order stream, with a Cowardin Classification of R4SB3J.

3.5.2.4 Federal and State Regulatory Jurisdiction

New Hampshire Stream Crossing Rules

The NHDES Stream Crossing Rules (Env-Wt 900) classify stream crossings as Tier 1, Tier 2, or Tier 3 based largely on watershed size. A Tier 1 stream crossing has a watershed of less than or equal to 200 acres, a Tier 2 stream crossing has a watershed size greater than 200 acres and less than 640 acres, and a Tier 3 stream crossing has a watershed size of 640 acres or greater. A Tier 1 or 2 stream crossing is upgraded to a Tier 3 if any of the following conditions are met: the stream crossing is located within ¼ mile of a designated river; the stream crossing is located within 100 feet of a prime wetland unless a prime wetland buffer waiver has been granted; the stream crossing is in a jurisdictional area that contains a protected species or habitat; the stream crossing is located within a 100-year floodplain or fluvial erosion hazard zone; or the stream crossing carries a watercourse that is listed on the current 305(b) report as not attaining surface water quality standards based on benthic macroinvertebrate index, fish assemblage index, habitat assessment, or stream channel stability. A stream crossing that is classified as Tier 3 based solely on the presence of protected species or habitat can be downgraded to a Tier 1 or Tier 2, based on watershed size, with the concurrence of NHB and/or NH F&G that impacts to the protected species or habitat will be avoided or mitigated. Table 3.5-2 summarizes the stream crossings located within the study area, including the watershed size, existing structure, and Stream Crossing Tier.

New Hampshire Designated Rivers

The New Hampshire Rivers Management and Protection Act (RSA 483) was established in 1988 to protect certain rivers for their outstanding natural and cultural resources. In order to be classified as a Designated River, a portion of a perennial river must have been specifically designated by the general court pursuant to RSA 483:15. There are four classifications of Designated Rivers including Natural, Rural, Rural-community, and Community. The Designated River corridor is defined as the river and the land area located within 1,320 feet (¼ mile) of the normal high water mark or to the landward extent of the 100-year floodplain as designated by the Federal Emergency Management Agency (FEMA), whichever distance is greater.

Each Designated River has a Local River Management Advisory Committee (LAC). The LAC develops and implements a River Management Plan and coordinates activities affecting the river on a regional basis. At the state level, the NHDES assists with the development and implementation of the management plan and enforces regulations concerning the quality and quantity of flow in protected river segments.

The Souhegan River is a NH Designated River from the confluence of its south and west branches in New Ipswich to the confluence with the Merrimack River in Merrimack. It is classified as a rural river from the point 0.5 miles below the Route 13 bridge in Milford to the F.E.E.T. bridge in Merrimack, and as a community river from the F.E.E.T. Bridge to the confluence with the Merrimack River in Merrimack.

The Lower Merrimack River is also a NH Designated River, with a community classification from the Bedford-Merrimack town line to the New Hampshire-Massachusetts state line. The northern end of the northern project segment is within ¼ mile of the Merrimack River.

Since parts of the project are located within the Designated River Corridors of the Souhegan River and Lower Merrimack River, coordination will occur with both the Souhegan River LAC and the Lower Merrimack River LAC.

Shoreland Water Quality Protection Act

In order to protect the water quality of the state's public waterbodies, minimum standards for activities within the Protected Shoreland have been established under RSA 483-B, The Shoreland Water Quality Protection Act (SWQPA). The SWQPA applies to all lakes, ponds, and artificial impoundments greater than 10 acres in size, coastal waters, perennial rivers classified as 4^{th} order or larger, as well as Designated Rivers, lakes, and ponds.

The Protected Shoreland is defined as all land located within 250 feet of the reference line (natural mean high water level or limit of flowage rights). Within the study area, Pennichuck Brook, Souhegan River, and Baboosic Brook fall under the jurisdiction of the SWQPA. A permit from the NHDES Shoreland Program would be required for any earth disturbance and tree clearing within the Protected Shoreland.

Navigable Waters

Under Section 9 of the Rivers and Harbors Act of 1899, and the General Bridge Act of 1946, the US Coast Guard has the authority to approve proposed bridge and/or causeway locations and plans. The primary purpose of these Acts is to preserve the public right of navigation and to prevent interference with interstate and international commerce.

In New Hampshire, the US Army Corps of Engineers has determined the Merrimack River to be navigable from the Massachusetts-New Hampshire state line to Concord, NH. Two other water bodies in northern New Hampshire were also designated as navigable. Since the proposed project will not involve any work within the Merrimack River or any other navigable waters, navigable waters will not be further addressed in this Environmental Study.

3.5.2.5 Water Quality

Section 303(d) of the Clean Water Act requires each state to submit a list of impaired waters to the US EPA every two years to identify surface waters that are impaired by pollutants, not expected to meet water quality standards within a reasonable time, and require the development of a Total Maximum Daily Load (TMDL) study. This list is prepared by NHDES as outlined in the *2016 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology*. According to the NHDES 2016 303(d) list (most recent available), the following waterbodies that occur in the study area are listed as impaired:

- Pennichuck Brook (Assessment Unit ID NHLAK700061001-04-02) is impaired due to iron.
- The Souhegan River (Assessment Unit ID NHRIV700060906-18) is impaired due to aluminum, dissolved oxygen, and pH.
- Baboosic Brook (Assessment Unit ID NHRIV700060905-19) is impaired due to dissolved oxygen, and benthic-macroinvertebrate bioassessments.
- Patten Brook (Assessment Unit ID NHRIV700060803-12) is impaired due to aluminum.

TMDLs have not been completed for any of the impaired waterbodies in the project area.

3.5.3 Floodplains

Federal regulations (23 CFR 650, 44 CFR 9) and Executive Order 11988 provide that federal projects must address impacts to floodplains and floodways. For the purposes of federal regulations, the 100-year floodplain is the regulated floodplain or Base Flood. The Federal Emergency Management Agency (FEMA) defines Base Flood as “the flood having a one percent chance of being equaled or exceeded in any given year” (44 CFR 59.1). This term is used in the National Flood Insurance Program (NFIP) to indicate the minimum level of flooding to be used by a community in its floodplain management regulations.

The Regulatory Floodway is defined in FEMA’s regulations (44 CFR 59.1) as “…the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.” The floodway also holds waters traveling at the highest velocities during a flood event.

State Executive Order 96-4 requires NH state agencies to comply with the floodplain management regulations of all communities that participate in the National Flood Insurance Program (NFIP). The City of Nashua, Town of Merrimack, and Town of Bedford all participate in the NFIP. The project lies within the mapped 100-year floodplain and regulatory floodway of several streams and one impoundment (Figures 3.5.3-1 and 3.5.3-2).

Pennichuck Brook

The F.E.E.T. crosses over Pennichuck Brook (Bowers Pond) in the southern project segment. Pennichuck Brook flows through a series of dams downstream, creating a reservoir used for drinking water supply. The study area lies within the 100-year floodplain and the regulatory floodway of this waterbody. Roughly 0.5 miles south of the bridge crossing, on both the northbound and southbound sides of the F.E.E.T., the study area includes a finger of the 100-year floodplain. On the east side of the turnpike there is an area of open water that is part of Pennichuck Brook, and on the west side there is a forested wetland. The two are connected by a 24” reinforced concrete culvert underneath the roadway.

Naticook Brook

This crossing is located near the southern terminus of the middle project segment. The study area occurs within the 100-year floodplain and regulatory floodway of Naticook Brook. On both the east and west sides of the F.E.E.T. the floodplains are relatively narrow, but east of the study area, in the vicinity of Horseshoe Pond, the floodplain widens extensively, before the confluence with the Merrimack River.

Souhegan River

The 100-year floodplain and regulatory floodway of the Souhegan River lie within the study area. This crossing is located in the middle project segment. At the location of the crossing, the river is contained within a well-defined, narrow valley with relatively high and steep banks. The floodplain is only slightly wider than the floodway in this area. The bridge over the Souhegan River was recently replaced and is wide enough to accommodate three lanes of traffic in both directions.

Baboosic Brook

This crossing is located in the middle project segment just north of Wire Road. Floodwater modeling shows that at this location, the existing roadway surface is overtopped by the 100-year flood event, although NHDOT has not found any records of that occurring. Baboosic Brook is a low gradient, meandering stream with extensive floodplains on both sides of the roadway in this area. The existing structure consists of twin 15’ closed cell box culverts, and is hydraulically undersized.

Patten Brook (South of I-293 Interchange)

The 100-year floodplain and regulatory floodway of this stream occur within the study area on both sides of the F.E.E.T. On the northbound side, the stream channel is linear and appears to be channelized.

On the southbound side, the substrate is predominately bedrock and the stream is well contained within the channel. West of the study area the stream is meandering and the floodplain is wider.

3.5.4 Wetlands

Wetlands are regulated by the federal government under the Clean Water Act (CWA). Section 404 of the CWA provides that discharges of dredged or fill materials into waters of the United States require a permit from the Army Corps of Engineers (ACOE). Waters of the United States include any non-isolated wetlands that meet the three parameters (hydrology, soils, and vegetation) as defined in the 1987 ACOE Wetlands Delineation Manual. The ACOE has issued a General Permit (GP) to the State of New Hampshire that expedites ACOE authorizations for projects with impacts up to three acres. Projects or actions with greater than three acres of impacts do not fall under the GP, and an individual ACOE permit would be required.

Federal Executive Order 11990, issued in 1977, is intended to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands". The Order, which applies to federal activities and programs affecting land use, requires federal agencies to consider alternatives to wetland impacts and to limit potential damage if an activity affecting a wetland cannot be avoided.

Wetlands are regulated in New Hampshire under RSA 482-A, Fill and Dredge in Wetlands. The law defines a wetland as “an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” Under NHDES Administrative Rules, wetlands are delineated on the basis of the 1987 ACOE Manual. NH law also regulates surface waters and their banks. “Bank” is defined in the rules as “the transitional slope immediately adjacent to the edge of a surface water body, the upper limit of which is usually defined by a break in slope….” A permit is required from NHDES if the applicant proposes dredge or fill in jurisdictional areas.

Wetland resource boundaries were delineated in July-September 2016 within the limits of the project based on the 1987 US Army Corps of Engineers *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* and the 2012 *Regional Supplement to the Corps Wetland Delineation Manual: Northcentral and Northeast Region*. Wetland flag locations were surveyed using a Trimble Geo7x handheld GPS unit with sub-meter accuracy. Wetlands were classified utilizing the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979, US Fish and Wildlife Service).

The wetlands within the study area consist of a variety of palustrine, riverine, and lacustrine systems. Palustrine wetland types that were identified include forested, shrub-scrub, emergent, and open water wetlands. Wetland project locations, classifications, and descriptions are provided in Table 3.5-3 (at the end of Section 3.5.4). Refer to Figures 3.5.2-2 and 3.5.2-3 for the locations of delineated wetlands throughout the project corridor.

The majority of wetlands in the study area were palustrine forested wetlands, typically dominated by red maple (*Acer rubrum*). Several potential vernal pool wetlands were identified along the study area. Additional wetlands included wet meadows, emergent marshes, ditches, and shrub-swamps.

3.5.4.1 Functions and Values

Wetland functions and values were evaluated using the US Army Corps of *Engineers Highway Methodology Workbook Supplement: Wetland Function and Values*, and are summarized in Table 3.5-4.

3.5.4.2 New Hampshire Prime Wetlands

In New Hampshire, individual municipalities may elect to designate wetlands as "prime-wetlands" pursuant to RSA 482-A and administrative rules Env-Wt 700. Wetlands are typically designated as prime because of large size, unspoiled characteristics, and ability to sustain populations of rare or threatened plant and animal species. A wetland designated as prime is assigned a 100-foot prime wetland buffer unless the town chooses to waive this buffer. The towns of Merrimack and Bedford do not contain any prime wetlands. The Town of Nashua has designated prime wetland in the study area along Pennichuck Brook. Nashua has waived the 100-foot buffer for all of its prime wetlands.

3.5.4.3 Vernal Pools

A vernal pool is a specific type of wetland that exhibits a seasonal flooding and drying cycle. According to NHDES (Env-Wt 101.108) vernal pools typically have the following characteristics: cycles annually from flooded to dry conditions, although the hydroperiod, size, and shape of the pool might carry from year to year; forms in a shallow depression or basin; has no permanently flowing outlet; holds water for at least two continuous months following spring ice-out; lacks a viable fish population; and supports one or more primary vernal pool indicators, or three or more secondary vernal pool indicators. Primary vernal pool indicators include the presence or physical evidence of breeding by spotted salamander (*Ambystoma maculatum*), Jefferson Salamander (*Ambystoma jeffersonianum*) blue-spotted salamander (*Ambystoma laterale*), marbled salamander (*Ambystoma opacum*), wood frog (*Lithobates sylvatica*), or fairy shrimp (*Eubranchipus spp.*). Vernal pools are considered essential breeding habitat for these primary indicator species. Secondary indicator species include clam shrimp (Orders: *Spinicaudata and Laevicaudata*), fingernail clams (Family: *Sphaeriidae*), spire-shaped snails (Families: *Physidae and Lymnaeidae*), flat-spire snails (Family: *Planorbidae*), aquatic beetle larvae (Families: *Dytiscidae, Gyrinidae, Haliplidae, Hydrophilidae*), caddisfly larvae (Families: *Limnephilidae, Phryganeidae, Polycentropodidae*), damselfly larvae (Families: *Coenagrionidae and Lestidae*), dragonfly larvae (Families: Aeshnidae and Libellulidae), and true fly larvae or pupae (Families: Culicidae, Chaoboridae, Chironomidae). Vernal pools also provide valuable habitat for a variety of other species of amphibians, turtles, snakes, birds, and mammals.

Potential vernal pools were identified during the wetland delineation that was conducted during July and August 2016. A total of ten potential vernal pool sites were identified within or in the immediate vicinity of the study area. Potential vernal pool sites were revisited on April 17, 2017 to confirm the presence or absence of primary and secondary indicator species, and determine whether these areas are functioning as vernal pools.

Southern Segment

Vernal Pool 1 is located approximately 0.3 miles north of the Tinker Road overpass in Nashua. This wetland area is approximately 125 feet from the highway and was not identified during the wetland delineation because of its distance from the roadway. This vernal pool is an isolated depression, in a forested area between Pennichuck Brook and the F.E.E.T. The area of open water is relatively large and deep. A total of 17 wood frog egg masses were counted in the pool. Spring peepers (*Pseudacris crucifer*) were also heard around the pool.

Middle Segment

Vernal Pool 2 (wetland W-9 on project mapping) is located in Merrimack, north of Exit 11, in a thin strip of forested habitat bordered by the turnpike to the east, and commercial development to the west. This area is an isolated depression that receives drainage from the roadway and nearby parking lots. Buttonbush (*Cephalanthus occidentalis*) is dominant in the shrub layer, and covers approximately 80 percent of the pool. Water depth in the pool was approximately two feet, with a substrate of leaf litter. Primary indicator species identified in the pool included 40 wood frog egg masses, and seven unknown mole salamander species egg masses. Spring peepers were also heard around the pool.

Vernal Pool 3 (W-11) is located in Merrimack, north of the Souhegan River on the west side of the turnpike. This area is a large open water wetland that remains permanently flooded but does not appear to support an established fish population. This area was delineated in August 2016 and still contained water in the middle. The substrate in this pool was sphagnum moss and muck. Buttonbush and leatherleaf (*Chamaedaphne calyculata*) are scattered around the pool in areas of shallower water, and red maple (*Acer rubrum*) is dominant along the edges. The depth of the pool exceeds 4 feet. Approximately 200 wood frog egg masses were observed in three separate clusters in this pool. Spring peepers were heard, and a garter snake (*Thamnophis sirtalis*) was seen along the edge of the pool.

Vernal Pool 4 (W-13) is located in Merrimack, just south of Baboosic Lake Road, on the west side of the turnpike. This area is an isolated depression, vegetated by aquatic grass species with buttonbush interspersed. This is a relatively large pool with an approximate depth of two feet. There are some anthropogenic disturbances including highway drainage and automotive debris (tires, transmission, etc.). A total of 14 wood frog egg masses and three unknown mole salamander egg masses were identified in the pool. Dense herbaceous vegetation in the pool and tannic water clarity could have potentially obscured additional egg masses. An adult wood frog was also observed in the pool.

Vernal Pool 5 (W-14) is located north of Baboosic Lake Road, on the west side of the turnpike. This pool is an isolated depression surrounded by forested habitat. Water in the pool was dark and tannic, and approximately 3-4 feet deep. Vegetation along the edges of the pool included highbush blueberry (*Vaccinium corymbosum*), winterberry (*Ilex verticillata*), sheep laurel, and leatherleaf. Approximately 30 wood frog egg masses were identified in this pool.

Vernal Pool 6 (W-19) is located adjacent to Baboosic Brook on the west wide of the turnpike. This pool is a depression located within the forested floodplain of Baboosic Brook. Water in the pool was tannic, and approximately 2-3 feet deep. The pool contained 3 wood frog egg masses, and fairy shrimp were abundant throughout the pool.

Vernal Pool 7 is a complex of pools (W-20) located on the west side of the turnpike, within the floodplain of Baboosic Brook. Not all of the pools contained primary indicator species but within this complex eight wood frog and three spotted salamander egg masses were identified. A painted turtle (*Chrysemys picta*) was found swimming in one of the pools. The water depth in these pools varied between 1-2 feet.

Vernal Pool 8 (W-21) is located opposite Vernal Pool 7 on the east side of the turnpike. This area appears to be a relic feature of Baboosic Brook. Water in this pool was approximately 2-3 feet deep. Primary indicator species included four wood frog egg masses. This pool did not appear to be as heavily used as some of the others in the study area. Wetland area WNBSH009f is located adjacent to WNBSH008e, and was identified as a potential vernal pool during the wetland delineation. WNSH009f is a small wooded depression, however no primary indicator species were identified in this pool.

Potential Vernal Pool 9 (W-24) is a forested depression located on the east side of the turnpike, south of Exit 12. This area is a broad, shallow depression, but only contained a small area of standing water at the time of the survey. The water was approximately one foot deep. There was no vegetation and little woody debris within the pool. No primary indicator species were identified. This wetland area does not appear to function as a vernal pool.

Potential Vernal Pool 10 (W-42) is a small forested depression located within the I-293 interchange. This area has limited habitat potential, as it is surrounded by multilane highways on all sides. The pool was approximately two feet deep, with a substrate of muck and leaf litter. The edges of the pool were surrounded by highbush blueberry and white pine (*Pinus strobus*). No primary indicator species were identified in the pool at the time of survey. This is likely due to the fragmentation of the surrounding habitat by the existing highways.

Table 3.5-3. Wetland Descriptions

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-1	Southern	Nashua	PSS1E	W-1 is a small palustrine scrub-shrub depression location adjacent to W-1. This area is located on the east side of the F.E. Everett Turnpike, north of the Tinker Road overpass. Dominant vegetation found in this wetland included red maple and white pine in the tree stratum; glossy buckthorn in the sapling/shrub stratum; and cinnamon fern, broad-leaf cattail, poison ivy, and purple loosestrife in the herbaceous stratum. Indicators of hydrology included saturation.
W-2	Southern	Nashua	PEM1Ed/Eh, L2UBFh	W-2 consists of a finger of the Pennichuck Brook impoundment, constructed stormwater treatment areas, and a ditch/swale along the toe-of-slope of the F.E. Everett Turnpike. These areas are all hydrologically connected. Dominant vegetation occurring in this wetland included glossy buckthorn and willows along the edges of the open water areas, and soft rush, purple loosestrife, American bur-reed, and tussock sedge in the herbaceous layer. Hydrology indicators included surface water and saturation.
W-3	Southern	Nashua	PFO1E	W-3 is a palustrine forested wetland depression located on the west side of the F.E. Everett Turnpike. This wetland extends outside the study area, and is hydrologically connected to Pennichuck Brook according to NWI wetland mapping. This area also coincides with the 100-year floodplain of Pennichuck Brook. Dominant vegetation includes red maple and white pine in the tree stratum. The herbaceous layer was sparse and consisted of marsh fern and small-spiked false nettle. Soils were saturated.
W-4	Southern	Nashua	PFO1E	W-4 is a palustrine forested fringe wetland along the Pennichuck Brook impoundment located in the southwest quadrant of the bridge crossing. Dominant vegetation in this wetland included red maple and American elm in the tree stratum; winterberry and maleberry in the sapling/shrub stratum; and marsh fern, sensitive fern, awl-fruited sedge, bladder sedge, and common arrowhead in the herbaceous stratum. Indicators of hydrology included saturation at a depth of approximately 8 inches. Soils were sandy loams with a layer of mucky mineral soil at the surface. These soils met the hydric soil indicator A11: Depleted Below Dark Surface.
W-5	Southern	Merrimack	PFO1E	W-5 is a palustrine forested fringe wetland along the Pennichuck Brook impoundment located in the northwest quadrant of the bridge crossing. Dominant vegetation in this wetland included red maple, white pine and green ash in the tree stratum; red oak in the sapling/shrub stratum; and cinnamon fern, hay-scented fern, and New York fern in the herbaceous stratum. This wetland area is located within the 100-year floodplain of Pennichuck Brook. Soils were silty loams with a depleted matrix and redoximorphic features.
W-6	Southern	Merrimack	PFO1E	W-6 is a palustrine forested fringe wetland along the Pennichuck Brook impoundment located in the northeast quadrant of the bridge crossing. Dominant vegetation in this wetland included red maple and white pine in the tree stratum; red maple in the sapling/shrub stratum; and cinnamon fern in the herbaceous stratum. This wetland area is located within the 100-year floodplain of Pennichuck Brook.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-7	Southern	Merrimack	PFO1E	W-7 is a small palustrine forested wetland located on the west side of the F.E. Everett Turnpike near the northern terminus of the southern project segment. This area is a small ditch that drains into a culvert flowing east underneath the F.E. Everett Turnpike (the outlet was not delineated because it is located outside of the proposed project area). This wetland is separated from a small pond to the west by a berm, and is hydrologically connected via a culvert through the berm. Dominant vegetation in this wetland included red maple and gray birch in the tree stratum; speckled alder in the sapling/shrub stratum; and spotted touch-me-not, small-spike false nettle, and several species of sedges in the herbaceous stratum. Indicators of hydrology included saturation and surface water. Soils were mucky sandy loams underlain by sand, and met hydric soil indicator A4: Hydrogen Sulfide Odor.
W-8	Middle	Merrimack	PEM/FO1E	W-8 is a large palustrine emergent/forested wetland complex. The wetland is located along the toe-of-slope on the west side of F.E. Everett Turnpike, south of Exit 11. The emergent portion of this wetland is a relatively thin strip along the existing ROW, and is dominated by common reed. The wetland transitions into a forested wetland and continues outside of the project area. Perennial stream S-2 is associated with this wetland complex. Soils were mucky and saturated with pockets of surface water present in lower lying areas.
W-9	Middle	Merrimack	PSS1E	W-9 is an isolated palustrine scrub-shrub vernal pool wetland in a depression surrounded by a narrow buffer of upland forest, and the F.E. Everett Turnpike to the east, and large parking lots to the west, north, and south. Vegetation in this wetland was dominated by buttonbush throughout the wetland, with winterberry and red maple along the edges. Unknown ambystomid salamander (likely Jefferson, blue-spotted, or a hybrid) egg masses were documented in this pool during a spring 2017 vernal pool survey. Sedimentation from the surrounding parking lots and highway was evident.
W-10	Middle	Merrimack	PFO1E	W-10 is a forested seep wetland located along the toe-of-slope of the F.E. Everett Turnpike, north of the Souhegan River crossing. Dominant vegetation in this wetland included red maple in the tree stratum, and winterberry in the sapling/shrub stratum.
W-11	Middle	Merrimack	PUBH	W-11 consists of a large area of open water that appears to be permanently/semi-permanently flooded, with a palustrine emergent/forested fringe. This area also functions as a vernal pool. Wood frog egg masses were documented in this wetland during the spring 2017 vernal pool survey. Dominant vegetation included rice-cut grass, white meadowsweet, and red maple. This pool is hydrologically connected to a larger forested wetland complex that extends to the west, outside the project area.
W-12	Middle	Merrimack	PFO1E	W-12 is a palustrine forested wetland located on the west side of the F.E. Everett Turnpike. Vegetation in this area was dominated by red maple and white pine in the tree stratum. The herbaceous layer was sparse but included bristly dewberry. Microtopography was present in the form of pit-mound topography. Soils were saturated and exhibited characteristics of spodic development.
W-13	Middle	Merrimack	PEM1E	W-13 is a palustrine emergent wetland located on the west side of the F.E. Everett Turnpike, south of the Baboosic Lake Road overpass. This wetland is a relatively large depression that is seasonally flooded and functions as a vernal pool. Spotted salamander and wood frog egg masses were documented in this wetland during a spring 2017 vernal pool survey. Dominant vegetation in this wetland included rice-cut grass and devil's beggar-ticks in the herbaceous layer and buttonbush in the shrub layer.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-14	Middle	Merrimack	PFO1E	W-14 is an isolated palustrine forested depression located north of the Baboosic Lake Road overpass, on the west side of the F.E. Everett Turnpike. The depression is a sparsely vegetated concave area and is a classic vernal pool, with wood frog egg masses documented during a spring 2017 vernal pool survey. Vegetation around the perimeter of the pool included red maple, highbush blueberry, winterberry, and sheep-laurel.
W-15	Middle	Merrimack	PFO1E	W-15 is a palustrine forested wetland associated with intermittent stream S-5, located southeast of the F.E. Everett Turnpike. Dominant vegetation in this wetland included red maple and white pine in the tree stratum; spicebush in the sapling/shrub stratum; and cinnamon fern, rough goldenrod, and Canada mayflower in the herbaceous stratum.
W-16	Middle	Merrimack	PFO1E/EM1E	W-16 is a palustrine forested wetland associated with intermittent stream S-5, located northwest of the F.E. Everett Turnpike. Vegetation documented in this wetland included red maple, yellow birch, and eastern hemlock in the tree stratum; red maple, winterberry, black elderberry, and spicebush in the sapling/shrub stratum; and spotted touch-me-not and cinnamon fern in the herbaceous stratum.
W-17	Middle	Merrimack	PEM1E	W-17 is a small palustrine emergent seep wetland located on the southeast side of the F.E. Everett Turnpike, east of the Wire Road crossing. This entire wetland area is located within a cleared and maintained mowed ROW area. The wetland drains to the northeast via an excavated drainage swale to another small depression with a culvert pipe inlet that drains under the highway. Dominant vegetation in this wetland included sedges, grasses, sensitive fern and broadleaf cattail.
W-18	Middle	Merrimack	PSS1E	W-18 is a palustrine scrub-shrub drainage associated with a small unnamed perennial stream (S-6). This area is located north of the F.E. Everett Turnpike and west of Wire Road. Dominant vegetation in this wetland included red maple, winterberry, maleberry and spicebush in the sapling and shrub stratum; and spotted touch-me-not, sensitive fern, and cinnamon fern in the herbaceous stratum.
W-19	Middle	Merrimack	PFO1E	W-19 is a palustrine forested depression located within the floodplain and adjacent to Baboosic Brook, northwest of the F.E. Everett Turnpike. This area is also a vernal pool wetland, with fairy shrimp and wood frog egg masses documented during a spring 2017 vernal pool survey. The majority of the wetland area is sparsely vegetated, but the edges were vegetated with red maple, cinnamon fern, and royal fern.
W-20	Middle	Merrimack	PEM1E/SS1E/FO1E	W-20 is a palustrine emergent/scrub-shrub wetland located primarily within a maintained utility ROW, on the northwest side of the F.E. Everett Turnpike. Wood frog egg masses were documented in a seasonally flooded depression within this larger wetland during the spring 2017 vernal pool survey. This area is located within the 100-year floodplain of Baboosic Brook. A culvert outlet and channelized forested drainage is located near the western edge of this wetland and hydrologically connects this wetland area to W-21. Dominant vegetation in this wetland included red maple and eastern hemlock in the tree stratum; speckled alder, buttonbush, and white meadowsweet in the sapling/shrub stratum; and cinnamon fern, royal fern, and sedges in the herbaceous stratum.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-21	Middle	Merrimack	PEM1E/FO1E	W-21 is primarily a palustrine emergent wetland located on the southeast side of the F.E. Everett Turnpike, across from wetland W-21. This area drains to the west to a culvert hydrologically connecting the two wetland areas. Recent development in the area has encroached on the wetland and the forested buffer surround it. It is located within the floodplain of Baboosic Brook, and appears to be a historic oxbow of Baboosic Brook that has since been isolated. Although not a high quality vernal pool, wood frog egg masses were documented in this area during the spring 2017 vernal pool survey. Dominant vegetation in this wetland included marsh fern, New York Fern, cinnamon fern, and sedges.
W-22	Middle	Merrimack	PFO1E	W-22 is a small isolated palustrine forested depression located just north east of W-21. This small area consisted of a sparsely vegetated concave surface, with Massachusetts fern in the herbaceous stratum, and red maple and American elm around the edges.
W-23	Middle	Merrimack	PFO1E	W-23 is a forested depression located northwest of the F.E. Everett Turnpike. This area is located in the 100-year floodplain, and also appears to have once been a part of the historic Baboosic Brook channel associated with wetlands W-22 and W-21. Soils in this area were saturated and consisted of a thick organic layer underlain by depleted mineral soil. Vegetation in this wetland included red maple, sedges, and Massachusetts fern.
W-24	Middle	Merrimack	PFO1E	W-24 is a forested depression located southeast of the F.E. Everett Turnpike. This sparsely vegetated concave depression was vegetated with devil's beggar-ticks, small-spike false nettle, and Japanese knotweed and red maple around the perimeter. This area resembles a vernal pool, and while inundated during the 2017 vernal pool survey, no primary indicator species were documented utilizing this wetland area.
W-25	Middle	Merrimack	PSS1E	W-25 includes a palustrine emergent cattail marsh in the interior of the wetland with palustrine scrub-shrub/forested areas around the perimeter. The wetland is located just north of the Exit 12/Bedford Road overpass on the west side of the F.E. Everett Turnpike, between the highway and Back River Road. Tree species documented in this wetland included black gum, pin oak, and red maple. The sapling and shrub layer around the edges was dominated by red maple, winterberry, and buttonbush, while the herbaceous layer contained broadleaf cattail and purple loosestrife.
W-26	Middle	Merrimack	PFO1E/SS1E/EM1E	W-26 is a ditched wetland complex located on the east side of the F.E. Everett Turnpike. Drain pipes from the highway contribute to some of the hydrology of this wetland. There is an open palustrine emergent area dominated by broadleaf cattail and purple loosestrife. The palustrine forested portion of this wetland is vegetated with red maple, spotted touch-me-not, sensitive fern, and poison ivy. This area drains to the northeast via an excavated ditch. The ditched area exhibited hydric soils with depleted matrix and redoximorphic features. Vegetation growing in the ditch included American elm and red maple saplings.
W-27	Middle	Merrimack	PFO1E	W-27 is an isolated palustrine forested wetland area located along the existing toe-of-slope, west of the F.E. Everett Turnpike. Vegetation was dominated by red maple, black birch, red oak, and eastern hemlock in the tree stratum and cinnamon fern in the herbaceous stratum.
W-28	Middle	Merrimack	PFO1E	W-28 is a palustrine forested depression located on the west side of the F.E. Everett Turnpike. Soils were saturated and exhibited redoximorphic features. Vegetation was dominated by red maple in the tree and sapling strata, and cinnamon fern and Massachusetts fern in the herbaceous stratum.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-29	Middle	Merrimack	PFO1E	W-29 is a small palustrine forested area associated with Dumpling Brook (S-9) and an unnamed intermittent stream (S-8). Vegetation was dominated by red maple in the tree stratum; red maple and white pine in the sapling/shrub stratum; and marsh fern and tussock sedge in the herbaceous layer. Soils were saturated.
W-30	Middle	Merrimack	PFO1E	W-30 is a palustrine forested wetland associated with Dumpling Brook, located on the west side of the F.E. Everett Turnpike. Soils were saturated at the surface, and a high water table was observed. Vegetation in this wetland included red maple, white pine, and tussock sedge.
W-31	Middle	Merrimack	PFO1E	W-31 is a palustrine forested depression located to the west of the F.E. Everett Turnpike. Soils in this area exhibited a depleted matrix with redoximorphic features. Vegetation was dominated by red maple trees and saplings and highbush blueberry in the shrub layer.
W-32	Middle	Merrimack	PEM1E/FO1E	W-32 is a palustrine emergent stormwater swale located on the west side of the F.E. Everett Turnpike, near the northern end of the middle project segment. This area drains southwest to a riprap swale down the embankment and empties into a palustrine forested wetland that continues outside of the delineation area.
W-33	Northern	Bedford	PSS1E/EM1E/FO1E	W-33 is a large wetland complex located south of the southern end of the northern project segment, on the east side of the F.E. Everett Turnpike. The palustrine emergent/scrub-shrub portion of this wetland is dominated by winterberry, maleberry, highbush blueberry, black chokeberry, leatherleaf, and red maple in the sapling and shrub stratum. The herbaceous stratum was dominated by broadleaf cattail, purple loosestrife, woolgrass, and cinnamon fern. The surrounding palustrine forested wetlands contained swamp white oak, red maple, eastern hemlock, and white pine. Soils in the forested areas were saturated and exhibited spodic characteristics.
W-34	Northern	Bedford	PEM1E	W-34 is an existing stormwater detention basin located behind a small office park, east of the F.E. Everett Turnpike. Surface water was present in the wetland. Soils were saturated and with a layer of muck at the surface. The area was vegetated by broadleaf cattail.
W-35	Northern	Bedford	PEM1E/FO1E	W-35 includes a palustrine forested area and a palustrine emergent ditch that drains to the north into the forested area. This wetland is located near the southern end of the northern segment, on the west side of the F.E. Everett Turnpike. Dominant vegetation included red maple in the tree stratum; American elm, glossy buckthorn, red oak, and white pine in the shrub stratum; and cinnamon fern, royal fern, Massachusetts Fern, and Canada mayflower.
W-36	Northern	Bedford	PEM1E	W-36 is a small grass swale located on the east side of the F.E. Everett Turnpike. Drainage pipes from the existing highway contribute to the hydrology of this area. The wetland is located within the existing mowed ROW. Vegetation in this area included grasses, sedges, and sensitive fern. Soils were saturated and exhibited the hydric soil indicator F6: Redox Dark Surface.
W-37	Northern	Bedford	PFO1E	W-37 is a small palustrine forested depression wetland located east of the F.E. Everett Turnpike. Vegetation in this wetland included red maple, marsh fern, and sensitive fern. Hydrology indicators included geomorphic position and water stained leaves.
W-38	Northern	Bedford	PFO1E	W-38 is a palustrine forested wetland associated with Patten Brook, located east of the Turnpike, south of the I-293 interchange. Dominant vegetation in this wetland included red maple and red oak trees; witch hazel, red maple, and red oak in the sapling/shrub stratum; and sensitive fern, marsh fern, New York fern, cinnamon fern, royal fern, poison ivy, Oriental bittersweet, and Canada mayflower. Soils were silty floodplain soils that exhibited redox.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-39	Northern	Bedford	PFO1E	W-39 is a palustrine forested wetland area associated with the floodplain of Patten Brook. This wetland is located to the east of W-38 and is hydrologically connected outside of the delineation area. Dominant vegetation in this wetland included red maple and cinnamon fern. Surface water was present in low laying areas within this wetland.
W-40	Northern	Bedford	PEM1F/PUBH	W-40 is a palustrine unconsolidated bed wetland with areas of emergent wetland along the edges. This is a large area of open water located within the clover leaf of the I-293 interchange F.E. Everett Turnpike northbound onramp. This area is permanently flooded. The majority of the wetland is open water, however wetland vegetation present included red maple, winterberry, white meadowsweet, broadleaf cattail, purple loosestrife, water lilies, and blue vervain.
W-41	Northern	Bedford	PEM1E	W-41 consists of a ditch that runs along a parking lot, west of the F.E. Everett Turnpike, south of the I-293 interchange. This area drains to the south before opening up into a larger wet meadow. Dominant vegetation in the shrub stratum included red maple and glossy buckthorn. Dominant herbaceous vegetation included broadleaf cattail, purple loosestrife, sensitive fern, and marsh fern.
W-42	Northern	Bedford	PFO1E	W-42 is a small, isolated forested depression located in the I-293 interchange on the east side of the F.E. Everett Turnpike. The area resembled a vernal pool, however no indicator species were observed during the spring 2017 vernal pool surveys. Soils consisted of a thick organic layer of muck, underlain by depleted mineral soils. Vegetation around the edges of the depression included red maple, white pine, winterberry, and highbush blueberry. Buttonbush was dominant in the middle of the wetland.
W-43	Northern	Bedford	PEM1E	W-43 is a palustrine emergent ditch located on the east side of the F.E. Everett Turnpike, within the I-293 interchange. Vegetation in this wetland included broadleaf cattail, purple loosestrife, and rough goldenrod.
W-44	Northern	Bedford	PFO1E	W-44 is a palustrine forested wetland system associated with intermittent stream S-11. This area is located adjacent to the stream in a narrow floodplain area. Vegetation in this wetland was dominated by red maple in the tree stratum; winterberry, green ash, glossy buckthorn, and American hophornbeam in the sapling/shrub stratum; and sensitive fern, Canada mayflower, and rough goldenrod in the herbaceous stratum. Soils were saturated, and exhibited a depleted matrix with redoximorphic features.
W-45	Northern	Bedford	PFO1E	W-45 is primarily a palustrine forested wetland, with an open area of cattails near the edge of the wetland along the F.E. Everett Turnpike. This wetland area is located on the west side of the highway, within the I-293 interchange. The contained surface water, that drained to the east, through a culvert, and is hydrologically connected to S-11 and W-44 on the east side of the highway. Water flowing through W-45 was diffuse and did not have a defined stream channel. Vegetation is this wetland was dominated by red maple, winterberry, and broadleaf cattail.
W-46	Northern	Bedford	PFO1E	W-46 is a small, isolated palustrine forested depression. Surface water was present in this wetland at the time of the delineation. Dominant vegetation in this wetland included red maple, white pine, winterberry, and red osier dogwood.

Wetland ID	Project Segment	Town	Cowardin Classification	General Description
W-47	Northern	Bedford	PEM1F/SS1E/FO1E	W-47 is a large wetland complex located north of the I-293 interchange, east of the F.E. Everett Turnpike. There is a large palustrine emergent cattail marsh in the middle of this area. It drains to the south into a palustrine forested area. Stream S-11 flows north under an Exit ramp and drains into a small pond located outside the delineation area, within W-47. Ultimately this area drains into the Merrimack River. Vegetation in the forested areas was dominated by red maple and white pine. Shrub species included glossy buckthorn, autumn olive, red maple, and button bush. Herbaceous species found in this wetland included broadleaf cattail, sensitive fern, and purple loosestrife. Soils were saturated and exhibited the hydric soil indicator F:6 Redox Dark Surface.
W-48	Northern	Bedford	PFO1E	W-48 is a palustrine forested wetland located along the toe-of-slope of the F.E. Everett Turnpike SB onramp. Stream S-12 is also associated with this wetland area. Dominant vegetation included red maple, gray birch, white pine, winterberry, rough goldenrod, soft rush, sensitive fern, and cinnamon fern. Soils were saturated and exhibited indicators of hydric soil.
W-49	Northern	Bedford	PEM1E/FO1E	W-49 is a large palustrine emergent cattail marsh located on the west side of the F.E. Everett Turnpike, near the northern terminus of the northern segment. Soils were saturated and exhibited the hydric soil indicator F:3 Depleted Matrix. Vegetation was dominated by broadleaf cattail, with scattered shrub species including silky dogwood and winterberry. The northern end of this wetland transitions into a palustrine forested wetland dominated by red maple, green ash, and American elm.

Table 3.5-4. Wetland Functions and Values

Wetland ID	Vernal Pool	Wetland Functions and Values											
		Groundwater Recharge/ Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/ Toxicant Retention	Nutrient Removal/ Ret./Trans.	Production/ Export	Sediment/ Shoreline Stabilization	Wildlife Habitat	Endang-ered Species	Educational/ Scientific	Uniqueness/ Heritage	Visual Quality/ Aesthetics
W-1					○	○							
W-2		✪	✪	✪	○	○	○	○	✪			✪	○
W-3			○						○				
W-4		○	○		○	○	○	✪	○				
W-5		○	○		○	○	○	✪	○				
W-6		○	○		○	○	○	✪	○				
W-7		○			○	○			○				
W-8		✪	✪		✪	✪	○	○	✪				
W-9	X	✪	✪		✪	✪	□		✪		○	○	
W-10													
W-11	X	✪	✪	○	✪	✪	○	○	✪	○	○	✪	✪
W-12							○		○				
W-13	X	✪	○		✪	✪	○		✪			○	
W-14	X	✪	○				○		✪			○	
W-15		○	○	○	○	○	✪	✪	○				
W-16		○	○	○	○	○	✪	✪	○				
W-17		○			○	○	○						
W-18		○	○	○	○	○	✪	✪	○				
W-19		○	○		○	○	○	○	✪			✪	
W-20	X	○	○		✪	✪	○		✪				
W-21	X	○	○		✪	✪	○		○			○	
W-22					○	○							
W-23		○	○		✪	✪	○		○				
W-24		○	○		○	○	○		○				
W-25		○	○		✪	✪	○		○				○

Wetland ID	Vernal Pool	Wetland Functions and Values											
		Groundwater Recharge/ Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/ Toxicant Retention	Nutrient Removal/ Ret./Trans.	Production/ Export	Sediment/ Shoreline Stabilization	Wildlife Habitat	Endang-ered Species	Educational/ Scientific	Uniqueness/ Heritage	Visual Quality/ Aesthetics
W-26		○			✪	✪	○		○				
W-27					○	○	○		○				
W-28		○			○	○	○		○				
W-29		○	○		○	○	○	✪	○				
W-30		○	○		□	□	○	✪	○				
W-31			○				○		○				
W-32		○	○		✪	✪	○		○				
W-33		✪	✪		✪	✪	○		✪			○	✪
W-34		○	○		○	○							
W-35					○	○	○		○				
W-36					○	○							
W-37		○			○	○	○		○				
W-38		○	○		○	○	○	✪	○				
W-39		○	○		○	○	○	✪	○				
W-40		✪	○		✪	✪	○	○	○			○	✪
W-41					○	○			○				
W-42		○					○		○			○	
W-43					○	○							
W-44		○	○		○	○	○	✪	○				
W-45		✪	✪		✪	✪	○	○	○				
W-46		✪			○	○		□	○			○	
W-47		✪	✪	○	✪	✪	○	○	✪			○	✪
W-48		○	○		✪	✪	○	○	○				
W-49		✪	✪		✪	✪	○	○	✪			○	✪

○ = Function/Value Present; ✪ = Principal Function

3.6 Land Resources

3.6.1 Geology and Soils

3.6.1.1 Bedrock Geology

Bedrock in the study area consists of metamorphic rock, primarily in the middle and southern segments, and igneous rock in the northern segment and portions of the middle segment. Bedrock in the southern project segment is entirely composed of metamorphic rock belonging to the Berwick Formation, a member of the Merrimack group. The bedrock in the middle segment is composed of both metamorphic rock and inclusions of igneous rock. Metamorphic rock is dominant throughout this project segment and is also composed of the Berwick Group. The igneous inclusions consist of Massabesic gneiss at the northern end of the segment, and Gray biotite granite in the middle of the project segment. Bedrock in the northern segment is entirely composed of Massabesic gneiss.

3.6.1.2 Soils

Soils in the study area are mainly derived from glaciofluvial deposits as well as glacial till. The most common soil series included Canton, Chatfield, Deerfield, Hinckley, and Windsor (Figures 3.6.1-1 and 3.6.1-2). Textures of these soils generally ranged from loamy sands to sandy loams and fine sands. Deerfield, Hinckley, and Windsor soils are coarse, sandy soils formed by alluvial deposits or glaciofluvial action. They are identified as excessively drained and tend to occur along rivers and valley floors. Canton and Chatfield soils are loamy, finer-textured soils formed in glacial till. They are deep to bedrock, well drained, and tend to occur on hilly uplands.

The most common soils in the study area are listed in Table 3.6-1.

3.6.2 Farmlands

The Farmland Policy Protection Act (FPPA) (Sections 1539-1549 P.L. 97-98, Dec 22, 1981), overseen by the Natural Resources Conservation Service (NRCS), was established to minimize the impact that Federal programs have on the conversion of farmland to nonagricultural uses. For the purpose of the FPPA, farmland includes areas where soils are designated as prime farmland soils or farmland soils of statewide or local importance, even if that land is not currently used for farmland. In addition, active farmland or agriculture areas were also considered. The FPPA excludes farmland soils that are in lands identified as urbanized areas on Census Bureau Maps. Since the entire study area is within an area designated as urbanized in the 2010 census, the FPPA does not apply. Construction within an existing ROW purchased on or before August 4, 1984 is also an activity that is not subject to the provisions of the FPPA.

3.6.2.1 Important Farmland Soils

Farmland soils were identified using the NRCS GIS layer, “Soil Survey Geographic (SSURGO) database for New Hampshire”. The 2010 US Census Bureau digital mapping of the Nashua, NH and Manchester, NH Urbanized Areas was overlaid onto the farmland soils mapping. The entire study area falls within the boundaries of the two urbanized areas. Therefore, while NRCS-mapped farmland soils are located along the project corridor, these areas are not subject to review under the FPPA because they occur in urbanized areas. In addition, the majority of the proposed work is located within the existing transportation ROW. No further analysis of farmland soils or impacts will be conducted.

3.6.2.2 Active Farmlands

The primary land use in the study area is a mix of commercial and industrial, residential, and forested. There are no active farmlands or agriculture areas in the vicinity of the project.

3.6.3 Conservation Lands

Conservation lands in the vicinity of the project were identified based on a review of data available from the NH Statewide GIS Clearinghouse (NH GRANIT) and are shown on Figures 3.6.3-1 and 3.6.3-2.

The southern project segment contains two areas of conservation land owned by Pennichuck Water Works. These areas are narrow strips of land that border the perimeter of Pennichuck Brook. The first area is on the east side of the highway approximately 0.5 miles south of the bridge where the F.E.E.T. crosses over Pennichuck Brook. The second area is the northbound shoreline of Pennichuck Brook, excluding the shoreline within the ROW.

The middle project segment contains several conserved lands. Birches Open Space is located on the west side of the F.E.E.T., adjacent to the study area near the southern end of the middle segment. This parcel is owned by the Town of Merrimack, and borders the study area for approximately 1,000 feet. Indian Rock Open Space is a large tract of land on the west side of the study area also owned by the Town of Merrimack. This parcel parallels the study area for roughly 1,800 feet. Near the northern terminus of the middle segment, the NH Fish and Game-owned Dumpling Brook Wildlife Management Area borders the study area on the west side of the F.E.E.T. for approximately 3,700 feet.

No conservation lands occur adjacent to the northern project segment.

The Conservation Land Stewardship (CLS) Program is responsible for monitoring and protecting the conservation values of conservation easement lands in which the State of New Hampshire has invested through the Land Conservation Investment Program (LCIP). The CLS Program is located within the NH Office of Strategic Initiatives. The project has been reviewed by the CLS Program Coordinator, and it was determined that there are no LCIP properties within the study area (Appendix B).

The New Hampshire Land and Community Heritage Investment Program (LCHIP) is an independent state authority that makes matching grants to communities and non-profits to conserve and preserve natural, cultural and historic resources. LCHIP has reviewed the project and determined that there are no LCHIP properties within the study area (Appendix B).

Through coordination with local officials and review of available GIS data, it has been determined that no other types of conservation land or public lands exist in or adjacent to the study area.

Table 3.6-1. Most Common Soils within Project Area

Map Unit	Soil Map Unit Name	Parent Material	Approx. Acreage in Proj. Area	Percentage of Overall Proj. Area
AgB	Agawam fine sandy loam, 3 to 8 percent slopes	loamy outwash over sandy and/or gravelly outwash derived from granite and gneiss or schist	13.5	6.0%
Bg	Binghamville silt loam	glaciolacustrine	4.2	1.9%
CaC	Canton fine sandy loam, 8 to 15 percent slopes	till	1.7	0.7%
CmB	Canton stony fine sandy loam, 3 to 8 percent slopes	till	7.0	3.1%
CmC	Canton stony fine sandy loam, 8 to 15 percent slopes	till	8.4	3.7%
CmE	Canton stony fine sandy loam, 25 to 35 percent slopes	till	2.7	1.2%
CpC	Chatfield-Hollis-Canton complex, 8 to 15 percent slopes	till	5.8	2.6%
CsC	Chatfield-Hollis complex, 8 to 15 percent slopes	till	7.7	3.4%
CtD	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	till	0.9	0.4%
DeA	Deerfield loamy fine sand, 0 to 3 percent slopes	sandy outwash derived mainly from granite, gneiss and schist	1.6	0.7%
HsB	Hinckley loamy sand, 3 to 8 percent slopes	stratified sandy and gravelly outwash	34.3	15.2%
HsC	Hinckley loamy sand, 8 to 15 percent slopes	stratified sandy and gravelly outwash	6.3	2.8%
HsD	Hinckley loamy sand, 15 to 35 percent slopes	stratified sandy and gravelly outwash	21.1	9.4%
NnA	Ninigret very fine sandy loam, 0 to 3 percent slopes	loamy outwash over sandy and/or gravelly outwash derived from granite and gneiss or schist	6.1	2.7%
PiA	Pipestone loamy sand, 0 to 3 percent slopes		14.4	6.4%
Pr	Pits, gravel		1.1	0.5%
Rp	Rippowam fine sandy loam	sandy and/or coarse-loamy alluvium derived from granite, gneiss or schist	1.0	0.4%
UdA	Udipsamments, nearly level		21.8	9.7%
WdA	Windsor loamy sand, 0 to 3 percent slopes		19.5	8.6%
WdB	Windsor loamy sand, 3 to 8 percent slopes		22.1	9.8%
WdC	Windsor loamy sand, 8 to 15 percent slopes		6.4	2.8%
WdD	Windsor loamy sand, 15 to 35 percent slopes		15.8	7.0%

3.6.4 Section 6(f) Properties

The Land and Water Conservation Fund (LWCF) is a program established by Congress in 1964 to create parks and open spaces; protect wilderness, wetlands and refuges; preserve wildlife habitat; and enhance recreational opportunities. The NH Division of Parks and Recreation is the State LWCF Manager. Section 6(f) of the Land and Water Conservation Act requires all property acquired or developed with LWCF assistance to be maintained perpetually in public outdoor recreation use. Any permanent or temporary use of a LWCF property must be reviewed and approved by the LWCF Manager and the National Park Service, and conversion of LWCF property requires mitigation. Based on a review of their LWCF files, the NH Division of Parks and Recreation has advised that there is one LWCF property present in the study area (Appendix B). The 6(f) property is located in the middle project segment in Merrimack, NH, in the southeastern quadrant of the Baboosic Lake Road Bridge over the F.E.E.T. This area consists of a gravel parking lot with four tennis courts, a basketball court, skate park, and an outdoor ice rink.

3.7 Fish and Wildlife

3.7.1 Wildlife

The U.S. Fish and Wildlife Service (USFWS) is responsible for the administration of the Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Federal protection of wildlife on private property is confined to migratory birds, listed species, and designated Critical Habitat.

The NH Fish and Game Department (NHFG) is responsible for managing and protecting resident wildlife species, which includes the implementation of the NH Endangered Species Conservation Act of 1979. NHFG has promulgated rules (NH Administrative Rules Chapter Fis 100 through 2000) for the protection and management of wildlife species. These rules pertain almost entirely to the exploitation of the species and not to the habitats. Some wildlife habitat is protected as state forests, state parks, or state-owned or state-managed wildlife management areas where additional restrictions on land use apply.

The 2015 NH Wildlife Action Plan (WAP) provides the framework for conserving Species of Greatest Conservation Need (SGCN) and their habitats in New Hampshire. The WAP identifies 169 SGCN and focuses on 27 habitats that support these species. The WAP includes habitat-based statewide mapping that identifies habitat land cover, depicting different types of wildlife habitat throughout the state; and Highest Ranked Wildlife Habitat, showing where habitat exists in the best ecological condition based on biodiversity, arrangement of habitat types on the landscape, and lack of human impacts.

3.7.1.1 Wildlife Habitats

Habitat types located along the project corridor include Appalachian oak-pine forests, hemlock-hardwood-pine forests, pine barrens, grasslands, palustrine emergent wetlands, palustrine scrub-shrub swamps, palustrine forested swamps, and floodplain forests. The majority of the land located along the project corridor has been previously disturbed from past highway construction. The areas of Nashua, Merrimack, and Bedford located along the project corridor are also highly developed with a mix of residential, commercial, and industrial land uses. Most of the habitat along the turnpike has been degraded by disturbance and fragmentation.

Despite the development, there are some relatively large, intact tracts of forested wildlife habitat remaining. In the southern segment, these areas are located around Pennichuck Brook in Nashua and Merrimack, and the area southwest of Exit 10. In the middle segment, large habitat blocks are located in the area north of the Souhegan River on the west side of the turnpike, Indian Rock Open Space, the Baboosic Brook Floodplain, and Dumpling Brook Wildlife Management Area. The northern segment has a few smaller patches of forest near the southern end, but becomes increasingly developed in the vicinity of the I-293 Interchange. The habitat value of this segment is limited.

The land cover types mapped within the general project area are described below, followed by a description of their occurrence within the project area.

3.7.1.2 Land Cover Types

The habitat types found in the project area form a mosaic of different land covers across the landscape throughout the project corridor (Figures 3.7.1-1 and 3.7.1-2). Areas along the F.E. Everett Turnpike in Nashua, Merrimack, and Bedford have experienced significant amounts of development and habitat fragmentation. Much of the land in the project area is classified as developed land. In the southern project segment, pine barrens are found on dry sandy sites interspersed with Appalachian oak-pine forests found on more mesic sites. Grasslands and hemlock-hardwood-pine are also present in the vicinity of the northern end of this segment.

Continuing north, much of the middle project segment in Merrimack has been developed and is classified as such. Pockets of Appalachian oak-pine forests still remain, with temperate swamps, marshes, and shrub wetlands interspersed. Floodplain forest is located along Baboosic Brook on the west side of the turnpike.

The northern project segment is also highly developed, especially in the areas surrounding the I-293 interchange. Land cover in this segment also consists of Appalachian oak-pine forest, with temperate swamps, marshes, and shrub swamps.

The land cover types mapped within the study area are described in more detail below.

Appalachian Oak-Pine Forest

This vegetation community typically occurs in southern New Hampshire, at elevations under 900 feet. Soils are nutrient poor, dry, and sandy. Typical vegetation includes oaks, white pine, hickories, mountain laurel, and sugar maple. Typical wildlife species that utilize this habitat type include wild turkey, whip-poor-will, ruffed grouse, a variety of songbirds, northern goshawk, Cooper's hawk, black bear, bobcat, deer, moose, New England cottontail, several species of bats, eastern hognose snake, black racer, and eastern box turtle.

Hemlock-Hardwood-Pine Forests

These forests are typically composed of hemlock, white pine, beech and oak trees. This forest type is the most common in New Hampshire, and it covers nearly 50 percent of the state. A variety of wildlife species can be found in this habitat including bobcat, black bear, deer, moose, porcupine, red squirrel, fisher, barred owl, and ruffed grouse.

Pine Barrens

This vegetation community occurs on sandy, nutrient poor soils, typically found along river banks and bluffs. Dominant species occurring in pine barrens include pitch pine and scrub oak interspersed with grassy clearings. Frequent disturbances such as fire help maintain this natural community type. Without disturbance pine barrens will naturally succeed into a more diverse forest type. Common Species that utilize this habitat type include white-tailed deer, turkey, and eastern towhee.

Grasslands

Grasslands are a land cover comprised of grasses, sedges, wildflowers, and other forbs, with little to no shrub and tree cover. Grasslands were once maintained by natural disturbances such as fire and beaver activity. Current grasslands typically consist of airports, landfills, wet meadows, and agricultural fields. Typical grassland species include a variety of birds, reptiles, and insects.

Palustrine Emergent/Scrub-Shrub Wetlands

Emergent marsh and shrub swamp wetlands have a broad range of hydrologic regimes, but are typically controlled by groundwater. These systems provide habitats for a variety of species and also provide additional valuable functions such as flood control and pollutant filtering. Typical species found in these types of wetlands include beavers, turtles, amphibians, blackbirds, waterfowl, and a variety of other species of birds.

Temperate Swamps

Temperate swamps are forested wetlands typically found in central and southern New Hampshire. They provide several valuable functions including flood control, pollutant filtration, and wildlife habitat. Species found in temperate swamps include many of the species found in upland forested habitats, as well as additional reptiles and amphibians.

Floodplain Forests

This forest community typically occurs in low lying areas along larger rivers. Common vegetation species in floodplain forests found in southern New Hampshire typically include; red maple, silver maple, green ash, and ironwood. Additional species including swamp white oak, sycamore, American elm, and eastern cottonwood can also be found in these forests. Wildlife species commonly associated with floodplain forests include American black duck, belted kingfisher, green heron, Jefferson salamander, northern leopard frog, otter, red-bellied woodpecker, and wood turtle.

3.7.1.3 NH Wildlife Action Plan Habitat Rankings

The 2015 New Hampshire Wildlife Action Plan ranks habitats across the state into three classes: Highest Ranked Habitat in the State, Highest Ranked Habitat in Biological Region, and Supporting Landscapes (Figures 3.7.1-3 and 3.7.1-4).

The project area is located within a developed highway corridor, and a large portion of the surrounding landscape has been developed and fragmented. The middle section contains a large area of unranked, developed habitats. Highest Ranked Habitat in the State is located near the northern end of the northern segment, and is associated with the Merrimack River corridor. Highest Ranked Habitats in the Biological Region are located in the southern segment surrounding the Pennichuck Brook impoundment as well as a large area north of Exit 10 on the west side of the F.E. Everett Turnpike, and in the vicinity of Baboosic Brook in the middle segment. Supporting Landscapes are located in the northern half of the southern segment; much of the middle segment, with the exception of the areas in the vicinity of Exit 11; and in the southern portion of the northern segment.

3.7.2 Fisheries

3.7.2.1 General Fisheries Habitat

Waterbodies in the study area support a variety of both coldwater and warmwater fish species. Pennichuck Brook has a warmwater fishery typical of impounded rivers in southern New Hampshire. Pennichuck Brook also contains American eel and tessellated darter, both listed as Species of Greatest Conservation Need in New Hampshire. NH Fish and Game did not have any records for species found in Naticook Brook, but suspected that American eel and sea lamprey are likely present. Baboosic Brook contains a warmwater fishery and is also likely to contain American eel and sea lamprey. In the vicinity of the study area the Souhegan River contains a warmwater fishery as well as American eel. NH Fish and game has records of sea lamprey and slimy sculpin in some of the smaller unnamed streams in the vicinity of the project. Dumpling Brook contains wild brook trout.

NH Fish and Game stock hatchery raised trout in several of the waterbodies throughout the study area for recreational fishing. In 2016 NH Fish and Game stocked rainbow trout, brown trout, and brook trout in the Souhegan River, and rainbow trout and brook trout in Baboosic Brook.

3.7.2.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act established a requirement of the Federal government to identify Essential Fish Habitat (EFH) and make conservation recommendations to agencies whose actions could impact it. The Act defines EFH as, “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.”

Fishery Management Councils are responsible for designating areas as EFH. The New England Council has determined the Merrimack River and many of the tributaries to the Merrimack River are EFH for all life cycle stages of Atlantic Salmon (*Salmo salar*). The Magnuson-Stevens Fishery Conservation and Management Act requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) on any proposed federal actions that may have an adverse effect on EFH.

Within the study area, designated EFH for Atlantic Salmon includes Naticook Brook and the Souhegan River. The following water bodies are EFH for all life cycle stages of Atlantic Salmon :

- Merrimack River – The Merrimack River is approximately 600 feet to 1.5 miles to the east and roughly parallel to the F.E. Everett Turnpike throughout the project area.
- Horseshoe Pond – This pond is located along Naticook Brook approximately 1,000 feet to the east of the middle segment.
- Naticook Brook – This stream crosses the middle segment of the project.
- Souhegan River – This river crosses the middle segment of the project and is spanned by Bridge 111/115.
- Pointer Club Brook – This stream is located outside the project area between the middle and northern segments, just south of the Bedford tolls.
- Bowman Brook – This stream is outside the project area located just north of the northern segment.

3.7.3 Threatened and Endangered Species

The US Fish & Wildlife Service (USFWS) *Information for Planning and Conservation System* (IPaC) web tool was utilized to request an official species list for federally listed species or critical habitats that could occur in the study area. The New Hampshire Natural Heritage Bureau (NHB) was consulted on the presence of rare species and exemplary natural communities within the study area. NHB reported records of four rare plant species, ten rare animal species, and two exemplary natural communities in the vicinity of the project. Below is a description of their known occurrences within the study area, the types of habitats where they may occur, and their potential for occurrence within the study area. Correspondence is included in Appendix B.

3.7.3.1 Plants

Federally Threatened and Endangered Plant Species

No Federally listed endangered or threatened species of plants are known to occur in or near the study area or are considered likely to occur there.

State Rare, Threatened and Endangered Plant Species

Bird-foot violet (*Viola pedata*): Bird-foot violet is listed as state-threatened and occurs at several sites in the study area. According to the NHB Report, in 1991 plants were transplanted from an off-site location to four different general locations along the project corridor. A return visit in 1993 confirmed survival at two of the locations, while the remaining two sites were not visited. Three out of these four sites occur within the middle segment of the study area, and the fourth site is just north of the northern terminus of the middle segment. In addition, a new population was discovered in 2012. The newly discovered population consisted of 528 individual plants identified north of Exit 8 on the F.E.E.T. in the vicinity of Pennichuck Brook. Typical habitat for bird-foot violet includes well drained sandy and rocky soils within open woods, fields, and along paths and roadsides[20]. There is potential suitable habitat along much of the project corridor, especially in the drier upland sites with sandy soils along the southern and middle segments. Additional field surveys should be conducted of suitable habitat to assess the potential presence of bird-foot violet within the study area. *(Environmental Commitment 12)*

Clasping milkweed (*Asclepias amplexicaulis*): Clasping milkweed is listed as state-threatened. According to the NHB, a single plant was identified in 1984 on the east side of US Route 3 approximately 0.4 miles from the project location. A return visit to the site in 2010 did not yield a positive identification. Clasping milkweed prefers open, dry, sandy or gravelly soils in fields, meadows, pastures and old sand dunes[21]. Suitable habitat potentially occurs along the project corridor, for example at power line crossings. Additional field surveys should be conducted of suitable habitat to assess the potential presence of clasping milkweed within the project corridor. *(Environmental Commitment 12)*

River birch (*Betula nigra*): The state-threatened river birch is known by the NHB to occur on an island in the Merrimack River. It was last documented there in 1992. Southern New Hampshire is at the northern limit of this species' range. River birch typically occurs along river banks, riparian forests, and lake shores (Haines, 2011). Suitable habitat in the corridor could potentially include the floodplains of the Merrimack River (very northern end of the project corridor) and the perennial streams such as Baboosic Brook, Souhegan River, and the two unnamed perennial streams. Additional field surveys should be conducted of suitable habitat to assess the potential presence of river birch within the project corridor. *(Environmental Commitment 12)*

Tall cottonsedge (*Eriophorum angustifolium*): Tall cottonsedge is listed as state endangered and was documented by the NHB in 2010 within a wooded fen/shrub bog complex located approximately 0.35 miles east of the F.E.E.T. near Exit 10, northeast of the northern terminus of the southern segment. Tall cottonsedge is a wetland-dependent species associated with peatlands, shorelines, and peaty soils around temporary pools[22]. There is no suitable habitat within or immediately adjacent the project corridor and no additional field surveys are recommended.

[20] ODNR, 1984. VIOLA PEDATA L. - Bird-foot Violet Rare Plant Abstract. Ohio Department of Natural Resources. Online. Available URL: http://naturepreserves.ohiodnr.gov/portals/dnap/pdf/Rare_Plant_Abstracts/Viola_pedata.pdf

[21] ODNR, 1994. ASCLEPIAS AMPLEXICAULIS Smith - Blunt-leaved Milkweed Rare Plant Abstract. Ohio Department of Natural Resources. Online. Available URL: http://naturepreserves.ohiodnr.gov/portals/dnap/pdf/Rare_Plant_Abstracts/ASCLEPIAS_AMPLEXICAULIS.pdf

[22] Haines, A, 2011. New England Wild Flower Society's Flora Novae Angliae: A Manual for the Identification of Native and Naturalized Higher Vascular Plants of New England, 1st Edition. Yale University Press. New Haven and London. 974 pages.

New Hampshire Exemplary Natural Communities

Red maple floodplain forest: The red maple floodplain forest is characterized by a dominant canopy of red maple (*Acer rubrum*) with variable amounts of American elm (*Ulmus americana*), black cherry (*Prunus serotina*), and musclewood (*Carpinus caroliniana*). Additional shrub species include winterberry (*Ilex verticillata*) and viburnums (*Viburnum spp*.). The herbaceous layer is often dominated by various fern species, including sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), northern lady fern (*Athyrium filix-femina*), marsh fern (*Thelypteris palustris*), cinnamon fern (*Osmunda cinnamomea*) and interrupted fern (*Osmunda claytoniana*). This community type occurs along the Baboosic Brook floodplain on the western side of the F.E.E.T. At this location there is also a forested wetland that consists of a large sparsely vegetated depression within the floodplain, adjacent to Baboosic Brook. Plant species include red maple, marsh fern, and cinnamon fern.

High-gradient rocky riverbank system: A high-gradient rocky riverbank system occurs along high gradient sections of rivers and large streams. Channel substrate is dominated by boulders and bedrock, while finer sediments are transported downstream at high or low river stages. This system occurs along the Souhegan River where it flows under the F.E.E.T. through the study area. This segment of the Souhegan River is dominated by bedrock, with a series of small vertical drops followed by long flat pools. Threats to this system also include hydrologic changes, land conversion and fragmentation, invasive species, and increased input of nutrients and pollutants.

3.7.3.2 Wildlife

Federally Threatened and Endangered Wildlife Species

According to the USFWS Official Species List, the federally threatened northern long-eared bat may occur in this and all other areas of the state. The Natural Heritage Bureau did not report any known winter hibernacula or maternity roost trees in the vicinity of the project. According to the USFWS, suitable summer habitat for northern long-eared bat consists of a variety of forested habitats. This species generally prefers closed canopy forest with an open understory. Potential roost trees include live trees or snags, at least 3” in diameter, with exfoliating bark, cracks, crevices, or cavities. Roost sites can also include structures such as buildings and bridges. Potential roosting habitat does exist in the study area.

State Rare, Threatened and Endangered Wildlife Species

Brook floater mussel (*Alasmidonta varicosa*): The state-endangered brook floater mussel has been documented in the Merrimack River, which is outside the project area. Brook floaters are a riverine species inhabiting clean and well-oxygenated small streams to large rivers. Although there are no other records of brook floaters in the project vicinity, they could occur in larger perennial streams such as Baboosic Brook.

American eel (*Anguilla rostrata*): The American eel is a state-listed species of special concern and has been identified in several waterbodies along the study area. American eels can be found in almost any freshwater habitat that has a connection to the ocean including both warmwater and coldwater rivers, streams, lakes, and ponds. American eel was documented in Baboosic Brook in 2000. In both 2007 and 2008 one eel was observed in the Souhegan River in the vicinity of the Merrimack Village Dam. A single eel was also found in the Souhegan River in 2009. In 2011 American eel was identified in Horseshoe Pond. Naticook Brook is associated with Horseshoe Pond, and could potentially contain American eel as well. Correspondence with NH Fish and Game also suggested that Pennichuck Brook contains American eel.

Bald eagle (*Haliaeetus leucocephalus*): The state-threatened bald eagle has been documented recurrently along the Lower Merrimack River. The study area roughly parallels the Merrimack River to the west at a varying distance of approximately 0.5-1.25 miles. From 2002-2012 there have been dozens of documented sightings of wintering bald eagles along the river corridor. There is a nesting location on the Merrimack River that has been monitored since 2012. In 2012 the nest was active with no chicks fledged, and the following three years the nest remained active with two chicks fledged per year. A second nest location has been documented at Pennichuck Brook. This site was active in 2013 and 2014, fledging 2 chicks both years. The F.E.E.T. crosses over Pennichuck Brook. Bald eagles are typically associated with aquatic habitats such as lakes, rivers, reservoirs, and coastal estuaries. Typical nest sites are found near these habitats in mature trees adjacent to forest edges or in super-canopy trees within more uniform forest cover. In New Hampshire 97% of documented nest structures occurred in white pine (*Pinus strobus*) trees. Suitable habitat in the study area would include large white pines along bodies of water such as Pennichuck Brook or Souhegan River, or further afield along the Merrimack River.

Blanding's turtle (*Emydoidea blandingii*): The state-endangered Blanding's turtle was identified in the middle segment of the study area in 2001. One adult male was found on the shoulder of the F.E.E.T. just north of the wetland north of the Souhegan River. In 2010 one adult was observed in a grassy field at Watson Park in Merrimack, NH. This park is located at the confluence of the Souhegan River and Baboosic Brook roughly 0.4 miles from the F.E.E.T. Both the 2001 and 2010 sightings are in the same general area, but are separated by two major roads, the F.E.E.T. and US Route 3. Blanding's turtles are known to inhabit vernal pools, marshes, and vegetated ponds. The wetland near the 2001 sighting could potentially provide suitable Blanding's turtle habitat. Other wetlands with suitable habitat are nearby within the same forest block.

Eastern hognose snake (*Heterodon platirhinos*): The eastern hognose snake is a state-listed endangered species and has been documented near the study area. Reports include: in 2001, one adult seen near County Road and Back River Road in Bedford, NH 0.6 miles from the study area; a 2004 report of an adult snake on Island Pond Drive in Merrimack, NH near Horseshoe Pond, 0.3 miles from the study area; in 2007, an adult snake observed on a foot trail between the F.E.E.T. and Harris Pond in Nashua, NH 0.6 miles from the study area; and a 2009 sighting near Continental Boulevard in Merrimack, NH 0.9 miles from the study area. These sightings are interspersed from the southern end to the northern end of the project. Eastern hognose snake habitat includes open woodland, grasslands, and fields with sandy soil derived from glacial outwash. There is suitable eastern hognose snake habitat along much of the study area. Some hibernation sites in NH are associated with active or abandoned sand and gravel operations. There is an active sand and gravel site on the eastern side of the F.E.E.T. north of Pennichuck Brook. This area is near the 2007 sighting.

New England cottontail (*Sylvilagus transitionalis*): In 2002, the state-endangered New England cottontail was identified at several locations proximate to the study area during a regional New England cottontail survey. One individual was observed east of the F.E.E.T. and north of US Route 3 near the I-293 interchange and Hawthorne Drive; another observation along the F.E.E.T. was east of Bumbo Hill near Baboosic Brook; two individuals were identified on a utility ROW west of the Merrimack River and East of US Route 3; and one individual was found near the sports complex off of US Route 3 in Bedford, NH. New England cottontail habitat includes native shrublands and early-successional forests with dense understory cover. Potential areas of suitable habitat along the study area include utility ROWs and other densely vegetated shrub-scrub areas including shrub swamps. Sightings from the 2002 study appear to be concentrated in the northern half of the middle segment and northern segment of the project. In more recent correspondence with the Natural Heritage Bureau (Appendix B), this species was dropped from the list of potential species as the local population apparently no longer exists.

Northern black racer (*Coluber constrictor*): Northern black racer is a state-threatened species. In 2009, six individual snakes were identified at six different sites in a large area just north of the end of the southern project segment, on the west side of the F.E.E.T. In 2010, three radio-tracked individuals were relocated from this site to another location. According to the Natural Heritage Bureau the habitat at this location was destroyed in 2011. Northern black racers are associated with a variety of early successional habitats including utility ROWs, grasslands, old fields, sandpits, rocky ridges and ledges, and edges of agricultural fields. Rock crevices may be used as nest sites, retreats, and hibernacula. Suitable black racer habitat in the study area includes utility ROWs, the sand and gravel site north of Pennichuck Brook (close to the historic documented site), an area of ledge in the northern segment, and much of the Appalachian Oak Pine Forest in the middle segment.

Sea lamprey (*Petromyzon marinus*): The sea lamprey is a state-listed species of special concern and has been identified in Naticook Brook. The last reported sighting was in 2009. Correspondence with NH Fish and Game also suggested that Baboosic Brook is likely to contain sea lamprey. Sea lamprey inhabit both warmwater and coldwater rivers and streams. They spawn in freshwater and require gravel/cobble riffles to construct their nests. In the study area sea lamprey are most likely to be found in Baboosic Brook and Naticook Brook.

Spotted turtle (*Clemmys guttata*): Spotted turtle is listed as a state-threatened species. In 2004, one individual was found dead on the F.E.E.T. near where Sebbins Brook crosses (shown on Figure 3.5.2-3). This area is located outside the study area between the middle and northern segments. Spotted turtle habitat includes marshes, wet meadows, ponds, forested and shrub swamps, fens, shallow slow-moving streams and rivers, and vernal pools. Potential spotted turtle habitat exists along the study area where these wetland resources are found, although the lack of records within the three project segments suggests this species would not be found in the immediate study area.

Wood turtle (*Glyptemys insculpta*): The wood turtle is a state species of special concern. Documented sightings include one individual observed in 2005 near the intersection of Corning Road and Route 3A in Litchfield, NH 0.7 miles from the study area; one was found in 2013 in a parking area off Executive Park Drive in Merrimack, NH adjacent to the study area; and an adult male was found in 2015 near Belmont Drive in Merrimack, NH approximately 0.4 miles from the study area. Wood turtles are typically associated with rivers and streams with hard sand or gravel substrates. Emergent marshes, swamps, and vernal pools, as well as upland habitats, may be utilized during spring and summer. Females lay eggs in sparsely vegetated, sandy-gravelly well drained soils in close proximity to water. Hibernation sites include undercut banks, large woody debris, wildlife burrows, and deep pools. The 2013 sighting is near the southern end of the middle segment of the project. Naticook Brook and a potential vernal pool shrub wetland are in the vicinity of this observation. In addition to Naticook Brook, additional suitable habitat includes Baboosic Brook and the Souhegan River. Smaller streams, ponds, vernal pools, and shrub swamps may also be used for foraging.

3.7.4 Invasive Species

An invasive plant is a non-native plant that is able to persist and proliferate outside of cultivation, resulting in ecological and/or economic harm. Under the statutory authority of NH RSA 430:55 and NH RSA 487:16-a, the NH Department of Agriculture, Markets & Food and NHDES prohibit the spread of invasive plants listed on the NH Prohibited Species List (AGR PART 3802.01). The project area contains the following prohibited invasive plants: autumn olive (*Elaeagnus umbellata*), burning bush (*Euonymus alatus*), glossy buckthorn (*Frangula alnus*), Japanese barberry (*Berberis thunbergii*), Japanese knotweed (*Polygonum cuspidatum*), Morrow's honeysuckle (*Lonicera morrowii*), multiflora rose (*Rosa multiflora*), Oriental bittersweet (*Celastrus orbiculatus*), purple loosestrife (*Lythrum salicaria*), and spotted knapweed (*Centaurea biebersteinii*).

Invasive species were documented throughout the project corridor. The most common species included autumn olive, glossy buckthorn, Oriental bittersweet, and purple loosestrife. Purple loosestrife was common throughout palustrine emergent wetlands including roadside ditches and cattail marshes.

In the southern project segment, purple loosestrife was documented in the vicinity of the Pennichuck Brook crossing and in the wetland W-2 near the southern end of the project. North of the Pennichuck Brook crossing, Morrow's honeysuckle, autumn olive, multiflora rose, and glossy buckthorn are interspersed throughout the forested edge.

The southern end of the middle project segment contains a high concentration of invasive plant species. Autumn olive and Oriental bittersweet were common along with patches of Japanese knotweed, with purple loosestrife in the wetland areas. There is also a high concentration of invasive species in the vicinity of the Wire Road and Baboosic Brook crossings. Invasive species in this area include autumn olive, burning bush, purple loosestrife, multiflora rose, Morrow's honeysuckle, and Oriental bittersweet.

The northern segment contained the highest concentrations of invasive species. Japanese barberry and multiflora rose were very common in the forested areas surrounding the roadway. Purple loosestrife was prevalent in the many emergent marshes located near the northern end of the project area. Glossy buckthorn and Oriental bittersweet were also common species growing along the disturbed forested edges.

In addition to invasive plants, the emerald ash borer (*Agrilus planipennis*) an invasive species of insect, and a federally-regulated pest has been documented in both Bow and Concord. In July of 2015 the New Hampshire Department of Agriculture implemented the Emerald Ash Borer Quarantine in order to prevent the unregulated movement of infested or potentially infested materials. Ash trees in the genus *Fraxinus* are the host species for the emerald ash borer. Quarantined areas in New Hampshire include Belknap, Hillsborough, Merrimack, and Rockingham Counties. The quarantine states that: "No person shall move, carry, transport, or ship (or authorize or allow any other person to do the same) Regulated Articles and Commodities from inside the quarantine area to outside of the quarantine area, unless specifically authorized in writing via Compliance Agreement issued by NHDAMF [the NH Department of Agriculture, Markets and Food] and moving with a PPQ540 (certificate) or PPQ 530 (limited Permit)". As of May 2018, the emerald ash borer had not yet been identified within the project area.

3.8 Cultural Resources

Preliminary identification of historical and archaeological resources, collectively known as historic properties under 36 CFR 800, commenced in 2016 for the F.E.E.T. widening project in the City of Nashua and the towns of Merrimack and Bedford, New Hampshire. The purpose of the investigation is to identify potential historic resources that may represent constraints to the transportation improvements. Both the archaeological and architectural historical work were initiated in 2016 and completed in 2018. The study includes a Phase IA archaeological survey of the entire project area, more intensive Phase IB and Phase II testing of archaeologically sensitive areas, and an architectural historical survey of individual resources and districts.

3.8.1 Regulatory Overview

Historical properties and archaeological resources that are listed in or are eligible for listing in the National Register of Historic Places are afforded protection by Section 106 of the National Historic Preservation Act (NHPA) and Section 4(f) of the Department of Transportation Act of 1966. The NHPA was enacted to ensure that the effects of federal, federally funded, or federally permitted projects on historic buildings, neighborhoods, landscapes and archaeological sites are considered.

Section 106 of the NHPA requires federal agencies to consider the effects of their activities and programs on any historic district, site, building, structure or object that is included, or eligible for inclusion in the National Register of Historic Places. The resources and the effects on those resources are evaluated by the federal agencies having jurisdiction in consultation with the State Historic Preservation Officer (SHPO) and any other consulting parties. In New Hampshire, the SHPO is the Director of the New Hampshire Division of Historical Resources (NHDHR).

The regulations of Section 106 emphasize consultation among the responsible federal agencies, the SHPO and other interested consulting parties, to identify, evaluate eligibility, determine the potential effects of the project on historic properties and if possible, to agree upon ways to protect properties that are affected.

Historical, architectural, archaeological, and historical archaeological properties that are usually fifty or more years in age gain significance for the National Register under four National Register criteria, seven elements of integrity, and the associated historical contexts significant to local, state or national historical development. The National Register criteria recognize historic property significance within four areas:

- Criterion A: contribution to the understanding of local, state, and or national historical trends and events;
- Criterion B: association with historically important individuals;
- Criterion C: representation of architectural styles and building forms and types as well as the work of a master; and
- Criterion D: Native American Pre-Contact or historic data that the property may provide through site investigation.

The seven elements of property integrity, which are not of equal importance in the evaluation of significance for every property, recognize property design, material, workmanship, location, setting, association, and feeling.

The significance of historic properties can be established only when evaluated within their historic contexts.

3.8.2 Historic Architectural Resources

3.8.2.1 Historic Context

The F.E.E.T. was conceived in the early 1950s after upgrades to Route 3 between Nashua and Concord could not relieve the traffic demands on this major north-south route. A toll highway was planned to bypass the heavily-congested city centers but remain close enough to the urban areas to be useful for motorists.

After the completion of the turnpike in 1955, dense residential areas, many as planned subdivisions, were developed along the new commuter route between Manchester and Nashua. The historical resources in the Project Area are predominantly residential, dating mostly from the mid-twentieth century when the Turnpike was constructed. Other resources date from the early to mid-nineteenth century, houses and farmsteads predating the Turnpike.

3.8.2.2 Properties on or Eligible for the National Register of Historic Places

Properties previously determined to be on or eligible for the National Register were determined by examining existing databases and NH Division of Historic Resources files. The Area of Potential Effect (APE) was determined to be the existing ROW and the land within 300 feet of the turnpike centerline.

The F.E.E.T. itself was surveyed in 2010, and it, along with its bridges and associated elements, was determined not eligible for the National Register.[23] In Merrimack, the Project Area is near the historic town center of Merrimack, which was surveyed in 2006, and determined not eligible (Merrimack Village Area Form, Area MER-VIL).

Three properties along the project corridor are either on or have been determined to be eligible for the National Register.

- The southernmost part of the Project Area falls within the boundary of the Pennichuck Water Works in Nashua and Merrimack, which was determined eligible for the National Register in 1993 and 2003.[24]
- The Signer's House and Matthew Thornton Cemetery are on the National Register and are on Greeley Street in Merrimack, just east of Exit 11 and outside the project's Area of Potential Effect.
- The Bigwood Historic District is along the east side of the turnpike north of Wire Road. It was determined eligible for the National Register in 2014.

3.8.2.3 Resources Potentially Eligible for the National Register of Historic Places

Research was conducted to identify other properties that could potentially be eligible for the National Register. This included any properties that met the age criterion, i.e., were 50 or more years old. Town records were searched through on-line town databases to identify structures within the APE that were constructed prior to 1968.

Because of the large number of such properties and the limited nature of work proposed on or adjacent to the properties, their National Register eligibility was not determined. Instead, the properties were identified and the work adjacent to each was described to determine whether there could be an effect. The results of this review are reported in Chapter 4.

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[23] This survey included the twelve bridges that were constructed for the Turnpike; see Preservation Company 2010: 28-30.

[24] Because no structures associated with the Water Works are within the Project's APE no photographs are included of this area.

3.8.3 Archaeological Resources

3.8.3.1 Methods and Findings

Archaeological resources include cultural and culturally associated remains below the surface of the ground as well as ruins above it. Archaeological studies included Phase IA Archaeological Sensitivity Assessments, supplementary Phase IB Intensive Archaeological Investigations and Phase II Determinations of Eligibility (DOEs) in 2017 and 2018 for the F.E.E.T. project. Initial investigations centered on the mainline turnpike widening. After stormwater best management practice (BMP) and noise wall locations became known, additional investigations occurred.

Mainline Turnpike

Archaeologists completed a Phase IA sensitivity assessment of the study area in 2016 and identified five Pre-Contact sites. The five sites identified are as follows:

Site Name	**Site Number**
Cinemagic Isolated Find	27-HB-473
Narrow Ridge	27-HB-472
Naticook Brook I	27-HB-471
Naticook Brook II	27-HB-470
Bowers Pond Isolated Find	27-HB-475

Archaeologists performed supplemental Phase IB and Phase II testing to evaluate the age, distribution and archaeological integrity of cultural deposits at the five sites to make a determination of each site's potential eligibility for listing on the National Register. Archaeologists used survey equipment to establish a grid at four of the five sites in order to map test pits and finds. The Bowers Pond Isolated Find occupies an extremely narrow landform that precludes use of a site grid, so the archeologist used a tape and compass to place the supplemental Phase IB test pits.

Archaeologists excavated all test holes and placed artifacts in bags labeled with their horizontal and vertical provenience. Crew members collected float and charcoal samples from cultural features using established archaeological methods to avoid contamination. Exposed soil stratigraphy was recorded with detailed profiles including soil color, compaction, and composition and supplemented the written data with digital photography. Finally, each site was documented with extensive photographs.

Results from the five sites are listed below.

Cinemagic Isolated Find

- The Cinemagic Isolated Find is the northernmost archaeological site documented for the F.E.E.T project.
- The 21 test holes excavated in 2017 were negative.
- Nothing was found to suggest that the one artifact that was previously discovered was part of a larger deposit.
- This site is not deemed eligible for listing on the National Register. No further study is recommended.

Narrow Ridge Site

- A limited presence of intact Pre-Contact cultural deposit was found.
- There is limited potential for the site to augment the current understanding of Pre-Contact land use.
- This site is not deemed eligible for listing on the National Register and no further archaeological investigation is recommended.

Naticook Brook I site

- This site contains Pre-Contact artifacts, items which indicate long-term habitation.
- The artifacts recovered suggest two distinct occupations including the Paleoindian Period and Archaic-Period.
- Based on the presence of intact artifacts and the two occupation episodes, this site was deemed potentially eligible for the National Register under Criterion D.
- Additional subsurface investigations were undertaken in 2018 to better define the limits of the resources. This investigation identified disturbed ground which does not contain resources, but confirmed the presence of two distinct occupations over an extended period in other portions of the site. The potential National Register eligibility of the site was also confirmed.

Naticook Brook II site

- Cultural deposits associated with Pre-Contact occupation were found.
- No diagnostic artifacts or datable features to determine the age of the deposit were found.
- There was a high level of disturbance at this site.
- This site is not considered eligible for listing on the National Register.

Bowers Pond Isolated Find

- A single core fragment was discovered.
- The test hole sites were negative.
- Reduced archaeological integrity of the site likely was part of the reason more material was not discovered.

- This site is not considered eligible for listing on the National Register.

Of the five sites that were documented, only one site, the Naticook Brook I site, was deemed potentially eligible for listing in the National Register of Historic Places.

Noise Wall and BMP Sensitivity Assessment

In addition to the work at the five known sites, archaeologists completed a Phase IA Archaeological Sensitivity Assessment followed by a Phase IB Intensive Archaeological Investigation of Best Management Practice (BMP) and noise wall locations that were outside the original 2016 project limits. Archaeologists used a combination of data from the distribution of known Pre-Contact sites, desktop review of soils and other environmental conditions, background research and a walkover inspection to evaluate the potential for Pre-Contact Native American archaeological resources. The Post-Contact Euroamerican sensitivity assessment follows the same steps but also includes a detailed review of historic maps to identify documented Post-Contact residential or commercial sites within the project area.

Archaeologists completed a Phase IA assessment of 22 potential BMP locations. Archaeologists identified sections of 9 BMPs (at Stations 778 Right, 814 Right, 963 Left, 965 Right, 975 Left, 1036 Left, 1338 Right, 1080 Left, and 1413 Right) as sensitive for Pre-Contact cultural deposits based on the presence of level, well drained landforms near streams, wetlands or other resource-rich hydrological features. BMPs at three locations are particularly sensitive as they are located partially within or very near known Pre-Contact archaeological sites, including the previously discovered Narrow Ridge and Naticook Brook I sites. Another BMP location is also in a highly sensitive location immediately adjacent to the Merrimack River.

Of the 22 potential BMP locations, 3 were previously surveyed in 2005 and 9 sites were determined to have Pre-Contact sensitivity. One BMP (at the Naticook Brook I site) was later removed from consideration, but the site was found to overlap the highway widening footprint. Results of that site are described above.

Follow-up Phase IB investigation found that seven sites had no evidence of Pre-Contact or Post-Contact land use and no further study is recommended. The remaining site, along the Merrimack River, had thermal features and artifacts and is likely eligible for the National Register. The BMP at that location was later removed from consideration.

In addition, archaeologists completed a Phase IA assessment of the potential noise wall locations. This field inspection revealed that three of the proposed seven noise walls have a potential to impact undisturbed cultural deposits related to Pre-Contact Native American land use as they extend across wooded landforms of sandy solid near wetlands and streams. The three noise walls that present possible impacts are at Noise Analysis Locations K, N and U. One of these (K) was previously surveyed with negative results, so no further survey is necessary. Follow-up Phase IB investigations of noise walls at N and U were undertaken with negative results.

3.9 Socio-Economic Resources

Demographic, population, racial composition, housing, employment, and income data were obtained from the US Census Bureau's American FactFinder website. Census data is based on the most recent 10-year census results supplemented by estimates of results for interim years. Interim year results are based on a variety of sources, including surveys and data on births, deaths, migration, and employment. See www.census.gov for more information.

3.9.1 Demographics

The three study area communities, Nashua, Merrimack and Bedford, are located within Hillsborough County and located within the same Primary Metropolitan Statistical Area. Nashua and Merrimack are within the jurisdiction of the Nashua Regional Planning Commission. Bedford is located within the jurisdiction of the Southern New Hampshire Regional Planning Commission.

Population, racial composition, housing, employment, and median household income information for these three town areas is presented below along with the County of Hillsborough and the State of New Hampshire for comparison purposes.

3.9.2 Population

Population changes were evaluated for the time period between 2000 to 2010 and 2010 to 2016 (based on estimated 2016 data). During the time period between 2000 and 2010, the following population growth occurred in these areas: Merrimack (+1.5%), Bedford (+13.8%), Hillsborough County (+5.0%) and New Hampshire (+6.1%). Nashua experienced a slight decline in population during this time period of -0.1%. From the time period of 2010 to 2016, the following growth occurred in these areas: Nashua (+0.9%), Merrimack (+0.3%), Bedford (+3.1%), and Hillsborough County (+1.0%). New Hampshire experienced a decline in population during this time period of -6.5%.

Over this 16-year period, Nashua, Merrimack, Bedford and Hillsborough County have increased in population. The population of New Hampshire has remained steady from the year 2000 with an increase of +6.0% during the years of 2000 to 2010 but decreasing by -6.5% during the years of 2010 and 2016. Refer to Table 3.9-1 Population for further details on this data and the changes that have occurred over the past 16 years.

Table 3.9-1. Population

	2000	2010	Est. 2016	% change	% change
				2000 to 2010	2010 to 2016*
Nashua	86,605	86,494	87,279	-0.1	0.9
Merrimack	25,119	25,494	25,580	1.5	0.3
Bedford	18,274	21,203	21,879	13.8	3.1
Hillsborough Co.	380,841	400,721	404,948	5.0	1.0
New Hampshire	1,235,786	1,316,470	1,235,786	6.1	-6.5

Source: U.S. Census Bureau / American FactFinder
*2016 data are based on estimates

3.9.3 Racial Composition

Changes to racial composition were evaluated for the years of 2000, 2010 and 2016. (Year 2016 data are based on estimates.) Over this 16-year period, the data show that relatively few changes in racial composition have occurred. The changes in racial composition that indicate an increase of minority populations include the following:

<u>Nashua</u>: An increase in the Asian population has occurred from 2000, when it was 3.9%, to 2010 (6.5%) and then again in 2016 (7.3%). The Hispanic or Latino population also increased from 2000 (6.2%) to 2010 (9.8%) and then again in 2016 (12.3%). Those who identified themselves as two or more races increased from 2000 (1.5%) to 2010 (2.5%) and then again in 2016 (3.4%).

<u>Merrimack</u>: The racial composition has remained similar with few increases or decreases during the 16-year time period.

<u>Bedford</u>: The racial composition has remained similar with few increases or decreases during the 16-year time period. Small incremental increases have occurred in the Asian, Hispanic or Latino, and those identifying themselves as two or more races, and in 2016 represent the following percentage of the overall population: Asian (3.3%), Hispanic or Latino (1.9%) and two or more races (1.6%).

<u>Hillsborough County</u>: The racial composition has remained similar with few increases or decreases during the 16-year time period. A small incremental increase has occurred in the Hispanic or Latino population which in 2016 represented 6.0% the overall population.

<u>New Hampshire</u>: The racial composition has remained similar with few increases or decreases during the 16-year time period.

Refer to Table 3.9-2 Year 2000 Racial Composition, Table 3.9-3 Year 2010 Racial Composition and Table 3.9-4 Year 2016 Racial Composition.

Table 3.9-2. Year 2000 Racial Composition

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
White	77,291	89.2	24,260	96.6	17,801	97.4	357,615	93.9	1,186,851	96.0
Black or African American	1,740	2.0	184	0.7	59	0.3	4,904	1.3	9,035	0.7
American Indian	275	0.3	48	0.2	11	0.1	943	0.2	2,964	0.2
Asian	3,363	3.9	378	1.5	234	1.3	7,601	2.0	15,931	1.3
Native Hawaiian or Pacific Islander	29	0.0	10	0.0	4	0.0	112	0.0	371	0.0
Hispanic or Latino	5,388	6.2	272	1.1	165	0.9	12,166	3.2	20,489	1.7
Two or more races	1,265	1.5	185	0.7	142	0.8	4,660	1.2	13,214	1.1
Total	89,351	103.1	25,337	100.8	18,416	101	388,001	101.8	1,248,855	101.0
Census Pop.	86,605	100	25,119	100	18,274	100	380,841	100	1,235,786	100

Source: U.S. Census Bureau / American FactFinder

Table 3.9-3. Year 2010 Racial Composition

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	%	Number	%	Number	%	Number	%	Number	%
White	72,120	83.4	24,230	95.0	20,044	94.5	362,153	90.4	1,236,050	93.9
Black or African American	2,346	2.7	192	0.8	135	0.6	8,298	2.1	15,035	1.1
American Indian	249	0.3	46	0.2	21	0.1	961	0.2	3,150	0.2
Asian	5,626	6.5	499	2.0	615	2.9	12,954	3.2	28,407	2.2
Native Hawaiian or Pacific Islander	26	0.0	4	0.0	3	0.0	140	0.0	384	0.0
Hispanic or Latino	8,510	9.8	546	2.1	367	1.7	21,241	5.3	36,704	2.8
Two or more races	2,182	2.5	404	1.6	307	1.4	7,939	2.0	21,382	1.6
Total	91,059	105.2	25,921	101.7	21,492	101.2	413,686	103.2	1,341,112	101.8
Census Pop.	86,494	100	25,494	100	21,203	100	400,721	100	1,316,470	100

Source: U.S. Census Bureau / American FactFinder

Table 3.9-4. Year 2016* Racial Composition

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	%	Number	%	Number	%	Number	%	Number	%
White	73,822	84.6	24,352	95.2	20,529	93.8	367,298	90.7	1,186,851	96.0
Black or African American	2,732	3.1	94	0.4	278	1.3	9,519	2.4	9,035	0.7
American Indian	116	0.1	28	0.1	0	0.0	460	0.1	2,964	0.2
Asian	6,405	7.3	546	2.1	713	3.3	14,945	3.7	15,931	1.3
Native Hawaiian or Pacific Islander	29	0.0	20	0.1	0	0.0	73	0.0	371	0.0
Hispanic or Latino	10,700	12.3	661	2.6	414	1.9	24,490	6.0	20,489	1.7
Two or more races	3,008	3.4	384	1.5	345	1.6	9,053	2.2	7,420	0.6
Total	96,812	110.8	26,085	102.0	22,279	102	425,838	105.1	1,243,061	100.5
Census Pop	87,279	100	25,580	100	21,879	100	404,948	100	1,235,786	100

Source: U.S. Census Bureau / American FactFinder

*2016 data are based on estimates

3.9.4 Housing

Housing changes were evaluated for the time period between 2000 to 2010 and 2010 to 2016 (estimated). During the time period between 2000 and 2010 the following growth of housing units occurred in these areas: Nashua (+4.8%), Merrimack (+8.7%), Bedford (+16.2%), Hillsborough County (+9.70%) and New Hampshire (+11.0%). From the time period of 2010 to 2016 the following growth in housing occurred in these areas: Merrimack (+2.4%), Bedford (+1.4%), Hillsborough County (+0.9%), and New Hampshire (+1.0). Nashua experienced a slight decline in housing units during this time period of -1.1%.

Over this 16-year period, the City of Nashua, the Towns of Merrimack and Bedford, as well as Hillsborough County and the State of New Hampshire, have all experienced increases in housing units with the larger growth period occurring between the years of 2000 and 2010.

Refer to Table 3.9-5 Housing for further details on this data and the changes that have occurred over the past 16 years.

Table 3.9-5. Housing

	All Housing Units			**2000 to 2010**	**2010 to 2016***
	2000	**2010**	**2016***	**% change**	**% change**
Nashua	35,387	37,168	36,762	4.8	-1.1
Merrimack	8,959	9,818	10,057	8.7	2.4
Bedford	6,401	7,634	7,744	16.2	1.4
Hillsborough County	149,961	166,053	167,606	9.7	0.9
New Hampshire	547,024	614,754	620,729	11.0	1.0

Source: U.S. Census Bureau / American FactFinder

*2016 data are based on estimates

3.9.5 Employment

Changes to employment were evaluated for the years of 2000, 2010 and 2016. Over this 16-year period, the data show that relatively few changes have occurred in the dominant employment sectors and the percentage of those employed has remained consistent throughout the three study area communities, Hillsborough County and the State of New Hampshire. A summary of the changes followings:

Nashua: The total number employed has remained stable during the 16-year period and consists of the following: 45,738 employed or 67.9% in 2000; 46,538 or 66.6% in 2010; and 47,206 or 66.4% in 2016. Over the 16-year period, Nashua has seen the most change in the employment sectors of manufacturing, construction/mining and trade. In 2000, Nashua's employment base consisted of 23.4% manufacturing, in 2010 manufacturing decreased to 0.2%. However, manufacturing increased to 16% in 2016. A similar pattern occurred in the trade sector where trade consisted of 16.6% in 2000, 0.2% in 2010 and 15% in 2016.

Merrimack: The total number employed has remained stable during the 16-year period and consists of the following: 9,215 employed or 67.8% in 2000; 10,325 employed or 65.61% in 2010; and 11,048 employed or 65.1% in 2016. In addition, the percentage of the dominant employment sectors have remained consistent.

Bedford: Similar to Merrimack, the total number employed has remained stable during the 16-year period and consists of the following: 14,660 employed or 78.7% in 2000; 14,586 or 73.1% in 2010; and 14,675 or 71.1% in 2016. The percentages of the dominant employment sectors have also remained consistent over the 16-year period.

Hillsborough County: The total number employed has remained stable during the 16-year period and consists of the following: 202,366 or 69.6 % in 2000; 213,942 employed or 67.9% in 2010; and 217,886 employed or 66.4% in 2016. In addition, the percentage of the dominant employment sectors have remained consistent.

New Hampshire: The total number employed has remained stable during the 16-year period and consists of the following: 650,871 employed or 67.8% in 2000; 695,283 or 65.8% in 2010; and 706,801 or 64.6% in 2016. Similar to Nashua, New Hampshire overall has seen the most change in the employment sector of manufacturing. In 2000, New Hampshire's employment base consisted of 18.14% manufacturing, in 2010 manufacturing decreased to 13.2%. A further decreased occurred in 2016 to 12.8%. All other employment sectors have remained stable.

Refer to Table 3.9-6 Year 2000 Employment, Table 3.9-7 Year 2010 Employment and Table 3.9-8 Year 2016 Employment.

Table 3.9-6. Year 2000 Employment

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Manufacturing	10,698	23.4	3,122	21.3	1,304	14.2	41,534	20.5	117,673	18.1
Construction/Mining	2,200	4.8	633	4.3	427	4.6	12,494	6.2	44,269	6.8
Trans, Comm, Utilities	1,796	3.9	662	4.5	510	5.5	9,028	4.5	27,006	4.1
Trade	7,594	16.6	2,517	17.2	1,603	17.4	34,606	17.1	112,515	17.3
Finance, Insurance, Real Estate	2,841	6.2	1,202	8.2	1,002	10.9	13,645	6.7	40,731	6.3
Government	1,147	2.5	409	2.8	234	2.5	5,937	2.9	24,822	3.8
Service and other	1,792	3.9	632	4.3	307	3.3	8,392	4.1	27,780	4.3
Total	28,068	61.3	9,177	62.6	5,387	58.4	125,636	62.0	394,796	60.7
Employed	45,738	67.9	14,660	78.7	9,215	67.8	202,366	69.6	650,871	67.8

Source: U.S. Census Bureau / American FactFinder

Table 3.9-7. Year 2010 Employment

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Manufacturing	8,044	0.2	2,528	17.3	1,208	11.7	33,191	15.5	91,791	13.2
Construction/Mining	2,762	0.1	890	6.1	517	5	15,123	7.1	52,071	7.5
Trans, Comm, Utilities	1,986	0.0	564	3.9	406	3.9	9,207	4.3	27,047	3.9
Trade	7437	0.2	2,107	14.4	1,393	13.5	34,453	16.1	114,913	16.5
Finance, Insurance, Real Estate	3,431	0.1	1,421	9.7	1,201	11.6	16,483	7.7	47,231	6.8
Government	1,265	0.0	585	4.0	344	3.3	6,516	3.0	26,785	3.9
Service and other	1,728	0.0	632	4.3	342	3.3	8,957	4.2	29,294	4.2
Totals	26,653	0.6	8,727	59.7	5,411	52.3	123,930	57.9	389,132	56.0
Employed	46,538	66.6	14,586	73.1	10,325	65.6	213,942	67.9	695,283	65.8

Source: U.S. Census Bureau / American FactFinder

Table 3.9-8. Year 2016* Employment

	Nashua		Merrimack		Bedford		Hillsborough County		New Hampshire	
	Number	%	Number	%	Number	%	Number	%	Number	%
Manufacturing	7,559	16.0	1,976	13.5	1,285	11.6	30,504	14.0	90,220	12.8
Construction/Mining	2,772	5.9	682	4.6	509	4.6	14,305	6.6	49,180	7.0
Trans, Comm, Utilities	1,880	4.0	700	4.8	362	3.3	9,223	4.2	27,197	3.8
Trade	7,040	15.0	2,407	16.4	1,382	12.5	32,888	15.1	107,630	15.2
Finance, Insurance, Real Estate	3,024	6.4	1,271	8.7	1,595	14.4	15,150	7.0	44,987	6.4
Government	1,125	2.4	564	3.8	270	2.4	7,259	3.3	27,119	3.8
Service and other	1,841	3.9	595	4.1	415	3.8	9,445	4.3	30,562	4.3
Total	25,241	53.6	8,195	55.9	5,818	52.6	118,774	54.5	376,895	53.3
Employed	47,206	66.4	14,675	71.1	11,048	65.1	217,886	66.4	706,801	64.6

Source: U.S. Census Bureau / American FactFinder

*2016 data are based on estimates

3.9.6 Median Household Income

Median Household Income was evaluated for the time period between 2000 to 2010 and 2010 to 2016. During the time period between 2000 and 2010, the following increases occurred in these areas: Nashua (+20.6%), Merrimack (+22.4%), Bedford (+27.4%), Hillsborough County (+23.0%) and New Hampshire (+21.8%). From the time period of 2010 to 2016, the following increase occurred: Nashua (+5.0%), Merrimack (+5.5%), Bedford (+7.7%), Hillsborough County (+5.3%), and New Hampshire (+7.6%). Over this 16-year period, the City of Nashua, the Towns of Merrimack and Bedford, as well as Hillsborough County and State of New Hampshire, have experienced increases in Median Household Income with the larger growth period occurring between the years of 2000 and 2010.

Refer to Table 3.9-9 Median Household Income for further details and the changes that have occurred over the past 16 years.

Table 3.9-9. Median Household Income

	Median Household Income			2000 to 2010	2010 to 2016*
	2000	2010	2016*	% change	% change
Nashua	$51,969	$65,476	$68,944	20.6	5.0
Merrimack	68,817	88,667	93,798	22.4	5.5
Bedford	84,392	116,299	126,030	27.4	7.7
Hillsborough County	53,384	69,321	73,189	23.0	5.3
New Hampshire	49,467	63,277	68,485	21.8	7.6

Source: U.S. Census Bureau / American FactFinder

*2016 data are based on estimates

3.10 LAND USE

Existing land use patterns in the vicinity of the F.E.E.T. project area are described below in a summary of the two land use planning regions and of each study area community.

Nashua Region

The Nashua Region, which includes Nashua and Merrimack along with towns to the east and west, overall has a diverse mix of land uses, and this is reflected in the F.E.E.T. corridor. The region provides a mix of urban, suburban and rural communities and neighborhoods placing residents an hour or less from major cities and recreation destinations. The region's communities have strong community centers, residential neighborhoods, and a mix of commercial and industrial districts. Nearly half of the region is

currently designated as residential use (44 percent). Vacant or undeveloped land covers 25 percent of the region, recreational and open space represents 15 percent, and the rest is evenly split among municipal buildings, water, and other industrial and commercial uses. It is worth noting that surface waters only cover one percent of the region, which is very low compared to other regions of the state. More information on the Nashua Region can be found at:
http://www.nashuarpc.org/files/9014/2186/6208/EC_Final_Adopted_121714.pdf

Nashua, NH

The City of Nashua's location has played a major role in its development and the resulting economy. The City's location on the Massachusetts border in a state without a sales or income tax has contributed to its success as a major regional and interstate retail destination. Its proximity to the greater Boston metropolitan area has also contributed to its success as a major employment and residential center. In terms of land use, Nashua's built environment until the 1950s was largely confined to the areas along the Nashua and Merrimack Rivers, the inner portions of the city, and the downtown. Residential neighborhoods then gradually spread out from the downtown area. These early residential neighborhoods spread north along Manchester and Concord Streets, south along South Main Street, west along West Hollis Street and Lake Street, and east along Canal Street and East Hollis Street. Until the 1960s, there were very few subdivisions built in the areas presently west and south of the F.E.E.T. In fact, phases of the City's development seem to correspond with the construction of the turnpike, which made access to the City much easier. The F.E.E.T. was completed in the mid -1960s, and according to the 2000 Nashua Master Plan, this transportation investment seems to correspond with the increased population statistics.

The City of Nashua actually experienced its greatest amount of population growth in the 1960s (43 percent). In the 1970s, the City experienced only half the percentage increase of the 1960s, with a 22 percent increase. However, the City's rapid expansion in terms of land use change resulting from development activity did not begin until the 1970s. At this time areas west of the turnpike, both in the northwest and southwest quadrants, expanded greatly with residential subdivisions. The pattern of commercial land use along Amherst Street and US Route 3 south also was largely defined in the 1970s, although the large quantity of commercial development and redevelopment did not really take place until the 1980s. The development activity of the 1980s and 1990s then followed the dictated land use pattern established by the 1974 zoning ordinance. Since 2000 the rate of growth has slowed significantly and most of the development activity has been experienced as infill development and redevelopment within already developed areas of the city.

Most existing commercial development is found along Amherst Street / Route 101A and along the Daniel Webster Highway to the south, with smaller concentrations in the inner city, along Broad Street and along Northeastern Boulevard. Most of the City's industrial areas were established prior to 1980. During the 1980s and, to a lesser degree the 1990s, some areas that were zoned industrial have been rezoned to commercial, particularly along the Route 101A corridor. The amount of land in active industrial use decreased by about 4 percent between 1985 and 2000. Much of this loss is probably due to the conversion of industrial land to commercial use, especially in the Route 101A corridor.

Looking to the F.E.E.T. corridor the Nashua portion of the project area is the most densely developed section. While there are some areas of residential development adjacent to the F.E.E.T., large portions of this corridor are adjacent to active commercial and industrial areas. There are four major interchanges within this section of the project area that are also surrounded by commercial and industrial development activity. It is also important to note that the F.E.E.T. crosses the Nashua River, Pennichuck Brook, and a large piece of land owned by Pennichuck Water Works that are both currently undeveloped open space areas of the community.

Merrimack, NH

The Town of Merrimack is bordered by the towns of Bedford and Manchester to the north and Litchfield and Nashua to the south. The Merrimack River forms the eastern boundary of the community just east of the F.E.E.T. According to the 2013 Master Plan the Town of Merrimack is typified by two land forms. The first is the somewhat hilly and wooded landscape of the land outside the floodplain, and the second is represented by the river valleys and floodplains. Much of the land in Merrimack, from the F.E.E.T. west to the Amherst line, is composed of the hilly wooded land form. From a land use perspective, the development patterns west of the F.E.E.T. have evolved from desirable for farming to desirable for single-family residential development. In the areas served by individual septic systems the resulting pattern reflects development on larger lots. Much of the Town’s preserved open space lies within this area to the west of the F.E.E.T. which further adds to its value for residential development.

The portions of Merrimack that include river valleys and floodplains also happen to be the locations of major regional transportation systems, including the F.E.E.T. and the Daniel Webster Highway. The Boston and Maine railroad also follows the Merrimack River while serving adjacent industrial uses. Development patterns within this north-south valley take advantage of the flat topography and connectivity regionally and are represented by larger footprint retail uses, office and industrial parks and large single use buildings. However, there is a small amount of older, small lot residential development and a few higher density residential developments composed of smaller lot sizes, apartments and condominiums located along the corridor. Town zoning policies over the years have supported this development pattern. It is important to note that much of Merrimack’s prime developable land has already been developed. Continental Boulevard, located in the southern portion of the town, links the commercial and transportation corridors (Daniel Webster Highway and F.E.E.T.) with Route 101A, a highly commercialized corridor located within a small portion of the southwest corner of the town.

The three largest land use categories in Merrimack include permanent open space at 15.5 percent, single-family residential development at 41.1 percent, and vacant land at 16.6 percent. The vast majority of the development in Merrimack is adjacent to the F.E.E.T. Industrial and commercial land uses only constitute a small amount of the overall development in Merrimack. Commercial development accounts for 3.6 percent of the land area, and industrial development accounts for 6.6 percent of the land area. While the community has experienced an increase in single-family housing since 2000, most of this development activity was located to the west of the F.E.E.T.

Southern New Hampshire Region

This region includes the study area communities of Londonderry and Bedford, and falls within the Southern New Hampshire Planning Commission (SNHPC) service area. Founded as agricultural communities originally, the existing land use distribution across the region today is a departure from that historical start. While some areas evolved quickly into urban centers and other areas remained rural, the vast majority of the region has developed into a suburban land use pattern. This pattern of existing land use found across the region today can be explained by the region's economic development and historic events.

The existing land use pattern today is dominated primarily by residential land uses. This pattern reflects periods of economic growth and decline in the region, as well as the expanding urban center of Boston and the resultant bedroom communities in the region. This existing land use pattern will dictate the character of future land use within the region to some degree. The Regional Plan predicts that continued population growth will require more acres to be devoted to residential and non-residential uses. These additional acres will be consumed to accommodate additional uses and the corresponding infrastructure.

The SNHPC Region is the largest populated region in the state, and the region is projected to add more than 30,000 residents between 2010 and 2020. Since the economic downturn, development activity has resumed in the region at a steady and constant rate. However, the largest amount of developed acreage in the region is designated as residential development. While industrial uses have incurred a steady decline within the region and the state, there are some notable exceptions near the F.E.E.T. The development activity near the Manchester-Boston Regional Airport has increased in recent years due to infrastructure and land availability in Londonderry. More information on the Southern New Hampshire Region can be found at: http://www.snhpc.org/index.php?page=master_plan

Londonderry, NH

Because the airport access road connects to the F.E.E.T. and Londonderry has experienced increased development activity near the Manchester-Boston Regional Airport, this community was added to the evaluation of the F.E.E.T. project area. Originally a rural agricultural community, Londonderry experienced extreme growth in the 1980s, making it the suburban community that it is today. This pattern of development is composed of a mix of low-density residential neighborhoods, auto-oriented retail corridors, and a significant amount of office and industrial development. The third largest community in the Southern New Hampshire Region, Londonderry functions as a suburban bedroom community for Manchester, Boston and other communities. Nearly 75 percent of Londonderry's residents commute out of town for work. The Londonderry Master Plan notes that the town is within a practical commuting distance (30 minutes) of approximately 750,000 people and beyond that, has easy access to the City of Boston and the I-495 corridor. Besides providing convenient access for commuters, Londonderry benefits from the presence of Manchester-Boston Regional Airport, and has the only remaining large area of undeveloped land around the airport.

As a largely suburban town, Londonderry's development pattern is defined by separated uses with a heavy focus on detached single-family neighborhoods and commercial strip centers, with some remnants of the rural landscape remaining intact. Many existing neighborhoods are built as quiet enclaves with streets that have limited access and often terminate in cul-de-sacs. Throughout the community, residential and commercial development is frequently surrounded by heavily wooded buffers giving Londonderry more of a rural appearance.

Londonderry's geographic location not only provides access to a broad labor market, it also enables easy transport of goods and services to local, regional, and international markets. The manufacturing sector is particularly strong and has a major regional concentration in Londonderry with opportunities for additional growth in the vicinity of Pettengill Road. The Pettengill Road area is largely accepted by the community and promoted as a desirable location for growth given its industrial zoning, proximity to the airport, and relative distance from residential neighborhoods. In recent years a number of large scale developments have been constructed in this portion of the community with easy access to the F.E.E.T. The office sector in Londonderry has also experienced growth in the past two decades, but represents a much smaller land use footprint.

Bedford, NH

The town's rolling landscape descends west to east toward the banks of the Merrimack River. Development patterns in Bedford have been shaped by these differences in land form and the resulting transportation system. The Route 101 corridor runs diagonally across the community from the northeast to the point where it crosses into Amherst. Since the 1960s Bedford has experienced the expansion of primarily residential development across the community. The resulting development patterns to the east of the F.E.E.T. along the Merrimack River take advantage of the flatter topography. This area has experienced higher residential densities as well as larger footprints of retail, office and industrial buildings, business parks and retail centers in a more typical commercial corridor.

The Route 101 corridor is where the two patterns of rural residential and the more suburban commercial and residential development meet. Pockets of commercial development are interspersed with the remaining undeveloped land areas creating a contrast between the rural patterns and suburban patterns of land development. To the west of the F.E.E.T., single family residential development has spread across most of the community as a fairly low-density suburban pattern. The town has made an effort to maintain its rural roots within the commercial areas through a combination of sign controls and land development regulations.

According to a build-out analysis prepared by the Southern New Hampshire Planning Commission (SNHPC) and analysis from the Bedford Master Plan, more than half of the total land area in Bedford is classified as undeveloped. This includes protected open space, which constitutes approximately 36.7% of Bedford's land area. However, the predominant land use is residential as it accounts for 57% of the total land area, and represents 83% of all the developed land. Commercial development only occupies 3% of Bedford's land area currently, and industrial and manufacturing uses account for approximately 1% of the town. However, the most intensely developed portions of the community border the F.E.E.T. project area.

3.11 VISUAL RESOURCES

The three segments of the study area have a relatively uniform landscape with similar topography, and much of the land area on both the east and west side of the F.E.E.T. is covered by forested growth. Although there is no formal "parkway" designation for the F.E.E.T. and there are no restrictions on vehicle types such as trucks (exclusion of truck traffic is typical of roads with official "parkway" designations), sections of the study area have a "parkway-like" look and feel. In the areas of dense forest only intermittent views of other land uses by travelers are provided. Similarly, on-lookers would have limited views of the turnpike outside of the immediate area. The forested sections of the turnpike would be considered high visual quality.

There are areas of development present within the study area located adjacent to the turnpike with limited or no vegetated or forested buffers. Views to and from these areas of development, consisting of commercial, retail and residential land uses, would be considered low visual quality.

Each of the three segments have been evaluated and inventoried for visual resources. The results for each segment are presented below.

Southern Segment (Nashua and Merrimack)

A portion of the southern segment is located within the City of Nashua and is approximately 0.6 miles in length. It is located at the north-center portion of the city and passes over the Pennichuck Brook into the Town of Merrimack. The study area begins just north of Tinker Road. The City of Nashua does not maintain public open space or public recreational facilities near the study area; however, the majority of the study area within the City of Nashua is adjacent to the Pennichuck Water Works, which was determined eligible for the National Register in 1993 and 2003. A small land area located within Merrimack (just on the north side of the Pennichuck Bridge) is also included in Pennichuck Water Works designation. There are no structures within this area designated National Register-eligible.

A portion of the southern segment is also located in the Town of Merrimack, beginning at the Nashua-Merrimack border (at Pennichuck Brook) and extending north approximately 0.7 miles to just south of Industrial Drive. This section of the turnpike contains dense forest on the west side with a few residential lots near the turnpike. The east side contains a narrow band of trees but is primarily light industrial with large parking areas (truck parking on paved and unpaved surfaces) and a few buildings.

Neither the City of Nashua nor the Town of Merrimack has designated scenic resources such as viewsheds, scenic easements or scenic roads in the vicinity of the study area. In addition, neither recreational facilities nor public open spaces are present within the vicinity of the study area.

Middle Segment (Merrimack)

The middle segment is entirely located within the Town of Merrimack and is approximately 5.3 miles in length. The segment passes over Naticook Brook, Souhegan River and Baboosic Brook. The study area begins at Greeley Street and extends north to where an overhead utility line crosses the F.E.E.T.

Similar to the southern segment, this segment contains dense forested areas along both the east and west sides of the turnpike; however, the forested areas are fragmented with development. The development that has occurred in the vicinity of the study area includes recreational, institutional, residential, office park, and industrial. These areas of development are buffered by a narrow band of vegetation. Some residential areas of note that are in close proximity to the turnpike include: Hillcrest Subdivision; Bigwood Historic District; Reeds Ferry Heights Subdivision and Oakland Park. Numerous structures in the vicinity of the turnpike are over 50 years in age and are currently under study for historical significance that may require additional evaluation of their visual context in relation to the turnpike and the proposed project. These structures include residential structures, office and commercial buildings and large areas of similar use, such as the Reeds Ferry Heights (residential) Subdivision. Refer to Section 3.8.2 for a discussion of the structures and districts under study.

In addition, the Merrimack High School is located adjacent to the turnpike just south of Baboosic Lake Road. The High School and its multiple athletic fields serve as a major recreational facility in the region. A narrow band of trees currently buffers the High School athletic fields from the turnpike.

The Town of Merrimack does not contain designated scenic resources such as viewsheds, scenic easements or scenic roads in the vicinity of the study area. However, similar to the open vistas provided at Pennichuck Brook in the southern segment, open vistas are provided along the turnpike where it crosses the Souhegan River and Baboosic Brook.

Northern Segment (Bedford)

The northern segment is entirely located within the Town of Bedford and is approximately 1.5 miles in length. The study area begins just south of the US Route 3 overpass and extends north traveling under I-293 and ends at the north side of the NH Route 101/ I-293 interchange. The northern segment contains intermittent areas of forest along both the east and west sides of the turnpike; however, the forested areas are fragmented with roads and development that include office park, commercial and industrial. The northern half of this segment is located within the turnpike / I-293 interchange where the turnpike is bordered by a mix of vegetation and the roadway network that makes up the interchange.

The Town of Bedford does not contain designated scenic resources such as viewsheds, scenic easements or scenic roads in the vicinity of the study area.

Summary of Visual Resources

Southern Segment (Nashua and Merrimack)

- Turnpike portion within City of Nashua: Although not designated as such, the section has a parkway-like look and feel.
- Turnpike crossing Pennichuck Brook: Open vista to the east and west over Pennichuck Brook and surrounded by dense forested growth.
- Turnpike portion within Town of Merrimack: Although not designated as such, the west side of the section of turnpike has a parkway-like look and feel.

Middle Segment (Merrimack)

- Although not designated as such, intermittent portions of the turnpike have a parkway-like look and feel.
- Open vistas to the east and west over Souhegan River and Baboosic Brook.
- Merrimack High School athletic fields.
- Potential historic structures and historic districts located throughout.

Northern Segment (Bedford)

- Although not designated as such, intermittent portions of the turnpike have a parkway-like look and feel.
- Potential historic structures.

3.12 Contaminated Properties and Structures

Hazardous waste sites are regulated by both the federal Resource Conservation and Recovery Act of 1980 (RCRA) (40 CFR Part 261 C) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1986 (CERCLA). NHDES regulations incorporate federal regulations 40 CFR 260-270 (hazardous waste) by reference. The regulations include procedures for identifying hazardous waste, requirements for generators and transporters of hazardous waste, requirements for treatment, storage and disposal facilities, and other provisions.

Database Review

Existing records and databases were searched for records of hazardous materials spills or occurrences in the project vicinity. Environmental regulatory agency records were searched through State and Federal databases accessed and summarized by Environmental Data Resources, Inc. (EDR). Each database was searched to a 0.25-mile radius of the limits of the existing highway and exit ramps. In addition, NHDES records were reviewed through the NHDES's OneStop Records Database (Figures 3.12-1 and 3.12-2).

Review of the regulatory databases and records indicate that there were no areas identified as representing potential areas of contamination relative to the southern and northern segments of the project corridor. Relative to findings for the middle segment, five listings/incidents were identified at various locations within the segment: three spill incidents and two lead removal projects on bridges. None of the incidents/actions are expected to impact the proposed activities within the middle segment with the exception of one spill incident as summarized below.

Spill incident reported on October 14, 1998 involving a release of 250 gallons of diesel fuel and 25 quarts of motor oil as a result of a tractor trailer accident on the highway. The incident occurred at the northbound lane bridge crossing Wire Road (NHDES Site #198810026). The spill was cleaned up and absorbent materials and approximately 30 cubic yards of contaminated soil were removed and disposed of at appropriate facilities. The spill incident was closed by the NHDES with the indication that residual contaminated soil may be encountered whenever excavation takes place to replace the bridge support structure. *(Environmental Commitment 21)*

Review of the NHDES records indicate one inactive asbestos disposal site (ADS), NHDES Site #60100, is located at Exit 6 on the FE Everett Turnpike. Exit 6 is located approximately one mile south of the southern-most limits of the project corridor. Based on the distance from the proposed limits of the project corridor, it is not expected that the ADS will be encountered during any construction activities, and as a result, will not impact the project corridor.

Based on the above findings, no subsurface investigation was recommended at that time. However, when road construction activities progress into the area of the above noted spill site, it is recommended that the soils be screened in the field for visual and olfactory evidence of contamination. Should potentially contaminated soils be encountered they should be segregated, tested, and disposed of accordingly.

Asbestos in Soils along the Turnpike

Asbestos has been used commercially in this country since about 1880. In Nashua, New Hampshire the Johns-Manville Company, which owned a large manufacturing plant, used asbestos fiber and Portland Cement to produce a variety of asbestos cement products for construction and industrial uses.

The Johns-Manville Company provided asbestos-containing waste material free of charge to area property owners for use as fill material. Asbestos-containing waste material was dumped in large quantities throughout the Nashua/Hudson communities, generally to fill low lying areas and facilitate land development. It is possible that fill along the turnpike could contain some of this asbestos-containing material. NHDOT has committed to conduct necessary subsurface investigations prior to project construction sufficient to identify and characterize asbestos in areas of proposed earthwork. NHDOT will plan for the proper handling and disposal of any asbestos-containing materials which may be encountered during project construction. *(Environmental Commitment 22)*

Limited Reuse Soils

Statewide analytical data collected by NHDOT, as well as nationwide information, indicates that roadside soils commonly contain metals at concentrations above naturally occurring background conditions, and Polycyclic Aromatic Hydrocarbons (PAHs) exceeding acceptable reuse concentrations. These “Limited Reuse Soils” (LRS) excavated from within the operational ROW must be addressed in accordance with applicable NHDES rules and/or waivers. Soils that are anticipated to meet the definition of LRS may be subject to management through a Soils Management Plan. Roadside soils currently managed as LRS by the Department include all topsoil within the limits of the existing ROW, regardless of its depth. In those instances where there is no measurable topsoil, LRS will be measured from the top of the ground to a depth of six inches.

During final design of the project, it will be determined if LRS will be generated by the project and, if generated, if the material will require reuse on-site, disposal, and/or temporary stockpiling. Any excess materials that result from the project within the operational ROW will be addressed in accordance with applicable NHDOT guidance and NHDES rules. *(Environmental Commitment 23)*

Hazardous Materials in Bridges

In 2017, NHDOT employed a contractor to examine the potential for asbestos-containing materials in the following bridges: F.E.E.T. over Pennichuck Brook, Baboosic Lake Road over F.E.E.T., and Wire Road over F.E.E.T. The Pennichuck Brook bridges did not contain asbestos, but additional sampling was recommended. Both the Baboosic Lake Road and Wire Road bridges contained asbestos in curbs and have decks with asbestos-containing material. The reports state that asbestos may be present in other parts of the bridges as well.

NHDOT assumes that these bridges also contain lead paint. *(Environmental Commitment 24)*

Polyfluoroalkyl substances (PFAS)

In recent years, per- and polyfluoroalkyl substances (PFAS) have been found in groundwater in portions of the project area. The NH Department of Environmental Services (NHDES) has identified Per- and polyfluoroalkyl substances (PFAS) as emerging contaminants and have developed Ambient Groundwater Quality Standards (AGQS) for two PFAS compounds, Perfluorooctanoic acid (PFOA) and Perfluorooctane Sulfonate (PFOS). NHDES will be setting Maximum Contaminant Levels (MCL’s) for drinking water standards for PFOA, PFOS, Perfluorononanoic acid (PFNA) and Perfluorohexane sulfonic acid (PFHxS) by January 1, 2019. Groundwater that has the potential to have PFAS-impacted groundwater above AGQSs may be subject to management through a Groundwater Management Plan (GMP).

4 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter provides a detailed description of the impacts associated with the alternatives under consideration. The impacts of alternatives that were screened out earlier in project development are discussed in Chapter 2.

4.2 TRAFFIC AND TRANSPORTATION

4.2.1 Traffic Volumes and Levels of Service

The traffic microsimulation model developed for this project evaluated 2016 and projected 2024 and 2044 traffic volumes and levels of service. Baseline 2016 design hour traffic volumes (see Chapter 3) were grown by 1.25% per year to obtain future-year volumes. This growth is based on historical trends observed at the NHDOT Bedford Toll count station (01037101-01037100) for data from 1989 through 2015. While AADT values have remained relatively flat since 2001, the most recent three years of data, from 2012 through 2015, show a similar annual trend to this overall historical growth.

The following assumptions were made for the 2024 and 2044 scenarios. These assumptions were included in both the No Build and Build conditions.

- Signal timings were optimized for future traffic volumes, where necessary, to prevent intersection-related queues from spilling back onto the turnpike. These types of improvements would be expected to occur in this time frame due to normal maintenance routines.
- Capacity was added at the Exit 8 Southbound off-ramp and Southwood Park Drive intersection. With the assumed future-year traffic growth, the Exit 8 Southbound off-ramp had substantial queues that impacted flow along F. E. Everett Turnpike. It was assumed for this analysis that future capacity improvements would be made at this location, as necessary, before flows impact the turnpike.
- For 2044, it was assumed that all traffic would pass through open road tolling (ORT) or all electronic tolling (AET). ORT and AET have no adverse effect on traffic flow; therefore, three open lanes in each direction were assumed through the Bedford toll with no additional toll lanes.

Tables 4.2-1 and 4.2-2 present the freeway LOS results for the No Build and Build conditions for 2016, 2024, and 2044. Tables 4.2-3 and 4.2-4 present a comparison between hourly traffic demand (the volume of traffic that the highway would accommodate if there were no constraints to traffic flow), throughput (the actual volume accommodated by the roadway), and percent served (the percentage of demand accommodated by the roadway). This metric is useful in comparing the extent of congestion and its full affects downstream of bottlenecks.

The Build condition results generally show improved levels of service along with a higher percentage of traffic demand accommodated. Looking at the LOS figures in conjunction with the accommodated demand figures, a few locations have increased density and lower LOS grades in the Build condition. These are locations with substantial unmet demand in the No Build condition due to upstream blockages. In the Build condition, the upstream blockages are resolved, and a much higher percentage of traffic demand is accommodated at these locations, resulting in higher densities.

The results of the modeling effort indicate the proposed project with 3 lanes in each direction throughout the corridor would result in improved operations. In addition to improvements in freeway level of service, the proposed design is projected to serve nearly all the future year traffic demand, in contrast to the No Build conditions, when as much as one-third of projected demand would be unmet.

4.2.2 Infrastructure Deficiencies

The Bridge over the Souhegan River was reconstructed in 2011/2012 to facilitate a six-lane turnpike, but the bridge and adjacent approaches were constructed with a normal crown section, which with the existing horizontal curves does not meet the 70 mph design speed superelevation requirements. The project proposes to flatten the curves immediately adjacent to the bridge to accommodate a normal crown section that would meet the design criteria for 70 mph and eliminate the need for bridge modifications.

Bridge structural and capacity deficiencies would be addressed by the Build Alternative. The Pennichuck Brook, Baboosic Lake Road, and Wire Road all have structural or functional deficiencies and would be replaced with new structures that would accommodate a wider turnpike. The Naticook Brook and Baboosic Brook culverts are both under-sized relative to hydraulic design flows and would be replaced with structures of sufficient size. The No Build Alternative would not correct these deficiencies, although at some point the bridges would require rehabilitation or replacement. The No Build would not correct capacity deficiencies.

4.2.3 Consistency with Local and Regional Planning

As detailed in Chapter 3, local and regional planners, individually and in planning documents, identify the turnpike as a critical local and regional travel route. They have concerns with the current and projected future levels of congestion and its effects on travel times and safety. The Build Alternative would address these concerns by providing greater capacity, reduced travel times, improved infrastructure, and presumably safer travel conditions. The No Build Alternative would not provide these benefits and would therefore be inconsistent with local and regional planning efforts. Section 4.9 addresses the project’s consistency with local and regional land use planning and growth.

Table 4.2-1. Density, speed, and LOS results (AM peak hour)

AM Peak Hour				2016 -Baseline			2024 -Baseline			2024 -Build			2044 -Baseline			2044 -Build		
Direction	Locaton	Description	Type	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS
Southbound	Exit 13	North of Exit 13	Basic	22	65	C	25	64	C	24	63	C	92	28	F	28	62	D
		Exit 13 to Exit 12	Basic	109	18	F	131	13	F	23	64	C	140	12	F	58	38	F
	Exit 12	Exit 12 SB On-Ramp	Basic	66	35	F	69	34	F	31	60	D	74	32	F	41	46	E
		Exit 12 to Exit 11	Basic	40	59	E	40	59	E	31	61	D	40	59	E	41	59	E
	Exit 11	Exit 11 SB Off-Ramp	Diverge	42	57	E	42	57	E	30	60	D	42	57	E	56	42	F
		Exit 11 SB Off-Ramp to Exit 11 SB On-Ramp	Basic	27	62	D	27	63	D	28	62	D	27	62	D	95	23	F
		Exit 11 SB On-Ramp	Merge	21	57	C	21	58	C	30	49	D	24	53	C	70	22	F
	Exit 10	Exit 10 SB Off-Ramp	Diverge	22	61	C	23	62	C	33	56	D	26	60	C	52	42	F
		Exit 10 SB Off-Ramp to Exit 10 SB On-Ramp	Basic	24	63	C	25	63	C	23	64	C	25	62	C	28	64	D
		Exit 10 SB On-Ramp	Merge	23	59	C	24	58	C	16	63	B	25	57	C	22	61	C
		Exit 10 to Exit 8	Basic	31	61	D	32	61	D	24	63	C	33	60	D	30	62	D
	Exit 8	Exit 8 SB Off-Ramp	Diverge	18	64	B	18	64	B	17	61	B	19	63	B	22	60	C
		Exit 8 SB Off-Ramp to Exit 8 SB On-Ramp	Basic	18	66	B	19	66	C	22	63	C	19	65	C	28	62	D
		Exit 8 SB On-Ramp	Basic	14	67	B	14	66	B	17	66	B	16	66	B	20	65	C
Northbound	Exit 13	North of Exit 13	Basic	20	63	C	23	61	C	19	65	C	37	51	E	23	64	C
		Exit 12 to Exit 13	Basic	21	62	C	24	62	C	17	65	B	30	61	D	21	64	C
	Exit 12	Exit 12 NB Off-Ramp	Diverge	26	60	C	29	60	D	17	63	B	38	57	E	20	62	C
		Exit 11 to Exit 12	Basic	25	61	C	28	61	D	19	64	C	36	58	E	23	62	C
	Exit 11	Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Merge	25	56	C	29	52	D	16	64	B	40	44	E	21	61	C
		Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Basic	18	64	C	20	63	C	15	66	B	26	61	D	19	64	C
		Exit 11 NB Off-Ramp	Diverge	11	65	B	12	65	B	14	65	B	16	64	B	16	64	B
	Exit 10	Exit 10 NB On-Ramp	Merge	10	65	B	11	62	B	12	63	B	14	61	B	16	60	B
		Exit 10 NB Off-Ramp to Exit 10 NB On-Ramp	Basic	12	67	B	13	67	B	14	67	B	17	66	B	17	65	B
		Exit 10 NB Off-Ramp	Diverge	17	62	B	21	62	C	18	60	B	75	61	F	24	58	C
		Exit 8 to Exit 10	Basic	27	61	D	30	60	D	20	64	C	47	50	F	25	63	C
	Exit 8	Exit 8 NB On-Ramp	Merge	18	63	B	21	60	C	18	65	B	91	11	F	22	63	C
		Exit 8 NB Off-Ramp to Exit 8 NB On-Ramp	Basic	15	67	B	17	66	B	18	66	C	130	12	F	22	65	C
		Exit 8 NB Off-Ramp	Diverge	17	64	B	19	65	B	20	64	C	37	52	E	25	63	C

Table 4.2-2. Density, speed, and LOS results (PM peak hour)

PM Peak Hour				2016 -Baseline			2024 -Baseline			2024 -Build			2044 -Baseline			2044 -Build		
Direction	Locaton	Description	Type	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS	Segment Density (veh/mi/ln)	Speed (mph)	LOS
Southbound	Exit 13	North of Exit 13	Basic	17	66	B	19	66	C	17	67	B	26	64	C	24	64	C
		Exit 13 to Exit 12	Basic	21	63	C	24	62	C	18	65	B	76	29	F	23	64	C
	Exit 12	Exit 12 SB On-Ramp	Basic	27	60	C	30	57	D	21	64	C	55	41	F	27	62	D
		Exit 12 to Exit 11	Basic	27	61	D	30	60	D	21	63	C	39	59	E	27	62	D
	Exit 11	Exit 11 SB Off-Ramp	Diverge	29	59	D	31	59	D	19	62	B	43	56	E	27	60	C
		Exit 11 SB Off-Ramp to Exit 11 SB On-Ramp	Basic	17	65	B	19	64	C	18	65	B	24	63	C	22	64	C
		Exit 11 SB On-Ramp	Merge	10	65	A	11	64	B	15	62	B	40	55	E	19	59	B
	Exit 10	Exit 10 SB Off-Ramp	Diverge	11	65	B	12	65	B	16	63	B	92	17	F	20	62	B
		Exit 10 SB Off-Ramp to Exit 10 SB On-Ramp	Basic	18	63	B	20	62	C	17	64	B	153	9	F	22	63	C
		Exit 10 SB On-Ramp	Merge	25	49	C	32	41	D	20	55	B	54	21	F	27	50	C
		Exit 10 to Exit 8	Basic	30	61	D	34	59	D	22	63	C	38	55	E	29	61	D
	Exit 8	Exit 8 SB Off-Ramp	Diverge	19	64	B	23	64	C	20	62	B	35	64	E	27	60	C
		Exit 8 SB Off-Ramp to Exit 8 SB On-Ramp	Basic	18	66	B	19	65	C	22	63	C	22	65	C	28	62	D
		Exit 8 SB On-Ramp	Basic	14	66	B	16	66	B	17	65	B	18	66	C	22	65	C
Northbound	Exit 13	North of Exit 13	Basic	26	61	C	27	59	D	24	64	C	39	49	E	31	62	D
		Exit 12 to Exit 13	Basic	32	60	D	32	60	D	25	63	C	32	61	D	33	60	D
	Exit 12	Exit 12 NB Off-Ramp	Diverge	41	56	E	40	57	E	28	59	C	41	57	E	40	57	E
		Exit 11 to Exit 12	Basic	39	55	E	39	55	E	29	61	D	38	55	E	38	58	E
	Exit 11	Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Merge	58	17	F	58	15	F	27	58	C	60	13	F	50	45	F
		Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Basic	49	38	F	142	11	F	21	64	C	150	10	F	30	61	D
		Exit 11 NB Off-Ramp	Diverge	17	63	B	148	11	F	23	60	C	166	8	F	33	54	D
	Exit 10	Exit 10 NB On-Ramp	Merge	17	58	B	133	15	F	23	53	C	170	6	F	33	45	D
		Exit 10 NB Off-Ramp to Exit 10 NB On-Ramp	Basic	16	66	B	33	45	D	20	64	C	180	6	F	27	62	D
		Exit 10 NB Off-Ramp	Diverge	19	63	B	21	63	C	19	62	B	112	13	F	22	60	C
		Exit 8 to Exit 10	Basic	30	61	D	33	60	D	23	64	C	59	37	F	29	62	D
	Exit 8	Exit 8 NB On-Ramp	Merge	20	60	C	23	58	C	18	64	B	112	10	F	24	61	C
		Exit 8 NB Off-Ramp to Exit 8 NB On-Ramp	Basic	16	66	B	19	66	C	20	65	C	163	8	F	26	64	D
		Exit 8 NB Off-Ramp	Diverge	19	64	B	21	63	C	24	63	C	150	10	F	30	61	D

Table 4.2-3. Vehicles serviced (AM peak hour)

AM Peak Hour				2016 -Baseline			2024 -Baseline			2024 -Build			2044 -Baseline			2044 -Build		
Direction	Locaton	Description	Type	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served
Southbound	Exit 13	North of Exit 13	Basic	3730	3742	100%	4119	4099	100%	4119	4124	100%	5281	4530	86%	5281	5297	100%
		Exit 13 to Exit 12	Basic	3565	3358	94%	3938	3247	82%	3938	3920	100%	5049	3116	62%	5049	5002	99%
	Exit 12	Exit 12 SB On-Ramp	Basic	4512	4232	94%	4983	4249	85%	4983	4963	100%	6388	4253	67%	6388	6241	98%
		Exit 12 to Exit 11	Basic	4512	4177	93%	4983	4206	84%	4983	4909	99%	6388	4231	66%	6388	6148	96%
	Exit 11	Exit 11 SB Off-Ramp	Diverge	4512	4163	92%	4983	4197	84%	4983	4896	98%	6388	4224	66%	6388	6113	96%
		Exit 11 SB Off-Ramp to Exit 11 SB On-Ramp	Basic	4028	3692	92%	4449	3721	84%	4449	4346	98%	5704	3735	65%	5704	5327	93%
		Exit 11 SB On-Ramp	Merge	4673	4319	92%	5161	4439	86%	5161	5063	98%	6617	4654	70%	6617	6209	94%
	Exit 10	Exit 10 SB Off-Ramp	Diverge	4673	4302	92%	5161	4423	86%	5161	5044	98%	6617	4641	70%	6617	6169	93%
		Exit 10 SB Off-Ramp to Exit 10 SB On-Ramp	Basic	3491	3171	91%	3856	3249	84%	3856	3717	96%	4944	3317	67%	4944	4540	92%
		Exit 10 SB On-Ramp	Merge	3645	3319	91%	4025	3413	85%	4025	3866	96%	5161	3525	68%	5161	4735	92%
		Exit 10 to Exit 8	Basic	3645	3271	90%	4025	3368	84%	4025	3812	95%	5161	3480	67%	5161	4664	90%
	Exit 8	Exit 8 SB Off-Ramp	Diverge	3645	3262	89%	4025	3358	83%	4025	3803	94%	5161	3470	67%	5161	4650	90%
		Exit 8 SB Off-Ramp to Exit 8 SB On-Ramp	Basic	3313	2938	89%	3659	3024	83%	3659	3436	94%	4691	3103	66%	4691	4194	89%
		Exit 8 SB On-Ramp	Basic	4362	3944	90%	4818	4145	86%	4818	4538	94%	6177	4542	74%	6177	5621	91%
Northbound	Exit 13	North of Exit 13	Basic	2975	2835	95%	3286	3155	96%	3286	3194	97%	4213	3935	93%	4213	4056	96%
		Exit 12 to Exit 13	Basic	2579	2490	97%	2848	2788	98%	2848	2821	99%	3651	3432	94%	3651	3576	98%
	Exit 12	Exit 12 NB Off-Ramp	Diverge	2879	2834	98%	3179	3162	99%	3179	3201	101%	4076	3892	95%	4076	4060	100%
		Exit 11 to Exit 12	Basic	2879	2842	99%	3179	3183	100%	3179	3208	101%	4076	3908	96%	4076	4075	100%
	Exit 11	Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Merge	2879	2866	100%	3179	3210	101%	3179	3220	101%	4076	3934	97%	4076	4091	100%
		Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Basic	2401	2397	100%	2652	2674	101%	2652	2682	101%	3400	3260	96%	3400	3396	100%
		Exit 11 NB Off-Ramp	Diverge	2635	2635	100%	2910	2934	101%	2910	2943	101%	3731	3583	96%	3731	3733	100%
	Exit 10	Exit 10 NB On-Ramp	Merge	2635	2632	100%	2910	2932	101%	2910	2943	101%	3731	3584	96%	3731	3730	100%
		Exit 10 NB Off-Ramp to Exit 10 NB On-Ramp	Basic	2260	2252	100%	2496	2513	101%	2496	2514	101%	3200	3044	95%	3200	3192	100%
		Exit 10 NB Off-Ramp	Diverge	3122	3128	100%	3448	3471	101%	3448	3474	101%	4421	4221	95%	4421	4421	100%
		Exit 8 to Exit 10	Basic	3122	3131	100%	3448	3474	101%	3448	3476	101%	4421	4221	95%	4421	4418	100%
	Exit 8	Exit 8 NB On-Ramp	Merge	3122	3124	100%	3448	3471	101%	3448	3477	101%	4421	4246	96%	4421	4424	100%
		Exit 8 NB Off-Ramp to Exit 8 NB On-Ramp	Basic	2919	2919	100%	3225	3243	101%	3225	3253	101%	4134	4030	97%	4134	4141	100%
		Exit 8 NB Off-Ramp	Diverge	4043	4056	100%	4465	4471	100%	4465	4501	101%	5725	5690	99%	5725	5731	100%

Table 4.2-4. Vehicles serviced (PM peak hour)

PM Peak Hour				2016 -Baseline			2024 -Baseline			2024 -Build			2044 -Baseline			2044 -Build		
Direction	Locaton	Description	Type	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served	Demand	Through-put	% Served
Southbound	Exit 13	North of Exit 13	Basic	3064	3071	100%	3384	3393	100%	3384	3381	100%	4339	4326	100%	4339	4329	100%
		Exit 13 to Exit 12	Basic	2774	2762	100%	3064	3083	101%	3064	3063	100%	3928	3806	97%	3928	3923	100%
	Exit 12	Exit 12 SB On-Ramp	Basic	3139	3130	100%	3467	3487	101%	3467	3458	100%	4444	4239	95%	4444	4397	99%
		Exit 12 to Exit 11	Basic	3139	3107	99%	3467	3457	100%	3467	3422	99%	4444	4181	94%	4444	4340	98%
	Exit 11	Exit 11 SB Off-Ramp	Diverge	3139	3097	99%	3467	3444	99%	3467	3414	98%	4444	4166	94%	4444	4330	97%
		Exit 11 SB Off-Ramp to Exit 11 SB On-Ramp	Basic	2620	2579	98%	2893	2867	99%	2893	2830	98%	3709	3449	93%	3709	3606	97%
		Exit 11 SB On-Ramp	Merge	2951	2905	98%	3259	3221	99%	3259	3188	98%	4178	3914	94%	4178	4073	97%
	Exit 10	Exit 10 SB Off-Ramp	Diverge	2951	2899	98%	3259	3207	98%	3259	3174	97%	4178	3785	91%	4178	4055	97%
		Exit 10 SB Off-Ramp to Exit 10 SB On-Ramp	Basic	2541	2478	98%	2807	2739	98%	2807	2711	97%	3598	2977	83%	3598	3459	96%
		Exit 10 SB On-Ramp	Merge	3425	3370	98%	3783	3715	98%	3783	3681	97%	4850	4144	85%	4850	4692	97%
		Exit 10 to Exit 8	Basic	3425	3344	98%	3783	3677	97%	3783	3644	96%	4850	4087	84%	4850	4639	96%
	Exit 8	Exit 8 SB Off-Ramp	Diverge	3425	3338	97%	3783	3668	97%	3783	3634	96%	4850	4076	84%	4850	4626	95%
		Exit 8 SB Off-Ramp to Exit 8 SB On-Ramp	Basic	3124	3031	97%	3451	3322	96%	3451	3302	96%	4424	3689	83%	4424	4187	95%
		Exit 8 SB On-Ramp	Basic	4326	4195	97%	4778	4626	97%	4778	4594	96%	6125	5357	87%	6125	5837	95%
Northbound	Exit 13	North of Exit 13	Basic	3779	3488	92%	4174	3677	88%	4174	3960	95%	5352	3954	74%	5352	5013	94%
		Exit 12 to Exit 13	Basic	3691	3495	95%	4077	3592	88%	4077	3958	97%	5227	3613	69%	5227	4995	96%
	Exit 12	Exit 12 NB Off-Ramp	Diverge	4212	4074	97%	4653	4176	90%	4653	4588	99%	5965	4203	70%	5965	5806	97%
		Exit 11 to Exit 12	Basic	4212	4089	97%	4653	4193	90%	4653	4603	99%	5965	4215	71%	5965	5828	98%
	Exit 11	Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Merge	4212	4153	99%	4653	4241	91%	4653	4639	100%	5965	4245	71%	5965	5908	99%
		Exit 11 NB Off-Ramp to Exit 11 NB On-Ramp	Basic	3160	3113	99%	3490	3128	90%	3490	3485	100%	4474	3037	68%	4474	4464	100%
		Exit 11 NB Off-Ramp	Diverge	3778	3745	99%	4173	3998	96%	4173	4157	100%	5350	3902	73%	5350	5328	100%
	Exit 10	Exit 10 NB On-Ramp	Merge	3778	3742	99%	4173	4125	99%	4173	4156	100%	5350	4038	75%	5350	5331	100%
		Exit 10 NB Off-Ramp to Exit 10 NB On-Ramp	Basic	3088	3061	99%	3411	3390	99%	3411	3400	100%	4373	3209	73%	4373	4365	100%
		Exit 10 NB Off-Ramp	Diverge	3477	3459	99%	3841	3888	101%	3841	3845	100%	4924	4039	82%	4924	4914	100%
		Exit 8 to Exit 10	Basic	3477	3459	99%	3841	3885	101%	3841	3845	100%	4924	4120	84%	4924	4914	100%
	Exit 8	Exit 8 NB On-Ramp	Merge	3477	3464	100%	3841	3881	101%	3841	3841	100%	4924	4272	87%	4924	4909	100%
		Exit 8 NB Off-Ramp to Exit 8 NB On-Ramp	Basic	3143	3124	99%	3472	3503	101%	3472	3460	100%	4451	3853	87%	4451	4428	99%
		Exit 8 NB Off-Ramp	Diverge	4578	4558	100%	5056	5094	101%	5056	5046	100%	6482	5778	89%	6482	6480	100%

4.3 AIR QUALITY

A microscale air quality analysis was completed to document project-level conformity with the National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO), fine particulate matter, and coarse particulate matter (airborne particles that are under 2.5 micrometers in diameter, called PM2.5 and PM10, respectively). Mobile Source Air Toxics (MSAT) and greenhouse gas emissions are also addressed.

4.3.1 Methods

The three intersections in the analysis were intended to represent the three most congested intersections within the study area. The three intersections had higher traffic volumes and worse levels of service than other intersections and were associated with turnpike on and off ramps. The intersections are as follows:

- Exit 11 Northbound off and on ramp with Greeley Street
- Exit 12 Northbound off ramp with Bedford Road
- Exit 12 Southbound on ramp intersection with Back River Road and Bedford Road

The analysis was done with the EPA Motor Vehicle Emissions Simulator (MOVES2014a) and dispersion modeling software CAL3QHC through the CAL3i Windows interface. The function of the MOVES modeling was to determine emission factors and emission inventories from on-road motor vehicles. MOVES models the emissions produced from cars and trucks at the identified signalized intersections based on vehicle types, time period of analysis, geographical area, vehicle operating characteristics, and road types. The pollution output from motor vehicles as calculated through MOVES2014a is then used as input for the CAL3QHC dispersion modeling. The CAL3QHC dispersion modeling determines concentrations of the pollutants at set distances from the intersection based on roadway geometries, receptor locations, meteorological conditions and vehicular emission rates. This analysis is to determine the concentrations of pollutants at receptor locations intended to replicate likely pedestrian experiences, essentially determining the air quality for someone walking along the sidewalk or nearby.

The worst-case scenario was modeled for the build design year with the presumption that if the concentrations of CO, PM2.5, and PM10 are substantially below the NAAQS limits, then it can be safe to assume the project would meet these standards during other scenarios, and no further modeling is necessary. The worst-case modeling assumptions were made for traffic, meteorological conditions, and other inputs to generate estimates of the maximum concentrations. Traffic volumes were taken at peak hours for the AM and PM. The model was run for January because winter months historically are found to have higher concentrations of air pollutants.

All modeling inputs and procedures were developed based on EPA guidance, including *EPA 1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections*, *Using MOVES2014 in Project-Level Carbon Monoxide Analyses*, and *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas*. These inputs reflect the traffic information generated for the project, including vehicle volumes and classifications (trucks, etc.). CAL3QHC inputs were per the EPA guidance, including *Users Guide to CAL3QHC Version 2.0: A Modeling*

Methodology for Predicting Pollutant Concentrations Near Roadway Intersections. Additional assumptions may be found in the *Air Quality Analysis* report.

4.3.2 Results

Carbon monoxide (CO)

Carbon monoxide (CO) concentrations were all modeled at 0.10 ppm at the three locations for both AM and PM. With the majority of the receptors recording a negligible concentration of CO under the worst-case scenario, it can be assumed that this project would not cause exceedances of the current 1-hour CO NAAQS of 35 ppm. Recent CO samples taken from the Londonderry Air Monitoring Station operated by NHDES at Moose Hill School in Londonderry, NH (approximately 5 miles east of the turnpike project area) show a maximum of 2.65 ppm over 8,600 hourly samples taken in 2011. Even if the ambient CO levels at the intersections of interest are equivalent to the highest measured concentrations at the Londonderry station, the concentrations would still be well below the 1-hour standard of 35 ppm. Due to these findings, no additional analysis of CO is necessary.

Coarse particulate matter (PM10)

Modeled PM10 concentrations ranged from 9.9 µg/m^3 to 12.0 µg/m^3 at the three locations over both time periods. The concentration limit in the NAAQS is 150 µg/m^3 averaged over a 24-hour period. There is no information in the State Implementation Plan (the state's air quality compliance document as discussed in Chapter 3) regarding an ambient concentration to consider in the modeling. Since modeled concentrations for the worst-case scenario are substantially below the NAAQS, no additional analysis of PM10 is believed to be necessary.

Fine particulate matter (PM2.5)

Modeled PM2.5 concentrations ranged from 1.5 µg/m^3 to 2.0 µg/m^3 at the three intersections over both time periods and are well below the 24-hour NAAQS concentration of 35 µg/m^3. Because these results represent the worst-case scenario for one hour, it is assumed the 24-hour average is well below the threshold and no further analysis is needed.

4.3.3 Mobile Source Air Toxics (MSAT)

For each alternative in this Environmental Study, the amount of mobile source air toxics (MSAT) emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the Build Alternatives is slightly higher than that for the No Build Alternative, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the preferred action alternative along the highway corridor, along with a corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds; according to the Environmental Protection Agency's (EPA) MOVES2014 model, emissions of all of the priority MSAT decrease as speed increases. Regardless of the effects of this project, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by over 90 percent between 2010 and 2050 (Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents, Federal Highway Administration, October 12, 2016). Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

4.3.4 Greenhouse Gas Emissions

According to the US EPA, the majority of greenhouse gas emissions from transportation are carbon dioxide (CO_2) emissions resulting from the combustion of petroleum-based products in internal combustion engines. The largest sources of transportation-related greenhouse gas emissions include passenger cars and light-duty trucks. According to a cost-benefit analysis[25] of the proposed improvements prepared in 2013 and revised in 2018, the project would result in 8% less gasoline and 10% less diesel fuel consumption between the years 2024 and 2044 compared to the No Build Alternative. The analysis indicates this corresponds to a reduction in emissions (carbon monoxide, mono-nitrogen oxides, and volatile organic compounds) of 8% over the same period. It is assumed that carbon dioxide emissions would decrease by a similar amount. This indicates the Build Alternative, although it has slightly higher traffic volumes than the No Build, would have lower greenhouse gas emissions.

4.3.5 Conclusions

The build conditions for the design year are well below the CO, PM2.5, and PM10 standards. Therefore, it is concluded that this project would not cause or contribute to exceedances of the NAAQS. MSAT emissions in the study area are likely to be lower in future years. Greenhouse gas emissions are likely to be lower than the No Build Alternative in future years.

[25] Technical Memorandum dated 1/2018: *F.E. Everett Turnpike: Assessment of widening two sections of the turnpike from four lanes to six lanes.* Prepared by CHA Consulting Inc.

4.4 NOISE

The noise analysis predicted existing and future sound levels for over 300 receptor locations along the proposed project corridor. Noise study methods, terminology, and existing noise levels are reported in Chapter 3. Noise levels for the 2044 No Build and Build Alternatives were found to be nearly identical (within one decibel), so only the Build Alternative results are reported below. A barrier analysis was conducted to determine if noise mitigation measures were feasible and reasonable.

4.4.1 Noise Analysis Results

This section summarizes noise analysis results for each Noise Analysis Location. For each location, results are compared to the Noise Abatement Criteria (NAC) to determine whether there would be a noise impact based on federal definitions. For each impacted location, the results of an abatement analysis are also reported, including the ability to achieve the required 7 dB reduction in noise levels ("insertion loss") at the most benefitted property, number of benefitted receptors, and barrier effectiveness. The results are summarized below in Tables 4.4-1 and 4.4-2.

In 2044, there would be impacts at 20 Noise Analysis Locations or distinct neighborhoods along the entire corridor between Exit 8 and the I-293 interchange; the other 5 locations would not reach the level of impact as defined by the NAC. The impacts range from marginal (66 Leq) to as high as 75 Leq. The number of impacted receptors at each location ranges from 1 to 54.

4.4.2 Noise Abatement Measures

Noise mitigation measures were evaluated for the receptor locations where adverse noise impacts have been identified. The primary mitigation measure considered for noise abatement for this project was the construction of a noise barrier. As defined in the NHDOT *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I & II Highway Projects,* a noise barrier is a solid wall, earth berm, or wall/berm combination located between the roadway and a ground-level receiver location, which breaks the line of sight between the receiver and the roadway noise sources. By breaking the line of sight, a noise barrier is able to diffract the sound transmitted to the receiver, and generally results in a reduction of at least 5 dB(A).

A noise mitigation measure must meet the feasibility and reasonableness requirements in order to be considered for construction. Insertion loss refers to the amount of noise reduction provided by a noise mitigation measure. An insertion loss of 10 dB(A) or greater at the first row of benefited receptors is preferred; however, to be considered feasible, a noise mitigation measure must provide at least a 5 dB(A) noise reduction for at least 1 impacted receptor.

Effectiveness is determined for each feasible noise mitigation measure. Effectiveness is determined on a dimensional basis by dividing the total protective surface area of the noise mitigation measure by the number of receptors receiving at least a 5 dB(A) insertion loss. NHDOT uses an Effectiveness Criterion of 1,500 square feet of noise barrier per benefitted receptor. A noise abatement measure is considered reasonable if it provides at least a 7 dB(A) or greater noise reduction for at least 1 benefited receptor.

Noise mitigation measures were evaluated for noise analysis locations with impacted receptors. An impacted receptor is a receptor that has a worst-case noise hour noise level (Leq) that is within 1 dB(A) of, or exceeds, the NAC for the corresponding Activity Category as described in Table 3.4-1. The following is an overview of the results of the abatement analysis for each Noise Analysis Location. See Figures 4.4-1 and 4.4-2 for locations of Noise Analysis Locations and proposed noise barriers.

NAL A: This site is located on the west side of the turnpike southbound northwest of Interchange 8, in the City of Nashua. NAL A encompasses the neighborhoods of Damper Circle, Sandstone Drive, Hearthside Drive, Tinker Road, and Fireside Circle. NAL A is expected to experience noise impacts, but a barrier exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL B: This site is located on the west side of the turnpike southbound between Interchange 8 and Interchange 10, in the Town of Merrimack. NAL B encompasses the neighborhood of Thornton Road West. NAL B is expected to experience noise impacts, but a barrier exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL C: This site is located on the west side of the turnpike southbound between Interchange 10 and Interchange 11, in the Town of Merrimack. NAL C encompasses the neighborhoods of Englewood Drive, Findlay Way, Danville Circle, Cranston Circle and the eastern part of Whittier Road. NAL C is expected to experience noise impacts, but a barrier exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL D: This site is located on the west side of the turnpike southbound, southwest of Interchange 11, in the Town of Merrimack. NAL D encompasses the neighborhoods of Briarwood Lane, Longwood Lane, Buttonwood Drive, Cottonwood Lane, Nottingwood Lane and Gull Lane. NAL D is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL E: This site is located on the east side of the F. E. Everett Turnpike northbound, between Interchange 10 and Interchange 11, in the Town of Merrimack. NAL E encompasses the multi-unit Residences at Daniel Webster apartment complex, located on the west side of US Route 3. NAL E is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL F: This site is located on the east side of the F. E. Everett Turnpike northbound, southeast of Interchange 11, in the Town of Merrimack. NAL F encompasses the neighborhood complex on Sentry Way, Turnbuckle Road, Turnbuckle Lane, Smith Road, and Flintlock Lane, located on the west side of US Route 3. NAL F is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL G: This site is located on the east side of the turnpike northbound in the town of Merrimack. It encompasses the neighborhood of Hoyt Street. NAL G is expected to experience noise impacts, but a barrier exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL H: This site is located on the east side of the F. E. Everett Turnpike northbound, northeast of Interchange 11, in the Town of Merrimack. NAL H encompasses the multi-unit apartment complex of East Ridge Road, Colonial Drive, Concord Road, Everett Lane, and Arlington Street and Road. NAL H is not expected to experience noise impacts, so no barrier analysis was warranted and no barrier is proposed.

NAL I: This site is located on the east side of the turnpike northbound, between Interchange 11 and Baboosic Lake Road, in the Town of Merrimack. NAL I encompasses the neighborhoods of Hillcrest Drive, East Chamberlain Road, Bretton Drive, Oak Street, and Penacook Terrace. NAL I is not expected to experience noise impacts, so no barrier analysis was warranted and no barrier is proposed.

NAL J: This site is located on the west side of the turnpike southbound between Interchange 11 and Baboosic Lake Road, in the Town of Merrimack. NAL J primarily encompasses the neighborhoods of West Chamberlain Road, Cascade Circle, Vanden Drive, Joston Drive, Summit Road, and Winrow Drive. NAL J is expected to experience noise impacts, but a barrier exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL K: Noise Analysis Location K is located on the east side of the F. E. Everett Turnpike northbound, southeast of Baboosic Lake Road, in the Town of Merrimack. NAL K encompasses the Mastricola Elementary and Merrimack High Schools, McElwain Street, Highland Green Lane, Appletree Village Lane, School Street, O'Gara Drive, and Bishop Street. NAL K is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL L: This site is located on the west side of the turnpike southbound along the north and south sides of Baboosic Lake Road in the Town of Merrimack. NAL L encompasses the neighborhoods of Souhegan Drive, Currier Road, Fir Street, Birch Street, Rose Lane, and Baboosic Lake Road. NAL L is expected to experience noise impacts, but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL M: This site is located on the east side of the turnpike northbound, on the southwest quadrant of the Wire Road overpass, in the Town of Merrimack. NAL M encompasses the neighborhood of Hillside Terrace and a portion of Wire Road. NAL M is not expected to experience noise impacts, so no barrier analysis was warranted and no barrier is proposed.

NAL N: This site is located on the east side of the F. E. Everett Turnpike northbound, northeast of Wire Road, in the Town of Merrimack. NAL N encompasses the neighborhoods of Sunnydale Drive, Wood Street, Bel Air Avenue, Oak Ridge Avenue, and McGraw Bridge Road. NAL N is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL O: This site is located on the west side of the turnpike southbound on the northwest quadrant of the Wire Road overpass, in the Town of Merrimack. NAL O encompasses the neighborhoods of Clay Street, Collins Avenue, Berkley Street, and Ivy Drive. NAL O is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL P: This site is located on the west side of the turnpike southbound on the northeast quadrant of the Wire Road overpass, in the Town of Merrimack. NAL P encompasses the neighborhood of Drake Lane and part of Mallard Point Road. NAL P is not expected to experience noise impacts, so no barrier analysis was warranted and no barrier is proposed.

NAL Q: This site is located on the west side of the turnpike southbound southwest of Interchange 12, in the Town of Merrimack. NAL Q encompasses the neighborhoods of Roundtree Drive, Davis Road, Vista Way, Ministerial Drive, Weston Road, and Kittridge Lane. NAL Q is expected to experience noise impacts, but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL R: This site is located on the east side of the turnpike northbound, southeast of Interchange 12, in the Town of Merrimack. NAL R encompasses the neighborhoods of Harris Avenue, Wheeler Street, and Chapel Lane. NAL R is expected to experience noise impacts, but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL S: This site is located on the west side of the turnpike southbound, northwest of Interchange 12, in the Town of Merrimack. NAL S includes Back River Road, Bradford Drive, Belmont Drive, Raymond Drive, Small Lane, and Brookfield Drive. NAL S is expected to experience noise impacts, but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL T: This site is located on the east side of the turnpike northbound, northeast of Interchange 12, in the Town of Merrimack. NAL T encompasses the neighborhood of Priscilla Lane and the adjacent church. NAL T is expected to experience noise impacts but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL U: Noise Analysis Location U is located on the east side of the F. E. Everett Turnpike northbound, between Interchange 12 and Interchange 13, in the Town of Merrimack. NAL U encompasses the neighborhoods of Kimberly Drive and Shelburne Road. NAL U is expected to experience noise impacts and a barrier would meet the square footage threshold and was therefore reasonable. A noise barrier is proposed at this location.

NAL V: This site is located on the east side of the turnpike northbound, between Interchange 12 and Interchange 13, in the Town of Merrimack. NAL V encompasses the neighborhood of Maple Ridge Drive. NAL V is not expected to experience noise impacts, as there is an existing noise barrier. No further abatement is proposed.

NAL X: This site is located on the west side of the turnpike southbound, between Interchange 13 and Route 3 (South River Road), in the Town of Bedford. NAL X encompasses the neighborhoods of County Road, Teaberry Lane, Heather Drive, Mulberry Lane, and Bayberry Court. NAL X is expected to experience noise impacts, but exceeds the square footage threshold and therefore is not reasonable. No barrier is proposed.

NAL Y: This site is located on the west side of the turnpike southbound in the Town of Bedford. It encompasses the neighborhood of Sunset Lane. NAL Y is expected to experience noise impacts, but exceeded the square footage threshold and was therefore not reasonable. No barrier is proposed.

NAL Z: This site is located on the west side of the turnpike southbound in the Town of Bedford. It is a single residence on South River Road. NAL Z was comparatively analyzed using NAL Y as it is located in similar proximity to the turnpike and has similar traffic conditions to NAL Y. As NAL Y is expected to experience noise impacts, but exceeded the square footage threshold, NAL Z is also expected to experience noise impacts, but exceed the square footage threshold. As such noise abatement at this location would not be reasonable. No barrier is proposed.

Residences at Executive Park: The Town of Merrimack Planning Board approved plans for a five-building apartment complex called the Residences at Executive Park located northwest of Exit 11, on the west side of Executive Park Drive. To date this complex has not received a final Building Permit or similar final approval from the town and thus currently it is not considered developed. As such, further impact and abatement assessment of this property is not warranted. Nevertheless, the likelihood of noise impacts at various distances from the turnpike have been calculated, and the current design plans indicate that the closest residential apartment building would be approximately 500 feet from the turnpike median, which is outside the area of likely noise impact. Also, no areas of frequent exterior use have been identified on the design plans. Noise impacts on this complex are not anticipated due to a lack of areas of frequent exterior use and as all buildings are located outside the area of likely noise impact.

A total of 7 barriers are proposed for construction, all within the Town of Merrimack. As shown in Table 4.4-2, effective barriers would range from 15.1 to 16.9 feet high and from 920 feet long (NAL E) to 3,625 feet long (K). The total length of barriers would be 11,870 feet, and total square footage would be 190,175. A total of 257 receptors would benefit from the proposed barriers. *(Environmental Commitment 1)*

Table 4.4-1. Measured, Existing, and Predicted Noise Levels

NOISE ANALYSIS LOCATION	HIGHEST Leq in NAL/NEIGHBORHOOD		IMPACT Y/N	TOTAL IMPACTS (2044)	MODELED Leq W/BARRIER @ SAME RECEPTOR (2044)	MAX. INSERTION LOSS IN NEIGHBORHOOD (2044)	ACCOUST. FEASIBLE OR REASONABLE
	2016	2044					
A	67	68	Y	5	61	7	Y
B	69	72	Y	1	65	7	Y
C	65	66	Y	2	60	7	Y
D	70	72	Y	41	60	12	Y
E	71	73	Y	54	64	9	Y
F	66	67	Y	12	58	9	Y
G	72	74	Y	2	65	9	Y
H	57	60	N	N/A	N/A	N/A	N/A
I	64	64	N	N/A	N/A	N/A	N/A
J	72	74	Y	8	66	8	Y
J(2)	72	74	Y	8	66	8	Y
K	67	68	Y	42	60	8	Y
L	65	66	Y	1	62	4	N
M	62	63	N	N/A	N/A	N/A	N/A
N	73	75	Y	15	66	10	Y
O	70	72	Y	12	61	11	Y
P	62	63	N	N/A	N/A	N/A	N/A
Q	72	74	Y	24	67	8	Y
R	68	69	Y	7	57	12	Y
S	72	74	Y	15	63	11	Y
T	72	73	Y	4	58	15	Y
T(2)	72	73	Y	4	58	15	Y
U	67	70	Y	36	63	7	Y
V	60	61	N	N/A	N/A	N/A	N/A
X	72	73	Y	5	62	11	Y
X(2)	72	73	Y	5	62	11	Y
X(3)	72	73	Y	5	62	11	Y
Y	67	72	Y	2	67	5	N
Z	67	72	Y	1	67	5	N

Leq = the value of a steady sound level that contains the same amount of energy as the actual time-varying sound evaluated ove
NAL = Noise Analysis Location (neighborhoods)
Insertion Loss = reduction in noise due to barriers
2044 results are the same for Build and No-Build Alternatives

Table 4.4-2. Noise Barrier Analysis Results

NOISE ANALYSIS LOCATION	BARRIER HEIGHT AVG.(FT)	BARRIER LENGTH (FT)	BARRIER AREA (SF)	NO. BENEFITTED RECEPTORS	BARRIER AREA PER BENEFITTED RECEPTOR (SF)	EFFECTIVE? (REASONABLE)
A	16.9	1,770	28,360	8	3,545	N
B	16	430	6,865	1	6,865	N
C	16.9	1,300	21,940	3	7,313	N
D	**16.9**	**1,785**	**30,120**	**60**	**502**	**Y**
E	**16**	**920**	**14,730**	**54**	**273**	**Y**
F	**16**	**1,395**	**22,300**	**36**	**619**	**Y**
G	16	900	14,380	2	7,190	N
J	16	2,470	39,500	20	1,975	N
J(2)	15.3	710	10,835	4	2,709	N
K	**16**	**3,625**	**57,975**	**42**	**1,380**	**Y**
L	25	820	20,500	0	0	N
N	**15.1**	**1,375**	**20,750**	**15**	**1,383**	**Y**
O	**16**	**1,325**	**21,185**	**18**	**1,177**	**Y**
Q	10	3,290	32,890	9	3,654	N
R	16	1,455	23,255	8	2,907	N
S	16	2,440	39,035	2	19,518	N
T	16	1,750	28,045	15	1,870	N
T(2)	16	800	12,800	7	1,829	N
U	**16**	**1,445**	**23,115**	**32**	**722**	**Y**
X	16	1,630	26,080	7	3,726	N
X(2)	16	2,250	36,010	9	4,001	N
X(3)	16	3,385	54,175	9	6,019	N
Y	25	480	12,000	0	0	N
Z	25	400	10,000	0	0	N

J(2) is a barrier along Cascade Circle area only; T(2) is a barrier along Priscilla Lane only; and X(2) and X(3) are longer barriers that would provide coverage for more residences within this neighborhood. NAL Z results are based on a comparison with NAL Y.

4.5 WATER RESOURCES

4.5.1 Groundwater

4.5.1.1 Introduction

This section presents an analysis of potential impacts to the groundwater resources within the project area associated with the project alternatives. The principal project alternatives include the Build and No-Build Alternatives. The No-Build alternative serves a baseline condition for comparison to the build alternative. The groundwater resources located within the project area include stratified-drift aquifers and public water supply wells. Some of the public water supply wells have Wellhead Protection Areas (WHPAs) associated with them; however, no WHPAs are located within the proposed project area. Increased impervious area represents a concern as it may reduce or restrict the amount of rainfall that is able to recharge the groundwater.

4.5.1.2 Stratified-Drift Aquifers

As discussed in Section 3.5.1.1, the majority of the project area is underlain by stratified-drift deposits, and most areas have moderately low transmissivity.

The No Build Alternative would not result in a change in the amount of existing impervious surface. The proposed project would result in 20.5 acres of new impervious surface, or a 21% increase, for a total of 120.0 acres of impervious pavement surface including the existing and proposed roadway.

Considering the densely developed nature of the project area, this increase in impervious surface is not expected to have a significant impact on aquifers.

Spills of oil, gas or other hazardous materials could also affect local aquifers. However, the Build Alternative would have a modest increase in vehicular traffic volumes compared to the No Build, so the chances of spills are only slightly greater. Also, the widened highway should result in safer driving conditions, reducing the chances of spills from vehicular crashes. Finally, most highway runoff would be captured in stormwater treatment practices, which should facilitate cleanup of any spills.

4.5.1.3 Public Water Supply Wells and Wellhead Protection Areas

There are 12 public water supply wells located within 1 mile of the proposed project limits (see Section 3.5.1 for further discussion of these resources). There are no WHPAs located within the project area. The closest WHPA is located upgradient, approximately 700 feet west of the southern end of the middle project segment. A small WHPA is located upgradient from the northern project segment, approximately 1,600 feet to the west.

According to the NHDES Public Water Supply Well and Wellhead Protection Area data layers, there are no public water supply wells or WHPAs located within the proposed project area. Given the proximity to the proposed project, and considering the closest WHPAs are located upgradient, it is unlikely that these resources would be affected by the proposed Build Alternative.

As described in Chapter 3, per- and polyfluoroalkyl substances (PFAS) have been found in groundwater in portions of the project area.

4.5.1.4 Mitigation

Stormwater Best Management Practice (BMP) areas would be incorporated into the drainage design for the Build Alternative to capture and treat stormwater runoff prior to discharge. There would be no mitigation with the No Build Alternative. Stormwater treatment is addressed in more detail in Section 4.5.2.

4.5.2 Surface Waters

4.5.2.1 Introduction

This section presents an analysis of potential impacts to the surface water resources within the project area associated with the Build and No-Build Alternatives. Direct impacts to surface waters including lands below ordinary high water and top of bank are discussed further in Section 4.5.4, Wetland and Waterway Impacts. The following section focuses on water quality impacts.

Increases in impervious area lead to increases in the amount of associated stormwater runoff. Highway runoff can contain a variety of contaminants derived from both atmospheric deposition on the roadway surface, as well as direct vehicular sources including exhaust and wear and tear of moving parts such as tires, brake linings, and oil and grease. Other possible sources include potential spills related to vehicle accidents, chemicals used to maintain ROW vegetation, and components of roadway deicing materials used for winter roadway maintenance. These contaminants can have detrimental effects on water quality and aquatic life in the surrounding surface waters.

The three communities along the project corridor, Nashua, Merrimack, and Bedford, require coverage under the National Pollutant Discharge Elimination System (NPDES) *General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems*, published in 2017 and referred to as the “NH Small MS4 General Permit”. The General Permit regulates discharges of stormwater runoff from roads, parking lots, and other impervious surfaces, including those located within the proposed project area.

4.5.2.2 Roadway Deicing Materials

Salt application is the principal form of roadway deicing on the turnpike. During stormwater runoff events, salt dissolves in water and dissociates into sodium and chloride ions or molecules. The sodium and chloride are carried into surface waters and groundwater. Additional chloride loading would occur in the surrounding surface waters and groundwater due to the increase in deicing applications required to maintain the additional travel lanes with the proposed Build Alternative. Existing salt application rates were obtained over a ten-year period (2008-2017) from the NHDOT Merrimack maintenance facility that covers the project area. Based on this information, road salt is applied at an average annual rate of 21.4 tons per lane-mile per year. The proposed widening segments contain a total of approximately 34.36 existing lane-miles; 7.97 lane-miles in the southern segment, 20.62 lane-miles in the middle segment, and 5.78 lane-miles in the northern segment (Table 4.5-1).

The No-Build Alternative would not add additional lane-miles. The average road salt application rate of 21.4 tons per lane-mile would be maintained over the existing 34.36 lane-miles in the project corridor. The No-Build Alternative would maintain the average quantity of road salt of 735.32 tons per year.

The proposed Build Alternative would result in a total of 48.64 lane miles, or the addition of 14.28 lane-miles. Based on the average annual rate of road salt application of 21.4 tons per lane-mile, the additional lane-miles proposed in the Build Alternative would result in a total of 1040.82 tons of road salt applied per year, or an additional 305.50 tons of road salt applied per year compared to the No-Build Alternative.

Table 4.5-1. Existing and Proposed Salt Application Load

Project Segment	Existing Lane-Miles	Existing Salt Load (tons)	Total Proposed Lane-Miles	Total Proposed Salt Load (tons)	Net Increase in Lane-Miles	Net Increase in Salt Load (tons)
Southern	7.97	170.53	10.45	223.73	2.49	53.20
Middle	20.62	441.17	30.34	649.30	9.73	208.12
Northern	5.78	123.62	7.84	167.80	2.06	44.18
TOTAL	**34.36**	**735.32**	**48.64**	**1040.82**	**14.28**	**305.50**

4.5.2.3 Chloride Management

According to the *2016 Section 303(d) Surface Water Quality List* published biannually by the NHDES, none of the streams within the project corridor are designated as being impaired for chloride concentrations. The NH Small MS4 General Permit lists BMPs that should be employed in discharges to waters impaired by chloride concentrations. Most of these BMPs are already employed by NHDOT on the turnpike, including salt use accounting at storage areas, pre-wetting pavement with brine, remote weather station monitoring, guidelines for application rates, spreading unit calibration, salt truck driver training, improved storage practices such as covering salt piles, and public education, such as variable message boards. Another measure, low salt zones, is not feasible on the turnpike because traffic volumes exceed NHDOT guidelines for such practices. The MS4 also requires preparation of a Salt Reduction Plan within a certain time frame, and NHDOT is preparing such a plan. NHDOT has also established a Winter Maintenance Snow Removal and Ice Control Policy. *(Environmental Commitment 2)*

4.5.2.4 Nutrient and Suspended Solids Loading

Phosphorus in highway runoff is primarily associated with atmospheric deposition that accumulates on the pavement surface. These particulates can be deposited as components of precipitation or as dry deposition from fine particulates in the air. The widening would result in approximately 20.5 acres of new impervious surface, or a 21% increase, which could result in corresponding increases in nitrogen, phosphorus and suspended solids in stormwater runoff from the turnpike widening segments. Other contaminants, such as metals and hydrocarbons, may also be found in stormwater runoff. Metals are often associated with suspended solids and are therefore removed by the same BMPs that remove suspended solids.

4.5.2.5 Stormwater Runoff Treatment

Nitrogen, phosphorus, and suspended solids would be treated in extended detention basins. The NH Small MS4 General Permit specifies that, for new development and redevelopment sites greater than one acre, a project proponent must, to the maximum extent practicable, implement BMPs that are designed to either treat the entire water quality volume or WQV (the first inch of runoff from the design storm event) or remove 80% of the average annual load of total suspended solids and 50% of the average annual load of total phosphorus from the project's total post-construction impervious area.

For the purpose of the stormwater treatment analysis, the proposed project area was divided into 8 sub-watersheds where drainage could be collected and treated in one or a small number of BMPs. The area of total pavement including existing and proposed was calculated and used to determine the percentages of treated and untreated pavement (Table 4.5-2). Stormwater treatment for the proposed project was provided to the maximum extent practicable. The only areas not treated are areas where stormwater collection and treatment was not feasible, such as at bridges over waterways, where there were substantial road geometry constraints or treatment would require substantial impacts to the waterways. These constraints preclude treating the entire water quality volume of project pavement.

The proposed project would treat 99.84 acres of the 122.70 acres of total pavement, or approximately 81.4% of the combined areas of existing and proposed pavement. Stormwater capture was not practical for 22.87 acres, or 18.6% of the total pavement in the proposed project area. Much of the pavement area that could not be captured is due to current roadway geometry that creates low points in the roadway and adjacent waterbodies that prohibit the placement of detention basins. A total of 16 new proposed stormwater treatment basins with various footprints and dimensions are proposed, averaging 1 acre in size (see Figures 2.1-1 through 2.1-6 for locations of BMPs).

Table 4.5-2. Stormwater Treatment Areas Summary

Watershed	Project Segment	Total Pavement Area (ac)	Area Treated (ac)	Area Partially Treated (ac)	Area Untreated (ac)	Percent Treated	Percent Partially Treated	Percent Untreated
Pennichuck Brook	Southern	20.19	17.99	0.000	2.20	89.1%	0.0%	10.9%
Unnamed Tributary to Merrimack River	Southern	6.59	5.48	1.102	0.00	83.3%	16.7%	0.0%
Naticook Brook	Middle	14.27	3.71	6.117	4.44	26.0%	42.9%	31.1%
Souhegan River	Middle	19.88	16.55	2.223	1.10	83.3%	11.2%	5.5%
Baboosic Brook	Middle	14.46	8.64	5.810	0.00	59.8%	40.2%	0.0%
Merrimack River/Exit 12 Area	Middle	15.15	12.15	0.735	2.26	80.2%	4.9%	14.9%
Dumpling Brook to Merrimack River	Middle	12.62	9.64	2.970	0.00	76.5%	23.5%	0.0%
Merrimack River	Northern	19.56	6.70	0.000	12.86	34.3%	0.0%	65.7%
	TOTAL	**122.70**	**80.88**	**18.96**	**22.87**	**65.9%**	**15.4%**	**18.6%**

The proposed stormwater basins would consist of wet extended detention basins with a sediment forebay. The permanent pool portion of each BMP area is designed to treat 50 to 100% of the WQV. The extended detention portion would treat the remainder of the WQV. Each structure would be designed to provide detention for the 50-year storm event. The typical pollutant removal rates of such structures are 68% of phosphorus, 55% of nitrogen, and 80% of total suspended solids. Runoff will also be directed to two existing gravel wetlands, which will be modified slightly to accommodate the increased flow. Also proposed are 19 treatment swales at 7 different locations. These would be 8 feet wide and 200 feet long with a slope of 0.5%. Typical pollutant removal rates for treatment swales are 20% of phosphorus, 10% of nitrogen, and 50% of total suspended solids. The project would provide as much treatment as practicable, and would result in a net improvement in stormwater treatment and presumably in stormwater runoff quality and the quality of receiving waters. NHDOT shall continue to explore ways to bring the BMP design into compliance with MS4 guidelines. *(Environmental Commitment 3)*

4.5.3 Floodplain Impacts

4.5.3.1 Impacts

The evaluation of floodplain impacts utilized information derived from the Federal Emergency Management Agency (FEMA) mapping for the project area, described in Chapter 3.

The volume of floodplain and floodway fill was calculated as the amount of fill to be placed within floodplains and floodways, from the existing ground surface to the floodplain elevation. Pennichuck Brook, Naticook Brook, Souhegan River, Baboosic Brook, and Patten Brook have FEMA mapped 100-year floodplains and associated regulatory floodways.

The No-Build Alternative would not result in any new impacts to floodplains or floodways within the proposed project area. However, the existing structures at Naticook Brook and Baboosic Brook are not large enough to accommodate the design storm (50-year storm event for Naticook and 100-year for Baboosic Brook) flow volume and therefore constrict flood flow and cause water to back up above the structures. At Baboosic Brook, hydrologic modeling indicates the 100-year storm flow overtops portions of the existing turnpike in the vicinity of the crossing; although NHDOT does not have records of the turnpike overtopping

The proposed Build Alternative would result in a total of approximately 25.56 acre-feet of fill to be placed within the 100-year floodplain. The volume of fill to be placed within the regulatory floodway, which is a subset of the floodplain impacts, would be 4.28 acre-feet.

At Pennichuck Brook, there would be 3.21 acre-feet in the 100-year floodplain, which includes 3.16 acre-feet of fill in the floodway. This fill could only be avoided by much more costly measures such as removing portions of the causeways, building retaining walls, or building substantially longer bridges. As described in Chapter 2, the recommended alternative represents a balance between water resource impacts, cost, and other considerations.

At Naticook Brook and Baboosic Brook, there would be fill placed within the floodplain and floodway, but the new structures would be larger and would accommodate the design storms. This will reduce the hazards of having water backed up at the inlets, which can cause erosion, endanger the road embankment, and at Baboosic Brook, overtop the turnpike road surface. The Naticook Brook work would fill 0.21 acre-feet of floodplain, of which 0.02 acre-feet would be floodway. The Baboosic Brook crossing replacement, where the floodplain is mapped on both sides of the turnpike for an extended distance, would result in approximately 22.05 acre-feet of fill in the floodplain, including 1.02 acre-feet of fill in the floodway. At Patten Brook, there would be 0.08 acre-feet of floodplain fill, all of it mapped as floodway.

4.5.3.2 Mitigation

At Naticook Brook and Baboosic Brook, work within the 100-year floodplain and floodway would result in improved hydrologic functioning and reduced flood hazards, so no mitigation is proposed. At Patten Brook, the impacts are likely to be small compared to the watershed size. During final design, floodplain and floodway impacts will be considered and ways to minimize or mitigate impacts will be explored. Because bedrock may need to be removed around the inlet, additional flood storage capacity may be created.

At Pennichuck Brook, the proposed work is within an impoundment (with other impoundments both upstream and downstream), and the impoundment controls flood elevations, so the effect on floodplains is likely to be negligible. Nevertheless, since the new roadway approach and bridges would involve work in the floodway, no increase is allowed in the base flood elevation without changing the official flood elevation. If there were such an increase, a new base flood elevation would need to be calculated and a Letter of Map Revision prepared and submitted to FEMA. During final design, ways to avoid or mitigate changes in the base flood elevation will be explored. *(Environmental Commitment 4)*

4.5.3.3 Floodplain Finding

Although this project is not a federal action, NHDOT's policy is to provide equivalent documentation on its non-federal projects. All federal actions potentially impacting floodplains require an evaluation under Executive Order 11988, *Floodplain Management* (May 24, 1977). The regulation that sets forth the policy and procedures of this order is entitled *Floodplain Management and Protection of Wetlands* (44 CFR Part 9), which is under the authority of FEMA. FHWA policies and procedures also cover the impact of projects on floodplains and floodways, and are found in *Location and Hydraulic Design of Encroachments on Floodplains* (23 CFR 650A).

The proposed project has been evaluated with respect to its effect on floodplains, practicable alternatives to such impacts, and practicable mitigation measures as required under the provisions of Executive Order 11988 and 23 CFR 650A.

The proposed Build Alternative would involve encroachments on the 100-year floodplain and regulatory floodway. The proposed Build Alterative would result in approximately 25.56 acre-feet of fill in the 100-year floodplain, including 4.28 acre-feet in the regulatory floodway. Additional impacts within the 100-year floodplain and regulatory floodway have been avoided by ensuring that all bridge and culvert replacements provide the same or greater hydraulic openings. The proposed stormwater BMP areas along the highway will also provide additional flood storage for 50-year storms.

The lead federal agency, the Army Corps of Engineers, is expected to approve the project under the Department of the Army General Permits for the State of New Hampshire issued in 2017. The General Permit includes the determination that there is no practicable alternative to the proposed construction in floodplains and the proposed Build Alternative includes all practicable measures to minimize impacts to floodplains.

4.5.4 Wetland and Waterway Impacts

4.5.4.1 Introduction

Section 404 of the Clean Water Act and Executive Order 11990 require consideration of impacts to wetlands and other Waters of the U.S., including direct impacts and impacts to functions and values. Other impacts considered include habitat fragmentation, the effects of runoff (erosion, sedimentation, flooding), other hydrologic modifications, and temporary disturbances associated with construction that may adversely affect wetland functioning.

A total of 49 individual wetland systems and 12 waterways were identified within the project area. Of these 49 wetland areas, 30 would be impacted directly by the proposed Build Alternative, and 10 out of the 12 waterways would be directly impacted as a result of the proposed Build Alternative. Impacts to these resource areas are described in the following sections. Compensatory wetland mitigation to offset these proposed project impacts is discussed in Section 4.5.4.5.

4.5.4.2 Wetland Impact Analysis Methodology

The areas of wetland impacts were determined by measuring the wetland area to be permanently cut or filled. Project slope lines were overlaid with delineated wetland boundaries, and the total amount of permanent wetland impact or fill was determined for each wetland area. Wetlands with direct impacts were evaluated on an individual basis to determine if there was potential for additional impacts resulting from permanent hydrologic changes or if a particular wetland area would be fragmented beyond its existing functional value.

4.5.4.3 Wetland Impact Analysis Results

No-Build Alternative

The No-Build Alternative would not have any direct construction related impacts on wetland resources, since there would be no new construction. There could be impacts to waterways when bridges and culverts reach the end of their design lives and need to be replaced. With no road widening, the impacts would be less than those proposed for this project.

Build Alternative

Direct wetland impacts, i.e., the loss of wetland acreage due to proposed grading, totals 0.99 acres of palustrine wetlands. Direct impacts to lands below ordinary high-water (stream channels) total 0.81 acres of permanent impacts and 0.17 acres of temporary impacts, which translates to 1,836 linear feet of permanent and 40 linear feet of temporary channel impacts. Impacts to banks total 0.27 acres and 1,085 linear feet, all permanent. Palustrine wetland and stream impacts are summarized in Tables 4.5-3 and 4.5-4. Impacts to wetland functions and values are summarized in Table 4.5-5. Wetland and waterway impacts are shown in Figures 4.5-1 through 4.5-9.

The proposed highway widening project follows an existing corridor. Many of the wetland systems in the vicinity of the proposed project have already been impacted in some way by the original construction of the existing highway. Most of the proposed wetland impacts are located along the edge of wetland systems that have experienced prior disturbance and modifications.

Indirect impacts to wetland systems can also result from highway construction. For example, hydrological changes can occur in wetland systems from drainage modifications and/or grading changes. The extension of culverts or installation of new culverts can alter the hydrology within the surrounding wetland systems. Tree clearing can reduce forested habitat and remove or thin the forest overstory, thereby eliminating shading of wetlands, vernal pools, or streams. This has the potential to increase water temperature and have an adverse effect on the ecological community. Increased sedimentation and pollution has the potential to adversely affect water quality in wetlands and streams if stormwater treatment BMPs are inadequate or not maintained.

The results of the wetland functional analysis demonstrate that most of the wetland systems that would be impacted by the proposed project serve to provide groundwater recharge/discharge, reduce flooding, retain sediment and toxicants, retain and remove nutrients, provide ecosystem production/export, and provide wildlife habitat. Both direct and indirect wetland impacts would have some effect on the functions and values of the overall wetland systems. However, as previously discussed, most of the wetland impacts resulting from the proposed highway reconstruction are located along the edge of wetland systems previously impacted by the highways original construction. In most cases the area of impacts constitutes a relatively small percentage of the overall wetland acreage. Therefore, it is assumed that the incremental impacts would not result in the elimination of functions and values of the remaining wetland areas.

Direct impacts to wetlands are discussed in more detail in the following sections. The sections are organized by project segment, starting at the southern end and continuing north.

Table 4.5-3. Palustrine Wetland Impact Areas

Wetland ID	Project Segment	Cowardin Classification*	Impacts (square feet)	Impacts (acres)	Notes
W-6	Southern	PFO1E	3514	0.08	
W-11	Middle	PUBH	454	0.01	Vernal Pool
W-15	Middle	PFO1E	965	0.02	
W-16	Middle	PFO1E	2914	0.07	
W-17	Middle	PEM1E	5026	0.12	
W-18	Middle	PSS1E	1084	0.02	
W-19	Middle	PFO1E	259	0.01	Vernal Pool
W-20	Middle	PFO1E	102	0.00	Vernal Pool
W-21	Middle	PEM1E	1311	0.03	Vernal Pool
W-22	Middle	PFO1E	1260	0.03	
W-23	Middle	PFO1E	309	0.01	
W-25	Middle	PSS1E	1420	0.03	
W-26	Middle	PFO1E	570	0.01	Ditch
W-27	Middle	PFO1E	2043	0.05	
W-28	Middle	PFO1E	536	0.01	
W-30	Middle	PFO1E	4	0.00	
W-32	Middle	PEM1E	555	0.01	Ditch
W-33	Northern	PFO1E	1616	0.04	
W-34	Northern	PEM1E	5006	0.11	Existing BMP
W-37	Northern	PFO1E	189	0.00	
W-38	Northern	PFO1E	23	0.00	
W-41	Northern	PEM1E	1675	0.04	
W-43	Northern	PEM1E	384	0.01	Ditch
W-44	Northern	PFO1E	537	0.01	
W-45	Northern	PFO1E	358	0.01	
W-46	Northern	PFO1E	766	0.02	
W-48	Northern	PFO1E	572	0.01	
W-49	Northern	PEM1E	9735	0.22	
		TOTAL	**43188**	**0.99**	

** Wetland classifications follow those listed in Cowardin et al. 1979. Classification of Wetland and Deepwater Habitats of the United States, published by the U.S. Fish and Wildlife Service.*

Table 4.5-4. Waterway Impact Areas

Stream ID	Project Segment	Waterbody Name	Impacts							
			Permanent (acres)		Temporary (acres)		Permanent (linear feet)		Temporary (linear feet)	
			OHW	Bank	OHW	Bank	OHW	Bank	OHW	BANK
S-1	Southern	Pennichuck Brook	0.45	0.27	0.13		202	1066	10	
S-3	Middle	Naticook Brook	0.12	0.00			360	15		
S-5	Middle	Unnamed Intermittent Stream (Ditched; Tributary to S-6)	0.06				765			
S-6	Middle	Unnamed Perennial Stream (Tributary to Baboosic Bk)	0.01				69			
S-7	Middle	Baboosic Brook	0.06		0.04		54		30	
S-8	Middle	Unnamed Intermittent Stream (Tributary to Dumpling Brook)	0.00				8			
S-9	Middle	Dumpling Brook	0.07				171			
S-10	Northern	Patten Brook	0.02	0.00			67	4		
S-11	Northern	Unnamed Intermittent Stream (Tributary to Merrimack R.)	0.02				81			
S-12	Northern	Unnamed Intermittent Stream (Tributary to S-11 / Merrimack River)	0.01				20			
		TOTAL	**0.81**	**0.27**	**0.17**	**0.00**	**1796**	**1085**		

Table 4.5-5 Wetland Function and Value Impacts

Wetland ID	Impacts (ac)	Vernal Pool	Wetland Functions and Values											
			Groundwater Recharge/ Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/ Toxicant Retention	Nutrient Removal/ Ret./ Transf.	Production/ Export	Sediment/ Shoreline Stabilization	Wildlife Habitat	Endang. species	Educ./ Scientific	Uniqueness/ Heritage	Visual Quality/ Aesthetics
W-6	0.08		○	○		○	○	○	✪	○				
W-11	0.01	X	✪	✪	○	✪	✪	○	○	✪	○	○	✪	✪
W-15	0.02		○	○	○	○	○	✪	✪	○				
W-16	0.07		○	○	○	○	○	✪	✪	○				
W-17	0.12		○			○	○	○						
W-18	0.02		○	○	○	○	○	✪	✪	○				
W-19	0.01	X	○	○		○	○	○	○	✪			✪	
W-20	0.002	X	○	○		✪	✪	○		✪				
W-21	0.03	X	○	○		✪	✪	○		○			○	
W-22	0.03					○	○							
W-23	0.01		○	○		✪	✪	○		○				
W-25	0.03		○	○		✪	✪	○		○				○
W-26	0.01					○	○							
W-27	0.05					○	○	○		○				
W-28	0.01		○			○	○	○		○				
W-30	0.0001		○	○		□	□	○	✪	○				
W-32	0.01		○	○		✪	✪	○		○				
W-33	0.04		✪	✪		✪	✪	○		✪			○	✪
W-34	0.11		○	○		○	○							
W-37	0.004		○			○	○	○		○				
W-38	0.001		○	○		○	○	○	✪	○				
W-41	0.04					○	○			○				
W-43	0.01					○	○							
W-44	0.001		○	○		○	○	○	✪	○				

Wetland ID	Impacts (ac)	Vernal Pool	**Wetland Functions and Values**											
			Groundwater Recharge/ Discharge	Floodflow Alteration	Fish and Shellfish Habitat	Sediment/ Toxicant Retention	Nutrient Removal/ Ret./ Transf.	Production/ Export	Sediment/ Shoreline Stabilization	Wildlife Habitat	Endang. species	Educ./ Scientific	Uniqueness/ Heritage	Visual Quality/ Aesthetics
W-45	0.01		✪	✪		✪	✪	○	○	○				
W-46	0.02		✪			○	○		□	○			○	
W-48	0.01		○	○		✪	✪	○	○	○				
W-49	0.22		✪	✪		✪	✪	○	○	✪			○	✪

○ = Function/Value Present

✪ = Principal Function

Southern Segment

Direct wetland impacts in the southern segment total 0.08 acres of palustrine wetland impacts, impacting one wetland area. These impacts are located within Wetland 6, a palustrine forested wetland located in the northeast bridge quadrant of the Pennichuck Brook crossing in Merrimack. This area is part of a larger forested wetland located adjacent to Pennichuck Brook. These impacts have the potential to reduce the floodflow capacity, sediment/toxicant retention and nutrient removal potential of the wetland. However, the remaining wetland would still be able to provide these overall functions and values. Additional impacts in this segment include 0.08 acres of fill in a finger of Pennichuck Brook located on the east side of the highway, south of the main crossing.

Permanent impacts to lands below ordinary high water within Pennichuck Brook associated with the construction of a new bridge structure total 0.45 acres, while temporary impacts total 0.13 acres (see Figure 4.5-10). There are also 0.27 acres of impacts to the banks of the Pennichuck Brook impoundment. As described in Chapter 2, several other alternatives were considered for the Pennichuck Brook crossing, with permanent waterway impacts ranging from 0 to 0.94 acres of fill and temporary impacts ranging from 0 to 0.62 acres. The proposed Build Alternative would have moderate permanent impacts, minimal temporary impacts, and a reasonable cost, and is believed to be the least environmentally damaging practicable alternative for this location.

Middle Segment

Direct palustrine wetland impacts in the middle project segment total 0.43 acres, comprised of 16 individual wetland areas.

The recommended alternative for the Naticook Brook culvert replacement (Figure 4.5-11) involves replacing the existing 60” concrete culvert with a 90” reinforced concrete pipe (RCP). The culvert would be embedded two feet to provide a natural stream channel bottom through the length of the structure. The new culvert would be installed on a skew, allowing the existing culvert to maintain stream flow during construction. Once the new culvert is installed, new stream channels would be constructed at the inlet and the outlet, and the existing culvert would be abandoned, likely to be maintained for utility crossings. Impacts to Naticook Brook associated with the culvert replacement and associated stream realignment total 0.12 acres of impacts to land below ordinary high water and <0.001 acres of bank. This includes a portion of Naticook Brook downstream from the culvert outlet, which would also require realignment due to proposed highway grading.

Impacts to Wetland 11 total 0.01 acres. This wetland area consists of a large, semi-permanent to permanently flooded area of open water, and functions as vernal pool and valuable wildlife habitat. The impacts to this wetland occur along the existing toe-of-slope of the highway and the forested/emergent edge of this wetland rather than the open water habitat in the middle of the wetland. These impacts may result in a slight reduction in sediment/toxicant retention and nutrient removal capabilities, but overall the functions and values of the larger wetland system would be retained. This wetland is part of a much larger wetland complex that extends to the northwest.

Continuing north along the proposed project corridor the next area of wetland impacts includes a complex of several palustrine wetlands and associated intermittent and perennial streams in the vicinity of the Wire Road overpass. Wetlands 15, 16, 17, and 18 are all located southwest of Wire Road. Direct impacts to these wetlands collectively total 0.23 acres. These individual resource areas are discussed below.

Wetland 15 is a fringe wetland located along intermittent stream S-5, on the southeast side of the highway. Impacts to this wetland area total 0.02 acres. Wetland 16 is a fringe wetland located along intermittent stream S-5, located on the northwest side of the highway. Impacts to this wetland area total 0.07 acres. These wetland impacts are associated with mainline grading and the culvert reconstruction. Both areas are relatively linear forested wetland systems associated with stream S-5. The remaining wetland areas would continue to provide the current functions and values.

Wetland 17 includes a palustrine emergent seep located in the highway shoulder, and an excavated swale that drains to the northeast. The majority of this wetland would be filled for highway grading, as well as the construction of a BMP area. For the purposes of the impact analysis, this entire wetland was considered to be impacted, since only a small sliver would remain between the proposed toe-of-slope of the highway and the stormwater BMP area. This is a marginal wetland area that has been previously disturbed and modified by existing highway construction. The moderate functions provided by this wetland of groundwater discharge, sediment/toxicant retention, and nutrient removal/retention would also be lost. The total wetland area and impacted area is 0.12 acres.

Wetland 18 is a palustrine scrub-shrub wetland located in a depression, associated with perennial stream S-6. The proposed area of impacts is 0.02 acres. These impacts are associated with the mainline grading as well as the replacement of the Wire Road bridge over the F.E. Everett Turnpike. The overall area of this wetland is approximately 0.22 acres. The remaining wetland area would continue to be able to perform the existing functions and values.

Stream S-5 is a small, partially ditched intermittent stream located west of the Wire Road intersection. A total of 0.06 acres of land below ordinary high water would be impacted from highway widening, a noise barrier, and the associated culvert reconstruction. Stream S-5 flows to the northeast paralleling the southbound side of the highway before flowing into stream S-6. Approximately 700 feet of stream S-5, a ditched segment of the channel, would require realignment further north due to proposed grading associated with the highway widening and noise barrier.

Stream S-6 is an unnamed perennial tributary to Baboosic Brook. Impacts to land below ordinary high water in this stream total 0.01 acres. These impacts are associated with highway widening, culvert reconstruction, and construction of the Wire Road Bridge over the F.E. Everett Turnpike.

Baboosic Brook (Stream S-7) is a perennial stream located northeast of the Wire Road crossing over the F.E.E.T. A total of approximately 0.06 acres of permanent channel and 0.04 acres of temporary impacts to land below ordinary high water would occur associated with proposed highway widening and culvert replacement. These impacts would result in approximately 54 linear feet of permanent and 30 linear feet of temporary impacts to the stream channel. See Figure 4.5-12.

Wetland 19 is a palustrine forested wetland that is also a vernal pool. Impacts in this wetland from the proposed project total 0.01 acres. This wetland is a small depression located within the floodplain of Baboosic Brook, directly adjacent to the channel, with a total area of only 0.15 acres. Approximately 0.16 acres of tree clearing would occur along the southern edge of this wetland and the southbound barrel of the F.E.E.T., which could result in indirect impacts associated with the removal of the overstory surrounding the pool. Increased sunlight could affect the water temperature, water retention time in the pool, and the vegetation community in and around this wetland. These impacts would likely result in a reduction in the size and quality of wildlife habitat, as well as the flood storage capacity, and sediment/toxicant retention abilities.

Wetlands 20, 21, 22, and 23 are a group of hydrologically connected wetlands located within the floodplain of Baboosic Brook. These areas appear to be associated with a historic oxbow of the river that is no longer part of the river, and has been further divided by the construction of the highway. Wetlands 20 and 21 also provide marginal vernal pool habitats. Two areas in Wetland 20 would be impacted. The first is a palustrine forested ditch located in the southwestern corner of the wetland, that drains from a culvert pipe hydrologically connected to Wetland 21. This area is not part of the wetland that functions as a vernal pool. The second area is a palustrine emergent wetland located within a disturbed existing utility ROW. This area is in the vicinity of the vernal pool habitat. Impacts to this wetland total 0.002 acres. The relatively small areas of impact would not likely have an effect on the functions and values of the larger wetland system.

Wetland 21 is located on the southeast side of the highway, opposite of Wetland 20. Impacts to Wetland 21 total 0.03 acres. These impacts are near the edge of the roadway and a ditched portion that leads to a culvert inlet. The total area of this wetland is 0.25 acres. This would result in an impact to some of the function and values provided by this wetland, including flood control, sediment/toxicant retention, and nutrient removal/retention.

Wetland 22 is a small, isolated, palustrine forested depression (0.03 acres). All of this wetland would be filled. The functions provided by this wetland as well as the overall quality are marginal. The sediment/toxicant retention and nutrient retention/removal capabilities, while already low, would be further reduced or eliminated by the proposed impacts.

Wetland 23 is a palustrine forested depression that appears to be part of the historic Baboosic Brook channel before the brook reconfigured itself. Impacts to this wetland area total 0.01 acres. This area is part of a larger forested wetland complex that extends to the west in the floodplain of Baboosic Brook. The small area of impacts would have a relatively minor impact on the functions and values provided by this larger wetland system.

Wetland 25 is located north of Exit 12, on the west side of the highway. A total of 0.03 acres of this wetland would be impacted by this project. The impacts are located along the toe-of-slope of the existing highway. This area of impacts consists of a narrow strip of palustrine scrub-shrub wetland along the edge, with a palustrine emergent cattail marsh located towards the interior of the wetland. The total area of this wetland is approximately 0.52 acres. The principal functions and values of sediment/toxicant retention and nutrient removal/retention of this wetland area would be reduced slightly, but retained by the remaining wetland system.

Wetland 27 is a palustrine forested wetland located on the west side of the highway, near the northern end of the middle segment. Impacts to this wetland area total 0.05 acres. This area is an isolated wetland system that provides marginal function and values. These would likely be reduced by the impacts associated with the project, however this is not a high-quality wetland system.

Wetland 28 is a palustrine forested system that continues to the west, outside the limits of the wetland delineation. The area of proposed impacts in this wetland total 0.01 acres. These impacts would result in some reduction in wildlife habitat, sediment/toxicant retention, and nutrient removal/retention, however the remaining wetland would continue to provide these functions and values.

Dumpling Brook (Stream S-9) is a small perennial stream located near the northern end of the middle project segment. Impacts to this stream associated with the highway widening, noise barrier and culvert reconstruction total 0.07 acres (0.05 acres downstream and 0.02 acres upstream). Stream S-8 is a small intermittent tributary to Dumpling Brook and will have 0.001 acres of impact.

Wetland 30 is a palustrine forested wetland area associated with Dumpling Brook. The construction of a stormwater BMP area would result in a negligible direct impact (approximately 4 square feet). This small area of impacts would have a negligible impact on the overall wetland system.

Wetland 32 is a constructed stormwater swale located on the west side of the highway near the northern terminus of the middle segment. A small sliver of impacts totaling 0.01 acres is proposed along the edge closest to the highway. This area drains toward a riprap slope that outlets into a larger palustrine forested wetland. The impacts to the ditched portion of this wetland have the potential to minimally reduce the floodflow capacity, sediment/toxicant retention, and the nutrient removal/retention capabilities of this wetland.

Northern Segment

Direct palustrine wetland impacts in the northern project segment total 0.48 acres, comprised of 11 different wetland areas.

Wetland 33 is a large wetland complex consisting of palustrine forested areas, with a large palustrine scrub-shrub swamp. A proposed stormwater BMP area would result in 0.04 acres of impacts to a portion of palustrine forested wetland. This relatively small area would have a minor impact on the much larger wetland complex and its associated functions and values.

Wetland 34 is an existing stormwater BMP area that has developed into a cattail marsh located behind a small office building. A proposed stormwater BMP area near the southern end of the northern segment could impact 0.11 acres of this wetland BMP. It is likely that the proposed BMP will be redesigned during final design and the existing stormwater BMP would not be altered. The existing area would be impacted by construction, but the installation of a new stormwater BMP area would offset any losses in floodflow control, sediment/toxicant retention, and nutrient removal retention.

Wetland 37 is a small, isolated, palustrine forested depression. Highway drainage contributes to the hydrology of this wetland. Total impacts to this wetland from the proposed project would be 0.004 acres. The total area of this wetland is 0.07 acres. There would be a slight reduction in the already marginal functions and values provided by this wetland area.

Patten Brook (Stream S-10) is a perennial stream located south of the Interstate 293 interchange. Impacts to land below ordinary high water total 0.02 acres (0.01 acres upstream and 0.01 acres downstream). Bank impacts along Patten Brook total <0.001 acres. These impacts are associated with the highway widening and culvert reconstruction. See Figure 4.5-13.

Wetland 38 is a palustrine forested wetland associated with the floodplain of Patten Brook. Impacts to this wetland total 0.001 acres comprised of relatively thin slivers along the existing toe-of-slope. These small areas of impact would not result in an overall change in the functions and values provided by this wetland system. Most of this wetland would remain intact.

Wetland 41 consists of a ditched area that runs along a parking area and drains to a larger palustrine emergent wet meadow. Impacts to this wetland from the proposed grading total 0.04 acres. These impacts would result in some reduction in wildlife habitat, sediment/toxicant retention, and nutrient removal/retention. This area coincides with an existing utility ROW, and has been previously disturbed. The overall quality of this wetland is marginal.

Wetland 43 is a short and narrow palustrine emergent ditch wetland within the I-293 interchange. Impacts from the proposed project total 0.01 acres. This is a marginal wetland area that provides some sediment/toxicant retention and nutrient removal/retention. The impacts from the proposed project would have a minor effect on these functions and values.

Wetland 44 is a palustrine forested fringe wetland along intermittent stream S-11 between I-293 interchange ramps. A small area of wetland impacts is proposed in Wetland 44 (0.01 acres) near the culvert outlet of stream S-11. The relatively small area of impacts would have a negligible impact on the sediment/shoreline stabilization function of the wetland system.

Stream S-11 is an unnamed intermittent tributary of the Merrimack River located within the I-293 interchange. Impacts to land below ordinary highway total 0.02 acres associated with highway widening grading and culvert reconstruction.

Wetland 45 is within the I-293 interchange and hydrologically connected to stream S-11 and Wetland 44 via a culvert pipe underneath the highway. The project proposes 0.01 acres of impacts to this wetland system. This is primarily a forested wetland but most wetland impacts are located along the edge of the wetland adjacent to maintained areas along the highway. Impacts to the functions and values of Wetland 45 are relatively minor.

Wetland 46, also within the I-293 interchange, is a small forested depression with 0.02 acres of proposed impacts. The impacts are located along the edge of this wetland area, and the remaining portion of the wetland should be able to continue to perform all of the present functions.

Wetland 48 is a relatively large forested wetland area within the ramp from NH 101 West to the turnpike southbound. Portions of this wetland impacted by the proposed project include a ditched area paralleling the existing toe-of-slope of the F.E. Everett Turnpike SB onramp, and a fringe wetland area along stream S-12. The total area of impacts proposed in this wetland are 0.01 acres. These impacts should not substantially alter this wetland's ability to provide its current functions and values.

Stream S-12 is a small intermittent stream located on the west side of the highway. It flows under the highway through a culvert and outlets into Wetland 47. This stream is also associated with Wetland 48. Impacts to land below ordinary high water in this stream total less than 0.01 acres associated with highway widening and culvert reconstruction.

Wetland 49 is located between the turnpike and ramps on the west side of the highway, opposite from Wetland 47. Before the construction of the existing highway these areas were likely part of a much larger wetland complex. Impacts to this wetland area total 0.22 acres, and consist of a narrow strip running almost the entire length of this wetland, parallel to the highway. While this is one of the larger areas of wetland impacts associated with the proposed project, it is a relatively small area compared to the overall area of Wetland 49. These impacts would primarily fill an area of palustrine emergent cattail marsh, and a narrow strip of scrub-shrub wetland along the edge. These impacts could potentially slightly reduce this wetland's flood storage capacity, sediment/toxicant retention and nutrient removal/retention capabilities, and the amount of wildlife habitat that this wetland provides. Overall, the majority of this wetland would remain intact and continue to provide these functions and values.

New Hampshire Prime Wetland Impacts

As discussed in Section 3.5.4.2, designated Prime Wetlands are in the City of Nashua. Prime Wetlands are areas designated by municipalities and NHDES that are given a higher level of regulatory protection through the State wetland process than non-designated wetland areas.

Pennichuck Brook has been designated a Prime Wetland in Nashua. Impacts to this wetland resource include 0.01 acres of permanent impacts (stream S-1) south of the F.E. Turnpike crossing over Pennichuck Brook. There are an additional 0.14 acres of permanent and 0.04 acres of temporary impacts to lands below ordinary high water in Pennichuck Brook, in Nashua. There are also 0.14 acres of impacts to the bank associated with Pennichuck Brook in Nashua. There is no jurisdictional 100-foot buffer associated with Prime Wetlands in the City of Nashua.

Pennichuck Brook is a large impoundment created by a series of dams downstream from the F.E.E.T. crossing. In addition to serving as the drinking water supply for the greater Nashua area, this lacustrine wetland system and the adjacent palustrine systems provide several functions and values. The principal functions and values of this Prime Wetland include groundwater recharge/discharge, floodflow alteration, fish and shellfish habitat, production/export, wildlife habitat, and visual quality/aesthetics.

Vernal Pool Wetland Impacts

Vernal pools located in the vicinity of the project area are discussed further in Section 3.5.4.3. Efforts were made during the preliminary design phase to minimize or avoid impacts to vernal pool resources. However, wetland impacts were unavoidable in four areas identified as vernal pool habitats.

The U.S. ACOE has developed Best Management Practices (BMPs) to protect vernal pools and the surrounding envelope and critical terrestrial habitat (CTH) that vernal pool-breeding amphibians depend on for survival. These areas support the non-larval life-cycle stages of vernal pool-breeding amphibians as well as protect the water quality of the vernal pool. The vernal pool envelope extends 100 feet from the vernal pool depression's edge. The CTH extends 100-750 feet from the vernal pool depression's edge. The U.S. ACOE recommends avoiding disturbance within the vernal pool depression and the associated envelope, and limiting development to less than 25% of the CTH. A total of 8 vernal pools were identified along the proposed project corridor. Given their proximity to the existing turnpike, the 100-foot envelopes of these pools have already been partially encroached upon by the existing roadway. The CTH of these pools have also been fragmented by the construction of the existing turnpike and by surrounding residential and commercial development.

Direct impacts to vernal pools were avoided wherever possible. At 4 locations impacts were unavoidable due to slope requirements and the pool's proximity to the existing turnpike. Impacts at these locations were minimized to the maximum extent practicable.

VP 1 is located approximately 0.3 miles north of the Tinker Road overpass in Nashua. This area would not be directly impacted by the proposed project. Highway widening would result in tree clearing and grading in the vicinity of this vernal pool, resulting in impacts within the envelope and CTH. However, impacts are in marginal habitat adjacent to the existing roadway, and are not anticipated to result in any direct impacts to this vernal pool.

VP 2/Wetland 9 is in Merrimack, north of Exit 11, in a thin strip of forested habitat bordered by the turnpike to the east and commercial development to the west. The proposed Build Alternative would avoid direct impacts to this pool by increasing side slopes in the vicinity of this resource area. This area has undergone substantial development and fragmentation including the highway and commercial development to the west, and there is little viable habitat remaining in the vicinity of the vernal pool. The proposed project would impact both the envelope and CTH of this vernal pool.

VP 3/Wetland 11 is in Merrimack, north of the Souhegan River on the west side of the turnpike. This area is a large open water wetland that appears to remain permanently flooded during most years. It is a high-quality wetland resource area that potentially supports a population of the State-listed endangered Blanding's turtle. During a spring 2017 vernal pool survey over 200 wood frog egg masses were documented in this pool. As discussed above, in the Wetland Impacts section, 0.01 acres of impacts would occur along the edge of this wetland. The proposed Build Alternative would not result in any fill within the limits of the actual pool. This area would continue to function as high quality vernal pool and wildlife habitat. Additional impacts to the vernal pool envelope and CTH would occur from the proposed Build Alternative.

VP 4/Wetland 13 is in Merrimack, just south of Baboosic Lake Road, on the west side of the turnpike. Direct impacts to this vernal pool would be avoided, although there would be minor impacts to the vernal pool envelope between the wetland edge and the highway including grading and tree clearing. Impacts from the proposed widening would also impacts CTH.

VP 5/Wetland 14 is located north of Baboosic Lake Road, on the west side of the turnpike. This pool is an isolated depression surrounded by forested habitat. This area is located approximately 60 feet from any proposed grading work or tree clearing and should not be affected by the project. A small portion of the vernal pool envelope will be impacted as well as some of the CTH associated with proposed highway widening and tree clearing.

VP 6/Wetland 19 is located adjacent to Baboosic Brook on the west wide of the turnpike. This pool is a depression located within the forested floodplain of Baboosic Brook. During a spring 2017 vernal pool survey three wood frog egg masses were documented as well as fairy shrimp. Proposed grading would result in 0.01 acres of impacts. These impacts would directly fill a small portion of the pool. In addition, some of the surrounding tree cover would be removed. Impacts within the envelope and CTH would also occur for proposed highway grading, tree clearing, and stormwater BMP construction. These impacts could potentially reduce the overall quality of this wetland and could potentially affect its ability to function as a vernal pool habitat.

VP 7/Wetland 20 is a marginal vernal pool located in a utility ROW on the west side of the turnpike. There is a complex of forested vernal pools in the floodplain of Baboosic Brook in the vicinity of this pool (outside the project area), although they did not all contain primary indicator species during a spring 2017 vernal pool survey. Direct impacts to the portion of Wetland-20 where the vernal pool was located total 102 square feet. This relatively small area would result in minor impacts to the overall quality of the pool. Tree clearing in the vicinity could potentially reduce shading, although this pool is on the edge of an already cleared utility ROW. There is also suitable habitat in the surrounding floodplain including additional vernal pools. Proposed highway grading and tree clearing would also result in impacts to the vernal pool envelope and CTH.

VP 8/Wetland 21 is located opposite Vernal Pool 7 on the east side of the turnpike, in an area that appears to be a historic oxbow of Baboosic Brook that has since been cut off from the main channel and further isolated from the floodplain by the construction of the existing highway. This area provides marginal vernal pool habitat, and contained four wood frog egg masses during a spring 2017 vernal pool survey. Recent development to the south and east of this area has further reduced habitat and encroached upon this vernal pool and its envelope. Much of the surrounding CTH has been developed. The proposed project would result in 0.03 acres of impacts to the edge of this wetland. These impacts are in an area that has been ditched for drainage. Associated grading and tree clearing would impact some of the upland forested habitat that comprises the vernal pool envelope and CTH.

4.5.4.4 Indirect Impacts

Indirect impacts to wetland resources associated with the proposed Build Alternative could potentially occur as a result of highway widening. The proposed project would result in a net increase in impervious pavement surfaces as well as associated stormwater runoff. Highway runoff can contain a variety of pollutants and can impact water quality. Stormwater BMP areas would be constructed to capture and treat the majority of runoff before discharging into wetlands or streams. During construction, earth disturbance and erosion could potentially lead to sedimentation issues in surrounding wetland areas. BMPs for soil erosion and sediment control would be implemented throughout construction to help minimize this type of impact.

Most of the proposed wetland impacts occur along the edges of wetland systems in areas that have been previously disturbed by highway construction activities. For these reasons, indirect impacts such as habitat fragmentation or degradation of habitat will be minimal.

Indirect impacts associated with induced growth from economic development and population growth from the proposed project are discussed in Section 4.13, Indirect and Cumulative Impacts.

4.5.4.5 Compensatory Wetland and Waterway Mitigation

Mitigation for wetland impacts followed a sequential approach of 1) avoidance, 2) minimization, and 3) compensation. Avoidance measures were taken early in the design process. High quality and significant wetlands were identified based on a variety of factors including size, functions and values, and potential for rare species habitat. Preliminary project slope lines were overlaid on delineated wetland mapping and areas were identified where impacts could be avoided or minimized by adjusting slope lines. Avoidance and minimization measures will continue to be explored during the final design process. *(Environmental Commitment 5)*

Compensation will be required for the approximately 0.86 acres of impacts to palustrine wetlands, 0.87 acres of impacts to lands below ordinary highwater, 0.27 acres of impacts to bank, 1,599 linear feet of permanent channel impacts, and 1,098 linear feet of temporary channel impacts. As impacts are refined in final design, a proposed mitigation package will be developed through coordination with regulatory agencies, local Conservation Commissions, and other interested parties as appropriate. The most likely form of compensation will be some combination of land preservation or in-lieu fee payment.

Land Preservation

The NHDOT owns a number of parcels in the general vicinity of the F.E.E.T. A desktop review of these parcels was conducted to determine potentially suitable sites for preservation. Two sites immediately adjacent to the project corridor and one area several miles to the north appear to have good habitat and conservation value and good wetland mitigation value. One such site is 54 acres and borders the turnpike a river, and local conservation land. It contains a mixture of upland forest, palustrine emergent and forested wetlands, and a small permanently flooded pond within the larger wetland complex that functions as a vernal pool and potential habitat for rare species. The proximity to a contiguous conservation area, as well as the proposed project area and associated impacts, the Souhegan River, and potential rare species habitat give this parcel high value as a potential mitigation site.

A 21-acre parcel in Merrimack is bordered by the F.E.E.T. to the east, local conservation land to the north and west, and commercial development to the south. The proximity to a contiguous conservation area, as well as the proposed project area and associated impacts, a large wetland complex, and a documented vernal pool in the vicinity give this parcel high value as a potential mitigation site.

In-Lieu Fee

The NHDES established the Aquatic Resource Compensatory Mitigation (ARM) Fund in 2006 to provide an additional compensatory mitigation option available to applicants for impacts to wetlands and other aquatic resources. In-lieu fee payment is the U.S. ACOE's preferred mitigation alternative, and the most common form of mitigation. The NHDES ARM Fund wetland payment amounts were calculated for all palustrine wetland and stream channel impacts associated with the proposed Build Alternative. The mitigation in-lieu fee amount for 0.99 acres of palustrine wetland impacts would be $217,734.18. The mitigation in-lieu fee amount associated with 1,796 linear feet of permanent channel impacts and 1,085 linear feet of permanent bank impacts would be $713,566.08. The combined in-lieu fee amount for all palustrine wetland and stream impacts for the entire project would be $931,300.26. This is a preliminary calculation that includes all impacts. The mitigation package for the proposed project has not yet been determined but will be developed in consultation with regulatory agencies. *(Environmental Commitment 5)*

4.6 LAND RESOURCES

4.6.1 Farmlands

The entire proposed project is also located within the Nashua, NH or the Manchester, NH Urbanized Area based on the 2010 U.S. Census Bureau determination. The Farmland Protection Policy Act (FPPA) specifically excludes lands identified as "urbanized area" on Census Bureau Maps. Consequently, the entire project area is excluded from the provisions of the FPPA. For this reason, Important Farmland Soils have been excluded from further analysis. There were no areas of active farmland identified within the project area and therefore no impacts to active farmland from the proposed project.

4.6.2 Conservation Lands

4.6.2.1 Impact Analysis Methodology

The New Hampshire Conservation/Public Lands GIS data layer was downloaded from NH GRANIT and the proposed project slope lines and clearing limits were initially overlaid on top of this layer to determine project impacts to conservations lands. Survey data that more accurately located ROW and property lines were then used to refine impact determinations. Noise wall locations and stormwater BMP areas were also reviewed for impacts to conservation lands.

4.6.2.2 Impact Analysis Results

The project will directly affect two conservation parcels and is immediately adjacent to three other open space parcels (Figure 4.6-1).

Dumpling Brook Wildlife Management Area is owned by NH Fish and Game and is an area of permanent conservation land under fee ownership. A proposed stormwater BMP area located partially within this conserved land would result in 0.59 acres of impacts to this 167-acre parcel.

The Mini Cooper auto dealer parcel on 209 South River Road in Bedford includes an area with a conservation easement. The F.E.E.T. project will require modifications to the existing Patten Brook inlet on this parcel. A drainage easement will be needed on approximately 0.27 acres of this land to accommodate the inlet modifications.

The widening is adjacent to, but will not directly impact, the following open space parcels:

- In the southern project segment, Pennichuck Water Works owns conservation land bordering the Pennichuck Brook Impoundment. The land consists of water supply lands under fee ownership with Pennichuck Water Works. Although the GRANIT GIS database shows the conservation land overlapping the F.E.E.T ROW, it is assumed the ROW does not include any conservation land.
- Birches Open Space is in the middle project segment, west of the F.E.E.T. and south of the Souhegan River. This is an area of permanent conservation land that was set aside as an Open Space Area of Developments and is owned by the Town of Merrimack.
- Indian Rock Open Space is another parcel of permanent conservation land set aside as an Open Space Area of Developments owned by the Town of Merrimack. This area is located west of the F.E.E.T., north of the Baboosic Lake Road overpass.

Since all proposed work would be within the ROW, which is intended for transportation purposes, it is assumed the work would not affect these conservation lands. During final design, efforts will be made to avoid impacts to these or other conservation lands. NHDOT will also continue to explore ways to minimize impacts to the Dumpling Brook Wildlife Management Area and Mini Cooper parcel and to avoid other conservation lands. *(Environmental Commitment 6)*

4.6.2.3 Mitigation

NHDOT will coordinate with the owners of conservation lands to determine whether the proposed impacts are of concern and whether mitigation may be desirable. Mitigation could take the form of new open space acreage to replace impacted areas, payment for the acquired land, or other mutually agreed-upon measures. *(Environmental Commitment 6)*

4.6.3 Section 6(f) Properties

The project is adjacent to one Section 6(f) property, which has received Land and Water Conservation Fund funding. Grading associated with the highway widening was originally proposed to overlap 0.06 acres of the parcel at the Merrimack school complex, abutting the turnpike and Baboosic Lake Road.

Although this portion of the parcel was not in active recreational use and the impact would not affect its use, the design has been modified to avoid this impact.

Section 6(f) of the Land and Water Conservation Fund Act of 1965 requires that all properties "acquired or developed, either partially or wholly, with LWCF funds" must be maintained as such in perpetuity. Such lands shall not be converted to a use other than public outdoor recreation without the approval of the Secretary of the Interior, acting through the National Park Service. Impacts to Section 6(f) properties require coordination with the NH Division of Parks and Recreation, which in turn consults with the National Park Service. A written evaluation would then be completed for any permanent impact and most temporary impacts to demonstrate that all practicable alternatives to the conversion have been evaluated. An equivalent property would need to be provided as mitigation.

NHDOT intends to avoid impacting this parcel. *(Environmental Commitment 6)*

4.7 Fish and Wildlife

4.7.1 Wildlife

4.7.1.1 Short-Term and Long-Term Impacts

Highway construction can have both short-term and long-term impacts on wildlife habitats and populations. Short-term impacts can result from disturbance caused by construction activities including increased noise levels, visual disturbances, tree clearing, earth disturbance, machinery, and the presence of humans. Long-term impacts related to highway construction can include permanent habitat loss. New highway construction on a new location can result in increased fragmentation and a loss of habitat connectivity. The proposed project is located within an existing highway corridor and the surrounding habitats have already been fragmented by the original construction of the highway and surrounding development.

Direct Mortality

Direct mortality due to construction impacts would potentially occur for fossorial (burrowing) mammals, reptiles, and amphibians, as well as breeding animals and their young, whose nests or dens may be destroyed by tree clearing and other construction activities. More mobile individuals and species would likely relocate to other habitats when disturbed by construction. These individuals may find habitat that has sufficient food and cover, assuming the adjacent habitats are not already at carrying capacity. Animals that are forced to relocate that are unable to find food or cover may fail to successfully breed, and eventually perish. Because the affected habitat is a small proportion of the available habitat, and the habitat quality is already diminished by the presence of the highway, the impacts to wildlife populations are expected to be minimal.

Tree Clearing

Based on preliminary limits of clearing, the proposed project would require approximately 47.4 acres of tree clearing associated with grading, construction of noise walls, and construction of stormwater treatment areas (detention basins and swales).

The southern segment of the project would require 8.5 acres of clearing; 4.0 acres for mainline widening and associated grading, and 4.5 acres for the construction of stormwater treatment areas.

The middle project segment would require approximately 34.5 acres of clearing; 20.8 acres for mainline widening and associated grading, 8.9 for the construction of stormwater treatment areas, and 4.8 acres for the construction of 7 noise walls.

The northern project segment is less forested than other areas of the project, and requires 4.5 total acres of tree clearing; 3.6 acres for mainline widening and associated grading, and 0.9 acres for the construction of stormwater treatment areas.

The majority of tree clearing (28.3 acres) is required for highway widening and the proposed grading. This clearing would typically remove trees and brush located immediately adjacent to the existing highway corridor. These forested habitats are typically edge habitats that have been disturbed by prior tree clearing associated with highway construction and maintenance. These areas are also exposed to higher levels of noise and disturbance given their proximity to the highway. The construction of stormwater treatment areas typically requires the clearing of larger, more contiguous patches of forest. There is a total of 16 new BMP areas proposed that average 1.0 acre in size, plus two existing basins to be modified and many treatment swales. Many of these proposed treatment measures are located almost entirely in forested areas adjacent to the highway.

Tree clearing may affect wildlife populations in several ways.

- **Noise and Disturbance –** Animal species living in proximity to the existing highway habituate to the elevated levels of noise; however, construction activities could result in elevated noise levels as well as sudden loud noises that could potentially disturb wildlife.
- **Home Range Impacts –** Animals with relatively small home range sizes such as amphibians, reptiles, and small mammals have a greater potential for impacts from the proposed highway widening. Medium-sized to large mammals generally have larger home ranges, and impacts would likely be less severe, given the larger area and their ability to move to other nearby habitats.
- **Wildlife-Vehicle Collisions –** Increasing the number of lanes can lead to increased wildlife mortality due to potential collisions with vehicles as animals attempt to cross a wider highway.
- **Travel Corridors –** Riparian corridors along streams and other waterbodies are important wildlife habitats and are often used as travel corridors. At the Pennichuck Brook and Baboosic Brook crossings, the new bridge design would incorporate wildlife shelves into the design. The shelves at these locations would help facilitate wildlife passage through the structures, and

result in an improvement to wildlife habitat connectivity. Culvert replacement at Naticook Brook would replace the existing 60-inch concrete culvert with a 90-inch concrete culvert that would be embedded two feet to provide a natural substrate. The proposed culvert would increase aquatic habitat connectivity and could potentially be used by some terrestrial species as well. Given the length of the culvert, it may not be utilized by all species; however, the larger diameter opening and natural substrate would help encourage use.

4.7.1.2 Highest Ranked Wildlife Habitat Impacts

The 2015 New Hampshire Wildlife Action Plan Highest Ranked Wildlife Habitat GIS data layer was overlaid with the preliminary proposed project slope limits and tree clearing limits to determine impacts to ranked wildlife habitats.

The proposed project would result in 5.4 acres of impacts to Highest Ranked Habitat in the State; 0.6 acres of impacts to Highest Ranked Habitat in the Biological Region; and 19.7 acres of impacts to Supporting Landscapes. The total area of impacts to Wildlife Action Plan Ranked Wildlife Habitats would be 25.7 acres. Most of these impacts are in the middle and northern project segments.

Impacts to Ranked Habitats in the southern project segment total 2.0 acres. In the southern half of the southern segment there would be 0.4 acres of impacts to Highest Ranked Habitat in the Biological Region. This habitat occurs in the forested areas surrounding Pennichuck Brook. These impacts are associated with highway widening and grading as well as two stormwater BMP areas. In the northern half of the southern segment there would be a total of 1.6 acres of impacts to Supporting Landscapes on the west side of the F.E. Everett Turnpike associated with highway widening and grading as well as a stormwater BMP area.

The middle project segment would impact a total of 14.0 acres of ranked habitats. Nearly all of the impacts in the middle segment occur in Supporting Landscapes, and are associated with proposed highway widening and grading, stormwater BMP areas, and noise wall construction. Most of the impacts would be in the middle of the middle project segment in the vicinity of Baboosic Lake Road and Wire Road crossings over the F.E. Everett Turnpike.

The northern project segment would impact a total of 9.7 acres of ranked habitats. An area of Highest Ranked Habitat in the State is mapped along the Merrimack River near the northern end of the northern project segment. This habitat is shown as mapped over the existing F.E. Everett Turnpike, parts of the Interstate 293 interchange, and nearby developed areas in Bedford, NH. A total of 5.4 acres of impacts are shown in Highest Ranked Habitat in the State. However, much of this area consists of existing highway pavements and development, and does not function as high-quality wildlife habitat. There would be a total of 4.3 acres of impacts to Supporting Landscapes in the southern half of the northern project segment from highway widening and associated grading as well as a stormwater BMP area.

4.7.1.3 Indirect Impacts

Indirect impacts to wildlife and wildlife habitats could include increased noise levels associated with the wider highway and increased traffic volumes. This increased disturbance could displace some animals currently living in the vicinity of the project area. Proposed highway widening and tree clearing would result in some habitat loss, particularly of the edge habitat along the existing highway corridor. While not high-quality habitat given its proximity to the existing highway and surrounding development, this habitat is important for some species. The proposed project would increase the width of the existing roadway by a lane in both the northbound and southbound direction. This additional distance created by the addition of two travel lanes could make wildlife crossing more difficult and possibly less successful, leading to increased wildlife-vehicle collisions or further isolating populations. Construction of proposed noise barriers could also create barriers to wildlife passage, although noise barriers would be placed between the highway and areas of dense residential development, where habitat value is limited.

4.7.1.4 Mitigation

There are no formal mitigation measures proposed for wildlife impacts associated with the proposed project. However, measures were taken to improve wildlife habitat and passage along the proposed project corridor. Both the Pennichuck and Baboosic Brook crossings would incorporate wildlife shelves into the design of the proposed structures to facilitate wildlife passage. Impacts to valuable habitats including vernal pools and other high-quality wetlands would be minimized and avoided wherever feasible. Wetland mitigation measures, such as the potential preservation of parcels along the F.E.E.T., would also potentially result in habitat preservation and improvements. *(Environmental Commitments 7, 8, and 9)*

4.7.2 Fisheries

4.7.2.1 Impacts to Fish Habitat

Direct impacts to fisheries resources may result from construction that places fill material in waterbodies or waterways and results in the loss of habitat. Highway construction can result in additional direct and indirect impacts including: stream channelization, loss of bank structural complexity, loss of stream flow complexity, shading from bridges or loss of shading from tree clearing, changes in water temperature, alterations in hydrology, and reduction of water quality from highway runoff.

Impacts to fisheries and other aquatic life were quantified by calculating the length of the proposed channel impacts, as well as comparing the existing and proposed structures at the locations of stream crossings.

Pennichuck Brook (S-1) has been modified by a series of downstream dams to create a large impoundment at the location of the F.E. Everett Turnpike crossing. Approximately 212 linear feet of the channel would be affected by the project. There is currently unrestricted fish passage within the brook under the turnpike bridges, and the proposed new bridges will maintain or expand this opening.

Stream S-2 is an unnamed perennial tributary of the Merrimack River located between the southern and middle project widening segments, between Exits 10 and 11. A noise wall is proposed on the east side of the F.E.E.T, opposite the delineated portion of the stream west of the highway. The stream flows through a culvert, southeast underneath the turnpike, and outlets south of the proposed noise wall on the east side. There are no proposed impacts to this waterbody.

The replacement of the Naticook Brook (Stream S-3) culvert as well as mainline grading would require the stream channel to be realigned both upstream and downstream from the crossing. Approximately 360 linear feet of the stream channel would be realigned or otherwise impacted. The existing crossing structure consists of a 60-inch reinforced concrete pipe, with a slightly perched outlet. The proposed structure would consist of a 90-inch reinforced concrete pipe that would be embedded two feet to allow for a natural substrate throughout the bottom of the structure. The proposed natural substrate and the elimination of the perched outlet would provide a substantial improvement for aquatic organism passage compared to the existing structure. Naticook Brook is a relatively shallow stream with a sand and gravel substrate. On the downstream end of the crossing there is a substantial amount of riprap within the channel. The stream was observed during low flow conditions and there was very little to no flow on the upstream end or through the culvert. Marginal fish habitat is present in this reach of Naticook Brook. Higher quality fish habitat most likely exists further downstream in the vicinity of Horseshoe Pond.

No work is proposed in the Souhegan River (Stream S-4).

Stream S-5 is a small unnamed intermittent stream that is a tributary to Stream S-6, a small unnamed perennial stream that is a tributary to Baboosic Brook. Stream S-5 would require approximately 765 feet of channel realignment. This small intermittent stream does not provide fish habitat due to its small size and intermittent flow regime.

Stream S-6, an unnamed perennial tributary to Baboosic Brook would require approximately 69 linear feet of stream channel realignment due to culvert reconstruction, highway widening, and the replacement of the Wire Road Bridge over the F.E.E.T. This stream is relatively small and does not likely support fish populations.

Baboosic Brook (Stream S-7) is a perennial stream located northeast of the Wire Road crossing over the F.E.E.T. The Selected alternative for the Baboosic Brook crossing would replace the existing twin 15-foot box culverts with a 66-foot full span structure. The proposed structure would provide a wildlife shelf and a natural stream channel substrate throughout. The wider structure and natural substrate would increase aquatic organism passage. The existing channel substrate in the project area consists primarily of sand, with some silt/clay and cobbles. A channel constriction further downstream (near the McGaw Road Bridge) has created a backwater effect and flow is almost nonexistent. The proposed culvert replacement would permanently impact approximately 54 linear feet (and temporarily impact 30 linear feet) of the Baboosic Brook channel outside of the existing culvert. This section of Baboosic Brook provides potential habitat for warmwater fish species.

Dumpling Brook (Stream S-9) is a small perennial stream located near the northern end of the middle project segment. Stream S-8 is a small intermittent tributary to Dumpling Brook. Hydrology from this stream comes from a wetland area on the west side of the highway as well as highway drainage. On the upstream end of the Dumpling Brook crossing the existing culvert would be extended. This would result in approximately 171 linear feet of channel impacts to S-9 and I linear feet to S-8. On the downstream end the side slopes were steepened and guardrail is proposed in order to minimize impacts. The substrate within the Dumpling Brook impact area was dominated by sand with organic matter accumulating in slower moving and backwater areas. Emergent wetland vegetation was growing along the banks and edges of the stream.

Patten Brook (Stream S-10) is a perennial tributary to the Merrimack River located just south of the Interstate 293 interchange. Highway widening and culvert reconstruction would result in approximately 67 linear feet of channel impacts. Immediately upstream from the culvert inlet is a bedrock outcrop in the stream channel that results in a near vertical drop of approximately 3-5 feet. This rock drop acts as a barrier to most aquatic organism passage. The downstream section of channel has a large scour pool at the culvert outlet, as well as some riffle pool complexes and undercut banks further downstream.

Streams S-11 and S-12 are two unnamed intermittent tributaries to the Merrimack River. There would be 81 and 20 linear feet of impacts to these streams, respectively. Given their sizes and intermittent flow regimes, it is unlikely that either stream supports fish populations.

4.7.2.2 Essential Fish Habitat

There are a total of six waterbodies in the vicinity of the proposed project area that have been designated as Essential Fish Habitat (EFH) for Atlantic Salmon for all life cycle stages (eggs, larvae, juveniles, and adults). These include the Merrimack River, Horseshoe Pond, Naticook Brook, Souhegan River, Pointer Club Brook, and Bowman Brook. Naticook Brook is the only one of these waterbodies that would be directly impacted by the proposed project. There is no bridge work proposed on the bridge over the Souhegan River, and therefore impacts to the river are not proposed. The remaining streams are located outside the limits of proposed work.

Naticook Brook currently has a 60-inch diameter concrete pipe with a corrugated metal pipe (CMP) end section on the downstream end. Hydraulic modeling, as well as field observations, indicates that the existing culvert is undersized for this crossing. The culvert outlet is also slightly perched during low flow conditions.

The recommended alternative for the replacement of the Naticook Brook culvert includes replacing the existing 60-inch culvert with a 90-inch reinforced concrete pipe (RCP) that would be embedded 2 feet to allow for natural stream substrate to be placed in the culvert.

The culvert replacement would result in a larger hydraulic opening with natural stream channel substrate throughout the culvert, and would also eliminate the perched outlet. These improvements would result in increased aquatic organism passage, providing improved access to upstream reaches, and improve the overall quality of the stream habitat. Stream realignment would permanently impact benthic communities within portions of the original channel that would be abandoned. However, it is anticipated that populations of benthic species would repopulate the realigned segments of the channel.

The Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies to conduct an EFH consultation with the National Marine Fisheries Service (NMFS) regarding any of their actions that may adversely affect EFH. An EFH Assessment Worksheet was completed for the project and concluded that any adverse effect on EFH would not be substantial given that the proposed work in Naticook Brook will result in an overall improvement in stream habitat and aquatic organism passage. Therefore, an abbreviated consultation was requested with NMFS. No response from NMFS has been received to date. The results of the EFH consultation, including any conservation recommendations received from NMFS, will be provided in the final environmental document and coordination with NMFS will continue throughout design of the project as needed. *(Environmental Commitment 10)*

4.7.2.3 Mitigation

Mitigation for fisheries habitat impacts consists of the waterway mitigation described in Section 4.5.4.5 above. *(Environmental Commitment 11)*

4.7.3 Threatened and Endangered Species

4.7.3.1 Plants

Federally Threatened and Endangered Plant Species

No Federally listed endangered or threatened species of plants are known to occur in or near the study area or are considered likely to occur there.

State Rare, Threatened and Endangered Plant Species

Bird-foot violet *(Viola pedata*)

Bird-foot violet is known to occur within the project limits at 5 distinct locations. These known locations will be identified and protected against disturbance during construction to the degree possible. In addition, surveys will be conducted prior to construction in likely habitat along the project corridor to identify any potential previously unknown populations. If previously unknown populations are discovered, they will also be protected from construction to the degree possible. If known or newly discovered populations cannot be avoided during construction, NHDOT will coordinate with the NHNHB to relocate individuals within the immediate vicinity, outside of the project impact area, or to one or more of the previously identified known population locations. Based on the aforementioned information, no substantial impact to this species is anticipated to occur as a result of this project. *(Environmental Commitment 12)*

Clasping milkweed (*Asclepias amplexicaulis*)

An individual clasping milkweed was identified in 1984 on the east side of US Route 3 approximately 0.4 miles from the project location. Potential suitable habitat within the project limits is restricted to dry, sandy, open areas within the maintained ROW. Surveys will be conducted prior to construction along the project corridor to identify any potential previously unknown populations of clasping milkweed. If previously unknown populations are discovered, they will be protected from construction to the degree possible. If newly discovered populations cannot be avoided during construction, NHDOT will coordinate with the NHNHB to relocate individuals within the immediate vicinity, to a location outside of the project impact area. No substantial impacts to clasping milkweed are anticipated as a result of this project. *(Environmental Commitment 12)*

River birch (*Betula nigra*)

A known concentrated population of mature river birch has been documented on Carthagina Island located within the Merrimack River, near the northern end of the proposed project. This species is also known to occur along the floodplain associated with the Merrimack River. The project area may support viable habitat along the floodplains associated with the larger streams including Baboosic Brook, Souhegan River, Naticook Brook, and Patten Brook. Prior to construction, these areas will be surveyed for the presence of river birch, and individual trees will be flagged and avoided to the extent possible during construction. Individuals that cannot be avoided could be replaced with plantings in adjacent suitable habitat within the ROW. As a result, no substantial impacts to river birch are anticipated as a result of the project. *(Environmental Commitment 12)*

Tall cottonsedge (*Eriophorum angustifolium*)

Tall cottonsedge was documented by the NHB within a wooded fen/shrub bog complex located approximately 0.35 miles east of the F.E.E.T. near Exit 10, northeast of the northern terminus of the southern segment. There is no suitable habitat within or immediately adjacent to the project area. The project is not anticipated to impact tall cottonsedge.

Wright's Spikesedge (*Eleocharis diandra*)

Wright's spikesedge has been documented at two locations along the open sandy-silty shoreline of the Merrimack River. Potential suitable habitat within the project limits is restricted to the banks and shoreline of Baboosic Brook. Surveys would be conducted prior to construction along Baboosic Brook to identify any potential previously unknown populations of Wright's spikesedge. If previously unknown populations are discovered, they would be protected from construction to the degree possible. If newly discovered populations cannot be avoided during construction, NHDOT will coordinate with the NHNHB to relocate individuals within the immediate vicinity outside of the project impact area. As a result, no substantial impacts to Wright's spikesedge are anticipated as a result of this project. *(Environmental Commitment 12)*

New Hampshire Exemplary Natural Communities

High-gradient rocky riverbank system

The reach of the Souhegan River that flows through the project area has been identified by NHNHB as a high-gradient rocky riverbank system, an Exemplary Natural Community type in the State of New Hampshire. The proposed project would not result in any impacts to the Souhegan River or this Exemplarily Natural Community system.

4.7.3.2 Wildlife

Federally Threatened and Endangered Wildlife Species

Northern Long-Eared Bat (*Myotis septentrionalis*)

Northern long-eared bats may occur in forested habitat throughout New Hampshire and may additionally use bridges for roosting. The project proposes clearing 47.4 acres of trees for road widening, construction of noise walls, and construction of stormwater BMP areas. All clearing will be located within 300 feet of a road surface. The F.E.E.T. bridges over Pennichuck Brook and the Baboosic Lake Road and Wire Road over the F.E.E.T. would be replaced. A review of these bridges for bat roosting potential has not yet been completed.

The Natural Heritage Bureau did not report any known winter hibernacula or maternity roost trees in the vicinity of the project. NH Fish & Game also has not indicated that known hibernacula or maternity roost trees exist in the vicinity of the project.

Tree clearing and bridge removal may take place during the active season for bats. The 4(d) Rule for northern long-eared bat allows incidental take resulting from tree removal unless one or more of the following applies:

- Removal of known, occupied maternity roost trees;
- Tree removal within 150 feet of a known, occupied maternity roost tree from June 1 through July 31; or
- Tree removal within 0.25 mile of a hibernaculum at any time of the year.

Since there are no known maternity roost trees or hibernacula in the vicinity of the project, it is anticipated that the proposed project would likely be approved under the 4(d) Rule. However, construction of the project is not expected to begin until 2022, at which time additional consultation under the Endangered Species Act would be required to determine if new information is available on potential species presence. To provide background information for future consultation, a limited acoustic survey was completed at eight survey sites within higher quality habitat in the project area. Results from this survey will be available for inclusion in the final Environmental Study and will help inform the level of future consultation that may be warranted.

Coordination with USFWS will take place approximately one year prior to construction to ensure compliance with applicable laws and agreements, and results from the acoustic survey will be utilized to inform this coordination. *(Environmental Commitment 13)*

State Rare, Threatened and Endangered Wildlife Species

Brook floater mussel (*Alasmidonta varicosa*)

The brook floater mussel is known to occur within the Merrimack River in the vicinity of the project area. Potential suitable habitat within the project limits also exists within the Souhegan River. No in stream work or other direct impacts to the Souhegan River or the Merrimack River are proposed as part of this project. Appropriate soil erosion and sediment control practices will be implemented during construction to minimize introduction of sediment into downstream waterways, including the Souhegan River. Based on this information the project does not have anticipated effects on brook floater. *(Environmental Commitment 14)*

American eel (*Anguilla rostrata*)

American eel has been documented in Baboosic Brook, Souhegan River, and Horseshoe Pond (east of project, associated with Naticook Brook). Correspondence with NHFG suggests that Pennichuck Brook may also support American eel. No in stream work or other direct impacts to the Souhegan River or Horseshoe Pond are proposed as part of this project. During construction, American eels would likely temporarily relocate within the watercourses where work is to be performed. Cofferdams or other standard stream diversion methods would be utilized during construction to maintain stream flows. In addition, all replacement bridges and culverts have been designed in accordance with USACOE guidelines to maintain aquatic life passage. Further coordination with the NHFG regarding additional avoidance and minimization measures would be conducted during the permitting process. As a result, impacts to American eel are not anticipated from the proposed project. *(Environmental Commitment 15)*

Bald eagle (*Haliaeetus leucocephalus*)

Wintering bald eagles have been well documented along the Merrimack River. However, only two known nesting locations have been documented within the vicinity of the project corridor. These bald eagle nests (active or alternate) cannot be seen from the F.E.E.T., and are not located within 660 feet of the project site. Based on current USFWS bald eagle management guidelines, the project will not “disturb" or otherwise agitate or bother a bald eagle to a degree that it causes, or is likely to cause injury to a bald eagle, a decrease in its productivity, or nest abandonment, based on the best scientific information available.

Blanding’s turtle (*Emydoidea blandingii*)

There have been two observations of Blanding’s turtles within the vicinity of the Souhegan River within and adjacent to the project area. Suitable habitats including wetlands and slow-moving streams, are located within the project corridor. Coordination with NHFG will occur to develop appropriate construction measures to prevent impacts to this species. Examples of such measures include:

- An environmental monitor could inspect work areas and relocate any Blanding’s turtles found there.
- The contractor could erect a silt/debris fence around the footprint of all proposed activities sufficient to exclude turtles.
- On-site construction workers could be required to attend a pre-construction educational presentation regarding identification of sensitive species.

While there could be impacts to Blanding's turtle habitat, no direct impacts are expected as a result of this project. *(Environmental Commitment 16)*

Eastern hognose snake (*Heterodon platirhinos*)

The eastern hognose snake has been documented at several locations within and adjacent the project area. While there could be impacts to hognose snake habitat, and because the species is often underground, construction activities could inadvertently impact individual snakes. During construction, measures such as those described above for Blanding's turtles could be implemented to minimize any impacts. *(Environmental Commitment 16)*

Northern black racer (*Coluber constrictor*)

The northern black racer was historically documented within a large contiguous area just north of the northern end of the southern project segment. According to NHFG, this population is considered to be extirpated due to den destruction by development. It is possible that there may be other undiscovered dens within the vicinity of the previously known location. The project impacts would be limited to the existing previously disturbed roadway corridor and immediately adjacent areas, and it is highly unlikely it would disturb any unknown den locations. During construction, measures such as those described above for Blanding's turtles could be implemented to minimize any impacts. As a result, impacts to northern black racers are not anticipated as a result of this project. *(Environmental Commitment 16)*

Peregrine Falcon (*Falco peregrines anatum*)

A single peregrine falcon nesting location has been documented in the vicinity of the project, on the I-293/NH Route 101 Bridge over the Merrimack River. The bridge is located approximately 0.4 miles from the proposed project area. Although peregrine falcons have become well adapted to the human environment and are often found nesting on buildings and bridges even in dense urban and high traffic locations, they are particularly sensitive to nest disturbances during the breeding season. The project would not involve disturbances to the I-293/NH Route 101 Bridge nesting location. In addition, the limited construction footprint in comparison to the ample amount of available foraging habitat in the vicinity of the known nesting location would not likely decrease the productivity of peregrine falcons. The project should have no effect on peregrine falcons.

Sea lamprey (*Petromyzon marinus*)

The sea lamprey has been documented in the Souhegan River, below the former Merrimack Village Dam. The dam has since been removed and no longer serves as a barrier to upstream travel of sea lamprey to the portions of Souhegan River within the projects limits. In addition, NHFG has suggested that sea lamprey may also occur within Baboosic Brook and Naticook Brook. During construction, sea lamprey would likely temporarily relocate within these watercourses away from work areas. The use of construction methods that allow for maintenance of instream flows would be utilized, and stream culverts and bridges have been designed in accordance with stream crossing guidelines to maintain aquatic life passage following construction. Further coordination with NHFG regarding additional avoidance and minimization measures, if any, would be conducted during the permitting process. As a result, there are no impacts to sea lamprey anticipated as a result of this project. *(Environmental Commitment 15)*

Spotted turtle (*Clemmys guttata*)

A single spotted turtle was documented as roadkill in the vicinity of Sebbins Brook, between the middle and northern project segments. Suitable habitats, including wetlands and slow-moving streams, are located within the project corridor. During construction, measures such as those described above for Blanding's turtles could be implemented to minimize any impacts. While there could be impacts to spotted turtle habitat, no direct impacts to the turtles are expected as a result of this project. *(Environmental Commitment 16)*

Wood turtle (*Glyptemys insculpta*)

There have been two documented occurrences of wood turtle within the vicinity of the project. Potential suitable habitat is present within the project corridor including numerous watercourses and their associated riparian wetlands and adjacent uplands. During construction, measures such as those described above for Blanding's turtles could be implemented to minimize any impacts. While there could be impacts to wood turtle habitat, no direct impacts to the turtles are expected as a result of this project. *(Environmental Commitment 16)*

4.7.4 Invasive Species

Invasive species are located throughout the project corridor and disturbance of these plants is likely to occur during construction. All appropriate Best Management Practices would be summarized in an Invasive Species Control and Management Plan and implemented during construction to avoid spreading invasive plants to new sites. NHDOT Standard Specifications designate invasive plants as Type I or Type II based on the complexity of control measures that are required to prevent the spread of the plants during construction. In general Type II plants require a greater level of control due largely to their ability to spread from stem or root fragments. Of the invasive plants identified in the project area, purple loosestrife, Japanese knotweed, and common reed require Type II control measures. The remaining species require Type I controls. *(Environmental Commitment 17)*

4.8 CULTURAL RESOURCES

4.8.1 Historic Architectural Resources

The National Historic Preservation Act, at 36 CFR 800.5, provides criteria for evaluating the effects of federal actions on historic properties:

> *An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.*

Examples of adverse effects include:

- Physical destruction or damage to all or part of the property;
- Alteration of a property that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR 68);
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; and
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.

No adverse effect may be found when the undertaking's effects do not meet the criteria for adverse effect, i.e., do not alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register. No adverse effect may also apply when the undertaking is modified or conditions are imposed to avoid adverse effects. If a project will not affect a historic property in any way, it is determined to have no effect.

As described in Chapter 3, the Area of Potential Effect (APE) extends approximately 300 feet from the turnpike centerline. Architectural historians reviewed project plans showing possible project impacts within the APE where properties that are on, eligible for, and potentially eligible for the National Register occur. Potential impacts included tree clearing, noise barriers, cut and fill slopes, and storm water management locations. Each such site was visited and photographs taken. Plans were prepared showing the locations of the parcels with respect to proposed project work. The proposed work adjacent to each such property was described and photos of the properties were included. This documentation was submitted to the NH Division of Historical Resources (NHDHR for their review, and the findings were discussed in meetings with NHDHR. For work within Army Corps (lead federal agency) jurisdiction, the Corps is making the determination of effect in consultation with NHDHR. For work outside of Corps jurisdiction, NHDOT consulted with NHDHR to determine the effects.

The following work is proposed in the vicinity of potentially eligible properties:

- Widening: The horizontal and vertical alignments were developed to follow the existing F.E.E.T. mainline to the maximum extent practicable. In widening the highway to three lanes in each direction, the roadway pavement and traffic will move closer to existing structures. This widening project will also necessitate some adjustments to the interchange ramps at Exits 10, 11, and 12 and at I-293. Side slopes will be graded to between 1V:6H and 1V:2H, depending on the length of the slope. Existing vegetation within the project footprint would be removed, the ground would be graded, and loam and seed would be applied. The widening would move the highway closer to adjacent properties, but the land use would be similar to the existing land use.

- Tree clearing: The footprint includes 5-10 feet of clearing for tree removal outside the proposed toe of slope in wooded areas. More clearing would occur where detention basins are proposed. In most cases a buffer of trees would remain between the structure and the highway. As with the widening, this would have an incremental effect on adjacent properties.
- The bridges carrying Baboosic Lake Road and Wire Road over the F.E.E.T. and the F.E.E.T. bridges over Pennichuck Brook and Baboosic Brook will require replacement. These are not currently contributing elements and would not adversely affect the setting of nearby resources.
- Stormwater management: Best management practices will consist primarily of extended detention basins. These will generally be rectangular basins. The footprint includes a perimeter access road, 4:1 embankment fill slopes and a permanent pool. Most of the basins are not proposed adjacent to structures over 50 years old, and a buffer of trees will remain adjacent to the others. There will also be 19 vegetated treatment swales constructed.
- Noise barriers are proposed at certain locations. Barrier heights range from 15 to 17 feet high, although end sections may be 10 to 12 feet high. The walls would be a solid, impermeable material, typically wood with concrete footings and posts. The walls will all be constructed within the ROW and will be similar in character to existing roadway structures. The walls will also provide some noise attenuation for adjacent properties.

Both the Army Corps and NHDOT have determined the proposed work will not physically alter the properties; will not change the character of the property's use or of physical features within the property's setting that contribute to its potential historic significance; and will not introduce visual, atmospheric or audible elements that diminish the integrity of the property's potentially significant historic features. Therefore, the project will have no adverse effect on historic architectural resources.

4.8.2 Archaeological Resources

As described in Chapter 3, Phase IA and IB investigation were undertaken in proposed road widening, BMP, and noise wall areas. All of the proposed BMP and noise wall areas are either outside of archaeologically sensitive areas or have been found not to contain archaeological resources.

Road widening overlaps one sensitive archaeological site. The Naticook Brook I site contains Pre-Contact artifacts with both Paleoindian Period and Archaic Period occupation, and is potentially eligible for the National Register. Archaeologists collected specific artifacts and all definitive or potential Pre-Contact cultural features in test holes west of the proposed fill extent and clearing limits. One fragment is the only diagnostic specimen from within the impact area, and it was in a B horizon (below the topsoil). However, a portion of the road embankment fill slope and associated tree clearing will overlap the sensitive area. To protect archaeological resources, the following are proposed:

- No ground disturbance, or even vehicular traffic, will occur west of the fill extent or in untested areas west of the known site limits and current project limits.
- Removal of “top soil” will include only the surface loam/A horizon, where only one non-diagnostic flake was found within the fill limits, and no vehicular traffic atop the exposed B horizon without the placement of fill or the use of matting or similar measures to prevent soil disturbance.
- Fencing will be placed along the known site limits and clearing limits prior to work and will be maintained in place during work to ensure no ground disturbance to the most intact portions of the site (west of the limits of fill).
- Non-mechanized clearing of all vegetation within the site limits and hoisting (not dragging) to remove fallen timber.
- Stumps may be ground but will not be excavated within the site limits.

(Environmental Commitment 18)

4.9 Socio-Economic Resources

4.9.1 Property Acquisitions

Portions of approximately 33 parcels would be acquired for the project (Table 4.9-1). The total land area would be approximately 13.49 acres. Most acquisitions are small slivers of land less than 0.1 acre in extent, but many acquisitions are for stormwater BMPs and range up to 2.20 acres in size.

Temporary easements would be obtained for temporary construction impacts. Five of the 33 impacted parcels would also require temporary easements for construction purposes, and an additional 13 parcels would require only temporary easements. Temporary impacts would total 0.88 acres.

Property requiring acquisition would be appraised using techniques recognized and accepted by the appraising profession. Acquisitions would be carried out in conformity with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended, and applicable New Hampshire state law. The amount offered for partial acquisitions is the difference between the fair market value of the property before the highway is built and its value after the portion needed for the highway has been acquired. Completed appraisals are carefully reviewed by an independent appraiser to ensure that requirements of condemnation law and acceptable appraisal methods are met.

No residences or businesses are expected to be displaced.

4.9.2 Property Value Impacts

With no new interchanges, no major improvements programmed at existing interchanges, and only partial property takings of vacant land adjacent to the existing ROW, there will not be major property value impacts resulting from the proposed improvements. It is conceivable that with reduced congestion and improved safety, some positive property value impacts will be felt within the corridor communities in the face of easier movement among the corridor communities. These impacts will probably be less serious than macro-economic factors such as interest rates and life style preferences.

Over the longer term, if the improvements were not undertaken, the LOS would decline to level E and F, which could have a negative effect on property values. Likewise, noise impacts would be mitigated with the construction of noise barriers where they have been found to be feasible and reasonable. The No Build Alternative would not include noise barriers unless they were constructed as part of another project.

4.9.3 Cost-Benefit Analysis

According to a cost-benefit analysis[26] of the proposed improvements prepared in 2013 and revised in 2018:

- The Turnpike currently carries 65,000-71,000 vehicles per day, resulting in a LOS in the range of D-E by 2024, which would improve to LOS C to D if the proposed widening was undertaken;
- If the improvements are not undertaken, the projected year 2044 LOS would drop to levels E and F;
- The proposed improvements would save an average of $11.3 million annually in travel time costs, fuel savings and safety.
- The proposed widening will resolve existing congestion issues, resulting in a reduction in the average commuter's time totaling 30.5 hours in 2024 and 56.5 hours in 2044.

In comparison to expected costs, the cost-benefit analysis estimates the widening has a benefit-cost ratio of 1.40, meaning calculated benefits exceed costs by 40% over the 21-year projection period. These are substantial savings and a measurable net benefit.

[26] Technical Memorandum dated 1/2018: *F.E. Everett Turnpike: Assessment of widening two sections of the turnpike from four lanes to six lanes.* Prepared by CHA Consulting Inc.

Table 4.9-1. Proposed acquisitions and temporary easements

South to North Order	Project Segment	Parcel ID	Area in Acres	Area of Temp. Impact (ac)	Area of Proposed Impact (ac)	City or Town	Reason for Acquisition
1	Southern	G-488	79.560		1.605	Nashua	2 Stormwater BMP Areas
2	Southern	2D-4-1	63.300		0.683	Merrimack	Stormwater BMP Area
3	Southern	3C-191-0	446.221		2.204	Merrimack	Stormwater BMP Area
4	Middle	4D4-17-0	0.576	0.017		Merrimack	
5	Middle	4D-73-0	1.649	0.262		Merrimack	
6	Middle	4D4-18-0	0.980	0.053	0.235	Merrimack	Mainline Grading
7	Middle	4D-71-0	2.401		0.077	Merrimack	
8	Middle	4D4-19-0	7.580		0.174	Merrimack	Mainline Grading
9	Middle	4D-72-0	1.356		0.298	Merrimack	
10	Middle	4D4-67-0	16.5		0.895	Merrimack	Stormwater BMP Area
11	Middle	4D-70-0	1.520		0.041	Merrimack	
12	Middle	4D-68-0	21.103		0.636	Merrimack	Stormwater BMP Area
13	Middle	4D3-76-0	7.922		0.082	Merrimack	Stormwater BMP Area
14	Middle	5C-659-0	55.900		0.258	Merrimack	Stormwater BMP Area
15	Middle	5D3-128-0	55.000	0.009		Merrimack	Mainline Grading (LWCF)

South to North Order	Project Segment	Parcel ID	Area in Acres	Area of Temp. Impact (ac)	Area of Proposed Impact (ac)	City or Town	Reason for Acquisition
16	Middle	5C-482-1	12.200		1.336	Merrimack	Stormwater BMP Area
17	Middle	5C-569-1	4.080	0.008	0.221	Merrimack	
18	Middle	5C-482-0	3.200	0.021	0.036	Merrimack	
19	Middle	5C-481-0	0.235	0.028		Merrimack	
20	Middle	5C-480-6	1.339	0.013		Merrimack	
21	Middle	5C-483-0	1.900	0.013		Merrimack	
22	Middle	5C-484-0	0.430	0.003		Merrimack	
23	Middle	5C-485-0	0.300		0.007	Merrimack	
24	Middle	5C-479-1	0.500	0.001		Merrimack	
25	Middle	5C-480-1	3.825	0.005		Merrimack	
26	Middle	5D3-1-0	4.15		0.584	Merrimack	Stormwater BMP Area
27	Middle	5D3-129-0	0.464	0.011		Merrimack	Mainline Grading
28	Middle	5D3-57-0	2.640	0.008		Merrimack	
29	Middle	5D3-58-0	2.235		0.386	Merrimack	Stormwater BMP Area
30	Middle	5D3-59-0	1.100	0.026	0.034	Merrimack	
31	Middle	5D3-60-0	0.790	0.003		Merrimack	
32	Middle	6D-529-0	126.000		0.993	Merrimack	Stormwater BMP Area
33	Middle	6D1-10-1	7.694		0.010	Merrimack	

South to North Order	Project Segment	Parcel ID	Area in Acres	Area of Temp. Impact (ac)	Area of Proposed Impact (ac)	City or Town	Reason for Acquisition
34	Middle	6D1-15-00	0.090		0.024	Merrimack	
35	Middle	6D1-20	1.306		0.020	Merrimack	
36	Middle	6D1-34-0	1.330		0.083	Merrimack	
37	Middle	6E2-2-0	20.600		0.207	Merrimack	
38	Middle	6E2-19-0	2.402		0.607	Merrimack	Stormwater BMP Area
39	Middle	7E-20-0	15.266		0.069	Merrimack	
40	Middle	7E-18-0	133.000		0.508	Merrimack	Stormwater BMP Area (Dumpling Brook WMA)
41	Northern	24/98/16	8.610		0.376	Bedford	Stormwater BMP Area
42	Northern	24/98/13	4.460		0.428	Bedford	Stormwater BMP Area
43	Northern	23/98/1	9.730		0.244	Bedford	Mainline Grading
44	Northern	22/8/3	6.457	0.128	0.103	Bedford	Mainline Grading
45	Northern	22/8/1	8.216		0.021	Bedford	Mainline Grading
46	Northern	22/27/00	11.994	0.274		Bedford	
			TOTAL:	**0.88**	**13.49**		

4.9.4 Impacts on Growth and Development

This section presents an overview of the anticipated land use impacts within the region and within each community impacted by this project. The Town of Londonderry has been included due to its proximity to the project area and the connection to the community from the F.E.E.T. via the airport access road.

4.9.4.1 Planning Perspectives

Nashua Regional Planning Commission (NRPC): NRPC staff were interviewed and commented that the F.E.E.T. project may allow for better utilization of developed lands/buildings in the region. However, the F.E.E.T. project alone was not seen as likely to attract or deter additional drivers. The NRPC Regional Plan indicates that residents would like to see additional transportation options to Boston and other locations in New Hampshire, and that having this improved option of travel could lessen congestion levels and support ongoing economic development efforts in the region.

Southern New Hampshire Planning Commission (SNHPC): The SNHRPC Regional Plan has very little reference to the F.E.E.T. project. This Regional Plan does note that planned transportation improvements in the SNHPC region in general will increase highway capacity and improve north-south highway travel in the region. SNHPC staff do not see this expansion of lanes on the turnpike as helping to attract workers, but do anticipate it will accommodate existing traffic volumes while improving safety.

City of Nashua: The Nashua Master Plan was adopted in 2000 and while it does not specifically identify the turnpike expansion, it does articulate the potentially conflicting goals of resource protection (i.e., watershed and water resources) and economic development, which requires an efficient transportation network. As far as transportation is concerned, the Master Plan sets goals for providing smooth transitions and linkages to the State highway system. The economic development objectives also call for improved transportation and other infrastructure improvements. City staff stated that the project will positively impact the City's citizens and employees by improving their safety and reducing their commuting time. Both of these improvements will also improve the quality of life and productivity of those using the turnpike.

Town of Merrimack: The Merrimack Master Plan calls for promoting and implementing a roadway system that encourages the appropriate use of the Town's street system to reduce traffic volumes, relieve congestion on some of the Town's major travel routes, and proactively anticipate changes in the local roadway system as a result of future development or changes in travel demand. The Master Plan specifically calls for development of a full interchange at Exit 12 of the F.E.E.T. to improve access for residents and businesses of northern Merrimack and improve access to undeveloped commercial and industrial land. The current F.E.E.T. project does not propose interchange upgrades. The NRPC Staff identified concerns at Exit 11 in the Executive Park Drive area when capacity on the turnpike increases. This is because there are a series of lights in close proximity that are not coordinated and the area already gets congested.

Merrimack's Community Development Department staff noted during an interview that expansion of the turnpike will alleviate gridlock and provide capacity for new development, but do not see it as inducing growth in the community. They also see this turnpike project as a necessary step for any future circumferential highway project in Nashua. According to Town staff there are several pending development projects in Merrimack. This includes some in the immediate vicinity of the turnpike that would potentially benefit from a safer and less congested F.E.E.T.

Town of Bedford: Most references to the turnpike in the Bedford Master Plan are related to it providing access in and out of Bedford, and its geographic location in the community. Town staff see the turnpike improvements as improving safety and increasing the ease of transportation to and from the community as well. They do note however that reduced traffic volume on US Route 3 in Bedford after turnpike expansion could be an issue for convenience retail businesses. They also noted that some residents have been requesting noise mitigation. During an interview with Town staff questions were raised about the possibility that residential units will increase because of improved commuting times, and the potential impact on Bedford's schools. However, staff noted that Bedford is nearly built out, and will be looking more at redevelopment projects going forward, so this was not a concern related to the F.E.E.T. project.

Town of Londonderry: The 2013 Londonderry Master Plan identified the Pettengill Road area as a growth node for Londonderry. Recently several new large-scale uses have been constructed in this area near the Manchester-Boston Regional Airport, and additional developments are expected. Elsewhere in the community additional developments have been proposed and are likely to be constructed in the next few years. These include large warehousing operations, an extensive new urbanist mixed use development with residential and retail/office facilities, and several workforce housing projects. The turnpike widening would improve access for Londonderry but is not expected to induce additional growth.

Summary: The land use patterns in the project area have evolved over time along the turnpike, and the communities directly impacted are concerned with the current congestion and safety-related issues on the F.E.E.T. Within the general project area, there is a sophisticated level of land use planning and regulation taking place in each of the communities, and little concern related to land use impacts of the project. More specifically, consensus from the interviews is that the addition of lanes on the F.E.E.T. in the project area is important for improved safety and quality of life, although noise was a concern. It was also determined that no substantial impact on growth or land use change is anticipated in the four communities because of the additional lane. A review of the existing planning documents in the project area identified support for the F.E. Everett Turnpike expansion whenever the topic was addressed. None of the planners interviewed had concerns related to their zoning or developable land areas when discussing the potential for additional lanes and capacity on the turnpike.

4.9.4.2 Analysis

The improvements in and of themselves will not substantially increase traffic flows. The current traffic issues take the form of peak hour delays and crashes. The improvements function as a more efficient and safer way to accommodate current and expected future Turnpike traffic. The improvements will have the impact of shortening commuting times both north and south bound. The CHA study estimates an average annual travel time reduction of 484,269 hours and an improved level of service both now and in the future. The delays now experienced have a perceptible negative impact on quality of life (and vehicular safety) within and passing through the corridor. The project will have the effect of potentially improving working conditions for area residents, who may be more likely to seek improved employment conditions within the corridor communities.

Most of the prime development sites in the corridor have already been developed (an exception is that Pettengill Road in Londonderry is still undergoing development). As a result, the widenings will not have a major impact on land development within the corridor. In the absence of the widenings, it is conceivable that the future LOS will deteriorate to the point where limited capacity will dilute future economic development among corridor communities.

Based upon the above findings, the project is not anticipated to generate significant economic and land development activity within the corridor.

4.9.5 Community Facilities

This section presents an overview of the anticipated impacts on community facilities, such as police and fire stations, schools, municipal buildings, post offices, libraries, public works facilities, etc. There would be no anticipated direct impacts to any of these types of community facilities from this project. During the construction phase of the project, when local bridges and roadways could be impacted, access to these facilities could be subject to delays. A particular area of concern is Baboosic Lake Road, where schools, town offices, and a police station are located. The recommended alternative includes a temporary bridge to keep two lanes of traffic (one in each direction) and a sidewalk open at all times during construction. This should prevent delays in accessing these facilities. A noise barrier is proposed between the school property and the turnpike, and should reduce traffic noise and improve the recreational environment of the facility.

4.9.6 Community Cohesion

The proposed improvements will be undertaken within the existing F.E.E.T. corridor. This contrasts with new roadways that can function as a barrier between and within communities. There is a high degree of interaction among the corridor communities for shopping, job commuting, visiting friends and relatives and for personal/business services. The proposed improvements will ease these interactions.

4.9.7 Environmental Justice

The F.E.E.T. project has been evaluated pursuant to Title VI of the Civil Rights Act of 1964 and Executive Orders 12898 and 13166, which are intended to ensure fair and full participation and equal receipt of any benefits that may be realized from the proposed project. The Civil Rights Act of 1964 (Title VI) prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, specifically requires federal actions to be reviewed for the potential to have disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, requires federal actions to translate public information meeting notices and to take appropriate measures to ensure language access.

In summary, projects having substantial effects on human health or the environment shall be undertaken in a manner that they do not have the effect of excluding persons from participation in, denying persons the benefits of, or subjecting persons to discrimination because of, their race, color or national origin.

An inventory of potentially underrepresented groups has been conducted within a one-mile radius and within a three-mile radius of the project corridor. Underrepresented groups have been identified within these locations. The underrepresented groups listed in Table 4.9-2 are those that occur in numbers meaningfully greater than the surrounding area and constitute Environmental Justice populations.

Table 4.9-2. Environmental Justice populations

Study Area	Ave. % Elderly	Ave. % Minority	Ave. % Low Income	Ave. % LEP*
1-mile Radius	10.15%	13.44%	10.85%	NA
3-mile Radius	NA	10.27%	18.88%	NA

Remarks:
*LEP Definition: Populations speaking English as a second language less than well

This project would not create new uses or changes in land use that would adversely impact underrepresented populations or populations speaking English as a second language less than well. The project does call for the partial purchase of 33 properties, totaling 13.49 acres, which are located adjacent to the existing F.E.E.T. ROW. These areas are undeveloped portions of the properties and are spread out along the entire project corridor. Given the relatively high level of income throughout the corridor towns, the general lack of elderly, minority, or low-income populations within the study area, the few properties subject to partial acquisition, and the dispersed nature of those properties along the study corridor, the project is consistent with the provisions of Title VI of the Civil Rights Act of 1964 and Executive Orders 12898 and 13166. Such populations would not be disproportionately impacted by the Build Alternative.

Although no impact is anticipated, the populations identified in Table 4.9-2 will be notified of public information meetings during the project design process. *(Environmental Commitment 19)*

4.10 Visual Resources

The size and scale of the F.E.E.T. within the study area would increase due to the expansion of the pavement footprint, widened bridges, removal of vegetation, and the expansion of the current cut and fill slope lines that are generally maintained grass areas adjacent to the existing pavement limits. Some areas of vegetation removal would occur in existing vegetation buffers between the F.E.E.T. and development areas including residential neighborhoods, businesses, and commercial sites.

The proposed reduction of vegetation and expansion of the cut and fill slope lines may create an adverse visual impact for the residents and businesses that rely on the vegetation buffers that serve to screen the views to the F.E.E.T. Similarly, portions of the proposed vegetation removal in forested areas may lessen the Parkway-like look and feel of the Turnpike for travelers.

The discussion below details the potential impacts of the No Build Alternative and Build Alternative to the visually sensitive resources identified in Chapter 3.

4.10.1 No Build Alternative

The No-Build Alternative would not directly alter the existing visual environment.

4.10.2 Build Alternative

Southern Segment (Nashua and Merrimack)

The proposed widening and removal of vegetation would encroach on a few residences located near the west side of the F.E.E.T. north of Tinker Road. In addition, vegetation removal would decrease the existing buffer between the F.E.E.T. and the Pennichuck Water Works, a National Register-eligible property. Three areas of proposed vegetation removal would extend into the forested area of the Pennichuck Water Works for the purpose of locating stormwater treatment features. These stormwater features (such as detention basins) are proposed on the east side of F.E.E.T. just north of Tinker Road, just south of Pennichuck Brook, and just north of Pennichuck Brook. A fourth area of proposed vegetation removal for stormwater treatment is located on the west side of the F.E.E.T. adjacent to the toll plaza near the northern terminus of the southern segment.

Much of the southern segment contains dense forest on the west side providing the Parkway-like look and feel. A few residential lots are located near the F.E.E.T in this area. The east side consists of a mix of dense forested areas and a large industrial parking area (truck parking on paved and unpaved surfaces) and a few buildings with a narrow band of vegetation for separation.

Although vegetation reduction is proposed, adverse impacts for most of the segment are not anticipated as little change in the visual character of the segment would occur. The open vista provided at the crossing of the Pennichuck Brook would be expanded on the east side and will retain similar visual character to the existing vista provided to travelers today. The existing areas of forested vegetation that provide the Parkway-like look and feel would be reduced in size but the visual character of these areas would remain similar to what exists today.

Middle Segment (Merrimack)

This segment is similar to the southern segment as it contains dense forested areas along both the east and west sides of the turnpike; however, the forested areas are more consistently fragmented with development. The development that has occurred in the vicinity of the study area includes recreational, institutional, residential, office park, and industrial uses which are generally buffered from the F.E.E.T. by a narrow band of vegetation.

Both the east and west sides of the F.E.E.T. south of Greeley Street have been developed and contain a residential subdivision and a business complex. The existing band of vegetation would be reduced however the increase of the view to the F.E.E.T. would be minimized by the proposed noise barriers south of the interchange.

Similar to the southern segment, expanded areas of vegetation removal are proposed throughout this segment for the purpose of providing stormwater treatment features. These stormwater features are proposed in areas near commercial or industrial development or in areas that lack the presence of residential development. Adverse visual impacts from the reduction of vegetation for the purpose of the placement of stormwater treatment features are not anticipated.

There are several locations in proximity to the F.E.E.T. that may experience a reduction in vegetative screening, however, many of these locations have been identified for the installation of noise barriers that will serve to mitigate for the noise impacts. In these areas, the walls would serve a dual purpose in that the view of the F.E.E.T. would be screened and noise levels would also be reduced.

Similarly, the Bigwood Historic District would experience increased views of the F.E.E.T. by the reduction in the vegetation buffer. A noise wall is proposed in this location, north of Wire Road, that would mitigate the increased views and mitigate noise. The Reeds Ferry Heights Subdivision and Oakland Park subdivision would experience increased views of the F.E.E.T. in a few locations, however, the vegetation buffer would remain similar to what exists today. Noise walls are not proposed here. Near the northern terminus of the segment, on the east side, the vegetation buffer would be reduced adjacent to a residential condominium complex. The increased views from this residential location would be mitigated by a noise wall, which as stated above, serves a dual purpose by reducing noise while acting as a visual screen.

Northern Segment (Bedford)

Similar to the southern segment, the proposed widening and removal of vegetation would encroach on a few residences located south of the US Route 3 overpass. Other uses adjacent to the F.E.E.T. include a few commercial buildings south of the I-293 Interchange. Much of the existing vegetation is currently fragmented on both the east and west sides of the F.E.E.T. from development. Additional fragmentation by the roadway network associated with the I-293 Interchange has occurred. The proposed vegetation reduction is not anticipated to induce an adverse impact in this segment as little change in the visual character would occur. The visual experience from the few residences, businesses, and travelers would remain similar to the current conditions.

4.10.3 Mitigation

The identification of efforts to mitigate the loss or reduction of the visual quality within the three segments would occur during the final design phase of the project. Mitigation measures may include the following:

- Allow areas disturbed during construction that are outside the clear zone to revegetate naturally.
- Design considerations for drainage structures, bridges, and other hardscape features to enhance their visual appearance
- In areas were visual impacts and noise impacts occur, and noise walls are found to be feasible and reasonable, noise walls would assist to mitigate in the visual impact by creating a barrier to the view of the F.E.E.T.

(Environmental Commitment 20)

4.11 Contaminated Properties and Structures

The project has the potential for involvement with hazardous materials at several locations.

- There was a spill involving a release of 250 gallons of diesel fuel and 25 quarts of motor oil on the highway in the vicinity of Wire Road in 1998 (NHDES Site #199810026). The spill was cleaned up and closed by the NHDES with the indication that residual contaminated soil may be encountered whenever excavation takes place to replace the bridge support structure. The soil in this area will be tested prior to construction to determine whether contaminants are present. *(Environmental Commitment 21)*
- It is possible that fill along the turnpike in Nashua may contain asbestos, and NHDOT has committed to conduct necessary subsurface investigations prior to project construction sufficient to identify and characterize asbestos in areas of proposed earthwork. NHDOT will plan for the proper handling and disposal of any contaminated materials which may be encountered during project construction. *(Environmental Commitment 22)*
- “Limited Reuse Soils” (LRS) excavated from within the operational ROW will be addressed in accordance with applicable NHDOT guidance and NHDES rules and may be subject to management through a Soils Management Plan. Roadside soils are currently managed as LRS by the Department. During final design of the project, it will be determined if LRS will be generated by the project and, if generated, if the material will require reuse on-site, disposal, and/or temporary stockpiling. Any excess materials that result from the project within the operational ROW will be addressed in accordance with applicable NHDOT guidance and NHDES rules. *(Environmental Commitment 23)*
- Asbestos occurs in some of the bridges to be replaced. The Pennichuck Brook Bridges were not found to contain asbestos, but additional sampling was recommended. Both the Baboosic Lake Road and Wire Road Bridges contain asbestos. NHDOT assumes that these bridges also contain

lead paint. During construction, these materials would be handled and disposed of in accordance with applicable laws and regulations. *(Environmental Commitment 24)*

- New Hampshire Department of Environmental Services (NHDES) has identified per- and polyfluoroalkyl substances (PFAS) as emerging contaminants and have developed Ambient Groundwater Quality Standards (AGQSs) for two PFAS compounds, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). NHDES will be setting Maximum Contaminant Levels (MCL's) for drinking water standards for PFOA, PFOS, Perfluorononanoic acid (PFNA) and Perfluorohexane sulfonic acid (PFHxS) by January 1, 2019. Groundwater that has the potential to have PFAS-impacted groundwater above AGQSs may be subject to management through a Groundwater Management Plan (GMP). *(Environmental Commitment 25)*

4.12 Energy Impacts

The proposed Build Alternative would require additional energy expenditures during construction in the form of consumable natural resources including diesel and gasoline fuels. The No-Build Alternative would not involve any additional energy expenditures. However, the existing highway infrastructure including bridges and highway pavement is deteriorating, and continued maintenance efforts would require energy-dependent work efforts over time.

The proposed project would reduce congestion and improve the flow of traffic through the project corridor. As documented in the cost-benefit analysis described in Section 4.9.3, the proposed Build Alternative would reduce vehicular energy requirements.

The additional travel lanes associated with the proposed Build Alternative would require greater energy expenditures in the future due to increases in routine maintenance activities. These fuel-requiring activities include things such as plowing, sanding, bridge and drainage maintenance, and roadway surface repairs. However, the new roadway surface would be built to improved standards, which would incorporate the latest technology and materials, and therefore require less maintenance in the future.

4.13 Indirect and Cumulative Effects

The Council on Environmental Quality (CEQ) regulations (40 CFR 1500 -1508) provide that indirect and cumulative effects must be considered in the NEPA process in addition to the direct effects. Although this project is not subject to NEPA, an effort is being made to provide an equivalent level of review. CEQ regulations (40 CFR 1508.7 and 1508.8) define direct, indirect, and cumulative effects as follows:

> **Direct effects** are caused by the action itself and occur at the same time and place (40 CFR 1508.8). The direct effects of the proposed project are detailed in the other sections of this chapter.
>
> **Indirect effects** are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use,

population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. (40 CFR 1508.8)

Cumulative effects are the impacts on the environment resulting from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions regardless of what agency, entity or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

According to FHWA's *Questions and Answers Regarding the Consideration of Indirect and Cumulative Effects in the NEPA Process*, indirect effects are caused by another action or actions that would not occur except for the implementation of a project.

Cumulative effects analysis is resource-focused, considering the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action, including the proposed project. Only cumulative effects to resources directly affected by the project are considered.

Both indirect and cumulative effects analyses consider "reasonably foreseeable" future actions and effects. According to FHWA's *Questions and Answers*, "reasonably foreseeable events, although still uncertain, must be considered probable. This means that those effects that are considered possible, but not probable, may be excluded from the analysis. There's an expectation in the CEQ guidance that judgments concerning the probability of future impacts will be informed, rather than based on speculation."

4.13.1 Indirect Effects

Screening of Activities for Consideration of Indirect Effects

The need for indirect effects analysis is determined on a case by case basis for each project and resource. As described in Sections 4.9 and 4.13 above, the F.E.E.T. widening project is unlikely to have measurable growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth. Therefore, it is assumed the project will not have indirect effects.

4.13.2 Cumulative Impacts

Selection of Resources for Cumulative Impacts Analysis

Cumulative impacts are addressed in this section for resources which may be negatively or positively affected by the project. The following resources are being considered in the cumulative impacts analysis:

- Wildlife Habitat
- Wetlands and Waterways
- Historic Resources
- Land Use

- Traffic and Transportation

General stressors affecting the above resources in the vicinity of the alternatives corridor, including past, present, and foreseeable future activities, include: increase in impervious area, tree clearing, fragmentation of the landscape, increased noise, and commercial and industrial development.

Wildlife Habitat: Paving and tree clearing would occur throughout the project corridor, primarily within the highway ROW but extending outside the ROW where detention basins are proposed. Tree clearing activities would result in the loss of approximately 47.4 acres of trees. The clearing would occur adjacent to residential and commercial development and in some undeveloped areas. In developed areas, the forested habitat is already fragmented and affected by adjacent development. Additional pavement and clearing would further reduce the quality of the habitat and its ability to support wildlife populations. In less developed areas, tree clearing would have an incremental effect on existing habitat. Further development within and around these areas would further reduce the size and quality of habitat. For most species, however, there are still broad areas of similar habitat found through much of the area.

Wetlands and Waterways: Historical impacts to the wetlands and streams in the project area are predominantly from land development and transportation infrastructure. Future foreseeable impacts to wetlands and surface waters within the project area are not quantifiable at this time but are anticipated to occur from additional development on undeveloped land, redevelopment and infill development, and transportation improvements throughout the corridor.

Future wetland and surface water impacts in the area will probably be incremental, as land is converted to residential, commercial, transportation, or other uses. Filling of wetlands, stormwater discharged into wetlands, culverting of streams for road crossings, and other impacts will likely continue to occur. The capacity for streams and wetlands to continue to perform their functions will depend both on the development pressure in the region and the regulatory environment in which development takes place.

Historic Resources: Most historic resources are located along area roadways, where the most rapid development is occurring. The cumulative impacts of historical land use changes would continue to change the setting of the historic resources. At some point these changes may cumulatively alter the setting or feeling of structures to the extent they are not eligible for the National Register. Structural modifications of historic resources will also continue. The project's contribution to cumulative impacts on historic resources is believed to be negligible, since the proposed work is very similar to existing conditions.

Land Use: As described in Section 4.9.4, the project is not expected to stimulate increased growth and development. The one large, foreseeable development proposal is in the Pettengill Road area of Londonderry. This development will proceed regardless of the turnpike widening project.

Traffic and Transportation: There are no other major transportation projects proposed along the corridor. There is regional interest in improving F.E.E.T. Exits 11 and 12, building a bypass around portions of Hudson and Nashua, and other projects, but they are not yet considered "reasonably foreseeable". The cumulative effects from these projects are likely to be positive from a transportation perspective. Based upon these considerations, no adverse cumulative impact is anticipated to occur to the transportation system in the region. The NHDOT would closely coordinate the construction of the project with other projects in the region to minimize impacts to the traveling public.

4.14 Construction Impacts

4.14.1 Effects

Impacts caused by construction activities would occur with the proposed Build Alternative. The No-Build Alternative would not result in any construction impacts. These impacts would be short-term and temporary in nature, but could potentially result in adverse effects during construction. The primary concerns include air quality, soil erosion and sediment control, traffic, and noise impacts.

Construction equipment and machinery powered by diesel and gasoline engines can emit air pollutants such as nitrogen oxides, carbon monoxide, hydrocarbons, and particulates. These emissions could potentially result in elevated ambient concentrations in the immediate vicinity of construction activity.

Particulate matter can also be emitted as dust as a result of excavating, hauling, grubbing, grading, and blasting operations. Dust emitted during construction can be minimized and controlled by wetting unpaved areas in the construction zone, covering loads on all open trucks, and seeding and revegetating all disturbed areas as soon as practicable. These methods would be implemented during construction of the Build Alternative in order to help minimize and avoid impacts.

Activities associated with the proposed construction would likely require the blasting of bedrock material in some areas requiring extensive grading. The grading would include the stripping of existing vegetation, followed by extensive excavation and filling. This construction would likely result in the complete reworking and/or removal of existing surficial and subsoils along the turnpike.

The removal of existing vegetation and the exposure of previously vegetated soils could potentially lead to erosion if not properly controlled. Increased erosion could lead to increased sedimentation in surrounding wetlands and streams. Increased runoff could also have a negative impact on water quality.

Construction activities can also result in impacts associated with elevated noise levels from construction equipment and machinery.

4.14.2 Mitigation

To mitigate potential sedimentation impacts from construction, a drainage and erosion control program, including BMPs, would be developed. The Contractor would be required to prepare a Storm Water Pollution Prevention Plan prior to the commencement of construction activities in compliance with the EPA Construction General Permit. *(Environmental Commitment 26)*

In order to reduce construction noise, contractors will be required to utilize properly maintained equipment with the appropriate emissions control measures. Where possible, proposed noise walls would be constructed as early action items within construction contracts, prior to reconstructing and widening the highway. *(Environmental Commitment 27)*

5 Comments and Coordination

This chapter describes efforts to inform, and obtain input from, the public, local officials, interested parties, and resource agencies during the preliminary design and environmental study phase of the project.

5.1 Communications Plan

A Communications Plan has been developed and is available on the project website. The project Communications Plan describes the project overall, the project development process, and communication methods. Communication methods include:

Project-specific website (see below)

Email: Certain project information will be disseminated to the stakeholders via email

Meetings (see below)

Media coverage: News releases and/or notices will be provided to the three towns, local and regional newspapers and news agencies as appropriate.

Social media: The NHDOT has a Facebook page and electronic newsletter that will be used to notify and inform the general public regarding project related information and to notify the public of upcoming meetings.

Newsletters: Project-specific newsletters will be prepared for distribution electronically and/or via the U.S. Postal Service. The newsletters will also be posted on the project website.

Mailings: The NHDOT will provide advance notice to project abutters through the U.S. Postal Service when the Public Hearing will occur. The location, time and other details of the Public Hearing will be included in the notice.

5.2 Project Website

A project-specific website was created and made publicly available in 2016 at the following url: http://everettturnpikewidening.com/. The website describes the major project elements, design considerations for each segment, the project development process, and ways for the public to provide input. It also provides contact information for the project team and access to certain project documents, including the Communications Plan. The website is updated regularly.

5.3 Local and Regional Organizations

A list of stakeholders has been developed and is used for obtaining feedback, informing them of project activities. These stakeholders are listed in the Communications Plan and include local officials, regional planning commission staff, watershed organizations, transportation organizations, and other groups.

5.4 Local Meetings

The NHDOT has held five local meetings and plans on a formal Public Hearing. The overall purpose of these meetings included:

- Introducing the project;
- Disseminating information within the three communities and provide a setting for discussion and gathering feedback that will help form the alternatives and impacts;
- Presenting and describing the potential alternatives and associated impacts of each;
- Providing adequate opportunity for public comments and public involvement throughout the multi-year process; and
- Addressing concerns of the public, officials, agencies and stakeholders.

The meetings have been open to all members of the public and have consisted of the following, in these general categories:

- Public Officials Meetings: The focus of these meetings is to engage and inform the elected officials, municipal staff, the members of the town boards within the three towns, and other interested members of the public about the details of the project. The following public officials meetings have been held to date:
    - Town of Merrimack Town Council: November 17, 2016
    - Town of Bedford Town Council: December 14, 2016
    - Nashua Regional Planning Commission and local officials: January 10, 2018
    - Town of Merrimack Director of Public Works and Town Engineer: January 9, 2018
- Public Information Meetings: The focus of these meeting was to engage and inform the general public within the three towns about the details of the project and receive feedback. These meetings were held:
    - Town of Bedford: March 29, 2018
    - City of Nashua: April 3, 2018
    - Town of Merrimack: May 1, 2018
- Public Hearing: The purpose of the Public Hearing is to inform the public of the design alternative that is recommended for construction. This hearing is a required step in the ROW acquisition process and serves to meet the requirements of the NHDOT public information process. The public hearing is scheduled for October 3, 2018 in Merrimack.

5.5 Resource Agencies

Meetings are held periodically with natural and cultural resource agencies to discuss project details relevant to their areas of expertise or regulatory jurisdiction. The purpose is to inform them of the project, and to obtain feedback regarding project impacts and permitting implications. Natural resource agencies represented at these meetings usually include ACOE, EPA, NHDES, and NHFG. Cultural resource agency meetings are typically attended by DHR representatives. Meeting minutes and certain other agency correspondence are included in Appendix B. Meetings have been held on the following dates:

- October 19, 2016 – natural resource agencies
- November 16, 2016 – natural resource agencies
- February 15, 2017 – natural resource agencies
- March 9, 2017 – cultural resource agencies
- May 17, 2017 – natural resource agencies
- June 14, 2017 – NH Fish and Game Department
- December 20, 2017 – natural resource agencies
- February 21, 2018 – natural resource agencies
- April 12, 2018 – cultural resource agencies

6 ENVIRONMENTAL COMMITMENTS

This chapter specifies the environmental commitments made in this environmental document. The section of the document in which the commitment was made is shown in parentheses after each commitment.

1. Noise abatement shall take the form of noise barriers, identified for seven locations along the corridor. (Section 4.4.2)
2. NHDOT shall review its salt application practices for continued compliance with the MS4 guidelines and will complete a Salt Reduction Plan. (Section 4.5.2.3)
3. Stormwater BMP areas shall be incorporated into the drainage design to capture and treat stormwater runoff prior to discharge. NHDOT shall continue to explore ways to bring the BMP design into compliance with MS4 guidelines. (Section 4.5.2.5)
4. During final design, floodplain and floodway impacts shall be considered and ways to minimize or mitigate impacts shall be explored, particularly at Pennichuck Brook and Patten Brook. If necessary, a new base flood elevation shall be calculated and a Letter of Map Revision prepared and submitted to FEMA. (Section 4.5.3.2)
5. Efforts shall continue to avoid or minimize direct impacts to wetlands and waterways. As impacts are refined in final design, a proposed mitigation package shall be developed through coordination with regulatory agencies, local Conservation Commissions, and other interested parties as appropriate. (Section 4.5.4.5)
6. During final design, impacts to conservation and Section 6(f) lands shall be avoided if possible. NHDOT shall coordinate with the owners of conservation lands to determine whether the proposed impacts are of concern and whether mitigation may be necessary. Mitigation measures shall be considered and implemented if appropriate. (Sections 4.6.2 and 4.6.3)
7. Both the Pennichuck and Baboosic Brook crossings shall incorporate wildlife shelves into the design of the proposed structures to facilitate wildlife passage. (Section 4.7.1.4)
8. During final design, impacts to valuable habitats including vernal pools and other high-quality wetlands shall continue to be minimized and avoided wherever feasible. (Section 4.7.1.4)
9. Wetland mitigation measures shall incorporate wildlife enhancements where appropriate. (Section 4.7.1.4)
10. Consultation with the National Marine Fisheries Service regarding essential fish habitat shall be completed. The results of that consultation, including any conservation recommendations, shall be provided in the final environmental document. (Section 4.7.2.2)
11. The Naticook Brook and Baboosic Brook structures shall incorporate substrates and slopes conducive to fish passage. (Section 4.7.2.3)
12. Surveys of rare plant species shall be conducted prior to construction in likely habitat along the project corridor to identify any potential previously unknown populations. Any identified populations shall be protected from construction to the degree possible. If populations cannot be avoided during construction, NHDOT shall coordinate with the NHNHB to relocate individuals

within the immediate vicinity, outside of the project impact area, or to one or more of the previously identified known population locations. (Sections 3.7.3.1 and 4.7.3.1)

13. Coordination with USFWS shall continue on northern long-eared bat approximately one year prior to construction to ensure compliance with applicable laws and agreements, and results from the acoustic survey shall be utilized to inform this coordination. (Section 4.7.3.2)
14. To protect rare mussels, appropriate soil erosion and sediment control practices shall be implemented during construction to minimize introduction of sediment into downstream waterways, including the Souhegan River. (Section 4.7.3.2)
15. To protect state-listed fish species, cofferdams or other standard stream diversion methods shall be utilized during construction to maintain stream flows. In addition, all replacement bridges and culverts shall be designed in accordance with USACE guidelines to maintain aquatic life passage. Further coordination with the NHFG regarding additional avoidance and minimization measures shall be conducted during the permitting process. (Section 4.7.3.2)
16. Coordination with NHFG shall occur to develop appropriate construction measures to prevent impacts to state-listed snake and turtle species. (Section 4.7.3.2)
17. All appropriate Best Management Practices shall be summarized in an Invasive Species Control and Management Plan and implemented during construction to avoid spreading invasive plants to new sites. (Section 4.7.4)
18. At the Naticook Brook I archaeological site:
    a. No ground disturbance, or even vehicular traffic, will occur west of the fill extent or in untested areas west of the known site limits and current project limits.
    b. Removal of “top soil” will include only the surface loam/A horizon, where only one non-diagnostic flake was found within the fill limits, and no vehicular traffic atop the exposed B horizon without the placement of fill or the use of matting or similar measures to prevent soil disturbance.
    c. Fencing will be placed along the known site limits and clearing limits prior to work and will be maintained in place during work to ensure no ground disturbance to the most intact portions of the site (west of the limits of fill).
    d. Non-mechanized clearing of all vegetation within the site limits and hoisting (not dragging) to remove fallen timber.
    e. Stumps may be ground but will not be excavated within the site limits.
    (Section 4.8.2)
19. Environmental Justice populations shall be sent project information, such as public meeting notices, in accordance with the project Communication Plan and all applicable laws and regulations. (Section 4.9.7)
20. Efforts to mitigate the loss or reduction of the visual quality within the three segments shall occur during the final design phase of the project. Mitigation measures may include natural revegetation, design features, or other measures. (Section 4.10.3)
21. The soil in the vicinity of Wire Road will be tested prior to construction to determine whether residual diesel fuel and motor oil from a 1998 spill are present. (Sections 3.12 and 4.11)

22. Residual contaminated soil and buried asbestos may be encountered whenever excavation takes place. NHDOT shall undertake additional subsurface investigations prior to construction sufficient to identify and characterize asbestos in areas of proposed earthwork. NHDOT will plan for the proper handling and disposal of any contaminated materials which may be encountered during project construction. (Sections 3.12 and 4.11)
23. “Limited Reuse Soils” (LRS) excavated from within the operational right-of-way must be addressed in accordance with applicable NHDES rules and/or waivers and may be subject to management through a Soils Management Plan. During final design of the project, it shall be determined if LRS will be generated by the project and, if generated, if the material will require reuse on-site, disposal, and/or temporary stockpiling. Any excess materials that result from the project within the operational right-of-way shall be addressed in accordance with applicable NHDOT guidance and NHDES rules. (Sections 3.12 and 4.11)
24. Asbestos and lead paint occur in some of the bridges to be replaced. During construction, these materials shall be handled and disposed of in accordance with applicable laws and regulations. (Sections 3.12 and 4.11)
25. PFAS-impacted groundwater that is dewatered within Project Limits shall be addressed in accordance with applicable NHDES rules and/or Groundwater Management Plans. (Section 4.11)
26. To mitigate potential sedimentation impacts from construction, a drainage and erosion control program, including BMPs, shall be developed. The Contractor shall be required to prepare a Storm Water Pollution Prevention Plan prior to the commencement of construction activities in compliance with the EPA Construction General Permit. (Section 4.14.2)
27. To reduce impacts associated with construction noise, where possible, proposed noise walls shall be constructed prior to reconstructing and widening the highway. (Section 4.14.2)