Everett-Boston BRT

IMPLEMENTATION PLAYBOOK

ITDP

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BUS ONLY

EXECUTIVE SUMMARY

SOURCE: Ad Hoc Industries

Good, reliable transit service is a baseline for livable, equitable communities and is essential to well-functioning cities and societies. The ability to travel comfortably and conveniently throughout the day without depending on a high-cost motor vehicle affords people of all income levels the ability to access opportunities and achieve economic security for themselves and for their families. When bus service is frequent and fast and connects people with where they want to go, it unlocks all the region has to offer. With a $55 monthly MBTA bus pass, a person can access jobs and job opportunities as well as libraries, educational and financial institutions, healthcare providers, and cultural amenities region-wide. Prioritizing and investing in high-quality, frequent, reliable transit such as Bus Rapid Transit (BRT) can address many of the challenges facing cities today, and it often offers both measurable and immeasurable benefits to local economies, social equity, public health, and environmental sustainability.

BRT is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services. It does this through the provision of dedicated lanes, with busways and distinctive stations, off-board fare collection, and fast, frequent, and coordinated operations. BRT is similar to a rapid transit system, so it is much more reliable, convenient, and fast than "regular" bus services. With the right features, BRT can avoid the types of delay that typically slow regular bus services, such as being stuck in traffic and having passengers queuing to pay on board.

Some of the most densely populated cities and towns in the United States are in Massachusetts, including Boston as well as inner-core suburbs like Cambridge, Chelsea, Somerville, Malden, and Everett. Population density and transit density generally work hand-in-hand: Most of these cities are served by a combination of MBTA rapid transit lines, "key" bus routes with frequent service, and Commuter Rail stations. This results in relatively high use of transit, with census data showing that at least one quarter of trips to work in these cities are made by transit, which is far higher than the regional and national average.

Boston and Cambridge are served by multiple rapid transit and key bus routes that move people between residential areas, job clusters, and the healthcare, lifestyle, and cultural amenities that add to the richness of life in Greater Boston. As for Everett, transit use is high, even though it is the only city in the Boston metro core region that lacks the infrastructure and service to reasonably support its transit riders. Chelsea is served by the 111 bus to downtown Boston—which comes every three minutes at rush hour—and a Commuter Rail station. Somerville hosts stations on the Red and Green Lines, and when the Green Line Extension opens, it will be even more thoroughly served by rapid transit. In Everett, transit riders only have several bus lines to choose from, none of which are frequent or fast, and all of which require transfers to other rapid transit lines to travel beyond the municipal border, including to the job centers of downtown Boston and Cambridge.

Despite the critical lack of transit-specific infrastructure, Everett is a city on the move. It has been a regional leader in transit-oriented development, adding new housing along bus routes with few, if any, parking spaces, while maintaining existing housing stock for low- and middle-income residents. It was a pioneer in installing peak-hour bus lanes on Broadway at a time when other cities were worried about whether such lanes would be feasible. Ever willing to be the first to try something new, Everett decided to put out cones one morning and make the new bus lane work (which it did, setting a new precedent for the region). For several years, Broadway bus passengers have glided by lines of traffic and passengers at busy stops have boarded buses quickly and comfortably using raised platforms. In 2020, Everett pushed further, installing the first evening peak-hour bus lane on Broadway and first-of-its-kind bus lanes through Sweetser Circle, one of the biggest bottlenecks for bus routes serving Everett and beyond.

Each of these transit-priority interventions has brought Everett closer to a full-fledged BRT corridor. Such a system would build on the existing bus lanes and add all-door boarding, level boarding at additional stops, off-board fare collection, a dedicated right-of-way where possible, and transit signal priorities to reduce delays for buses at intersections. BRT improves accessibility, equitability, and legibility, making the bus transit experience more time-efficient and easier to use and understand.

Making the bus transit experience demonstrably better is not the only important outcome of a BRT system. A highly functioning BRT system will lift up the bus transit experience in ways many people have never experienced, improving the quality of trips for current riders and supporting transit use by people who might not otherwise make this choice. It will also establish clarity of place, defining the BRT corridor as an environment that's friendly to people and small business, as the overall safety and appearance of the public realm will be improved.

Implementing each of the steps toward BRT will have its challenges:

- Broadway in Everett is a narrow, busy, complex street, with many businesses, public institutions, driveways and intersecting roadways, and different types of road users competing for space.

- Sweetser Circle, now home to new bus lanes, is complex in a different way, with several intersecting traffic streams, grade separations, and a site with geometric constraints.

- Lower Broadway was recently rebuilt in a manner that makes exclusive bus right-of-way difficult. Beyond that the corridor includes a drawbridge and the long-discussed Sullivan Square and Rutherford Avenue reconstruction project.

None of this makes a BRT corridor connecting Everett and downtown Boston insurmountable, though. Everett was able to implement bus lanes on the narrow portion of Broadway at rush hour when many other municipalities balked at removing the parking that would be necessary for similar projects. Despite involving multijurisdictional coordination and complex road geometry, Sweetser Circle has been restriped and painted with first-in-the-nation bus lanes through a rotary, saving commuters valuable time during heavy-traffic times of day. The rest of the proposed BRT corridor is wider, and the opportunity exists to build additional bus priority in and out of Sullivan Square, reducing delays for bus passengers there. In short, recent experience demonstrates that BRT is a reasonably achievable goal in this area.

The potential to extend rapid bus service on the Broadway corridor farther than its current termination at Sullivan Station is significant. Today most Everett passengers transfer at Sullivan Square to the Orange Line or to buses serving Cambridge, Somerville, and beyond (the 86 bus eventually winds up at Reservoir Station in Brookline, running through Somerville, Cambridge, Allston, and Brighton on the way). A dedicated busway running south along Rutherford Avenue could provide a one-seat ride to certain downtown destinations. As Rutherford Avenue is redesigned, it will be important for the City of Everett to work closely with the City of Boston and MassDOT to make sure this major roadway is redesigned with BRT in mind. BRT routes can also continue from Sullivan Square to Kendall or beyond, creating a new transit link between Everett, Cambridge, and Somerville, where current data show significant travel from Everett but relatively low transit use.

After careful consideration of different options for BRT corridor infrastructure, service plans, and policies to support transit-oriented communities, it is clear there are reasonable and achievable ways to implement BRT between Everett and Boston. To summarize the key takeaways from this Everett-Boston BRT how-to:

- Regional transit connections between Everett, Boston, and Cambridge/Somerville will be improved with the addition of new, frequent BRT routes.

- The BRT corridor will improve service speed, frequency, and reliability, helping to create a high-quality transit experience for existing transit passengers.

- Providing a one-seat ride between Everett and parts of downtown Boston can improve the travel burden for people with strollers or children, wheelchair users, and people with disabilities.

- Comfortable, convenient, and reliable BRT service may entice people who currently drive to get on the bus.
- Trade-offs between accommodating on-street parking and other modes will need to be reconciled along the narrower sections of the corridor, especially in Everett.
- Anti-displacement/housing stability measures in conjunction with the BRT corridor implementation will allow *current* residents to enjoy the benefits of BRT investments while encouraging and enabling new residents to avoid auto-dependence.

Everett's political and technical leadership has been a driving force for BRT on the Everett portion of the Everett-to-Boston corridor. However, it is not feasible or logical for BRT to exist in a municipal vacuum. Since the initial bus lanes were painted in Everett, the region has seen a wave of additional bus lanes and bus priority measures in Boston, Cambridge, Watertown, Somerville, Arlington, and Chelsea. It is reasonable to conclude that Everett has acted as the catalyst for better buses region-wide. This implementation playbook is a pathway toward BRT in Everett. It offers data-driven insight into how a successful BRT in Everett can both benefit the communities it serves and be replicable across the region.

SOURCE: Ad Hoc Industries


ONLY
BUS
16
MEDFORD
SOMERVILLE

EVERETT
Save a life.
Wear a mask.
Mass.gov/StopCOVID19
97 WELLINGTON
LOCAL ACCESS ONLY
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SOURCE: Ad Hoc Industries

INTRODUCTION

Everett is a diverse, vibrant community of approximately 40,000 outside of Boston. It borders the larger city to the south, and City Hall in Everett is only 3.5 miles from City Hall in Boston—closer than many parts of Boston itself. It is the fifth most densely populated city in the Commonwealth of Massachusetts, with nearly 12,000 people per square mile, and it has a progressive plan to build significant new transit-oriented development along its transit corridors. Yet despite this density and proximity, it lacks the level of transit service that serves other nearby communities.

It is impossible to get to most of the region from Everett by transit without making a transfer: The core of regional jobs in Boston and Cambridge can only be reached by changing to the Orange Line. Everett is also the only city in this cohort that has neither a rapid transit station nor service from what the MBTA designates as a "key" bus route, which requires a minimum level of service[1]. Relative to these lines, Everett's bus routes are slower, less frequent, and less reliable, while still crowded.

Everett was never split apart by highways as many communities were; it is skirted to the west by the Northern Expressway (I-93) and to the east by the Northeast Expressway (Route 1). This limited displacement and urban renewal in the city, especially in the postwar era, means Everett has retained its prewar urban fabric. (Some housing was taken when Revere Beach parkway was widened in the 1950s, though.) The transit system, however, has been degraded. Center-running streetcar lines were replaced with trolleybuses: Most of Everett's bus routes were electrically powered until 1963. Before the Orange Line was relocated and extended in 1975, the line ended in Everett, albeit in the southern part of town, relatively far from the population center. When the Orange Line was relocated along the Boston and Maine's Western Route rail line in the 1970s, Everett was bypassed, and while Medford and Malden saw transit improvements, Everett's transit was further degraded.

Today Everett is served by nearly a dozen bus lines, but none is a high-frequency, high-amenity route. Rapid transit connections are split amongst multiple nodes, so Everett passengers often have to choose between transfer points, rendering the potential of interlined routes to provide frequent service less functional. Increasing congestion combined with traffic pattern changes have made buses even less reliable, with choke points causing undue delay to passengers on trunk routes—more than 10,000 passengers pass through Sweetser Circle every day on every route serving Everett. Even relatively small changes to the bus system in Everett can yield dramatic results to improve mobility and equity if the buses can be made more frequent, faster, and more reliable.

1 MBTA defines Key Bus Routes as generally operating longer hours and at higher frequencies that local routes to meet high levels of passenger demand in high-density travel corridors (MBTA 2017).

BRT CORRIDOR LINKING EVERETT AND DOWNTOWN BOSTON

There are many ways to build a more efficient, accessible, reliable transit system. The Lower Mystic Working Group report[2] studied a wide range of potential interventions, including improved bus service between Everett and Sullivan Square as well as a spur of the Orange Line in a tunnel through Everett. While the multibillion-dollar Orange Line spur was forecast to produce new ridership and shift more riders from driving, the Bus Rapid Transit scenarios ranked well, and at a much lower cost. BRT—a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities—can provide a similar benefits[3] yet be realized in months, not decades. BRT is especially worthy of consideration since the greatest impediments to better transit service in Everett are a series of small bottlenecks and choke points.

The Everett to Sullivan corridor along Broadway is a natural candidate for BRT: It is a straight line, it serves the center of Everett's population and commercial activity, and it feeds directly into a major transit node at Sullivan Square, with transfers to the Orange Line and a dozen bus routes that fan out across the region. This type of corridor would be well-suited for a direct-service BRT model corridor-based BRT system that allows multiple routes to merge or "interline" along the BRT corridor infrastructure major trunk route and then either serve a major destination node (like a downtown area or a rapid transit connection) or branch out to other destinations, or a combination of both.

To take advantage of this sort of BRT, buses need several improvements that are currently lacking on the corridor. At a baseline, public transit should be accessible and legible, but BRT goes beyond that. It adds platform-level boarding to speed the boarding process, BRT lanes and signal treatments to speed up transit, and branding to make the system easier to use. In this corridor, frequency is also important: When people make a transfer, the utility of their trip is only as good as the least-frequent mode, so making the bus as frequent as a subway line makes it as useful as a subway. With improvements to this trunk route, Everett's buses should be concentrated to take advantage of the infrastructure, and to provide very frequent service to Sullivan Square and beyond.

In 2021, the MBTA will open the Green Line Extension along a parallel corridor in Somerville and Medford. This will provide better rapid transit service there compared with existing buses (which have minimal priority) and will, if the bus network is redesigned around the new rapid transit, free up some of the existing bus fleet for overcrowded routes in other parts of the region. A BRT in Everett will be well-situated to take advantage of some of these resources, and a BRT that avoids traffic congestion will allow these buses, as well as existing buses, to be used more efficiently, providing more service with the same number of vehicles. Some of these routes could be extended farther, providing direct service to downtown Boston with additional corridor improvements or to other employment centers in Cambridge and elsewhere.

2 MAPC and CTPS 2019
3 ITDP 2016

COMMUNITY BENEFITS OF IMPLEMENTING BRT

BRT can provide rapid-transit level service, using buses to provide service akin to what might be provided by a light rail, heavy rail, or Commuter Rail line. BRT services are, in general, frequent, fast, convenient, and reliable, bypassing traffic and providing fast connections between where people live today and where they want to go. Like any transit improvement, BRT can shift drivers from cars to transit, make transit more efficient, and leverage more sustainable land use along its corridors. It can, for a relatively small investment, create major changes to the built environment, improving mobility, air quality, and quality of life and at the same time reducing the negative impacts of particulate matter emissions that threaten public health locally and carbon emissions that contribute to global climate change.

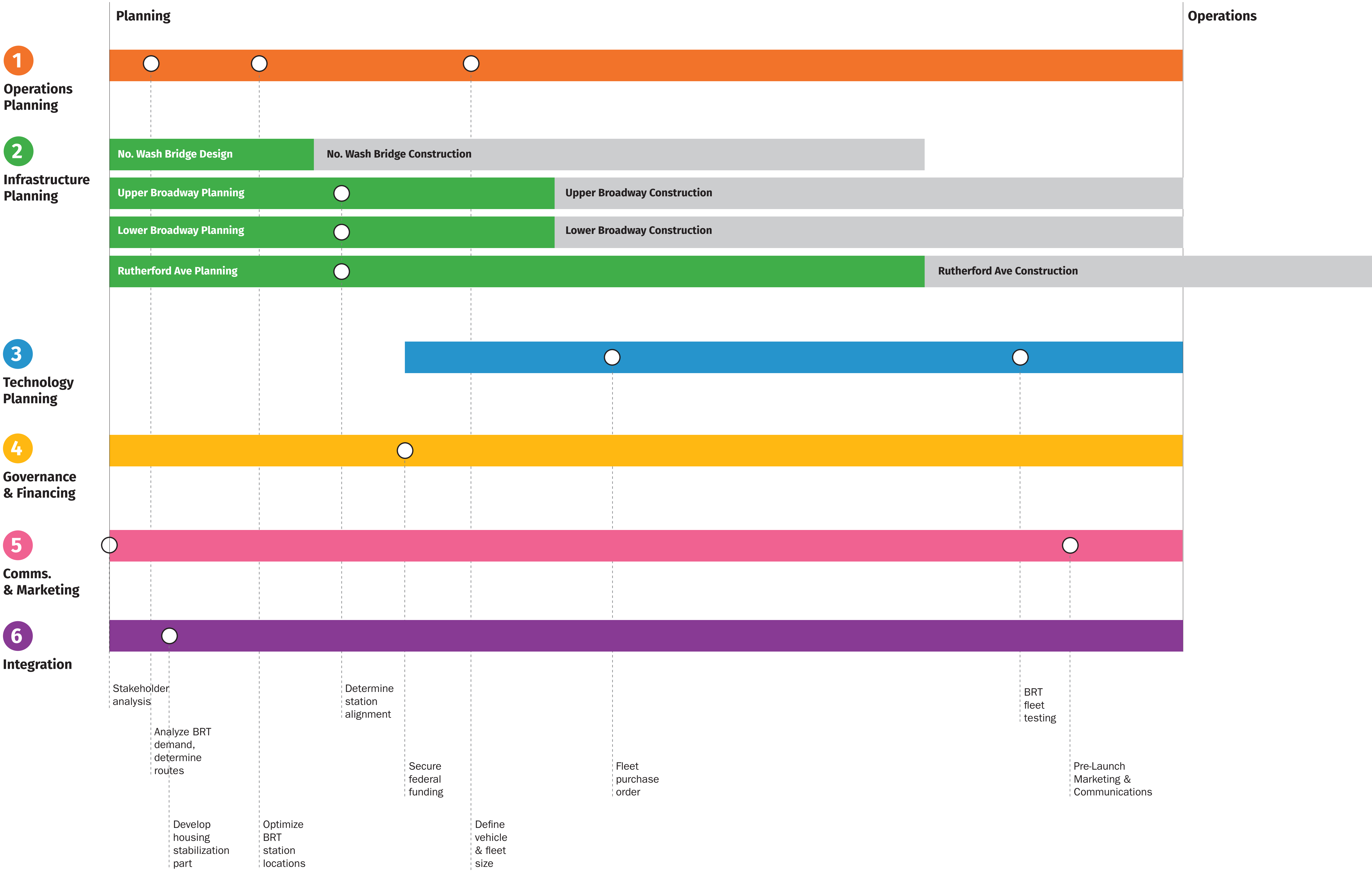
BRT IMPLEMENTATION PHASING

Implementing a full BRT corridor between Everett and Boston will require several years. Arterial BRT corridors in the U.S. took on average almost seven years to plan and another nearly three years to construct.[4] There are outliers in both directions that can be demonstrated in the City of Boston. There, on Columbus Avenue, the city is building a center-running bus lane within one year of first proposing it. However, a mile away on Blue Hill Avenue, plans for a center-running BRT have been discussed on and off for more than a decade.

The sequencing of the BRT development steps (e.g., operations planning, infrastructure design, public engagement, marketing, and branding) needs to be planned. ITDP has developed a sample timeline (**Figure 1)** for implementing this corridor, showing the different steps, in relative order, and highlighting the sequencing of key decisions and milestones. This will need to be refined early in the project's development and updated through the planning process.

4 This estimated implementation schedule is based on data from five arterial U.S. BRT corridors (Cleveland, Eugene, Richmond, Albuquerque, and San Bernardino). Planning time is estimated to begin when a locally preferred alternative is chosen or the project enters FTA's preliminary engineering phase.

Figure 1: Estimated Everett-Boston BRT Corridor Implementation Timeline



Furthermore, it may be necessary or beneficial to implement the BRT corridor infrastructure and/or services in phases, according to the schedules of related plans and projects such as the North Washington Street Bridge and Rutherford Avenue redesign. This phased planning and construction of the discrete segments of the corridor is shown in the Infrastructure Planning phase of the project implementation timeline (**Figure 1**).

A potential phased rollout of the Everett–Boston BRT corridor over the next few years could look like this (see **Figure 2**):

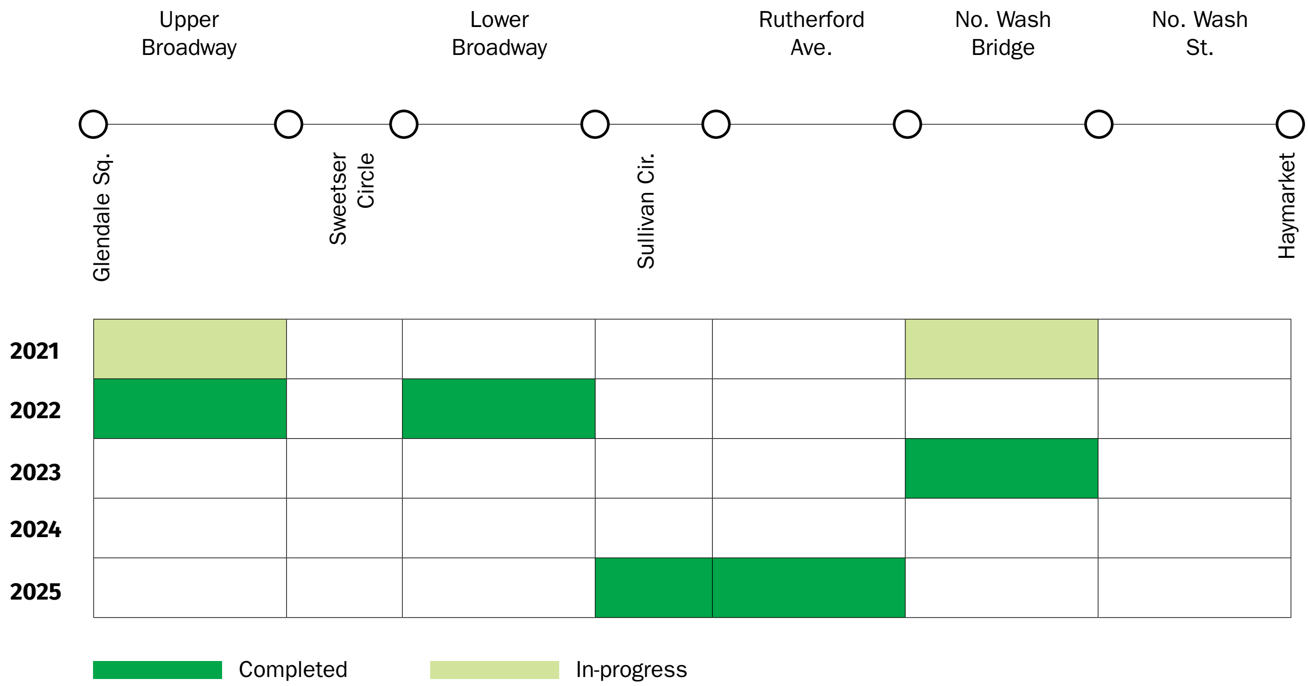
PHASE 1
Upper and Lower Broadway dedicated lanes could be implemented first. Along with the new Sweetser Circle bus-only lanes, existing transit passengers (routes 104, 105, 109) will benefit from improved speeds and reliability.

PHASE 2
The North Washington Street Bridge, with its (southbound only) dedicated bus lane, is expected to be completed by Spring 2023, although a temporary inbound bus lane will operate during construction.

PHASE 3
Perhaps the Rutherford Avenue segment including Sullivan Circle is the third phase, since its construction is not expected to be completed until at least FY2025.

FUTURE PHASES
Further phasing could be coordinated with the City of Boston's Center City Link project as it is moved from conceptual design phases to reality, as well as with the more overarching Silver Line 3 Extension project.

Figure 2: Phased Implementation of Everett–Boston BRT Corridor Elements



In the short term, incorporating BRT elements into the plans for a redesigned Rutherford Avenue is critical if deemed necessary for BRT ridership (see Roadway Design/Rutherford Avenue). The City of Boston submitted their most recently proposed designs to MassDOT for review in the fall of 2020, and expects to present it to the public in winter 2021. At this point the designs ought to reflect feasible alignment of BRT lanes and resolve the question of whether the underpasses will be preserved. Rutherford Avenue redesign is not scheduled for the MPO until 2022, but BTD wants early action by March 2021.

In terms of including an Everett–Boston BRT corridor in the MPO's Transportation Improvement Program (TIP)[5], the earliest feasible TIP is Federal FY2022–26 TIP. The engagement process for this TIP began in October or November 2020, with the project sponsor(s) beginning conversations with MassDOT and the MPO about the BRT project and its regional significance (see Governance/Including BRT in the TIP).

DOCUMENT ORGANIZATION

This document provides a set of recommendations to move toward a bus rapid transit corridor in Everett and new BRT routes connecting Everett to Boston and surrounding communities. The document is organized according to the same BRT development phases shown in the timeline (**Figure 1**). Section 2 covers operations planning, demand analysis, and the utility of BRT in the corridor. Section 3 covers communications and marketing, branding, and public engagement. Section 4 focuses on governance and financing, and how the project fits into the regional transportation plan.

Section 5 illustrates the infrastructure plan for the corridor, looking at roadway geometry, traffic and signaling, station types and locations, and fleet storage, while Section 6 specifically focuses on the fleet, door positions, level boarding, and how zero-emission vehicles may be used. It also discusses fare payment systems and transit signal priority.

Section 7 discusses how the corridor can be integrated into the local and regional context. This includes integration with the regional transit system, bicycling and walking facilities, and the built environment. BRT is only successful if it both provides better transit service to people already using transit and enables more people to live without having to drive cars.

5 FTA's website includes a description of what the TIP is, and what it must include: https://www.transit.dot.gov/regulations-and-guidance/transportation-planning/transportation-improvement-program-tip

OPERATIONS PLANNING

1

The operations planning considers how to optimize BRT ridership, capacity, and service frequency. It involves understanding the existing travel demand and forecasting future demand of the proposed BRT services. The network of BRT routes is optimized and details of the BRT service plan are resolved, including BRT stop spacing, speed and capacity, and impacts on general traffic.[6]

DEMAND ANALYSIS

Travel demand analysis involves considering

- where the existing public transport demand is concentrated and then
- estimating where there is potential future BRT demand.

Some of the existing bus and rail demand between Everett, Boston, and surrounding areas is expected to transfer to a new BRT corridor. Some trips currently made on other modes may be drawn to the BRT, and finally the BRT services may induce some new BRT trips from Everett to new destinations. These elements combine to make up the forecasted BRT demand.

The existing public transit demand is the most important factor in determining whether a corridor is appropriate for BRT.[7] The existing transit riders using the corridor are most likely going to benefit from the BRT. Analysis of the potential BRT passenger demand between Everett and Boston is the foundation for subsequent corridor planning and design. The demand analysis will inform the infrastructure design, ensuring adequate capacity to efficiently handle future growth in ridership. The demand estimate will also dictate the vehicle size, fleet size, and BRT service plan.

DEVELOP AND REFINE EVERETT-BOSTON BRT DEMAND ESTIMATES

There are six main steps to developing and refining the demand analysis for BRT between Everett and Boston:

1. Understand the existing public transport network;
2. Create a rapid demand assessment with passenger demand by link;
3. Use a travel demand model to create a more accurate BRT demand estimate;
4. Estimate the mode shift to BRT;
5. Determine the utility of the BRT corridor;
6. Quantify the risk and uncertainty of the demand analysis.

6 This operations planning section borrows heavily from the concepts in ITDP's *Online BRT Planning Guide*. See Volume 2 for more detailed discussion of demand analysis, service planning, and corridor and station capacity (ITDP 2021).
7 See Chapter 4 of the BRT Planning Guide (ITDP 2021) for more discussion about BRT travel demand analysis.

UNDERSTAND THE EXISTING PUBLIC TRANSPORT NETWORK

Everett lacks a single "key" bus route, which the MBTA defines as a route that has high ridership and higher frequency standards (see Appendix A). It is currently served by nine routes with confusing, infrequent service that prioritize coverage over frequency. None of the existing bus routes provides a fast connection to the job centers of downtown Boston, Cambridge, or Somerville. These routes are not well-coordinated, and northbound passengers have to choose a transfer point, all of which have less service.

Existing bus routes on Broadway include the 104, 105, and 109, which all terminate at Sullivan Station. MBTA's Better Bus Project has identified routes 104 and 109 as important routes in the system that are frequently crowded and need more service.[8] There are additional routes that serve parts of Broadway and then run to Wellington station, providing a similar connection to Boston.

It is impossible to get to most of the region from Everett by transit without making a transfer, since the core of regional jobs in Boston and Cambridge can only be reached by changing to the Orange Line or at Sullivan for a bus to Cambridge. **More than half of passengers boarding a bus in Everett are heading to downtown Boston (or beyond) and have to transfer**. From Sullivan Square, passengers can also transfer to the 92 and 93 and continue to Haymarket via local service in Charlestown or to several routes to access Somerville and Cambridge.

DAILY PASSENGERS PER BUS ROUTE

The MBTA bus routes operating along Broadway in Everett collectively carry more than 1,500 weekday passengers per direction, including to both Sullivan and Wellington stations.[9] North Washington Street from Charlestown, across the bridge to Haymarket Square, also carries at least 1,500 bus passengers per direction each weekday. More than 10,000 passengers pass through Sweetser Circle every day, with routes fanning out north on Main Street and Broadway, south on Broadway, and west on Revere Beach Parkway.

BUS FREQUENCY PER ROUTE

There is a bus on the upper portion of Broadway in Everett on average every four or five minutes toward Boston at peak times. At peak hour, including buses operating on Main Street, there are approximately 25 buses per hour from Everett to Sullivan and Wellington spread across these eight routes. However, these buses are split over a number of routes with multiple destinations and transfer points, and the schedules are not well coordinated, so longer waits are common.

8 Route profiles for all MBTA bus routes are available here (MBTA 2018).
9 These data are collected by the MBTA via automatic passenger counts.

BUS AND OTHER VEHICLE SPEEDS

Everett's existing bus service is plagued by congestion and slow speeds. Today the 104/105/109 bus has an average operating speed of 7 mph during peak hours and a scheduled speed of 13 miles per hour at off-peak times.

Vehicle speeds along the corridor depend on the portion of the corridor as well as congestion. Between Glendale Square and Sweetser Circle, vehicle speeds range from 15 mph to 20 mph at off-peak times down to 8 mph to 12 mph at peak time, not including congestion getting through Sweetser Circle, where just traversing the circle can take several minutes. Between Sweetser Circle and Sullivan Square, traffic speeds can range from 30 mph at off-peak times to less than 10 mph when the area is congested.

BOARDINGS AND ALIGHTINGS BY STOP

MBTA boarding and alighting data by bus stop of each bus route operating along the Everett–Boston corridor can be combined to calculate the number of onboard passengers along each road segment. These can be aggregated for all of the routes in the corridor to determine the **maximum passenger load on the critical link**.

EXISTING ORIGINS AND DESTINATIONS OF PASSENGER VEHICLE TRIPS

In order to inform our recommendations about BRT service and infrastructure between Everett and Boston, ITDP directed a study undertaken by AECOM to identify travel patterns between the two cities and specifically travel patterns along Rutherford Avenue. This included weeklong traffic counts at three separate points along the corridor, as well as zone data from Streetlight, which tracks cell phone data along the corridor. The main conclusions are summarized below and a detailed description of the analysis is provided in appendices D and E.

- Approximately 95% of daily trips from Everett are made in passenger vehicles, but these trips have destinations across the region: Only a relatively small portion are to destinations in Boston and Cambridge that would be served by BRT. Of vehicles starting in Everett and crossing the Alford Street Bridge to Charlestown (10,370), slightly more are headed to Cambridge/Somerville (4,600) than to downtown Boston (3,600). **Expanding bus service to provide convenient and efficient connections between Everett and Cambridge/Somerville, Charlestown, and downtown Boston could encourage more transit use to these areas. In addition, providing transit from Everett to other transit connections offers more flexibility to travel to areas that were not previously accessible.**

EXISTING ORIGINS, DESTINATIONS, AND TRANSFERS OF TRANSIT TRIPS

It is important to investigate the destinations and transfers of Everett transit passengers, since where they are going from Everett will impact the efficacy of the BRT, especially if routes are extended beyond Sullivan. To do this, ITDP used data from the MBTA's Origin-Destination-Transfer (ODX) data set, developed by MIT.[10] We used a typical time of year and looked at the relative prevalence of destinations and transfers for transit passengers with origins in Everett and their destinations (see Appendix F). Based on these data, the following trends are observed.

- **Approximately one in four passengers boarding a bus in Everett has a destination in downtown Boston** for which they currently have to make a transfer at Sullivan but where a direct bus would create a one-seat ride.

- However, the transfer at Sullivan is important, because there are **an additional one in three passengers going beyond downtown Boston on the Orange Line (about 20% of all riders) or to Cambridge and Somerville (about 12%)** who would likely make use of the transfer points there. Ridership in Cambridge and Somerville is quite distributed; there is no single destination point or bus route that has significantly more ridership than any other, so it is difficult to recommend a specific destination to serve with a new BRT route from Everett. Such a route would be used by additional travelers transferring from the Orange Line, however, which may suggest a specific desire line. If a route to Cambridge were selected, it is likely that ridership along this route would increase.

ESTIMATE THE UTILITY OF THE BRT CORRIDOR

It is important to examine whether the proposed BRT will save passengers time and money compared to the existing public transport system. Comparing the travel time and costs for a given set of trips before and after the BRT will shed some light on this and give an indication of how much utility the new BRT corridor would provide potential passengers. By converting travel time to a monetary value, we can examine how much changes to the transport system might encourage people to switch modes. ITDP compared travel time and costs for trips between Everett Square and either Haymarket or Back Bay, with and without the BRT.

UTILITY OF DIRECT EVERETT BRT SERVICE TO HAYMARKET FOR PASSENGERS DESTINED FOR HAYMARKET

While the total travel times are the same, currently Everett transit passengers heading to Haymarket have to transfer to the Orange Line at Sullivan Square, while drivers do not (Table 1). For those with limited mobility—whether that's people using wheelchairs, pushing a stroller, or carrying luggage—a transfer can be a significant physical burden in addition to taking extra time. The driving trip is three times more expensive than transit because of the cost of parking in downtown Boston (unless that

10 Vanderwaart 2016. More information about the MBTA ODX model can be found on MBTA's blog here.

cost is subsidized by an employer). Direct BRT service between Everett and Haymarket eliminates the transfer and parking cost and is estimated to take the same amount of time as driving. **If it were possible to reduce the BRT trip from Everett to Haymarket to less than 35 minutes, it would be even more competitive with driving.**

Table 1: Comparing Cost of Peak-Hour Trip from Everett to Haymarket on Different Modes

	In Vehicle Time	Transfer + Walk + Walk Time	Total Time	Cost of Time[11] (A)	Trip Cost[12] (B)	Parking Cost (C)	Total Cost (A+B+C)
Existing Bus + Train	24 min[13]	11 min	35 min	$10.50	$4.80	$0	$15.30
Car	35 min[14]	0 min[15]	35 min[16]	$10.50	$5.75	$30[17]	$46.25
BRT	29 min	6 min	35 min	$10.50	$3.40	$0	$13.90

UTILITY OF DIRECT EVERETT BRT SERVICE TO HAYMARKET FOR PASSENGERS DESTINED FOR DOWNTOWN CORE

For this analysis, ITDP assumed that continuing the Everett–Boston BRT route past Haymarket, through the streets of downtown Boston, with speeds that are competitive with the (grade-separated) Orange Line would be difficult. However, transit riders perceive in-vehicle travel time differently from waiting time (which is how transfer time is generally measured), so there are some marginal benefits to Everett passengers of a one-seat transit ride to downtown Boston. That route extension could be explored further, but here it is assumed that the BRT route would terminate at Haymarket.

Direct BRT service between Everett and Haymarket would not eliminate the transfer for passengers destined for other areas farther into the core of downtown, such as Back Bay. Passengers would still need to transfer from the BRT to the Orange Line. Making this transfer farther upstream from Haymarket—at Wellington or Sullivan—makes for a faster trip, since even with the most aggressive transit priority on a BRT corridor, the grade-separated Orange Line will be faster than a parallel surface route (see Table 2).

11 This estimate uses a time value of $18/hour, (VTPI 2020a) and adjusts it for income in Massachusetts as compared to the national average, plus inflation since the study, to $17.94, which was rounded to $18 for simplicity.
12 For transit, the current transit fares are assumed. For driving hyperlink 2020 IRS reimbursement rates are used
13 General Transit Feed Specification (GTFS) estimated travel time.
14 Estimated, based on pre-COVID traffic.
15 This assumes no walk time from the parking garage to the car driver's destination, which is fair, given ample parking adjacent to Haymarket.
16 Estimated, based on pre-COVID traffic.
17 Parking cost was estimated from a 2019 survey of Boston parking garages (Kennedy 2019).

Table 2: Comparing Cost of Peak Hour Trip from Everett to Back Bay on Different Modes

	In Vehicle Time	Transfer + Walk + Walk Time	Total Time	Cost of Time[18] (A)	Trip Cost[19] (B)	Parking Cost (C)	Total Cost (A+B+C)
Existing Bus + Train (transfer at Sullivan)	33 min	11 min	44 min	$13.20	$4.80	$0	$18.00
BRT + train (transfer at Haymarket)	38 min	11 min	49 min	$14.70	$4.80	$0	$19.50
BRT + train (transfer at Sullivan)	31 min	11 min	47 min	$14.10	$4.80	$0	$18.90
Car	45min[20]	–	45min[21]	$13.50	$6.90	$30[22]	50.40

This analysis of the travel time and costs of different modes highlights that people driving are already paying nearly triple the cost of taking transit. In planning an Everett–Boston BRT corridor it is important to understand drivers' willingness to pay for the utility of driving. The Central Transportation Planning Staff (CTPS) should utilize a full mode choice model to develop a more complete assessment of the utility of a new BRT service and a more refined estimate of the feasibility of the BRT system.

ROUGHLY ESTIMATE MODE SHIFT TO BRT

Transit use on bus routes in Everett declined less during the COVID-19 outbreak than overall transit use, indicating that transit is a lifeline for many Everett passengers. High-quality BRT service between Everett and Boston that provides real transit priority and speeds up the trip will elevate the bus experience for the thousands of people who currently use transit in Everett.

Shifting trips from motor vehicles to BRT to reduce air pollution and congestion may also be a goal of the BRT corridor project. Achieving this shift will depend on several factors including the relative speeds, throughput, and cost of driving and BRT (see tables 1 and 2). Everett's low public transit mode share for all trip purposes (3% to 4%)[23] suggests some potential to attract new transit riders with convenient and efficient new BRT service. Mode shift to BRT would depend on the cross-price elasticity of the

18 This estimate uses a time value of $18, (VTPI 2020a), and adjusts it for income in Massachusetts as compared to the national average, plus inflation since the study, to $17.94, which was rounded to $18 for simplicity.
19 For transit, the current transit fares are assumed. For driving, 2020 IRS reimbursement rates are used.
20 Estimated, based on pre-COVID traffic.
21 Estimated, based on pre-COVID traffic.
22 Parking cost was estimated from a 2019 survey of Boston parking garages (Kennedy 2019).
23 For trips originating in Everett, public transit represents 3.47%; for trips ending in Everett, it accounts for 3.81%. (MAPC 2018).

trips being taken. A reasonable estimate[24] yields a **4% mode shift from cars to BRT, or 125 people per day between Everett and downtown Boston**. New BRT service to Kendall Square would probably attract additional trips from cars.

ROUGHLY ESTIMATE BRT DEMAND

Demand on the future BRT corridor won't exactly match the existing public transit demand for several reasons. Some bus routes or portions of routes may be eliminated with the introduction of the BRT service (see Service Planning section), and so these existing transit passengers may shift to alternative modes. If speeds on the BRT routes exceed existing bus speeds, BRT may attract passengers from other routes or modes. Likewise, extending BRT routes to new destinations not currently served by transit will induce demand.

The current transit demand on the corridor is 3,000 weekday passengers. Contributions to BRT demand can be roughly estimated as follows:

- If 3% of that ridership is lost to other modes by eliminating portions of existing routes (-90 passengers/day);
- Mode shift from private vehicles (+125 passengers/day) (see previous section);
- And new BRT routes to Kendall attract 5% of the current driving trips from Everett to Cambridge (+150 passengers/day)

While these rough estimates need more interrogation, this back-of-the-envelope calculation suggests a **daily demand of 3,185 weekday passengers** on the BRT corridor. This does not consider land-use changes such as densification around BRT stations, or travel demand management measures such as reducing parking availability or increasing parking costs. The influence of those factors can be better determined in a full transport model.

REFINE BRT DEMAND AND MODE SHIFT ESTIMATES WITH FULL TRANSPORT MODEL

An integrated land-use and transport model can more accurately estimate future BRT demand in the corridor by taking into consideration people's travel choices and the effect of congestion and land-use changes on different parts of the transport network. ITDP plans to work with the regional MPO on a regional transport modeling study that can produce a more accurate BRT demand analysis.

A logistic regression mode choice model can estimate how many Everett travelers will opt for the BRT, rail, private vehicle, bike, or walking. As part of this forthcoming modeling exercise, mode shift with a new Everett–Boston BRT corridor will be examined.

24 We've used 0.4 here based on sources such as VTPI 2020b.

SENSITIVITY ANALYSIS

Any transport demand forecast includes a degree of uncertainty. The best way to address this uncertainty is to develop BRT demand forecasts under different scenarios—both high-growth, transit-supportive scenarios, and low-growth, less transit-supportive scenarios. It would be helpful to deconstruct the individual components of the BRT demand under each scenario, showing the contribution of baseline transit ridership, mode shift from private vehicles, ridership from transit to new destinations, and land-use changes.

CORRIDOR AND NETWORK DEVELOPMENT

The *BRT Standard* defines a BRT corridor as "a section of road or contiguous roads served by a bus route or multiple bus routes with a minimum length of 3 kilometers (1.9 miles) that has dedicated bus lanes." (See Appendix B: What is BRT? for more discussion about the building blocks of BRT.)

The proposed Everett–Boston BRT corridor benefits from significant political support from the mayor of Everett. In this case, demand analysis (see previous section) is not informing corridor selection or prioritization; it will help inform whether the Everett–Boston corridor is suitable for BRT, will provide adequate benefits to transit passengers, and will help induce transit-oriented development. Other steps in the development of the BRT corridor and network include analyzing transit speed and delays and optimizing the length of the corridor.

TRANSIT SPEED AND DELAY ANALYSIS

BRT corridor infrastructure offers the most benefit where existing bus operating speeds are very low. The slower the buses, the greater potential benefits BRT can deliver. Therefore, it's worthwhile examining existing bus speeds in the Broadway and Rutherford corridors and understanding the common sources of delay and how the BRT might address those.

For the existing buses and the proposed BRT between Everett and downtown Boston, compare the time spent in each of the following states:

- Free travel
- Dwell time (stopping and starting)
- Dwell time (boarding and alighting)
- Signal minimum delay
- Additional signal delay from traffic
- General traffic congestion

A BRT corridor's dedicated lanes help reduce delays from traffic congestion. Median-aligned lanes reduce delays from turning vehicles. Off-board fare collection and platform-level boarding speed up passenger boarding and alighting, while transit signal priority reduces signal delay. The BRT corridor elements should be assembled to address the sources of existing delay in the corridor.

OPTIMIZE CORRIDOR LENGTH

The BRT corridor infrastructure includes the dedicated bus lanes and stations (see Appendix B) and the BRT routes operate within and (sometimes) beyond the corridor. The length of the BRT corridor infrastructure along Broadway and Rutherford needs to be optimized. The road segments with the highest demand and lowest speeds are often where it is most politically difficult to provide transit priority but also most beneficial. BRT infrastructure will yield the greatest benefits along the segments with the highest passenger demand and lowest bus speeds.

An alternative approach is to complete a cost-benefit analysis of the corridor length based on the time savings created by the BRT's exclusive lanes. When the dedicated busway no longer provides net time savings benefits compared to the construction costs, then the exclusive bus lanes no longer justify the cost.

SERVICE PLANNING

The BRT services running inside the BRT corridor infrastructure need to be planned. The BRT service plan should aim to **carry as many trips as possible at the highest speed with minimal transfers**. The corridor infrastructure can then be designed to accommodate the service plan and minimize the delay for as many bus passengers as possible. The BRT service plan also optimizes the schedule and vehicle and fleet requirements.

CHOOSE BRT SERVICE MODEL

ITDP recommends a **direct service model** for the Everett–Boston BRT with several BRT routes operating within the corridor infrastructure, taking advantage of the dedicated bus lanes, transit priority, and efficient passenger boarding (see Appendix B, section BRT Corridor Versus Routes). In a direct service model, multiple BRT routes merge together, or "interline" along the corridor, to provide frequent service to a major destination node, like a downtown area or rapid transit terminal. BRT routes may exit the corridor and branch out to other destinations in curbside bus lanes or mixed traffic.

DETERMINE WHICH ROUTES TO INCLUDE IN THE BRT CORRIDOR

The City of Everett, in conversation with the MBTA, needs to determine which of the existing bus routes serving Broadway and Rutherford will be allowed to operate inside the BRT corridor infrastructure. A rule of thumb is to exclude routes that (a) have little overlap with the proposed BRT corridor (e.g., 10% to 20% overlap) and (b) carry few passengers. The corridor infrastructure will be designed to accommodate at least the demand of the remaining bus routes serving Broadway and Rutherford. In this situation, station saturation is an unlikely concern.

CONSIDER NEW BRT ROUTES

The BRT implementation can extend or create routes to better serve the destinations people are travelling to. ITDP has given initial consideration to extending routes that currently terminate at Sullivan Square to downtown Boston and providing new routes to Cambridge/Somerville, and via Chelsea to downtown Boston.

EXTEND SERVICE FROM SULLIVAN SQUARE TO DOWNTOWN BOSTON

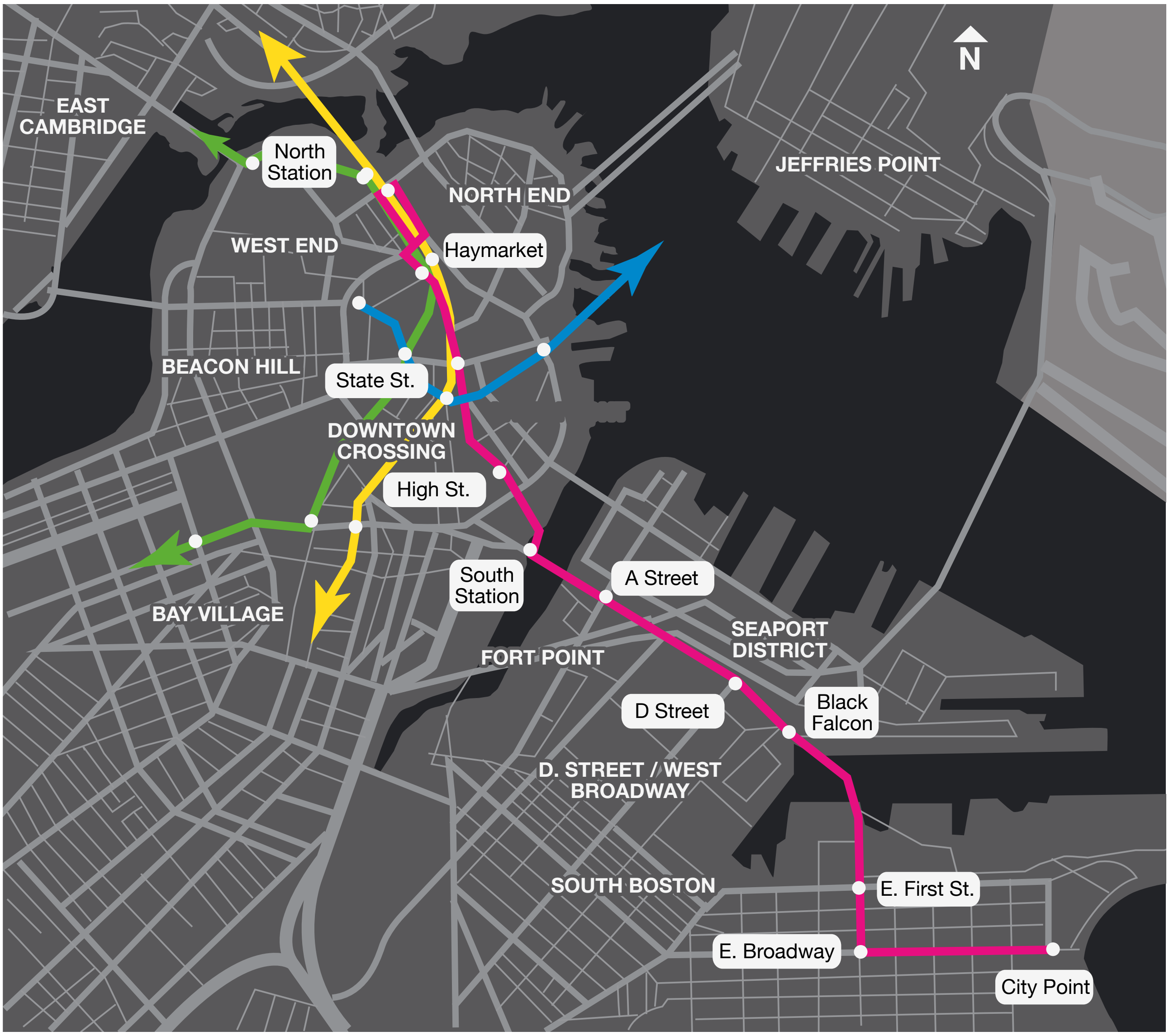
As previously discussed, extending existing MBTA routes 104, 105, and 109, which currently terminate at Sullivan Station, along Rutherford Avenue, over the North Washington Bridge, onto Causeway Street, to terminate at North Station or Haymarket would take advantage of the existing bus priority lanes on North Washington Street between the bridge and Haymarket. Once in downtown Boston, buses could continue through the city via the proposed "Center City Link"[25] (**Figure 3**), distributing passengers through downtown, the Financial District, South Station, and to South Boston. This option would allow buses to terminate at MBTA or Massport facilities in the Seaport or South Boston, which would aid in schedule adherence compared to the current busway at Haymarket or on-street facilities in downtown Boston.

Adding BRT to Rutherford Avenue may prove politically difficult since it may be seen as redundant with the Orange Line—MBTA has recently invested in an expanded fleet to enable increased service frequency on the Orange Line. Given the wide geometry of Rutherford Avenue and the plans for bus priority on the North Washington Corridor farther south, there are few geometric hurdles in the corridor, and the corridor could also be used for direct BRT service to Community College, Lechmere, and Kendall Square (see next section).

ITDP's job access analysis showed that extending more frequent service from Everett to downtown Boston makes much of downtown Boston accessible within 30 minutes from Everett, opening up access to significantly more jobs than the current service. This is especially true for trips that currently require two transfers or a walk from the Orange Line, which could be served directly by buses (Appendix H). The main obstacle to providing this service is finding a corridor through downtown Boston's narrow streets that could maintain reasonably fast speeds. The travel demand modeling exercise with CTPS should consider how extending service to different downtown locations impacts BRT demand.

25 Vanasse 2019.

Figure 3: City of Boston's Proposed Center City Link.



SOURCE: Vanasse 2019.

NEW (OR EXTENDED) EVERETT TO CAMBRIDGE/SOMERVILLE ROUTE

Equal numbers of Everett commuters go to Harvard, Kendall, and Central squares (appendices D and E). Relatively few people live in Everett and commute to Kendall Square for work by transit (2%), possibly because it requires a bus transfer to a low-frequency route[26] (Appendix F). If a new BRT route is added to connect Everett to Somerville or Cambridge, it is not obvious which route would have the highest demand, since the existing transit passengers' destinations in Somerville and Cambridge are dispersed. There is no one destination or route that would serve significantly more trips than any other. Given that each of these destinations has a large employment base and that growth is projected near Lechmere and Kendall as a result of the Green Line extension, better transit connections from Everett may boost BRT demand.

ITDP's job access modeling (see Appendix H) revealed that a direct trip to Kendall (the densest job cluster in the region outside of Boston) using a BRT route would make the jobs there more accessible to Everett residents by transit. If that BRT route enjoyed bus full priority, then the Kendall-area jobs would be more accessible from Everett by transit than by driving given the congestion along the corridor.

There are several service options to consider to improve transit connectivity between Everett and Somerville/Cambridge:

- A direct BRT route from North Everett via Sullivan Station and on to Kendall, Central, or Harvard squares;
- BRT route from North Everett to Sullivan, then transfer to an existing bus route (e.g., 86, 91, 90, CT2);
- BRT route from North Everett to Sullivan, then transfers to Orange and Red lines.

The utility of these different options should be tested, comparing estimated travel times and costs. The travel demand modeling should include scenarios with these route options as well as checking potential demand. With that information, a decision can be made about which routes to extend or preserve between Everett and Cambridge/Somerville.

NEW EVERETT-BOSTON ROUTE VIA CHELSEA BUSWAY

A new route/extension connecting Everett and downtown Boston via the Chelsea busway is worth examining. An extension of the current SL3 route would connect Eastern/Beach area to South Station. This would provide a direct trip from Everett to Logan Airport, the Seaport, and South Station, albeit with a drawbridge and several heavy-traffic choke points along the route.

26 The CT2 route runs only every 20 minutes at rush hour. The trip is scheduled to take 18 to 25 minutes, but it is susceptible to traffic, and fewer than half of trips adhere to schedule (MBTA 2018).

In December 2020, MassDOT piloted an inbound bus lane on the Tobin Bridge[27] that allows buses to bypass chronic congestion on the bridge. Instead of a BRT route from Everett through Chelsea continuing along the Silver Line busway, it could instead use a Tobin Bridge bus lane to reach Boston, along with the 111 and other bus routes. This alignment would provide the fastest and most reliable trip from Chelsea to Boston, since with the exception of a lightly used exit from the bridge, the route would be fully separated inbound[28] and avoid common sources of delay on the SL3[29] (see Appendix C: Lessons from the Silver Line). Combined with a downtown Link bus lane (Figure 1), travel to South Station would be faster via the Tobin Bridge from Chelsea for transit users.

Each of these proposed new BRT routes will be included in the travel demand modeling exercise CTPS will undertake in 2021. That will indicate the level of daily demand each new route can reasonably expect. This process may include changes to the Tobin Bridge, since the 111 may operate significantly faster at rush hour and attract more ridership from Chelsea and Everett.

OPTIMIZE BRT STOP SPACING

Eliminating some existing bus stops from the BRT corridor will improve BRT vehicle speeds since there will be dwell time at fewer stations. There is a trade-off between wider stop spacing and accessibility, since some passengers will experience longer walk times to the BRT stations. If the trips origins and destinations are randomly distributed along the length of the corridor, a starting point for BRT stations spacing is every quarter mile. Denser station spacing may be needed where demand is highest. Another consideration is where there's adequate right-of-way width to accommodate a station.

Stop consolidation should be approached with sensitivity. Eliminating a bus stop may inadvertently send the message to members of that neighborhood that the BRT is trying to bypass them because the new, improved transit service is not for people "like them." For these reasons, stop consolidation must be addressed with care, after extensive community input and discussion.

The cities of Everett and Boston will need to lead a public engagement process around BRT station locations and stop consolidation that considers accessibility and vulnerable populations and assures that there is mitigation if the buses bypass certain existing stops. (See Stations section for more discussion about station locations and design.)

27 CTPS 2020 and MilNeil 2020b.

28 Outbound there is rarely congestion on the bridge itself, since traffic is usually bottlenecked on the highways approaching it, but the buses use surface streets with transit treatments; buses also have to cross from the left side of the highway to the right on the bridge, complicating the placement of any bus lane.

29 These three issues include: the Chelsea drawbridge, which can cause delays at any time of day, frequent severe congestion in the Ted Williams Tunnel, and a long route through the Seaport.

OPTIMIZE VEHICLE SIZE AND FLEET SIZE

Optimizing the BRT bus size and fleet size is an iterative process. Standard 40-foot buses or 60-foot articulated buses are likely the most appropriate options for the Everett–Boston corridor. The larger the vehicle, the smaller the required fleet. Given the same fleet size, larger vehicles tend to have lower operating costs but also translate into lower frequency and longer wait times for passengers. MBTA will need to evaluate these trade-offs when optimizing the vehicle size needed for this corridor.

The fleet size is determined by the number of vehicles needed to serve the maximum passenger load on the critical link during peak time. Since BRT reduces bus delay from traffic congestion and other sources, buses on the routes can be used more efficiently, providing more service with the current fleet size.

OPTIMIZE SYSTEM SPEED AND CAPACITY

To be competitive with other modes, the BRT system needs to be designed with sufficient capacity and speed. As the passenger demand and fleet size increase, so does the potential for bottlenecks and operational snags along the corridor.

DETERMINE SERVICE FREQUENCY

The greatest benefit to bus travel time along Broadway is increased service frequency. While there is a benefit from speeding up buses and eliminating transfers, these do not impact passengers as much as simply running buses more frequently. However, these are intertwined: Faster and more reliable buses can run more frequently. Faster buses simply cover the same route in less time, allowing them to provide more trips, while more reliable buses require less schedule recovery time, allowing the same improvement. And up to a point, increasing vehicle frequency on the corridor will increase the capacity.[30]

Service frequency makes the BRT more viable for people who need to make a transfer. When people make a transfer, the utility of their trip is only as good as the least-frequent mode: Making the bus as frequent as the Orange Line makes it as useful as the Orange Line (see Table 1).

Along Broadway, several interlined bus routes currently combine to provide bus service every six to 15 minutes between Everett and Sullivan Square, depending on time of day (see Understand Existing Public Transport Network). Along the Broadway corridor, ITDP recommends the new BRT routes combine to provide service at least every three to six minutes. Along Rutherford Avenue, the BRT service plan should aim for service headways of 10 minutes, with more service as demand requires. The fleet size will determine the minimum service frequencies.

30 At frequencies of 60 buses per hour, there's a risk of saturation and bus bunching. Given the relatively low demand on the Everett–Boston corridor, this is not a relevant challenge. If limited capacity becomes an issue, microsimulation of the corridor or stations could certainly help clarify how to resolve any bottlenecks.

The cities of Everett and Boston and the MBTA should prioritize corridor design elements that can help increase operating speeds:

- **Platform-level boarding** (a Basic BRT Element; see Appendix B) requires minimizing the horizontal and vertical gap, or a bridge plate;
- **Bus-station docking procedure.** A slow, careful approach to the station increases the dwell time and slows down service frequencies. Mechanical docking aids such as Kassel curbs, a rub rail, or Carey fingers (compressible rubber fingers along the outside edge of the station platform) can reduce the station–bus gap and speed up docking;
- **Off-board fare collection** (a Basic BRT Element, see Appendix B);
- **More and wider bus doors.** The BRT buses should include as many wide doors as possible (see Fleet/Vehicle Selection).

CONSIDER MULTIPLE SUB-STOPS

In higher-capacity systems, some or all stations may include multiple docking bays or places where multiple buses can dock on the same side of the station/direction of travel. This is especially helpful where multiple BRT routes converge. The additional bus docking bays can add walking time and confusion for passengers if not designed and signed well. The demand on the Everett–Boston corridor likely obviates the need for multiple sub-stops at most stations. An exception might be Sullivan Square, where several BRT routes likely intersect the corridor, such as connections to downtown Boston and Cambridge/Somerville if these destinations aren't served by routes originating in North Everett.

CTPS and the cities of Everett and Boston should explore the operational benefits of multiple sub-stops at a Sullivan Square BRT station, as well as the infrastructure requirements. Microsimulation could help illustrate what impact adding a docking bay at Sullivan Square station has on corridor capacity and speed.

TRAFFIC IMPACT ANALYSIS

Traffic engineers will need to assess how the proposed changes to the corridor to accommodate BRT will impact the other modes using the transport network. This will be an iterative process. As the BRT corridor design is resolved, the traffic impact analysis can be refined from a planning level, to operational, to finally micro simulation of individual intersections.

There are three primary reasons to analyze the traffic impact of the BRT:

1. To understand the impact of the general traffic on BRT operations. Congestion could block intersections and impede the movement of the BRT buses.

2. To assess the **impacts of the BRT on general traffic**. Changes to the street cross-section and signalization can impact general traffic. Traffic engineers should assess all the ways a BRT corridor affects other road users, including:

    a. Reallocation of travel lanes to BRT
    b. Removal of on-street parking
    c. Narrowing of travel lanes to accommodate BRT lanes and stations
    d. Changes to signal timing, including TSP, which will shorten the green time available for general traffic, especially cross traffic
    e. Left-turn restrictions across the BRT lanes and rerouting turning movements
    f. Traffic diversions to parallel streets
    g. Removing local buses from mixed-traffic lanes
    h. Increased pedestrian and bicycle activity at BRT stations
    i. Improved general traffic flow at corridor bottlenecks such as Sweetser Circle, Sullivan Square

3. Massachusetts **environmental review process** will likely require a traffic impact analysis to demonstrate the environmental impacts of the BRT corridor.[31]

Traffic engineers at the cities of Everett and Boston should identify impacts of the BRT corridor on the transport network and recommend mitigation measures, including street design, signalizations, and parking provision/ policies.

31 Massachusetts' environmental review process is described in detail here: https://www.mass.gov/doc/transportation-impact-assessment-guidelines/download

SUMMARY OF NEXT STEPS: OPERATIONS PLANNING

The next steps to advance the Everett–Boston BRT operations planning are summarized below by key actors.

	NEXT STEP: OPERATIONS PLANNING	ACTORS			
		City of Everett	City of Boston	MBTA	CTPS
DEMAND ANALYSIS	Determine current maximum passenger load on critical link and with BRT	●			●
	Full transport modeling of BRT to refine BRT demand and mode-shift estimates				●
	Mode choice modeling to refine mode shift and BRT utility analysis				●
	Sensitivity analysis with modeling scenarios				●
CORRIDOR AND NETWORK DEVELOPMENT	Bus speed and delay analysis	●			
	Optimize corridor length	●			
SERVICE PLANNING	Determine which existing bus routes will operate inside the BRT corridor infrastructure	●		●	
	Travel demand modeling of proposed new BRT routes (to Cambridge/Somerville, via Chelsea)				●
	Choose new routes to include based on utility of these different options and future demand	●	●	●	
	Optimize BRT stop spacing	●	●		
	Optimize vehicle size and fleet based on service plan			●	
OPTIMIZE SYSTEM SPEED AND CAPACITY	Determine service frequency			●	
	Prioritize corridor design elements that increase BRT speed and frequency	●	●	●	
	Determine whether to include sub-stops at Sullivan aSquare station		●	●	
TRAFFIC IMPACT ANALYSIS	Iterative analysis of impact of BRT on the transport network and identification of mitigation measures	●	●		●

COMMUNICATIONS AND MARKETING

2

This chapter highlights the next steps in creating a communications strategy for engaging internal and external stakeholders and getting their buy-in about the project, marketing the new BRT service to potential riders, and educating passengers about how to use the BRT service. Strategic communication is also essential in justifying the project to the public, promoting its benefits, and proactively addressing any concerns about the project's impacts.[32]

STRATEGIC PLANNING FOR COMMUNICATIONS

Communicating effectively with the diverse people who can influence the BRT project decision-making, as well as the community members who will be impacted by its construction and operations, is crucial to its success.

DEDICATE STAFF AND BUDGET

Dedicating staff and budget to outreach (as well as marketing and branding) will lead to greater success than assuming that this important work can be executed effectively by existing planning staff alone. This may be helpful for both the cities of Everett and Boston and the MBTA.

DEFINE BRT COMMUNICATIONS GOALS AND OBJECTIVES

An essential first step is clearly defining the BRT project's communications goals and objectives. These will underpin all communications efforts, set expectations, clarify resource gaps, and help measure progress. The goals and objectives might include the following:[33]

- Asking for public input about BRT plans and designs;
- Informing internal and external stakeholders about the benefits of the project;
- Inspiring the public, cultivating support for the project;
- Educating people about how the BRT works;
- Mitigating project risks.

PERFORM A STAKEHOLDER ANALYSIS

Identify all of the internal and external stakeholders of the project—the people who have influence over the decision-making and are impacted by the

32 This communications and marketing section borrows heavily from the concepts in ITDP's *Online BRT Planning Guide*. See Volume 3 for more elaboration on strategic communications, public participation, marketing, and branding (ITDP 2021).
33 Carrigan, Wallerce, and Kodranksy 2019.

BRT planning, construction, and operations. A stakeholder mapping exercise would help identify individuals in this initial list of stakeholders groups:

- **Public sector decision-makers** including local and state government, the transit agency, and MPO are essential partners. See section on Governance and Coordination.

- **Stakeholders** who will most directly benefit from the BRT implementation can be vocal supporters. This may include large employers on the corridors, developers, and educational and cultural destinations served by the BRT routes.

- **Community-serving organizations** such as places of worship, senior centers, racial/ethnic community groups, veterans support groups, youth groups, and disability rights organizations can be effective channels through which to communicate information (translated as necessary) about the BRT directly to specific target populations.

- **Advocacy organizations** are essential project partners who can amplify the project sponsor's own outreach by mobilizing their members/ constituents to support the project. This is especially helpful if the advocates' core missions are complementary to transit, such as equity, public health, environmental justice, climate change, and active transportation.

Table 3 lists the growing coalition of Everett–Boston BRT allies. Understanding these stakeholders' diverse points of view about the BRT project will help the project sponsor address their needs and expectations.

Table 3: Coalition of Everett–Boston BRT Allies

Corridor stakeholders	• Encore Casino • Hood Park Developers • Bunker Hill Community College • Churches	• CHA Everett Care Center • The Batch Yard • Everett Fire Department • Parlin Memorial Library
Community-serving organizations	• Everett Haitian Community Center • La Communidad • Everett Community Health Partnership • Everett Chamber of Commerce	• The Neighborhood Developers • Cambridge Health Alliance • Everett Community Growers
Advocacy organizations	• One Everett • Everett Transportation Advisory Committee • Downtown Everett Association • Charlestown Neighborhood Council • 02129 Alliance • GreenRoots Chelsea	• LivableStreets Alliance • Transit Matters • WalkBoston • Boston Cyclists Union • MassBike • Transportation for Massachusetts • ITDP

SHARPEN MESSAGING

Messages need to be carefully crafted to reach different internal and external stakeholders. Try to be consistent, clear, positive, and relatable. Staff from Connecticut DOT found their messaging to external stakeholders about the CT*fastrak* BRT was most effective when they focused more on describing what people could do with the BRT rather than on the technical details about the busway infrastructure they were proposing. Mayor DeMaria has already been quite effective in articulating his vision for BRT in Everett as a delivery mechanism for unlocking a host of valuable benefits to the city that are not directly tied to transportation or mobility, such as creation and preservation of affordability, cleaner air, and the ability to "walk to the corner store to get an ice cream with your kids as in the days of yesteryear."[34]

EMPOWER PROJECT PROPONENTS

Identify supporters of the BRT project and provide them with the information and tools they need to promote the project as surrogates for city staff. Community advocates whose mission is complementary to public transit (i.e., walking, biking, public health) should be empowered with knowledge about the design, operations, and benefits of the BRT so they can communicate that to their constituents. These proponents can help amplify the city's message, effectively extending the city's public engagement resources.

PUBLIC ENGAGEMENT

DEVELOP AND IMPLEMENT A PUBLIC ENGAGEMENT STRATEGY

The cities of Everett and Boston can approach public engagement for the BRT corridor as a way to authentically connect with the communities served by the BRT, genuinely listening and responding to their concerns, and ultimately building a coalition of support for the project. Recommendations for more effective BRT engagement include:[35]

- Public outreach and community engagement needs to **begin immediately** and continue through detailed planning, construction, and launch of the service.
- Community engagement for the project should actively try to reach as many of the **diverse constituents** as possible, not just the few who are able and comfortable to attend public meetings regularly.
- **Work through grassroots and community-serving organizations** to reach the people most impacted by the project and bring diverse voices to the table. Special attention should be paid to including neighborhoods and demographics that have historically been marginalized and negatively

34 DeMaria 2020a.
35 Carrigan, Wallerce, and Kodransky 2019.

impacted by transportation infrastructure investments in Everett and Boston.

- **Meet people where they are at** instead of asking people to come to a public meeting. Rely on a variety of communication channels to share information and solicit feedback about the project.
  Set up information tables or intercept surveys at existing bus stops, public libraries, or grocery stores in the corridor all hours of the day.
  Bring project information or questions to neighborhood and community group meetings, business association meetings, religious centers, schools and universities, and youth and senior centers.

ITDP's review of 11 U.S. cities' experience implementing BRT highlighted three key elements of the most successful public engagement strategies: Anticipate common concern, communicate door-to-door along the corridor, and engage businesses. These are explained briefly below.

ANTICIPATE COMMON CONCERNS

It can be helpful to anticipate some of the questions and concerns the business and residential communities may have about the BRT corridor. The BRT public engagement and communication strategy can proactively address these questions and allay some of the concerns about the project's impacts. While examining other U.S. cities' experiences implementing BRT, ITDP identified three common concerns that new projects should anticipate and be prepared to address:[36]

- **Stop consolidation.** The BRT service plan may require consolidating some existing bus stops to end up with BRT stations one quarter of a mile apart to preserve fast service (see Optimize BRT Stop Spacing). Stop consolidation can increase walking distances for some passengers and may inadvertently send the message to members of that neighborhood that the BRT is trying to bypass them. For these reasons, stop consolidation must be addressed sensitively, after extensive community input and discussion.

- **Parking changes on the corridor.** Providing dedicated BRT lanes requires reallocating limited street space, which may require a trade-off between on-street parking and transit priority (see Roadway Design and TDM Strategies sections). Business and resident concerns about on-street parking restrictions are nearly universal. A block-by-block plan for addressing changes in on-street parking and commercial loading can be effective. When parking changes are scrutinized at this level of detail, alternative parking on adjacent streets or in structured garages can often be identified.

- **Left-turn restrictions.** Similarly, plans to restrict left-turning vehicles across the BRT lanes is often met with concern (see Limit Turning Movements). Public education about the turn restrictions will be essential, as will plans to reroute traffic, such as through jug-handle movements.

36 Carrigan, Wallerce, and Kodransky 2019.

COMMUNICATE DOOR-TO-DOOR ALONG THE CORRIDOR

The most effective outreach approach is walking the corridor to speak with every business or residence and then following up on their questions and concerns. This is labor-intensive and requires dedicated staff and funding, hence the recommendation to dedicate communications and marketing staff and budget.

ADDRESS BUSINESS COMMUNITY DIRECTLY

Businesses along an arterial BRT are often an organized and vocal group of constituents. They are an important stakeholder group whose buy-in is essential to delivering a project with reasonable public acceptance. The cities of Everett and Boston would be smart to develop a specific communication strategy for corridor businesses that includes the following:

- Highlighting the **economic benefits** of the BRT project.
- Emphasizing any **streetscape improvements** packaged with the BRT corridor infrastructure.
- Creating a **BRT business forum** to hear the business community's concerns and recommendations, such as how the city can support them during BRT construction.
- Anticipating that businesses' concerns will likely relate to how **changes to on-street parking and turn restrictions** will affect their customers and operations. (See subsequent section Anticipate Common Concerns.)
- Developing creative ways to **promote and support corridor businesses during BRT construction**. Albuquerque created a campaign called 66 Reasons to Love Central Avenue and organized and promoted live music events at small businesses along its BRT corridor. The City of Oakland and ACTransit launched a program to provide financial assistance to businesses along the East Bay bus corridor.

MARKETING AND BRANDING

DEFINE AND DEVELOP EVERETT-BOSTON BRT BRANDING

The elements comprising the BRT corridor and service—stations, buses, logo, and the service and route names—are all parts of the BRT brand. The MBTA will develop the BRT service brand according to its agency-wide brand guidelines. An important consideration for the City of Everett and, to a lesser degree, Boston is if and how the Everett–Boston BRT corridor will be differentiated from the MBTA's Silver Line, which does not adhere to the *BRT Standard's* definition of Basic BRT. For instance, should the BRT services along the Everett–Boston BRT corridor continue the Silver Line branding as SL7, SL8, etc., or should the corridor, which has the potential to meet the higher standard of true BRT, be differentiated, such as with a new brand like the Gold Line? An advantage of differentiating the brand from the Silver Line is to communicate to riders that the Everett–Boston BRT has a higher service quality.

DESIGN MARKETING CAMPAIGN FOR NEW BRT SERVICE

The marketing campaign should educate the public about what the BRT is and how to use it, and it should entice new riders. The information communicated and channels used will change through the course of the project, and at a minimum, the following phases should be considered:[37]

- Project inception
- Final design of corridor and routes
- Construction
- Prelaunch
- Launch
- Operations

Communicating how transit service and individual bus stops will change is particularly important—passengers should be familiar with where the new BRT station will be located, what the route and service frequencies are, and where and how to purchase and validate a ticket. This can take the form of signage, infographics, videos, and even transit training. The project could aspire to follow Connecticut DOT's precedent and have real-time BRT service information available from day one in third-party mobile apps. Whatever the format, it is important to communicate specific bus-stop-level changes well in advance of launching the BRT service.

37 Section 11.6 https://brtguide.itdp.org/branch/master/guide/the-case-for-marketing-and-customer-service/implementation#marketing-plan-project-phases of the *BRT Planning Guide* explains how to develop and implement a phase BRT marketing strategy (ITDP 2021).

SUMMARY OF NEXT STEPS:
COMMUNICATION AND MARKETING

The next steps needed to advance the Everett–Boston BRT Communications and Marketing are summarized below by key actors.

	NEXT STEP: COMMUNICATIONS AND MARKETING	ACTORS		
		City of Everett	City of Boston	MBTA
STRATEGIC PLANNING FOR COMMUNICATIONS	Dedicate staff and budget	●	●	●
	Define BRT communications goals and objectives	●	●	●
	Complete stakeholder analysis	●	●	●
	Sharpen messaging	●	●	●
	Empower project proponents	●	●	●
PUBLIC ENGAGEMENT	Develop and implement public engagement strategy	●	●	●
	Anticipate common concerns	●	●	●
	Communicate door-to-door along corridor	●	●	
	Address business community directly	●	●	
MARKETING AND BRANDING	Define and develop Everett-Boston BRT branding	●	●	●
	Design marketing campaign	●	●	●

GOVERNANCE AND FINANCIAL PLAN

3

PROJECT GOVERNANCE

Developing and implementing a BRT corridor, especially one that crosses multiple jurisdictions like the Everett–Boston corridor, involves many stakeholders and decision-makers. All of these bring their own perspectives, priorities, and agendas to the project. Planning, funding, constructing, and operating a BRT requires agreement between decision-makers about everything from bus lane alignment and fleet selection to the service plan and fare policies.[38] The people gathered at the BRT decision-making table should:

- Represent all of the entities with authority over the project and
- Have the necessary decision-making authority on behalf of their organization.

For this BRT corridor, **key decision-makers** include at least:

- MBTA
- MassDOT
- Cities of Everett and Boston
- Possibly cities of Cambridge and Somerville, depending on BRT route alignment
- Boston Region MPO, Central Transportation Planning Staff (CTPS)
- Metropolitan Mayors Coalition—influence over new MBTA garages
- Massachusetts Department of Conservation & Recreation

COORDINATING A PHASED IMPLEMENTATION

The Everett–Boston BRT corridor will likely have a phased implementation, with segments of the corridor pieced together over the next few years. Project roles, decision-makers, funding sources, and schedules will vary for each corridor segment.

CONVENE BRT CORRIDOR PROJECT TEAM

One of the challenges this phased implementation approach introduces is coordinating and integrating planning, decision-making, project management, and construction for the discrete segments while ensuring continuity in the transit operations and passenger experience end-to-end on the corridor. Convening the key decision-makers, planners, and

38 Carrigan, Wallerce, and Kodransky 2019.

implementers for each segment will help ensure continuity for the project from Glendale Square to downtown Boston while retaining the bigger vision for the full corridor. Lower Mystic Working Group could provide a forum for the inter-agency coordination needed to deliver the BRT corridor, one of the Working Group's recommendations.

KEY PROJECT ROLES

Certain project roles will be consistent across each phased segment of the corridor. For instance, MBTA, as the transit operator, has a key role in the development of each segment. The MPO, Central Transportation Planning Staff (CTPS), will play a regional coordination role and perhaps a funding role for the whole project. The project's eligibility for some federal and state funding will depend on its being included in the LRTP and TIP developed by the MPO. The MPO has some direct financing authority, which it could use in innovative ways to support the BRT.[39]

CLARIFY IMPLEMENTER ROLES BY PHASED SEGMENT

Three critical implementer roles on a BRT project will likely vary for each segment of the phased corridor:[40]

- **Project sponsor.** The initial idea for a BRT project is formally adopted by a project sponsor when it is incorporated into the MPO's long-range transportation plan and shorter-term Transportation Improvement Program. The sponsor develops the project concept, initiates the funding request, applies for funding, and sees the project through to completion. The sponsor must be a government agency or other entity that is eligible to apply for the necessary state or federal funding. Different types of entities are eligible to receive certain federal and state funding. For instance, almost any public entity, including cities, is eligible for BUILD grants. States and transit agencies are typically eligible for New Starts and Small Starts grants. Smaller items can be initiated as pilot projects, or in some cases, pilot projects that are designed to become permanent if successful ("the pilot is the process"[41]).

- The **lead planning agency** is often also the agency champion or the technical champion, and it should have sufficient staff capacity as well as some experience leading multi-stakeholder transit planning projects. This may be the City of Everett, City of Boston, or MassDOT for some segments.

- The **owner of the right-of-way** is a crucial stakeholder in a BRT project. Having the owner of the right-of-way as the lead agency for construction often improves the efficiency of the implementation by speeding along permitting and construction management. This is especially crucial when the BRT project incorporates parallel utility upgrades and the owner of the right-of-way has authority over the public utility agency. When the state owns the right-of-way, as is the case with Route 99, Broadway, and Rutherford Avenue, additional coordination may be needed. MassDOT will need to approve the BRT corridor designs, which

39 Transportation for America's "The Innovative MPO" (2014) offers suggestions for ways an MPO can create innovative partnerships and funding solutions to advance BRT and other transportation projects.
40 Carrigan, Wallerce, and Kodransky 2019.
41 MilNeil 2020a.

can become a protracted process if the state has not previously approved the design and operation of a transit street on a state-owned corridor.[42] In general, projects that cross multiple road ownership jurisdictions are more complicated than projects within a single city or town.

COORDINATE WITH EXISTING/CONCURRENT PLANNING PROCESSES

Several plans affecting the Everett–Boston BRT corridor are currently in development and implementation. Successfully implementing the BRT will require close coordination with those current and short-term future processes, and in some cases, quick design modifications of infrastructure will be needed to accommodate a future BRT corridor.

See Appendix N for a list of these projects.

FINANCING THE BRT CORRIDOR

INCLUDE (PARTS OF THE) BRT IN THE TIP

The BRT corridor, or segments thereof, will need to be included in the Boston MPO's TIP to be eligible for certain types of federal funding. As a multijurisdictional BRT corridor, the project could be sponsored by the cities of Everett or Boston.

Each TIP takes effect in October, the start of the federal fiscal year. It is most feasible for the **Everett–Boston BRT to be included in the FFY2023–2027 TIP**. The MPO begins discussions about potential projects to program in the TIP in October of the prior year. Before a project could be considered for programming in the TIP, it must be approved by MassDOT.

The steps required for MassDOT approval would need to be completed by early December 2021:

1. **Initiate project with MassDOT.** The project sponsor needs to submit a Project Need Form (PNF) and Project Initiation Form (PIF) online to MassDOT via the MaPIT portal.

2. **Review and approval by MassDOT.**

3. **Review and approval by MassDOT Project Review Committee (PRC).** The PRC meets in April, August, and December. In addition to the PNF and PIF forms, a project sponsor must submit a Functional Design Report to MassDOT that includes future build and no-build scenarios.

Projects that are approved by MassDOT's PRC at its early-December quarterly meeting would be eligible for evaluation by the MPO Board and consideration for programming in the upcoming TIP.

42 Carrigan, Wallerce, and Kodransky 2019.

The schedule for the FY2023–27 TIP development is:

- October 2021: Sponsoring municipality begins advocating to MPO for consideration of BRT for TIP programming.
- December 2021: MassDOT PRC approves project. MPO begins project evaluations.
- May 2022: MPO endorses TIP.
- October 2022: TIP takes effect.

The City of Everett is currently serving as a member of the MPO, elected as an at-large city. This may help in advocating for the Everett–Boston BRT corridor to be included in the TIP. Somerville is currently serving as an elected subregion representative, while Cambridge is not currently serving on the MPO. This may influence the alignment of the BRT route to Kendall Square (904) via Somerville rather than through Cambridge.

DEVELOP CAPITAL COST ESTIMATES

The capital cost of the Everett–Boston BRT corridor will include constructing busways and stations, reconfiguring intersections and rotaries, any land acquisition costs, TSP, and fleet acquisition. As a comparison, the Silver Line SL3 Chelsea corridor cost $56.7 million to implement (or $50 million per mile of busway). However, the capital cost estimates of the Everett–Boston BRT corridor should be informed by other full-fledged U.S. BRT corridors, not a low-grade bus route like the Silver Line.

For segments of the Everett–Boston corridor excluding Rutherford Avenue, comparable capital costs from other U.S. corridors might include Eugene–Springfield's EmX Greenline ($3.9 million/mile in 2019 dollars), Richmond's Pulse ($8.7 million/mile), or Albuquerque's ART ($15.2 million/mile).[43] Cleveland's Healthline corridor included property line to property line upgrades and cost $33.4 million/mile. The full cost of rebuilding an at-grade Rutherford Avenue and eliminating the underpasses may approach the higher capital costs seen in dedicated busway implementation in Hartford, Los Angeles, or Pittsburgh, which were as high as $81.8 million per mile.[44] Many of these costs can be attributed to overall roadway reconstruction, and any capital cost estimates should show the marginal cost of building a busway compared to the overall cost.

As the infrastructure plan is further developed, more detailed capital cost estimates can be created based on the proposed designs for each segment of the corridor.

43 Carrigan, Wallerce, Kodransky 2019.
44 Carrigan, Wallerce, Kodransky 2019.

FINANCING CAPITAL EXPENDITURES

IDENTIFY POTENTIAL CAPITAL FUNDING SOURCES FOR EVERETT-BOSTON BRT

Financing the capital costs of the BRT corridor will likely require piecing together a patchwork of local, state, and federal sources. Potential funding sources should be identified early in the planning process, once some of the major roadway alignment and design questions have been answered. Possible funding sources include the following:

FEDERAL SOURCES:

- **BUILD grants** can fund multijurisdictional, multimodal projects that are hard to fund with other sources, and almost any public entity, including cities, is eligible. They are very competitive (only 5% to 10% of projects are funded), and awards are capped at $25 million.
- **New Starts** and **Small Starts** are FTA programs to provide federal funding for transit improvements. New Starts are for large fixed-guideway projects (generally larger than all but the most expensive BRT projects) and have more stringent requirements than Small Starts projects. Most BRT projects, including this corridor, would likely fall into the Very Small Starts guidelines.
- **Bus and Bus Facilities** generally fund bus fleets and maintenance facilities, but several in recent years have been used to fund BRT guideways and other resources.
- **Additional Infrastructure** funding may become available depending on congressional appropriations.

STATE AND REGIONAL SOURCES

- The Baker–Polito Administration's $16.5 billion **Transportation Bond Bill** includes approximately $5.7 billion for MBTA improvements. The bill also includes proposals for accelerating the rate of capital investment and leveraging private sector investment in transit. The bill authorizes up to 50% of the revenue generated by regional market-based compliance programs in the transportation sector, including the Transportation and Climate Initiative, to be used to support public transit capital investments that reduce greenhouse gas (GHG), emissions in the transportation sector.[45]
- **Transportation and Climate Initiative** is currently under development with other Northeast and Mid-Atlantic states and the District of Columbia.

45 Office of MA Governor Baker 2019.

LOCAL SOURCES:

- **MassGaming Community Mitigation Funds.** The cities of Everett and Somerville have been allocated $425,000 for a Transit Project of Regional Significance, the planning and design of MBTA Silver Line BRT service from Chelsea through Everett along the MBTA Commuter Rail right-of-way to Sullivan Square and then to Somerville. The City of Boston also received $200,000 in CMF funding toward the Rutherford Avenue and Sullivan Square redesign. CMF funds could support both the planning and capital costs of an Everett–Boston BRT corridor.

- MBTA has an $8 billion **Capital Investment Plan** in place. It's a rolling five-year, fiscally constrained CIP.

PRIVATE SECTOR SOURCES:

- Governor Baker's $16 billion transportation bond bill would enable the MBTA to partner with developers willing to build or improve transit infrastructure to expedite the distribution of public benefits and use well-established procurement methods such as Job Order contracting for smaller projects. MassDOT and the MBTA would be authorized to follow a streamlined process for entering into public–private partnerships and use Design-Build project delivery for all projects, including those with budgets under $5 million.[46]

☐ IDENTIFY POTENTIAL FLEET FUNDING SOURCES

Currently 60-foot battery-electric buses cost approximately $1.3 million (see Appendix L: Fleet Procurement). Battery-electric buses cost as much as $200,000 more than hybrid or diesel buses, but current models have to return to the depot for recharging after less service time than hybrid buses.[47] The 60-foot BEB buses manufactured by New Flyer and BYD have passed FTA's model bus testing program (Altoona Testing), a prerequisite for federal funding eligibility.

Funding for fleet procurement from a combination of state and federal sources will need to be identified. Federal discretionary grants could support fleet procurement. MBTA procured the five New Flyer BEBs for in-service testing on the Silver Line with a $10 million grant through **FTA's Low and No Emission Vehicle Deployment Program (LoNo)**, which also supported the cost of five charging stations at the South Hampton Garage. New electric BRT buses could also be financed with **Volkswagen settlement funds** or possibly the proposed **Transportation Bond Bill**.

46 Office of MA Governor Baker 2019.
47 Linsinski 2019.

ESTIMATE ANNUAL OPERATING AND MAINTENANCE COSTS

Lower Mystic Working Group estimated the annual operating costs of the BRT routes from Chelsea to Kendall Square and from Everett's Glendale Square to North Station to be $32 million. For comparison, in 2017, Silver Line operating expenses were $18.49 million. The marginal cost may actually decrease, though, since more-efficient BRT buses may carry more passengers with fewer vehicles. However, if it provides service that is redundant because of the parallel Orange Line, it may prove less cost-effective. Since much of the cost of BRT is based on labor costs, buses that experience minimal congestion while carrying high passenger loads can be operated quite efficiently.

SUMMARY OF NEXT STEPS: GOVERNANCE & FINANCIAL PLAN

The next steps needed to advance the Everett-Boston BRT Governance and Financial Plan are summarized below by key actors.

		ACTORS				
	NEXT STEP: BUSINESS PLAN	**City of Everett**	**City of Boston**	**MPO**	**MassDOT**	**MBTA**
PROJECT GOVERNANCE	Convene BRT Corridor Project Team	●	●			
	Clarify implementer roles by phased segment	●	●			
COORDINATION	Coordinate with existing/concurrent planning processes	●	●	●	●	●
FINANCING THE BRT	Include BRT corridor in the TIP			●		
	Develop capital cost estimates	●	●	●		
	Identify potencial capital funding sources	●	●	●		
	Identify potential fleet funding sources					●
	Estimate annual operatin and maintenance costs					●

INFRASTRUCTURE PLAN

4

This section describes the steps for planning the BRT corridor busways, stations, intersections, and garages.[48] While specific roadway and station design considerations are presented for each segment of the corridor, this section does not address detailed civil engineering or construction, which are beyond the scope of this roadmap.

ROADWAY AND STATION CONFIGURATIONS

ROADWAY CROSS-SECTION

As an older city with narrow streets, Everett's task of incorporating BRT along the Broadway corridor is difficult. North of Revere Beach Parkway, Broadway is only 65 feet wide between property lines and just 42 to 44 feet wide between curbs.

In considering how to accommodate BRT lanes on the Everett corridor, ITDP has made several assumptions, including: (1) changing the curb lines is not feasible, since it would require a full-depth reconstruction of the roadway and associated drainage, and (2) widening the road is unacceptable, since it would encroach upon street trees and the pedestrian environment. This roadway width of 42 feet to 44 feet requires significant compromises to prioritize transit and accommodate other users, especially since there are no nearby parallel roadways in the corridor.

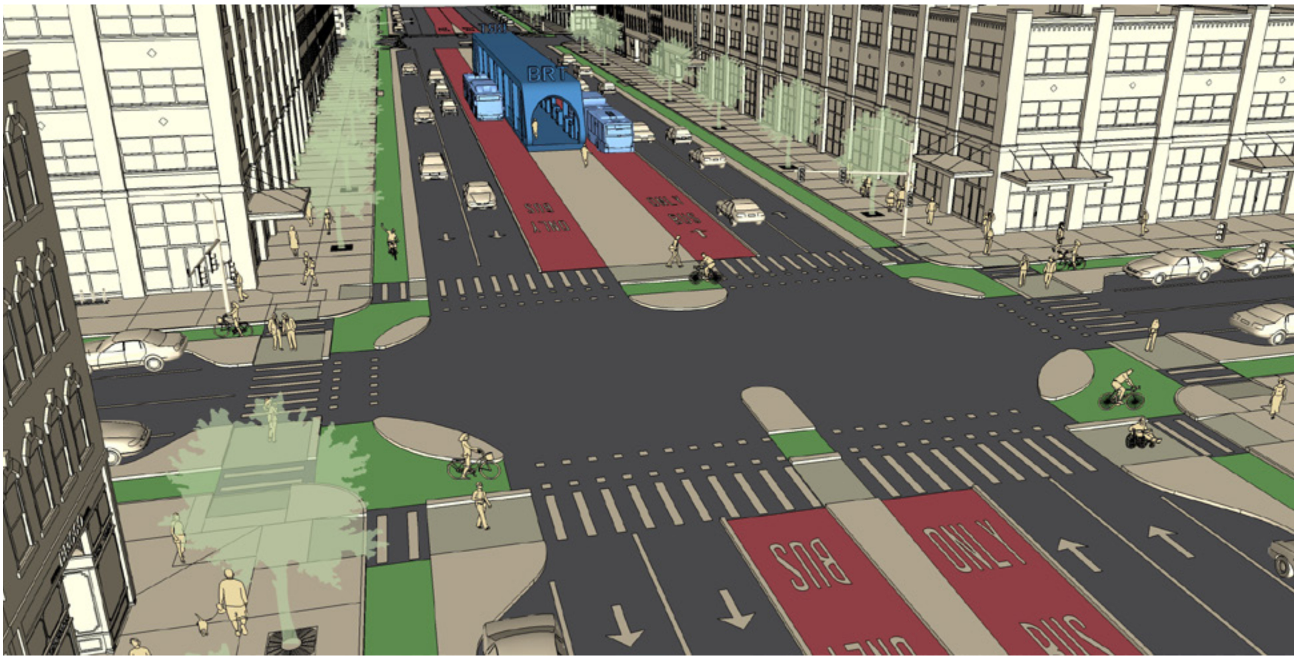
Dedicated BRT lanes that are physically separated from general traffic provide the best protection for buses from delays caused by mixed traffic.[49] Low barriers like curbs can still be mounted by buses or emergency vehicles, but they discourage other vehicles from entering the bus-only lanes. In Boston, the choice of BRT lane separator should take into consideration snow removal operations.

BUSWAY CONFIGURATIONS

In general, best practices dictate, and ITDP recommends, aligning the dedicated BRT lanes to the center of the roadway (see **Figure 4**) rather than the curb to deliver the highest-quality bus ridership experience. Center-aligned BRT lanes help reduce bus delays at the curb and from right-turning vehicles at intersections.

48 This BRT infrastructure section borrows heavily from the concepts in ITDP's *Online BRT Planning Guide*. See Volume 6 for more detailed discussion about detailed busway and station configurations, design principles, calculations (ITDP 2021).
49 ITDP 2016.

Figure 4: Example of a Two-Way Median-Aligned Busway



SOURCE: ITDP 2016.

A corridor may have multiple configurations over its length. If the dedicated bus lanes cannot be median-aligned the whole length of the corridor, dedicated lanes should still be prioritized in alternative configurations. A lesson from the Silver Line is worth keeping in mind for Everett–Boston BRT: Without a continuous dedicated bus-only lane with physical separation and enforcement for the entirety of the corridor, mixed traffic will cause unpredictable service and poor on-time performance (see Appendix C).

The narrow street width on most of Broadway means median-aligned bus lanes cannot be implemented, with significant trade-offs for other road users. Likewise, the entire Everett–Boston BRT corridor from Glendale Square to Haymarket Station includes distinct sections with specific characteristics that present challenges or opportunities for incorporating BRT corridor infrastructure. These corridor segments and their implications for the BRT infrastructure are discussed in the subsequent sections. The cities of Everett and Boston need to assess the trade-offs between different roadway designs and prioritizing different road users.

STATION CONFIGURATION

SELECT STATION ALIGNMENT/CONFIGURATION

Accommodating the width of a station within narrow streets can be a challenge. The cities will have to weigh the implications of different ways of accommodating the station platform, such as replacing an existing median, removing on-street parking, removing left-turn pockets, or utilizing creative station configurations.

Where the street width allows, a **single center station platform** serving bidirectional BRT routes is the simplest, most convenient for passengers and the cheapest to construct. In this configuration, buses would dock to the right side of the platform and passengers board through left-side bus doors. The station platform can be **elongated** and the boarding areas for the bidirectional service offset to reduce the necessary width.[50] When the stations are aligned to the outside (left) curb of the busway (see Figure 5 top), buses dock on the right side of the station and passengers would board through left-side bus doors.[51]

Alternatively, the station platform could be **split** into inbound and outbound platforms aligned to the inside (right) curb of the busway (see Figure 5, bottom).[52] In this configuration, buses dock to the left side of the platform and passengers would board through right-side bus doors. Any BRT buses with left-side doors should have right-side doors as well so that they can serve curbside stations, whether along an Upper Broadway transitway or when the BRT route exits the corridor and operates curbside, say en route to Kendall Square.

Figure 5: BRT stations can be aligned to the inside of the dedicated bus lanes (left), as in Albuquerque's ART, or to the outside of the lanes (right), as in Richmond, Virginia's Pulse BRT.

Source: ITDP (top); Beyond DC via Flickr (bottom)

50 Section 22.3 of the *BRT Planning Guide* (italics) includes extensive details about different BRT station configurations and their tradeoffs (ITDP 2021).

51 The MBTA operated a fleet with left-side doors since the 1930s for operation in the Harvard Tunnel. Other instances of buses with left-hand doors in the U.S. are BRTs in Albuquerque, Cleveland, and Eugene, as well as Indianapolis's new Red Line and Oakland's Tempo bus corridors (Carrigan, Wallerce, and Kodransky 2019).

52 Split station platforms can also be aligned to the outside (left) of the bus lane. Less road width is needed at stations compared to single center platforms, and buses could board passengers through left-side doors.

The trade-offs between center platforms that board from the left or right side are primarily width, capital costs, and fleet compatibility (see Table 4). A single shared center platform can reduce construction costs but is wider and requires buses with left-hand doors which MBTA's current fleet does not have. Generally, the longer-term operational efficiencies and capital costs should be prioritized over shorter-term fleet compatibility issues.[53] MBTA may need to procure additional buses to operate the Everett-Boston BRT routes at the proposed frequencies in any case, so choosing the BRT station alignment based on the existing fleet is shortsighted. Everett and Boston staff, in consultation with MBTA, will need to select a preferred station alignment (inside or outside), while the station platform configurations will need to be optimized for each station location.

Table 4: Considerations for Left- and Right-Side-Boarding Center Station Platforms

LEFT-SIDE BOARDING	+ Possibly lower station capital costs of constructing one shared center platform versus two split stations. + Allows larger left-side-door fleet for use in Harvard Tunnel Busway[54] - Existing Silver Line buses and the rest of the MBTA fleet with right-side doors will be incompatible with these stations.
RIGHT-SIDE BOARDING	+ Compatible with Chelsea Busway: BRT route could begin at Glenwood, enter Chelsea Busway, and continue to downtown. + Does not require MBTA to purchase and maintain another BRT sub-fleet. - Possibly higher station capital costs because two platforms, canopies, etc., are required.

ROADWAY DESIGN

As BRT ridership grows, especially in space-constrained corridors, the system must be planned so that successful implementation and high demand do not cause a reduction in the transit level of service provided. In the Everett corridor, care should be taken to make sure that the infrastructure built does not preclude future speed or capacity, as has been the case on the Silver Line (see Appendix C).

Subsequent sections describe some of the roadway design options and constraints for segments of the BRT corridor. This roadway design discussion assumes that the BRT corridor begins with bus lanes in some configuration at Everett's Glendale Square and continues along Broadway, crosses the Alford Street Bridge, serves Sullivan Square, continues along Rutherford Avenue, crosses the North Washington Street Bridge, and terminates at Haymarket. This includes the bus priority lanes bypassing traffic at Sweetser Circle, implemented in winter 2020, and at least the southbound bus-only lane planned for the reconstructed North Washington Street Bridge.

53 Carrigan, Wallerce, and Kodransky 2019.
54 The MBTA has operated a fleet with left-side doors since the 1930s, because of the need to board passengers from the platform in the Harvard Busway. When the 77 bus and other lines were converted to diesel buses in the 1950s, the diesels were not given left-side doors, and southbound buses in the tunnel using diesels to this day drop passengers off on the "wrong" side of the tunnel, requiring them to cross the active busway to access the curb. Operating buses with left-side doors on the Everett-Boston BRT corridor would allow the MBTA to acquire a larger fleet to improve operations for bus lines serving the Harvard Busway and to eliminate this archaic practice.

SELECT PREFERRED DESIGN ALTERNATIVE FOR UPPER BROADWAY

The current configuration of Upper Broadway has limited transit prioritization, with only the southbound A.M. and northbound P.M. peak curbside lanes. Elements of the current street design that degrade the bus passenger experience include:

- The painted bus lane provides no physical separation to prevent mixed traffic from moving into the lane;
- Curbside bus lanes expose buses to delays from vehicle activity at the curb or right turns at intersections;
- The bus-only lanes are only available during specific times of day;
- No transit prioritization off-peak or in the northbound direction past Chelsea Street/Everett Square.

ITDP considered ways to enhance transit prioritization with segregated bus lanes and by reducing curbside bus–vehicle conflicts with median-aligned lanes within the existing narrow right-of-way. ITDP explored the feasibility of, and trade-offs associated with, four configurations of BRT lanes on Upper Broadway, beginning at the intersection with Ferry Street near Glendale Square and continuing to Sweetser Circle:

- Existing curbside bus lanes[55]

A **Configuration A:** Two center-aligned bus-only lanes, with split stations aligned to the inside (right) or outside (left) of the lane

B **Configuration B:** One center-aligned shared (bidirectional) bus-only lane

C **Configuration C:** A transitway

Given the narrow width of Upper Broadway, significant compromises will need to be made to incorporate transit priority lanes beyond the side-running lanes that are currently implemented and proposed. Reallocating street space to prioritize transit requires reducing space for parked cars, vehicles, or bicycles. Certain design configurations also have implications for the bus door position on the BRT fleet. To summarize the main trade-offs between each design (see Table 5):

- Each of the design options (configurations A, B, and C) provides more transit priority than the existing conditions ;
- Two center BRT lanes (Configuration A) reduce the most transit delay but do not accommodate bicycles or vehicular traffic well (requiring at least one direction of vehicle traffic to be removed from the street);

55 A northbound/outbound bus-only lane launched in October 2020 which operates in the PM peak only. There are now curbside time-of-day lanes in both directions on Upper Broadway. In the future these lanes could be converted to full-time BRT lanes as conditions permitted, although given the current use of the street, some short-term parking/pullout lanes may still be required.

- One shared center BRT lane (Configuration B) provides the least transit priority of the options considered, has significant operational hurdles[56], has the least impact on vehicular traffic, and requires new buses with left-side doors;

- The transitway (Configuration C) maximizes the benefits for transit passengers and bicyclists and is the most disruptive to vehicles.

Cross-section schematics and more details of each configuration for Upper Broadway are shown in Appendix K. The City of Everett will need to evaluate the trade-offs and select a preferred roadway design alternative.

Table 5: Trade-Offs Between Accommodating Transit, Automobiles and Bicycles on Upper Broadway anchor24

CONFIGURATION	Physically Segregated BRT Lanes	Transit Priority SB and NB	More Than Time-of-Day Lanes	Reduce Bus Delays at Curb and Intersecions	Vehicle Traffic	Bike Lanes	Bus Door Position*
Existing Conditions: 2 curbside bus lanes	✕	✓	✕	✕	✓	—	Right
A: 2 center BRT lanes	✓	✓	✓	✓	—	✕	Right or both sides[57]
B: 1 shared center BRT lane	✓	✕	—	—	✓	—	Both sides
C: Transitway	✓	✓	✓	✓	✕	✓	Right or both sides

* This assumes all BRT buses will need right-side doors so they can continue off-corridor and access curbside bus stops.

56 BRT systems in Eugene, Oregon, and Albuquerque, New Mexico, use short, bidirectional bus lanes as part of their BRT systems (Carrigan, Wallerce, and Kodransky 2019). There is a short portion of the Silver Line 3 route in Chelsea that also has a single-lane section. In these cases, however, bus frequency is lower than in Everett, routes are not shared by several bus lines requiring schedule coordination, and stations are not incorporated into the one-lane segment.

57 Split stations are easier to accommodate on narrow Upper Broadway. The boarding platforms could be aligned to the inside or outside of the BRT lane, accommodating either left- or right-side bus doors.

SELECT PREFERRED DESIGN ALTERNATIVE FOR CHELSEA BUSWAY EVERETT EXTENSION

MassDOT is currently evaluating alternative alignments for extending the Chelsea Busway from its current terminus at Chelsea Station to Broadway in Everett, including:

1. Continuing along the **rail right-of-way** and meeting Broadway just south of Sweetser Circle[58];
2. Diverting from the rail right-of-way and routing along **surface streets** to Broadway, probably via 2nd Street;
3. A combination of these dependent on the direction of travel.

Some preliminary trade-offs with each corridor alignment are listed in Table 6. MassDOT, with the City of Everett and MBTA, will need to evaluate the design alternatives and select a preferred option.

Table 6: Multi-Modal Design Trade-Offs for Chelsea Busway Extension Alignments

BRT CORRIDOR ALIGNMENT	Dedicated Bus Lanes	Signalized Intersections	Ease of Pedestrian Access
A: Along rail right-of-way	✓	✗	Low
B: Surface streets via 2nd St	—	✓	High
C: One-way on rail right-of-way, one-way on surface streets	—	✓	Mixed

SELECT PREFERRED DESIGN ALTERNATIVE FOR LOWER BROADWAY

The main objective for incorporating BRT lanes on Lower Broadway is to continue the transit prioritization from Upper Broadway through to Sullivan Square by offering some travel time advantage for bus passengers.

There are several options for BRT on this corridor given its width, most of which require major infrastructure changes to the roadway (see Appendix K). A center-running BRT would be feasible with these changes, but it would still face several hurdles, including requiring significant changes to the north and south to allow buses to transition in and out of a center-

58 Connecting from the rail right-of-way to Broadway in the Sweetser Circle area would be difficult, however, and CTPS found several narrow sections that may preclude a busway. See Appendix J (MAPC and CTPS 2019).

running configuration. This is necessary because the new bus-only lanes through Sweetser Circle are aligned to the outside (right) of the rotary, and outside lanes will likely be necessary to access Sullivan Square. The City of Everett will need to evaluate the trade-offs and select the preferred design alternative for the BRT corridor on Lower Broadway, and it would require a complete rebuild of a street that was redesigned and rebuilt within the past five years.

SELECT PREFERRED DESIGN ALTERNATIVE FOR ALFORD STREET BRIDGE

The bridge deck is 44 feet wide on each side, with a curb-to-curb width of approximately 38 feet. The bridge incorporates two travel lanes, shoulders, and a bike lane in each direction. Congestion on the bridge is variable, with the most need for bus lanes going northbound.

The primary design consideration is the alignment of the bus-only lanes on the Alford Street Bridge -- whether center or curbside (see Table 7). In either case, there is sufficient width to accommodate a dedicated bus lane leading from the Alford Street Bridge into Sullivan Square.

The City of Everett, with input from the MBTA, will need to evaluate the trade-offs and select a preferred design alternative for the BRT corridor across the Alford Street Bridge. The timing of the bridge opening and its impact on off-peak BRT service should also be considered early in the planning process.

Table 7: Trade-Offs of BRT Lane Alignment on the Alford Street Bridge

BUS-ONLY LANE ALIGNMENT	TRADE-OFFS
CURBSIDE LANES	+ Pre-position buses to enter curbside lanes into Sullivan Station + Little curbside activity to delay buses - Combined bicycle/bus lane will be required to accommodate bicycles
MEDIAN LANES	- Little curbside activity to warrant median lanes - Likely requires transition to curbside lanes entering Sullivan

PROMOTE INCLUSION OF BRT IN UPCOMING RUTHERFORD AVENUE REDESIGN

BRT lanes along Rutherford will connect bus-only lanes on Broadway with proposed lanes on North Washington Bridge, providing continuous transit priority between Everett and Boston. BRT stations on Rutherford will make it more feasible to access Community College or the new Hood Park development without a car. A Sullivan Square BRT station favors at-grade bus-only lanes along the redesigned Rutherford Avenue rather than below-grade BRT lanes (see Intersections/Sullivan Circle).

The Rutherford Avenue underpass is 56 feet to 65 feet wide, which could accommodate two travel lanes in each direction. **Just because Rutherford Avenue has the cross-section present today does not mean that it needs to retain that cross-section in the future.** Rutherford Avenue should be used as a minor arterial roadway at most, and it would be better integrated into the neighborhood than serving as a high-speed, low-traffic barrier with a bottleneck at either end.

The City of Boston is currently redesigning Rutherford Avenue with the goals of improving pedestrian and bicycle connections, reducing congestion, protecting Main Street from cut-through traffic, creating public and open space, and unlocking opportunities for new development.[59] The upcoming redesign of Rutherford Avenue should pursue opportunities to include BRT and accommodate the following design considerations:

- Reallocate **excess vehicle capacity** to improve transit priority and safe pedestrian and bicycle connections;
- Address two **major bottlenecks** through Sullivan Square and Prison Point Bridge (see Appendix K);
- Accommodate or reroute **heavy-duty vehicles**. As a designated Critical Urban Freight Corridor, Rutherford currently experiences significant daily heavy-duty vehicle traffic, especially trucks accessing the Boston Sand & Gravel.

ITDP is working with the City of Everett and other stakeholders to promote inclusion of BRT lanes in the redesign of Rutherford Avenue. BTD's plans to present 25% designs to the public in the winter of 2021 have been delayed due to the COVID-19 pandemic.

SELECT PREFERRED DESIGN CONFIGURATION OF RUTHER-FORD AVENUE

A BRT corridor along Rutherford Avenue does not require preserving the underpasses; indeed, it benefits from their removal. BRT buses would be unlikely to use the Rutherford underpasses since they need to remain at-grade to access Sullivan Square Station. Travel time on the corridor would

59 BTD 2021.

not suffer from removing the underpasses as there is a negligible difference in travel time between the underpass and surface road design options.[60]

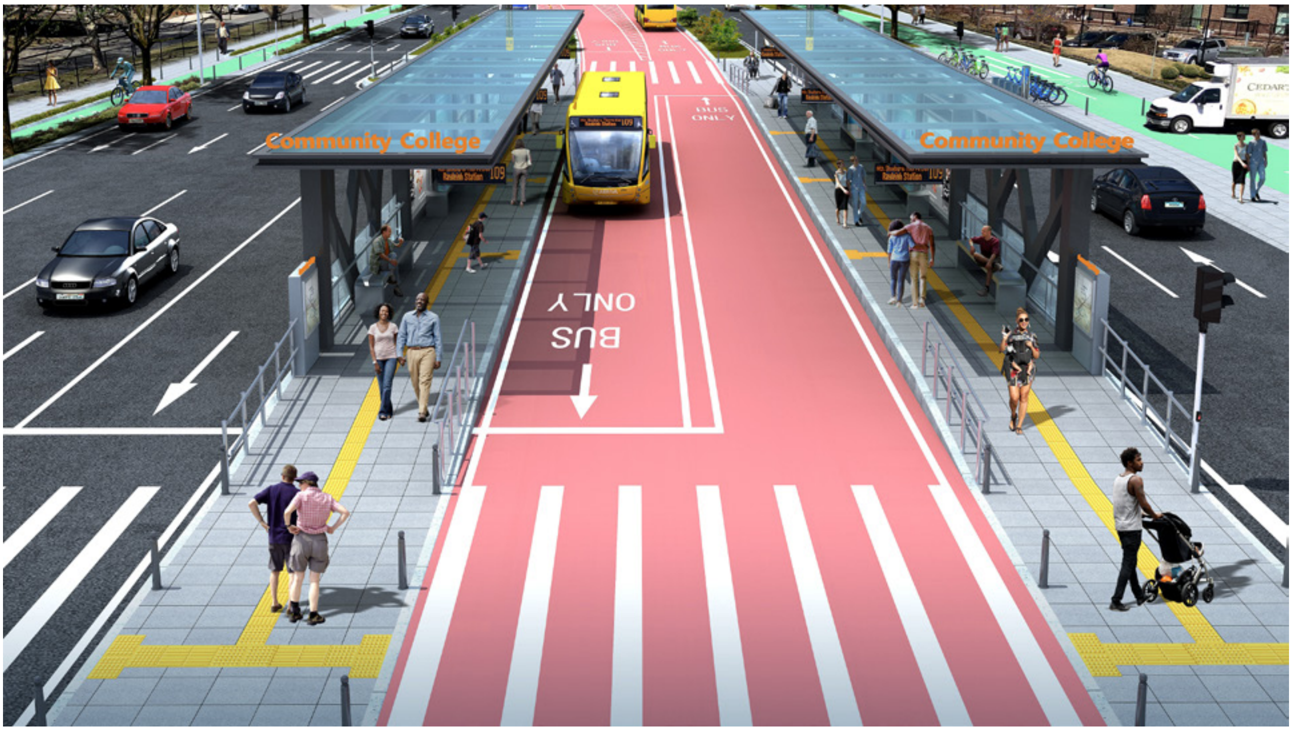
If the Rutherford underpasses are removed, they could give way to an at-grade boulevard designed to meet regional transit, equity, and climate change goals. An improved, at-grade Rutherford Avenue could prioritize transit, improve pedestrian and bicycle connections between adjacent neighborhoods, replace excessive hardscape with green infrastructure, and ultimately move more people safely and more efficiently.

The final configuration of Rutherford Avenue vis-à-vis the underpasses and prioritization of right-of-way impacts how BRT could be incorporated along the corridor (see Appendix K/Rutherford Avenue).

UNDERPASSES REMOVED

If an entirely at-grade Rutherford Avenue is proposed, center-running BRT lanes could be considered (see Figure 6). The addition of new cross streets and signalized intersections along Rutherford may introduce convenient locations for BRT stations. The new mixed-use development along the southside of Rutherford Avenue (e.g., The Graphic Lofts, Hood Park) would benefit from improved transit service and may even consider reducing the amount of parking built on site as a result. These developers are important stakeholders in the redesign of Rutherford and should be engaged early about the benefits of transit service, transit priority, and BRT.

Figure 6: Rutherford Avenue Rendering at Community College, Without an Underpass



Source: ITDP

60 The Lower Mystic Regional Working Group found that there was a negligible difference in travel times between the underpass and surface road design options (MAPC and CTPS 2019). The travel time from Sullivan Square to the North Washington Street Bridge will only be 3.2 minutes longer with the surface option in the morning and 2.7 minutes in the afternoon peak hours in 2040 (RCIC 2017). This is a negligible difference given the modeling and forecasting uncertainty.

UNDERPASSES RETAINED

If the Rutherford Avenue underpasses are preserved, it would likely be preferable to keep the BRT lanes and stations aligned to the at-grade service lanes between Sullivan Square and Chelsea Street. This would require one-way BRT lanes in each direction and split-platform stations. The bus-only lanes could be aligned to the outer curb of the service lane or the inner curb of the central roadway (see Figure 3 in Station Configuration).

Current design plans for Rutherford Avenue as programmed in the 2020 TIP include only minimal accommodations for buses—far from what could be described as BRT, which is a missed opportunity to connect two dedicated bus lane segments on Broadway in Everett and (at least inbound) on the North Washington Street Bridge in Boston. Furthermore, as of October 2019, the City of Boston's preliminary plans for the corridor preserved the underpasses. ITDP is engaged in conversations with the City of Boston, MassDOT, the MBTA, and other stakeholders to consider including dedicated bus lanes and complete BRT infrastructure (including stations with platform boarding) in the 25% design plans.

CHOOSE ROADWAY DESIGN FOR SULLIVAN-CAMBRIDGE/SOMERVILLE CORRIDOR

Any alignment selected for the BRT route from Sullivan to Cambridge/Somerville will encounter heavy traffic congestion. Transit prioritization will need to be incorporated into the corridor for the travel time to be competitive with a rail connection through downtown. This could include dedicated bus lanes or at least a queue jump lane approaching Lechmere.

The cities of Boston and Cambridge/Somerville will need to consider different roadway design options.

PROMOTE INCLUSION OF BRT LANES ON NORTH WASHINGTON STREET BRIDGE

MassDOT and the City of Boston are constructing a new North Washington Street Bridge to replace the 100-year-old structure. The final design includes a dedicated bus lane in the inbound direction only, plus two travel lanes in each direction (see Appendix K). Construction is currently in progress and is expected to continue until spring 2023. The construction is phased and includes a temporary bridge structure that also includes a dedicated inbound bus lane and one travel lane in each direction. This temporary bridge is scheduled to be operational throughout Stage 2 of the project, from November 2019 to October 2021. The final alignment could be restriped to swap a northbound general-purpose travel lane for a northbound bus lane given the limited upstream throughput for traffic originating from narrow streets in Boston. ITDP has discussed data collection with the City of Boston while a single outbound lane is being provided to determine whether this could be carried into the final configuration. If an outbound dedicated bus lane can be accommodated, both bus lanes could be moved to the center of the bridge.

INTERSECTIONS AND SIGNALS

The intersections along the BRT corridor determine how efficiently the buses and pedestrians can access the stations while there is also a perceived impact on general traffic. An important step in the BRT corridor planning will be optimizing the intersection performance by designing the intersection configuration and adjusting the traffic signal timing.

Each intersection along the BRT corridor will need to be optimized individually based on the characteristics of that site. The intersections should be designed to achieve the following:[61]

1. Safe and convenient crossings for pedestrians;

2. Minimal delay for BRT buses;

3. Minimal delay for mixed traffic.

The intersections along the BRT corridor need to be designed to operate as efficiently as possible for all road users. This is an iterative process. It should start with data collection about the existing flow of people and vehicles. By removing travel lanes, the BRT corridor may exacerbate existing bottlenecks along the corridor, which will need to be resolved. The proposed service frequency combined with the configuration of the lanes and signal timing along the corridor may also cause bottlenecks in the bus lanes, which will need to be identified and mitigated. Several techniques can be used to rationalize the intersections on the corridor.

COLLECT TRAFFIC COUNTS AND DETERMINE INTERSECTION DELAY

Data about the existing traffic conditions in the corridor needs to be collected and analyzed to inform design of the BRT corridor intersections. Traffic volume data and turning movements will be needed for each intersection along the BRT corridor. ITDP contracted a consultant to collect some traffic count data for lower Broadway intersections in January 2020.

It will be critical to understand where all of the existing bottlenecks and pinch points are and how they may be affected by the addition of BRT lanes and potential removal of general traffic lanes. Next, the impact of the existing traffic signal phasing on the BRT lanes needs to be examined to see if the signal delay will make the busway congested. Each intersection must be analyzed to understand its impact on the BRT corridor and the general traffic. Any intersection that introduces significant delay should be redesigned to improve the overall efficiency for all road users. This will be an iterative process, incorporating some of the subsequent steps.

61 For a more extensive discussion about how to approach intersection design along the BRT corridor, see Section 24.2 of the *BRT Planning Guide* (ITDP 2021).

OPTIMIZE THE NUMBER OF TRAFFIC SIGNALS ALONG BRT CORRIDOR

The number of signalized intersections along the BRT corridor should be optimized to improve the efficiency of all road users. As turning movements are streamlined along the corridor, it may be possible to remove some existing signalized intersections. New traffic signals and/or signalized intersections can improve BRT vehicle movements and station access. For instance, where the BRT lane alignment changes from median to curbside, or vice-versa, a new traffic signal may make it easier for the BRT buses to shift their alignment. Adding a signalized intersection before or after the Alford Street Bridge could provide an opportunity to shift the BRT lane alignment from center to curbside, depending on the lane alignment on Lower Broadway and Sullivan Circle.

OPTIMIZE BRT STATION LOCATIONS RELATIVE TO INTERSECTIONS

The location of the BRT stations with respect to the signalized intersections impacts the efficiency and speed of the BRT services as well as the width of the right-of-way needed to accommodate the BRT corridor. When the station is located right at the intersection, the bus lanes can become congested as buses waiting for a green light obstruct access to the station for subsequent buses. Moving the BRT station slightly away from the intersection can alleviate that queue of buses. Intersections are also a common place for general traffic lanes to become congested, so using the limited right-of-way at the intersection for the BRT station may negatively impact the efficiency of the general traffic lanes. Away from the intersection, it may be easier to accommodate the width of the BRT station and bus lanes and still allow for sufficient general traffic capacity at the intersection. Each station needs to be sited with respect to the intersection, taking into account the unique geometry and demand at each location.

LIMIT TURNING MOVEMENTS

At the intersections along the BRT corridor, eliminating traffic signal phases that conflict with the flow of the BRT buses will help reduce delays for passengers. More signal phases erode the green time available for the transit priority corridor, slowing down all directions of travel. Eliminating traffic signal phases that conflict with the flow of the BRT buses will help reduce delays for passengers. The priority should be to eliminate as many left turns across the BRT corridor as possible and to detour those vehicles intending to turn left.[62] For instance, between Dexter Street and Sweetser Circle, most left turns going northbound, other than to access the casino, could be accommodated by rerouting turning traffic via Robin and Beacham streets, creating a long "jug-handle" type movement to remove the need for a left turn.

62 Section 24.5.2 of the *BRT Planning Guide* describes a variety of detour options for left-turning vehicles (ITDP 2021).

The technical feasibility of eliminating left turns will need to be carefully analyzed at each intersection along the BRT corridor. The adjacent local street network will inform which detour options are most viable. Instituting left-turn restrictions also necessitates strong political will, as it often garners public criticism. As Richmond, Virginia, and Albuquerque discovered in their arterial BRT corridors, extensive public education campaigns need to accompany left-turn restrictions.[63]

PLAN BRT BUS TURNING MOVEMENTS

At several locations the BRT buses may need to turn on or off the BRT corridor. For instance, BRT buses may turn between the Everett corridor and the Chelsea Busway extension. Likewise, buses on the BRT route to Cambridge/Somerville will need to turn off the Everett–Boston corridor after Sullivan Square, perhaps onto the Prison Point Bridge. The turning movements of BRT buses at these locations may warrant protected signal phases, or TSP.

OPTIMIZE TRAFFIC SIGNAL TIMING AND CONSIDER TSP

Traffic signal timing needs to be optimized at each signalized intersection along the BRT corridor. Delays should be minimized for bus passengers as well as pedestrians, bicyclists, and general traffic. Traffic microsimulation can help evaluate the efficiency of the intersection for all modes.
Signal timing should provide as much priority, or green-light time, to the BRT buses as possible. A decision needs to be made about whether to incorporate passive or active transit signal priority in the corridor (see Technology/Traffic Signal Control and TSP). Passive signal priority includes extending the green phase for the BRT corridor, at the expense of the perpendicular streets without transit. Active signal prioritization uses technology to detect an approaching BRT bus and change the traffic signal phasing.[64]

PROVIDE BUS PRIORITY THROUGH ROUNDABOUTS

Two of the major existing bottlenecks along the BRT corridor are rotaries—Sweetser and Sullivan circles—which will require innovative solutions to incorporate BRT lanes and transit priority.

DESIGN BUS PRIORITY THROUGH SWEETSER CIRCLE

In October 2020, bus-only lanes were painted through Sweetser Circle as part of the $16 million MassDOT redesign effort. The City of Everett leveraged the MassDOT opportunity to transform the rotary into a more functional, safer node. The impacts of bus-only lanes on transit speed and reliability need to be fully assessed. Design consultant Howard Stein Hudson is preparing data on the Sweetser Circle lanes, and ITDP is working with Stantec to analyze the impact of the length of bus-only lanes up Broadway. Reductions in typical traffic volumes during COVID-19 have hampered both efforts.

63 Carrigan, Wallerce, and Kodransky 2019.
64 Section 24.3 of the *BRT Planning Guide* explains passive and active signal priority (ITDP 2021).

DESIGN BUS PRIORITY THROUGH SULLIVAN SQUARE

Plans to redesign Sullivan Circle and Sullivan Square MBTA station are underway. In October 2019, the City of Boston's proposed design called for replacing the circle with two signalized intersections (see Appendix K). It will be more feasible to include dedicated BRT lanes through two intersections than through the current circle, and traffic signal prioritization (TSP) here will help reduce delay for bus passengers, although the number of transferring passengers at Sullivan Square may preclude any travel path that bypasses the station itself.

The October 2019 City of Boston proposal for a redesigned Sullivan Square only includes a dedicated bus lane southbound on Alford Street; including northbound dedicated lanes would help reduce delays from congestion and turning vehicles for P.M. peak bus passengers as well. Integrating TSP into the new signalized intersections will advantage buses over vehicular traffic through this congested area. (See Stations section for discussion about location and design of a Sullivan Square BRT station.)

STATIONS

High-quality stations are one of the elements that distinguish BRT from conventional curbside bus service. The *BRT Standard* suggests four essential BRT station design characteristics: width, weather-protection, safety, and attractiveness. BRT stations should be comfortable places for all passengers to wait in all weather at all times of day. The station architecture can also add visual interest to the transit corridor and act as a community anchor.

DEFINE STATION TYPES

Several typologies of BRT stations exist, depending on their function and location. The ones most relevant to the Everett–Boston corridor include:

- **Standard stations**, which should be sized according to the expected passenger demand;
- **Transfer stations** that facilitate transfers to other BRT corridors, BRT routes, or other modes. This type may be needed at Sullivan Square and where the proposed Chelsea Busway extension meets the Everett–Broadway corridor;
- **Curbside stops** may occur along a transit mall or after the BRT route exits the BRT corridor.

The cities of Everett and Boston, in partnership with the MBTA, will need to define the station typologies relevant for this corridor and determine where each type is needed.

DETERMINE STATION LOCATIONS

After considering the implications of stop consolidation; current and future trip generators and destinations; and how to optimize the number of signalized intersections along the BRT corridor, the BRT station locations need to be refined. ITDP created an initial BRT station location plan including 10 stations, spaced approximately 0.3 miles to 0.37 miles apart (see Figure 7). This would involve eliminating approximately five existing curbside bus stops along the corridor[65]. Proposed station locations include:

- McKinnon's Market @ Broadway between Morris and Hosmer streets
- City Hall @ Broadway between Webster and Church streets
- Sumner G. Whittier School @ Broadway and Gladstone Street
- Bowdoin Street and Broadway
- Encore Casino
- Sullivan Square Station
- Hood Park
- Community College
- City Square
- Haymarket

Figure 7: Potential BRT Station Locations

65 Because existing inbound and outbound curbside stops are not aligned, there may be more stops changed in one direction than another, so approximately five stops in each direction will be affected.

RESOLVE SULLIVAN SQUARE BRT STATION LOCATION

It is worth noting that ITDP recommends including a BRT station at Sullivan Square to allow transfers to the Orange Line and several existing MBTA bus routes. MBTA's Focus40 report notes that plans are underway to redevelop Sullivan Square Station. Depending on "the form and intensity" of the station-area development, a Superstation with Commuter Rail, Orange Line, and BRT connections may be warranted, and it is identified in the plan as a "Big Idea" to consider in the future.[66] Physical integration of a BRT station with the rail modes at such a Superstation would help facilitate more seamless multimodal transfers. There is significant right-of-way available adjacent to the Orange Line, but any track realignment will have to contend with the presence of structural steel for the elevated highway above. There are also groups advocating for using some of the right-of-way to build a bicycle and pedestrian link between Assembly Square and Kendall Square in this area.

The City of Boston's latest plans for a redesigned Sullivan Square propose a BRT station at the entrance/exit of a three-lane underpass (City of Boston 2019). This configuration introduces significant pedestrian safety concerns. The roadway is at its widest here, making for very long pedestrian crossings. Vehicles passing through the (unsignalized) three-lane underpass will be traveling at relatively high speeds at its entrance/exit, making this an unsafe location for a pedestrian crossing. The proposed station location is partially below-grade, so passengers will have to wait in a microenvironment with poor air circulation and high concentration of air pollutants from vehicle exhaust.[67] An alternative location for a BRT station should be considered, including at the proposed new signalized intersection of Main and Alford streets or at the existing Sullivan Station

66 MBTA and MassDOT 2019.
67 Betancourt 2017.

The intersection of Rutherford and Austin Street is an important connection to Bunker Hill Community College and the MBTA Orange Line Community College Station to the south. This is recommended as a preliminary BRT station location. The Rutherford Avenue service lanes narrow here, so the design and configuration of curbside BRT lanes and station will need to be carefully studied.

IDENTIFY STATION CAPACITY REQUIREMENTS

BRT station capacity requirements should be informed by existing travel demand and boarding and alighting patterns along the corridor, as well as by estimated future demand at each stop. Stations with higher boardings, alightings, or transfers may require higher capacity, such as larger boarding platforms to accommodate more passengers comfortably without slowing down the BRT operations. The expected demand at each station will inform its design capacity.

DESIGN STATION-VEHICLE INTERFACE

Any vertical gap between the station platform and bus floor should be minimized. Ideally, the BRT stations and vehicles will allow level-boarding, which is not only more accessible and convenient for many passengers but quicker too.

The horizontal gap between the station platform and bus floor should also be minimized. This is especially important so that wheelchair users and others with limited mobility can easily and safely cross the gap. Common BRT design elements that help minimize the horizontal bus-station gap include:[68]

- **Alignment markers:** A marker on the busway surface and on the bus windscreen can help the driver dock the bus at the station with a minimal vehicle-to-platform gap.
- **Platform edge treatment:** A protective strip along the outside edge of the platform, and possibly the bus, is forgiving of slightly misaligned docking. Several U.S. BRT corridors have implemented Carey fingers, a fringed rubber bumper, on the outside platform edge.
- **Beveled curbs:** A beveled curb can guide vehicles into a docking position close to the platform edge. The curb is hardened and smoothed to reduce wear on vehicle tires.

68 Section 25.8 of the *BRT Planning Guide* explains different methods of interfacing the BRT buses and station platform (ITDP 2021).

DETAIL BRT STATION ARCHITECTURE

The design of the BRT stations can help unify the corridor, make a statement or adhere to a local aesthetic, and act as a neighborhood anchor. BRT stations are often designed with modern and minimalist architecture. Some BRT systems incorporate public art into the stations that may even depict local points of interest or communities. Renderings by architecture firm Utile depict conceptual median-aligned left-side boarding BRT stations on Upper and Lower Broadway (see Figure 8).

Figure 8: Conceptual Everett–Boston BRT Station Designs

Source: Utile

GARAGES

DETERMINE SUITABLE MBTA GARAGE FOR BRT FLEET

New BRT service along the Glendale Square-Haymarket and Chelsea Station–Kendall Square corridors will require space at MBTA bus garages for layovers, recharging/refueling, and maintenance. Especially if the BRT fleet is electric, the MBTA may need to expand existing garages or construct new ones (see Appendix L: Where to Recharge Electric BRT Buses).

If the garage where the BRT buses will overnight is far from the BRT route, it will increase non revenue service hours and in turn require a larger fleet to provide the same service frequency. The draft service plan assumed the BRT buses would charge overnight at the MBTA Southampton Garage, where the five new Silver Line BEBs charge. Having the option to charge overnight at the Everett Main Repair Facility or the Charlestown Garage would reduce non revenue service hours.

Source: Ad Hoc Industries


PARKING
BUS

SUMMARY OF NEXT STEPS:
INFRASTRUCTURE PLANNING

The next steps needed to advance the Everett-Boston BRT Infrastructure Planning are summarized below by key actors.

		ACTORS					
	NEXT STEP: INFRASTRUCTURE PLANNING	**City of Everett**	**City of Boston**	**MBTA**	**MassDOT**	**City of Chelsea**	**City of Cambridge/ Somerville**
ROADWAY AND STATION CONFIGURATION	Define station typologies	●	●	●			
	Select preferred station alignment	●	●	●			
	Select preferred alignment on Upper Broadway	●					
	Select preferred alignment for Chelsea Busway	●		●	●	●	
	Select preferred alignment on Lower Broadway	●					
	Select preferred alignment on Alford Street Bridge	●					
	Promote inclusion of BRT on Rutherford Avenue	●					
	Select preferred design configuration on Rutherford		●		●		
	Choose roadway design for Sullivan-Cambridge corridor		●				●
	Promote inclusion of BRT lanes on North Washington Street Bridge	●	●		●		

	NEXT STEP: INFRASTRUCTURE PLANNING	ACTORS					
		City of Everett	City of Boston	MBTA	MassDOT	City of Chelsea	City of Cambridge/ Somerville
INTERSECTIONS AND SIGNALS	Collect traffic counts and determine intersection delay	●	●				
	Optimize number of traffic signals along BRT corridor	●	●				
	Optimize BRT station locations relative to intersections	●	●				
	Limit turning movements	●	●				
	Plan BRT bus turning movements	●	●	●			
	Optimize traffic signal timing and consider TSP	●	●				
	Design bus priority through Sullivan Circle		●				
STATIONS	Define station typologies	●	●	●			
	Determine station locations	●	●				
	Identify station capacity requirements	●	●	—			
	Design station-vehicle interface			●			
	Design station architecture	●	●				
GARAGES	Determine suitable MBTA garage for BRT fleet			●			

5 TECHNOLOGY

This section addresses the various technology systems incorporated into a BRT system, including fleet, fare system, and traffic signal control and relevant considerations for the Everett–Boston corridor.[69]

FLEET

BRT vehicle selection is complex and depends on a variety of considerations, including operational, legal, institutional, and strategic factors.

VEHICLE SELECTION: BODY DESIGN

DETERMINE VEHICLE BODY SPECIFICATIONS

Using 60-foot articulated buses on the Everett–Boston BRT corridor will increase vehicle carrying capacity and allow a smaller fleet (compared to 40-foot buses) to meet the expected passenger demand. This vehicle type is familiar to the MBTA, as its fleet already includes articulated 60-foot buses on the Silver Line and other high-capacity routes. Because of steep grades on parts of the route, especially in Everett, buses with dual-powered axles would be required for winter travel conditions. In addition, stops and street geometry on other local portions of the route would need to be analyzed for compatibility with 60-foot buses.

DETERMINE DOOR POSITION (LEFT, RIGHT)

The proposed BRT is envisioned with a direct service model in which several BRT routes continue off the busway and service curbside bus stops (see Operations/Service Planning). As a result, all BRT buses will require at least right-hand doors. If the BRT stations are aligned to the inside (right) of the bus-only lanes, then passengers can board through the right-hand doors. Alternatively, if the BRT stations are aligned to the outside (left) of the bus-only lane, the BRT buses will also require left-hand doors. (See section Roadway and Station Configuration for a discussion about the trade-offs between left- and right-side stations.)

DETERMINE NUMBER OF PASSENGER DOORS

The number of passenger doors also needs to be selected—two, three, or four. The MBTA's 60-foot fleet has three doors on the right side, allowing increased passenger flow compared to two doors. There are some examples of 60-foot buses with four doors on each side, notably Van Hool buses operated by AC Transit in Oakland.[70]

69 This technology section borrows heavily from the concepts in ITDP's *Online BRT Planning Guide*. See Volume 5 for more information about BRT vehicles, fare systems, traffic signal control and TSP, and other BRT IT systems (ITDP 2021).

70 Streetcarmike.com (Stauch 2017) lists the various Van Hool buses operated by AC Transit here: http://streetcarmike.com/actransit_vanhool_2000.html

VEHICLE SELECTION: FUEL AND PROPULSION

SELECT A ZERO-EMISSION BUS TECHNOLOGY

Transportation accounts for nearly one-third of Boston's greenhouse gas emissions, and Broadway and Rutherford have among the highest vehicle emissions levels in the region. Massachusetts' most vulnerable populations—Black residents, individuals with lower education, and households with an annual income of less than $20,000—are burdened with exposure to higher concentrations of local air pollutants.[71] To address this inequity, zero-emission buses should be prioritized for this BRT corridor that serves Environmental Justice[72] communities in Everett and Boston.

The MBTA buses that currently connect Everett to Sullivan Square (routes 104, 105, and 109) are diesel-powered, so shifting this corridor to electric-powered transit would result in a net reduction in emissions of local air pollutants and greenhouse gases, helping to address local public health disparities and address climate change.

ITDP examined two types of electric buses for this BRT corridor: battery-electric buses (BEB) and electric trolleybuses. More discussion of the trade-offs between BEBs and electric trolleybuses is available in Appendix L. To summarize the primary considerations for fleet selection:

- **Operational Range.** The battery range of a BEB determines how long it can operate between charges. Other U.S. cities' experience with articulated BEBs underscore that battery technology is improving but not yet meeting transit operational requirements.[73] Electric trolleybuses would require installation of overhead catenary wires, which are infeasible on the Alford Street Bridge but would be unable to continue off-corridor to Cambridge/Somerville as the service plan requires.

- **Fleet procurement.** Converting the fleet to battery buses may require additional fleet. Overnight-charge battery buses may not have enough range to provide a full day of service.[74]

- **Recharging.** With the installation of in-route chargers, BEBs can partially recharge during service, but they will need to fully recharge overnight at a garage with charging infrastructure. Electric buses using opportunity charging facilities at route termini may be feasible for some of the routes[75] served on the corridor and could be studied further. Because of several corridor geometric issues, in-motion charging is not likely appropriate for the Everett–Boston corridor.

- **Winter traction.** MBTA's current 60-foot articulated buses are often removed from service during snowy conditions as they are likely to lose traction and slip.[76] There are some steep grades on the Everett-Boston BRT corridor, so the BRT fleet will require domestically available articulated buses with a second, powered axle to improve safety and performance in winter.

71 Rosofsky et al. 2018.
72 EPA offers more resources about Environmental Justice at: https://www.epa.gov/environmentaljustice
73 Carrigan, Wallerce, and Kodransky 2019.
74 Vaccaro 2020.
75 Especially the 104, which could tie into existing power at both Sullivan and Malden.
76 MBTA and MassDOT 2019.

- **Adequate HVAC power.** Auxiliary diesel- or electric-powered heaters can be added onto BEBs to adequately heat the bus interior during winter.
- **Maintenance costs.** While the cost of electricity will be consistent between BEBs and electric trolleybuses, the two technologies have different maintenance costs. Data from other cities have shown maintenance cost of trolleybuses can differ from that of BEBs, and MBTA's ongoing two-year pilot of five BEBs on the Silver Line should offer insights into their maintenance costs.[77]

The MBTA, City of Everett, and City of Boston need to consider the short- and long-term trade-offs of battery-electric and electric trolleybuses for this corridor.

FLEET SIZE

As explained, decisions about station alignment impact the bus door position (see Roadway and Station Configuration sections). If buses require left-hand doors on the corridor, a new fleet will be required, and the same is true if electric buses are preferred. Low-floor articulated buses with right-hand doors exist in the MBTA fleet and could be reassigned to the Everett–Boston BRT corridor. For instance, as the Green Line Extension makes some existing bus routes redundant, it will free up some of the existing bus fleet for service in other parts of the network.

DETERMINE FLEET SIZE REQUIREMENTS

Fleet requirements need to be determined for the Everett–Boston BRT routes. As the sketch service plan is refined, the number of buses and service frequencies needed to meet the expected passenger demand on each route will be calculated.

The initial BRT service plan includes extending existing bus routes—such as the Silver Line extension to Everett, and continuing the 104/105/109 from Sullivan Square to downtown Boston. Longer and more frequent bus routes would require additional vehicles as well as a place to store, refuel/recharge, and service them.

FARE SYSTEM

The MBTA is currently undertaking the initial steps for a new fare system known as "Fare Transformation" or "AFC 2.0."[78] This project will replace the existing, aging automated fare collection system with a newer system (some of its features, such as the ability to pay single fares with a contactless credit card, are already being put into place). In theory, all-door boarding is planned as part of AFC 2.0 for all bus routes, but the specifics of this implementation have not been decided, and the devil is in the details. For instance, the agency is proposing a distributed network of fare vending

77 Vaccaro 2020.
78 The timeline and scope of MBTA's fare transformation program is explained here: https://www.mbta.com/projects/fare-transformation

machines but does not indicate whether they would be available at every BRT station. Furthermore, MBTA has not concluded how it will enforce proof-of-payment bus fares and how such a policing effort would be made equitable across the system.

TRAFFIC SIGNAL CONTROL AND TSP

The type of transit signal priority desired along the Everett–Boston corridor is active TSP that grants signal priority to all transit buses, not only those that are behind schedule. Among the major stakeholders of this project—MBTA and the cities of Everett and Boston—there is limited experience with this type of TSP.[79] Everett and Boston have discussed implementing TSP along Lower Broadway to improve transit now that the casino is open, and Everett officials suggest that this would not be a major undertaking.

The TSP hardware on the MBTA buses using the BRT corridor will need to be compatible with traffic signal hardware in Everett, Boston, and along the Chelsea busway extension and Silver Line. The TSP protocols used in each location need to be compatible as well. Decades-old traffic systems will likely need to be upgraded. A traffic signal technology inventory along the corridor will clarify possible paths toward effective TSP in a multijurisdictional BRT corridor. This will likely need to be part of a region-wide discussion of signal priority.

Ideally, the TSP would operate seamlessly end to end, even as the BRT corridor crosses municipal boundaries. This will require early coordination and hardware integration between MBTA (which owns the fleet), City of Everett (which owns the traffic signals in Everett), and the City of Boston (which owns the hardware in Boston). DCR will also be an important stakeholder for TSP on bus priority lanes that cross parkways, such as through Sweetser Circle.

Important next steps for advancing TSP along this corridor include:[80]

- [ ] **Early interagency coordination and communication.**

- [ ] **Inventory existing traffic signal and in-vehicle hardware to assess TSP compatibility.** This should include the Everett–Boston corridor, Cambridge/Somerville route alignment, Silverline, and MBTA buses plying routes on these corridors, with the aim of understanding current technology, ownership of the signal hardware, signal phasing, and how to optimize it all for BRT operations.

- [ ] **Review of lessons learned from TSP implementations along other (multijurisdictional) bus and BRT corridors in the U.S.** This ought to include Albuquerque, Richmond, and Hartford.

79 MBTA and the City of Boston have minimal experience implementing TSP along the Silver Line, bus route 57, and the B and C corridors of the Green Line light rail (CTPS 2018). See Appendix I. MBTA's TSP applications have focused only on buses that are behind schedule. Everett's recent efforts to implement TSP in conjunction with dedicated bus lanes along Broadway were hampered by unreliable hardware.

80 CTPS 2018.

SUMMARY OF NEXT STEPS:
TECHNOLOGY

The next steps needed to advance the technology components of the Everett–Boston BRT are summarized below by key actors.

	NEXT STEP: TECHNOLOGY	ACTORS			
		City of Everett	City of Boston	MBTA	City of Cambridge/ Somerville
FLEET	Determine vehicle body specifications	●	●	●	
	Determine door position	●	●	●	
	Determine number of doors	●	●	●	
	Select zero-emission BRT bus technology	●	●	●	
	Determine fleet size requirements			●	
	Identify fleet procurement funding options			●	
FARE POLICY	Ensure MBTA'S Fare Transformation Program supports BRT elements (all door boarding) and equitable fare inspection			●	
TRAFFIC SIGNAL CONTROL AND TSP	Early interagency coordination	●	●	●	●
	Inventory traffic signal and in-vehicle hardware	●	●	●	●
	Review lessons learned from other multijurisdictional TSP applications	●	●	●	●

INTEGRATION

6

The Everett–Boston BRT can be more than corridor infrastructure and buses. It can shape the surrounding built environment, influence travel demand and mode choice, and support sustainable and equitable transit-oriented communities. This depends on the BRT corridor being integrated with other regional transport networks, systems, and services and proactively stabilizing housing. A BRT corridor that is well-integrated with the multimodal network not only improves access but also facilitates easy connections between modes.[81]

MULTIMODAL INTEGRATION

The Everett–Boston BRT corridor should be planned to maximize its connections with the existing MBTA bus and rail networks as well as pedestrian and bicycle facilities. Integration can happen on three levels: physical, fare, and information.

PHYSICAL INTEGRATION

When designing the BRT corridor, it is critical to keep its physical integration with existing transport networks front of mind. Stations and terminals where the BRT routes connect with other MBTA bus and rail services will be most important to design well. Thinking of the passenger's journey between modes can help to identify gaps and confusing or unsafe infrastructure. Integrated transport facilities should include a continuous, accessible pedestrian pathways, safe bicycle facilities and parking, adequate curb access for mobility services, and seamless transfer between modes.

PHYSICALLY INTEGRATE BRT AND OTHER TRANSIT FACILITIES

Sullivan Square is the third-busiest bus transfer node in the MBTA network, so physically integrating the BRT station at Sullivan Square with the other MBTA station facilities will be essential to ensuring passengers can safely and easily transfer to other regional bus routes and the Orange Line.

Other nodes along the BRT corridor where physical integration with existing or planned transportation facilities should be carefully considered include:

- Haymarket Station
- Chelsea Busway extension (which would provide access to the Commuter Rail)
- BRT route to Cambridge's connection with Kendall Square Station
- Community College Orange Line station
- South Station via the City of Boston's Center City Link proposal

81 This section about integrating the BRT corridor into the surrounding community borrows heavily from the concepts in ITDP's *Online BRT Planning Guide*. See Volume 7 for more discussion about the multimodal integration, TDM, and transit-oriented communities concepts introduced here (ITDP 2021).

The physical integration of shared mobility modes (e.g., bikeshare, scooters, TNCs) is also important to think about when designing the BRT corridor and stations (see section Bicycle Connections). For instance, the location of Blue Bike stations along the BRT corridor could be adjusted slightly to make them more convenient for passengers exiting or entering the BRT stations.

FARE INTEGRATION

MBTA's new rollout schedule for the Fare Transformation program may align with implementation of the Everett–Boston BRT. It is unclear if ticket vending machines in the BRT stations will be able to dispense Charlie Cards and tappable Charlie Tickets that facilitate more seamless transfers between the MBTA bus, BRT, and rail networks.

UPDATE FARE POLICY TO ALLOW FREE TRANSFERS BETWEEN BRT AND OTHER MODES

MBTA fare policy will need to be updated to reflect the new BRT fares and permit transfers between the BRT and other bus, rail, and commuter rail routes.

EXPLORE FEASIBILITY OF PAYMENT INTEGRATION BETWEEN SHARED MOBILITY AND TRANSIT

Consider fare integration between Blue Bikes, MBTA BRT, and other transit services. This could include allowing people to rent a Blue Bike with a tap of a Charlie Card, or purchasing MBTA and Blue Bike tickets within the same mobile app.

INTEGRATED PASSENGER INFORMATION

DESIGN BRT PASSENGER INFORMATION AND SIGNAGE

It is equally important for the BRT passenger information to be well integrated with signage and information about other regional transportation services. This should include clear information about transit connections at BRT stations, maps showing the BRT corridor as part of the MBTA network, as well as passenger wayfinding signage directing people to nearby destinations, attractions, and other mobility services. BRT route, operational, and fare information should also be incorporated into MBTA's GTFS feed so that it can be integrated into any third-party trip-planning and transit information apps.

PEDESTRIAN CONNECTIONS

All transit trips begin or end as walking trips, so improving pedestrian accessibility and connections along the BRT corridor is essential. The BRT corridor development creates an opportunity to improve pedestrian accessibility, safety, and connections along Broadway and Rutherford Avenue.

☐ PRIORITIZE IMPROVING ROAD SAFETY ALONG BRT CORRIDOR

In recent years Broadway, Sweetser Circle, and Rutherford Avenue have been the sites of many road crashes and some fatalities each year. As part of the city's Vision Zero commitments, improving road safety for all modes should be a top priority during the design of the BRT corridor infrastructure. While the streets are redesigned to include bus lanes and stations, general traffic speeds can be calmed, and intersections can be redesigned to shorten pedestrian crossing distances and shield pedestrians and bicyclists from motor vehicles.

☐ IDENTIFY GAPS IN THE PEDESTRIAN AND BICYCLE NETWORK TO BE ADDRESSED

There are ample opportunities to improve pedestrian safety, accessibility and comfort in the corridor, especially along Lower Broadway and Rutherford. This may include wider, level sidewalks, curb ramps, and pedestrian crossings at BRT stations. Walking audits with advocates and community members can help highlight places where pedestrian infrastructure can be improved.

In addition, the BRT corridor development can also take the opportunity to enhance connections between the corridor and adjacent walking and bicycle paths and destinations, such as:

- **Encore Harborwalk.** This extension of the Boston Harborwalk is integrated into the Encore Casino via a connection at Alford and Dexter streets.
- **Mystic Crossing.** This bridge in the Lower Mystic fills a gap in the regional bicycle/pedestrian network by helping to complete the 25-mile Mystic Greenway and provides a direct connection between Everett and the MBTA Orange Line Assembly Square Station. The bridge provides a safe bicycle link from a wide swath of Everett, Malden, and beyond to downtown Boston. Encore originally planned to begin construction in 2020 but has faced delays.
- **DCR's Gateway Park in Everett**
- **Draw 7 Park + Path**. A new path connecting Assembly Row with Route 99/ Assembly Square. Owned by the MBTA, DCR led the redesign of adjacent park.

- **Chelsea Busway Multiuse Path.** The 0.5-mile multiuse path parallel to the busway from Box District Station to Eastern Avenue Station in Chelsea could be connected to the Broadway corridor.
- **Paul Revere Landing Park** and the North Bank Bridge to Lechmere.
- **A bicycle/pedestrian link across the Tobin Bridge** has been proposed,[82] and if built, it would require connections to the regional pedestrian network.
- **Assembly Square**
- **Charlestown**
- **Sullivan Square to Somerville via the Inner Belt Area**, connecting to the proposed Grand Junction Path and the under-construction Somerville Community Path.
- **Lechmere** and the Somerville Community Path, which connect to a larger portion of the regional bicycling network.

BICYCLE AND MICROMOBILITY CONNECTIONS

DESIGN SAFE BICYCLE FACILITIES ALONG BRT CORRIDOR

People do currently bike along parts of the Broadway–Rutherford corridor. The redesigned BRT corridor design needs to include high-quality bicycle infrastructure—ideally separated from general traffic lanes—to support the people who currently bicycle and to encourage new bicycle trips, including bike–transit transfers.

There are currently bicycle lanes along the Alford Street Bridge and Broadway that are unprotected except for a short section on Lower Broadway near the casino. There are bicycle markings in the Sullivan Square rotary that were added within the past five years, but these do not make for a safe or pleasant bicycle experience. There are no bicycle facilities along Rutherford Avenue, although they are proposed for the future.

IDENTIFY WHERE BICYCLE AND BRT NETWORKS COMPLEMENT EACH OTHER

The BRT corridor planning process should include an assessment of how the redesigned transit priority corridor fits within the local and regional bicycle networks. As with the pedestrian network, the BRT corridor construction creates an opportunity to enhance bicycle connections between Everett, downtown Boston, and surrounding communities. (See list of critical bicycle connections above.)

82 Daniel 2016.

DECIDE WHETHER TO ACCOMMODATE BIKES ONBOARD BRT VEHICLES

MBTA will need to determine whether or not to accommodate bicycles on board the BRT buses. This could be achieved with external bike racks as on other buses in MBTA's fleet or internal bike racks. Several U.S. BRT corridors allow bikes on board and provide internal bike racks for one to three bikes, including Eugene, Hartford, Los Angeles, and Richmond. Indianapolis's Red Line and Oakland's Tempo corridors also allow bikes on board.

PROVIDE BICYCLE PARKING AT BRT STATIONS

Wherever possible, the BRT station design should accommodate secure bicycle parking. The type and capacity of bicycle parking may need to scale with the BRT station typologies (see Define Station Types) and with bicycling demand.

INTEGRATE SHARED MOBILITY WITH BRT STATIONS

Providing shared mobility (e.g., bikeshare, scooters, TNCs) at or near the BRT stations will help improve first-/last-mile options for BRT passengers and may encourage more linked trips. There are several Blue Bike stations along the corridor, and their locations could possibly be adjusted to make them more convenient for passengers exiting or entering the BRT stations. As the cities of Everett and Boston consider permitting other shared micromobility services, it may be helpful to cordon off space near the BRT station entrances to eventually designate as parking for other dockless shared scooters and bikes.

TRANSPORTATION DEMAND MANAGEMENT (TDM) STRATEGIES

Transportation Demand Management aims to (1) encourage efficient travel modes (that consume less roadway space and energy per passenger-mile) to increase the efficiency of existing infrastructure and (2) shift trips by less efficient modes to off-peak times to reduce congestion.[83] TDM strategies strive to reduce vehicles miles traveled by increasing the variety of travel options, providing incentives and information to encourage people to change their travel behavior, and reducing the physical need to travel with transportation-efficient land uses.

Investment in a BRT corridor is itself a TDM strategy, as it provides a convenient and efficient alternative to driving. The cities of Everett and Boston can also implement TDM strategies that complement the transit investment to further shift travel choices and behavior. Strategies that increase the cost of less-efficient modes or reduce the available supply of roadway and parking infrastructure should be considered in conjunction with the BRT investment.

83 Chapter 32 of the *BRT Planning Guide* includes an explanation of cost-based, supply-based, and supportive TDM strategies (ITDP 2021).

CONSIDER PARKING AND ROADWAY PRICING STRATEGIES

Cost-based TDM strategies aim to make hidden costs of using the roads and parking more explicit for the driver so it's easy to compare the cost of a BRT trip with one in a personal vehicle. Ensuring that on- and off-street parking along the BRT corridor is not free and setting adequate fees can help encourage a shift to more efficient modes such as the BRT. As the Lower Mystic Working Group's modeling revealed, public transit investments like the BRT corridor are more effective when paired with parking reforms such as market-rate commuter parking pricing.[84] The cities of Everett and Boston could reevaluate parking pricing policies along the BRT corridor as a way to encourage more trips to shift to the new transit service.

Traffic congestion can be considered the result of not properly charging for the value of road access.[85] Smart tolling and congestion pricing assess drivers a fee for using limited roadway capacity during peak hours and can be effective at reducing congestion. One potential application for smart tolling along the Everett–Boston BRT corridor is in conjunction with bus-only lanes along the Tobin Bridge. As mentioned in the service planning section, a BRT route could connect Everett to downtown Boston via the Chelsea busway extension and these new Tobin bridge bus-only lanes.

SUPPLY STRATEGIES

Another approach to curbing travel demand and encouraging private vehicle trips to shift to more efficient public transit is to reduce roadway and parking capacity. The recommended design for Rutherford Avenue significantly reduces capacity of the roadway, which is currently underutilized. This allows space on the corridor to be reallocated to more efficient modes like the BRT, bicycling, and walking.

CONSIDER REDUCING ON-STREET PARKING SUPPLY

In order to incorporate dedicated BRT lanes and stations along Upper and Lower Broadway, the narrow existing roadway space needs to be reallocated, often at the expense of on-street parking spaces. Reducing total parking supply along the BRT corridor may also discourage some driving trips and encourage public transit ridership.

The dedicated bus lanes on Broadway require the restriction of roughly 200 parking spaces controlled by the City of Everett during the hours of bus lane operation.[86] MAPC data show that while little parking is in use in Everett during the morning peak, there is higher parking utilization at other times, although at no time does utilization eclipse 75%. Off-street parking opportunities are extremely underutilized and present the biggest opportunity for shared parking programs that can help move cars from Broadway to create room for BRT. An effective parking management strategy could provide spaces in school and other municipal lots and potentially reach out to businesses about using excess spaces in their lots that may not be required during weekday evening rush hour.

84 MAPC and MassDOT 2019.
85 ITDP 2021.
86 MAPC and MassDOT 2019.

In two MAPC studies in 2016 and a Stantec study in 2019[87], there was a finding that overall, parking is most utilized on-street and during the late-morning and early-afternoon hours. In addition to creating a shared parking program, Stantec recommended changing the zoning to reconsider parking minimums in favor of maximums, require data and reporting on trips by mode, and improve connections to existing transit and bicycle facilities[88].

REFORM DEVELOPMENT OFF-STREET PARKING REQUIREMENTS

Off-street parking requirements, or parking minimums, are still prevalent in most American cities, including Everett, which requires two spaces per dwelling unit. As an MAPC inventory of 200 developments in the region concluded, parking is generally overbuilt and underutilized.[89] These excessive minimum parking requirements increase the cost of construction, decrease housing affordability, and incentivize car ownership and driving.

Instituting parking maximums instead of minimums or eliminating parking requirements altogether and leaving it up to developers to decide how much parking the market will bear[90] can be an effective strategy for reducing vehicle miles traveled and encouraging more people to travel by BRT. Somerville recently amended its zoning to mostly eliminate parking minimums and to establish parking maximums near existing and under-construction transit stations.[91] In June 2020, Mayor deMaria introduced a Transportation Demand Management ordinance to City Council.[92] Under this ordinance, developers would receive credits for reducing vehicle dependency, including constructing less on-site parking.

> **"[Everett's] development process has . . . overlooked the fact that half of all trips in Everett are not taken in an automobile and the exorbitant cost of constructing new parking, which can increase the cost of a unit of housing by as much as $100,000."**
>
> **Everett Mayor DeMaria[93]**

87 MAPC 2016b, MAPC 2016c, and Stantec 2019.
88 MAPC 2016b, MAPC 2016c, and Stantec 2019.
89 MAPC's Perfect Fit Parking Initiative (2019) overnight residential parking data showed 3 out of 10 spaces sit unused during peak demand.
90 Schmitt 2017.
91 City of Somerville 2019.
92 DeMaria 2020b.
93 Everett Independent 2020.

OTHER SUPPORTIVE TDM STRATEGIES

CREATE A TRANSPORTATION MANAGEMENT ASSOCIATION

In 2019, the Lower Mystic Regional Working Group's "Planning for Improved Transportation and Mobility in the Sullivan Square Area" recommended a regional transportation management association[94]. A Transportation Management Association (TMA) for the City of Everett has been a recommendation in a number of plans and is currently pending approval of the TDM Ordinance by the City Council. An Everett TMA would provide a platform for businesses and property owners, including developers, to collaborate in offering transportation options to tenants and employees and to create an "economy of scale" for providing services, such as shuttles and ridesharing.

EQUITABLE TRANSIT-ORIENTED COMMUNITIES

Implementing a high-quality BRT corridor can help catalyze economic development if there are opportunities for redevelopment along the transit corridor. Some housing or commercial real estate projects are going to be sited along the Broadway and Rutherford Corridor regardless of the BRT project, but they will certainly benefit from the improved transit access it provides. In other cases, the public investment in BRT can attract new private development to the corridor. Zoning changes that lower parking requirements near BRT stations can suddenly make a residential development financially feasible. Extending the BRT corridor improvements from property line to property line (e.g., upgraded utilities, enhanced sidewalks, and streetscaping) adds value to the corridor, making it more attractive for redevelopment.

As ITDP's jobs-access analysis showed, investing in fast and frequent BRT service between Everett and downtown Boston puts hundreds of thousands of jobs a short commute away from Everett residents. The investment in high-quality BRT will make this corridor a more attractive place for people to live and work, without necessarily needing to own a car. Infill development near the BRT stations will provide more transit-supportive density.

Land-use changes planned for the Route 16 and Lower Broadway corridors are beginning to shift the development patterns toward a more dense, walkable neighborhood. Examples of this include the rezonings for the Lower Broadway Economic Development District and the Commercial Triangle Economic Development District.[95]

TRANSIT-SUPPORTIVE ZONING

Transit-supportive zoning along a BRT corridor can encourage new TOD. In conjunction with the BRT corridor development, cities should review and update their zoning regulations if necessary. Several strategies could be used to attract development along the Everett–Boston BRT corridor that

94 MAPC and CTPS 2019.
95 Daniel 2018 and Domelowicz 2013.

incorporates essential elements of TOD, such as mixed uses and incomes, active ground floors, safe pedestrian and bicycle connections, and minimal parking:

- **Reduce parking supply near BRT** to reduce the cost of construction, increase affordability of new units, and encourage people to rely on transit, walking, and biking instead of driving (see TDM strategies above).
- **Up-zone at least near BRT stations.** Eliminating single-family zoning and replacing it with multifamily zoning increases housing supply and reduces costs, which can support more diverse neighborhoods.
- **Offer height or density bonus near BRT stations.** This can be an attractive incentive that makes a new development financially feasible.

Two FTA programs are potential resources for supporting the development of more TOD along the Everett–Boston BRT corridor:

- **TOD pilot funding program** offers cities technical assistance for implementing TOD near a federally funded transit corridor. The technical assistance has included assessments of local development capacity and potential along a corridor, recommendations for reducing regulatory barriers to TOD, and suggestions for expanding financing strategies (such as TIF) to support TOD. Indianapolis's IndyGo received $320,000 to support TOD planning along its Blue Line bus corridor, and Cleveland's RTA was awarded $336,000 to plan for TOD along its HealthLine.[96]
- **TOD Technical Assistance Initiative** provides online and on-site technical assistance to support transit-oriented development and is administered by Smart Growth America.

UP-ZONE NEAR BRT CORRIDOR OR CITYWIDE

Everett has been a regional leader in planning large-scale housing development[97], which is needed because of a supply–demand imbalance in Boston and the surrounding region. In many cases, the city is planning to permit housing with minimal parking requirements, allowing more units to be built at a lower expense.

Replacing as-of-right single-family zoning with multifamily zoning allows for more residential density. Cities such as Minneapolis and Portland have eliminated single-family zoning citywide in an effort to increase housing supply, drive down housing costs, and create more racially and economically integrated neighborhoods.[98] This could be a strategy to implement in Everett, where most of the neighborhoods within walking distance of Upper Broadway are zoned "Dwelling District," which permits single-family homes or duplexes. More residential density near the Everett–Boston BRT corridor would allow more people to live within walking distance of frequent transit and have convenient access to hundreds of thousands of jobs.

96 Carrigan, Wallerce, and Kodransky 2019.
97 The City of Everett worked with MAPCS to develop a housing production plan that would allow the City to meet its housing goals. These include preserving existing affordable housing and increasing housing that's affordable to low- and middle-income households (MAPC 2016a).
98 Green and Gonzalez 2019.

OFFER HEIGHT OR DENSITY BONUS NEAR BRT STATIONS

Changing zoning ordinances to include a "density bonus" or "height bonus" and grant developers additional height if they include affordable housing, open space, or other amenities[99]is one of the most common ways communities are creating incentives to build more affordable housing. Zoning for Everett's Business District along Broadway restricts maximum building height to four stories.[100] Allowing developers more height for including more than the mandated 15% affordable housing would create more housing near transit that Everett's working-class residents could afford.

For example, Albuquerque's revised development ordinance includes development bonuses for locating near Central Avenue BRT stations. These include a height bonus for locating development along the BRT corridor and additional height bonuses for building workforce housing.[101]

ANTI-DISPLACEMENT, HOUSING STABILIZATION STRATEGIES

The investment in public transit infrastructure and the resulting increases in accessibility often put pressure on the local housing market, driving up demand and prices. For example, a direct trip to Kendall using a BRT route would make the jobs there more accessible to Everett residents by transit (and with bus priority, than car travel as well), although it also may make Everett a more attractive location for highly paid technology workers in Kendall, raising the possibility of gentrification and displacement.

Especially in cities like Everett and Boston with a history of redlining and barriers to homeownership for communities of color, protections need to be put into place early on in the BRT corridor planning process to ensure the investment in transit uplifts rather than displaces the existing and historic residents.[102] While planning its BRT corridor, the City of Everett should proactively implement policies that are effective at stabilizing housing prices and reducing displacement:

- **Enact tenant protections** for residential units, small businesses, and commercial properties in the neighborhoods most at risk for displacement and gentrification. Protections might include rent control and just-cause eviction ordinances.[103]

- **Create more subsidized housing.** A large and stable supply of subsidized housing can reduce displacements. Cities can preserve the affordability of existing housing and accelerate construction of new affordable housing. These strategies are detailed below.

99 For more information about density bonuses and inclusionary zoning see Local Housing Solutions' (2021) Housing Policy Library.
100 City of Everett 2019.
101 Carrigan, Wallerce, and Kodransky 2019.
102 Bates et al. (2017) discuss how transit investments and TOD can also spur gentrification and displacement if affordable housing is lost.
103 Carrigan, Wallerce, and Kodransky 2019.

> **“The cities should continue to utilize land-use policies that promote local accessibility, sufficient density, a mix of uses, and affordable and workforce housing. These policies should involve the preservation of existing subsidized housing, as well as the production of new housing that is affordable to a wide range of income groups.”**
>
> **Lower Mystic Working Group 2019 report (MAPC and CTPS 2019)**

PRESERVE EXISTING AFFORDABLE HOUSING NEAR BRT

In recent years the City of Everett has seen an economic resurgence after several decades of decline and trailing the region. Property values and housing demand have increased as more people who are displaced from rapidly gentrifying places like Somerville move to Everett. This has put a strain on Everett’s housing market and can be felt all throughout the city.

Policies to protect the existing affordable housing must be in place prior to the implementation of BRT. This could include an affordable housing preservation fund (see Appendix M for affordable housing fund precedents) or housing assistance program to ensure existing residents are able to continue to afford living in their homes. Everett should continue to preserve the city’s existing affordable housing through its current programs (Housing Rehabilitation Program, First-Time Home Buyers Program)[104] or new ones.

BUILD MORE AFFORDABLE HOUSING NEAR BRT

Everett’s community leaders, elected officials, and mayor are committed to building more affordable housing and preventing displacement. Affordable housing policies implemented in conjunction with the BRT corridor planning can help Everett meet its affordability goals:

- **Revised inclusionary zoning ordinance.** When Everett required developers to include 20% affordable units, few new developments were built. Fearing that their 20% affordability requirement was scaring developers away,[105] in 2018 the City Council lowered the inclusionary zoning ordinance to require 15% affordable units. The hope is that the revision will encourage more development and incrementally add affordable units.[106]

- Everett and Boston can **allocate vacant publicly owned land** near the BRT corridor for affordable housing.

104 Find more information about Everett’s existing affordable housing programs at: http://www.cityofeverett.com/418/Community-Development-Housing
105 Resnek 2018.
106 Everett Independent 2018.

- **Reducing parking requirements**, especially near BRT stations, can help reduce the cost of development and make including more affordable units financially feasible (see section Reduce Parking Requirements near BRT).

- Creating a **housing trust fund** to finance land acquisition around new transit investments can fund the construction or preservation of affordable housing (see Appendix M). A similar affordable housing trust fund has been proposed in Everett in the city's 2016 Everett Housing Production Plan and in the 2018 Everett for Everyone—a Five-Year Affordable Housing Plan.

SUMMARY OF NEXT STEPS: INTEGRATION

The next steps needed to advance multimodal integration and transit-oriented communities around the BRT corridor are summarized below by key actors.

	NEXT STEP: INTEGRATION	ACTORS		
		City of Everett	City of Boston	MBTA
MULTIMODAL INTEGRATION	Physically integrate BRT and other transit facilities		●	●
	Update fare policy to allow free transfers between BRT and other modes			●
	Explore feasibility of payment integration between shared mobility and transit		●	●
	Design BRT passenger information and signage	●	●	●
PEDESTRIAN, BICYCLE, AND MICROMOBILITY CONNECTIONS	Prioritize improving road safely along BRT corridor	●	●	
	Identify gaps in the pedestrian network to be addressed	●	●	
	Design safe bicycle facilities along BRT corridor	●	●	
	Identify where bicycle and BRT networks complement each other	●	●	
	Decide whether to accommodate bikes on board BRT vehicles			●
	Provide bicycle parking at BRT stations	●	●	
	Integrate shared mobility with BRT stations	●	●	
TDM STRATEGIES	Consider parking and roadway pricing strategies	●	●	
	Consider reducing on-street parking supply	●	●	
	Reform development off-street parking requirements	●	●	
	Create a TMA	●		
TRANSIT SUPPORTIVE COMMUNITIES	Up-zone near BRT corridor or citywide	●	●	
	Offer height or density bonus near BRT stations	●	●	
	Preserve existing affordable housing near BRT	●	●	
	Build more affordable housing near BRT	●	●	

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