



Nashua Inter-Regional Transit Expansion Study

June 2021 (revised Oct 2021)



Cover Images – Clockwise from top left: Nashua Transit Center

FEE Turnpike Exit 8 Park & Ride

Lowell Gallagher Intermodal Transit Center

Alewife MBTA Station

U.S. Route 3 near Burlington

University of Massachusetts North Campus Shuttle Stop outside Olney Hall

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EXECUTIVE SUMMARY

The Nashua Regional Planning Commission (NRPC), in consultation with various partners and agencies, evaluated the feasibility of expanding transit service from Nashua to four key destinations in Massachusetts along the Route-3 corridor. Studies had shown there is a demand for a transit connection between the Nashua Region and Northern Middlesex County among many commuters who currently drive across the state border. Moreover, existing transit riders in both regions also desire such an inter-regional connection, which would improve the connection between the Nashua Transit System (NTS), Lowell Regional Transit Authority (LRTA), and Massachusetts Bay Transportation Authority (MBTA) networks.

Reviewing past studies, plans, and public input, as well as consulting with partners and agencies on both sides of the state border, NRPC staff developed four inter-regional transit routes and a set of operating parameters, including service frequency and vehicle type. The four inter-regional transit routes are:

- Nashua Shuttle to Lowell Gallagher Transit Terminal
- Nashua Shuttle to Alewife MBTA Station, Cambridge
- Nashua Shuttle to UMass Lowell
- Nashua Shuttle to Bedford/ Burlington Employment & Retail Clusters

NRPC staff conducted ridership forecast on these routes based on a travel impedance model using the U.S. Census LODS data, and then a cost estimate assuming an operating expense of \$5.55 per mile, which is the current level for NTS operations and includes the cost of vehicle depreciation.

With the forecasted ridership and cost estimate, NRPC staff further evaluated the regulatory framework, political conditions, and potential funding sources to determine the feasibility of the proposed service. Being aware that these factors may differ based on how the service is operated, NRPC staff identified and explored four operating models, each with its set of advantages and disadvantages.

- Expand NTS or LRTA Service
- Partner with Middlesex 3 TMA
- Form a new Nashua Region TMA
- Commercial Operator

Based on the findings of the various analyses and evaluations in this study, NRPC staff provides the following list of strategies toward implementation:

1. Assess the interest of NRPC, potential partnering agencies, local businesses/employers, municipalities in the Nashua Region, and businesses/employers in Massachusetts in forming a Nashua-based TMA, and then evaluate whether forming the TMA would be superior to joining the M3 TMA.
2. Engage the Middlesex 3 Coalition and M3 TMA in a more serious discussion about cross-border collaboration and the pilot of the proposed inter-regional transit service via M3 TMA shuttles.
3. Continue the discussion with UMass Lowell on identifying funding for the Nashua Shuttle to UMass Lowell, as well as other opportunities to collaborate between the university and the Nashua Region.

4. Survey current riders (NTS/LRTA/M3 TMA shuttles) and potential riders for interest and input once a greater level of details on the proposed service and operations are determined, similar to the survey given to UMass Lowell students and employees residing in the Nashua Region.
5. Facilitate collaboration between NTS and LRTA, especially on the potential pilot of the Nashua Shuttle to Lowell Gallagher Station, as well as the possible pilot of the regular LRTA service to the Pheasant Lane Mall mentioned in LRTA's recent comprehensive regional transit plan update.
6. Work with NHDOT and NMCOG to explore the potential use of CMAQ funds available for piloting the proposed inter-regional transit service
7. Explore and identify other available funding, including contributions from businesses and private foundations
8. Collaborate with Boston Express on potential ways its service may strengthen the transit connection between Nashua and Massachusetts (e.g. adding a stop at Alewife Station on its Nashua-Boston route would essentially duplicate the proposed Nashua Shuttle to Alewife Station)

All of the shuttle services considered are feasible for implementation under the right circumstances, some more so than others. Although NRPC staff made the best estimation with available data, ridership/utilization of the service remains a key uncertainty. Feasibility of service does not infer recommended inclusion of the proposed inter-regional transit service in the long-range Metropolitan Transportation Plan (MTP), as this step should entail a further exploration of implementation, communication with stakeholders, exploration of funding sources, and presentation to NRPC's Transportation Technical Advisory Committee (TTAC) and Metropolitan Planning Organization (MPO) Policy Committee. Accordingly, the feasibility study will be presented to these groups for review and comment but MPO action to endorse the document is not being sought. Further discussions and follow-up may result in components of this study being incorporated into the MTP with its next major update in December 2022.

1. INTRODUCTION

The New Hampshire Employment Security office estimates that over 30% of Nashua's labor force commutes to jobs in Massachusetts¹. A total of 36,100 people commuted to Massachusetts from the Nashua NH-MA NECTA daily. The largest share, by far, commuted to Middlesex County which includes the Cities of Lowell and Cambridge as well as the concentration of employers along Route 128 (I-95) and I-495. Additionally, 14,200 Massachusetts residents commute into the Nashua NECTA, the largest share of which commuted to jobs within the City of Nashua.

A 2018 survey of passenger rail riders indicated that just over 300 riders from the NRPC and surrounding area board the Lowell commuter rail line daily at the Gallagher Terminal in Lowell or North Billerica stations². The City of Lowell and the University of Massachusetts at Lowell (UMass Lowell) in particular, have increasingly become destinations for Nashua area workers and students due to the overall growth of the campus and the introduction of discounted tuition for Nashua area residents.³ In addition to serving as a commuter rail station, the Gallagher Terminal/Kennedy Center serves as the hub for all eighteen Lowell Regional Transit Authority (LRTA) bus lines. LRTA serves twelve communities bordering or close to the New Hampshire border, including service to major employers along the I-495 corridor such as Raytheon, important institutions such as UMass Lowell and the Lahey Clinic, the Burlington Mall, and other transit hubs such as the Willington MBTA Commuter Rail station.

Currently, transit service from the Nashua region to Massachusetts is provided by Boston Express from the FEE Turnpike Exit 8 Park & Ride in Nashua and a Park & Ride just south of the NH border in Tyngsborough, MA with stops at South Station in Boston and Logan Airport. South Station provides connections to Amtrak's Northeast Corridor passenger rail service to New York, DC, and other east coast destinations as well as the MBTA's Red Line subway, the Silver Line, inter-city bus services, and regional commuter rail. No transit connections are available to Boston's North Station, the Gallagher Terminal at Lowell, Alewife Station in Cambridge, or the I-95/Route 128 area, and transit access to major employment destinations such as Cambridge's Kendall Square is limited and cumbersome. The lack of interstate transit alternatives serving the region, and the US 3/FEE Turnpike corridor, in particular, limits economic growth and opportunity and is a contributing factor to traffic congestion along the corridor.

Moreover, although the number of workers commuting to the Nashua area from Massachusetts is only about one-third of the number commuting out, the volume is nevertheless significant and many large Nashua area employers strive to attract more workers, especially younger highly skilled tech workers from Boston, Cambridge and Somerville, may benefit from an interstate transit alternative.⁴ Due to the lack of convenient last-mile connections on the Nashua's end of the trip, an inter-regional transit service

¹ New Hampshire Employment Security (NHES). June 2018. *Nashua Inter-state Analysis, A Profile of the Nashua, NH-MA NECTA*. Available via NHES's website <https://www.nhes.nh.gov/>.

² NRPC survey of passenger rail riders at Lowell and North Billerica stations. The estimate is developed based on factoring of the survey sample to the full rail rider population, based upon the 2017-2017 MBTA passenger counts.

³ UMass Lowell participates in multiple regional tuition discount programs organized by the New England Board of Higher Education. One of these programs is a Proximity Allowance of the New England Regional Program. This program allows New Hampshire residents from selected towns within a 20-mile radius of UMass Lowell to be eligible for a tuition discount for most majors.

⁴ NHES. June 2018. *Nashua Inter-state Analysis, A Profile of the Nashua, NH-MA NECTA*.

alone may not be an attractive alternative to commuters who currently drive from Massachusetts to the Nashua area. However, it would be a critical first step.

1.1. Purpose and Scope

To address these commuting challenges, the Nashua Regional Planning Commission (NRPC), in consultation with various partners and agencies, including the Nashua Transit System (NTS)⁵, the Federal Transit Administration (FTA) Region 1 Division⁶, Northern Middlesex Council of Government (NMCOG)⁷, and Middlesex 3 Coalition (M3C)⁸, University of Massachusetts Lowell⁹, and several transit operators in nearby regions¹⁰, evaluated the feasibility of expanding transit service from Nashua to four key destinations in Massachusetts along the Route-3 corridor.

The cross-jurisdictional nature of this study presents an opportunity for NRPC staff to reach out and gather information and knowledge both across political boundaries and different levels of government. Similarly, it is foreseeable that the implementation of the proposed inter-regional transit service also requires cooperation and partnership with the mentioned partners and agencies.

⁵ NRPC staff contacted NTS for general information about its transit operation and, more specifically, the likelihood of NTS operating the proposed inter-regional transit service. This Information is helpful for evaluating Operating Model 1 – Expand NTS or LRTA Service, which is discussed in Section 4.3.1.

⁶ NRPC staff contacted the FTA Region 1 Division Office for information on federal regulations, including FTA rules and Federal Motor Carrier Safety Administration rules. The latter is not under the FTA's jurisdiction. This information informs the analysis on federal regulations applicable to the proposed inter-regional transit service, which is discussed in Section 6.1.1.

⁷ As the regional Metropolitan Planning Organization for the Northern Middlesex region, NMCOG provides transportation planning to the Lowell Regional Transit Authority (LRTA). NRPC staff contacted the NMCOG for general information on LRTA and, more specifically, for an understanding of LRTA's potential in operating the proposed inter-regional transit services. This Information is helpful for evaluating Operating Model 1 – Expand NTS or LRTA Service, which is discussed in Section 4.3.1.

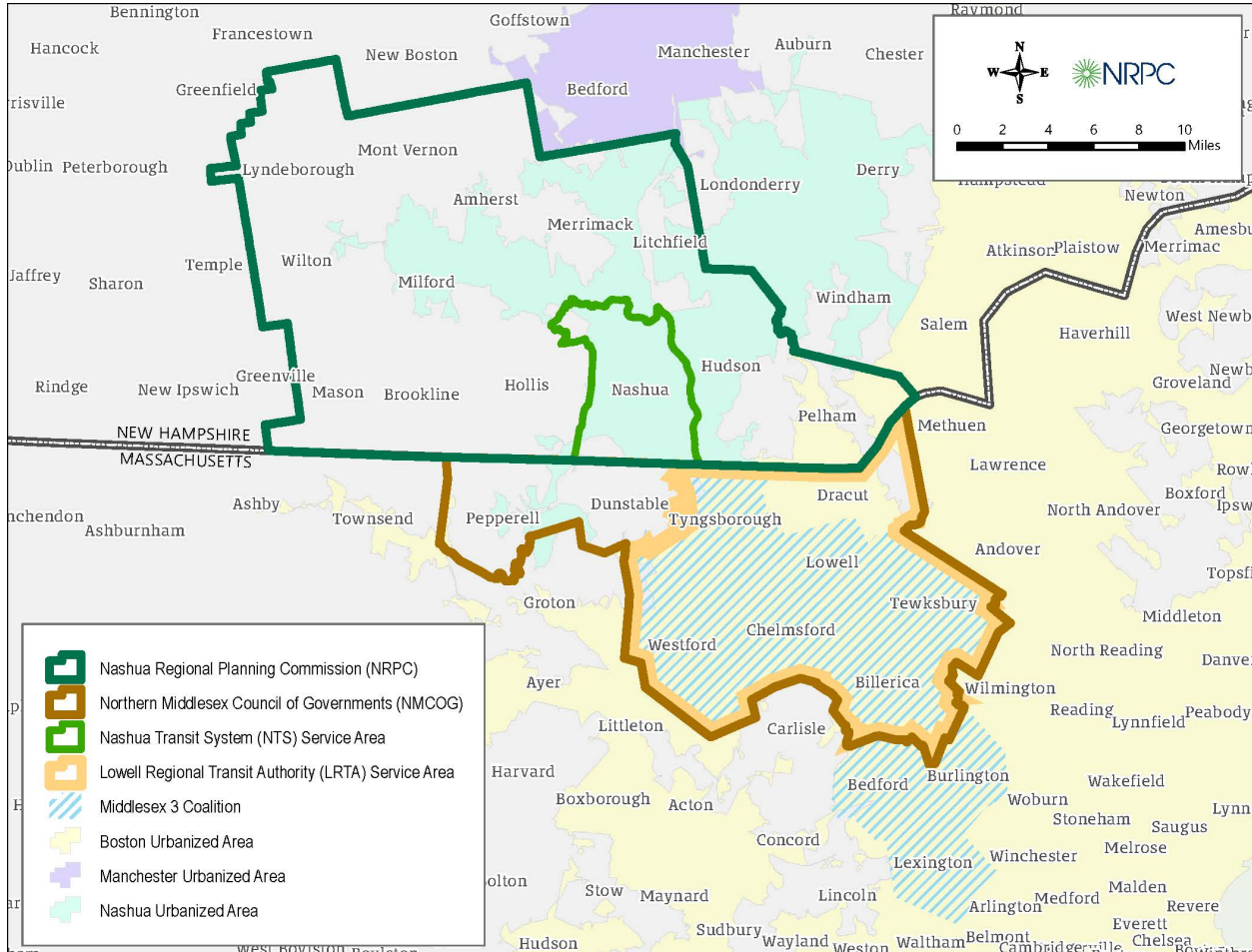
⁸ Middlesex 3 Coalition is a 501(c)6 non-profit organization that advance business and economic development interest in the Middlesex County communities along the Route 3 Corridor. M3C also administers a transportation management association, which operates employer shuttle services through a private transportation consultant. Section 3.3.2 includes more information about M3C and how it may be a feasible operating model for the proposed inter-regional transit service.

⁹ After identifying that UMass Lowell is interested to study the potential of a shuttle between Nashua and the university campus, NRPC staff worked with the university to conduct an online survey of university students and employees living within the Nashua Region. The survey and its result are discussed in Section 3.3.1. NRPC staff used the survey result in the ridership forecast of the proposed Nashua Shuttle to UMass Lowell, which is discussed in Section 5.5.1. NRPC staff also had a follow-up discussion with the university's transportation and planning staff members about potential funding and operating alternatives of the proposed inter-regional transit service.

¹⁰ Besides NTS and LRTA (via NMCOG), NRPC staff contacted Advance Transit (Wilder, VT), Cooperative Alliance for Seacoast Transportation (Dover, NH), and Merrimack Valley Regional Transit Authority (Haverhill, MA) for information on their cross-state-border transit routes and compliance with federal regulations. This information informs the analysis on federal regulations applicable to the proposed inter-regional transit service, which is discussed in Section 6.1.1.

For the reader's reference, the following map illustrates the political boundaries of key state and local partners and agencies relevant to this study, alongside the boundaries of the Urbanized Areas around the Nashua Region, which is a geographical basis for FTA grant funding allocation.

Map of Key Partners and Agencies Relevant to This Study and Urbanized Areas



Building upon the 2019 *NRPC Nashua Regional Transit Expansion Study* and 2016-2025 *NTS Comprehensive Plan*, both of which recommend a transit feasibility study that will evaluate the potential for inter-regional transit service between the Nashua Region and Middlesex County, MA, this study identifies four potential routes based on recent studies and public input, ridership forecast, and cost estimates for these proposed routes, and evaluates the feasibility of these routes under various operating models.

As this chapter lays out the purpose and scope of the study, Chapter 2 covers the analysis of recent studies and plans, including public input gathered for earlier studies and this study. Chapter 3 explains the development of the proposed routes and operating parameters. Chapter 4 covers the first part of the feasibility evaluation – ridership and operating cost forecast. Chapter 5 covers the second part of the feasibility evaluation – operating models and funding sources, and then provides an overview of the evaluation results. Chapter 6 concludes the study.

2. INPUT ANALYSIS

This study reviewed recent public input, as well as studies and plans published by NRPC and other agencies outside of the region, to understand transit system operations, costs, and benefits of the envisioned inter-regional expansion, as well as how the expansion could be coordinated with other public transit systems outside the Nashua region.

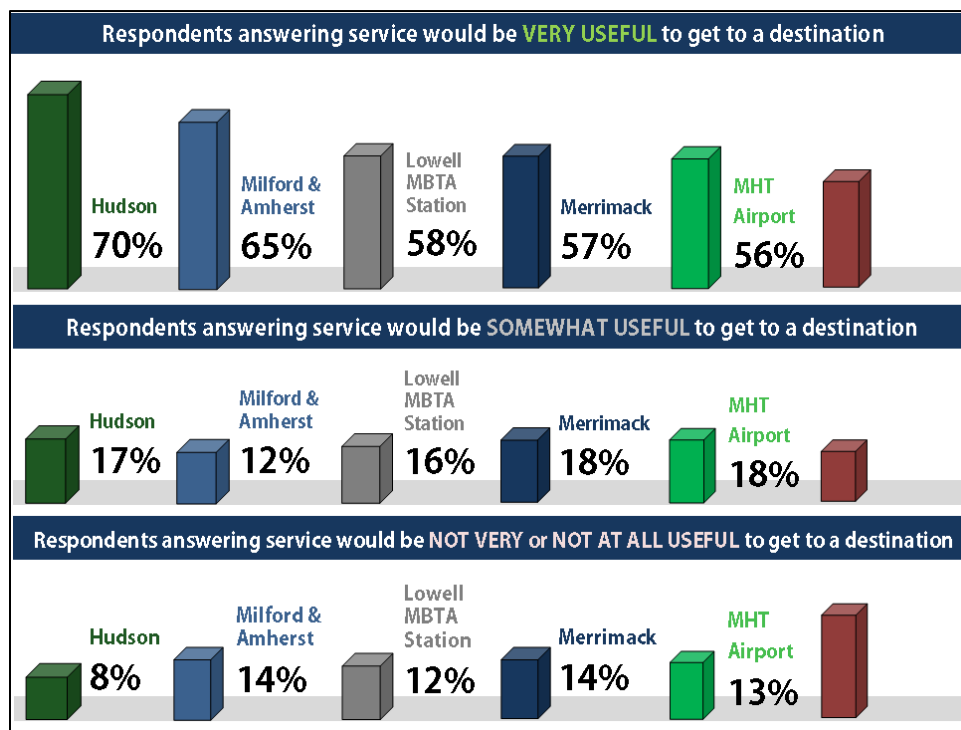
2.1. Public Input from the 2019 Nashua Regional Transit Expansion Study

The *2019 Nashua Regional Transit Expansion Study*¹¹ includes data from several surveys, which are informative to this study. Rather than reiterating every detail of the survey results, which is laid out in the 2019 study, the following sections summarize the data from each survey and note any key takeaways relevant to this study.

2.1.1. NTS Comprehensive Plan 2015 Outreach

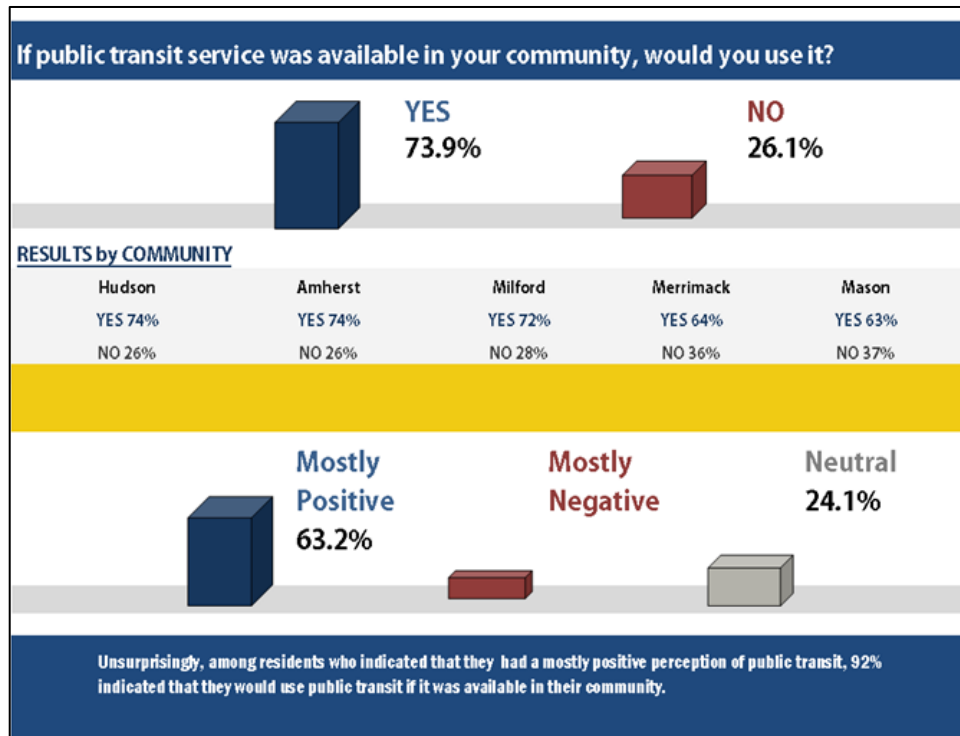
NRPC and NTS conducted a series of surveys in 2015 to gauge the interest in service extensions beyond the region, including surveys of existing riders and the general public within the region. The following graphics from the public survey provides data on the potential for transit expansion:

2015 NTS Public Outreach Transit Survey – Chart 1

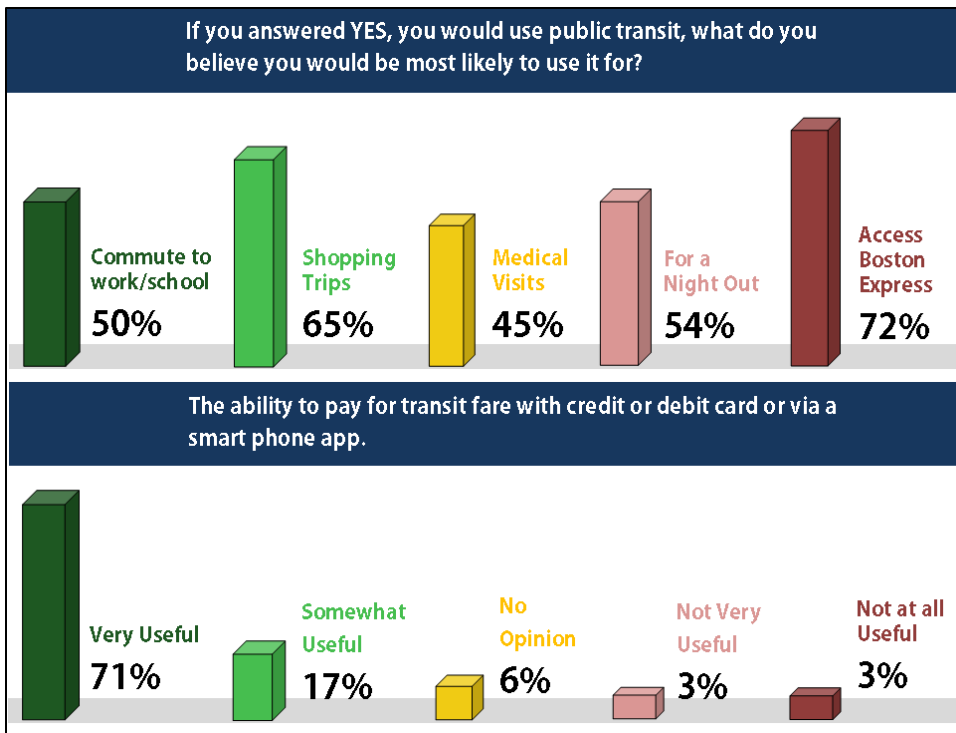


¹¹ NRPC. December 2019. *Nashua Regional Transit Expansion Study*. Available via NRPC's website <https://www.nashuarpc.org/>.

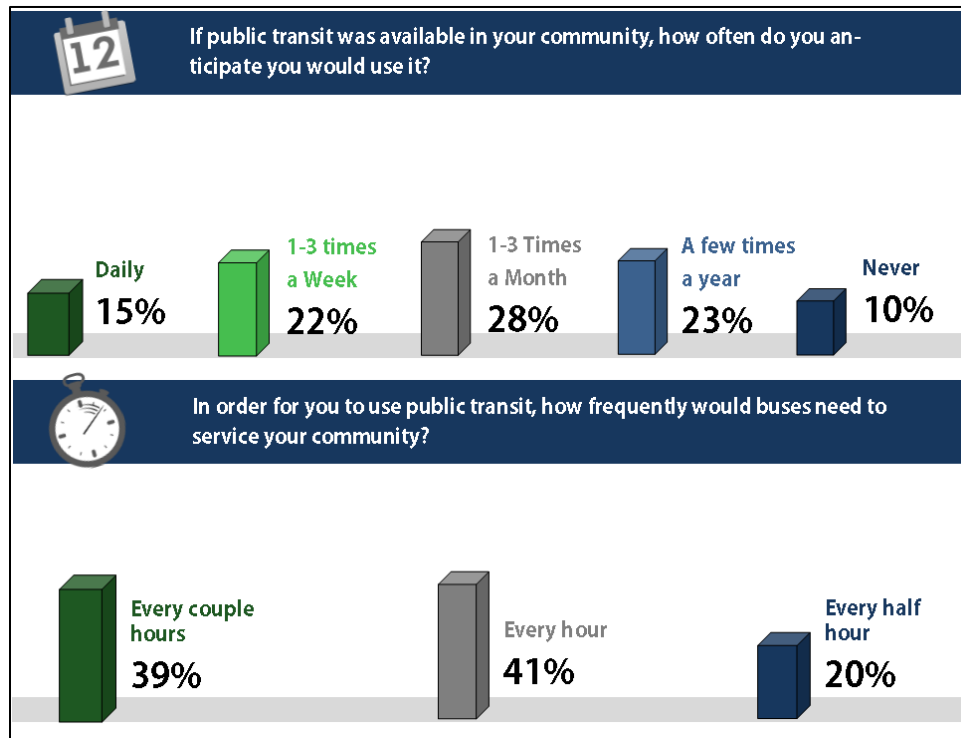
2015 NTS Public Outreach Transit Survey – Chart 2



2015 NTS Public Outreach Transit Survey – Chart 3



2015 NTS Public Outreach Transit Survey – Chart 4



While these data support the focus in the 2019 plan – intra-regional transit expansion within the Nashua Region, they are also supporting an inter-regional transit connection between the Nashua Region and Massachusetts, namely a connection to the Lowell MBTA Station, Gallagher Terminal, (see Chart 1) and a connection to access the Boston Express (see Chart 3).

According to Chart 3, access to the Boston Express is a key driver for the potential use of the NTS bus service if it is made available to the respondent’s community. However, according to Chart 4, even though 39% of the respondents would tolerate a lower level of service (one bus every couple of hours), only 15% of the respondents would use the transit service daily. The majority of the respondents would use the transit service from a few times a week to a few times a year.

2015 NTS Public Outreach Transit Survey – Additional Feedback

Additional Feedback



Reasons People Do Not Currently Use Public Transit	Suggestions
• It is easier to use a car because there is more flexibility • Public transit does not fit all work schedules • Kids need to be dropped off at daycare • People work outside of the service area	• A rail from North Station in Boston to Manchester or Nashua would be useful • Having sheltered bus stops, more lighting, and sidewalk access • It would be helpful if public transit connected to major hubs in MA

In noting that they would not utilize public transit, survey respondents most commonly indicated that they owned a car and found driving most convenient for their needs. Other respondents noted that they lived in rural areas where transit service was not feasible, or concern regarding local taxes and the role of government. Many volunteered that while they would not choose to use public transit, they knew of others in their community who would benefit from it.

As shown above, additional feedback from the respondents suggests that a public transit connection to Massachusetts, whether by rail to Boston North Station or by other means to major hubs, would serve at least some segments of the population.

2.1.2. Nashua Transit On-Board Survey

NRPC staff conducted an on-board survey of NTS riders during the spring of 2018. With over 500 responses, the survey results are representative of the NTS rider population. The key findings are as follow:

- **Rider Profile:** A majority of NTS riders is between 35 and 64 of age (47%), is employed (68%), is white (67%), does not have a driver license (65%) or an available automobile (80%), and has a household income under \$20,000 (50%). Disabled persons make up 25% of the NTS riders.
- **Trip Frequency:** NTS riders are predominantly frequent transit riders (80% take the bus at least 3 days per week, and 54% take the bus 5+ days per week).
- **Reasons for Taking NTS CityBus:** By a substantial majority, NTS riders (60%) are taking the bus because it is the only transportation mode available to them.
- **Transit Trip Characteristics:** A majority of NTS riders walk 5 minutes or less between the bus station and trip origin/destination (61% within 5-minute walk from home to bus, 82% within 5-minute walk from bus to destination). More than 95% walk to and from the bus station.
- **Trip Purpose:** The primary trip purpose is for work (49%), followed by shopping (27%).
- **Desired Service Area Extensions:** Amherst (57%), Hudson (53%), and Merrimack (46%) are the top desired areas for potential extension of bus services.

2.1.3. Survey of the General Public

NRPC staff administered an online survey in 2018 to reach those potentially interested in transit services but are not necessarily users of NTS. While marketed as such, all members of the public were able to participate, and a Spanish version was made available. The survey received 325 responses, with an over-representation of Merrimack residents. The key findings follow:

- Respondent Profile: A majority of the respondents is between 35 and 64 of age (50%), is employed (58%), is white (89%), has an available automobile (71%), and has a household income of \$80,000 or more (38%). 20% of respondents reported they had a physical disability. Also worth noting, 35% of the respondents were 65 or older, as compared to 9% among the NTS riders.
- Destination: Respondents were asked to list the top destination and purpose of their bus trips. Nashua is the most frequently mentioned top trip destination, followed by Merrimack. “Medical” is the most frequently mentioned purpose for the bus trip to Nashua. Nashua also is the most frequently mentioned destination for work-related trips among the respondents. The destinations for 5% of work-related trips and 13% of all trips are outside of the Nashua region.
- Travel Corridors: The leading travel corridors include NH 101A to Milford (70%), Daniel Webster Highway in Merrimack (62%), and Continental Boulevard in Merrimack (54%).
- Mode of Travel: Travel modes are primarily: Drive alone (76%), Public Bus (8%), Drive or ride w/ others (7%).
- Most Frequent Travel Time to Destination: Top 3 – 11-20 min (35%), 21-30 min (25%), 10 min or less (15%).
- Non-weather Travel Issues Experienced: Top 3 – Vehicle traffic or congestion (53%), Other (11%), Lack of sidewalks or crosswalks (9%).
- Transit Use Frequency: 1 or more days per week (9.5%), 1-2 days per month (3.8%), less than 1 day per month (5.7%), Never (80.9%).
- Preferred Bus Destinations:
 - Top 3 Routes – NH 101A, Milford to Nashua (30%); Daniel Webster Highway, Merrimack (23%); Lowell Road, NH3A, Hudson (12%).
 - Top 3 Bus Stop Locations: Walmart, Amherst (44%); Manchester-Boston Regional Airport (35%); Premium Outlets, Merrimack (35%).
- Maximum Potential Fare: \$2 (44%), \$3 (23%), Other (12%).
 - Note: most riders would be willing to pay significantly more than the fare for existing NTS service that is confined to the city limits.
- Additional Travel Time: 10 min or less (31%), 15 min (26%), 20 min (24%), 25 min (3%), 30 min (9%)
 - Note: The results seem to indicate that potential users understand the travel time tradeoff and are willing to incorporate significant increases in trip time to make their journey by bus.
- Desired Transit Hours of Operations: Transit services beginning at 6:00 AM meets the travel needs of most respondents. However, a vast majority (85%) indicated a need for evening service past the regular commuting hours.
- Trip Purposes: Groceries & Basics (59%), Medical Appointments (58%), Work (39%), School (12%).

- Desired Amenities: Top 3 – Convenient Bus Stop Location (78%), Easily accessible route and schedule information (60%), Sheltered Stops (60%).

2.1.4. 2018 NRPC Metropolitan Transportation Plan Survey

A total of 573 responses regionwide were obtained in a 2018 survey for the update of the *NRPC Metropolitan Transportation Plan*¹². Asked to rank the top transportation projects in the NRPC Long-Range Plan, a majority of the respondents identified Nashua-Manchester Passenger Rail to Boston (65%) and expansion of NTS to Milford, Merrimack, and/or Hudson (42%) as two of the top four regional transportation needs.

2.1.5. Employer Survey for the Hitchiner Manufacturing Company

NRPC assisted the Hitchiner Manufacturing Company, located on NH 101A Elm Street in proximity to the NH 101 Bypass interchange in western Milford, to undertake an employee survey, as the company expressed interest in a transit route extension that would enable the company to attract employees from Nashua. Out of 277 employees who completed the survey, 39 commuted from Nashua, who comprise the target of the survey.

The majority of the 39 respondents drive alone (84%) and none responded that a vehicle is rarely available to make the trip either as a driver or passenger. 78% of the respondents would consider taking a public bus to the workplace and 50% said they would take the bus frequently if it is available. There were 36% of respondents who knew someone residing in Nashua and would be interested in working at Hitchiner but does not have reliable transportation to make the daily trip.

For this study, the Hitchiner employees would be unlikely to benefit from the proposed inter-regional transit service. However, results from the Hitchiner survey may imply that other employers and their employees in the Nashua Region, including south of the state border, would also benefit from a more connected transit system.

2.1.6. Transit Workshop Outreach Events

NRPC staff conducted eleven public outreach events, in a workshop format, throughout the 2019 study area to gather perceptions around transit and potential demand for expanded transit service along proposed corridors in the 2019 study area.

Due to the intra-regional focus of the previous study, little emphasis was placed on evaluating the potential inter-regional connection. Input from the workshops, as summarized in the 2019 report, ranges from modifications to existing service routes to transit fare reduction. Except for one comment from the Hudson Public Library Workshop - there should be a [transit] connection to the future commuter rail station in Nashua - none of the noted public comments from the workshops are relevant to the present study.

2.1.7. Summary of Public Input from the 2019 Transportation Expansion Study

Due to the intra-regional focus of the 2019 study, the public input mainly concerns transit service within the Nashua Region. Nevertheless, the surveys indicate a strong interest in expanding the NTS system

¹² NRPC. December 19, 2018. *Nashua Region Metropolitan Transportation Plan 2019 to 2045*. Available via the NRPC's website <https://www.nashuarpc.org/>.

beyond Nashua's city limit, as well as a commuter rail extension from Boston. The surveys also provide a snapshot of the demographics of NTS riders and potential riders.

For the present study, these two interests would align with the proposed inter-regional transit service, which will both extend the local bus network beyond the city limit and work as a bus substitute for a Lowell line commuter rail extension.

Furthermore, several observations are relevant to this study:

1. Unlike existing NTS riders, potential riders are more likely to have an available automobile and currently drive to their destinations
2. The income level between existing NTS riders and potential riders are on the opposite ends: a majority of NTS riders have a household income at the lowest income bracket on the survey while a majority of potential riders have a household income at the highest income bracket on the other survey
3. A large share of the bus trips taken by existing NTS riders are work-related. On the other hand, a smaller share of the potential bus trips potential riders would take would be work-related

These observations indicate there are two main groups of demographics that the potential inter-regional transit service would serve: 1) riders with lower income, do not have regular access to an automobile, and have to rely on transit for work and other trips; 2) potential riders with higher income, have regular access to an automobile, and would like to take transit to work, and occasionally for other trips, as an alternative to driving.

An indeterminate but likely small number of the first group of riders is already using the existing transit system regularly but would like to expand their access to destinations beyond the existing service area. The NTS on-board survey revealed a handful of people who desired service to Lowell and the LRTA general public survey in its 2021 Comprehensive Regional Transit Plan Update and indicated "many" people expressed a desire to utilize transit to Nashua. However, NRPC staff cannot identify any data that provide the percentage of existing LRTA riders who would ride to Nashua locations.

For the second group, a significant number of the potential riders has never or not regularly used the transit system but would be interested if there is a more direct and convenient transit connection to their destinations (mainly their jobs). Those who commute into the Boston Metro Area by car would benefit the most as they face more serious congestion and higher parking fees than those who commute to destinations outside the metro area.

2.2. Regional Transportation Plans

Various state-wide and regional plans in New Hampshire and Massachusetts justify the proposed inter-regional transit connection. From the Nashua region, these include various key transportation planning documents prepared by NRPC: the *Nashua Region Metropolitan Transportation Plan 2019-2045*, *Nashua Transit System Comprehensive Plan 2016-2025*, *NRPC Locally Coordinated Transportation Plan for the Nashua and Milford Region 2016*, *NRPC Congestion Management Plan 2010*, and *NRPC Ten-Year Transportation Improvement Plan*. Reduction of travel times, cost savings to commuters, reduced fuel consumption, and improved air quality is cited as key benefits in these documents.

2.2.1. Nashua Region Metropolitan Transportation Plan 2019-2045

As stated in the *Nashua Region Metropolitan Transportation Plan*¹³, the Nashua region has no immediate access to passenger rail to Boston; however, connection to rail service in Lowell or North Billerica can be made via access to station parking. Boston Express provides a direct transit connection to Boston downtown, South Station, and Logan International Airport from the North Southwood Drive park-and-ride lot off the F.E.E. Turnpike Exit 8. However, this service encounters the same degree of congestion on the highway network as do private auto operators.

Additionally, the NTS fixed-route transit system does not extend beyond Nashua's city limit. Consequently, the plan highlights the passenger rail service and transit improvements beyond the Nashua (including offering service to access major social service agencies and employers) as illustrative projects – "an additional transportation project that may (but is not required to) be included in a financial plan for a metropolitan transportation plan, TIP or STIP if reasonable additional resources were to become available." In other words, there exists no current identifiable funding source to implement such a service.

As noted in Section 2.1.4, a majority of respondents who took the survey conducted for the *Metropolitan Transportation Plan* ranked these two illustrative projects as important.

2.2.2. Nashua Transit System Comprehensive Plan 2016-2025

Besides addressing the intra-regional transit needs within the Nashua Region, which includes service expansion beyond the City of Nashua, the *NTS Comprehensive Plan*¹⁴ also identified service expansion beyond the NRPC Region as a priority outcome toward NTS's goals. Suggested service expansions include transit connections to the Boston-Manchester Regional Airport, Manchester Transit Authority, park & ride facilities to access destinations in Massachusetts via commuter rail or commuter bus service, and seasonal services to Hampton Beach and Canobie Lake Park.

The plan also notes that 1) future expansion of fixed-route transit outside of Nashua would require local support to identify sources of matching funds to support operations and capital purchases, and 2) coordination with other jurisdictions, likely through a Memorandum of Understanding, would help streamline the placement and maintenance of facilities beyond the Nashua region.

2.2.3. NRPC Locally Coordinated Transportation Plan for the Nashua and Milford Region 2020

While the *NRPC Locally Coordinated Transportation Plan*¹⁵ emphasizes more on-demand response transportation to serve the elderly, population with disabilities, and youths than on services that target commuters and the general population, the plan's strategies and identified projects share similar themes of improving inter-regional transit connection. Two recommendations are improving the transit

¹³ *Ibid.*

¹⁴ NTS and NRPC. 2015. *Nashua Transit System Comprehensive Plan 2016-2025*. Available via the NRPC's website <https://www.nashuarpc.org/>.

¹⁵ NRPC. April 15, 2020. *Locally Coordinated Transportation Plan for the Greater Nashua and Milford Region 2020-2024*. Available via the NRPC's website <https://www.nashuarpc.org/>.

connection to the LRTA bus network and strengthening participation with the Northern Middlesex Council of Government.

The plan provides a list of strategies and projects, which includes developing transit connections to future commuter rail stations, expanding public bus and rail service between cities, providing a transit connection from Nashua to the Lowell Regional Transit Authority bus stop in Hudson, and building upon public-private partnership such as the NTS bus route partially funded by a contribution from the private aerospace company BAE Systems. The plan also suggests making use of the Congestion Mitigation and Air Quality (CMAQ) program funding for these transit improvements.

2.2.4. NRPC Congestion Management Process (CMP) 2010

The *NRPC Congestion Management Process*¹⁶ reiterates the goals and objectives from the NHDOT's *NH Long-Range Transportation Plan* (see Section 2.2.6 below), including:

1. Establish inter-city transit connections including passenger rail service.
2. Promote access to transportation for the under-served and include plans and projects that ensure that the needs of transit users, bicyclists, and pedestrians are met.
3. Encourage public/private sector partnerships and private sector participation in the financing of transportation projects and services.

The plan also lists the implementation of park & ride lots and implementation of rail transit as two items in its Congestion Management Process Strategies Toolbox.

The 2021 CMP update, now in a draft version pending MPO approval, also lends support to the extension of transit services to the south of Nashua and identifies existing levels of highway congestion, measured by peak period speeds and volume-to-capacity ratios, that would be somewhat mitigated by the implementation of transit service.

2.2.5. Commuter Rail Studies

For over thirty years the NRPC has worked toward the implementation of passenger rail service to Boston via an extension of the existing MBTA commuter rail service from Lowell to Nashua. A *Passenger Rail Feasibility Study*¹⁷ was conducted in 1988, which provided the first estimates of ridership at NRPC rail stations, capital costs, and ongoing funding for operations. This effort was followed up in 1990 with an *Implementation Alternatives Study*¹⁸ which provided additional detail to operational and institutional aspects of a rail extension. In 1999, NRPC revised its passenger rail estimates for a *Major Investment Study*¹⁹, in which a private consultant was retained to provide engineering review of capital upgrade needs and cost of improvements.

¹⁶ NRPC. September 2010. *Congestion Management Process*. Available via the NRPC's website <https://www.nashuarpc.org/>.

¹⁷ NRPC. 1988. *Passenger Rail Feasibility Study for the Nashua Area*.

¹⁸ NRPC. 1990. *Passenger Rail Implementation Alternatives Study*.

¹⁹ NRPC. 1999. *Major Investment Study for Nashua Passenger Rail Service*. Available via the NRPC's website <https://www.nashuarpc.org/>.

The current proposal, known as the New Hampshire Capital Corridor, would extend commuter rail service as far as downtown Manchester with a connection to the Manchester-Boston Regional Airport. In 2014, AECOM, a private consultant retained by NHDOT completed the *Capitol Corridor Rail & Transit Alternatives Analysis*²⁰, which analyzed various conceptual rail and bus alternatives to Nashua, Manchester, and Concord. This included ridership estimates, capital costs, projected operating deficits, a financial plan. In 2019, NRPC was asked to review and comment on the consultant ridership analysis. NRPC applied its ridership forecasting procedure to 2015 journey-to-work data and concurred that the consultant estimates for a rail extension to Nashua were reasonable and perhaps on the conservative side. NRPC did not apply the forecasting procedure to estimate trips to Manchester or Concord but did not concur with the high ridership estimates north of Nashua, because work trips to Boston from Manchester and north are significantly lower than those from the Nashua region. Work trips are known to comprise 85% to 90% of commuter rail trip purposes.

The Capitol Corridor initiative has now advanced to the Project Development Phase which includes taking engineering to the 30% design level, undertaking an environmental assessment, and developing a detailed financial plan. While the long-term goal is for a restoration of regular passenger rail service to the Nashua region, NRPC is exploring lower-cost alternatives that can be implemented in the short-term, for an interim period or longer, as well potential transit links to destinations that would not be served by the Capital Corridor project. A shuttle bus is one of the two primary transit alternatives evaluated in this study targeted to travelers to Boston and elsewhere in the immediate metro area.

2.2.6. NH Long Range Transportation Plan 2010-2030

The *NH Long Range Transportation Plan 2010-2030*²¹ published by the New Hampshire Department of Transportation also lends support to the implementation of new transit services. The New Hampshire Transportation Vision laid out in the plan emphasizes expanding the state's multimodal system, including transit and rail service, to achieve sustainable economic development, reducing transportation impacts on environmental, cultural, and social resources, a safer transportation network especially for bikers and pedestrians, and a stable financial outlook. This emphasis translated into various performance measures categorized by the different goal areas. The connectivity and accessibility of transit systems are key factors for the performance measures: Extent of Land Use – Transportation Coordination under Goal 1 – Land Use-Transportation Integration; and Inter-Regional Accessibility and Mode Share under Goal 2 – Mobility & Modal Choice.

2.2.7. NMCOG Regional Transportation Plan FFY 2020-2040

In Massachusetts, the Northern Middlesex Council of Governments (NMCOG) has identified the need for a transit connection between Northern Middlesex County and the Nashua Region. Input from the public outreach effort conducted by NMCOG for its *Regional Transportation Plan*²² indicates that public transportation is inadequate in the NMCOG region, with residents consistently identifying the need to

²⁰ NYDOT. December 2014. *Capitol Corridor Rail & Transit Alternatives Analysis (Parts A & B)*. Available via the NYDOT's website <https://www.dot.nh.gov/>.

²¹ NHDOT. July 2010. *NH Long Range Transportation Plan 2010-2030*. Available via NHDOT's website <https://www.dot.nh.gov/>.

²² NMCOG. July 2019. *Northern Middlesex Regional Transportation Plan FFY 2020-2040*. Available via NMCOG's website <https://www.nmcog.org/>.

expand commuter rail to New Hampshire and bus service to shopping centers in Nashua. They stated these expansions would not only benefit the economy, but also the quality of life for residents. Furthermore, the public outreach input identified peak-hour congestion at the Merrimack River crossings in Lowell, particularly around the Rourke Bridge and on Bridge Street in Lowell, as key issues. General congestion in downtown Lowell, particularly during peak hours, was also frequently identified.

The plan supports but does not identify, a funding source for the Tyngsborough Park & Ride Lot expansion and continual work toward implementing the Commuter Rail Extension Project to Nashua. Utilization data were calculated for the Tyngsborough Lot (248 spaces), the North Billerica Commuter Rail Station Parking Lots (541 spaces), and the Gallagher Terminal Parking Garages (870 spaces). The first two have been consistently full between 2010 and 2018 and the Gallagher Terminal Parking Garage has consistently seen about 75% utilization.

Figure 10.1: Tyngsborough Route 113 Park and Ride Occupancy

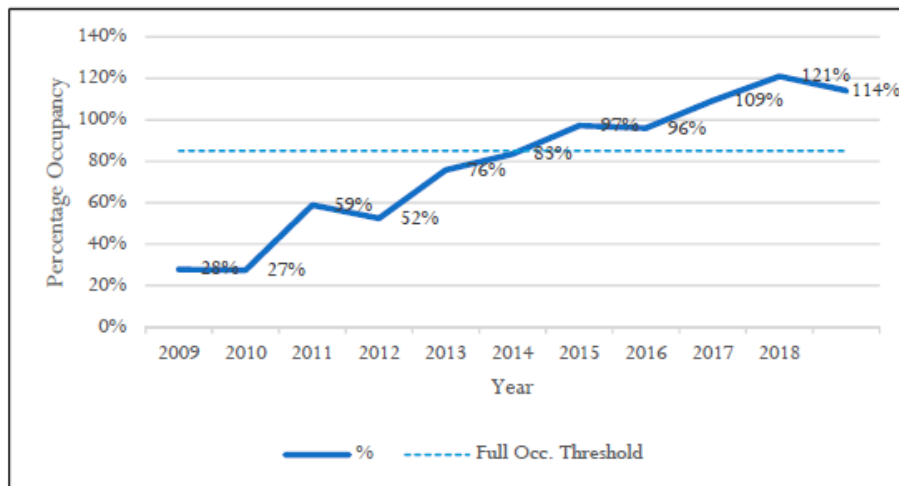


Figure 10.2: North Billerica Parking Occupancy, 2010-2018

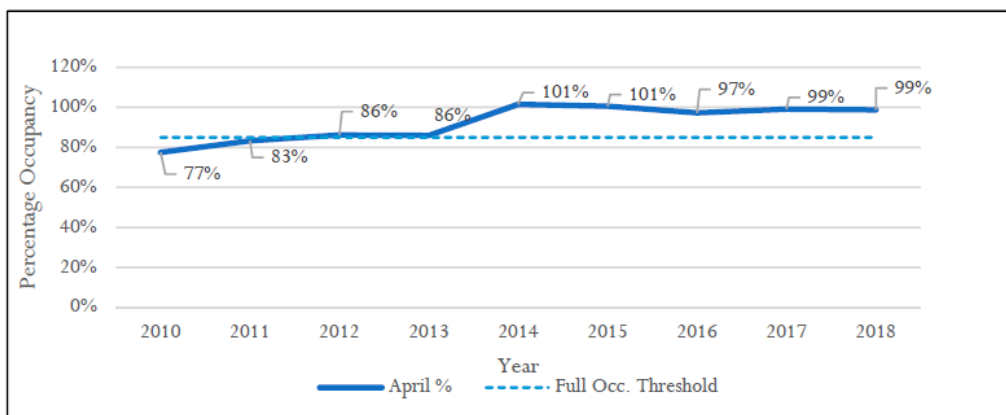
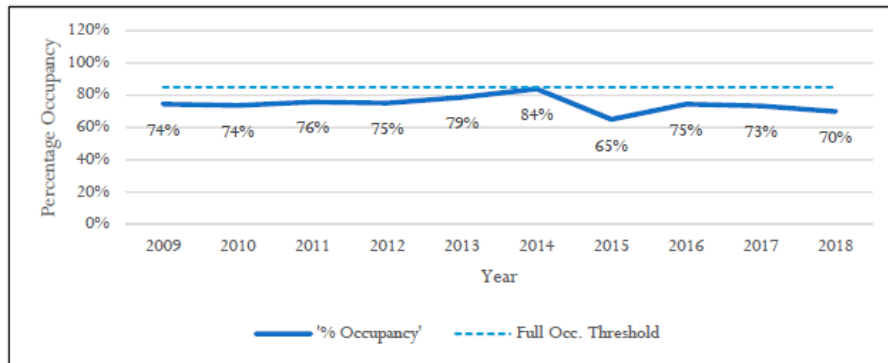


Figure 10.3: Lowell Gallagher Terminal Parking Occupancy, 2009-2018



Source: NMCOG Monitoring

2.2.8. LRTA Comprehensive Regional Transit Plan Update 2020

The LRTA (with consultant AECOM) recently updated its *Comprehensive Regional Transit Plan*²³. Due to the limitations of the COVID-19 Pandemic, LRTA and its consultant conducted an online stakeholder outreach survey open to the public and collected 313 responses. The survey did not achieve a statistically valid sample of either LRTA riders or the region's residents but provided useful insights into key transit needs, issues, and priorities. Four key takeaways from the survey are:

1. Expanded service was a top priority for riders, especially a permanent Sunday service. Later evening service and more connections outside of Lowell were also common requests.
2. While 28 percent of riders who only used fixed-route service rode LRTA daily, only 13 percent of this group had a monthly pass. This may be due to the cost of a monthly pass being financially prohibitive.
3. Many riders, both fixed route and demand response, wanted LRTA to offer more service to New Hampshire, both Nashua generally and the Pheasant Lane and Nashua Malls in particular.
4. Riders wanted the rider-facing bus tracking technology to improve, as many have issues with the RouteShout app that is currently used by LRTA and were either unaware of service changes or unable to tell when a bus is delayed (note that the RouteShout app was suspended at the time of the survey due to COVID-related service changes).

The third takeaway aligns with this NRPC inter-regional transit expansion study and echoes the need for a Nashua-Lowell transit connection among NTS riders and potential transit users in the Nashua region. Accordingly, one of the plan's many recommendations suggests exploring opportunities for implementing pilot regular LRTA service to the Pheasant Lane Mall in Nashua.

Another helpful insight from the *LRTA Comprehensive Regional Transit Plan* is its planning approach to the uncertain post-pandemic future. The plan acknowledges the post-pandemic realities, such as more frequent sanitization of vehicles and more spacious facilities, as well as the uncertainty of the post-

²³ LRTA and AECOM. *Comprehensive Regional Transit Plan Update 2020*. Available via the LRTA's website <https://lrta.com/>.

pandemic ridership level. The plan offers different sets of recommendations based on three different scenarios: a high-ridership scenario (a return to 86% of pre-pandemic ridership), a medium-ridership scenario (between 60 and 85% of pre-pandemic ridership), and a low-ridership scenario (below 60% of pre-pandemic ridership).

2.2.9. Middlesex 3 Community Compact Transportation Study

The Middlesex 3 Coalition is a nonprofit organization created to advance transit interests in northern Middlesex County, MA. The Middlesex 3 TMA is an affiliated transportation management association created to provide transit links for commuters and reverse commuters between Boston/Cambridge and the Middlesex 3 service area. This joint-agency study done for the Middlesex 3 Coalition²⁴ recognizes that enhancing transit services will improve access for the economically disadvantaged population, facilitate economic development by expanding the labor and talent pool to employers, alleviate traffic congestion, and improve air quality. The study provides a list of recommendations, including the following:

1. Expanding the Tyngsborough Park & Ride Lot;
2. Creating additional park & ride facilities;
3. Expanding the Middlesex 3 TMA shuttle services to and from Burlington;
4. Promoting inter-regional (among RTAs) coordination and cooperation;
5. Collaborating with the Boston Express; and,
6. Investigating legislative and policy changes to remove barriers to inter-regional transportation services.

The study includes a business survey conducted by NMCOG regarding employee commute and availability, with 20 responses from businesses within the Middlesex 3 communities. The key findings are as follow:

- 49% of the employees reside within the study area (Middlesex 3 communities), 51% reside outside the study area;
- 65% of the employees arrive at work between 6:00 am and 9:00 am;
- 85% of the employees drive alone to/from work; 10% takes the TMA shuttle;
- Only 2 out of the 20 businesses provide some degree of transportation assistance, incentives, or services for employees;
- 20% of the businesses stated that their businesses have been affected by a lack of transportation options;
- 17% of the businesses stated that they lost 1-5 employees in the past year due to transportation issues; 6% stated that they lost more than 5 employees for the same reason; and,
- 52% of the businesses stated there is usually a surplus of parking on-site; 29% stated there is adequate parking; 14% stated parking is problematic sometimes, and 5% stated there is a chronic shortage of spaces.

²⁴ NMCOG, Metropolitan Area Planning Council, and Central Transportation Planning Staff. 2017. *Middlesex 3 Community Compact Transportation Study*. Available via NMCOG's website <https://www.nmcog.org/>.

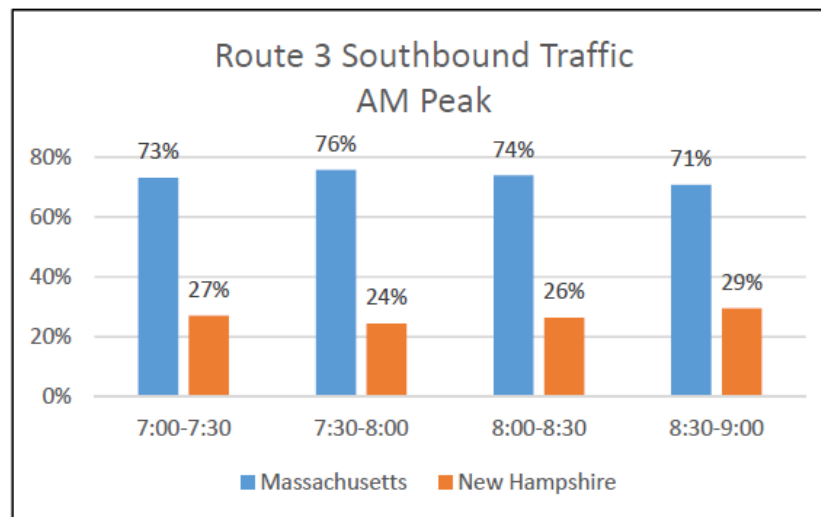
The study also includes an analysis of commuting patterns, complemented by a license state survey. The commuting patterns analysis reviewed the American Community Survey data (2009 – 2013) on the place of residences versus the place of employment. Besides looking within the Middlesex 3 communities, the analysis expanded to include the five southern New Hampshire communities of Hollis, Hudson, Merrimack, Nashua, and Pelham. The analysis found 11.5% of the combined workforce in these five communities work in the Middlesex 3 study area, as shown in the table below:

TABLE 9: COMMUTING PATTERNS - EMPLOYEES LIVING IN SOUTHERN NEW HAMPSHIRE AND WORKING IN THE STUDY AREA

Place of Residence	Place of Employment								
	Total	Bedford	Billerica	Burlington	Chelmsford	Lexington	Lowell	Tewksbury	Tyngsborough
Hollis	302	15	31	180	20	24	32	-	-
Hudson	2,133	151	324	180	489	98	510	296	85
Merrimack	822	57	263	121	107	79	47	99	49
Nashua	4,732	572	657	740	859	345	998	330	231
Pelham	1,344	83	181	67	121	31	769	71	21
Total	9,333	878	1,456	1,288	1,596	577	2,356	796	386
American Community Survey 2009 - 2013									

The license plate survey was an exercise to determine the percentage of New Hampshire drivers who regularly commute along Route 3 and was conducted during the morning peak at the Orchard Street overpass in Billerica. The result is shown below:

FIGURE 9: PERCENTAGES OF NEW HAMPSHIRE VERSUS MASSACHUSETTS COMMUTERS ALONG ROUTE 3 SOUTHBOUND (AM PEAK)



2.2.10. University of Massachusetts Lowell Transportation Master Plan Update 2018

The University (with consultants Stantec and Nelson Nygaard) updated its *Transportation Master Plan*²⁵ in 2018. Enhancing regional transportation & leadership is one of the plan's seven recommendations. This recommendation further breaks down into 6 sub-recommendations:

1. Work with Regional Transit Authorities to provide more direct, one-seat ride service to campus;
2. Remove last-mile barriers to campus;
3. Work with partners to identify more regional intercept points such as park & ride facilities;
4. Develop leadership around regional transportation challenges;
5. Re-engage with local Transportation Management Association (TMA), Middlesex 3 Coalition; and,
6. Coordinate with long-range plans for the extension of Lowell Line to Nashua/Manchester, with a rail stop at UMass Lowell.

The plan recognizes the importance of regional transit services in offering an alternative to driving for commuters who live outside of Lowell, mitigating the parking demand on campus and traffic congestions around Lowell, and achieving the University's sustainability goals.

The plan is informed by an extended outreach effort, which includes an online survey to the university community with 3,840 responses. The key findings are the following:

1. Most university employees drive alone to work, 64% of students who live off-campus in Lowell or commute from their family homes drive alone, while students who live in on-campus residence halls rarely drive.
2. Among a list of primary reasons for driving alone, time and convenience are the top reasons, but one-third of drive-alone commuters cited emergency or errands as a reason for driving.
3. Many respondents perceive travel time by the university shuttle service as too long and that the shuttles are not available to most employees and students who live off and away from the campus.

2.3. Public Outreach

Due to the study coinciding with the COVID-19 pandemic, new in-person public outreach was limited for this study. Also, NRPC staff determined the timing was not right to initiate discussions with Nashua area employers regarding potential transit services, including the proposed inter-regional transit routes and the possibility of operating micro-transit services to their facilities from Massachusetts origins. One notable event was that BAE terminated its contribution to the NTS downtown shuttle due to the pandemic and uncertain prospects to work commute in the foreseeable future. This highlights the fact

²⁵ UMass Lowell, Stantec, Nelson Nygaard. December 2018. *UMass Lowell Transportation Master Plan Update 2018*. Available via UMass Lowell's website <https://www.uml.edu>.

that pre-COVID commuting patterns must be largely re-established for new transit services to be considered.

NRPC staff did contact various organizations for relevant information and data for this study, including UMass Lowell, Middlesex 3 Coalition, and public transit serving the Nashua and Lowell areas. For UMass Lowell, NRPC partnered with the University to conduct an online survey of its students, faculty, and other UMass Lowell staff living in the NRPC region. The survey was conducted over the first quarter of 2021.

2.3.1. Survey of University of Massachusetts-Lowell Employees and Students

The primary means of evaluating potential demand for a Nashua to UMass Lowell transit service is the application of the ridership estimation procedure used for other alternatives. The survey to the University's students, faculty, and other UMass Lowell staff living in the NRPC region provides supplemental information and gauges the level of interest that may exist for the proposed service. The survey form is available in Appendix 1 – UMass Lowell Survey of Nashua Area Resident Students and Faculty/Staff Survey Form.

There were 114 participants in the survey, which represents about 20% of the total 227 students and 346 faculty (573 total) living in the NRPC region. The survey was conducted during the 2020-21 school year, which was substantially impacted by COVID. The policy of the university for the school year was that students would primarily attend class remotely, except for circumstances that necessitated in-person learning, such as lab classes. Remote learning was reported by 75% of student respondents and in-person instruction by 25%.

The survey responses break down as follows, with survey percentages applied to the 573 total to produce an estimated breakdown shown below.

UML Category	Survey	Total
Full-Time Faculty/Staff	49.5%	284
Part-Time Faculty/Staff	3.5%	20
Full-Time Student	37%	212
Part Time Student	10%	57

It is anticipated that following the widespread distribution of vaccines, normal campus life will return for the 2021-2022 school year. Survey respondents were asked where they expected to live when in-person instruction resumes, with the results presented in the following table.

Expected Place of Residence	Survey	Total
City of Nashua	49%	281
Other Nashua area	40%	229
UML On-Campus housing	7%	40
Off-Campus & Other	4%	23

This question was answered by all but one survey taker. Since seniors will generally not be returning to UML next school year, they anticipated a return either later in the present term or addressed the

question in a hypothetical This indicates that nearly 90% of the 573 total students and faculty living in the NRPC region will be candidates for a shuttle service to the campus.

The vast majority of students and faculty/staff expect to be on campus regularly once in-person learning does resume, with three-fourths stating they will be on campus 4 to 5 times per week (70% being every weekday). Combined with the high percentage of students intending to commute from the Nashua area rather than re-located to housing in Lowell provides a strong potential for the success of a shuttle service.

Frequency On Campus	Survey	Total
4 to 5 days/week	75%	430
2 to 3 days/week	17%	99
1 to 2 days/week	6%	35
Less Often	2%	10

Survey takers were asked how often they would use a shuttle bus to UMass Lowell once normal campus operations resume. The following table presents the distribution. Those who did not respond are included with the Rarely/Never group. This group, comprising nearly 40% of all Nashua area-based UML students and employees, is presumed to be non-riders of any future shuttle service.

These results can also be used to calculate the expected value of daily shuttle users by multiplying the number of factored responses for each frequency by the mean of that distribution. In other words, a 3-to-4-day response produces an average of 3.5 days/week, which works out to .7 trips per day for an average respondent in this range. This is then multiplied by the total factored 98 responses in this range.

The calculation to produce an overall stated preference estimate is:

$$72 + .7 * 98 + .3 * 98 + .5 * 83 = 211.5$$

This stated preference result will be compared with the estimate developed using the ridership model estimation procedure.

Shuttle Use	Survey	Total
Every Weekday	13%	72
3 to 4 times/week	17%	98
1 to 2 days/week	17%	98
Occasionally, < 1x/week	14%	83
Rarely/Never/No Response	39%	222

UML students and faculty/staff were asked what the highest daily roundtrip fare they would be willing to pay to use a shuttle service to campus. One-third (33%) would only ride a free shuttle, another 29% would pay \$4 per day maximum and a small percentage (6%) would be willing to pay \$6. Nearly one-third of respondents (32%) said they would not ride the shuttle or did not respond to the question.

Highest Roundtrip Fare	Survey	Total
Would not ride/No resp	32%	184
Ride only if free	33%	189
\$4 maximum roundtrip	29%	164
\$6 maximum roundtrip	6%	36
\$10 maximum roundtrip	0%	0

The next question dealt with the preferred park-and-ride location for picking up the shuttle. Interestingly, there was greater interest in park-and-ride-location than there was for riding a shuttle. The responses were dispersed among the various locations offered, so a clear preferred location did not emerge. Since the combination of Tyngsborough P&R and the Pheasant Lane Mall total 28% (35% excluding the no responses) provides a solid case for a southern Nashua location, 28% of the respondents to this question favor the Exit 8 P&R, suggesting two stops may be needed to fulfill shuttle demand. It is not likely that residents in south Nashua would drive north to the Exit 8 lot to board a southbound bus to Lowell.

Only 10% stated downtown Nashua in the vicinity of the NTS transit center as a preferred location. There is also no free parking in this area, which is seen as a strong inducement to take a shuttle. However, a bus starting from this location – at least on a trial basis – would provide an alternative to those without access to vehicles. The bus might then travel to the Exit 8 lot, where it would begin its southbound journey. For riders who board from downtown, it would be a circuitous path but they would have the transportation alternative available.

Preferred Park-Ride Location	Survey	Total
Nashua CBD/Transit Center	10%	57
Exit 8 Park-Ride Lot	23%	129
Tyngsborough Park-Ride Lot	12%	67
Pheasant Lane Mall	16%	93
Nashua Mall	15%	88
Other	5%	31
No Response	19%	108

Respondents were also asked to rank shuttle bus service amenities in order of priority. There were 87 responses to this question, in which at least one amenity was ranked. Those ranked 1 through 5 were tabulated and are summarized in the following table. The percentages for each rank are based on the 87 responding to the question and the total for each amenity rank is obtained by applying this percentage to the ratio of the questions responses to the total sample (87/114) and applying this result to the total population of 573 students and faculty/staff who live in the Nashua area. For each amenity, the total number of responses ranked 1 through 5 are summed. Finally, a total score is obtained by assigning 5 points for a number 1 rank, 4 points for number 2, and so forth. Free or low-cost parking received the most 1 through 5 ranks (357), as well as the highest total score (1503). This was followed by convenient parking with 337 ranked and a score of 1377. Ease of access and a sheltered wait area are the other two amenities that received notable rankings.

Importance of Shuttle Bus Amenities

Amenity Type	Amenity Rank				Total 5 Ranked	Total Score
	1	2	3	4		
Convenient parking	136 31%	126 29%	55 13%	10 2%	10 2%	337 1377
Free/low-cost parking	176 40%	116 26%	35 8%	25 6%	5 1%	357 1503
Ease of access	70 16%	60 14%	70 16%	40 9%	25 6%	266 910
Proximity to bus stops	5 1%	20 5%	20 5%	15 3%	10 2%	70 206
Bicycle Accessibility	0 0%	0 0%	10 2%	0 0%	10 2%	20 40
Pedestrian accommodations	5 1%	5 1%	5 1%	25 6%	10 2%	50 121
Sheltered wait area	25 6%	40 9%	75 17%	65 15%	40 9%	246 684
Seating	0 0%	15 3%	45 10%	75 17%	55 13%	191 402
Access to restrooms	0 0%	5 1%	10 2%	15 3%	25 6%	55 106
Proximity to coffee/food estab.	5 1%	0 0%	5 1%	5 1%	35 8%	50 85
Other	15 3%	0 0%	10 2%	0 0%	0 0%	25 106

The final two questions dealt with the frequency of use of transportation modes before COVID impacted the UML campus, which required remote learning, and the intended frequency of use of these modes when campus life returns to normal. It is to be noted that the question did not specify transportation to UML, but simply the use of various modes in general. However, it does indicate a propensity to use these modes and potential use for future service to the campus.

The “Often” category was combined with “Very Often” since the former resulted in a low response rate and the difference between categories is subjective, as specific frequencies were not provided. Similarly, “Rarely” and “Never” were combined, as the former had a low response the use of these distinctions between the two is minimal.

Respondents were prompted to check all that apply, consequently, frequency columns can add to over 100%, which is the case for the “Often” frequency for modes. The use of private vehicles, mostly driving alone and secondarily with others, predominates as a mode among this population, which is true for virtually all trip-makers in the region other than the transit-dependent population. Those who indicated

they have often used shuttle buses or public transit in the pre-COVID period total 22% of the population and would mostly be the student component of the population. For this study, there is not a significant distinction between these modes, indicating that about 120 of the 573 respondents have often used the transit/shuttle modes and another 92 have been occasional users.

Transportation Modes Used Before COVID Shift to Remote Learning

Mode	Often	Sometimes	Rarely/ Never
Drive Alone	527 92%	17 3%	29 5%
Drive/Ride with others	80 14%	69 12%	424 74%
Public Bus	40 7%	46 8%	487 85%
Shuttle Bus	80 14%	46 8%	447 78%
Commuter Rail	46 8%	46 8%	481 84%
Uber/Lyft	17 3%	40 7%	516 90%
Bicycle to school/work	0 0%	34 6%	539 94%
Walk to school/work	23 4%	11 2%	539 94%

Asked how frequently they would be willing to use any of the listed transportation modes (if available) when in-person instruction resumes, there was significant interest in the use of public transit and shuttle services. Whereas about 7% of respondents indicated they often used public buses and 14% before COVID restrictions, the percentages following resumption of normal campus life rise to 17% and 44% respectively. The two-mode percentages for each scenario are not additive, as one person may take each mode for different trip purposes. However, the results are encouraging in terms of identifying a potential market for inter-regional transit service to UML.

Frequency of Transportation Modes Use Upon Return to Regular Campus Life

Mode	Often	Sometimes	Rarely/ Never
Drive Alone	481 84%	46 8%	46 8%
Drive/Ride with others	109 19%	132 23%	332 58%
Public Bus	97 17%	115 20%	361 63%
Shuttle Bus	252 44%	115 20%	206 36%
Commuter Rail	103 18%	115 20%	355 62%
Uber/Lyft	0 0%	46 8%	527 92%
Bicycle to school/work	0 0%	29 5%	550 96%
Walk to school/work	40 7%	6 1%	527 92%

2.3.2. Input from Middlesex 3 Coalition

As noted above, the Middlesex 3 Coalition is a 501(c)6 non-profit organization that advances business and economic development interest in 9 Middlesex County communities along the Route 3 Corridor – Bedford, Billerica, Burlington, Chelmsford, Lexington, Lowell, Tewksbury, Tyngsborough, and Westford, MA. It was formed in 2014 to address transportation challenges similar to those currently faced by the Nashua region. M3C also administers a transportation management association (TMA), which operates employer shuttle services through a private transportation consultant.

The Coalition is led by a board of directors consisting of municipal, business, educational, financial, and real estate leaders from the Middlesex 3 communities, and membership is available to regional stakeholders, including leaders in finance, education, medical, real-estate development, engineering, non-profits and the community at large.²⁶ In addition to transportation issues, the Middlesex 3 Coalition also focuses on other issues pertinent to business and economic development, such as education and workforce development, infrastructure, and real estate development

The Middlesex 3 TMA, a separate 501(c)6 entity but administered by the M3C staff, is supported with funds contributed by various regional employers interested in offering transit connections to their employees. The TMA contracted a corporate transit consultant to operate four shuttle routes before the COVID-19 pandemic, including shuttle service between the MBTA Alewife Station and several large

²⁶ Middlesex 3 Coalition. 2021. "About Us". Undated. <https://middlesex3.com/about-us/>. Accessed June 2, 2021.

Route 128 (I-95) area employers. Beyond shuttles, the TMA also offers other travel demand management programs through its consultant.

NRPC staff communicated with M3C for more information, which revealed the following:

1. Aside from liability insurance coverage, there are no notable obstacles for M3 TMA, as a private entity, to expand service across the state line in New Hampshire.
2. Operating with private contributions has fewer compliance and restriction challenges, as compared to public funds; e.g. equipment accessibility, hours-of-operation.
3. Two TMA members had expressed interest in providing Nashua-Billerica shuttle service: Farley White at 1001 Pawtucket Blvd. and Lowell General Hospital on Varnum Ave.
4. M3 TMA had four shuttle routes, but they were reduced to one during the pandemic. One was a Billerica-Alewife shuttle service which had minimal ridership northbound.
5. The TMA faced difficulties in accessing the Lowell Gallagher Center. As a workaround, the TMA shuttle used the parking lot of Dunkin Donuts on Dutton Street

NRPC staff also reached out to M3 TMA's corporate shuttle consultant, TransAction Associates, to understand the services and shuttle vehicles they provided to M3 TMA.

2.3.3. Examples of Other Inter-Regional and Inter-State Transit Connections

There are examples of cross-state-border public transit connections/services in nearby regions. NRPC reached out to several of these operators to learn more about their operations.

Advance Transit serves multiple destinations between New Hampshire and Vermont in the Lebanon-Hanover area. While originated in New Hampshire and registered as a New Hampshire non-profit organization, Advance Transit currently operates out of its Wilder, VT headquarters. The system has four cross-state-border routes. Advance Transit also operates on a distinctive fare-free model and organizes a transportation management association (TMA) for its region.

On the New Hampshire seacoast, the COAST Bus system operates two routes into Maine, including a route between Portsmouth, NH, and Kittery, ME that provides transit service to the Portsmouth Naval Shipyard, a key employment center in the region.

In Massachusetts, Haverhill-based Merrimack Valley Regional Transportation Authority (MVRTA) operates multiple routes into Southern New Hampshire, including a route from Lawrence to the Walmart in Plaistow, and a seasonal route to Hampton Beach. Even though the routes are open to the public on both sides of the state border, the New Hampshire communities served by these routes do not contribute toward the service. Nevertheless, these routes provide valuable transit connections for many MVRTA riders.

LRTA does not operate across state borders but two LRTA routes terminate just south of the state line on Route 3A (at Ayotte's Stateline Market in Tyngsborough, MA) and at the Pheasant Lane Mall (inside the mall's parking lot but south of the state border), providing transit connections from Lowell to destinations on both sides of the state border.

Even though NRPC did not reach out to the MBTA for input to this study, it is worth noting that the MBTA South Coast Commuter Rail Line serving Boston, Stoughton, Providence, and other destinations in between Massachusetts and Rhode Island has consistently been the busiest route in the MBTA Commuter Rail system.²⁷

The 2018 Nashua Inter-State Analysis mentioned in the introduction concludes after presenting its findings, “This analysis illustrates the fact that labor markets do not recognize state borders. Distance and drive time to a job are more important to commuters.” Besides the noted examples of inter-state transit services, many more across the United States show that communities along state borders can benefit from transit connections as much as communities in the heart of a state.

The challenges of providing transit service across state borders can be overcome with an understanding of the relevant regulatory framework, regional benefits, and opportunities for cross-border and cross-jurisdiction partnerships.

2.3.4. Boston Express Ridership Data

NRPC staff was able to acquire ridership data from Boston Express, which is used as input to the alewife shuttle ridership forecast. In 2019, before the COVID-19 pandemic, weekday roundtrips during the peak travel months averaged 261 per day, of which 75 were to Logan Airport and 186 disembarking on the commuter loop (stops at State/Washington Streets, Park Street Station, Tufts Medical Center) or the terminus at South Station.

Boston Express Summer 2019 Ridership

	Ave Wkday Roundtrips	Pct. Logan Airport	Total Logan	Total So. Station
May	250	29%	72	178
June	278	28%	78	200
Sept	258	28%	72	186
Oct	257	30%	76	181
Ave - Peak Mos.	261	29%	75	186

NRPC had intended to survey Boston Express passengers boarding at Exit 8, to obtain information regarding rider town of residence, final destination, trip purpose, use of alternative modes, and other information. As arrangements were being made with NHDOT to facilitate the conduct of the survey with the consent of Boston Express management, the COVID pandemic hit. Boston Express service was suspended and did not resume until August 16, 2020. Ridership remains significantly below pre-COVID levels and now stands at about 65 per weekday. A count of parked vehicles at the lot for a weekday in May 2021 indicated around 100 vehicles, which is down from 344 in March 2020, just before the pandemic struck.

²⁷ MBTA and MassDOT. January 28, 2019. *Commuter Rail Ridership Counts*.

3. OPERATIONAL ANALYSIS

Based on the input provided in Chapter 2, NRPC staff developed a set of operational parameters for the proposed inter-regional transit service, from routing to service models. These parameters serve as the input for the ridership projection in Chapter 4 and, in Chapter 5, each model would be evaluated for each of the proposed routes as part of the feasibility evaluation.

3.1. Destinations and Routes

Previous studies, plans, and public outreach provide insight into potential destinations for the proposed inter-regional transit service. However, NRPC staff had to fill in several missing but critical details such as the location of the origin stations, the number of stops along the routes, and the exact path of the proposed routes. The analysis behind the selection of the proposed routes is laid out in the next three sub-sections.

3.1.1. Destination Selection

The *2019 NRPC Transit Expansion Study* and *2016-2025 NTS Comprehensive Plan* identify the following destinations to be evaluated in this study:

1. The Charles A. Gallagher Transit Terminal in Lowell, which includes the Lowell MBTA Commuter Rail Station and the Robert B. Kennedy Bus Transfer Center).
2. Pheasant Lane Mall.
3. Park-and-ride facilities in Massachusetts that offer commuter rail or commuter bus service.

Further discussion with NRPC partners identified two more destinations:

4. The University of Massachusetts Lowell (UMass Lowell)
5. Business/retail clusters along the Route 3 corridor in Bedford, MA, and Burlington, MA. (Bedford/Burlington)

The University has a substantial number of students and staff members who reside in and commute from Nashua who can benefit from a direct transit connection. Similarly, a large number of employees and, to a lesser extent, customers, can benefit from a transit connection from Nashua to the various business and retail clusters near the Route 3 / I-95 Interchange.

Lastly, NRPC staff identified another destination:

6. The Alewife MBTA Red Line Station

While a transit connection to the Lowell Gallagher Terminal provides Nashua's commuters direct access to downtown Boston's North Station via the MBTA Commuter Rail, a transit connection to the Alewife Station provides direct access to Somerville, Cambridge, and Boston via the Red Line – including stops at Harvard, MIT, and Mass General Hospital, with rapid transit connections to the Green Line at Park Street Station. Notably, Alewife Station is also the principal destination for the M3 TMA shuttle bus service, primarily to facilitate the reverse commute of employees from Boston/Cambridge/Somerville to Rte. 128 employers.

Further analysis grouped the Pheasant Lane Mall and park-and-ride facilities as potential locations for origin stations, as described in the following section, which leaves four destinations (#1 Gallagher Terminal, #4 UMass Lowell, #5 Bedford/Burlington, and #6 Alewife).

3.1.2. Origin Station Locations in the Nashua Region

Given the Nashua-focus perspective of this study, NRPC staff considered the Nashua Region as the origin of the proposed inter-regional transit service. Nevertheless, this does not mean the proposed transit service consisted of one-way routes nor do the services only cater to the needs of the residences of Nashua and in New Hampshire. It is recognized, though, that reverse trip potential is limited due to the lack of “last mile” service or the inconvenience of having to make one or more transfers on the NTS system.

For the route origin, NRPC staff identified the following locations:

- Nashua Transit Center in Downtown Nashua
- Pheasant Lane Mall
- Tyngsborough Park & Ride Lot.
- FE Everett Turnpike Exit 8 Park & Ride Lot
- FE Everett Turnpike Exit 5 Park & Ride Lot

Nashua Transit Center

The Nashua Transit Center on Elm Street, Downtown Nashua, is a potential origin location for the proposed inter-regional transit service. It is an established transit hub serviced by the majority of NTS bus routes. It is directly adjacent to a city parking garage and the Nashua City Hall, as well as within walking distance to many downtown neighborhoods. However, the city’s parking garage does not offer free parking and the transit center is many blocks away from Highway 3, which makes any originating routes from the Nashua Transit Center more susceptible to in-town traffic congestion, especially during rush hours. This location will appeal to those without access to vehicles and are by definition transit-dependent. The one proposed service for which a downtown origin is not considered is the Bedford/Burlington employer shuttle, as the existing pool of commuters utilize private autos for travel and hence can easily access a shuttle at a park-and-ride location.

Pheasant Lane Mall

Strategically located immediately north of the state border to attract customers from both the Nashua region and northern Massachusetts, the Pheasant Lane Mall is another potential origin location. Its greatest appeal will be to those in the southern portion of the Nashua Region who would prefer a southern boarding point for a shuttle service. The mall is close to the highway ramps and has plenty of parking spaces. Furthermore, during the mall’s hours of operation, the shops, food/coffee establishments, and restrooms are all complementary to a transit stop. Therefore, it is not surprising that the 1999 Passenger Rail Alternative Analysis identifies Pheasant Lane Mall as a potential railway station. However, the willingness of the mall owner and any subsequent negotiation to allow an inter-regional transit station and the use of its parking spaces for commuter parking would dictate the feasibility of running the proposed service routes from the mall.

Park & Ride Lots

The three Park & Ride Lots are located along the Turnpike/Route 3 with easy access to the highway and all offer free parking. The Tyngsborough and Exit 8 lots are serviced by the Boston Express while the Exit 5 lot is serviced by NTS. The Tyngsborough and Exit 8 lots have more parking spaces but also experience high utilization (parking fills up quickly, and users have a hard time finding vacant spaces during the workday). The Exit 5 lot has fewer parking spaces but experiences a lower utilization (given the lot is not serviced by the Boston Express). None of the park & ride lots are close to any food/coffee establishment but the Exit 5 lot is adjacent to the Nashua YMCA, which has restrooms available to its members.

Another issue NRPC staff identified is that the Exit 8 lot is located rather north of the city center, which may preclude commuters who live near the city center or any point south, who may not find driving north before boarding a southbound bus to be intuitive. For this reason, a second stop either at a new southern Nashua park-ride lot or the Tyngsborough lot would be needed for a shuttle originating at the Exit 8 location to reach its full ridership potential.

Pros and Cons of Potential Origin Locations

Potential Origin Location	Pros	Cons
Nashua Transit Center (504 spaces) ²⁸	- Established Transit Hub serviced by local transit (NTS) - Close to coffee/food and restrooms - Walkable distance to many downtown neighborhoods	- Parking not free - Many blocks away from the highway ramp
Pheasant Lane Mall (about 5,000 spaces) ²⁹	- Shops, coffee/food, and restrooms (during the mall's hours of operation) - Plenty of parking spaces (likely free if negotiated) - Close to the highway ramp	Feasibility dictates by the willingness of the mall owner and subsequent negotiations
Tyngsborough MassDOT Park & Ride Lot (248 spaces) ³⁰	- Serviced by Boston Express - Free Parking - Close to the highway ramp	- Not serviced by local transit (LRTA) - Not close to coffee/food and restrooms - High Utilization / Parking fills up quickly (average utilization over 100%)³¹

²⁸ Parkopedia.2021. <https://www.parkopedia.com/>. Accessed June 17, 2021. Parkopedia indicates the Elm Street Garage has 504 parking spaces.

²⁹ Google. 2021. <https://www.google.com/maps/>. Accessed June 17, 2021. Rough estimate of the mall parking spaces based on Google Map aerial/satellite imagery.

³⁰ NMCOG Regional Transportation Plan FFY 2020-2040

³¹ *Ibid.*

FE Everett Turnpike NHDOT Exit 8 Park & Ride Lot (377 spaces) ³²	• Serviced by Boston Express local transit (NTS) • Free Parking • Close to the highway ramp	• Not close to coffee/food and restrooms • High Utilization / Parking fills up quickly • Commuters living in Nashua and south of the station may not find it intuitive to drive north to board a southbound bus
FE Everett Turnpike NHDOT Exit 5 Park & Ride Lot (108 spaces) ³³	• Serviced by local transit (NTS) • Free Parking • Close to the highway ramp • Lower Utilization then the other two Park & Ride lots • Adjacent to Nashua YMCA (restrooms available to YMCA members)	• Not serviced by Boston Express • Not close to coffee/food • This Park & Ride is smaller than others such as the Exit 8 Park & Ride Lot

Summarized in the table above, there are various pros and cons associated with each potential location as the origin station for the proposed inter-regional transit service. The characteristics of these locations would also serve some riders better than others. For example, the Park and Ride Lots offers free parking and convenient access to riders who have access to an automobile but are far away from the city center and amenities, which renders the Park and Ride Lots less convenient to riders who do not have access to an automobile.

As noted in Section 2.1.7, NRPC staff identified two distinctive groups of riders that would benefit from the proposed inter-regional transit service: 1) riders with lower income, do not have regular access to an automobile, and have to rely on transit for work and other trips; 2) riders with higher income, have regular access to an automobile, and would like to take transit to work, and occasionally for other trips, as an alternative to driving. Consequently, NRPC staff determined that the first group would be best served by an origin station at the Nashua Transit Center while the second group would be best served by an origin station in one or two of the larger park and ride lots.

Despite being a popular destination for both NTS and LRTA riders, the Pheasant Lane Mall is not considered in the current routing iteration due to the uncertainty on the willingness of the mall owner to allow the proposed inter-regional transit service and commuters' use of its parking lot. Moreover, adding another stop off the highway will lengthen travel time. Nevertheless, further coordination between NTS and LRTA on their services to Pheasant Lane Mall is included as an implementation strategy in Section 5.4.

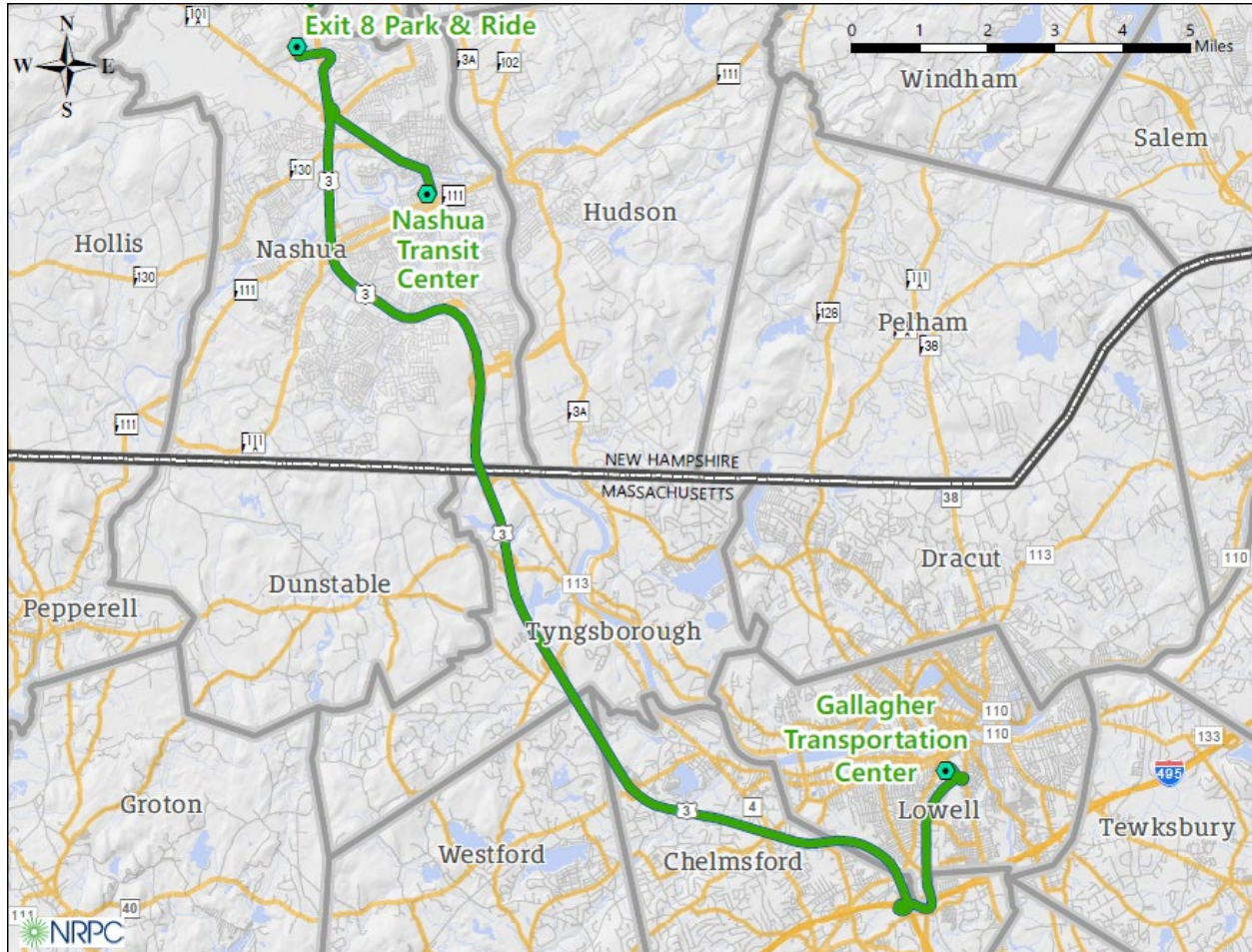
³² NHDOT. 2011. "NH Rideshare Program". <https://www.nh.gov/dot/programs/rideshare/lots/index.htm>. Accessed June 17, 2021.

³³ *Ibid.*

3.1.3. The Four Proposed Routes

Based on the selected destinations and origin station locations, four routes were proposed for evaluation in this study, as follow:

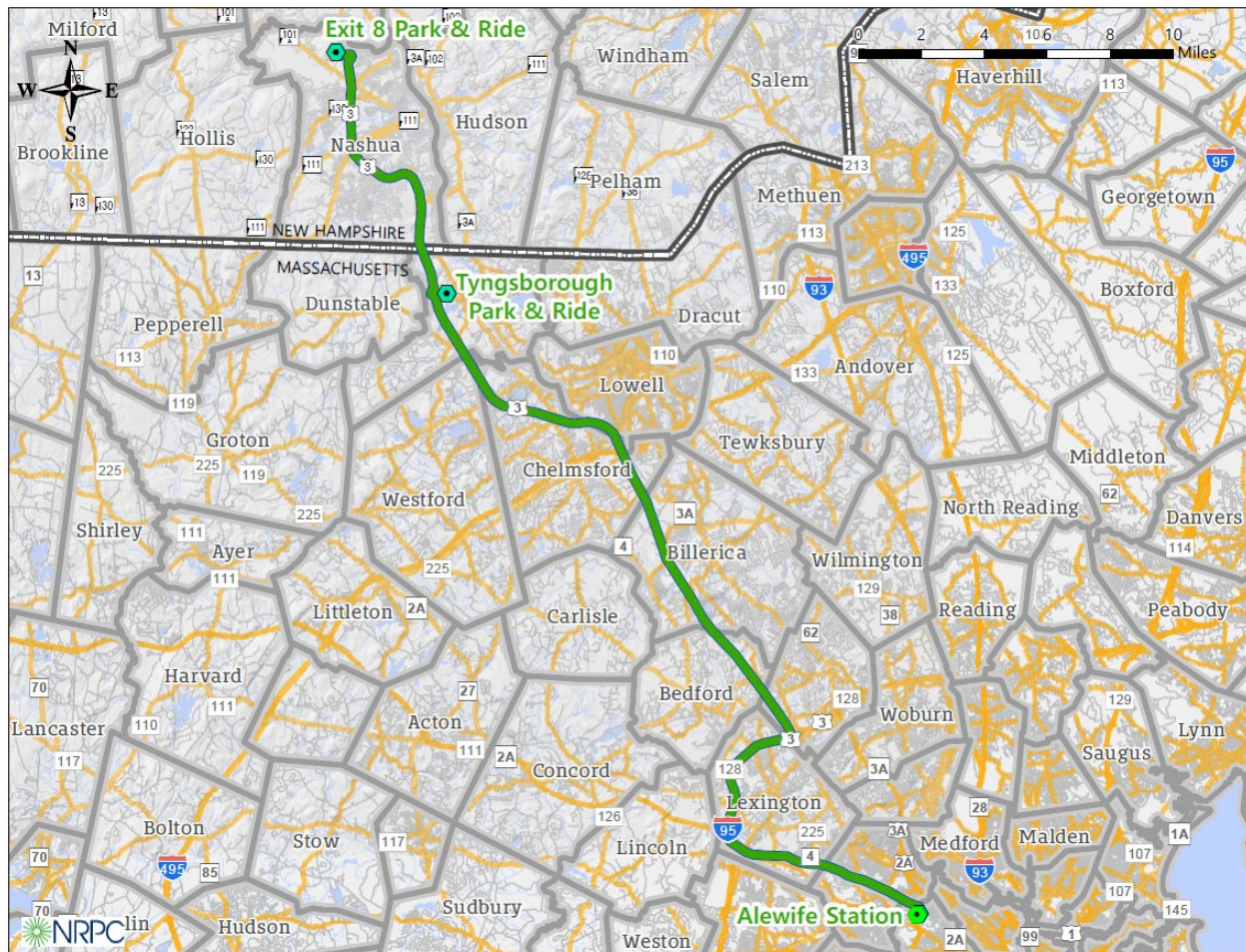
Nashua Shuttle to Lowell Gallagher Transit Terminal



This route originates from the Nashua Transit Center, stops at Exit 8 Park & Ride, and then terminates at the Gallagher Transportation Center in Lowell. Stopping at both the Nashua Transit Center and Exit 8 Park & Ride Lot would provide riders both with or without access to an automobile a direct transit connection to Lowell and the opportunity to transfer to the LRTA system or MBTA's Commuter Rail.

As public input from the NMCOG Report has indicated, there is a notable demand for a transit connection from Lowell to Nashua as well. The ridership potential is indeterminant, due to a lack of data, but is likely to be small based on responses obtained in the 2018 on-board NTS survey which showed a handful of NTS riders would utilize a transit service into Lowell. NRPC staff recognizes the opportunity to serve such demand through a return trip from the Gallagher Transportation Center to Nashua Transit Center.

Nashua Shuttle to Alewife MBTA Station, Cambridge



This route originates from the FFE Exit 8 Park & Ride located north of Downtown Nashua, stops at the Tyngsborough Park and Ride Lot, and terminates at the Alewife MBTA Subway Station. The purpose of this route is mainly to provide a transit alternative to commuters who currently drive into Boston proper. Essentially, it is an alternative to operating a shuttle to Lowell terminal to connect with rail to Boston.

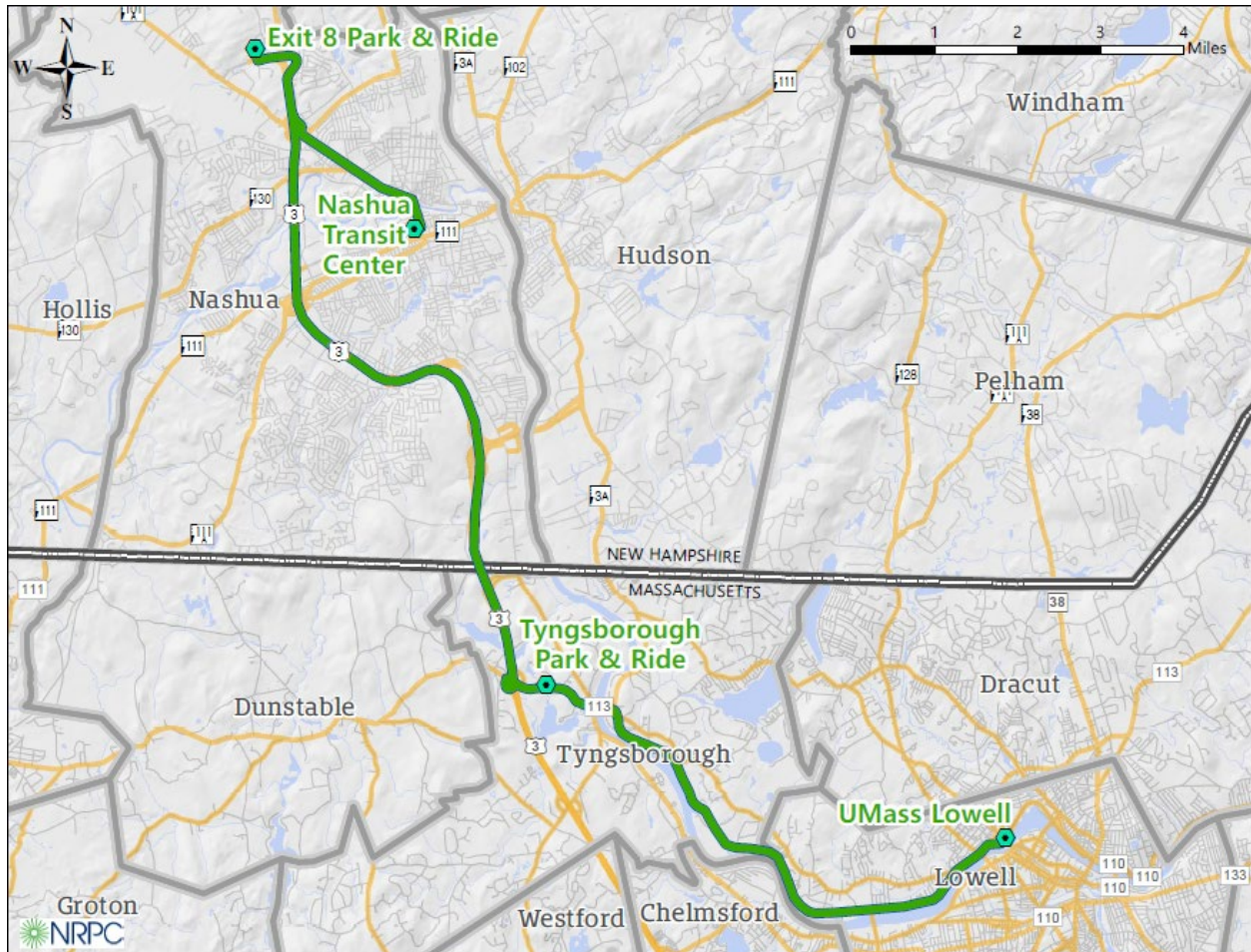
Together with the consideration of shortening the travel time, NRPC staff opted not to begin the route from the Nashua Transit Center. Riders who do not have access to an automobile may instead utilize existing NTS service from downtown to the Exit 8 lot.

NRPC staff also designed the route to make a stop at the Tyngsborough Park & Ride after considering many commuters who live south of the Exit 8 Park & Ride Lot may not see it intuitive to drive north to catch a south-bound shuttle. Furthermore, stopping at Tyngsborough (or a new south Nashua lot) offers the transit connection to more commuters and also potentially increases the ridership.

As is true for the Nashua to Lowell Gallagher Terminal shuttle, there is a limited potential for reverse trips, as the lack of “last mile” connections discourages the use of the mode. However, a stop at the

Nashua Transit Center would provide a shuttle transit alternative for transit-dependent persons along all NTS route corridors. This is further discussed in Section 4.4.1.

Nashua Shuttle to UMass Lowell



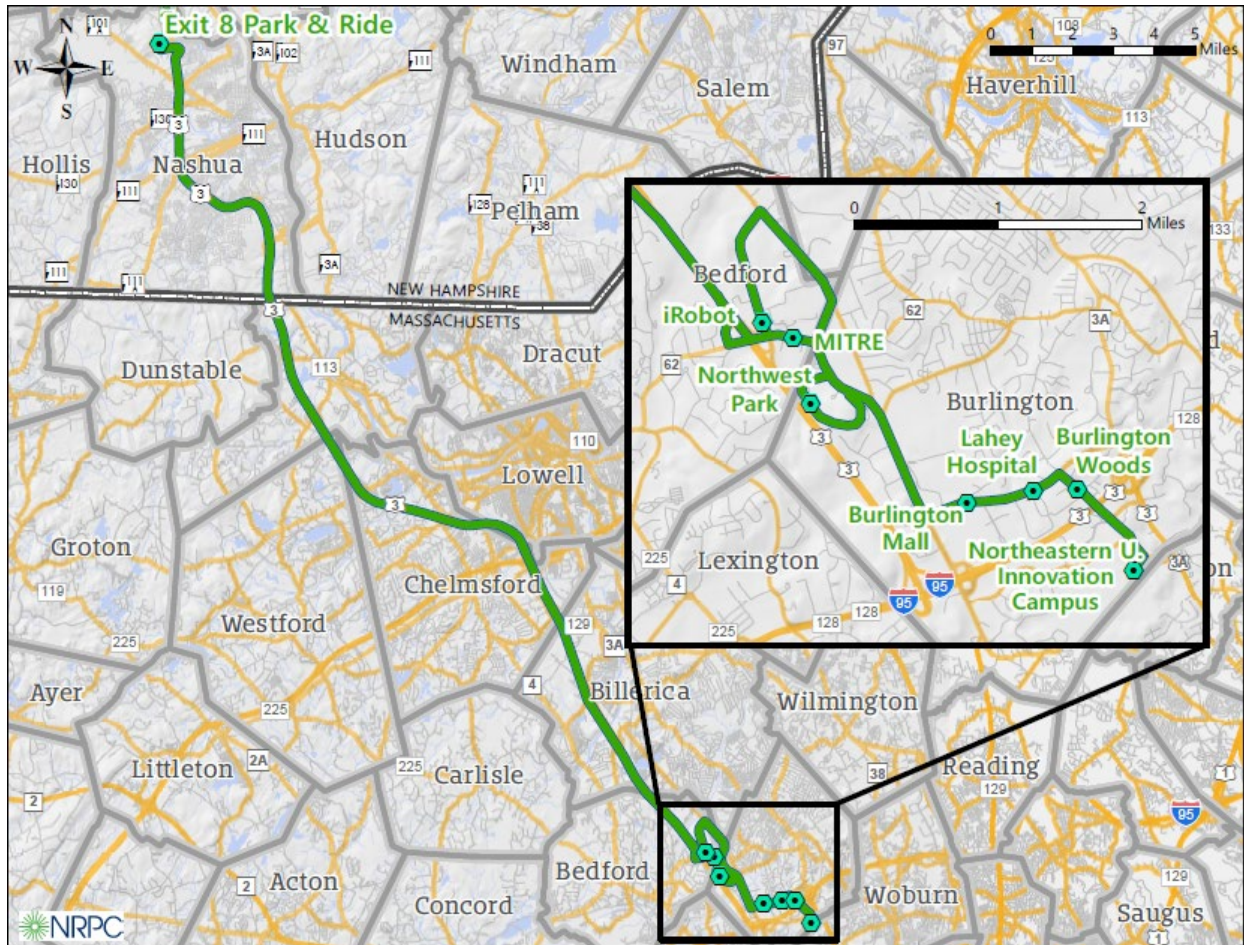
This route originates from the Nashua Transit Center, stops at the Exit 8 Park & Ride Lot, stops again at the Tyngsborough Park & Ride Lot, and terminates at UMass Lowell North Campus. Again, akin to the proposed Nashua Shuttle to Lowell Gallagher Transit Terminal, stopping at both Nashua Transit Center and the Exit 8 Park & Ride Lot would offer students and university employees both with and without access to an automobile a direct transit connection to the university.

For the route's terminus, the North Campus Shuttle Stop (or a nearby on-street location due to the university policy forbidding outside operators from campus grounds out of liability/insurance concerns) is chosen to minimize delay and contribution to congestion across the Merrimack River crossings in Lowell, especially since the UMass Lowell Roadster shuttle system already provides university's riders connections from North Campus to other parts of the university.

After determining that Route 113 through the Tyngsborough Bridge offers the most direct path to the destination, NRPC staff designed the route to make a stop at the Tyngsborough Park & Ride Lot, which is right along Route 113.

The Middlesex 3 Coalition indicated that several of its member along Route 113/Pawtucket Boulevard are interested in having a transit connection to Nashua. While not considered in this scenario, collaboration with these employers is certainly a great opportunity. However, delay in travel time and a mix of different types of riders would have to be considered (e.g. fare options).

Nashua Shuttle to Bedford/Burlington Employment & Retail Clusters



This route originates from the Exit 8 Park and Ride Lot located north of Downtown Nashua and makes stops at various employment/retail destinations across Bedford and Burlington. The final location of the stops will be dependent on interest from the regional employers to fund the proposed transit service. NRPC staff has identified key employment and retail destinations: iRobot, MITRE, Burlington Mall, Lahey Hospital, Burlington Woods, and the Northeastern University Innovation Campus.

Given the circuitous route and significant travel time necessary to service multiple employment/retail destinations, alongside the commuter-oriented nature of this route, NRPC staff decided not to add a stop at either the Nashua Transit Center or Tyngsborough Park & Ride Lot to this route.

3.2. Service Envisioned

Besides the location of the origin station location and routing, NRPC staff developed other critical operating parameters such as operating hours, frequency, type of vehicle, fare pricing, and station facilities based on the planning and public input laid out in Chapter 2, professional expertise, and sensitivity analysis on the ridership projection models (such as balancing fare versus ridership).

3.2.1. Service Frequency

Largely due to cost constraints, staff determined a commuter shuttle model will be the most viable type and level of service for the proposed route. Various service frequencies are used in the ridership forecast and cost estimation in Chapter 4: from 8-roundtrips-per-day down to 3-roundtrips-per-day. 8-roundtrips-per-day is the default frequency while lesser frequencies are used in scenarios with limited forecasted ridership, particularly for the Nashua Shuttle to UMass Lowell and the Nashua Shuttle to Bedford/ Burlington Employment & Retail Clusters.

The distribution of trips across the day and the exact timing of each trip are not factored in the ridership forecast and cost estimation as these details make no differences in the preliminary analyses. Nevertheless, for illustrative purposes, the following is a set of mockup schedules for an 8-roundtrips-per-day frequency of service, assuming a 30-minute one-way travel time. Six out of the eight roundtrips would take place during the rush hours of 5:30 AM – 7:30 AM and 3:00 PM – 7:00 PM, with the remaining two roundtrips scheduled during the mid-day hours.

A Mockup Route Schedule with 8 Roundtrips – Outbound

Outbound Trip	Nashua Region	Destination in Massachusetts
1 – morning rush hours	5:30 AM	6:00 AM
2	6:30 AM	7:00 AM
3	7:30 AM	8:00 AM
4 – mid-day hours	9:00 AM	9:30 AM
5	12:00 PM	12:30 PM
6 – evening rush hours	2:00 PM	2:30 PM
7	3:30 PM	4:00 PM
8	6:00 PM	6:30 PM

A Mockup Route Schedule with 8 Roundtrips – Inbound

Inbound Trip	Destination in Massachusetts	Nashua Region
1 – morning rush hours	6:00 AM	6:30 AM
2	7:00 AM	7:30 AM
3	8:00 AM	8:30 AM
4 – mid-day hours	11:00 AM	11:30 AM
5	1:30 PM	2:00 PM
6 – evening rush hours	3:00 PM	3:30 PM
7	4:30 PM	5:00 PM
8	7:00 PM	7:30 PM

3.2.2. Type of Vehicles

Learning from the Middlesex 3 TMA's experience, NRPC staff determined the corporate shuttles (mini-bus chassis) with passenger capacity ranging from 14 to 33, provided by the M3 TMA's consultant, as the ideal type of vehicles to service proposed routes with a limited number of stops.

If the inter-regional service were to be operated by NTS or LRTA services, the ADA-equipped transit van would be a functional equivalent.



Examples of Corporate Shuttles

Photo courtesy of Middlesex 3 TMA



Example of ADA-equipped Vans

Photo courtesy of NTS

3.2.3. Fare Pricing

As the proposed inter-regional transit service is not designed to generate a profit, NRPC staff assumed a fare that would offset part of the operating cost in all of the proposed routes except for the Nashua Shuttle to UMass Lowell. The fare ranges from \$4 to \$8 per one-way trip.

For the UMass Lowell route, its ridership forecast determined that ridership level would not be viable if a fare is collected. NRPC includes two scenarios in Section 4.5.1 as an illustration – one scenario with no fare and another with a cost-offsetting \$5 per roundtrip.

Chapter 4 will cover more specific pricing details under the “Cost and Revenue Analysis” sub-section for each proposed route.

3.2.4. Station Facilities

The majority of stops and destinations on the proposed routes – Nashua Transit Center, the two Park & Ride Lots, Lowell Gallagher Center, and Alewife Station are already serviced by public transit service and are established ADA-accessible public transit station facilities.

The stations serving the employment/retail clusters on the Nashua Exit 8 Park & Ride – Bedford/Burlington Route lacks these station facilities. Signs for the shuttle stops would be necessary at the minimum and facility improvements such as bus shelters could be added if the route is successful and will be operated in the long term.

While the UMass Lowell North Campus Shuttle Stop is also well equipped for transit operations, the current university policy forbids outside operators from campus grounds out of liability/insurance concerns. Consequently, a nearby on-street location would require similar facilities – a sign at the minimum.

These improvements would incur additional costs. Nevertheless, the use of existing transit facilities may also incur additional costs due to usage/maintenance fees mentioned in Section 5.1.8. Moreover, every location would require the permission of the agency or municipality that owns the property or public right-of-way.

3.3. Operating Models

A critical component of the proposed inter-regional transit service would be its operating model, which addresses two key questions – 1) who will operate the service? 2) who will pay for the service?

While NRPC staff recognize there is no one way to operate transit services but, for evaluating the feasibility of the proposed routes, four potential operating models are explored, each with its own sets of advantages and disadvantages. Please note these four models are not mutually exclusive nor do they represent an exhaustive list. The following section provides an overview of each operating model while, in Chapter 5, they will be examined in the context of the proposed routes’ feasibility analysis.

3.3.1. Operating Model 1 – Expand NTS or LRTA Service

Available funding notwithstanding, the two local public transit operators – Nashua Transit System (NTS) and Lowell Regional Transportation Authority (LRTA) are in a good institutional position to provide the proposed service from their respective facilities in downtown Nashua and Lowell. Mentioned in Chapter 3, studies and plans from both NRPC and NMCOG (NTS’s and LRTA’s respective metropolitan planning agency) indicated riders of both systems have expressed a need for a transit connection between the two cities.

However, there is a considerable political challenge to either operator in offering transit service outside of its system boundary (Nashua city limit for NTS and the 14 contributing municipalities in Middlesex

County for LRTA). Moreover, both transit operators draw funding from shared Federal sources and are financially constrained. Thus, securing outside funding, whether a standalone federal funding source or contribution from private entities, would be a prerequisite to this operating model. Yet, the next two operating models may be more effective in securing private funding.

Specifically for the Nashua Shuttle to UMass Lowell, NRPC staff also explored the possibility of the university shuttle service (Roadster) directly operating the inter-regional transit service. Discussion with the university revealed that, while fleet vehicles and drivers would be available, this arrangement would not produce much, if any, cost savings due to the additional cost of expanding insurance coverage across the state border.

3.3.2. Operating Model 2 – Partner with Middlesex 3 TMA

As Middlesex 3 TMA (M3 TMA) has successfully provided shuttle services to its members across the Northern Middlesex Region, there is a great opportunity for the Nashua region, either through NRPC or for the area employers, to partner with Middlesex 3 TMA to expand its shuttle service across the state border. The structure of the M3 TMA and its use of a corporate transit consultant offers much flexibility in operating the new transit routes. Moreover, the existing interest of several Massachusetts employers, among them members of the M3 TMA, for a transit connection to Nashua can easily jumpstart the implementation process.

Furthermore, the M3 TMA already provides shuttle service from between Alewife and the Bedford/Burlington area employers. Collaboration and coordination with the M3 TMA may create synergy between its existing shuttle service and two of the proposed routes: Nashua Exit 8 Park & Ride – Alewife Station, and Nashua Exit 8 Park & Ride – Bedford/Burlington.

Lastly, even though Federal transit regulations supersede Massachusetts bus regulations on transit services that cross the state border, any formal and informal understanding and collaboration with Massachusetts municipalities within the service area of the proposed inter-regional transit service would be valuable for transit operations and future cooperation. The M3 TMA can offer such opportunities, given that most of these municipalities are members of the Middlesex 3 Coalition.

3.3.3. Operating Model 3 – Form a new Nashua Region TMA

Taking a cue from the Middlesex 3 TMA, The Nashua region could organize or facilitate the organization of a new TMA, which in turn could contract a private operator to operate the proposed service routes. A Nashua-based TMA could specifically cater to the needs of the Nashua Region. However, this model would demand resources to form and administer a new TMA, which could be less cost-effective than partnering with the Middlesex 3 TMA. A new Nashua-based TMA might also have a harder time attracting businesses and employees in Massachusetts.

There are existing TMAs in New Hampshire, including Upper Valley Transportation Management Association (of which Advance Transit is a member), and CommuteSMART Seacoast (of which COAST is a member). As such, forming the TMA entity should not be challenging. However, recruiting businesses and municipalities to join the MTA would be a more involved effort, which would depend on the general interest in transit service among the local entities, interest of Massachusetts entities to participate, as well as resources that NRPC and other agencies would be willing to contribute toward the effort.

3.3.4. Operating Model 4 – Commercial Operator

If the proposed service has the potential to become profitable, one or more commercial operators may be interested in providing the service. The most obvious potential private operator of the proposed inter-regional transit service would be Boston Express, which already provides regular service from Nashua to Boston (including the Logan International Airport) along the same path as some of the proposed routes, such as stopping at the park and ride lots at Exit 8 and in Tyngsborough.

Other potential private operators include demand-response and school bus operators who are already servicing the Nashua Region and Northern Middlesex Region.

4. RIDERSHIP PROJECTION

4.1. Introduction

Estimation of ridership for four shuttle alternatives has been conducted by NRPC, which include service from Nashua to:

- Lowell Gallagher Terminal, connecting with MBTA passenger rail service and Lowell Regional Transit Authority (LRTA) bus routes;
- Alewife Station in Cambridge, Mass., connecting with the MBTA Red Line;
- University of Massachusetts Lowell (UML) campus; and,
- Employers in Bedford and Billerica along Middlesex Turnpike and Burlington Mall Road.

In this section, the transit modes ridership estimation procedure previously developed by NRPC for evaluation of passenger rail service to the region is applied to the four shuttle bus options listed above. A survey of UML employees and students living in the NRPC region was conducted as a secondary source of evaluating the demand for this shuttle service. Additionally, costs, revenues, and anticipated funding requirements are estimated for each service alternative.

4.2. Ridership Estimation Procedure

NRPC maintains a regional travel model that is capable of forecasting future traffic demand and impacts of highway network improvements; however, it does not encompass a mode split module that can be applied to forecasting the use of alternative modes, including transit extensions. It was the advice of a Federal Highway Administration (FHWA) model expert, when the regional model was developed in 1991, that transit ridership was not of a sufficient level in the region to incorporate the mode into the regional model four-step process.

FHWA recommended the use of alternative mode choice analysis techniques which can be easily adapted to a specific transit analysis. Such a methodology has been developed and applied several times over for the estimation of modal shares is conducted following a procedure described in the National Cooperative Highway Research Program (NCHRP) Report 187; Quick-Response Urban Travel Estimation Techniques and Transferable Parameters. The procedure calculates all travel impedances for each mode. Travel impedances are the sum of travel time and monetary costs of making a trip via a particular mode. Since impedance is expressed in terms of time, it is necessary to convert costs of trip making to time by applying a value of time (VOT).

The impedances for each competing mode are used in the following equation to produce mode splits:

$$M_{st} = \frac{1}{1 + (I_t/I_a)^b}$$

where: M_{st} = fractional share of trips estimated to use the transit mode

I_t = measure of Mode n impedance

I_a = measure of sum of all available modes impedance

b = exponent of trip impedance, calibrated through an iterative process

5.3 MODE SPLIT CALIBRATION

The ridership estimation procedure is calibrated to existing mode splits observed, as was done previously by NRPC for estimation of passenger rail ridership from one or more Nashua area stations. Exponent “b” is the calibrating tool and various values tested to achieve the best fit with observed data. The calibration is based on travel to Boston from Nashua with three available modes: 1) private auto, 2) Boston Express from the Exit 8 park-and-ride, and 3) auto-access passenger rail from Lowell or North Billerica stations.

The known modal volumes are for Boston Express and passenger rail. There are 261 daily roundtrips made via the bus to Boston but about 25% of these are to Logan Airport. The latter group, primarily composed of airline passengers, who have a specific need for direct travel to their destination. Over 90% of bus or rail trips into the Boston Core are work trips and it is upon journey-to-work patterns that model estimation is based. Logan trips do not fit into the model and have a low potential for being satisfied by rail or other services which are destined to the Boston Core.

Boston Express logs indicate peak weekday non-Logan travel of 226 passengers, which is used for the model calibration. Passenger rail trips to Lowell and North Billerica stations have been recorded as 308 as recently as 2018. The number of auto work trips to Boston is not known but can be estimated by subtracting the two transit mode totals from an adjusted total commuting statistic. Total daily work trips are based on U.S. Census Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employer Statistics (LODES) data. The LODES data provide total workers from the municipality of residence in Boston. The raw volume for each origin is adjusted downward to account for factors such as 1) many long-distance commuters travel less often than daily; 2) some trips are to Boston but not very accessible by transit and therefore should be removed from the journey-to-work total that is the dependent variable of the mode split calibration. Making these adjustments, the adjusted daily commuter trips to Boston by all modes is 1,218.

The following table calculates impedances from origin towns to the final destination in Boston for each existing mode. Definitions of components of impedances and assumptions made are as described:

Auto Travel to Boston

- Auto Travel Time – The National Performance Monitoring Research Data Set (NPMRDS), which is based on cell phone data, was utilized to calculate peak period congested speeds from the NH/Massachusetts border to the Boston Financial District. This result was added to the travel times for each origin municipality to the border to produce a total travel time.
- Auto Travel Cost – Auto cost per mile is assumed to be \$0.30, which excludes depreciation and insurance from the trip cost, as these are not likely to count toward a driver’s perceived cost of commuting via private auto. This out-of-pocket cost is converted to a time equivalent by multiplying by 3 (60 minutes/assumed \$20 per hour VOT). The total is then divided by 1.25 to account for cost-sharing under the assumption that 25% of long-distance auto commutes to Boston will be two-person carpools.

- Parking Cost – Parking costs in downtown Boston can be made daily commuting by auto impractical for many. A Google search of all-day parking at eight downtown garages indicated an average cost of \$27.5. The reality is that many auto commuters have access to free or much lower-cost parking. An average parking cost of \$8 per day was used, which relied on data from the Boston MPO Central Transportation Planning Staff (CTPS) model, which provides average parking cost by traffic zone. Parking cost is converted to time in the same manner as the auto mileage cost, except that the total cost is divided by two, as it is spread between the inbound and outbound commuter trips.
- Walk Egress Time – The amount of time to reach the final destination from the parked vehicle, assumed to be an average of four minutes.

Boston Express to Boston

- Auto Access Time – The time from a municipal center to the Turnpike Exit 8 park-and-ride on North Southwood Drive.
- Initial Wait – The average time walking from a parked vehicle to the terminal and waiting until the bus departure, estimated at 8 minutes.
- Boston Express In-Vehicle Travel Time (IVTT) -90 minutes per the schedule and NPMRDS travel time.
- Boston Express Fare - \$10 fare converted to minutes per formula described.
- Transfer Wait – It is assumed that 50% of bus riders transfer to an MBTA bus or rapid transit. The most recent MBTA passenger survey was reviewed when developing an estimate of 4 minutes (50% of commuters have an 8-minute transfer wait).
- Transfer Fare – Calculated based on the current \$2.40 fare, 50% transfer, and converted to VOT.
- MBTA IVTT – 50% of commuters take a 12-minute rapid or bus trip to their destination.
- Walk Egress Time – Assumed to be 8 minutes, based on MBTA passenger survey data.

Auto Access Passenger Rail from Lowell/North Billerica to Boston

- Auto Access Time – The time from a municipal center to Lowell or North Billerica stations, whichever is closer.
- Initial Wait – Calculated as a function of the distance from the town of residence, with a 9-minute minimum.
- Rail IVTT – 43 minutes per MBTA schedule.
- Rail Fare - \$8.50 converted to minutes.
- Parking Cost – One-half (to account for two-one trips) of the \$8 parking cost at Lowell terminal.
- Transfer wait/IVTT/fare – Same as Boston Express
- Walk Egress – Same as Boston Express

CALCULATION OF TOTAL IMPEDANCE FOR EXISTING MODES TO DOWNTOWN BOSTON

		Private Auto to Boston (assumes 25% of person trips are by multi-occupancy vehicle)											
	Dist	Auto Time	Mi. Cost in Min.	.5 Park Cost (min)	Walk EgressTime								Total Impedance
Amherst	63	83	45	10	4								142.0
Brookline	58	87	42	10	4								142.4
Hollis	53	77	38	10	4								128.8
Hudson	45	72	32	10	4								118.0
Litchfield	50	80	36	10	4								129.6
Merrimack	56	77	40	10	4								130.9
Milford	58	86	42	10	4								141.4
Nashua	47	72	34	10	4								119.4
Pelham	36	64	26	10	4								103.5
Other	65	76	47	10	4								136.4
NPMRDS travel time from Nashua/Mass SL to Boston CBD= 70 min.													
		Boston Express from FEE Turnpike Exit 8 Park-and-Ride to Boston Commuter Loop & South Station											
	Auto Acc Dist	Auto Acc Time	Auto Acc Cost (min)	Init Wait	Bos Exp Bus IVTT	BosExp Fare (min)	.5 Park Cost (min)	Transf Wait	MBTA IVTT	T-Fare in Min.	Walk EgrTime	Total Impedance	
Amherst	10	20	9.0	8.0	90	30	0	4	6	3.6	8	178.6	
Brookline	14	24	12.6	8.0	90	30	0	4	6	3.6	8	186.2	
Hollis	8	15	7.2	8.0	90	30	0	4	6	3.6	8	171.8	
Hudson	5	14	4.5	8.0	90	30	0	4	6	3.6	8	168.1	
Litchfield	17	21	15.3	8.0	90	30	0	4	6	3.6	8	185.9	
Merrimack	7	11	6.3	8.0	90	30	0	4	6	3.6	8	166.9	
Milford	9	20	8.1	8.0	90	30	0	4	6	3.6	8	177.7	
Nashua	5	10	4.5	8.0	90	30	0	4	6	3.6	8	164.1	
Pelham	16	26	14.4	8.0	90	30	0	4	6	3.6	8	190.0	
Other	20	27	18.0	8.0	90	30	0	4	6	3.6	8	194.6	
		Auto Access Passenger Rail Lowell to Boston Downtown											
	Auto Acc Dist	Auto Acc Time	Auto Acc Cost (min)	Init Wait	Rail IVTT	Rail Fare in Min.	.5 Park Cost (min)	Transf Wait	Subway IVTT	T-Fare in Min.	Walk EgrTime	Total Imped.	
Amherst	31	43	28	14.3	43	26	12	4	6	3.6	8	187.3	
Brookline	25	41	23	13.7	43	26	12	4	6	3.6	8	179.3	
Hollis	24	33	22	11.0	43	26	12	4	6	3.6	8	167.7	
Hudson	20	25	18	9.0	43	26	12	4	6	3.6	8	154.1	
Litchfield	24	38	22	12.7	43	26	12	4	6	3.6	8	174.4	
Merrimack	25	34	23	11.3	43	26	12	4	6	3.6	8	169.9	
Milford	29	45	26	15.0	43	26	12	4	6	3.6	8	188.2	
Nashua	17	21	15	9.0	43	26	12	4	6	3.6	8	147.4	
Pelham	8	22	7	9.0	43	26	12	4	6	3.6	8	140.3	
Other	30	43	27	14.3	43	26	12	4	6	3.6	8	186.4	

The total impedances for the three modes are input into the mode split formula, which generates mode utilities. These utilities represent the attractiveness of each mode. Each mode utility is divided by the sum of all mode utilities to produce ridership shares for each mode. Mode shares are multiplied by the daily trips to estimate ridership by mode. The resulting splits for private auto, Boston Express, and Lowell Line passenger rail are compared with passenger counts. The exponent (b) that is applied to the ratio of single-mode impedance divided by the sum of all modes impedances is adjusted until the calculation provides the closest fit as possible to the actual counts. As the table below shows, the calibration results in nearly a perfect fit for the two transit modes, for which we have accurate existing data. With calibration completed, the estimation procedure can now be applied to new modes of travel.

BASE YEAR CALIBRATION OF EXISTING MODES: AUTO, BOSTON EXPRESS, RAIL FROM LOWELL

	Total Travel Impedance				Mode Utilities			Mode Shares			Model JTW by Mode				Survey JTW/Mode	
	Auto	Bos Exp	Com Rail	Sum of Imped	Auto	Bos Exp	Com Rail	Auto	Exp	Rail	Adj JTW	Auto	Bos Exp	Com Rail	Bos Exp	Com Rail
Amherst	142.0	158.6	187.3	487.9	0.028	0.019	0.011	48%	34%	18%	21	10	7	4	NA	3
Brookline	142.4	186.2	179.3	507.8	0.031	0.013	0.015	54%	22%	25%	8	4	2	2	NA	3
Hollis	128.8	171.8	167.7	468.3	0.033	0.013	0.014	56%	21%	23%	33	18	7	8	NA	11
Hudson	118.0	168.1	154.1	440.2	0.036	0.011	0.015	58%	17%	24%	174	101	30	42	NA	47
Litchfield	129.6	185.9	174.4	489.9	0.037	0.011	0.014	60%	18%	23%	29	17	5	6	NA	3
Merrimack	130.9	166.9	169.9	467.8	0.032	0.014	0.013	54%	24%	22%	91	49	22	20	NA	14
Milford	141.4	177.7	188.2	507.3	0.032	0.015	0.012	54%	25%	20%	40	22	10	8	NA	3
Nashua	119.4	164.1	147.4	430.9	0.033	0.011	0.016	54%	18%	27%	593	323	108	161	NA	158
Pelham	103.5	190.0	140.3	433.8	0.050	0.006	0.020	66%	8%	26%	80	53	7	21	NA	22
Other	136.4	194.6	186.4	517.4	0.038	0.011	0.013	60%	18%	21%	150	90	27	32	NA	44
											1,218	688	225	305	226	308
											Mode Share	56%	18%	25%	18%	25%
											Calibration Error				0%	-1%
											Total Transit Modes					530
											Transit Mode Share					44%

4.3. Nashua Shuttle to Lowell Gallagher Transit Terminal

The Charles A. Gallagher Transit Terminal is an intermodal transit located off Thorndike Street (MA-3A) near the end of the Lowell Connector south of downtown Lowell. The transit complex includes an MBTA Commuter Rail station as well as the Robert B. Kennedy Bus Transfer Center, which serves local and intercity buses. The commuter rail station is the northern terminus of the Lowell Line and is a major park-and-ride station for the system, serving commuters from Lowell, northern Massachusetts, and southern New Hampshire. The Kennedy Bus Transfer Center is the transfer point for all Lowell Regional Transit Authority local bus routes and several intercity bus routes by other operators.

4.3.1. Ridership Estimation

Travel impedances are calculated for the operation of a shuttle from Nashua to Lowell terminal, where riders board the train to Boston as they do now via auto access. A one-way shuttle fare of \$4 (\$8 for a roundtrip) is assumed, which equals the \$8 parking fee at Lowell terminal but presents savings on driving trips avoided. The calculated total impedance for the new mode to be estimated is then inputted to the ridership estimation function with the other three modes. The resulting mode split percentages are applied to total commute trips to provide new estimates for each mode.

The Nashua shuttle to rail mode share is estimated at 20%, with 240 passengers using the new mode. The largest diversion occurs among auto commuters, with the mode share declining from 56% to 41% and daily trips from 688 to 504. Only 18 trips are estimated to divert from Boston Express to the rail shuttle bus and 42 are estimated to switch from auto access rail to the shuttle bus. For this transit alternative, Boston Express ridership is 208 (17% mode share) and auto access rail is 266 (22% share). The total transit mode share increases from 44% with existing services to 59% with the additional transit service.

There does exist the potential for additional ridership, resulting from persons who wish to travel to Lowell to connect with LRTA service. Previous surveys of NTS riders and the general public have revealed at least a minimal level of interest, which might add a handful of riders to the daily total. To maintain conservative estimates, these potential riders are not factored into the cost and revenue analysis.

RIDERSHIP ESTIMATE FOR SHUTTLE BUS FROM NASHUA TO LOWELL GALLAGHER TERMINAL

	Total Travel Impedance					Mode Utilities				Mode Shares				Estimated JTW by Mode				
	Bos	Com	Lowell	Sum of	Imped	Bos	Auto	Shuttle		Bos	Auto	Shuttle		Adj	Bos	Auto	Bus	
	Auto	Exp	Rail	Shuttle		Auto	Exp to Rail	to Rail		Auto	Exp to Rail	to Rail		JTW	Auto	Exp to Rail	to Rail	
Amherst	142.0	158.6	187.3	185.7	673.6	0.069	0.052	0.032	0.033	37%	28%	17%	18%	21	8	6	4	4
Brookline	142.4	186.2	179.3	182.2	690.0	0.072	0.035	0.039	0.038	39%	19%	21%	20%	8	3	2	2	2
Hollis	128.8	171.8	167.7	170.9	639.2	0.077	0.036	0.038	0.036	41%	19%	21%	19%	33	13	6	7	6
Hudson	118.0	168.1	154.1	159.5	599.7	0.081	0.031	0.041	0.037	43%	17%	21%	19%	174	74	29	37	34
Litchfield	129.6	185.9	174.4	174.9	664.8	0.083	0.032	0.038	0.038	43%	17%	20%	20%	29	12	5	6	6
Merrimack	130.9	166.9	169.9	172.7	640.5	0.074	0.039	0.037	0.035	40%	21%	20%	19%	91	36	19	18	17
Milford	141.4	177.7	188.2	187.1	694.3	0.075	0.041	0.035	0.035	40%	22%	19%	19%	40	16	9	7	8
Nashua	119.4	164.1	147.4	152.6	583.5	0.074	0.031	0.043	0.039	40%	17%	23%	21%	593	235	99	136	123
Pelham	103.5	190.0	140.3	166.1	599.9	0.108	0.021	0.053	0.033	50%	10%	25%	15%	80	40	8	20	12
Other	136.4	194.6	186.4	188.9	706.3	0.084	0.033	0.038	0.036	44%	17%	20%	19%	150	66	26	30	28
														1,218	504	208	266	240
														Mode Split	41%	17%	22%	20%
														Total Transit Modes			714	
														Transit Mode Share			59%	

4.3.2. Cost and Revenue Analysis

As a Nashua to Lowell terminal shuttle is estimated to attract similar ridership as does Boston Express at present, a similar service frequency is anticipated to be required to meet this demand. Therefore, the operational plan is for eight roundtrips per day. For a service beginning at the Nashua Transit Center, stopping at the Turnpike Exit 8 lot and continuing to the Lowell terminal (with perhaps an incidental stop in South Nashua or the Tyngsborough park-and-ride), a one-way trip would be 26 miles (52 miles for a roundtrip). An operating expense of \$5.55 per mile is applied, per the NTS current level. This figure includes the cost of vehicle depreciation; therefore, the capital cost is fully incorporated into the operating cost and does not need to be itemized separately.

The calculation results in a roundtrip cost of \$289 and a daily cost of \$2,309 for eight runs. An annual expense of \$588,744 is estimated, based on 255 days of service (weekdays less five major holidays). Revenue for an average of 240 roundtrip riders per day at an \$8 roundtrip fare would be \$489,600 annually, resulting in a projected deficit of \$99,150 that would require public funding. This comes to a net operating cost of \$0.01 per rider-mile.

At this ridership level, a \$9.62 roundtrip fare would be a break-even fare; however, ridership would likely drop somewhat at a higher fare. A roundtrip fare of \$10 or more likely would be required to erase the operating deficit, and this would be dependent upon the inelasticity of rider demand, i.e. ridership decreases less than proportionately to an increase in fares.

4.4. Nashua Shuttle to Alewife MBTA Station, Cambridge

Alewife Station is a Massachusetts Bay Transportation Authority (MBTA) intermodal transit station in the North Cambridge neighborhood of Cambridge, Massachusetts. It is the northwest terminal of the rapid transit Red Line (part of the MBTA subway system). It is also a hub for several MBTA bus routes; however, these are primarily oriented toward providing feeder service to rail from nearby residential areas and would not likely serve destination points for users of a Nashua-origin bus service. The station is at the confluence of the Minuteman Bikeway, Alewife Linear Park, Fitchburg Cutoff Path, and Alewife Greenway off Alewife Brook Parkway adjacent to Massachusetts Route 2, with a five-story parking garage for park and ride use.

There are about 11,700 inbound boardings on the Red Line at Alewife Station each weekday, according to the most recent systemwide passenger count. A survey of MBTA users completed in 2017 gives additional information regarding the makeup of ridership. About 9,300 home-based trips (84%) are traveling to work, 300 (3%) are school trips and 1,599 (13%) are other trip types. There are also 700 non-home-based trips from Alewife but these are not of relevance to the present study, which targets potential riders at their New Hampshire residences.

With most rapid transit users from this station being commuters, the majority are riders every weekday or more often. About 62% ride five days a week or more often, 16% ride three to four times per week, 8% ride one to two days per week, and 14% ride less than once a week.

MTBA RAPID TRANSIT NETWORK (ALEWIFE AT NORTHERN TERMINUS OF RED LINE)³⁴



³⁴ Massachusetts Bay Transportation Authority. 2021. Rapid Transit/Key Bus Routes Map. Available via the MBTA's website: <https://www.mbtta.com/maps>. Accessed 03/18/2021.

4.4.1. Ridership Estimate

The ridership estimation procedure was repeated, substituting a Nashua shuttle to Alewife instead of operating buses to Lowell terminal. It primarily serves the same commuter market; however, it would not originate from the Nashua Transit Center, as there it is not likely to find much demand for the transit-dependent population, as would a service that connects to LRTA. Current users of NTS wishing to utilize the service could do so by transferring from Route 2 at the Exit 8 park-and-ride. This would entail payment of the full fare for the shuttle to Alewife.

The shuttle to Alewife Station is estimated to attract 227 roundtrip riders per weekday, for a mode share of 19%. The ridership estimate is just short of that for the Lowell terminal shuttle, which had a 20% mode share. The total transit share for all non-auto modes is estimated at 58% compared with 59% for the Nashua to Lowell bus.

There may be potential for additional reverse-commuter riders, though this potential was not included in the analysis, as such trips are marginal on other transit systems (e.g. MBTA commuter rail and express bus). Returning shuttles from Alewife to the Exit 8 Park and Ride Lot could be designed to drop off and pick up employees directly from major employer locations such as BAE Systems. However, this would not be practical for more distantly located employers.

4.4.2. Cost and Revenue Analysis

The route from the Exit 8 park-and-ride to Alewife Station runs 41 miles one-way (82 miles roundtrip), producing a roundtrip cost of \$455. Operating eight roundtrips per day produces a daily cost of \$3,641 and an annual expense of \$926,160. Ridership estimation was based on a \$16 roundtrip fare (\$8 one-way), which would generate \$926,160 per year. With an annual operating deficit of only \$2,244, the service can be considered financially self-sustaining. This comes to a net operating cost of virtually zero per rider-mile.

RIDERSHIP ESTIMATE FOR SHUTTLE BUS FROM NASHUA TO ALEWIFE MBTA RAPID TRANSIT STATION

	Total Travel Impedance					Mode Utilities				Mode Shares				Estimated JTW by Mode				
	Auto	Bost Exp	Auto to Rail	Alewife Shuttle	Sum of Imped.	Auto	Bost Exp	Auto to Rail	Alewife Shuttle	Auto	Bost Exp	Auto to Rail	Alewife Shuttle	Work Trips	Bost Auto	Auto Exp	Alewife to Rail	Alewife Shuttle
Amherst	142.0	178.6	187.3	189.8	697.7	0.075	0.041	0.036	0.034	40%	22%	19%	18%	21	8	5	4	4
Brookline	142.4	186.2	179.3	186.3	694.1	0.073	0.036	0.040	0.036	40%	19%	22%	19%	8	3	2	2	2
Hollis	128.8	171.8	167.7	175.0	643.3	0.078	0.036	0.039	0.034	41%	19%	21%	18%	33	14	6	7	6
Hudson	118.0	168.1	154.1	163.6	603.8	0.082	0.032	0.041	0.035	43%	17%	22%	18%	174	75	29	38	32
Litchfield	129.6	185.9	174.4	179.0	668.9	0.084	0.032	0.039	0.036	44%	17%	20%	19%	29	13	5	6	5
Merrimack	130.9	166.9	169.9	176.8	644.6	0.075	0.040	0.038	0.034	40%	21%	20%	18%	91	37	19	18	16
Milford	141.4	177.7	188.2	191.2	698.4	0.076	0.042	0.035	0.034	41%	22%	19%	18%	40	16	9	8	7
Nashua	119.4	164.1	147.4	156.7	587.6	0.075	0.032	0.044	0.037	40%	17%	23%	20%	593	238	101	138	116
Pelham	103.5	190.0	140.3	170.2	604.0	0.109	0.022	0.054	0.031	51%	10%	25%	14%	80	41	8	20	12
Other	136.4	194.6	186.4	193.0	710.4	0.086	0.034	0.038	0.035	45%	18%	20%	18%	150	67	26	30	27
														1,218	511	210	270	227
														Mode Split	42%	17%	22%	19%
														Total Transit Modes				707
														Transit Mode Share				58%

4.5. Nashua Shuttle to UMass Lowell

The University of Massachusetts Lowell (UMass Lowell) is one of the large public universities close to the Nashua Region. Under a program organized by the New England Board of Higher Education, UMass Lowell offers a tuition discount for most majors to New Hampshire residents from selected towns within a 20-mile radius of the university. While the university is becoming a popular choice for New Hampshire students, many employees of UMass Lowell also choose to live in New Hampshire, especially within the Nashua Region. Consequently, the university generates a notable number of commuting trips from the Nashua Region, which are almost exclusively done by driving.

As mentioned in Section 2.2.10, UMass Lowell seeks to promote an alternative to driving for commuters who live outside of Lowell, mitigate the parking demand on campus, mitigate the traffic congestions around Lowell, and achieve the University's sustainability goals. And the University recognizes that regional transit services are an important element in these efforts.

Thus, UMass Lowell worked with NRPC staff to survey university students and employees who reside in the Nashua Region. The result from this survey informs the following ridership estimation process. The survey is discussed in Section 2.3.1.

4.5.1. Ridership Estimation

For travel to UMass Lowell, the auto provides the only existing travel mode. The reality is that there is an additional dynamic at work, in which students who attend remotely as a choice may choose to commute to campus should a transit alternative be made available. There is no reliable way to quantify this through a modeling process, so the assumption is that only students and faculty/staff who commute to campus (the pre-COVID numbers are used) are strong candidates to switch to transit service and those who study remotely are likely to continue (most likely because they have jobs or other commitments during the day that precludes commuting).

The impedance for auto commuting to campus includes parking fees of \$450 per year for students and \$400 for faculty. The annual total is divided by 144 academic school days in the year and assumes that students commute each day. Students also are assumed to have a value of time half that of university employees, as they must rely on part-time or no income. The VOT difference is applied to vehicle operating costs as well as parking. UML data indicate 7% of staff carpool to campus and 50% of students; these rates were applied to costs, under the assumption that costs are divided between occupants.

Ridership estimation was done under two scenarios: 1) fare-free and 2) a \$5 roundtrip fare, both assuming 1 roundtrip per day per rider. The free shuttle scenario results in a daily ridership (roundtrip) estimate of 188 – 76 employee trips and 112 student trips. The employee mode share is 22% bus/78% auto and the student breakdown is 49% shuttle/51% auto.

Under the second scenario, with a \$5 roundtrip fare, the estimated ridership (roundtrip) drops to 97. The student shuttle mode share drops to 24% and employer shuttle share decline to 12%, At this ridership level it is likely that operating a Nashua to UML shuttle is not a viable alternative.

CALCULATION OF MODE IMPEDANCES, NASHUA SHUTTLE TO UMASS LOWELL, FREE FARE

Private Auto to U Mass Lowell (7% of employees and 50% of students are multi-occupancy)

	Auto	Auto TT	Parking Cost (min)		Veh Oper Cost (min)		Tot Imped/Veh Trip		Tot Imped /Pers Trip	
	<u>Veh Mi.</u>	<u>to UML</u>	<u>Faculty</u>	<u>Student</u>	<u>Faculty</u>	<u>Student</u>	<u>Faculty</u>	<u>Student</u>	<u>Faculty</u>	<u>Student</u>
Amherst	26.4	40	2.8	6.3	15.8	31.7	59	78	55	52
Brookline	26.5	39	2.8	6.3	15.9	31.8	58	77	54	51
Grnvl/Mason	30.0	53	2.8	6.3	18.0	36.0	74	95	69	64
Hollis	21.5	31	2.8	6.3	12.9	25.8	47	63	44	42
Hudson	11.4	25	2.8	6.3	6.8	13.7	35	45	32	30
Litchfield	17.7	35	2.8	6.3	10.6	21.2	48	62	45	42
Merrimack	22.9	31	2.8	6.3	13.7	27.5	48	65	44	43
Milford	26.6	42	2.8	6.3	16.0	31.9	61	80	57	53
Nashua SE	13.8	21	2.8	6.3	8.3	16.6	32	44	30	29
Nashua SW	14.7	24	2.8	6.3	8.8	17.6	36	48	33	32
Nashua NW	17.4	25	2.8	6.3	10.4	20.9	38	52	36	35
Nashua NE	18.6	26	2.8	6.3	11.2	22.3	40	55	37	36
Pelham	7.9	17	2.8	6.3	4.7	9.5	25	33	23	22
Wilton	31.7	47	2.8	6.3	19.0	38.0	69	91	64	61

Shuttle Bus from South Nashua/Hudson to U Mass Lowell, Free Fare

	Auto	Auto TT	Shuttle Fare (min)		Shuttle	Shuttle	Veh Oper Cost (min)		Tot Imped/Veh Trip		Tot Imped /Pers Trip	
	<u>Veh Mi.</u>	<u>to Lot</u>	<u>Faculty</u>	<u>Student</u>	<u>Wait</u>	<u>IVTT</u>	<u>Faculty</u>	<u>Student</u>	<u>Faculty</u>	<u>Student</u>	<u>Faculty</u>	<u>Student</u>
Amherst	17.8	33	0.0	0.0	6.6	19	10.7	21.4	69	80	65	53
Brookline	16.1	30	0.0	0.0	6.0	19	9.7	19.3	65	74	60	50
Grnvl/Mason	24.1	45	0.0	0.0	9.0	19	14.5	28.9	87	102	82	68
Hollis	12.4	23	0.0	0.0	4.6	19	7.4	14.9	54	61	51	41
Hudson	5.9	17	0.0	0.0	3.4	19	3.5	7.1	43	46	40	31
Litchfield	12.2	28	0.0	0.0	5.6	19	7.3	14.6	60	67	56	45
Merrimack	14.3	23	0.0	0.0	4.6	19	8.6	17.2	55	64	52	43
Milford	17.5	34	0.0	0.0	6.8	19	10.5	21.0	70	81	66	54
Nashua SE	3.8	13	0.0	0.0	3.0	19	2.3	4.6	37	40	35	26
Nashua SW	4.6	15	0.0	0.0	3.0	19	2.8	5.5	40	43	37	28
Nashua NW	8.8	17	0.0	0.0	3.4	19	5.3	10.6	45	50	42	33
Nashua NE	10.2	19	0.0	0.0	3.8	19	6.1	12.2	48	54	45	36
Pelham	10.7	21	0.0	0.0	4.2	19	6.4	12.8	51	57	47	38
Wilton	22.4	39	0.0	0.0	7.8	19	13.4	26.9	79	93	74	62

RIDERSHIP ESTIMATE FOR NASHUA SHUTTLE TO UMASS LOWELL, FREE FARE

NH Commuters			Total Travel Impedance to UML				Mode Shares to U Mass Lowell				Trips by Mode to U Mass Lowell			
			Auto Mode		Shuttle Mode		Auto Mode		Shuttle Mode		Auto Mode		Shuttle Mode	
	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student
Amherst	11	4	55	52	65	53	76%	54%	24%	46%	8	2	3	2
Brookline	4	3	54	51	60	50	69%	44%	31%	56%	3	1	1	2
Grrvl/Mas	0	4	69	64	82	68	77%	62%	23%	38%	0	2	0	2
Hollis	25	11	44	42	51	41	74%	46%	26%	54%	18	5	7	6
Hudson	54	49	32	30	40	31	82%	56%	18%	44%	44	27	10	22
Litchfield	14	6	45	42	56	45	82%	63%	18%	37%	11	4	3	2
Merrimack	19	14	44	43	52	43	74%	47%	26%	53%	14	7	5	7
Milford	12	15	57	53	66	54	74%	51%	26%	49%	9	8	3	7
Nashua SE	27	15	30	29	35	26	74%	33%	26%	67%	20	5	7	10
Nashua SW	72	56	33	32	37	28	68%	30%	32%	70%	49	17	23	39
Nashua NW	44	12	36	35	42	33	75%	43%	25%	57%	33	5	11	7
Nashua NE	16	10	37	36	45	36	78%	48%	22%	52%	13	5	3	5
Pelham	47	26	23	22	47	38	99%	98%	1%	2%	47	25	0	1
Wilton	1	2	64	61	74	62	73%	53%	27%	47%	1	1	0	1
346			227								270	115	76	112
											78%	51%	22%	49%
											Auto		Shuttle	
											Total Trips by Mode		385	
											Mode Share		188	
											67%		33%	

RIDERSHIP ESTIMATE FOR NASHUA SHUTTLE TO UMASS LOWELL, \$5 ROUNDTRIP FARE

NH Commuters			Total Travel Impedance to UML				Mode Shares to U Mass Lowell				Trips by Mode to U Mass Lowell			
			Auto Mode		Shuttle Mode		Auto Mode		Shuttle Mode		Auto Mode		Shuttle Mode	
	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student	Emp	Student
Amherst	11	4	55	52	69	60	84%	73%	16%	27%	9	3	2	1
Brookline	4	3	54	51	65	56	79%	65%	21%	35%	3	2	1	1
Grnvl/Masor	0	4	69	64	86	75	83%	76%	17%	24%	0	3	0	1
Hollis	25	11	44	42	55	48	84%	71%	16%	29%	21	8	4	3
Hudson	54	49	32	30	45	38	91%	83%	9%	17%	49	41	5	8
Litchfield	14	6	45	42	61	51	89%	82%	11%	18%	12	5	2	1
Merrimack	19	14	44	43	56	49	84%	71%	16%	29%	16	10	3	4
Milford	12	15	57	53	70	61	82%	71%	18%	29%	10	11	2	4
Nashua SE	27	15	30	29	40	33	87%	70%	13%	30%	24	11	3	4
Nashua SW	72	56	33	32	42	35	83%	66%	17%	34%	60	37	12	19
Nashua NW	44	12	36	35	46	40	86%	73%	14%	27%	38	9	6	3
Nashua NE	16	10	37	36	49	43	88%	75%	12%	25%	14	8	2	2
Pelham	47	26	23	22	52	45	100%	99%	0%	1%	47	26	0	0
Wilton	1	2	64	61	79	68	80%	69%	20%	31%	1	1	0	1
346			227								304	173	42	54
											88%	76%	12%	24%
											Auto		Shuttle	
Total Trips by Mode											476		97	
Mode Share											83%		17%	

4.5.1. Cost and Revenue Analysis

The cost analysis is based on a 22-mile one-way trip starting at the Nashua Transit Center, proceeding north to the Exit 8 lot, and making an additional stop in south Nashua or the Tyngsborough park-and-rider before reaching the UML campus. The one-way cost is \$122 (\$244 for a roundtrip). Under the free fare estimate of 197 riders, six daily round trips are the required minimum to accommodate the commuting total. The daily operating cost of \$1,465 translates to \$210,989 annually with no revenue offset. This comes to a net operating cost of \$0.17 per rider-mile. This amount would presumably be funded by the University or incorporated into the student fees. Additionally, the University would lose about \$81,000 in parking fees as commuters switch to shuttle use.

Under the second scenario, the estimated ridership drops to 97 with a \$5 daily bus fare. This might be accommodated by four roundtrips per day. The operating cost would be \$140,659 per year for this service level and the fare would generate \$69,840 in annual revenue. This comes to a net operating cost of \$0.12 per rider-mile. This results in an annual operating deficit of \$70,819 that would need to be funded by UML. Additionally, the university would lose an estimated \$41,500 parking revenue.

4.6. Nashua Shuttle to Bedford/Burlington Employment & Retail Clusters

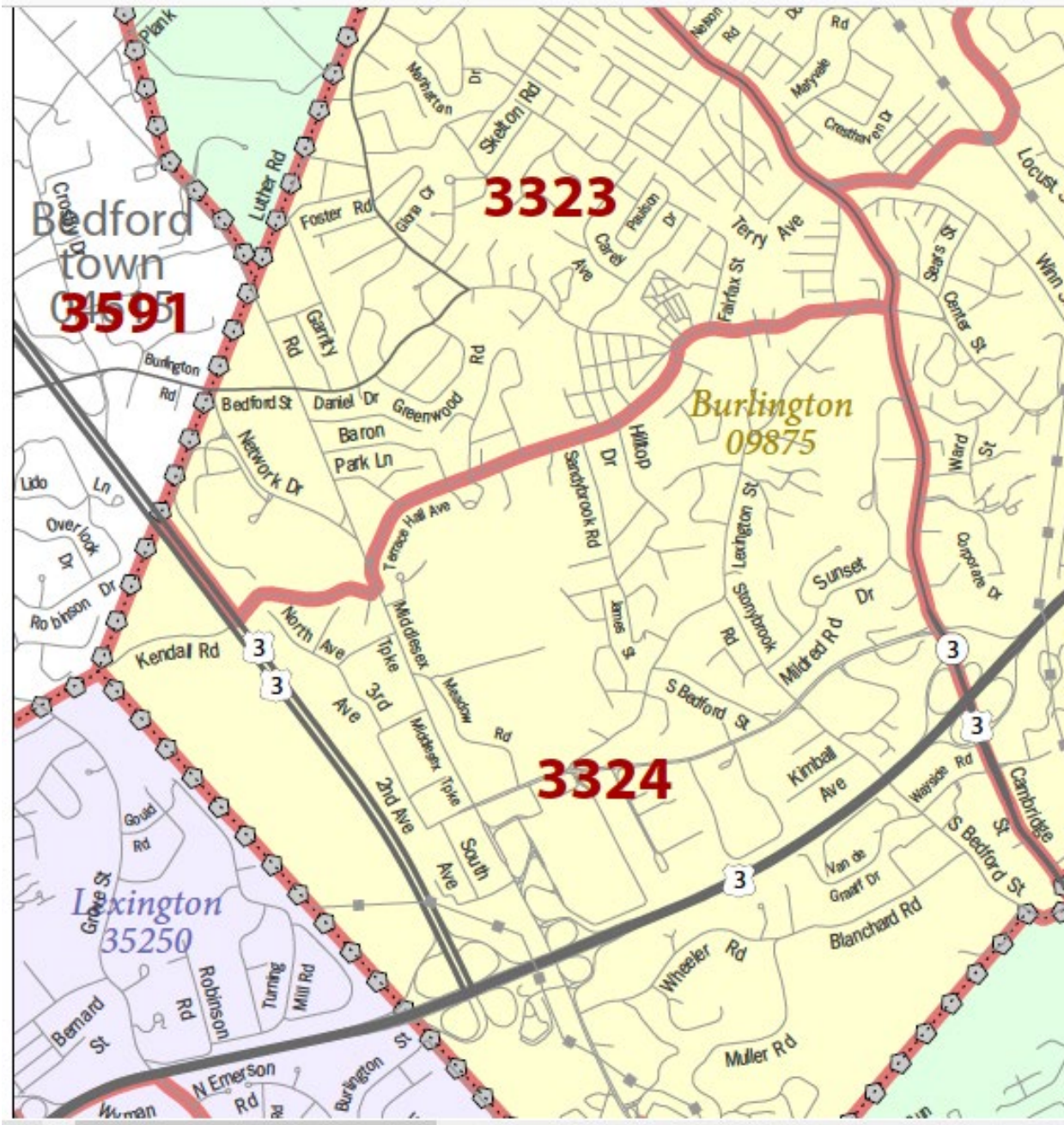
A plethora of employers works in office parks in and around Middlesex Turnpike off MA-3 in Bedford and Burlington, as well as a regional shopping center and major medical center. The ridership analysis focuses on a shuttle route that would service the entire area in a loop; however, it is recognized that only a handful of individual businesses may be interested in the shuttle concept. In the latter case, micro-transit services, targeted at specific businesses rather than the entire area as a loop shuttle, may be a viable operating model for consideration. The list of businesses that would be served by a loop shuttle is shown below:

BEDFORD/BURLINGTON EMPLOYERS ALONG MIDDLESEX TURNPIKE/BURLINGTON MALL RD

<u>Census Tract 3591</u>	<u>Census Tract 3524</u>
Oracle	Digital Alloys
Novanta	Vulcan Forms
Cambridge Technology	Viken Detection
Fujifilm Recording Media USA	Altran
Casenet LLC	Abbott
EDB	Nordblom Co.
Interactive Data	Desktop Metal
Ocular Therapeutix	Best Buy
Aspen Technology	Burlington Mall
Midori USA	Lahey Medical Center
Integral BilSystems	Burlington Woods Office Park
Entegris	Center at Corporate Dr.
MITRE	Target
iRobot Corp.	Northeastern Univ Innovation Campus
EDCO Collaborative	
Aware Inc - Biometrics Software	
Guideware Software	
EMD Sorono Research Center	
<u>Census Tract 3523</u>	
Patriot Energy	
Volt DB	
Stantec	
Veracode	
Avid Technology	
Oracle	
Netbrain Technologies	
QsaGlobal	

4.6.1. Ridership Estimation

The first three evaluations of shuttle alternatives were based on the town of origin to single destinations, which resulted in a single impedance calculated for each town to a destination for each alternative mode. Because there are various destinations for a shuttle route to Bedford/Burlington employment areas along Middlesex Turnpike and Burlington Mall Road, NRPC utilized U.S. Census “LODES” data to identify commuting totals to each of three census tracts that surround the potential shuttle route. Only a portion of tract 3591 would be served and the data were accordingly adjusted. The map below shows the tracts around the two roadways served by the shuttle.



The following table provides the daily commuting totals from each Nashua area community to the three census tracts. Overall, the commuting total to this area is 1,321. This raw figure is adjusted downward at the census tract level to subtract the portion of the tract that is deemed not conveniently accessible by a shuttle bus and at the universal level to account for LODES data representing total rather than daily commuters. The adjusted daily commute total to the shuttle route area is 685.

COMMUTERS TO BEDFORD/BURLINGTON EMPLOYER AREA BY CENSUS TRACT (LODES Data)

<u>Census Tract Work Destinations</u>				
	Partial			
Residence	3591	3323	3324	Total
Amherst	8	11	20	39
Bedford	8	18	55	81
Brookline	3	2	7	12
Hollis	5	6	18	29
Hudson	40	45	83	168
Litchfield	8	12	23	43
Merrimack	9	23	50	82
Milford	11	17	30	58
Nashua	156	169	337	662
Pelham	16	20	92	128
Other	8	2	9	19
Total	272	325	724	1,321

The following tables provide the impedances for each town to tract for the auto and shuttle modes. A shuttle fare of \$6 is assumed. The shuttle, however, is not very competitive with private auto, capturing only an 11% mode share for 76 roundtrip riders per day. If employers were willing to jointly fund the shuttle and enable free fare, the ridership estimate (roundtrip) increases to 143.

CALCULATION OF AUTO AND SHUTTLE IMPEDANCES TO BEDFORD/BURLINGTON EMPLOYERS

Private Auto to Bedford/Burlington Employment Center					Total Imped.
	Census Tract	Dist	Time	Mi. Cost in Min.	
Amherst	3591	36	63.2	28.2	91.4
Amherst	3323	37	63.2	29.0	92.2
Amherst	3324	40	63.2	31.3	94.5
Bedford	3591	41	60.8	32.1	92.9
Bedford	3323	42	60.8	32.9	93.7
Bedford	3324	46	60.8	36.0	96.8
Brookline	3591	36	60.0	28.2	88.2
Brookline	3323	37	60.0	29.0	89.0
Brookline	3324	40	60.0	31.3	91.3
Hollis	3591	31	54.4	24.3	78.7
Hollis	3323	32	54.4	25.0	79.4
Hollis	3324	35	54.4	27.4	81.8
Hudson	3591	25	49.6	19.6	69.2
Hudson	3323	26	49.6	20.3	69.9
Hudson	3324	29	49.6	22.7	72.3
Litchfield	3591	31	57.6	24.3	81.9
Litchfield	3323	32	57.6	25.0	82.6
Litchfield	3324	35	57.6	27.4	85.0
Merrimack	3591	33	54.4	25.8	80.2
Merrimack	3323	34	54.4	26.6	81.0
Merrimack	3324	37	54.4	29.0	83.4
Milford	3591	36	62.4	28.2	90.6
Milford	3323	37	62.4	29.0	91.4
Milford	3591	40	62.4	31.3	93.7
Nashua	3591	28	44.8	21.9	66.7
Nashua	3323	29	44.8	22.7	67.5
Nashua	3324	32	44.8	25.0	69.8
Pelham	3591	20	52.0	15.7	67.7
Pelham	3323	21	52.0	16.4	68.4
Pelham	3324	28	52.0	21.9	73.9
Other	3591	41	60.8	32.1	92.9
Other	3323	42	60.8	32.9	93.7
Other	3324	45	60.8	35.2	96.0

Nashua Shuttle to Bedford/Burlington Employment Center									
	Census Tract	Auto Acc Dist	Auto Acc Time	Auto Acc Cost (Min)	Init Wait	Shuttle IVTT	Shuttle Fare (Min)	Walk Egress	Total Imped.
Amherst	3591	17	31.0	15.3	10.3	48.0	18.0	6.0	128.6
Amherst	3323	17	31.0	15.3	10.3	56.0	18.0	8.0	138.6
Amherst	3324	17	31.0	15.3	10.3	72.0	18.0	8.0	154.6
Bedford	3591	22	28.0	19.8	9.3	48.0	18.0	6.0	129.1
Bedford	3323	22	28.0	19.8	9.3	56.0	18.0	8.0	139.1
Bedford	3324	22	28.0	19.8	9.3	72.0	18.0	8.0	155.1
Brookline	3591	16	29.0	14.4	9.7	46.0	18.0	6.0	123.1
Brookline	3323	16	29.0	14.4	9.7	56.0	18.0	8.0	135.1
Brookline	3324	16	29.0	14.4	9.7	72.0	18.0	8.0	151.1
Hollis	3591	12	22.0	10.8	8.0	46.0	18.0	6.0	110.8
Hollis	3323	12	22.0	10.8	8.0	56.0	18.0	8.0	122.8
Hollis	3324	12	22.0	10.8	8.0	72.0	18.0	8.0	138.8
Hudson	3591	6	16.0	5.4	8.0	46.0	18.0	6.0	99.4
Hudson	3323	6	16.0	5.4	8.0	56.0	18.0	8.0	111.4
Hudson	3324	6	16.0	5.4	8.0	72.0	18.0	8.0	127.4
Litchfield	3591	12	26.0	10.8	8.7	46.0	18.0	6.0	115.5
Litchfield	3323	12	26.0	10.8	8.7	56.0	18.0	8.0	127.5
Litchfield	3324	12	26.0	10.8	8.7	72.0	18.0	8.0	143.5
Merrimack	3591	14	22.0	12.6	8.0	46.0	18.0	6.0	112.6
Merrimack	3323	14	22.0	12.6	8.0	56.0	18.0	8.0	124.6
Merrimack	3324	14	22.0	12.6	8.0	72.0	18.0	8.0	140.6
Milford	3591	17	32.0	15.3	10.7	46.0	18.0	6.0	128.0
Milford	3323	17	32.0	15.3	10.7	56.0	18.0	8.0	140.0
Milford	3591	17	32.0	15.3	10.7	72.0	18.0	8.0	156.0
Nashua	3591	5	10.0	4.5	8.0	46.0	18.0	6.0	92.5
Nashua	3323	5	10.0	4.5	8.0	56.0	18.0	8.0	104.5
Nashua	3324	5	10.0	4.5	8.0	72.0	18.0	8.0	120.5
Pelham	3591	10	19.0	9.0	8.0	46.0	18.0	6.0	106.0
Pelham	3323	10	19.0	9.0	8.0	56.0	18.0	8.0	118.0
Pelham	3324	10	19.0	9.0	8.0	72.0	18.0	8.0	134.0
Other	3591	22	30.0	19.8	10.0	46.0	18.0	6.0	129.8
Other	3323	22	30.0	19.8	10.0	56.0	18.0	8.0	141.8
Other	3324	22	30.0	19.8	10.0	72.0	18.0	8.0	157.8

RIDERSHIP ESTIMATE FOR MIDDLESEX TURNPIKE/BURLINGTON MALL ROAD SHUTTLE

Census Residence Tract Dest	Total Travel Impedance			Mode Utilities		Mode Shares		Estimated JTW by Mode		
	Emp	Sum of	Emp	Auto	Shuttle	Auto	Shuttle	Adj JTW	Auto	Emp Shuttle
Amherst 3591	91.4	128.6	220.0	0.008	0.002	83%	17%	5	4	1
Amherst 3323	92.2	138.6	230.8	0.009	0.001	87%	13%	5	5	1
Amherst 3324	94.5	154.6	249.1	0.011	0.001	91%	9%	10	9	1
Bedford 3591	92.9	129.1	222.0	0.007	0.002	82%	18%	5	4	1
Bedford 3323	93.7	139.1	232.8	0.009	0.001	86%	14%	9	8	1
Bedford 3324	96.8	155.1	251.9	0.011	0.001	90%	10%	27	24	3
Brookline 3591	88.2	123.1	211.2	0.008	0.002	82%	18%	2	2	0
Brookline 3323	89.0	135.1	224.0	0.009	0.001	87%	13%	1	1	0
Brookline 3324	91.3	151.1	242.4	0.011	0.001	91%	9%	3	3	0
Hollis 3591	78.7	110.8	189.5	0.008	0.002	83%	17%	3	3	1
Hollis 3323	79.4	122.8	202.2	0.010	0.001	88%	12%	3	3	0
Hollis 3324	81.8	138.8	220.6	0.012	0.001	92%	8%	9	8	1
Hudson 3591	69.2	99.4	168.6	0.008	0.002	84%	16%	25	21	4
Hudson 3323	69.9	111.4	181.3	0.010	0.001	89%	11%	22	20	2
Hudson 3324	72.3	127.4	199.7	0.013	0.001	93%	7%	41	38	3
Litchfield 3591	81.9	115.5	197.3	0.008	0.002	83%	17%	5	4	1
Litchfield 3323	82.6	127.5	210.1	0.010	0.001	88%	12%	6	5	1
Litchfield 3324	85.0	143.5	228.5	0.012	0.001	92%	8%	11	10	1
Merrimack 3591	80.2	112.6	192.8	0.008	0.002	83%	17%	6	5	1
Merrimack 3323	81.0	124.6	205.6	0.010	0.001	88%	12%	11	10	1
Merrimack 3324	83.4	140.6	224.0	0.012	0.001	92%	8%	25	22	2
Milford 3591	90.6	128.0	218.5	0.008	0.002	83%	17%	7	6	1
Milford 3323	91.4	140.0	231.4	0.009	0.001	88%	12%	8	7	1
Milford 3591	93.7	156.0	249.7	0.012	0.001	91%	9%	15	13	1
Nashua 3591	66.7	92.5	159.2	0.007	0.002	82%	18%	98	81	18
Nashua 3323	67.5	104.5	172.0	0.010	0.001	88%	12%	83	73	10
Nashua 3324	69.8	120.5	190.3	0.013	0.001	92%	8%	165	152	13
Pelham 3591	67.7	106.0	173.7	0.010	0.001	89%	11%	10	9	1
Pelham 3323	68.4	118.0	186.4	0.013	0.001	92%	8%	10	9	1
Pelham 3324	73.9	134.0	207.9	0.014	0.001	94%	6%	45	42	3
Other 3591	92.9	129.8	222.7	0.008	0.002	82%	18%	5	4	1
Other 3323	93.7	141.8	235.5	0.009	0.001	87%	13%	1	1	0
Other 3324	93.7	141.8	235.5	0.009	0.001	87%	13%	4	4	1
Total								685	610	76
Mode Share									89%	11%

4.6.2. Cost and Revenue Analysis

The operation of three round trips per day would probably be the minimum to provide capacity and convenience for 76 shuttle users. The 64-mile roundtrip generates an operating cost of \$1,066 per day and \$271,728 per year. A \$12 roundtrip fare (\$6 one-way) would generate \$232,560 annually, resulting in a \$39,168 operating deficit. This comes to a net operating cost of \$0.03 per rider-mile. This is a moderate amount to be shared by area employers.

Providing free fare to riders, however, would probably necessitate a fourth roundtrip to accommodate an estimated 143 roundtrip passengers and the annual cost would rise to \$362,304 (net operating cost of \$0.16 per rider-mile), all of which would have to be funded by area employers.

5. FEASIBILITY EVALUATION

5.1. Regulatory and Political Considerations

Understanding how regulations at the different levels of government would apply to the proposed inter-regional transit service across different government jurisdictions is essential for evaluating the feasibility of the services. Besides Federal regulations associated with the use of Federal transportation funds, the Federal Motor Carrier Safety Administration (FMCSA) rules may apply to the proposed service across state borders. In addition, anti-competition prohibition use of the federal fund in the Urban Mass Transportation Act (UMTA) may apply to a certain operating model. In addition to Federal regulations, NRPC staff also reviewed state and local regulations, as well as political considerations.

5.1.1. Federal

The Federal government has jurisdiction on transit services that 1) use federal funding and 2) cross state or international borders (which constitutes interstate commerce). Moreover, federal laws such as the Civil Rights Act of 1964 and the American Disabilities Act of 1994 also have significant implications for the planning and operations of transit services.

5.1.2. FTA Regulations

The Federal Transit Administration (FTA), part of the U.S. Department of Transportation, administers the granting of federal transit funding to eligible operators. Furthermore, all federally funded transit services are subjected to Federal Transit Administration (FTA) regulations and oversight. According to the FTA's website, the FTA establishes and follows federally mandated procedures such as the following³⁵:

- Demonstrating legal, financial, and technical capacity to carry out programs and projects
- Providing technical inspection and supervision by qualified professionals of all work in progress
- Ensuring compliance with procurement requirements, including the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards
- Complying with all applicable civil rights statutes and implementing regulations
- Complying with applicable safety and asset management

Existing public transit services such as the NTS and LRTA are partly funded by FTA grants so they are subjected to FTA regulations and oversight. On the other hand, the employer shuttle services provided by Middlesex 3 TMA do not use federal funding and, thus, are not subjected to FTA regulations and oversight.

5.1.3. Charter Service Regulations

Besides the general regulations, the Charter Service Regulations within the FTA rules [49 CFR Part 604, which implement 49 U.S.C. 5323(d)] is of interest to this study. The Charter Service Regulations “protect private charter operators from unauthorized competition from FTA grant recipients ... ensure that transit agencies, subsidized with federal money, do not unfairly compete with privately owned bus

³⁵ FTA. 2021. “Regulations & Programs”. Undated. <https://www.transit.dot.gov/regulations-and-guidance/regulations-and-guidance>. Accessed June 2, 2021.

companies.”³⁶ The regulations define charter service as “transportation provided by a [FTA] grant recipient at the request of a third party for the exclusive use of a bus or van for a negotiated price” but excludes demand response service nor regularly scheduled services. There are several limited exceptions to the regulations, including by agreement with all registered charter providers.³⁷

As previously noted, Boston Express is a private operator and operates a bus route from the FEE Turnpike Exit 8 Park & Ride and a Park & Ride just south of the NH border in Tyngsborough, MA, with stops at South Station and Logan Airport. Therefore, the proposed routes that stop in both park & ride lots, as well as the proposed routes that offer a transfer connection into Boston via the MBTA commuter rail and subway services (at Lowell and Alewife), could be considered as competing with Boston Express. If categorized as Charter Services based on the aforementioned definition, these routes would be prohibited from using FTA funds. However, FTA funds could be used if these routes are advertised as fixed-route services and open to the public at large.

5.1.4. Civil Rights Act Title VI – Public Notice and Participation

A key federal statute governing the use of FTA funds is Title VI of the Civil Rights Act of 1964. Regardless of the operating model of the provided transit service, if FTA funds are used for the service, Title VI requires the operator to post a public notice and involve public participation in the planning process. This will most likely be done with assistance from the regional MPOs, namely NRPC and NMCOG.

5.1.5. American Disability Act

Under the U.S. Department of Transportation oversight, the American Disabilities Act applies to both public and private ground transportation providers, rider information, assistance equipment, and accessible features, boarding time, service animals, priority seating and signs, and operator training.³⁸

A public entity entering into a contract or agreement with a private entity to operate transportation services must ensure that the private entity meets all ADA requirements for the public entity.³⁹

The requirements for fixed-route transportation systems, including commuter and over-the-road bus systems, further cover architectural requirements on the vehicle and the station facilities. The proposed service must adhere to these requirements if the operation involves a public entity and fixed-route transportation and rail service.⁴⁰

Fixed route transportation system is also required to be supplemented by ADA complementary paratransit service that covers a three-quarter-mile area on either side of a fixed route and operates on comparable hours and fare as the fixed-route service. However, commuter bus, commuter rail, and

³⁶ FTA. 2021. “Charter Bus Service Regulations”. Undated. <https://www.transit.dot.gov/regulations-and-guidance/access/charter-bus-service/charter-bus-service-regulations-0>. Accessed June 2, 2021.

³⁷ *Ibid.*

³⁸ ADATA.org. The ADA & Accessible Ground Transportation. <https://adata.org/factsheet/ADA-accessible-transportation>. Accessed 5/17/2021.

³⁹ *Ibid.*

⁴⁰ *Ibid.*

intercity rail (e.g. Amtrak) services are specifically exempt from this requirement.⁴¹ Commuter bus service is defined as:

Fixed route bus service, characterized by service predominantly in one direction during peak periods, limited stops, use of multi-ride tickets, and routes of extended length, usually between the central business district and outlying suburbs. Commuter bus service may also include other service, characterized by a limited route structure, limited stops, and a coordinated relationship to another mode of transportation.⁴²

For private transportation providers that use vehicles that are not accessible to disabled persons, providing equivalent accessible service (e.g. via a different accessible vehicle) will fulfill the ADA paratransit service requirement.⁴³

The proposed inter-regional transit service may or may not fit the definition of the commuter bus service, and thus it is uncertain whether paratransit would be required. Either way, given the Route 3 corridor from Nashua to Lowell is well-served by demand response services provided by NTS and LRTA through their partner services, the ADA complementary paratransit service requirement could be satisfied by these services if the proposed service involved both agencies or through a service agreement if the proposed service involved only one or neither agency.

5.1.6. FMCSA

Any interstate passenger service is required to comply with the Federal Motor Carrier Safety Administration (FMCSA) rules and regulations, which cover registration, inspection, documentation, insurance, and operations (including specific requirements for vehicles and drivers)⁴⁴.

- Obtain operating authority registration from FMCSA.
- Meet specific financial responsibility through insurance or other acceptable security
- Comply with FMCSA's safety regulations
- Drug and alcohol test for drivers

However, depending on the operating model, the rules and regulations may apply differently or even be exempt in certain cases. The following exemptions may apply to the proposed inter-regional transit service: commercial zone exemption, transit authority exemption, and employer-related transportation exemption.

Government Exemption

The FMCSA Rules §390.3(f)(2) exempts transportation performed by the Federal Government, a State, or any political subdivision of a State from the FMCSA Rules.⁴⁵ However, this exemption does not apply

⁴¹ 49 CFR § 37.121 - Requirement for comparable complementary paratransit service.

⁴² 49 CFR § 37.3 – Definitions.

⁴³ ADA.org. The ADA & Accessible Ground Transportation.

⁴⁴ FMCSA. 2013. "About Us". Last updated December 12, 2013. <https://www.fmcsa.dot.gov/mission/about-us>. Accessed June 2, 2021.

⁴⁵ FMCSA. 2021. "Part 390". Undated. <https://www.fmcsa.dot.gov/regulations/title49/part/390>. Accessed June 2, 2021.

to the CDL requirements in part 383. Also, if governmental entities engage in interstate charter transportation of passengers, they must comply with accident report retention requirements of part 390.⁴⁶

The Nashua Transit System is part of the city's organization, which in turn is a political subdivision of the State of New Hampshire. Thus, the proposed inter-regional transit service would be exempt from FMCSA rules if they are operated by NTS.

While the Lowell Regional Transit Authority is one of Massachusetts's 15 regional transportation authorities (RTAs), which are political subdivisions of the Commonwealth of Massachusetts, LRTA contracted a private operator to run its transit operations as RTAs are prohibited by Massachusetts state law from operating any mass transit services directly.⁴⁷

FMCSA guidance clearly stated its Government Exemption under §390.3(f)(2) applies only when the government is the motor carrier, excluding motor carriers doing business with the government. Consequently, the proposed inter-regional transit service would not be exempt from FMCSA rules if they are operated by LRTA through its private operator.

Commercial Zone Exemption

§372.241 of the Federal Motor Carrier Safety Administration rules exempts inter-state transit operators from the FMCSA rules when operating within an interstate/foreign commercial zone as defined in the section. The commercial zone is a function between the population of the last municipality serviced before crossing the state/international border (recognized as the "base municipality") and the distance beyond the boundary of the base municipality. The larger the population, the further the commercial zone extends from the boundary of the base municipality across the border. Furthermore, the

FMCSA Case Studies

Advance Transit (Wilder, VT) is a non-profit operator operating multiple bus routes between New Hampshire and Vermont. It is currently headquartered in Vermont and has facilities on both sides of the border. Consequently, Advance Transit has to comply with FMCSA Rules, including operating authority registration, proof of insurance, regulations on driver's driving time and working hours, and record-keeping subjected to random and post-accident inspections by the FMCSA.

Cooperative Alliance for Seacoast Transportation (Dover, NH) is a non-profit operator operating two bus routes between New Hampshire and Maine, plus another route within Maine.

COAST has to comply with FMCSA Rules but taking advantage of the FMCSA's Commercial Zone and government organization exceptions, COAST only has to file an annual Universal Certification of Registration submittal to the NHDOT.

Merrimack Valley Regional Transit Authority (Haverhill, MA) is a state-mandated regional transit authority operating two routes between Massachusetts and New Hampshire through its contracted operator. MVRTA takes advantage of the FMCSA's Commercial Zone exception without registering or filing plans either with the FMCSA or NHDOT.

⁴⁶ *Ibid.*

⁴⁷ Massachusetts General Laws Part I Title XXII Chapter 161B Section 25

commercial extends out to the full extent of any municipalities that fall within the prescribed distance from the boundary of the base municipality.

In the context of the proposed routes in this study, Nashua would be the base municipality on the New Hampshire side of the state border. Nashua has a population of 86,494 at the 2010 census. According to the exemption's formula, Nashua's commercial zone extends into Massachusetts anywhere 6 miles beyond the city limit of Nashua, as well as the full extent of municipalities that have any part that falls within 6 miles of the city limit of Nashua. Chelmsford, Dracut, Lowell, Tyngsborough, and Westford are Massachusetts municipalities that fall within Nashua's commercial zone.

If the proposed service were to travel through Route 3A to Lowell via Hudson and Tyngsborough, the base municipality will be Hudson instead of Nashua. While Hudson's population (24,476 in 2010) will allow a 4-mile commercial zone buffer, it is closer to Lowell. All 5 Massachusetts municipalities mentioned will also fall within Hudson's commercial zone.

This means the proposed routes to the Lowell Gallagher Terminal and UMass Lowell would be exempted from FMCSA under §372.241, while the proposed routes to the Burlington employment centers and Alewife MBTA Station would not.

However, if the proposed service were to be operated from Lowell or another location within Massachusetts, then the base municipality would be Tyngsborough, MA. Since the City of Nashua directly abuts Tyngsborough, Tyngsborough's commercial zone would extend to the entirety of the City of Nashua. Since all of the proposed stops north of the state border are within the City of Nashua, the commercial exception would apply to all of the proposed routes in this case.

Employer-Related Transportation Exemptions

The employer-related transportation exemptions are complex in which there are multiple requirements and meeting all or some of the requirements would allow an exemption for different sets of provisions. The FMCSA's website guides through several examples, as shown below⁴⁸:

Some passenger transportation by employers is exempted or excepted, in whole or in part, from FMCSA's jurisdiction. The following are some examples:

An employer that transports employees in interstate commerce operating a van or vehicle that (1) is designed and used to transport 15 or fewer passengers (including the driver), (2) has a gross vehicle weight and gross vehicle weight rating less than 10,001 pounds, and (3) is not transporting hazardous materials requiring placarding, is not required to use a driver with a commercial driver's license and is not required by FMCSA to administer driver drug and alcohol testing.

If a company collects no fees from its employees for transportation, there is no compensation and, therefore, operating authority registration is not required.

⁴⁸ FMCSA. July 2019. "Employer-Related Transportation". Last updated July 30, 2019. <https://www.fmcsa.dot.gov/regulations/employer-related-transportation>. Accessed June 2, 2021.

An employer organizes a company retreat in which employees pay a single fee for various services including lodging, food, entertainment, and transportation. The employer transports its employees to a neighboring State with 15-passenger vans that have both a gross vehicle weight and gross vehicle weight rating of less than 10,001 pounds. These vans are also never operated beyond the seating capacity. The employer is not required to comply with most of the safety regulations. However, the company is required to register with FMCSA and to comply with the commercial regulations.

While the requirement for this exemption is more restrictive than the previous two exemptions (e.g. 15 passenger limit), this exemption would be worth considering if any of the proposed service routes do not qualify for the earlier exemptions due to being outside of the base municipality's commercial zone and not operated by a government entity.

5.1.7. State

Staff consulted with NTS and NMCOG, reviewed literature on both New Hampshire and Massachusetts statutes, and concludes that no state regulations and rules would specifically apply to the proposed inter-regional transit service because regulation on interstate public transportation is preempted by federal regulations.

Nevertheless, the state-level Department of Transportation in both states administer the allocation of FTA and other federal transportation funds within their respective state.

It is also worth noting that several Massachusetts regulations, including Chapter 159A, Chapter 161A, and Chapter 161B, apply to private fixed-route bus services that operate only within the state. These regulations provide licensing authority to the MBTA, regional transit authorities (RTAs), city or town, and the Department of Public Utilities depending on the jurisdiction in where the proposed route would operate.⁴⁹

5.1.8. Local

Local ordinances and regulations may apply where local public funds are used to subsidize transit services or local facilities are used. While political consideration and fiscal constraints play a key role in all levels of government, they are more pronounced at the local level due to the size of the local government and budgets. Staff consulted with both NTS, NMCOG, and LRTA, finding that, while neither public transit systems are bounded by regulation to operate within a certain geographic area, both would face a political challenge in extending service beyond their member communities – the City of Nashua for NTS, 14 communities including City of Lowell for LRTA.

LRTA is further limited by the state law that mandated regional transit authorities (RTAs)⁵⁰:

⁴⁹ Central Transportation Planning Staff. June 2013. *Massachusetts Regional Bus Study*. Available via CTPS's website <https://www.ctps.org>.

⁵⁰ NMCOG, Metropolitan Area Planning Council, and Central Transportation Planning Staff. 2017. *Middlesex 3 Community Compact Transportation Study*. Available via NMCOG's website <https://www.nmcog.org/>. Page 41.

- An RTA can technically extend service beyond its service area, the RTA receives no funding for service provided beyond its service area boundaries, except for fare revenues.
- There is also no mechanism available to the LRTA that allows them to charge a non-member community for new service.

Moreover, LRTA is sensitive to the 100-vehicle limit imposed by current federal legislation, with the risk of losing significant federal operating funds.⁵¹

Furthermore, both transit systems rely on limited FTA funding for their operations. While NTS is a designated recipient for the FTA grant allocated to the Nashua-New Hampshire-Massachusetts Urbanized Area, NTS annually participates in negotiations with LRTA and the Manchester Transit Authority on how to split the funding among the three public transit operators as all of them provide service to part of the Nashua urbanized area. Similarly, LRTA negotiates with MBTA and other public transit operators for the FTA grant allocated to the Boston-Massachusetts Urbanized Area. Consequently, as indicated in NRPC's consultation with both agencies, neither NTS nor LRTA would like to allocate its limited FTA grant funding toward additional services beyond its service area.

Another local consideration is the use of public transit facilities, including the NTS's Nashua Transit Center, LRTA's Lowell Gallagher Transit Terminal, and MBTA's Alewife Station, which would require permission and, possibly, negotiation with these agencies over scheduling, fees, and/or shared expenses. In addition, consultation with NMCOG noted that LRTA would be concerned about a potential loss in parking revenue for commuters who would arrive via transit instead of driving to and parking at the LRTA-operated parking garage at the Gallagher Transit Terminal. According to the LRTA's Comprehensive Regional Transit Plan, a significant portion of LRTA's non-subsidy operating revenue comes from parking fees collected at the Lowell Gallagher Center.⁵²

On the other hand, the Park & Ride lots are owned and maintained by the Department of Transportation in their respective states. The use of these lots may involve private transit operators (e.g. Boston Express) depending on the service arrangement between the DOTs and operators (e.g. permit, lease, etc.).

The use of public right-of-way as a transit stop (e.g. at the Bedford/Burlington clusters, and on-street location near the UMass Lowell North Campus) would require similar permissions from the corresponding municipalities but perhaps through a simpler process.

5.1.9. University of Massachusetts Lowell

The University is a unique state entity with relative financial and operating autonomy. As a potential partner for the proposed inter-regional transit service, it can be assumed that the University will work with the operator of the proposed service to cater to the University's needs. Nevertheless, the University may have specific policies not typical to general public transit operations.

⁵¹ *Ibid.*

⁵² ⁵² LRTA and AECOM. *Comprehensive Regional Transit Plan Update 2020*. Available via the LRTA's website <https://lrta.com/>. Page 27.

5.2. Financials

Financing the proposed inter-regional transit service would likely involve various funding sources. This section examines funding from a variety of sources, including federal, state, local, and private sources.

5.2.1. Cost of Proposed Inter-Regional Transit Service

The cost of the proposed inter-regional transit service was already addressed, by each proposed route, in Chapter 4 under the four “Cost and Revenue Analysis” sub-sections. The cost includes both operating cost by mileage, referenced from NTS operating cost data, and amortized vehicle cost. Due to the different length of and ridership forecast for each proposed route, the operating cost per rider varies, as shown in the table on the following page. After accounting for the farebox revenue noted below, the net operating cost per rider-mile is a good indicator for evaluating the proposed service’s financial feasibility before subsidies and external contributions are considered.

5.2.2. Funding Source – Farebox

As noted in Section 3.2.3 and again in Chapter 4 under the “Cost and Revenue Analysis” for each proposed route, while the proposed inter-regional transit service is not designed to generate a profit, NRPC staff assumed a fare that would offset part of the operating cost. However, as noted in the Cost and Revenue Analysis sections, fare level has an inverse relationship to ridership, which becomes more disproportionate with higher fares.

Except for the Nashua Shuttle to UMass Lowell, Farebox revenue would be a significant funding source but other sources would be necessary to support the proposed inter-regional transit service. The Nashua Shuttle to UMass Lowell, on the other hand, would have to rely heavily on university subsidies if there are no other available funding sources.

Estimated Operating Cost, Revenue, and Balance for Proposed Shuttle Routes

	Roundtrip Miles	Cost per Roundtrip*	Daily Roundtrips	Total Cost [^]	Daily Ridership (Roundtrip)	Fare	Total Revenue [^]	Annual Balance	Gross Operating Cost	Net Operating Cost
Lowell Gallagher Shuttle	52	\$288.60	8	Daily \$2,309 Annually \$588,744	240	Round trip \$8.00 One-way \$4.00	Daily \$1,920 Annually \$489,600	per rider-mile per rider (rt)	\$0.19 \$9.62	(\$0.03) (\$1.62)
Alewife Station Shuttle	82	\$455.10	8	Daily \$3,641 Annually \$928,404	227	Round trip \$16.00 One-way \$8.00	Daily \$3,632 Annually \$926,160	per rider-mile per rider (rt)	\$0.20 \$16.04	(\$0.00) (\$0.04)
UMass Lowell Free Shuttle	44	\$244.20	6	Daily \$1,465 Annually \$210,989	197	Round trip \$0.00 One-way \$0.00	Daily \$0 Annually \$0	per rider-mile per rider (rt)	\$0.17 \$7.44	(\$0.17) (\$7.44)
UMass Lowell Shuttle w/fare	44	\$244.20	4	Daily \$977 Annually \$140,659	97	Round trip \$5.00 One-way \$2.50	Daily \$485 Annually \$69,840	per rider-mile per rider (rt)	\$0.23 \$10.07	(\$0.12) (\$5.07)
Bed/Burling Emp Free Shuttle	64	\$355.20	4	Daily \$1,421 Annually \$362,304	143	Round trip \$0.00 One-way \$0.00	Daily \$0 Annually \$0	per rider-mile per rider (rt)	\$0.16 \$9.94	(\$0.16) (\$9.94)
Bed/Burling Emp Shuttle w/fare	64	\$355.20	3	Daily \$1,066 Annually \$271,728	76	Round trip \$12.00 One-way \$6.00	Daily \$912 Annually \$232,560	per rider-mile per rider (rt)	\$0.22 \$14.02	(\$0.03) (\$2.02)

* Assumed \$5.55 per mile operating cost based on NTS average.

[^] Assumed 255 operating days per year (all working days of the year) for all routes except UMass Lowell Shuttle, which uses 144 operating days (school calendar days).

5.2.3. Funding Source – Federal Funding

The Fixing America's Surface Transportation (FAST) Act was signed into law in December 2015. The act, which supports transit funding through the fiscal year 2020, reauthorized FTA programs and included changes to improve mobility, streamline capital project construction and acquisition, and increase the safety of public transportation systems across the country.

FTA funds made up the bulk of the federal funding available for the construction, operation, and maintenance of transit services. However, as noted in Section 5.1.8 above and again below, existing transit services have virtually curved up all available FTA funding and there is still not enough money to go around, leading to budget deficits and service cuts.

In addition, an important factor common to nearly all the federal funding programs listed below is that they require non-federal (local, state, or private) matching dollars. Securing adequate matching funding is a challenge for all transit systems in New Hampshire.

Various FTA Programs

In Large Urbanized Areas with populations over 200,000, transit agencies are designated recipients of Section 5307 funding and receive funds directly from FTA. Apportionment of funding in Large UZAs is based on a combination of population, population density, and route miles of service. Funds for each Urbanized Area are divided up among eligible transit operators every year, usually based on negotiation.

Since the proposed inter-regional transit service would service both the Nashua Urbanized Area and Boston Urbanized Area, the proposed service may be eligible for FTA funding in either or both UZAs. However, the cross-UZA nature of the inter-regional transit service would also create difficulty in funding allocation, notwithstanding transit agencies' reluctance to allocate their limited FTA grant funding toward additional services beyond their service area, as mentioned in Section 5.1.8.

For the Nashua Urbanized Area, NTS had experienced a significant 37% or \$870,000 reduction in the FTA urbanized area formula funding between 2012 and 2015, after the Nashua Region was designated as a large urbanized area (200,000 population) based on the 2010 Census. The FTA funding level has not returned to the pre-designation level and NTS is projecting a shortfall of operating funding in excess of \$400,000 by FY 2022.

The shortfall notwithstanding, both the 2018 NRPC Metropolitan Transportation Plan and 2019 NRPC Regional Transportation Expansion Study already identify a list of 3 new routes and route extensions recommended for expansion within the Nashua Region.⁵³

⁵³ NRPC. December 19, 2018. *Nashua Region Metropolitan Transportation Plan 2019 to 2045*. Available via the NRPC's website <https://www.nashuarpc.org/>. Pages 125-126.

NRPC. December 2019. *Nashua Regional Transit Expansion Study*. Available via NRPC's website <https://www.nashuarpc.org/>. Pages 51-53.

Similarly, the 2019 NMCOG Regional Transportation Plan also includes a list of recommended operations improvements without a funding source, including the proposed regular LRTA service to Pheasant Lane Mall.⁵⁴

As a result, it is highly unlikely that FTA funding from either Urbanized Area would be available to the proposed inter-regional transit service in the near future.

Congestion Mitigation and Air Quality (CMAQ) Program

CMAQ funds are available to all 50 states for programs that reduce traffic congestion and improve air quality. However, since New Hampshire is in attainment for transportation-related air pollutants, the state's CMAQ allocation has been transferred to the Surface Transportation Program fund allotment.

CMAQ funding for transit can be used to purchase buses, vans, or rail equipment; for transit passenger facilities; or for operating support for pilot transit services. Funding may be used for all projects eligible under FTA programs including operating assistance for up to five years. However, a non-federal match of 20% is required. New Hampshire CMAQ funds are typically available on a two-year cycle, allocated through a competitive grant administered by the NHDOT.

Given the purpose of this funding, there is a requirement to demonstrate air quality benefits from the funded projects. Consequently, when CMAQ funds are used for transit, it is typically for fixed-route commuter transit, where it can be demonstrated that the bus is taking cars off the road.

For example, the NTS fixed-route service to Walmart in Amherst is being funded through the CMAQ program, up to the third year of service. After the third year, the service would have to be sustained through other funding, such as conventional FTA urban formula funds.

It is worth noting that the 2019 Nashua Regional Transit Expansion Study also identifies CMAQ funds as a potential funding source for transit service expansion (3 recommended new routes/route extensions) within the Nashua Region, which may become competing projects if the proposed inter-regional transit service also seeks the same funding source.⁵⁵

In Massachusetts, CMAQ funds are allocated in two ways⁵⁶:

1. Each MPO received an allocated amount based on a calculation of relative air quality and the number of residents affected by air pollution. The MPO prioritized and programmed the use of funding through the Transportation Improvement Program planning process, which is then reviewed by a CMAQ Consultation Committee.

⁵⁴ NMCOG. July 2019. *Northern Middlesex Regional Transportation Plan FFY 2020-2040*. Available via NMCOG's website <https://www.nmcog.org/>. Page "15-14".

⁵⁵ NRPC. December 2019. *Nashua Regional Transit Expansion Study*. Available via NRPC's website <https://www.nashuarpc.org/>. Page 58.

⁵⁶ MassDOT. September 21, 2017. *Statewide Funding Programs and Categories*. Available via the Commonwealth of Massachusetts' website <https://www.mass.gov/doc/statewide-funding-programs-and-categories>.

2. A statewide CMAQ program administered by the MassDOT, which in turn funded several competitive grant programs, including a workforce transportation grant⁵⁷.

Given that Lowell is within an air quality maintenance area for carbon monoxide, at least several of the proposed routes, such as the Nashua Shuttle to Lowell Gallagher Terminal and Nashua Shuttle to UMass Lowell, may be eligible for Massachusetts CMAQ funding.⁵⁸ Under the first allocation method, the proposed inter-regional transit service would first have to be prioritized and programmed by NMCOG in its planning documents. NRPC staff is uncertain whether the cross-state-border nature of the proposed transit service would complicate the process, but it would be worth exploring with NMCOG, alongside opportunities under the second allocation method (statewide CMAQ competitive grants).

5.2.4. Funding Source – State and Local Contributions

Very little funding, if any, could be expected from the state and local levels for the proposed inter-regional transit service. Despite a continuous effort by the NH Transit Association and other advocacy groups to develop a dedicated source of state funding for public transportation, the State of New Hampshire currently contributes very little to support public transportation. On the other hand, while Massachusetts spent the most on public transit among New England states, the inter-state and Nashua-focused nature of the proposed service would face difficulties in obtaining competitive state grant funding.

At the local level, as mentioned in Section 5.1.8, municipalities that already provide or contribute to transit services are fiscally constrained and unlikely to fund new services that serve beyond their service area. Nevertheless, the 2019 Nashua Regional Transit Expansion Plan suggests funding raised by a surcharge on local vehicle registration fees and local option fees.⁵⁹

5.2.5. Funding Source – Business/Employer Support

Aside from collecting a cost-offsetting fare, financial support from businesses and regional employers is the most likely funding source for the proposed inter-regional transit service. As demonstrated by Middlesex 3 TMA's robust membership, as well as input from both employers and employees such as the Hitchiner Manufacturing Company's survey in Section 2.1.5, there exists interest in the business community to support transit services that would facilitate their employee's commute trips, expand their accessible talent pool, and, more generally, promote economic development in the region.

Experience from Middlesex 3 TMA shows that businesses and employers are more likely to be interested if there is matching funding to their contribution. Moreover, it takes at least one year for the piloted transit service to demonstrate its value and benefits, which then will entice the contributors to continue

⁵⁷ Massachusetts Municipal Association. May 29, 2019. "New workforce transportation grant targets congestion, air quality". <https://www.mma.org/new-workforce-transportation-grant-targets-congestion-air-quality/>. Accessed June 30, 2021.

⁵⁸ NMCOG. July 2019. Northern Middlesex Regional Transportation Plan FFY 2020-2040. Available via NMCOG's website <https://www.nmcog.org/>. Page "13-1".

⁵⁹ NRPC. December 2019. *Nashua Regional Transit Expansion Study*. Available via NRPC's website <https://www.nashuarpc.org/>. Page 60.

funding the service. Thus, it is critical to secure adequate funding to operate any new services for at least an entire year.

On the other hand, such business interest and support would be very helpful in leveraging public funding, such as providing the required match to government grants, as well as local political support for the proposed inter-regional transit service.

For the Nashua Shuttle to UMass Lowell, without another funding source, the prospect of its implementation would depend on whether UML chooses to subsidize the route to offer a fare-free service to at least university students and employees. Discussion with the university concluded that this is not very likely due to budgetary constraints and competing transit needs, especially if there are no other funding sources or matching contributions.

5.2.6. Other Funding Sources

Beyond the farebox and the aforementioned funding sources, few other funding sources might apply to the proposed inter-regional transit service. Advertisement on the shuttle's interior and exterior is one source but would be rather limited given the limited number of trips.

Another alternative funding source may be a donation and grant funding from a private charity or foundation that might have an interest in promoting transit connections between the Nashua Region and the Greater Boston Region.

5.2.7. Conclusion on Financials

The ridership forecast and cost estimates have demonstrated that cost-offsetting fares are workable for three out of the four proposed transit routes. Nevertheless, it is foreseeable that additional funding would be necessary to supplement transit fares to cover any additional expenses such as station infrastructure, facilities use fees, consultant fees, as well as any shortfalls.

With very limited government funding available, perhaps except CMAQ funding, financial support from businesses and regional employers would be critical to make possible the proposed inter-regional transit service.

5.3. Feasibility

Considering the regulatory, political, and financial factors discussed above, this section lays out the overall feasibility and key challenges of implementing the proposed inter-regional transit routes, as well as exploring several operating models that may be employed for the proposed routes.

5.3.1. Overall Feasibility

Out of all four proposed routes, the **Nashua Shuttle to Lowell Gallagher Transit Terminal** is forecasted to serve the most riders – 240 daily roundtrip riders. The route would be feasible if there is available funding to fill its roughly \$71,000 annual operating deficit. As mentioned in the input analysis within Chapter 2, there has been expressed demand among existing riders for the Lowell-Nashua transit connection.

The **Nashua Shuttle to Alewife MBTA Station** is forecasted to serve the second-most riders – 227 daily roundtrip riders. As mentioned in Section 4.4.2, this route is virtually break-even with a \$16 roundtrip

fare and will certainly be so with a slightly higher fare. For comparison, Boston Express charges \$24 round trip and \$13 one-way for its Route 3 route from Exit 8 to Boston South Station. One potential challenge to this route would be its ineligibility for the Commercial Zone Exemption to the FMCSA regulations, which may limit the feasibility for certain operating models. Nevertheless, without a financial barrier, NRPC staff considers this route to be the most feasible out of the four proposed routes.

The **Nashua Shuttle to the University of Massachusetts, Lowell** would serve between 97 and 197 daily roundtrip riders (during the time of the year when the university is in session) depending on the fare level. A fare-free shuttle would see higher ridership but require roughly \$211,000 to cover the annual operating deficit while the \$5 roundtrip fare level would still require around \$71,000 for a smaller, but still sizable, annual operating deficit.

The **Nashua Shuttle to Burlington/Bedford Employment & Retail Clusters** would serve between 76 and 143 daily roundtrip riders depending on the fare level. Due to the longer distance and more complex routing this proposed route has to cover, the difference in the annual operating deficit between the fare-free and \$12-roundtrip fare scenarios is greater than that for the UMass Lowell shuttle – about \$362,000 for fare-free and \$39,168 for a \$12 roundtrip fare. Fortunately, as this route is purposed to provide transit connections to employees who work within the employment and retail clusters, the funding gap may not seem as daunting if several employers see the benefits of the connection and band together in supporting it financially. One thing to note, however, is that this route would be ineligible for the Commercial Zone Exemption to the FMCSA regulations, which may limit the feasibility for certain operating models.

5.3.2. Operating Models

Expand NTS or LRTA Service: Due to the ownership of the corresponding terminal facility between Nashua and Lowell, as well as an expressed demand among existing NTS and LRTA riders, the NTS/LRTA Service would be most suitable in operating the Nashua Shuttle to Lowell Gallagher Transit Terminal. Nevertheless, the public operator would have to secure additional funding to offset the operating deficit. Given that the FTA funding is limited and LRTA is also sensitive to a fleet size constraint, as noted in Section 3.3.1 and 5.1.8, NTS/LRTA would likely need to partner with each other, other agencies, private businesses, and organizations such as TMAs to fund the shuttle. This challenge would be the same for the other proposed shuttle routes.

Due to the similar routing of the Nashua Shuttle to UMass Lowell with the Shuttle to Gallagher Terminal, it is foreseeable that the NTS/LRTA Service would be suitable to run the university route as well. The two remaining routes, running beyond either the NTS's and LRTA's service area, may be less suitable for the NTS/LRTA Service. Moreover, the use of FTA funds may require the consideration of the FTA's Charter Service Regulations, mentioned in Section 5.1.3.

Partnership with Middlesex 3 TMA: As mentioned in Section 3.3.2, the TMA is financially supported by several employers in the Northern Middlesex County and, through a contracted operator, runs an employee shuttle between Burlington/Bedford and the Alewife MBTA Station. A partnership between interested parties in the Nashua Region with the TMA could create synergy in extending the TMA shuttles to Nashua. The proposed Nashua Shuttle to Alewife MBTA Station and Nashua Shuttle to the Bedford/Burlington Retail and Employment Clusters would be a good fit with this operating model.

The TMA may run the two other proposed routes if a financial agreement can be arranged with the City of Lowell and UMass Lowell, both of which are members of the Middlesex 3 Coalition but not currently part of the TMA. Nevertheless, securing financial contributions from interested employers would remain a prerequisite. An advantage of the TMA contracting a private operator to run the shuttles is that the operator may have inter-state transit operation expertise or experience that would help navigate applicable FMCSA regulations.

However, given Middlesex 3 TMA's focus within the Northern Middlesex County region, it may take additional organizing effort, such as a partnership with NRPC, to connect the TMA with interested parties in the Nashua Region.

Form a new Nashua Region TMA: Forming a Nashua Region TMA would address the aforementioned challenge in organizing interested parties in the region. If there is popular support from businesses and employers in the region, the new TMA may contract a private operator to run the proposed service akin to the Middlesex 3 TMA's shuttles. In addition, the TMA can help organize and promote other TDM programs targeted at the Nashua Region.

Past employer surveys such as the one taken by Hitchiner Manufacturing Company, as mentioned in Section 2.1.5, indicate that some employers are interested in more transit services and other transportation programs for their employees. However, more surveys would need to be conducted to ascertain whether such interest is widespread across the region.

Moreover, New Hampshire lags behind other states such as Massachusetts in financial incentives for TDM programs and government funding for public transit. Existing mode share and general interest in public transit in New Hampshire also fall behind other states. Regardless of the level of employer interest, a new Nashua Region TMA would not be as easy to establish as in other states. And given the inter-regional nature of the proposed service, with or without a Nashua Region TMA, partnering with Middlesex 3 TMA and leveraging shared experiences and resources appears to be the most feasible path toward running the shuttle service.

Commercial Operator: As noted in Section 3.3.4, commercial operators may be interested in providing the proposed service if it is profitable. With its estimated operating budget to be virtually breakeven with a \$12 roundtrip fare, the Nashua Shuttle to Alewife MBTA Station will be the most likely candidate for a commercial operation. While Boston Express, given its existing service between Nashua and Downtown Boston, appears to be the most suitable operator for this proposed route, the private operator may find the route competing with its existing service and, thus, not desirable. While another private operator may be interested in running the proposed route, it may be worthwhile to collaborate with Boston Express to explore potential ways, perhaps through modifying the routing of its existing service, to meet the unmet transit needs from the Nashua Region to Alewife Station.

Other proposed routes are estimated to have sizable operating deficits and, therefore, do not seem feasible for commercial operators without some sort of financial partnership with government agencies, organizations such as TMAs, and private businesses/employers.

5.4. Strategies for Implementation

This study has shown that at least some of the proposed routes would be feasible with the appropriate operating model. Such inter-regional service would serve notable, albeit not sizable, transit needs,

including commuters who are driving but desire to commute by transit. Based on the findings of the various analyses and evaluations in this study, this section provides a list of strategies toward implementation.

1. Assess the interest of NRPC, potential partnering agencies, local businesses/employers, municipalities in the Nashua Region, and businesses/employers in Massachusetts in forming a Nashua-based TMA, and then evaluate whether forming the TMA would be superior to joining the M3 TMA.
2. Engage the Middlesex 3 Coalition and M3 TMA in a more serious discussion about cross-border collaboration and the pilot of the proposed inter-regional transit service via M3 TMA shuttles.
3. Continue the discussion with UMass Lowell on identifying funding for the Nashua Shuttle to UMass Lowell, as well as other opportunities to collaborate between the university and the Nashua Region.
4. Survey current riders (NTS/LRTA/M3 TMA shuttles) and potential riders for interest and input once a greater level of details on the proposed service and operations are determined, similar to the survey given to UMass Lowell students and employees residing in the Nashua Region.
5. Facilitate collaboration between NTS and LRTA, especially on the potential pilot of the Nashua Shuttle to Lowell Gallagher Station, as well as the possible pilot of the regular LRTA service to the Pheasant Lane Mall mentioned in LRTA's recent comprehensive regional transit plan update.
6. Work with NHDOT and NMCOG to explore the potential use of CMAQ funds available for piloting the proposed inter-regional transit service
7. Explore and identify other available funding, including contributions from businesses and private foundations
8. Collaborate with Boston Express on potential ways its service may strengthen the transit connection between Nashua and Massachusetts (e.g. adding a stop at Alewife Station on its Nashua-Boston route would essentially duplicate the proposed Nashua Shuttle to Alewife Station)

6. CONCLUSION

The purpose of the present study was to evaluate the feasibility of implementing transit alternatives between Nashua and Middlesex County, Massachusetts. Two of the service alternatives, the Lowell Terminal shuttle, and the Alewife shuttle, serve the same primary commuting market. Therefore, the implementation of one would preclude consideration of the other. The other alternatives, a shuttle to the University of Massachusetts, Lowell, and to the Burlington/Bedford employer area, serve distinctly different markets from each other and from the first two shuttle services which are primarily intended to facilitate commuter trips into the Boston metro area.

All of the shuttle services considered are feasible for implementation under the right circumstances, some more so than others. Although NRPC staff made the best estimation with available data, ridership/utilization of the service remains a key uncertainty. Feasibility of service does not infer recommended inclusion of the proposed inter-regional transit service in the long-range Metropolitan Transportation Plan (MTP), as this step should entail a further exploration of implementation, communication with stakeholders, exploration of funding sources, and presentation to NRPCs Transportation Technical Advisory Committee (TTAC) and Metropolitan Planning Organization (MPO) Policy Committee. Accordingly, the feasibility study will be presented to these groups for review and comment but MPO action to endorse the document is not being sought. Further discussions and follow-up may result in components of this study being incorporated into the MTP with its next major update in December 2022.

At the moment, we can draw the following conclusions for each service alternative:

Nashua Shuttle to Lowell Gallagher Transit Terminal – For over thirty years, there has been a stated regional goal of extending passenger rail service from Lowell to Nashua and various levels of study and follow-up actions have been undertaken to achieve this end. At present, the Capitol Corridor Project Development Phase in progress attempts to make a final determination regarding the implementation of this service to Nashua and further north to Manchester.

The most recent capital cost estimate for the extension of rail to Nashua (terminating there, not continuing to Manchester) is \$159 million, assuming a project started in 2029. Even if the Capitol Corridor Project Development Phase ultimately results in a plan to carry forward the project (which would almost certainly necessitate an unprecedented amount of state funds to match a federal discretionary grant application), the path to passenger rail service is not expected to be expeditious and numerous obstacles can potentially arise.

For this reason, it may prove beneficial to initiate a Nashua to Lowell Terminal shuttle as an interim service, with the possibility that it will also be the only long-term alternative if the obstacles that have blocked passenger rail for the past years are unable to be overcome in the future. A shuttle service is somewhat less convenient than a passenger rail extension to Nashua, as the shuttle would travel highways with a degree of congestion to reach Lowell Terminal, as opposed to boarding a train in south Nashua. Given the considerable difference in capital costs of implementation and operating deficits that must be funded annually, it is a service alternative that should be given strong consideration.

Nashua Shuttle to Alewife MBTA Station – For the purpose of this study, NRPC staff assumed the Alewife shuttle and the Nashua to Lowell Terminal shuttle as serving the same primary market, in which the two proposed routes share similar ridership estimates. Nevertheless, a direct shuttle from Nashua to Alewife would provide a more convenient path for commuters who travel to MBTA Red Line stations in Cambridge and Mass General in Boston than passenger rail service to Boston via Lowell since it avoids the need to transfer to the Green Line at North Station followed by another transfer to the Red Line at Park Street Station for a back-tracking trip to the final destination. There may also be potential reverse commuter ridership.

There are two negatives associated with the Alewife shuttle. First, the shuttle has a long trip along the congested highway network in Massachusetts to reach the station. Variability in congestion from day to day would result in uncertain destination times at Alewife. Fortunately, the rapid transit system operates quite frequently during commute hours, and therefore missing a subway connection is not nearly as onerous as missing a less frequently scheduled passenger rail run.

The other disadvantage of this service is that it does not serve the secondary market of existing transit users who desire to travel between Nashua and Lowell. This tends to render the Alewife shuttle a less preferred alternative to the Lowell Terminal shuttle.

Nashua Shuttle to University of Massachusetts, Lowell – Because UML has a large Nashua area commuter population comprised of faculty and students, a shuttle service is likely to be highly successful, as long as it is largely subsidized by the University. The ridership analysis has indicated that charging a moderate fare reduces the ridership potential to a level that is not supportive of the service. Herein lies the main obstacle to implementation. Not only would UML have to allocate resources to fund the service, but it would also lose parking revenues from commuters who switch to transit. However, the shuttle concept is clearly in concert with the University's master plan goals of achieving environmental benefits through its policies and programs.

Should UML express interest in supporting a Nashua shuttle service, NRPC is available to conduct analysis that would enumerate the environmental and societal benefits, including reduced highway congestion, fuel conservation, and reduction of air emissions.

Nashua Shuttle to Burlington/Bedford Employment & Retail Clusters – Based on the ridership estimate, the Burlington/Bedford employment & retail clusters shuttle appears to have a low level of feasibility as a full loop service through Middlesex Turnpike and Burlington Mall Road. This is not an unexpected finding. Similar services have had varying degrees of success in the Boston metro area. A very successful shuttle was operated by Teradyne for years from South Station to its downtown facilities (ultimately, the company sold its two Boston buildings and consolidated all Boston-area staff to its current site in North Reading). The high demand for the service was due to the exorbitant cost of parking a private auto downtown, in addition to the other major inconveniences of commuting into the city.

On the other hand, a Route 128 employer area shuttle was attempted from the Anderson Regional Transportation Center in Woburn – a station served by the Lowell commuter rail line and close to I-93. A Metro-North Shuttle to Lahey Hospital/Medical Center and a nearby business center was operated in 2005-2006 but discontinued due to low ridership and loss of state funding. The shuttle evaluated for the Bedford/Burlington area would serve a similar area – relatively easily accessible

by private auto (at least when compared to driving into a dense downtown urban center) with free and available parking.

There is one potential emerging trend that may alter the potential for the employer loop shuttle. The failed Anderson RTC – Route 128 shuttle occurred during an era of lower gasoline prices (\$2.30 at the time). Over the past year, the national average gas price has risen from \$2.18 to \$3.12 per gallon. Should this develop into a secular upward trend, the prospects for employer shuttles even to areas with free and adequate parking would be enhanced.

An alternative to a shuttle loop serving a general area would be the concept of micro-shuttles, i.e. services that pinpoint a specific employer or close cluster of businesses. An example would be a shuttle to MITRE/iRobot specifically; one to the Lahey Clinic, etc. The potential for these would be determined by direct communications with employers that are conducive to promoting corporate involvement in transportation alternatives and have a pool of commuters to provide the demand for service.

NRPC intends to transmit this feasibility study to various stakeholders mentioned in the report, with the goal of identifying which services should be incorporated into the next Metropolitan Transportation Plan update and what further implementation steps should be initiated in the interim future. A follow-up to the completed study is funded through the NRPC's Unified Planning Work Program under the category Transit Assistance.

APPENDIX 1 – UMASS LOWELL SURVEY OF NASHUA AREA RESIDENT STUDENTS AND FACULTY/STAFF SURVEY FORM

The Nashua Regional Planning Commission, in partnership with UMass Lowell Transportation Services is conducting a transportation survey to study the feasibility of shuttle bus service from locations in Nashua to UMass Lowell

We are asking for your help to determine how willing you would be to use such a service.

If you have any questions about this survey, please contact:

Matt Waitkins, Nashua Regional Planning Commission, mattw@nashuarpc.org / 603-417-6566

- 1) Are you currently enrolled as a student, or do you teach or work at UMass Lowell
Please check all that apply.
 - a. Enrolled as a fulltime undergraduate student
 - b. Enrolled as a parttime undergraduate student
 - c. Enrolled as a fulltime graduate student
 - d. Enrolled as a parttime graduate student
 - e. Fulltime faculty or staff
 - f. Parttime faculty or staff
 - g. Vendor e.g. Aramark Dining Staff or similar
 - h. Other _____
- 2) If a student, how are you currently taking classes/labs?
 - a. Remote
 - b. In-person instruction
- 3) When regular in-person instruction resumes at UMass Lowell, where do you expect to live?
 - a. City of Nashua
 - b. NH town near Nashua
 - c. UMass Lowell on campus housing
 - d. City of Lowell – off campus
 - e. Other _____
- 4) When regular in-person instruction resumes at UMass Lowell, how frequently would you expect to be on campus?
 - a. Five days a week, Monday – Friday
 - b. Four days week, Monday – Thursday
 - c. Two to three days a week
 - d. One to two days a week
 - c. Less than once a week

5) Please indicate how frequently you used any of the following transportation modes **prior** to the shift to remote learning due to COVID-19

	Very Often	Often	Sometimes	Rarely	Never
Drive alone					
Drive with others					
Public Bus					
Shuttle Bus					
Commuter Rail					
Uber/Lyft/Taxi					
Bike to school or work					
Walk to school or work					
Not applicable newly enrolled student or new employee					
Other _____					

6) Please indicate how frequently you would be willing to use any of the following transportation modes when in-person instruction resumes

	Very Often	Often	Sometimes	Rarely	Never
Drive alone					
Drive with others					
Public Bus					
Shuttle Bus					
Commuter Rail					
Uber/Lyft/Taxi					
Bike to school or work					
Walk to school or work					
Other _____					

7) When regular in-person instruction resumes at UMass Lowell, how frequently would you use a shuttle bus from Nashua to UMass Lowell

- a. Daily
- b. Three to four times per week
- c. One or two times per week
- d. A few times per month
- e. Less than once a month
- f. Rarely or never

8) What is the most you would be willing to pay for a **round trip** ride on a shuttle service from Nashua to UMass Lowell)?

- a. Would not take shuttle even if free, prefer private car
- b. Would take shuttle but only if free
- c. Would be willing to pay up to \$4/day
- d. Would be willing to pay up to \$6/day
- e. Would be willing to pay up to \$10/day

- 9) If a shuttle bus were available to provide transportation from Nashua to UMass Lowell, which pick/drop off location would best meet your needs?
- a. Downtown Nashua Transit Center on Elm Street (behind City Hall)
 - b. Exit 8 Park & Ride facility
 - c. Tyngsborough Park & Ride facility
 - d. Pheasant Lane Mall
 - e. Nashua Mall
 - f. Other _____
- 10) If a shuttle bus were available to provide transportation from Nashua to UMass Lowell, what accommodations would be most important to you? Please rank the following in order of importance.
- a. Convenient parking
 - b. Free or low-cost parking
 - c. Ease of access
 - d. Proximity to City bus stops
 - e. Bicycle accessibility such as bike lanes and bike racks
 - f. Pedestrian accommodations such as sidewalks and crosswalks
 - g. Sheltered waiting areas
 - h. Seating
 - i. Access to public restrooms
 - j. Proximity to coffee shops/restaurants
 - k. Other _____
- 11) When in-person instruction resumes, how frequently will you use the LRTA bus service from UMass Lowell campus to Gallagher Transportation Terminal in Lowell?
- a. Daily
 - b. Three to four times per week
 - c. One or two times per week
 - d. A few times per month
 - e. Less than once a month
 - f. Rarely or never
- 12) Do you have any additional comments about transportation to/from the Nashua Region to UMass Lowell?

Thank you for participating in our survey!