Prepared For:

City of Nashua, NH

And

East Hollis Street and Bridge Street Intersection Improvement Project

Nashua, NH

Engineering Study Report

Prepared By:

McFarland Johnson

53 Regional Drive • Concord, NH 03301

NHDOT Project No. 16314

November 2018

TABLE OF CONTENTS

Project Description

East Hollis Street and Bridge Street are both east-west arterial roadways in the City of Nashua. The two roads intersect approximately 400 feet west of the Taylor Falls Bridge and Veterans Memorial Bridge. These bridges cross over the Merrimack River and connect the City of Nashua to the Town of Hudson. These roads serve as the main route for traffic going to and from Nashua from the Route 102 and Route 111 corridors to the east. The next closest options for traffic to cross the Merrimack River are either three miles to the south or eleven miles to the north. The project limits start at the Bridge Street and Sanders Street intersection and at the East Hollis Street and C Street intersection. The project ends at the western abutments of the bridges over the Merrimack River.

The purpose of this project is to improve mobility and access for all modes of transportation while facilitating land use and not adversely affecting traffic, and to provide an aesthetically pleasing gateway into the City of Nashua with neighborhood amenities.

This intersection has been studied in the past, but those previous studies did not progress past the planning phase. The most recent planning study done by STV Incorporated in 2015 was used as a base starting point.

Existing Roadway Conditions

This section provides a summary of the existing roadways and intersections within the project limits as shown in Figure 1.

Within the project limits, Bridge Street and East Hollis Street are two-way roads at the western edge of the project and one-way at the eastern edge. The traffic on Bridge Street travels westbound from the east of the project over the Taylor Falls Bridge from the Town of Hudson. The traffic on East Hollis Street travels eastbound to the east of the project over the Veterans Bridge and into the Town of Hudson. East Hollis Street becomes Ferry Street on the bridge. In the center of the project area the two roads intersect in the shape of an “X” with a two-phase traffic signal controlling them. This intersection is used to transition the two-way roads into the one-way roads. Vehicles traveling westbound from Hudson and staying on Bridge Street use a free-flowing slip lane. Vehicles traveling eastbound on East Hollis Street going to Hudson use a free-flowing slip lane to reach the Veterans Bridge. Both roads were originally designed using a speed of 30 mph. The vertical alignments for both roads are fairly flat at the western edge of the project limits but begin to rise at a moderate rate when moving east towards the bridges. The horizontal alignments for both Bridge Street and East Hollis Street feature gradual reverse curves through the intersection.

There are no existing bicycle facilities and shoulder widths are inadequate for bicycle traffic. Sidewalks exist on the southernmost and northernmost edges of both Bridge Street and East Hollis Street. The width of the sidewalks is generally 4.5’ wide excluding the curb. There are two crosswalks within the project limits that are located at the existing traffic signal. On street parking exists only on East Hollis Street to the west of the intersection with Hobbs Avenue. There are several residential and commercial driveways along Bridge Street and East Hollis Street, with the majority located at the western side of the project. There is a temporary traffic signal at the intersection of D Street, Bridge Street, and the driveway in front of 46-50 Bridge Street. This signal was installed as part of the project that built the Riverfront Landing apartments. The signal was put in as temporary because it was known that the Bridge Street and East Hollis Street intersection would be undergoing improvements that could result in different access points. The only other way to access Riverside Landing is with the right-in/right-out on Bridge Street.

To the south of the project area is Crown Street, which runs parallel to East Hollis Street. There are several businesses and a newly built park and ride with 250 parking spaces located on Crown Street. This park and ride is where a future train station would be located if commuter rail comes to Nashua. The main ways that vehicles access Crown Street today are by taking Arlington Street, Allds Street, or Chase Street. These streets would not be able to handle the increase in traffic created by a train station.

Bridge Street and East Hollis Street are connected by three side streets. C Street is a two-way road, D Street runs one-way in the northbound direction and E Street runs one-way in the southbound direction.

Figure 1: Project Study Area

Resource Identification

Potential environmental resources located within the project area and in the general vicinity were reviewed using existing GIS data available from NH GRANIT, the City of Nashua, and additional online sources. A field review of the site was conducted on April 24, 2018 to check for the presence of jurisdictional wetland areas, delineate the ordinary high water (OHW) and top of bank of the Merrimack River, identify populations of invasive plant species within the project area, and identify any additional environmental resources or concerns located in the vicinity of the project area. Environmental and natural resource figures are included in Appendix A – Resource Figures. Figure 1 in Appendix A provides an overall project location and Figure 2 shows an aerial view of the project area.

Water Resources

Surface Waters

The Merrimack River and the Nashua River are the only surface waters in the vicinity of the project area. The Nashua River is a tributary to the Merrimack River, with the confluence located approximately 900 feet north of the project area. The Nashua River will not be impacted as a result of this project. The Merrimack River is immediately adjacent to the project area, with the levee on the western bank of the Merrimack River roughly demarcating the eastern limits of the project. As proposed, the project is not anticipated to result in any direct impacts to the Merrimack River or the levee. There is no proposed work on either of the bridges carrying Bridge Street and East Hollis Street over the river. At this location, the Merrimack is a seventh order river with a watershed size of approximately 4,000 square miles. The river provides drinking water to the City of Nashua and surrounding towns as well as downstream communities in Massachusetts, including the cities of Lowell and Lawrence. The Merrimack River also provides valuable fish and wildlife habitat and recreational opportunities.

The segment of the river in the project area is a Designated River under the NH Rivers Management and Protection Act (RSA 483) and is known as the Lower Merrimack River. The Lower Merrimack segment was designated in June 1990 and begins at the Merrimack-Bedford town line and flows south for approximately 15 miles through the communities of Merrimack, Litchfield, Hudson, and Nashua before entering Massachusetts. The Designated River Corridor is defined as the land located within 1,320 feet (1/4 mile) of the normal high water mark or the landward extent of the 100-year floodplain as designated by the Federal Emergency Management Agency (FEMA), whichever distance is greater. The proposed project is located within the Designated River Corridor of the Lower Merrimack and, therefore, coordination with the Local River Management Advisory Committee (LAC) will be required if the project requires permits from NHDES.

The NH Shoreland Water Quality Protection Act (SWQPA) (RSA 483-B) applies to fourth order and greater streams and rivers; rivers or river segments designated under RSA 483, the Rivers Management and Protection Program; lakes and ponds greater than 10 acres in size; and tidal waters subject to the ebb and flow of the tide. At the project location, the Merrimack is a seventh order river and is therefore subject to the jurisdiction of the SWQPA. The Protected Shoreland extends 250 feet from the reference line, or the ordinary high water mark. A Shoreland permit from NHDES will be required for work within 250 feet of the Merrimack River.

The US Army Corps of Engineers has determined that the navigable portion of the Merrimack River in New Hampshire extends from the Massachusetts-New Hampshire state line north to Concord, NH. There is no work proposed in the Merrimack River or on the bridges over the river. Therefore, coordination with the US Army Corps of Engineers and/or the US Coast Guard regarding navigable waterways is not required.

Impaired Waters

The Federal Water Pollution Control Act (Public Law 92-500, commonly referred to as the Clean Water Act [CWA]), as last reauthorized by the Water Quality Act of 1987, requires each state to submit two surface water quality documents to the U.S. Environmental Protection Agency (EPA) every two years. The first document is a requirement of Section 305(b) of the CWA, commonly called the "305(b) Report", that describes the quality of its surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreational activities in and on the water. The second document is a requirement of Section 303(d) of the CWA and is typically called the "303(d) List". The 303(d) List includes surface waters that are impaired or threatened by a pollutant or pollutant(s); not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources; and require development and implementation of a comprehensive water quality study called a Total Maximum Daily Load (TMDL) study, that is designed to meet water quality standards. The segment of the Merrimack River adjacent to the project area (Assessment Unit ID: NHRIV700061206-24) is listed as impaired for aluminum and pH for Aquatic Life and Chlorophyll-a for Primary Contact Recreation on the NHDES 2016 303(d) List (most recent available). A Total Maximum Daily Load (TMDL) has not been established for this segment of the Merrimack River. The proposed project is not expected to cause or contribute to surface water quality impairments.

Wetlands

A field review of the site was conducted on April 24, 2018. The ordinary high water and the top of bank of the Merrimack River were delineated (Appendix A, Figure 3). There were no additional wetland resource areas identified in the project area.

In New Hampshire, individual municipalities may elect to designate wetlands as "Prime Wetlands" pursuant to RSA 482-A. Wetlands are typically designated as Prime due to their large size, unspoiled characteristics, and ability to sustain populations of rare plant and animal species. Prime Wetlands are assigned a 100-foot Prime Wetland buffer unless the city or town chooses to waive this buffer. The City of Nashua has designated Prime Wetlands and has elected to waive the 100-foot buffer associated with these areas. Prime

Wetlands in Nashua, and in the vicinity of the project, include the Merrimack River and the Nashua River. Impacts to the bank and/or channel of the Merrimack River are not anticipated from the project.

Groundwater

The project area is located within a GA2 Groundwater Classification Area (Appendix A, Figure 4). The NH Groundwater Protection Act (RSA 485-C) enacted in 1991 establishes four classes of groundwater. 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 of 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. There are no land use restrictions or active management for GA2 Groundwater Classification Areas until the local community initiates reclassification to the GAA or GA1 class.

The project area is underlain by an aquifer with a transmissivity value of 2,000 to 4,000 feet squared per day. Aquifer transmissivity quantifies the ability of an aquifer to transmit groundwater horizontally. This aquifer is not a Sole Source Aquifer regulated by the U.S. Environmental Protection Agency, under Section 1424(e) of the Safe Drinking Water Act of 1974 (Public Law 93-523, 42 U.S.C. 300 et. seq).

There are no public water supply wells or Wellhead Protection Areas located in the vicinity of the project area. The project area is not located within a Source Water Protection Area.

Floodplains and Floodways

The most recent FEMA Flood Hazard Mapping was reviewed for the project area. Almost the entire project area is mapped as "Area with Reduced Risk Due to Levee" (Appendix A, Figure 5). The Merrimack River has a Regulatory Floodway associated with it, located near the eastern limits of the project. The proposed project is not anticipated to impact the regulatory floodway or floodplain of the Merrimack River. The project would not result in an increase in the Base Flood Elevation. There are no anticipated impacts or modifications to the existing levee.

Rare Species and Fish and Wildlife Habitat

Federally Threatened and Endangered Species

The U.S. Fish and Wildlife Service Information for Planning and Consultation (IPaC) webtool was accessed on April 9, 2018, and an Official Species List for Federally-listed species and/or their critical habitats was generated for the proposed project area. According to the Official Species List, the Federally-threatened northern long-eared bat (*Myotis septentrionalis*) (NLEB) could potentially occur within the project area.

This species has the potential to occur throughout New Hampshire. According to the US Fish & Wildlife Service, 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. Bridges and other structures can also provide suitable roosting habitat. This species overwinters in hibernacula such as caves. The majority of the project area consists of cleared land, currently in urban/transportation land uses. There is no suitable habitat for NLEB located within the project area. There is no proposed work on the bridges over the Merrimack River. Therefore, the proposed project is not anticipated to have any effect on Federally-listed species or critical habitats.

State Rare, Threatened, and Endangered Species and Exemplary Natural Communities
The project was submitted to the NH Natural Heritage Bureau (NHB) via their online DataCheck Tool. NHB reviewed the project area for the possible presence of state-listed rare species and exemplary natural communities. According to the NHB response issued on April 16, 2018, "It was determined that, although there was a NHB record (e.g., rare wildlife, plant, and/or natural community) present in the vicinity, we do not expect that it will be impacted by the proposed project." Based on NH NHB's review, there are no anticipated impacts to any state-listed rare species or exemplary natural communities.

Essential Fish Habitat
The Merrimack River is designated Essential Fish Habitat (EFH) for all life cycle stages of Atlantic Salmon (*Salmo salar*). There is no in-water work proposed in the Merrimack River and therefore an EFH Assessment is not required.

New Hampshire Wildlife Action Plan
Wildlife habitat in New Hampshire has been mapped in the 2015 NH Wildlife Action Plan. Habitat that exists in the best ecological condition has been classified as Highest Ranked Wildlife Habitat in the State, Biological Region, and Supporting Landscapes. There are no Highest Ranked Wildlife Habitats or Supporting Landscapes located within the proposed project area. The project area consists of developed, urban land and provides minimal, relatively low-quality habitat.

Public and Conserved Lands

The NH GRANIT Conservation/Public Lands GIS data layer was reviewed to determine if any of these resources are located in the vicinity of the project area (Appendix A, Figure 6). Merrill Park in Hudson, NH is located approximately 650 feet southeast of the project area, on the opposite (east) side of the Merrimack River. This area is a 9.3-acre Town of Hudson owned park, located on the east side of the Merrimack River, offering birdwatching, canoeing, kayaking, photography, and picnicking opportunities. Given the distance from the project area, impacts to Merrill Park are not anticipated.

City of Nashua GIS data layers for City Owned Land, City Parks, and Conservation Easements were also reviewed. The City of Nashua's City Parks GIS data layer shows David Dean Skateboard Park located northeast of the Bridge Street and Bancroft Street intersection. However, a field visit confirmed that this facility has been demolished and there is now an active construction site for a large residential housing development project in its place. The City of Nashua owns a parcel of land north of the project area, along the Merrimack River and Bridge Street, that has been designated as open space and is the site of an existing detention basin. There are two City owned parcels of vacant land located at the northwestern and southeastern corners of the project area.

Responses were solicitated from the New Hampshire Land Conservation Investment Program (LCIP) and Land and Community Heritage Investment Program (LCHIP) regarding the proposed project. There are no LCIP or LCHIP properties or concerns in the project area.

Section 4(f) Resources (Parks and Historic Properties)
There are no parks, recreation areas, or waterfowl and wildlife refuges in the vicinity of the project area. Coordination with NHDHR will continue in order to determine the presence of any historic properties in the project area. As a federally funded transportation project, any impacts to historic sites will need to be assessed under Section 4(f) of the US DOT Act. Section 4(f) requirements will be carried out in the next phase of the project.

Section 6(f) Lands (Land and Water Conservation Fund Lands)
The New Hampshire Department of Natural and Cultural Resources Division of Parks and Recreation staff reviewed the proposed project and determined there would not be any impacts to any properties funded through the Land and Water Conservation Fund (LWCF) State and Local Assistance Program.

Historic Resources

The proposed project area was evaluated for the presence of potentially historic resources and a Request for Project Review (RPR) was submitted to the New Hampshire Division of Historical Resources (NHDHR) on October 10, 2018. NHDHR reviewed the proposed project and has determined that the area is considered to be archaeologically sensitive. They also requested further consultation to determine the impacts and scope of the above-ground inventory. The project was presented at the NHDOT Cultural Resource Agency Meeting on November 8, 2018, where it was determined that a Phase IA/IB archaeological survey would be required. It was also determined that a District Area Form would need to be prepared as well as Individual Inventory Forms once impacts to individual properties are determined. Coordination with NHDHR will continue as the project progresses.

Soils & Farmland

Soils in the project area have been previously disturbed from previous construction and development. The majority of the project area is underlain by soils identified as Urban Land (Ur) by NRCS Soil Survey Maps (Appendix A, Figure 7). There is a narrow strip of land directly adjacent to the Merrimack River that is mapped as Occum fine sandy loam, high bottom (Om). This soil series is classified as prime farmland if protected from flooding or not frequently flooded during the growing season.

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 are also considered.

The FPPA excludes farmland soils that are within areas identified as urbanized areas on Census Bureau Maps. According to the 2010 U.S. Census, the entire project area is located within the Nashua, NH—MA Urbanized Area. Therefore, the project is exempt from the Farmland Protection Policy Act. There is no active agriculture in the vicinity of the project.

Invasive Species

Invasive plant species in the project area were identified during a field visit conducted on April 24, 2018 (Appendix A, Figure 8). An invasive plant is a non-native plant that can 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. 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 to their ability to spread from stem or root fragments.

Japanese knotweed (*Reynoutria japonica*), a Type II species, was identified at three locations in the project area. The first location is just south of the westbound barrel of Bridge Street, just west of the levee along the Merrimack River. There is a second population of Japanese knotweed along the westbound barrel of Bridge Street, approximately 125 feet west of the first population. Both of these occur along the roadway bank right up to the guardrail. There is a third population of Japanese knotweed along E Street between 9 E Street and 59-61 Bridge Street. This area is a small vacant lot behind the existing edge of the sidewalk.

Additional invasive species were identified growing along the bank of the Merrimack River. Species in this area included Japanese knotweed, Morrow's honeysuckle (*Lonicera morrowii*), tree-of-heaven (*Ailanthus altissima*), and burning bush (*Euonymus alatus*). All of these are Type I species, with the exception of Japanese knotweed. However, this area is not expected to be impacted by the project.

Hazardous Materials

The project area was reviewed for known and potential environmental contamination and hazardous materials. The area has a long history of commercial and residential land use. Much of the commercial development in this area was a result of the proximity to the nearby rail lines. There are several existing and historic auto repair facilities and filling stations located in the vicinity of the project. The Johns Manville Corporation was a large manufacturer of asbestos containing material (ACM). Through the late 1970s, the Johns Manville Corporation provided asbestos waste from its manufacturing process as “clean fill” to property owners. Construction on the existing intersection was conducted between 1974-1977. Therefore, the potential exists for existing fill to contain ACM. There are 12 NH DES Asbestos Disposal Sites (ADSs) located within 500 feet of the project area. Six (6) of these ADSs are located either within or directly adjacent to the project area. Table 1 provides a summary of the ADSs located in the vicinity of the project.

Table 1. Asbestos Disposal Sites (ADSs) Located within 500’ of Project

DESID	SITE_NAME	ADDRESS	Approximate Distance from Project Area
17519	55, 59 & 65 CROWN ST (FORMER ADS 196)	55 59 & 65 CROWN ST	390’
17520	75 CROWN STREET (FORMER ADS 197)	75 CROWN ST	130’
17571	10 SANDERS STREET	10 SANDERS ST	470’
17573	WBMR/NORTH OF BRIDGE ST (FORMER ADS 241)	W. BANK OF M. RIVER/ BRIDGE ST	0’
17746	EAST HOLLIS STREET (FORMER ADS 199)	E HOLLIS ST	0’
17748	120 EAST HOLLIS STREET (FORMER ADS 239)	120 E HOLLIS ST	45’
17771	41 - 43 BRIDGE STREET (ADS #)	41 - 43 BRIDGE STREET	180’
17772	FMR MANVILLE MFG PLANT (FMR ADS 238)	40 BRIDGE ST	0’
17773	WBMR/PARALLEL TO RIVER (FORMER ADS 200)	WBMR/PARALLEL TO RIV	0’
17774	LOCK STREET SUBSTATION (FORMER ADS 401)	TAX MAP 41-10	475’
17796	MAINE MANUFACTURING (MAMACO) (ADS 236A)	46 BRIDGE STREET	0’
17824	177 EAST HOLLIS STREET (ADS #)	177 EAST HOLLIS STREET	5’

According to NHDES files, chlorinated volatile organic compounds (CVOCs) have been identified at concentrations exceeding the ambient groundwater quality standards in the groundwater in the vicinity of the project area. There is potential that groundwater in the project area may be impacted with CVOCs. Groundwater in the project area is located at a depth of approximately 20 feet. Groundwater is not expected to be encountered during construction.

Given the past land uses, there is potential for hazardous materials and/or petroleumrelated impacts to soil and groundwater within the project area including:

- Possible ACM in soils related to the Johns Manville Corporation, and known ADSs located within and adjacent to the project area;
- Potential soil impacts related to historical operations of gasoline service stations and auto repair facilities located within and adjacent to the project area; and
- Potential groundwater impacts related to (1) an off-site CVOC plume that has been previously identified at parcels adjacent to the project area, and/or (2) releases of hazardous materials or oil that may have occurred from the historical operation of gasoline service stations and auto repair facilities.

See Appendix F for more details. Subsurface explorations will be carried out during the next phase of the project to evaluate if ACM exists in soils that will be disturbed during construction.

Air Quality

The Clean Air Act Amendments of 1990 (CAAA) requires federal actions to be consistent with the State Implementation Plan for achieving and maintaining Federal air quality standards. Transportation conformity must be shown at both a regional and project level.

The project is located in a Carbon Monoxide (CO) maintenance area. Moreover, this project is listed in the Statewide Transportation Improvement Program (STIP) but not as a regionally significant project. In accordance with 40 CFR 93, the FHWA includes a finding of regional transportation conformity through the STIP. For these reasons, a regional analysis of the proposed project is not required.

Project-level conformity must demonstrate that a project will not violate National Ambient Air Quality Standards (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 is typically completed to determine pollutant concentrations. This analysis generally focuses on carbon monoxide (CO) and particulate matter (PM), the constituents that can be addressed at the project level. Under the CAAA, this analysis is typically only required for projects that are located in a nonattainment or maintenance area.

The National Environmental Policy Act (NEPA) also requires federal actions to consider project-level impacts on air quality regardless of location. 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.

Because this project is located in a CO maintenance area, and because the proposed intersection improvements involve new traffic signals, a quantitative microscale analysis for CO and PM will be required to assess the project's impact on local pollutant concentrations. This analysis will be carried out during preliminary design and the results will be coordinated with the NHDOT Air and Noise Program and FHWA. As proposed, the project is expected to have low potential MSAT effects and will require only a qualitative assessment of MSAT emissions during preliminary design.

<u>Noise</u>

The NH Department of Transportation's *Policy and Procedural Guidelines for the Assessment and Abatement of Highway Traffic Noise for Type I and II Highway Projects* (November 2016) defines a Type I Project as a highway project which involves:

(1) The Construction of a highway on a new location; or
(2) The Physical alteration of an existing highway where there is either:
    (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or
    (ii) Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or
(3) The addition of one or more through-traffic lane(s). This includes the addition of a through traffic lane that functions as an HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or
(4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or
(5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or
(6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or
(7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.
(8) If a project is determined to a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

The proposed alignment does not result in a substantial horizontal or vertical alteration, and additional lanes being added consist of turn lanes, not through-traffic lanes. Therefore, the proposed intersection improvement project does not meet any of the above criteria for a Type I highway project. The NHDOT Air and Noise Program Manager has concurred with this finding. Since the proposed project is not a Type I project, further noise analysis including a noise impact study and abatement assessment will not be required.

Socio-economic Composition & Environmental Justice

Executive Orders 12898 and 13166, signed in 1994 and 2000 respectively, require that an Environmental Justice (EJ) evaluation be conducted for all transportation projects that are undertaken, funded, or approved by the Federal Highway Administration to avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, and social and economic effects on minority populations and low income populations.

The US Department of Transportation has adopted the following EJ principles:

1. To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
2. To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
3. To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

The project area was reviewed using the U.S. Environmental Protection Agency's Environmental Justice Screening and Mapping Tool (Version 2017). The project area is divided into two census block groups. Table 2 summarizes the environmental justice population data for the project area.

Table 2. Environmental Justice Population Percentile Data

EJ Criteria	Census Block Group 330110106004 State Percentile	Census Block Group 330110106001 State Percentile	City of Nashua State Percentile	Hillsborough County State Percentile
Minority Population	98%	94%	93%	81%
Low Income Population	97%	79%	67%	56%
Linguistically Isolated	88%	94%	90%	85%
Over Age 64	17%	61%	44%	45%

The proposed project involves reconfiguring and reconstructing an intersection and associated roadways in order to improve access and mobility for all modes of transportation including vehicular, pedestrian, and bike traffic. Public meetings for this project were noticed in a variety of ways in advance of the meetings, and meetings were located in accessible buildings.

Traffic Evaluation

A comprehensive traffic analysis was performed along both Bridge Street and East Hollis Street at the existing intersections to evaluate the existing and future traffic operations under several alternative design scenarios. The first step in the traffic analysis was the collection of existing traffic volume data. Turning Movement Counts (TMC) and vehicle classification counts were performed during the weekday AM peak hours (6-9AM) and weekday PM peak hours (3-6PM) on Tuesday, April 10, 2018.

Automatic Traffic Recorder (ATR) counts were collected for three days (April 10-12, 2018) along Bridge Street on Taylor Falls Bridge Eastbound to determine daily traffic volumes along the roadway.

Evaluation of the peak period traffic counts indicate that the weekday AM peak hour occurs generally occurs between 7:15-8:15 and the weekday PM peak hour occurs between 4:45-5:45. All count data are included in Appendix B.

Generally, the designated design hour is the 30th highest volume for the year at a given intersection. NHDOT collects statewide data and publishes seasonal adjustment factors to convert data collected during any time of the year to these designated design hour volumes. There was a permanent count station located at Taylor Falls Bridge up until 2016, but it is not included in NHDOT's Seasonal Data Report. Therefore, it was necessary to utilize data from the 2016 Group 4 Averages for Urban Highways to determine a peak month condition.[1] The 2016 data was used because the 2017 data was not available at the time the analysis was performed for this project.

The base 2018 traffic volumes need to be adjusted to represent an opening year of 2019 and then estimated for the design year, which for this project is 2039. A review of the historical traffic data from the local permanent count station for the last ten years reveals a decline of -1.2%.

Understanding that traffic volumes are likely to increase in the future, the Nashua Regional Planning Commission (NRPC) was contacted to discuss historical growth in this area considering this count station in particular and the region in general. The discussion focused on how NHDOT has seen a general reduction in growth rates across the state; sometimes these rates are negative as indicated by the ten-year count data from Taylor Falls Bridge. However, the NHDOT policy for design projects is to utilize a minimum growth rate of 1% to allow for some growth along the corridor to provide a conservative analysis that does not over exaggerate the future volumes. The NRPC agreed that a 1% per year growth rate should be used in this area to account for some future growth as it was unrealistic to assume that a decline would continue into the future. Therefore the 1% per year growth rate was applied to the volumes along Bridge Street and East Hollis Street.

[1] *Seasonal Adjustment Factors – Group 4 Averages*, NHDOT 2016

In addition to historical background growth, the City of Nashua indicated that there is additional potential growth within the project area to the north and south along Bancroft Street and Crown Street. Working with city staff and the NRPC, additional traffic volumes for a full build out scenario of these areas were developed based on a mixture of residential, commercial and office space.

These historic and future development growth rates were applied to the 2018 base year volumes to obtain the 2019 opening year and 2039 design year volumes. The AM and PM peak hour volumes for the 2019 opening year and 2039 year are shown in Appendix B.

Crash History

Crash history for the most recent five-year period between 2012 and 2016 was collected from the NH Department of Transportation along Bridge Street, East Hollis Street, and for all of the intersections within the project limits. The data shows that there are approximately 10 to 20 crashes in this area per year. These crashes are spread out on both Bridge Street and East Hollis Street. There does not appear to be any higher density of crashes at any particular locations. The main contributing factors for crashes appear to be driver inattention, failure to yield, and following too close based on limited crash documentation.

The crash documentation is inconclusive as it does not have enough data to determine a cause of the crashes or to determine if there are any trends at a particular location that might be indicative of a problem that is correctable. See Appendix C for the Crash History.

Capacity Analysis Methodology

Capacity analysis is used to assign levels of service to traffic facilities under various traffic conditions. The capacity analysis methodology is based on the concepts and procedures outlined in the HCM[2].

Intersection Capacity – Unsignalized Intersections

Level of service (LOS) is a term used to characterize the operational conditions of a traffic facility and their perception by motorist and/or passengers at a particular point in time. Numerous factors contribute to a facility's LOS index including travel delay and speed, congestion, driver discomfort, convenience, and safety based on a comparison of the facility's capacity to the facility's demand. The alphabetic designations A through F define the six levels of service. LOS A represents very good traffic operating conditions with minimal delays while LOS F depicts poor traffic operating conditions with excessive delays and queues that are unacceptable to most motorists.

[2] Highway Capacity Manual 6th Edition, Transportation Research Board, Washington DC 2016.

Operating levels of service are calculated using the procedures defined in the HCM. The operating LOS of two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections is the computed or measured control delay. The intersection delay is based upon the quality of service for the vehicles turning into and out of minor approaches, i.e.; approaches that are stop controlled. The availability of sufficient gaps in the traffic stream on the major street controls the capacity for movements to and from the minor approaches, thus resulting in delay for the minor approaches. The criteria, i.e., the delays associated with corresponding levels of service for TWSC and AWSC intersections, as specified by the HCM and are shown in Table 3 below.

Table 3 - Unsignalized Intersection Level of Service Criteria

Level of Service	Control Delay (sec/veh) TWSC and AWSC Intersections
A	< 10
B	> 10 and < 15
C	> 15 and < 25
D	> 25 and < 35
E	> 35 and < 50
F	> 50

Intersection Capacity – Signalized Intersections

The operating LOS of a signalized intersection is based on the average control delay per vehicle. The control delay per vehicle is estimated for each lane group, combined for each approach and the intersection as a whole. The criteria, i.e., the delays associated with corresponding levels of service for signalized intersections, as specified by the HCM are shown in Table 4.

Table 4 - Signalized Intersection Level of Service Criteria

Level of Service	Control Delay (sec/veh) Signalized Intersections
A	< 10
B	> 10 and < 20
C	> 20 and < 35
D	> 35 and < 55
E	> 55 and < 80
F	> 80

For this project, Synchro version 10 was used to model the signalized intersections.

Public Involvement

A fundamental aspect of the design process for any project is to develop an alternative that meets the needs of the community and will be supported by the public. The best way to gain this support is to engage the public early in the process of developing alternatives. The public involvement process is as much about informing the designers of the needs of the community, as it is about involving the public in the design process.

Steering Committee

The City of Nashua created a Project Steering Committee comprised of residents, business owners, SMC Management, MakeIt Labs, the Town of Hudson, and a number of representatives from the City of Nashua. The purpose of the steering committee was to work collaboratively with the design team throughout the project to broadly represent the community and stakeholders. The Steering Committee met five times during the conceptual design phase of the project and many members attended the Public Listening Session discussed below. Prior to the fourth Steering Committee meeting, a meeting was held with The Mayor and other City of Nashua staff to ensure that the alternatives being developed met the Purpose and Need statement. The Steering Committee members included the following individuals:

- Janet Graziano, City of Nashua, Financial Manager
- James Vayo, City of Nashua, Downtown Specialist
- June Caron, City of Nashua, Ward 7 Alderman
- Peter Kohalmi, City of Nashua, Deputy City Engineer
- Sarah Marchant, City of Nashua, Director Community Development
- Julie Chizmas, City of Nashua, Transportation Planner
- W. Husband, City of Nashua, Senior Traffic Engineer
- T. Cummings, City of Nashua, Director of Economic Development
- Adam Shrey, MakeIt Labs, President
- Shauna Riley, SMC Management
- Bob Simonds, SMC Management
- Elvis Dhima, Town of Hudson, Town Engineer
- Steve Malizia, Town of Hudson, Town Administrator
- Steve Bonnette, Area Property Owner
- Peter Schaefer, Area Resident

Public Listening Session

The first public meeting for this project consisted of a Public Listening Session held on April 4, 2018 at City Hall in Nashua, NH. The consultant team gave a brief overview of the project, but quickly broke into a public discussion about the project. For the public discussion, members of the audience were asked to answer three specific questions:

- What are the problems/challenges of the intersection?
- What are the opportunities for the area?
- What does a gateway look like to you?

The audience then presented their answers and there was a vigorous exchange of information, ideas, challenges, and opportunities. A summary of the Public Listening Session is included in Appendix H. The information from the Public Listening Session was used by the consultants to develop a Project Purpose and Need statement for the Steering Committee to consider. The Purpose and Need Statement is the basis for determining why the project is being undertaken and whether the proposed solutions actually address the needs. The Purpose and Need Statement is shown on the next page.

Project Purpose and Need

Purpose

The purpose of this project is to 1) improve mobility and access for all modes of transportation while facilitating land use and not adversely affecting traffic at this vital link between the City of Nashua's downtown core and communities to the east and 2) provide an aesthetically pleasing gateway with neighborhood amenities into the City of Nashua.

Need

The economic development of this area of Nashua relies on the transportation system to provide a link for all modes of transportation between Crown Street and the development currently under construction north of Bridge Street. Current traffic conditions consist of daily congestion during the morning and evening peak hours, causing excessive queues and delays. This area also lacks accommodations for bicycles and pedestrians.

Improve access between Crown Street and Bridge Street:

- The merging of vehicles creates a safety issue on East Hollis Street heading into Nashua and on the Ferry Street bridge.
- The high vehicular traffic volumes and lack of bike lanes create safety concerns for bicyclists.
- The lack of pedestrian accommodations makes it unsafe to walk from East Hollis Street to Bridge Street.

Provide an aesthetically pleasing gateway with neighborhood amenities:

- The project site is a major entrance into the City of Nashua and the existing aesthetics of the area do not provide a welcoming gateway that defines the City's boundary.
- The neighborhood does not have any existing amenities for recreational activities.

Subsequent to the Public Listening Session, the consultant team prepared conceptual alternatives of improvements for the corridor including the traffic analysis of the proposed improvements and potential landscape improvements. These alternatives were presented to the public at the Nashua Gateway Options Workshop held on August 15, 2018 at Dr. Crisp Elementary School in Nashua, NH.

Figure 2: Project Website

Project Website

To ensure all project information was available to the Steering Committee and public, a project website was created. The website, www.nashuagatewayproject.com, contains meeting minutes, meeting presentations, project plans, a comment area, and a sign up for a project e-newsletter. Figure 2 is the home page of the website.

Alternatives Development

The intent of the alternatives development process is to identify any and all reasonable alternatives for achieving the goals established in the Project Purpose and Need. For this project the issues of balancing the traffic demands along the corridor with providing access to the adjacent developments while also providing improvements to the safety of all users including pedestrian, bicycles, and vehicles were paramount. Currently the corridor lacks bicycle lanes or wide shoulders and the pedestrian crossings at the intersections are not ADA compliant. Providing improvements for pedestrians and bicycles to increase their safety and promote more use is a key component of this project.

There is significant traffic volume at the Bridge Street and East Hollis intersection during both the AM and PM peak hour. Under the existing conditions the intersection operates at a reasonable LOS with moderate delays. The westbound movement from Hudson to Bridge Street and the eastbound movement from East Hollis Street to Hudson see no delay as they are not under signal or sign control. Occasionally the eastbound lanes on the bridge will back up, but this is due to the signals in Hudson spilling back into the bridge.

Several of the public comments indicated that the majority of the traffic operational issues at this intersection are observed during the peak hours.

MJ developed three alternatives for the corridor; a one-traffic signal alternative, a four-traffic signal alternative and a two-traffic signal alternative, and compared each to the No-Build alternative. There were four figures developed for each alternative (Appendix D). The first was a color plan of the intersection that would be constructed as part of this project. The second was a color plan of what the intersection could look like with a connection to Crown Street. The third was a plan of what landscaping components could be built under this contract. The final was a plan of what the City of Nashua could build with funding outside of this project.

Roundabouts were investigated, but it was determined that they would not function properly for this intersection. The traffic flows from Hudson in the morning and Bridge Street in the afternoon made it difficult for vehicles from other roads to enter the roundabout. This created queue lengths that were unacceptable. There was also a chance that traffic could back up from Hudson causing the roundabout to lock up. A metered roundabout resulted in the same issues.

A description of the three alternatives developed is outlined below:

Alternative 1 – One-Traffic Signal Alternative

This alternative would involve maintaining the existing signalized intersection of Bridge Street and East Hollis Street, the right-in/right-out access at Riverfront Landing, and the existing access at Crown Street with the potential for a future reconfigured right-in/right-out only access for Crown Street. In addition, this alternative would maintain the existing traffic signal at the intersection of Bridge Street and D Street. The traffic analysis for this alternative indicates that the Bridge Street and East Hollis signalized intersection would operate as follows:

- LOS D during the 2039 AM peak hour
- LOS E during the 2039 PM peak hour

The existing queues on the eastbound and westbound approaches will continue to grow and could potentially impact the operations of the free flow operation of the westbound movement from Hudson and the eastbound movement into Hudson. Table 5 below shows the operations of this alternative. This alternative will function the same as the No-Build alternative from a traffic capacity perspective. The traffic analysis for the No-Build Alternative can be found in Appendix B.

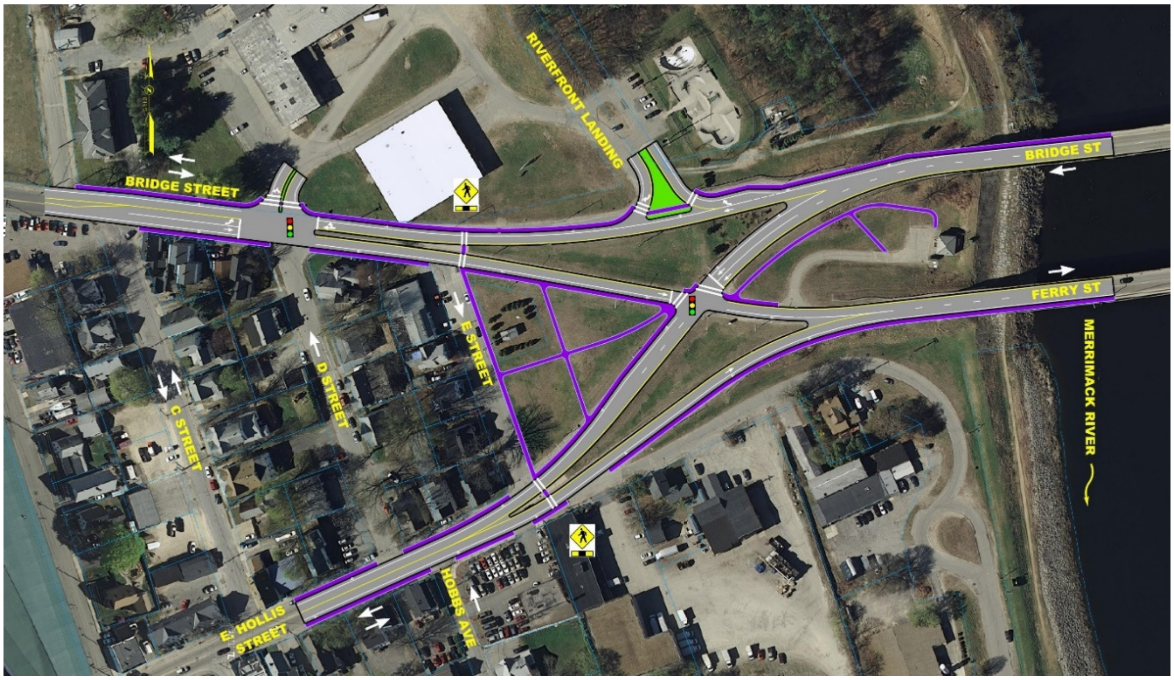

Figure 3: Alternative 1 – One-Traffic Signal

The advantage of this alternative is that it would provide improved pedestrian and bicycle accommodations throughout the corridor, especially at the signalized intersection where ADA compliant equipment will be provided, with the crossings of Bridge Street and East Hollis Street controlled with rectangular rapid flashing beacons (RRFB)s. Bridge Street and East Hollis Street will both have a shoulder wide enough for bicyclists. This alternative will have the least impact on existing and future traffic operations throughout the corridor.

The main disadvantage of this alternative is that it will limit access to Bancroft Street and the Crown Street area to right-in/right-out. This may limit future development, as traffic from continued use of D Street to access Riverfront Landing development in these areas will need to travel through other local roads that have existing operational difficulties. In addition, emergency vehicles must use side streets to travel between Bridge Street and East Hollis Street. Other disadvantages include the greenspace and the merging/weaving areas. The greenspace of this alternative will be separated into four areas. Only two of these areas will be large enough for people to use. The two small ones will only have room for plantings. The existing merge from Bridge Street to East Hollis Street will not be improved and traffic will continue to weave on Ferry Street at the bridge.

Table 5 - Capacity Analysis Summary– 2039 Conditions Alternative 1

Intersection/ Lane Group	2039 No-Build Alternative v/c[a]	Delay[b]	LOS[c]	Queue[d]
Bridge Street at East Hollis Street				
Weekday AM:				
Bridge St. EB thru	0.92	43.0	D	381/614
Bridge St. SWB thru	0.90	32.9	C	371/515
Overall Intersection		**36.4**	**D**	
Weekday PM:				
Bridge St. EB thru	1.05	86.3	F	1018/1278
Bridge St. SWB thru	0.90	52.4	D	356/441
Over all Intersection		**71.4**	**E**	
Bridge Street at D Street				
Weekday AM:				
Bridge St. EB thru	0.57	6.2	A	122/231
Bridge St. SE left-turn	0.22	50.9	D	12/39
Bridge St. WB thru/right	0.96	30.4	C	455/1229
D St. NB thru/left	0.14	43.3	D	11/36
D St. NB right-turn	0.12	1.2	A	0/0
Driveway SB left-turn	0.29	48.2	D	18/50
Driveway SB right-turn	0.12	1.2	A	0/0
Overall Intersection		**22.4**	**C**	
Weekday PM:				
Bridge St. EB thru	0.98	38.3	D	848/1323
Bridge St. SE left-turn	0.22	65.6	E	17/45
Bridge St. WB thru/right	0.71	19.9	B	459/685
D St. NB thru/left	0.22	65.6	E	18/46
D St. NB right-turn	0.01	0.0	A	0/0
Driveway SB left-turn	0.43	93.2	F	20/52
Driveway SB right-turn	0.12	1.0	A	0/0
Overall Intersection		**31.2**	**C**	

[a] Volume-to-capacity ratio [b] Average control delay in seconds per vehicle [c] Level of Service
[d] Maximum queue length in feet per lane during Avg/95th percentile cycle (assuming 25 feet per vehicle)

Alternative 2 – Four Signal Option

This alternative would involve realigning the intersection of Bridge Street and East Hollis Street to create two connector roads between the two east-west roadways. New signalized intersections would be at the junction points of these connector roads with Bridge Street and East Hollis Street. One connector road would be located east of E street and the other would be aligned with Bancroft Street and the future Crown Street connection. The proposed signal at the intersection of East Hollis Street and the future Crown Street connection would not need to be installed until the Crown Street connection is constructed. The intent of this option is to create a counterclockwise cyclical flow around the central green space created by Bridge Street, East Hollis Street and the two connector roads. This queues vehicles on the outside of the system thus minimizing queue spillback between signals. All signals in this system will be coordinated and it is recommended that adaptive signal technology be implemented to maximize the operational effectiveness of the available green time and flexibility of the system to the extent practical. This alternative allows for full access to Bancroft Street and the future Crown Street connection.

This alternative would remove the existing signal at the intersection of Bridge Street and D Street. It would include bicycle accommodations, sidewalks and crosswalks with ADA compliant signal equipment to allow all users full access to the project area. This alternative was analyzed without an exclusive pedestrian phase to model anticipated operating conditions for the majority of the peak hour. However, it should be noted that when the exclusive pedestrian phase is activated at the intersections, it increases the overall delay as all vehicles must wait for pedestrians to cross. The signals will be designed assuming that they would operate with a Concurrent Pedestrian phasing where feasible where the pedestrians get a “Walk” indication at the same time the adjacent vehicle traffic has a green light to limit the amount of delay to other vehicles not affected by the “Walk” phase. Table 6 below shows the operations of Alternative 2. The traffic analysis for Alternative 2 can be found in Appendix B.

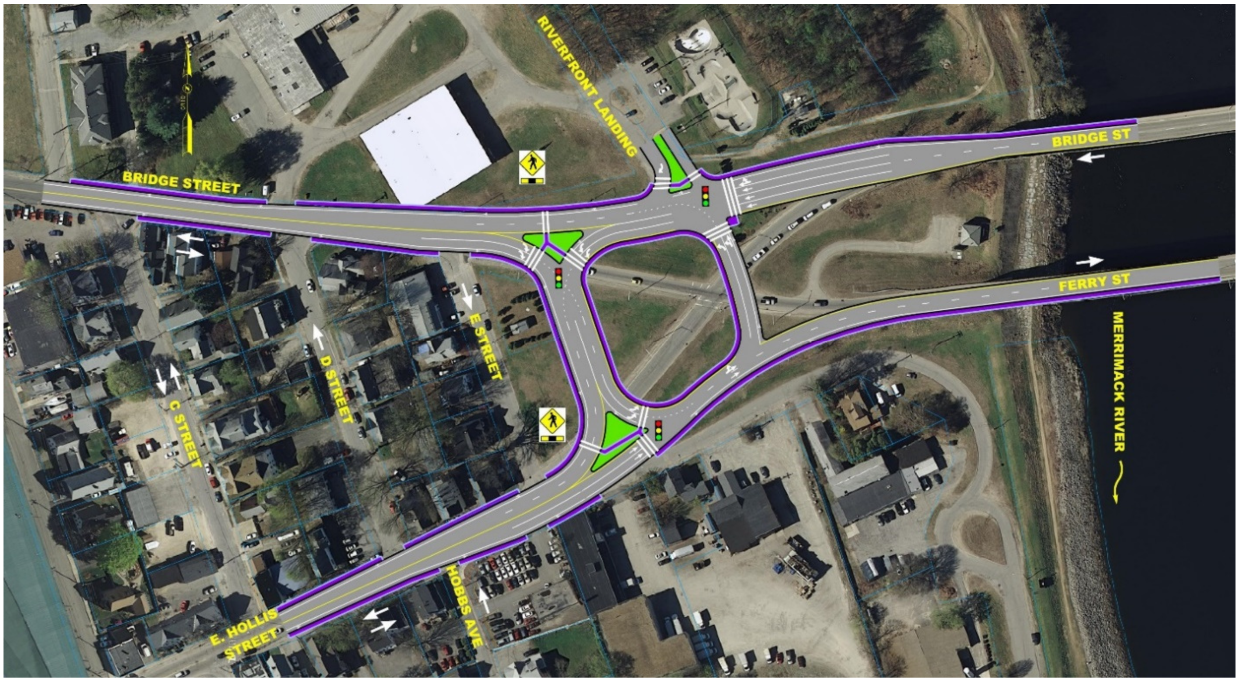

Figure 4: Alternative 2 – Four Signal Option

The advantages of this alternative are the provided signalized crosswalks with protected pedestrian phases at all intersections and bicycle shoulders through the entire project area. This alternative would require two RRFBs. One would be on Bridge Street and the other on East Hollis Street. The alternative also provides full access to both Bancroft Street and a future Crown Street connection for existing and future development and eliminates the existing signal at D Street. In addition, Emergency Vehicles can use the new signals to travel between Bridge Street and East Hollis Street. The safety of the merge for vehicles coming from Bridge Street to East Hollis Street would be improved as the speed of traffic would be slowed down. The weaving on Ferry Street at the bridge would be eliminated as vehicles would be able to pick what lane to be in at the proposed signals.

The disadvantage of this alternative is that some of the vehicle movements will need to travel through multiple traffic signals and will see increased delay over existing conditions. This delay would be most noticeable for traffic coming from Hudson to Bridge Street and from East Hollis Street to Hudson since these are unsignalized under the existing conditions. Even with this new delay, the overall queue lengths will not increase for the intersection.

The landscaping of this alternative would be both an advantage and a disadvantage. The advantage is that there would be two large greenspace areas and one small one located next to E Street. This means that several amenities could be constructed in the center island area. The disadvantage is that the center area is surrounded by roadway. This means pedestrians have to cross at least four lanes of traffic to get to it.

Table 6 - Capacity Analysis Summary – 2039 Conditions Alternative 2

Intersection/ Lane Group	2039 Alternative 2 v/c[a]	Delay[b]	LOS[c]	Queue[d]
Crown Street at East Hollis Street				
Weekday AM:				
East Hollis St. EB thru/left/right	0.78	10.2	B	194/426
Crown St NB thru/right	0.75	35.6	D	108/181
Overall Intersection		**14.0**	**B**	
Weekday PM:				
East Hollis St. EB thru/left/right	1.10	62.9	E	1312/1444
Crown St NB thru/right	1.06	117.0	F	246/427
Overall Intersection		**68.0**	**E**	
East Hollis Street at Connector Road				
Weekday AM:				
East Hollis St. EB thru	0.55	16.0	B	138/190
Conn. Rd. SB left-turn	0.57	5.0	A	0/0
Conn. Rd SB right-turn	0.54	3.6	A	63/177
Overall Intersection		**7.3**	**A**	
Weekday PM:				
East Hollis St. EB thru	0.91	38.2	D	561/686
Conn. Rd. SB left-turn	0.91	64.9	E	350/360
Conn. Rd SB right-turn	0.39	3.6	A	83/75
Overall Intersection		**37.8**	**D**	
Bridge Street at Connector Road				
Weekday AM:				
Bridge St. EB right turn	0.89	35.3	D	173/284
Bridge St. WB left-turn	0.84	8.8	A	25/36
Bridge St. WB thru	0.44	0.3	A	0/0
Overall Intersection		**11.0**	**B**	
Weekday PM:				
Bridge St. EB right turn	0.92	37.7	D	494/646
Bridge St. WB left-turn	0.78	27.7	C	364/199
Bridge St. WB thru	0.29	0.2	A	0/0
Overall Intersection		**25.4**	**C**	

[a] Volume-to-capacity ratio [b] Average control delay in seconds per vehicle [c] Level of Service
[d] Maximum queue length in feet per lane during Avg/95th percentile cycle (assuming 25 feet per vehicle)

Table 6 (cont.) - Capacity Analysis Summary – 2039 Conditions Alternative 2

Intersection/ Lane Group	2039 Alternative 2 v/c[a]	Delay[b]	LOS[c]	Queue[d]
Bridge Street at Bancroft Street				
Weekday AM:				
Bridge St. WB thru/right	0.72	12.0	B	234/320
Conn. Rd NB left-turn	0.45	9.5	A	0/10
Conn. Rd NB thru	0.13	25.7	C	5/8
Bancroft St. SB right	0.40	4.6	A	0/8
Overall Intersection		**11.8**	**B**	
Weekday PM:				
Bridge St. WB thru/right	0.43	8.7	A	166/234
Conn. Rd NB left-turn	0.52	7.8	A	0/43
Conn. Rd NB thru	0.58	36.5	D	53/83
Bancroft St. SB right	0.48	11.9	B	0/29
Overall Intersection		**10.2**	**B**	

[a] Volume-to-capacity ratio [b] Average control delay in seconds per vehicle [c] Level of Service
[d] Maximum queue length in feet per lane during Avg/95th percentile cycle (assuming 25 feet per vehicle)

Alternative 3 – Two Signal Option

This alternative would involve realigning the intersection of Bridge Street and East Hollis Street to create a single connector road between the two east-west roadways aligned with Bancroft Street and the future Crown Street connection. The connector roadway would need to have multiple lanes in the southbound direction for vehicle storage and improved operation. The two signals will be coordinated, and it is recommended that adaptive signal technology be implemented to maximize the operational effectiveness of the available green time and flexibility of the system to the extent practical. This alternative allows for full access to Bancroft Street and the future Crown Street connection. In addition, this alternative would remove the existing signal at the intersection of Bridge Street and D Street.

However, it should be noted that when the exclusive pedestrian phase is activated at the intersection, it increases the overall delay as all vehicles must wait for pedestrians to cross. The signal will be designed assuming that it would operate with an exclusive pedestrian phase. The exclusive pedestrian phase causes all vehicles in the intersection to stop during the pedestrian “Walk” phase and allows the “Right-Turn on Red” movements for vehicles during the “Don’t Walk” phase once the vehicles have yielded to pedestrians in the crosswalk. Some consideration was also given to using Concurrent Pedestrian phasing where the pedestrians get a “Walk” indication at the same time that the adjacent vehicle traffic has a green light (i.e. pedestrians crossing Bancroft Street get the “Walk” indication at the same time Bridge Street westbound vehicle through movements have a green light). However, the concurrent pedestrian phase was determined to be less safe with the introduction of dual left-turn lanes on the westbound Bridge Street approach and was not evaluated at this location. This alternative will include bicycle accommodations, sidewalks and crosswalks with ADA compliant signal equipment to allow all users full access to the project area. Table 7 below shows the operations of the Alternative 3. The traffic analysis for the Alternative 3 can be found in Appendix B.

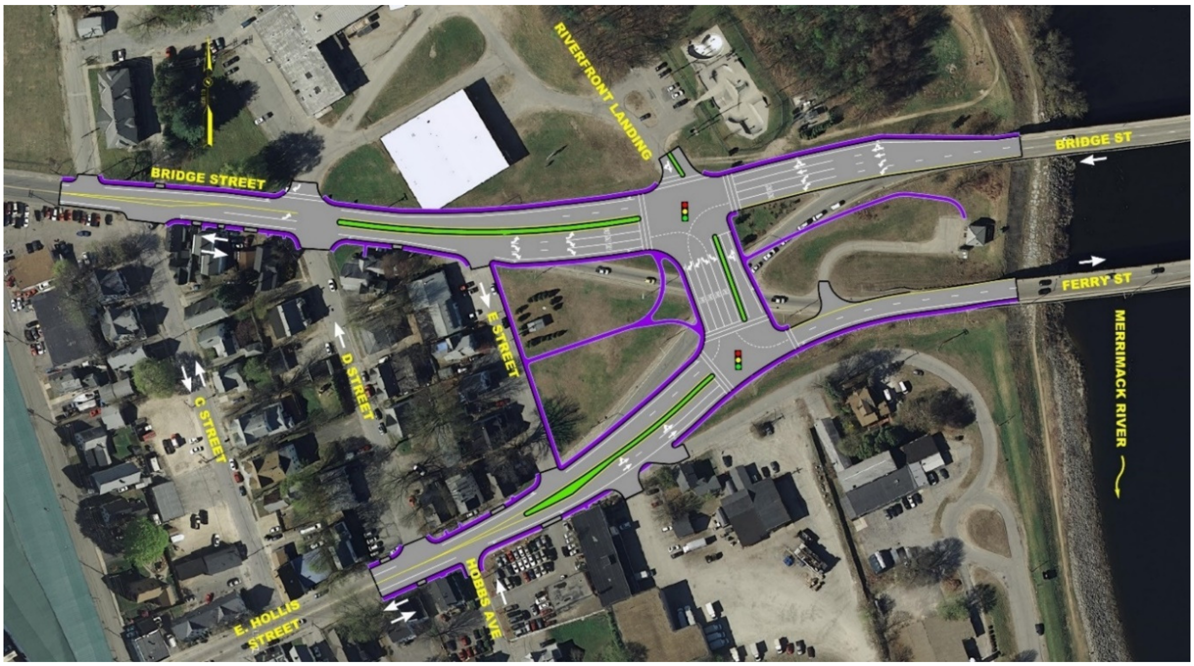

Figure 5: Alternative 3 – Two Signal Option

The advantages of this alternative are that it provides signalized crosswalks with exclusive pedestrian phases at all intersections and bicycles shoulders through the entire project area. The alternative also provides full access to both Bancroft Street and a future Crown Street connection for existing and future development and eliminates the existing signal at D Street. In addition, Emergency Vehicles can use the new signals to travel between Bridge Street and East Hollis Street. The safety of the merge for vehicles coming from Bridge Street to East Hollis Street would be improved as the speed of traffic would be slowed down. The weaving on Ferry Street at the bridge would be eliminated as vehicles would be able to pick what lane to be in at the proposed signals. The greenspace in this alternative is an advantage as it would be split up into two large areas. The larger area would be located adjacent to E Street and would not require pedestrians to cross through the main intersections to get there.

The disadvantages of this alternative are that some of the vehicle movements will need to travel through more than one traffic signal and will see increased delay over existing conditions, specifically the movements from Hudson to Bridge Street and East Hollis

Street to Hudson. This will not, however, increase the overall queue lengths at the intersection.

Table 7 - Capacity Analysis Summary – 2039 Conditions Alternative 3

Intersection/ Lane Group	2039 Alternative 3 v/c[a]	Delay[b]	LOS[c]	Queue[d]
Crown Street at East Hollis Street				
Weekday AM:				
East Hollis St. EB thru/left/right	0.77	43.5	D	284/409
Crown St NB left-turn	0.53	68.5	E	66/116
Crown St NB thru/right-turn	0.58	44.6	D	135/222
Conn. Rd SB left-turn	0.74	21.3	C	134/118
Conn. Rd SB thru/left-turn	0.74	56.7	F	405/481
Conn. Rd SB right-turn	0.56	5.5	A	136/127
Overall Intersection		**35.3**	**D**	
Weekday PM:				
East Hollis St. EB thru/left/right	1.09	92.6	F	845/986
Crown St NB left-turn	0.61	81.4	F	71/129
Crown St NB thru/right-turn	1.09	144.6	F	213/382
Conn. Rd SB left-turn	1.10	87.4	F	640/792
Conn. Rd SB thru/left-turn	1.09	107.9	F	764/1085
Conn. Rd SB right-turn	0.37	3.4	A	75/113
Overall Intersection		**78.5**	**E**	
Bridge Street at Bancroft Street				
Weekday AM:				
Bridge St WB thru/right-turn	0.62	15.6	B	294/484
Bridge St WB left-turn	0.84	34.6	D	500/639
Bridge St EB left-turn	0.12	61.8	E	8/27
Bridge St EB right-turn	0.77	30.5	C	215/310
Conn. Rd NB thru/left-turn	0.33	72.1	E	59/146
Bancroft St SB thru/right-turn	0.65	48.9	D	124/120
Overall Intersection		**31.6**	**C**	
Weekday PM:				
Bridge St WB thru/right-turn	0.50	19.8	B	265/315
Bridge St WB left-turn	0.69	39.7	D	382/500
Bridge St EB left-turn	0.64	81.7	F	81/142
Bridge St EB right-turn	0.90	35.4	D	409/519
Conn. Rd NB thru/left-turn	0.35	56.8	E	71/66
Bancroft St SB thru/right-turn	0.60	48.9	D	46/105
Overall Intersection		**35.0**	**D**	

[a] Volume-to-capacity ratio [b] Average control delay in seconds per vehicle [c] Level of Service
[d] Maximum queue length in feet per lane during Avg/95th percentile cycle (assuming 25 feet per vehicle)

Streetscape

The Project Purpose and Need statement calls to “provide an aesthetically pleasing gateway with neighborhood amenities into the City of Nashua.” The desire to make the intersection of Bridge Street and East Hollis Street a gateway with greenspace areas was a common theme heard from the Steering Committee and the public. The project landscape architect identified two large areas of greenspace where the City of Nashua could construct amenities such as a playground, a public garden, and a dog park. This project will only construct walkways in those greenspace areas but will be designed in a way that will allow for amenities to be added in the future. The main gateway feature will be street trees as requested by the public. In addition to providing a welcoming feel to downtown Nashua, these trees will also help to calm traffic.

The graphic below illustrates the proposed landscaping for Alternative 3. The street trees along Bridge Street and East Hollis Street would promote the Gateway theme. The greenspace areas would be located on both sides of the proposed intersection. This project would construct the walkways shown and leave space for future amenities. A connection to the Merrimack River would also be provided through the use of a sidewalk off of East Hollis Street.

Figure 6: Proposed Streetscape

Preferred Alternative

The Engineering Study Phase of this project developed three alternatives and compared them to the No-Build alternative, for consideration by the City of Nashua. To help the City and steering committee evaluate which alternative was best, a decision matrix was created (See Appendix F). This matrix used criteria such as mobility, traffic operations, and cost and rated them from 1 to 5. This matrix showed Alternatives 2 and 3 had the most positive ratings.

The final Steering Committee meeting to pick which alternative would be recommended to the City of Nashua was held on August 29, 2018. At that meeting, Alternative 2 was quickly dismissed as it did not receive enough support from the public at the Public Gateway Options Workshop. The main reasons for this were the confusing layout and number of signals required. Alternative 1 was also dismissed as it did not meet enough of the Purpose and Need Statement. The Steering Committee felt Alternative 3 should be the recommendation as it increased access to properties in the area, did not make traffic worse, provided the opportunity for a gateway, and provided enhanced pedestrian and bicycle facilities.

Alternative 3 was presented to Nashua's Committee on Infrastructure and Planning and Economic Development Committee on October 24, 2018. Both groups supported the project at the end of that meeting. Alternative 3 was then presented to the Board of Public Works on October 25, 2018. They approved moving forward with the project using Alternative 3.

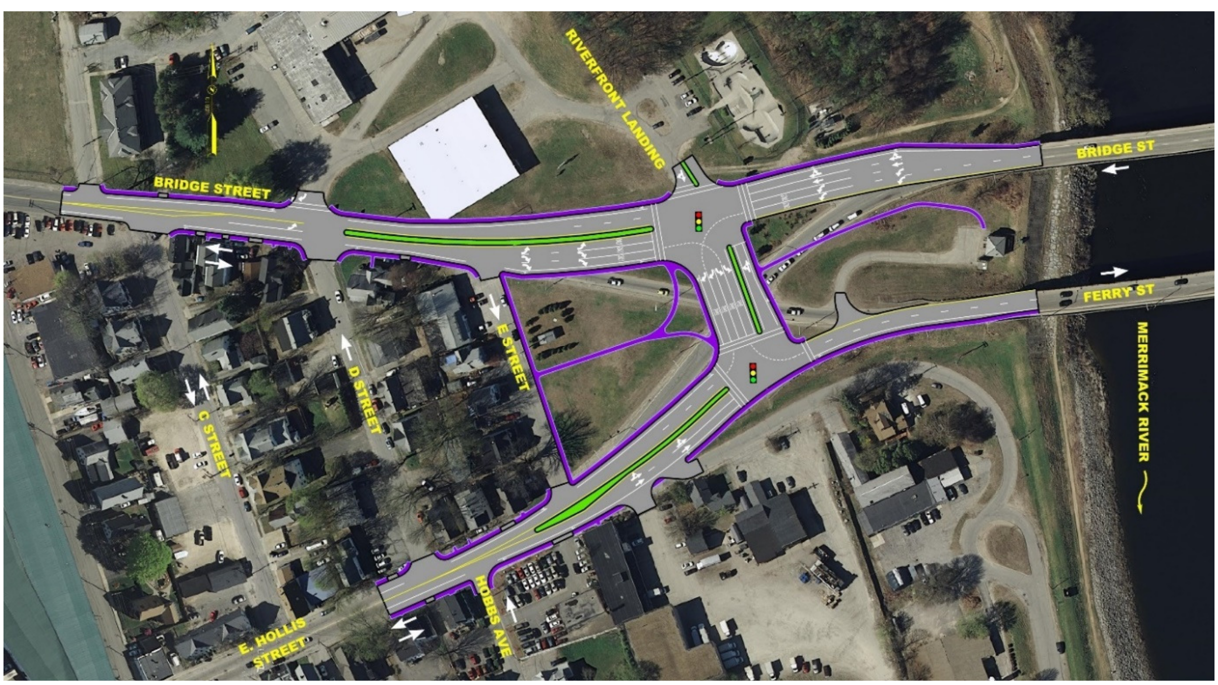

Figure 7: Recommended Alternative

Environmental Permitting

Wetland Permit

The proposed project is not anticipated to impact any wetland resource areas under jurisdiction of the NH Wetlands Bureau or the US Army Corps of Engineers. Therefore, no wetland permitting is anticipated.

Shoreland Permit by Notification

Portions of the project are located within the Protected Shoreland (within 250 feet) of the Merrimack River and it is assumed that proposed work will require a Shoreland from NHDES. A Shoreland application must be prepared and submitted to NHDES for approval.

Alteration of Terrain Permitting and Erosion Control Plans

As the project is within the protected shoreland of the Merrimack River and will disturb more than 50,000 sq. ft of earth during the roadway reconfiguration, which will result in an increase in impervious area, it is assumed that the project will require an Alteration of Terrain Permit from NHDES.

Utilities

Overhead and underground utilities are present along the Bridge Street and East Hollis Street corridors. Overhead utilities include power, cable television, fiber optic and telephone. The poles carrying these utilities run along both sides of Bridge Street and the south side of East Hollis Street. Several poles on Bridge Street will need to be relocated as a result of the road being widened and the new intersection layout. The poles along East Hollis Street will not need to be relocated as part of this project.

Underground utilities along both East Hollis Street and Bridge Street include telephone, fiber optic, sewer, water, and gas. The utility companies may use this project as an opportunity to upgrade some of the lines within the project limits. It is also likely that minor relocations will be needed as part of the project.

Traffic Control

Traffic control for Alternative 3 will utilize three phases during construction. The first phase will build a temporary “X” intersection and signal to the west of the existing intersection. The second phase will send traffic through the temporary intersection. While traffic is using that, the majority of the new intersection can be constructed behind barriers. Phase 3 will send traffic through the final intersection configuration. The temporary intersection can then be demolished, and the remaining roadway work can be done.

Cost Estimate

A conceptual construction cost estimate was prepared for each alternative using the NHDOT “Weighted Average Bid Prices,” recent bid results on similarly sized projects, and engineering judgment. Roadway costs generally include excavation, pavement, gravel sub-base, curbing, concrete sidewalk, and landscaping. These costs do not include engineering, right-of-way or mitigation costs, but do include construction engineering. A summary of the anticipated costs for each alternative is summarized below:

- Alternative 1: $2,300,000 (Includes $400,000 for landscaping)
- Alternative 2: $2,700,000 (Includes $100,000 for landscaping)
- Alternative 3: $2,700,000 (Includes $300,000 for landscaping)

The higher roadway costs for Alternatives 2 and 3 are attributed to the additional signals and roadway work required over Alternative 1. Alternative 1 would be constructed in the same footprint as the existing intersection and would require two relatively small traffic signals.

All construction cost estimates are using 2018 dollars and the estimates can be found in Appendix E.