

Lowell Regional Transit Authority

Regional Transit Plan

Final Report - August 2015

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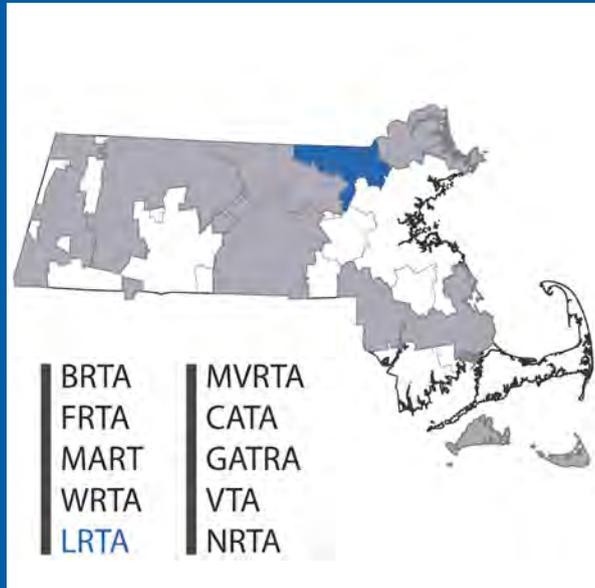
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Executive Summary

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EXECUTIVE SUMMARY

Overview

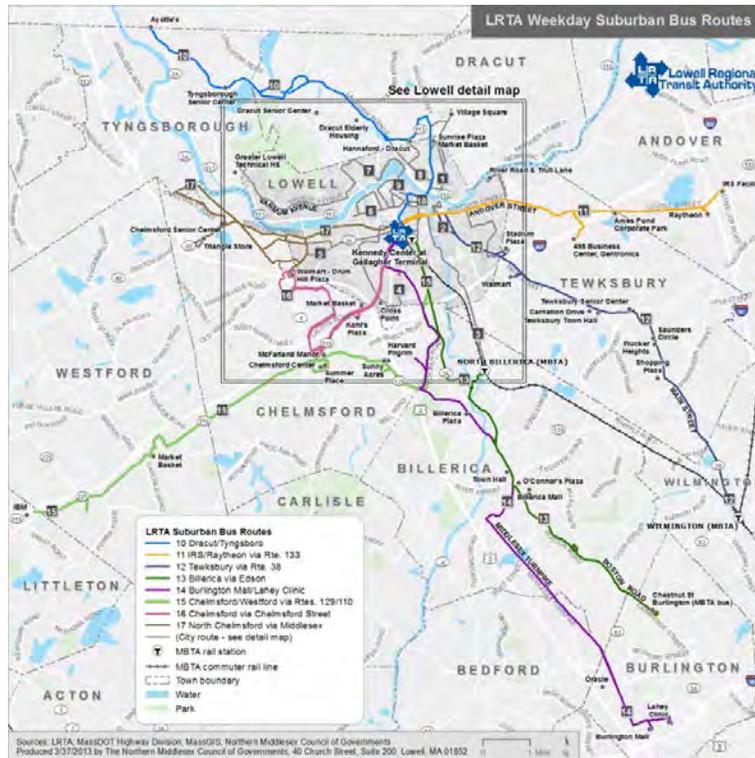
The State Legislature, in response to requirements of the Transportation Finance Bill passed in 2013, tasked each Regional Transit Authority (RTA) in the Commonwealth of Massachusetts to prepare a Regional Transit Plan. The purpose of this plan is to:

- examine existing service
- identify local markets with potential ridership
- provide recommendations on ways to improve service operations.

The consultant firm of AECOM was selected to prepare this plan with assistance provided by Lowell Regional Transit Authority (LRTA), MassDOT, and local stakeholders.

LRTA provides transit service for the cities and towns of Acton, Billerica, Chelmsford, Dracut, Dunstable, Groton, Lowell, Maynard, Pepperell, Tewksbury, Townsend, Tyngsborough, and Westford. Fixed route service is operated in six member communities while Paratransit service is available in all thirteen cities and towns. Figure 1 depicts LRTA's service area.

Figure 1. LRTA Service Area (Weekday)





There are 19 bus routes which operate six days a week with service generally starting as early as 6:00 AM and ending as late as 9:30 PM. With a fleet of 50 vehicles, LRTA operates 9 city fixed-routes, 8 suburban routes, and 1 shuttle service; an additional route is operated on Saturday during the winter holiday season only. LRTA requires 43 buses to operate its weekday service and carries over 1.5 million riders annually.

Recommended Phase Approach

To meet the goals of the plan, recommendations have been made to improve LRTA service over 3 phases, as follows:

Phase 1 recommendations include streamlining service and eliminating redundancy, establishing clock face schedules¹, and improving connections and transfers with MBTA and MVRTA.

Phase 2 seeks to implement limited service on Sundays, expand holiday service routes to year round, and to implement new routes.

Lastly, in Phase 3, frequencies would be improved, service hours would be expanded on Sundays and a new route would be implemented to service Bedford VA, Middlesex Community College, and Billerica Technology Park.

Figure 2 depicts the LRTA service area with the proposed route network based on the recommendations in all three phases.

¹ A clock face frequency is established when a transit timetable offers consistent, frequent service at regular intervals such as 00:15, 00:30, or 00:45 past the hour. These frequencies create an easy to remember timetable for riders.

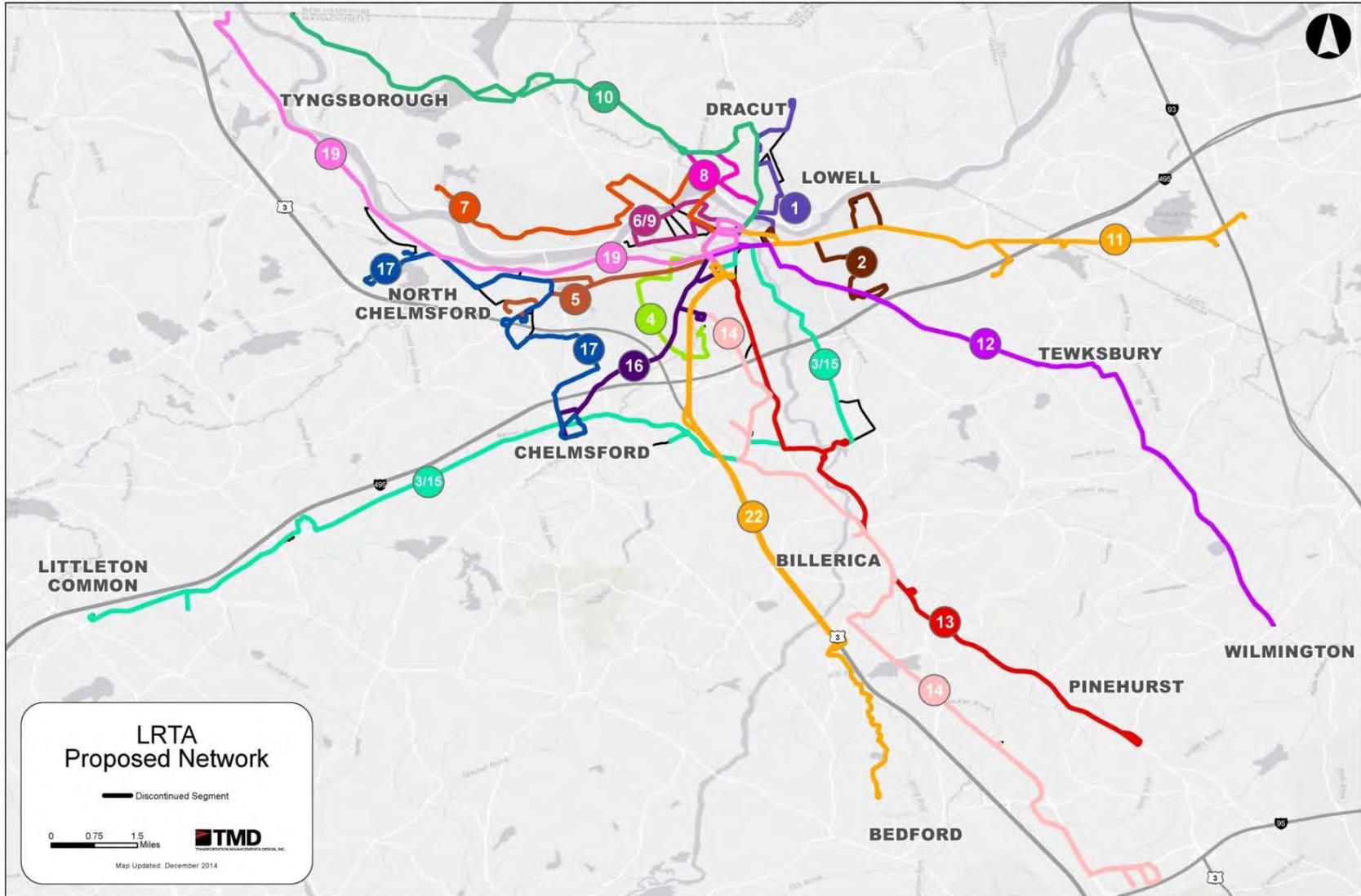


Figure 2. Proposed Route Network



Benefits

Implementing the phased recommendations would provide benefits to LRTA and aid them in meeting their goals and objectives to provide a cost-efficient system while maintaining a high level of service to its riders. The phased service improvements would result in the following benefits:

1. Standardizing headways and implementing clock face frequencies will create a simpler, user-friendly system for LRTA riders.
2. Expanding service to new areas, extending hours of operation to service densely populated areas, shopping and medical facilities, and implementing service on Sunday will expand mobility in the region.
3. Improving route frequencies will provide a higher and more convenient level of service to LRTA riders.
4. Eliminating redundant routes will streamline LRTA's service.
5. Improving connections and transfers with MBTA and MVRTA will improve mobility in the region.

The following are LRTA goals and objectives that have been met through the development and selection of the phased recommendations:

Goal #2: Expand Transit Services

Objective 2.a: Generally 60 minute headway service on approximately 12 routes for fixed routes and complimentary Paratransit service to the Fixed Route service.

Objective 2.b: To offer later night service to corridor routes servicing dense populated areas, shopping and medical facilities.

Objective 2.c: Add service to core routes and economic development areas.

Goal #3: Improve the Current Transit Services

Objective 3.a: Improve frequency of service on high performing routes from 60 to 30 minutes during the weekday and Saturday.

Objective 3.b: To work with other RTAs and the MBTA to further the coordination of inter-regional connections between the LRTA, adjacent RTAs and the MBTA.

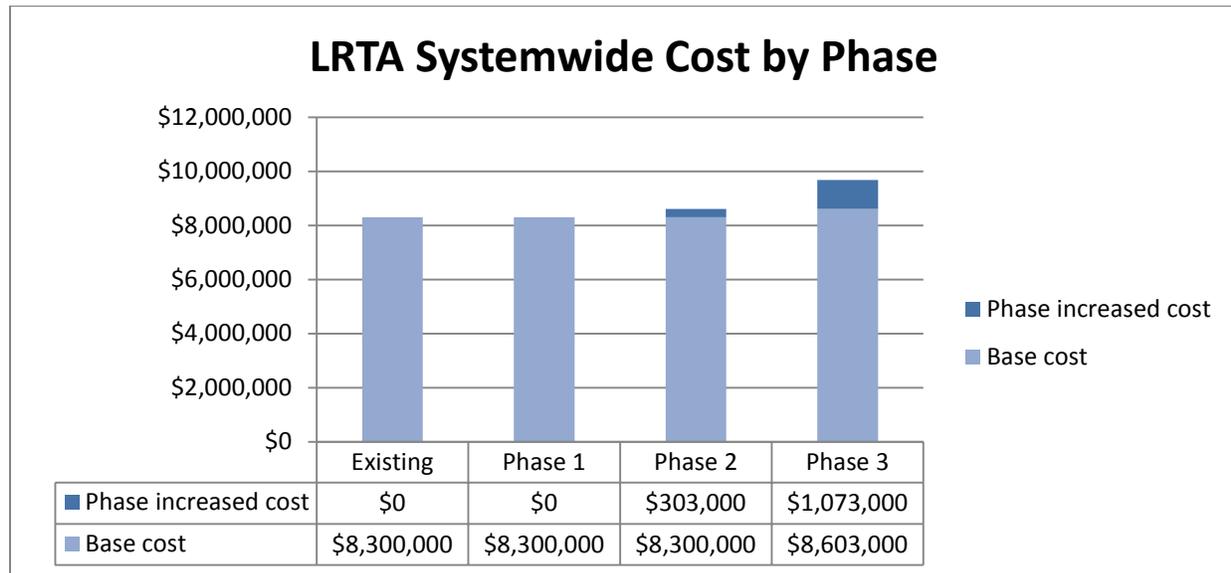
Cost Estimation

With the implementation of each phased recommendation, additional operational and capital improvements would increase LRTA's annual cost. Figure 3 depicts the base operating costs for the existing system along with the additional costs associated with the service improvements in each phase.



LRTA’s existing annual revenue operating hours are 88,700; these hours are expected to change throughout each phase. During Phase 2 annual revenue hours would increase by 3,221 and finally by 11,400 to an estimated 99,400 hours in Phase 3.

Figure 3. Cost by Phase



Capital Costs

Phase 1 service improvements have been designed using the constraint of LRTA’s existing fleet of 50 buses, although only 42 are used for peak service (29 for fixed-route and 13 school trippers). Phases 1 and 2 operate with a reduced peak fleet which requires only 26 and 25 local fixed-route buses, respectively.

Additional vehicles will be required for the recommendations presented in Phase 3. To implement this phase in a timely manner, the LRTA must begin the planning process now as vehicle procurement can take up to two years before the buses can be put into service.

Framework

Recommendations were developed using a cumulative process that incorporated public outreach, a diverse steering committee, operational input from LRTA, and analysis of existing transit service and the local/regional market. Strategies to improve the system were developed based on LRTA’s goals and objectives and the following guidelines:

1. **Simplify** – Routes should be designed along main corridors with minimal schedule deviations. For routes that are not linear, service should be provided in both directions.
2. **Service should match demand** – The denser (both in terms of employment and population) areas should have a higher level of service with either higher frequency routes or multiple lower frequency routes. Major corridors often warrant higher frequencies.



3. **Standardized frequency** – Frequencies should be standardized using clock-face schedules to create 30, 60 and 120 minute headways.
4. **Priority to existing ridership** – Service should be increased in areas that warrant it over servicing new areas if limited resources are available.
5. **Connections** – No route should be designed in isolation. If possible it should connect to at least one hub. Where connections to hubs are not possible the route should connect with at least one other route to facilitate transfers.
6. **Efficiency** – Where possible routes should be designed to be the most efficient. Decisions to deviate off the main corridor and add time to the route are only warranted where key destinations like shopping centers are too far off the main road, there are a lack of pedestrian facilities or the benefit (due to demand) of servicing the deviation outweighs the additional time incurred to others on the route.
7. **Consistency** – Except where warranted by peak only routes or increased peak hour service, service should have consistent headways throughout the day using clock-face schedules.
8. **Regional network** – Regional connections should be improved to provide access outside of the LRTA service area through transfers with other systems such as MVRTA or MBTA, to areas identified as common destinations through the market analysis and public outreach process.

Task Summaries

The Transportation Finance Bill assigned the following nine tasks to be evaluated by each RTA:

Task 1. Comprehensive Assessment of Transit Services

LRTA has identified four goals to help guide service improvements. These goals, as outlined below, have been considered in the development of this Regional Transit Plan.

- Goal 1: Provide 21st Century Fleet and Facilities for its Customers
- Goal 2: Expand Transit Services
- Goal 3: Improve the Current Transit Services
- Goal 4: Maintain a Strong Financial Plan

Task 2. Examination of Ridership Trends

Ridership data collected from FY 2012, 2013, and 2014 was used to analyze yearly transit ridership trends. In FY 2014, LRTA reported 1.49 million passenger trips and averaged 120,000 passengers each month. Use of LRTA's service has fluctuated between FY 2012 and FY 2014; ridership declined by 0.3 percent between FY 2012 and FY 2013 but increased by 6.7 percent by FY 2014. The top three weekday routes that experienced the most growth over this period are Routes 15 (34.5% increase), 12 (20.9% increase), and 14 (20.8% increase), all of these are suburban routes.



Task 3. Performance Analysis of Service

Each route in the LRTA service area was evaluated based on several factors including ridership, passengers per revenue hours, and subsidy per passenger. The top performing routes during the weekday include routes 2, 5, 7, 14 and 18. These routes are top priorities for service investment and may benefit from increased service frequencies or service spans. Routes performing below average may require additional analysis to determine the cause of the problem or may be considered for discontinuation of service.

Task 4. Develop and Evaluate Service Alternatives

Service alternatives for the entire LRTA system were evaluated through a process that incorporated public outreach, a diverse steering committee, operational input from LRTA, and analyses of the existing transit service and local market. Alternatives were guided by the four goals identified by LRTA to improve service. Preliminary alternatives were presented to LRTA at a workshop where they were further refined.

Task 5. Recommendations to Better Align Service

Recommendations for LRTA have been presented through a three phase approach. Phases establish the immediacy and prioritization of needs and are based on an incremental approach and by the availability of resources. Recommendations in Phase 1 can be implemented immediately while recommendations in Phase 2 and 3 can only be implemented as resources become available.

Phase 1 focuses on streamlining service, creating consistent clock face frequencies and enhancing connectivity with MBTA and MVRTA routes. During Phase 2, service is added to previously underserved areas and limited service is implemented on Sundays. Finally in Phase 3, service is expanded on Sundays.

Task 6. Commonwealth's Environmental Policies

GreenDOT's implementation plan, developed in 2012, identifies themes, goals and indicators to guide transportation development to a more sustainable future. An evaluation of LRTA's services was conducted to determine their ongoing compliance with the policy. While there are over 300 short, medium, and long-term indicators, only 68% are applicable to LRTA. Of these applicable indicators, LRTA is already meeting 72% and working towards meeting additional medium-term indicators by 2015 and long-term indicators by 2020.

Task 7. Fare Rates and Collection Methods

In November 2011, LRTA installed a Scheidt & Bachmann Fare Collection system on fixed route buses which offers SmartCard capabilities and is interoperable with CharlieCard. There is currently no financial incentive for using the SmartCards over cash fares. The last fare increase occurred in 2002 and implementing a new increase is currently being evaluated. A local adult fare costs \$1.00, although the adult fare on a suburban route costs \$1.50; local transfers are \$0.25 and suburban transfers are \$0.50. Moving forward, LRTA should explore new technology, such as mobile payments or Bpay/Magic Band/Uband, to replace outdated fare collection methods.



Task 8. Region's Job Creation Goals and Employment Needs

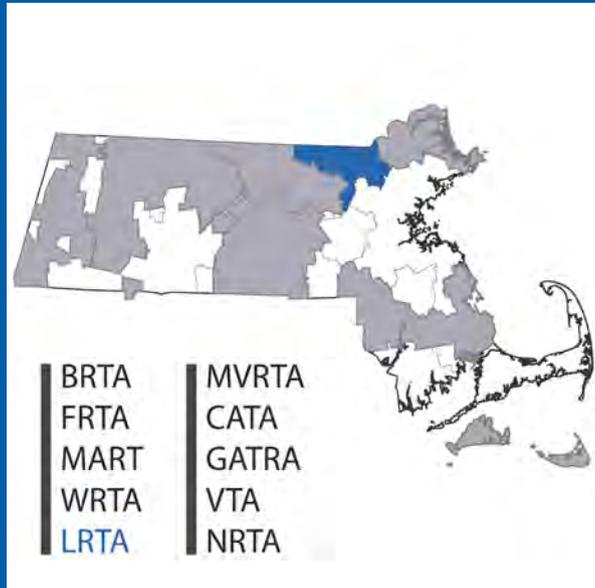
LRTA is experiencing a transition from an economy that was once strongly supported by manufacturing to now one that is more service-based. As of June 2013, the region consisted primarily of industries in the service-providing domain and these establishments have increased 3.6% since 2011. Service-providing industry establishments outnumber goods-producing industry establishments by 5 to 1. The greatest growth in establishments has occurred in the Education and Health Services sector which has experienced an increase of 153.4%. In terms of employment, several sectors have increased the average number of people employed including construction (11.0%), goods-producing industry (4.2%), service industry (2.5%), although the information sector experienced a 23.1% decrease in employment. Understanding the region's employment sector will allow LRTA to provide a better level of service to workers in the region.

Task 9. Determination of Effectiveness of LRTA Service to Meet the Needs of the Region's Workforce

The following indicators were used to identify demand levels across the region: population density, employment density, elderly populations, zero vehicle households, median household income, disabled households, schools, colleges and universities, hospitals, priority development areas, park and ride lots, and commuter rail. The analysis revealed that LRTA provides fixed-route service to all areas with highest transit demand. Areas in Maynard and Acton exhibit a higher demand for transit and are currently receiving service through the MassDOT/LRTA jointly funded Crosstown Connect TMA. There is also an area in Billerica that has the potential for future demand with the development of a priority growth area. If this area is developed service should be explored. Lastly the communities of Townsend and Pepperell have a higher demand surrounding certain areas. It would be difficult for LRTA to service these communities with fixed routes as they are not located near Lowell. If these communities were to approach LRTA about service, LRTA would have to obtain a new contract with a local operator to provide the service.

The Northern Middlesex Council of Governments identified priority development areas (PDAs). The following towns have identified priority economic development areas: Billerica (11), Chelmsford (11), Dracut (7), Lowell (28), Pepperell (7), Tewksbury (4), Tyngsborough (3) and Westford (2). The majority of the PDAs are currently serviced by LRTA routes.

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Chapter 1

Project Overview

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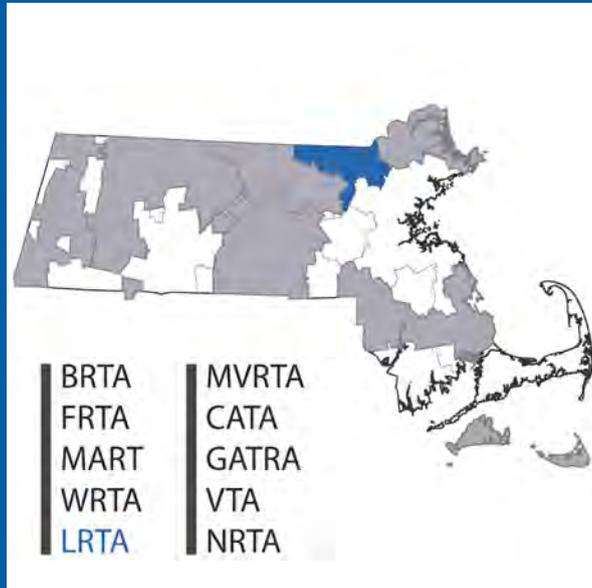
1. PROJECT OVERVIEW

The State Legislature has instructed all Regional Transit Authorities (RTAs) in the Commonwealth of Massachusetts to undertake the preparation of a Regional Transit Plan as a requirement of the Transportation Finance Bill passed in 2013. These Regional Transit Plans present an opportunity to improve local bus service operations, identify new markets of service opportunity, and meet the identified needs for public transit services in each respective RTA service area. Section 63 of the Bill notes nine discrete tasks that each Regional Transit Plan must address. These tasks are as follows:

- (1) Comprehensive assessment of transit services
- (2) Thorough examination of the ridership trends for each line and service provided by the regional transit authority
- (3) Performance analysis of existing services
- (4) Development and evaluation of alternative service scenarios
- (5) Development of a recommendation to better align service with local and regional demand
- (6) Commonwealth's environmental policies
- (7) Fare rates and collection methods
- (8) Region's job creation goals and employment needs
- (9) Determination of whether the regional transit authority's service is deployed in the most effective way possible to accommodate the transit needs of the region's workforce.

Each RTA is also required to hold a public hearing on the draft relating to the development of its Regional Transit Plan in order to inform the public and gather their input.

The Lowell Regional Transit Authority has prepared this Draft Regional Transit Plan in accordance with the Transportation Finance Bill.



Chapter 2

Project Purpose

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2. PROJECT PURPOSE

2.1 LRTA Overview

The Lowell Regional Transit Authority (LRTA) began operations in late 1976 pursuant to the provisions of Chapter 161B of the General Laws of the Commonwealth of Massachusetts. The Authority is given general responsibility to develop, finance and contract for the operation of Mass Transportation facilities and services. The LRTA originally comprised the City of Lowell, Billerica, Tyngsborough, Chelmsford and Dracut. Since the early 1980's to now, it has grown and expanded to 13 cities and towns including Tewksbury, Carlisle, Groton, Acton, Townsend, Dunstable, Maynard, Pepperell and Westford. The LRTA, through its management companies, operates Fixed Route Service in six communities and Paratransit Services with its Road Runner on local Council on Aging's in all 13 towns. The LRTA operates 19 bus routes, 50 Fixed Route buses 6 days a week.

The LRTA has its main operations and maintenance center for Fixed Route at 100 Hale Street in Lowell and also operates the Gallagher Intermodal Center which comprises three parking garages totaling 1,000 spaces, an office and maintenance center for its Paratransit operations, along with a terminal for bus and rail passengers. Adjacent to the Gallagher Terminal is the Kennedy Bus Center which comprises 13 bays for LRTA Fixed Route Operations.

The affairs of the LRTA are managed by an Administrator who serves as the CEO and who is appointed by the Advisory Board. The Advisory Board consists of the City Manager of the City of Lowell and the Chairman of the Selectman or designee from the other cities and towns of the authority. The Advisory Board is responsible for general policy matters, the approval of the Annual Budget and any changes in fares and substantial service changes.

The LRTA has an Operating Budget of approximately \$10 million and a yearly Capital Budget ranging from \$3 to \$10 million per year. The LRTA carries approximately 1.5 million riders annually.

2.2 Core Goals and Objectives

In April 2013, representatives from several RTAs were asked what they wanted their Regional Transit Plans to accomplish. Ideas were developed and ranked by these representatives to create a core list of goals and objectives for each RTA's Regional Transit Plan. The most highly-rated concepts – and those to which each of the Regional Transit Plans will respond – are as follows:

- Better align service with needs
- Improve efficiency and cost-effectiveness of system
- Improve transit access for the public
- Increase ridership levels
- Increase transit frequency and service options
- Increase revenue



- Improve transit access for transit-dependent populations
- Support economic development

While goals outline priorities, objectives are measurable actions that are necessary to realize the goals. The above list can be broken down as follows:

Table 1. Core Goals and Objectives

Goals	Objectives
<ul style="list-style-type: none"> • Increase ridership levels • Better align service with needs • Support economic development • Increase revenue 	<ul style="list-style-type: none"> • Increase transit frequency and service options • Improve transit access for the public • Improve transit access for transit-dependent populations • Improve efficiency and cost-effectiveness of system

It should be noted that goals and objectives that were ranked favorably by individual RTAs but did not receive an overall high ranking will still be considered in the Regional Transit Plan for those authorities. Section 2.2 explains the goals and objectives that are specific to LRTA.

2.3 LRTA Goals and Objectives

In addition to responding to the core goals and objectives outlined in Section 2.1, the Regional Transit Plan for LRTA is also based on concerns related to their system. This document highlights the mission, goals, and objectives of the RTA.

Mission Statement:

The LRTA’s mission is to provide the highest quality of public transportation service to the Greater Lowell area which is safe, convenient, affordable, accessible and on schedule.

Goal 1: Provide 21st Century Fleet and Facilities for its Customers

The LRTA will look to operate state-of-the-art fleets, facilities and infrastructure in order to provide superior service to its customers and leverage best practices nationwide.

Objectives:

1. Ensure that the LRTA Bus and Paratransit Fleets are modern, safe, accessible and in a state of good repair.
2. Maintain and improve service reliability, the preventative maintenance schedules and a mid-life overhaul program.
3. Provide a fleet that continually improves vehicle mileage and reduces carbon dioxide emissions.
4. Pursue alternative bus technologies such as compressed natural gas (CNG), electric and hybrid electric for the 21st Century.



5. Maintain and upgrade all LRTA facilities to a 21st Century condition. This includes the Gallagher Intermodal Center, parking garages, Kennedy Bus Hub and operation and maintenance centers.

Goal 2: Expand Transit Services

The LRTA will look to potentially offer a Sunday service to the Greater Lowell area and improve regional connections.

Objectives:

1. To offer Fixed Route/Paratransit Service on Sundays similar to the services operated on Saturdays. Generally 60 minute headway service on approximately 12 routes for fixed routes and complimentary Paratransit service to the Fixed Route service.
2. To offer later night service to corridor routes servicing dense populated areas, shopping and medical facilities.
3. Add service to core routes and economic development areas.

Goal 3: Improve the Current Transit Services

The LRTA will continually look to improve daily and Saturday service. Additionally, the LRTA will look to potentially offer a Sunday service to the Greater Lowell area and improve regional connections.

Objectives:

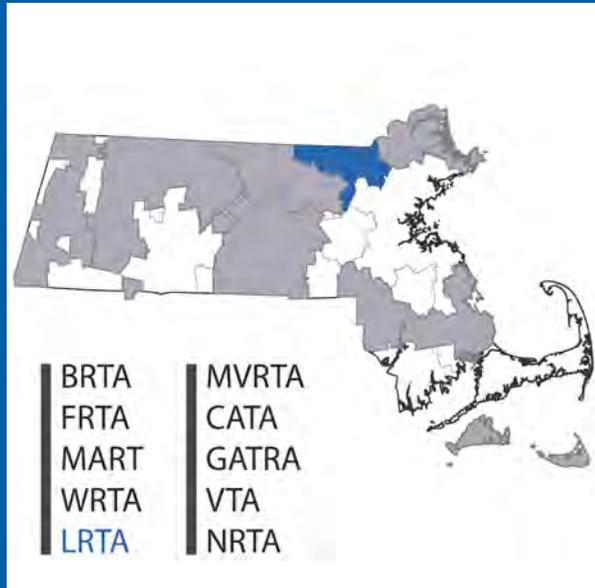
1. Improve frequency of service on high performing routes from 60 to 30 minutes during the weekday and Saturday.
2. To work with other RTAs and the MBTA to further the coordination of inter-regional connections between the LRTA, adjacent RTAs and the MBTA.

Goal 4: Maintain a Strong Financial Plan

The LRTA has maintained a strong financial plan during its tenure. This is the result of a conservative approach, which carefully monitors revenue versus expenditure. The LRTA is also multi-funded and has a multiple of sources for its revenues. The future will require the same approach so that if a source of funding is reduced or delayed another can help minimize any impact.

Objectives:

1. Maintain a strong balance of funding from all local, state and federal sources.
2. Maximize all non-fare income. Included within this area is parking revenue, rents at Gallagher Terminal, vending machines and bill board opportunities.
3. Periodic adjustments to fare revenue as required.



Chapter 3

Performance Analysis

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3. WRTA RIDERSHIP AND RIDERSHIP TRENDS

3.1 Service Overview

The Lowell Regional Transit Authority (LRTA) provides transit service to a population of 330,000 people. The LRTA service area is composed of 13 communities: Acton, Billerica, Chelmsford, Dracut, Dunstable, Groton, Lowell, Maynard, Pepperell, Tewksbury, Townsend, Tyngsborough, and Westford. LRTA also provides paratransit service to eligible individuals. All routes operate to and from Lowell, with the majority of the routes serving the Union Station Hub.

LRTA runs two types of service: fixed-route service and ADA paratransit service. LRTA operates 18 routes: 9 city fixed-route, 8 suburban services, and 1 shuttle service. In addition, LRTA runs one Saturday-only route during the winter holiday season. Of the 19 routes, 18 run on weekdays, 18 run on Saturdays, and none run on Sundays. LRTA maintains a fleet of 50 vehicles, and requires 43 buses for weekday services.

Table 2 provides an overview of services provided by LRTA.

Table 2. LRTA Route Guide

Route	Service Type	Description	Days Operated	Weekday Service Span	Weekday Service Frequency	Saturday Service Span	Saturday Service Frequency
1	City	Christian Hill	Mon-Sat	6:45 AM - 6:45 PM	60	8:00 AM - 5:30 PM	60
2	City	Belvidere	Mon-Sat	6:15 AM – 8:15 PM	30	7:45 AM – 6:15 PM	60
3	City	South Lowell	Mon-Sat	6:00 AM – 6:30 PM	30/60	8:00 AM – 5:15 PM	60
4	City	Highlands via Stevens	Mon-Sat	6:15 AM – 6:30 PM	30/60	See Route 3	
5	City	Westford Street	Mon-Sat	6:00 AM – 8:30 PM	30	7:45 AM – 6:15 PM	60
6	City	Broadway / UMass Lowell	Mon-Sat	6:00 AM – 6:00 PM	35	8:00 AM – 5:15 PM	60
7	City	Pawtucketville / UMass Lowell North	Mon-Sat	6:00 AM – 9:00 PM	30	7:45 AM – 6:15 PM	60
8	City	Centralville	Mon-Sat	6:15 AM – 8:00 PM	30/60	See Route 1	
9	City	Lowell Circulator	Mon-Sat	6:15 AM – 8:30 PM	40	See Route 6	
10	Suburban	Dracut / Tyngsboro	Mon-Sat	6:30 AM – 7:30 PM	60	8:30 AM – 6:15 PM	60



Route	Service Type	Description	Days Operated	Weekday Service Span	Weekday Service Frequency	Saturday Service Span	Saturday Service Frequency
11	Suburban	IRS/Raytheon via Route 133	Mon-Fri	4 trips		4 trips	
12	Suburban	Tewksbury via Route 38	Mon-Sat	7:00 AM – 7:00 PM	60	7:00 AM – 5:45 PM	60
13	Suburban	Billerica	Mon-Sat	6:30 AM – 7:00 PM	30/60	7:30 AM – 5:00 PM	60
14	Suburban	Burlington Mall / Lahey Clinic	Mon-Sat	6:00 AM – 8:00 PM	60	8:00 AM – 5:45 PM	60
15	Suburban	Chelmsford / Westford via Rte. 129/110	Mon-Sat	6:00 AM – 8:00 PM	90	8:00 AM – 5:45 PM	90
16	Suburban	Chelmsford Center via Chelmsford St.	Mon-Sat	6:15 AM – 8:30 PM	40/90	8:00 AM – 5:30 PM	60
17	Suburban	North Chelmsford via Middlesex	Mon-Sat	6:00 AM – 7:00 PM	60	8:00 AM – 5:45 PM	60
18	Shuttle	Downtown Shuttle	Mon-Sat	5:30 AM – 9:30 PM	15	7:15 AM – 7:00 PM	30

3.2 System Ridership

LRTA’s annual ridership was 1.40 million passengers in FY 2012, 1.39 million in FY 2013, and 1.49 million in FY 2014. Ridership declined by 0.3 percent between FY 2012 and FY 2013 but increased 6.7 percent between FY 2013 and FY 2014.

Figure 2 shows average LRTA monthly ridership. LRTA averages 120,000 passengers each month. Average monthly ridership increased in FY 2014 after an increase in the amount of provided service. Large variations in ridership occur over the year, with lower ridership during the summer months and higher ridership in the fall and spring, coinciding with the school year. This is partially attributed to the additional school tripper service LRTA provides for Lowell High School. These are timed to bell times and only run when school is in session. In addition, UMass Lowell is served by two routes which supplement transit service provided by the university.

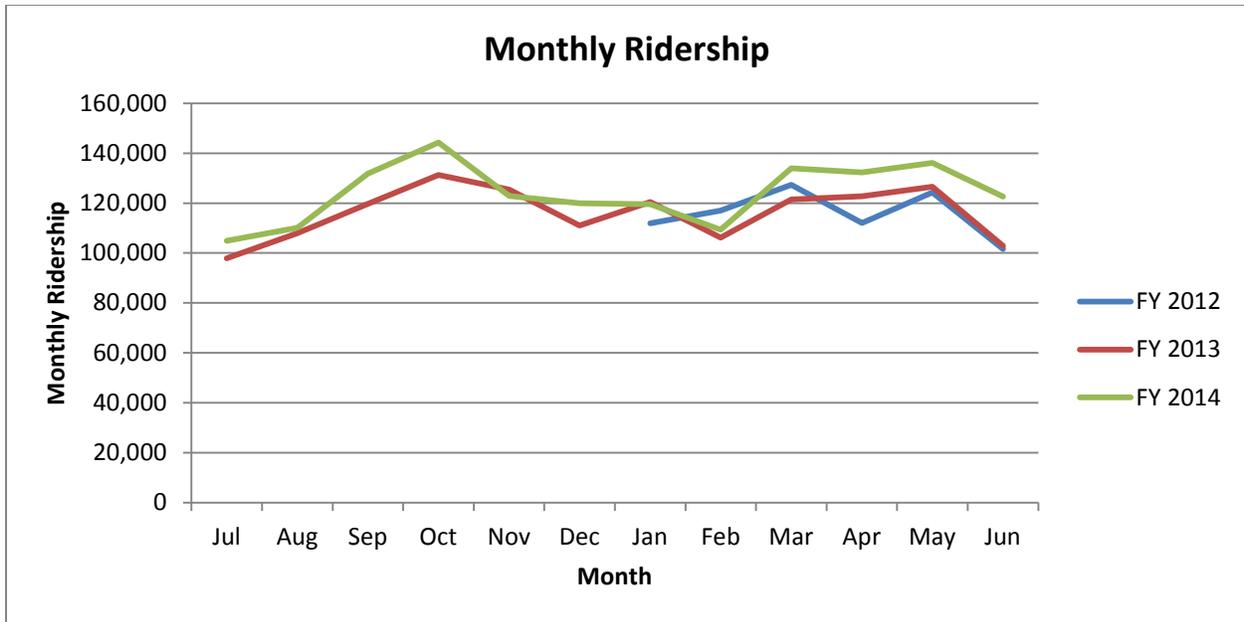


Figure 2. LRTA Monthly Ridership

3.21 Weekday Ridership

Average daily weekday system ridership is 5,300 passengers. Routes 7, 5, and 2 had the highest weekday ridership for city routes, while Route 14 had the highest ridership of the suburban routes. Route 18, the Lowell Downtown Shuttle, is also a strong performer at 605 passengers per day. Figure 3 shows the average weekday ridership by route for FY 2014. At an average of 318 passengers per day, city routes performed better than suburban routes which averaged 243 passengers per day.

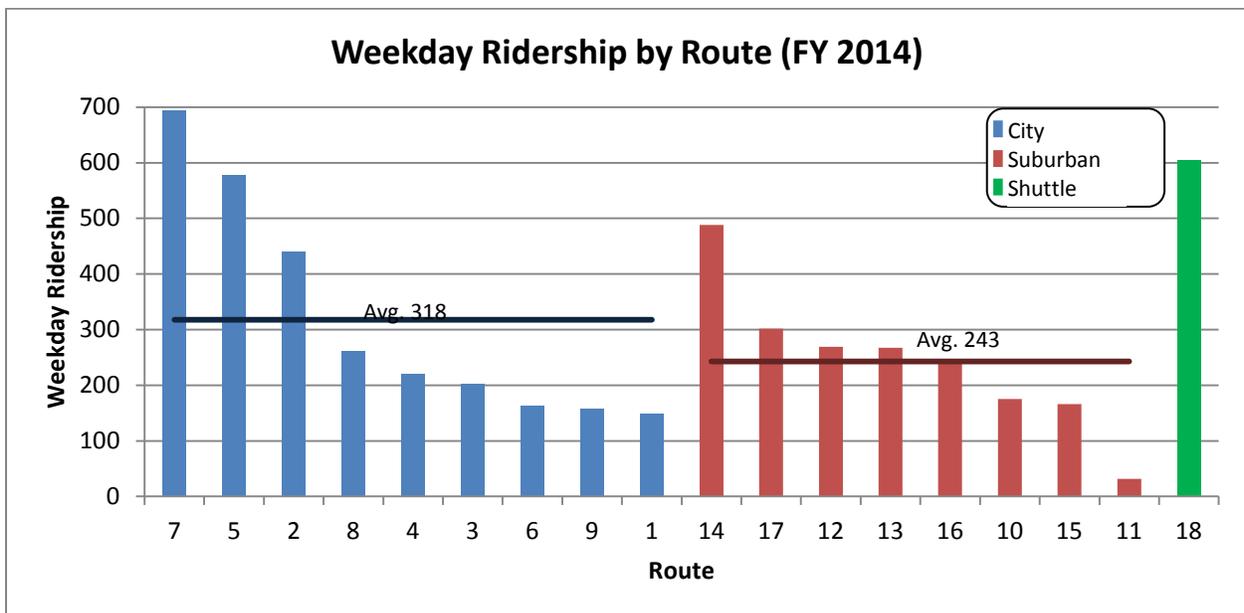


Figure 3. LRTA Weekday Ridership by Route (FY 2014)



Figure 4 shows the percent change in daily average ridership from FY 2012 to FY 2014 for routes in operation during all three fiscal years. City routes varied in ridership changes, with three routes increasing ridership, two routes having no change in ridership, and four routes decreasing ridership. All but one suburban route increased ridership, with the largest ridership gain occurring on Route 15 at 34 percent. The Downtown Shuttle increased in ridership over the three year period as well.

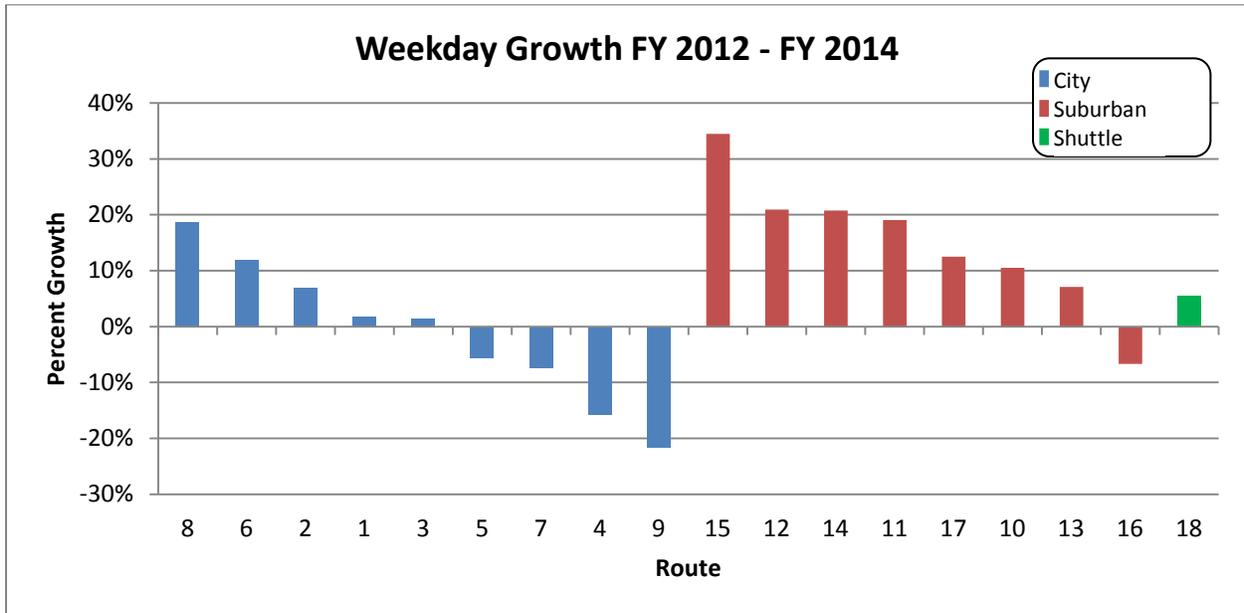


Figure 4. LRTA Weekday Ridership Growth, FY 2012 to FY 2014

3.22 Saturday Ridership

Ridership is lower on Saturdays than on weekdays. Saturday ridership averages 1,900 passengers or 37 percent of weekday ridership. With lower demand for service, some routes are combined to optimize service efficiency. These routes serve most segments of geographically-adjacent weekday routes through one-way loops. As with weekday service, Routes 7, 5, and 2 had the highest ridership for city routes, while Route 14 had the highest ridership for suburban routes. Figure 5 shows average Saturday ridership by route.

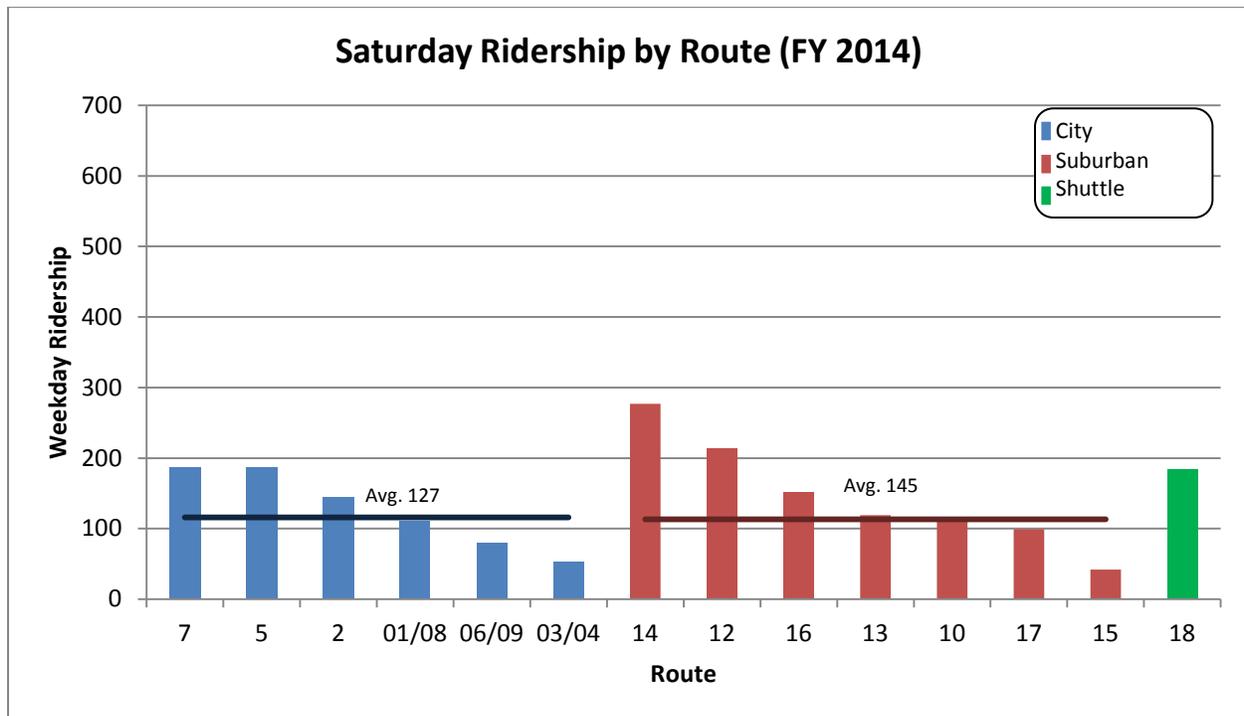


Figure 5. LRTA Saturday Ridership by Route

Like weekday ridership, Saturday ridership increased overall from FY 2012 to FY 2014. Saturday ridership growth is shown in Figure 6. All routes in the system experienced ridership gain on Saturdays with the exception of Route 5, which experienced a nine percent drop in ridership from FY 2012 to FY 2014. Saturday ridership grew considerably more compared to weekday ridership, with interlined routes in Lowell all more than doubling ridership over FY 2012 – FY 2014. This is likely due to the January 2013 service increase on interlined Saturday routes from service every 120 minutes to every 60 minutes. Suburban routes all increased ridership over the three year period as well. Note that Route 15 is not included in this comparison as this route recently added Saturday service in April 2014. The largest growth on Saturdays was interlined Routes 1 and 8 with 197 percent growth.

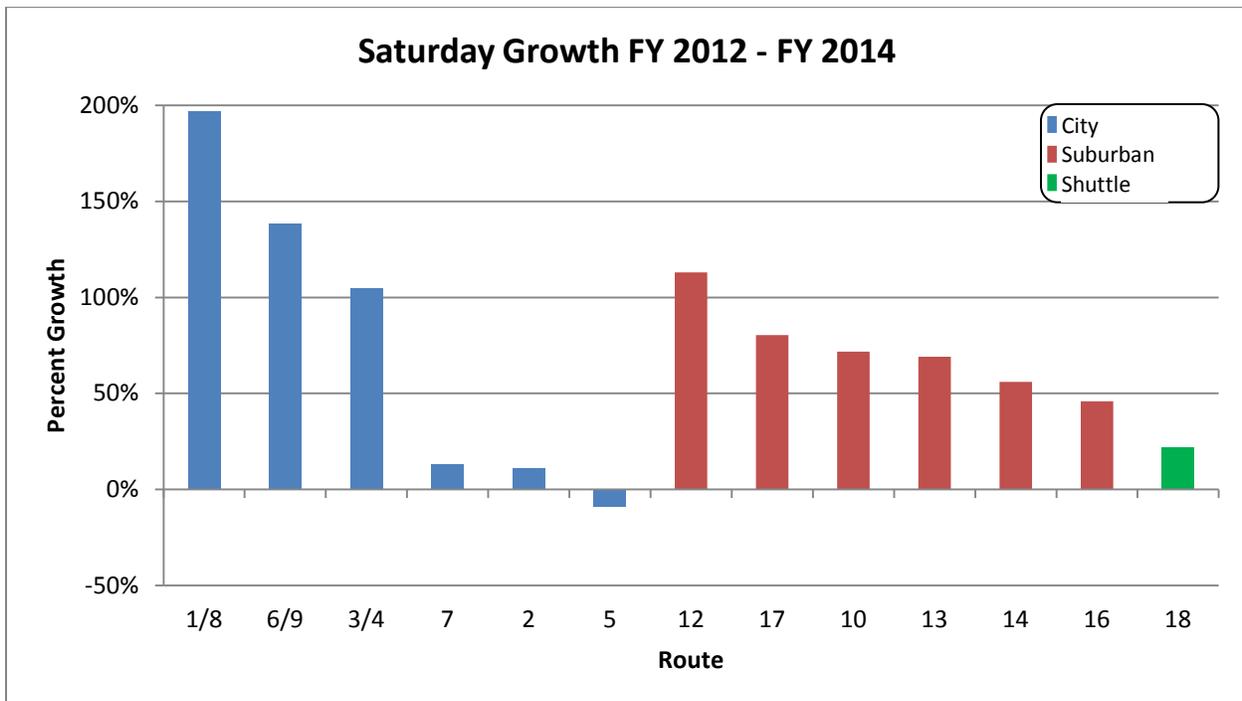


Figure 6. LRTA Saturday Ridership Growth, FY 2012 to FY 2014

3.3 Service Operations

3.31 Revenue Hours

LRTA operates 88,000 revenue hours each year with a projected quarterly average of 22,000 hours, as shown in Figure 7. Saturday service was expanded in January 2013², and weekday service was expanded in August 2013³, which constituted the majority of increased revenue hours seen for FY 2014. Revenue hours were unchanged from FY 2012 to FY 2013 and increased 12 percent from FY 2013 to FY 2014, for an overall increase of 12 percent from FY 2012 to FY 2014.

² Saturday service frequencies improved on suburban routes to every hour from every 80-120 minutes.

³ Weeknight service span expanded on all day routes during the evening, with each route adding one to three trips. Route 18 service expanded to 9:30 PM.

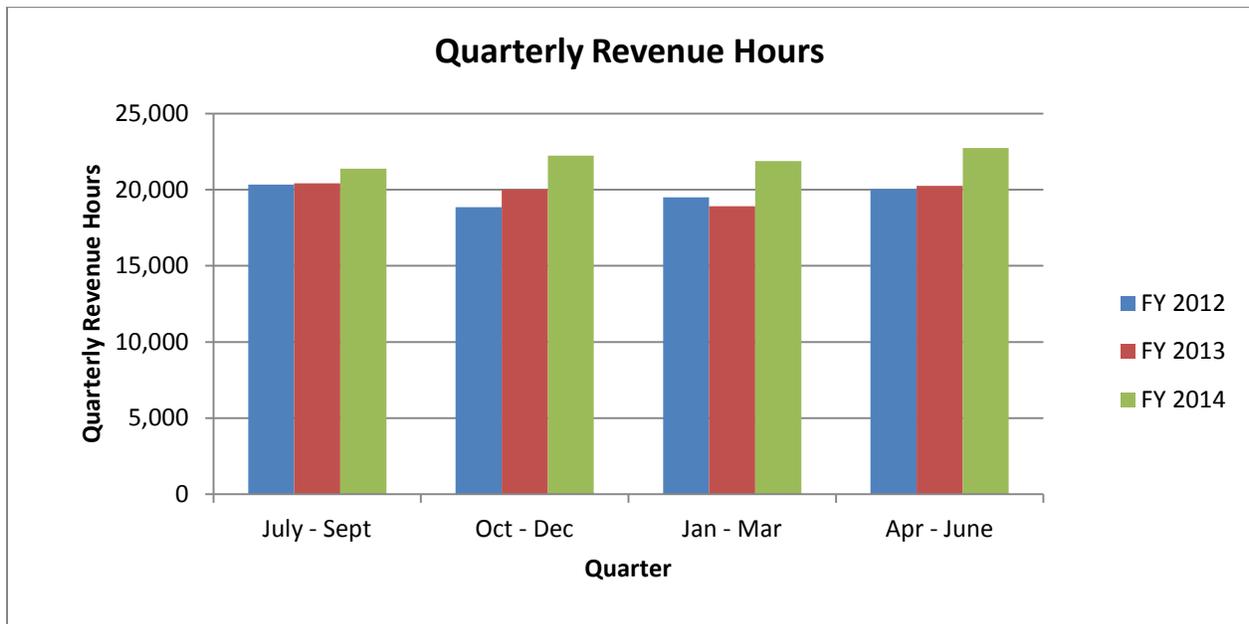


Figure 7. LRTA Quarterly Revenue Hours

3.32 Revenue Miles

An increase in revenue miles follows an expansion in revenue hours. Revenue miles increased one percent from FY 2012 to FY 2013 and 13 percent from FY 2013 to FY 2014, for an overall increase of 15 percent from FY 2012 to FY 2014. Figure 8 shows the quarterly trends in revenue miles for the past three fiscal years.

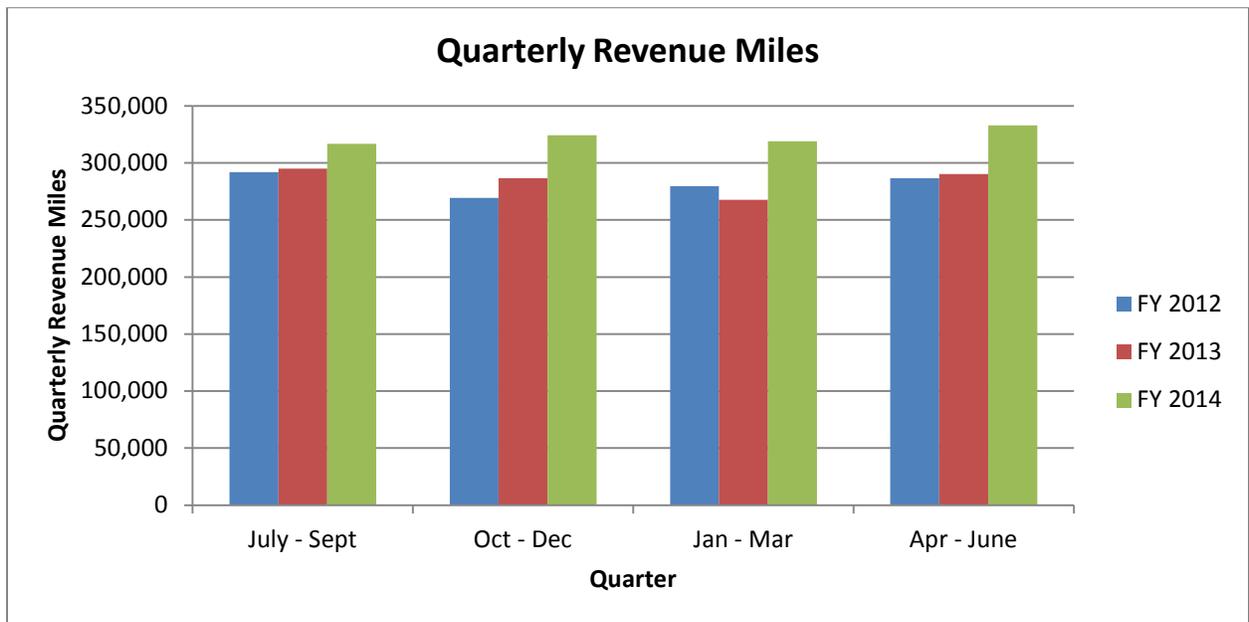


Figure 8. LRTA Quarterly Revenue Miles



3.33 Operating Costs

LRTA operations cost \$8.3 million annually with a quarterly average of \$2.1 million. According to 2012 NTD reporting data, LRTA had an hourly operating cost of \$93.98 per revenue hour. Figure 9 shows the quarterly trends in operating costs for the past three fiscal years.

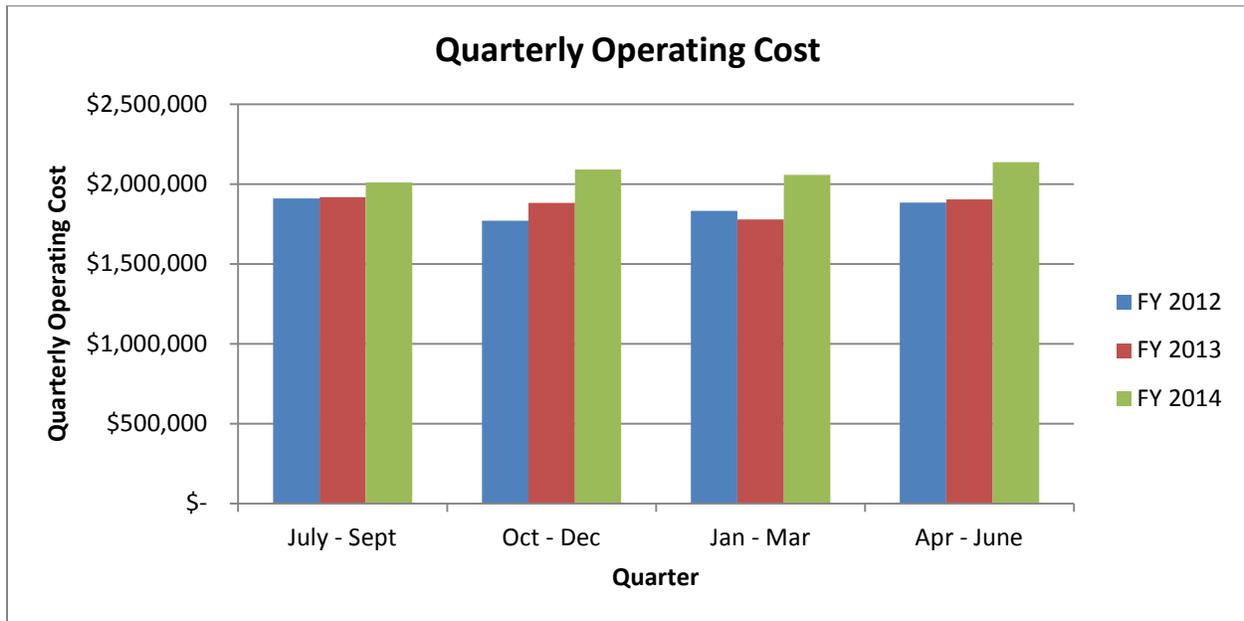


Figure 9. LRTA Quarterly Operating Costs

3.4 Service Productivity

3.41 System Productivity

Productivity measures the ridership generated per unit of service – in this instance, revenue hours of service – and provides an understanding of the effectiveness of a route or transit network. LRTA has seen declines in service productivity on a revenue hour basis. Productivity was 17.5 passengers per revenue hour in FY 2012, 17.5 in FY 2013, and 16.8 in FY 2014, shown in Figure 10. The lower productivity in FY 2014 is attributed to the service increase in August 2013.

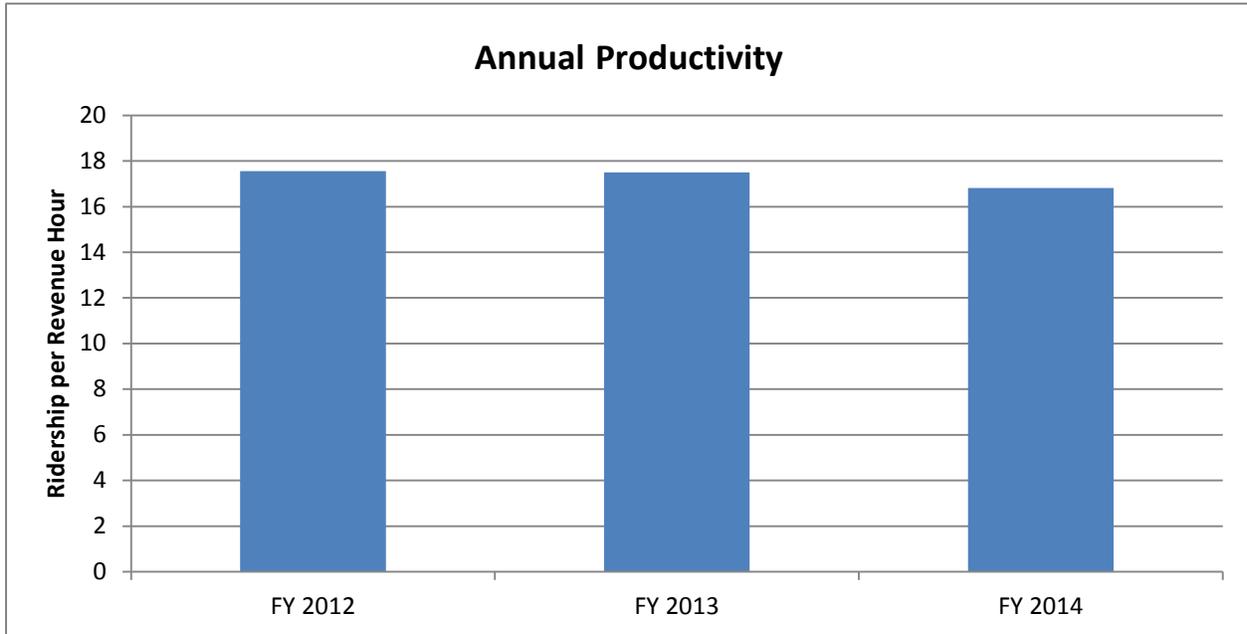


Figure 10. LRTA Annual Ridership per Revenue Hour

3.42 Weekday Productivity

LRTA routes exhibit a wide range of performance as shown in Figure 11. City routes have an average weekday productivity of 18.9 passengers per revenue hour, while suburban routes average 13.0 passengers per revenue hour. The Downtown Shuttle, Route 18, averages 20.3 passengers per revenue hour. The route with the highest productivity is Route 5 with 33 passengers per revenue hour while the least productive route is Route 10 with 8.6 passengers per revenue hour. Route 7 had the highest ridership in the system, but ranked second in productivity, while Route 5 was the most productive route with the second highest ridership in the system.

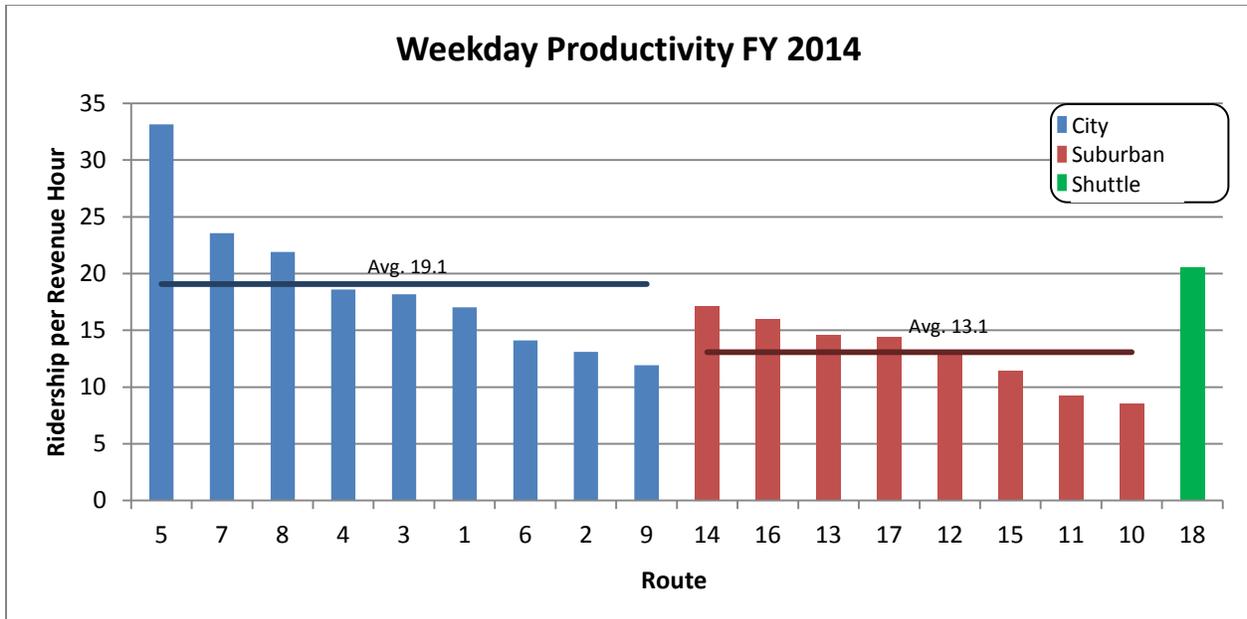


Figure 11. LRTA Weekday Productivity by Route

Figure 12 shows the percent change in productivity from FY 2012 to FY 2014. Four of the nine city routes experienced increased productivity, while the five remaining routes experienced decreased productivity. Half of the suburban routes increased in productivity, with Route 15 experiencing the largest increase system-wide in weekday productivity at 35 percent. The strongest routes by ridership – Routes 5, 7, and 18 – all experienced declines in productivity. This was likely a result of increased service not resulting in equivalent increases in ridership. Route 18, the Downtown Shuttle, experienced the largest decrease in productivity with a 35 percent decline.

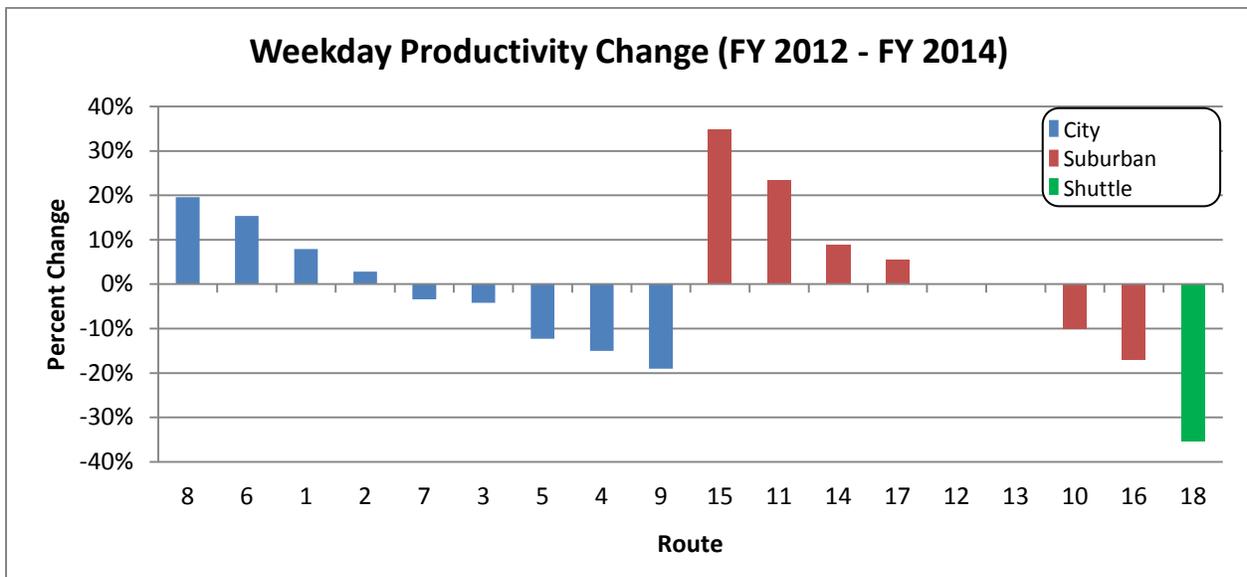


Figure 12. LRTA Weekday Productivity Change FY 2012 to FY 2014



3.43 Saturday Performance

Saturday routes are less productive compared to weekday routes. Average Saturday productivity for city routes is 16.9 passengers per revenue hour and 11.0 for suburban routes. Route 5 is the most productive route with 33.1 passengers per revenue hour while Route 15 has the lowest at 4.0 passengers per revenue hour. Figure 13 shows average Saturday productivity by route.

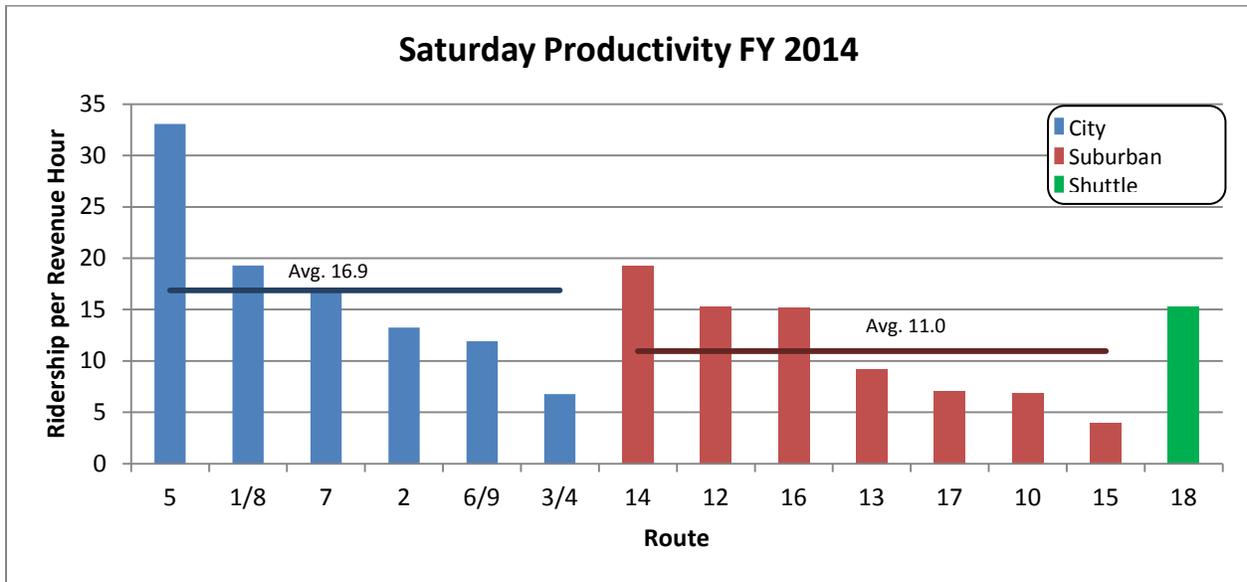


Figure 13. LRTA Saturday Productivity by Route

Productivity on Saturday routes has declined over the past three fiscal years. This is likely attributable to increased Saturday service system-wide introduced in January 2013. Figure 14 shows the change in Saturday productivity by route. While five of six city routes increased productivity, all suburban routes as well as the Downtown Shuttle experienced declines in productivity. Route 15 was not included in the year-over-year productivity change as Saturday service was only recently introduced. Combined Route 01/08 experienced the highest productivity gain of 45 percent. Route 18 had the largest decrease in productivity with a 33 percent decline. This is a likely result of the additional service provided starting August 2013 and will need additional time for ridership to mature with the increased service.

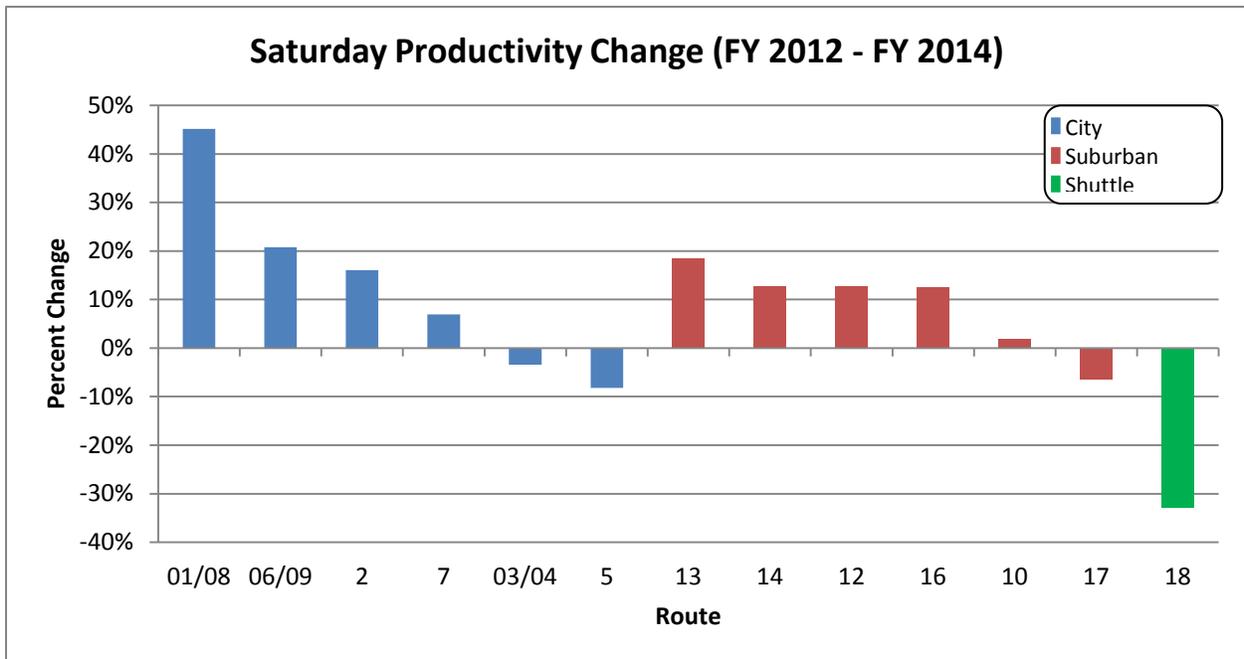


Figure 14. LRTA Saturday Productivity Change, FY 2012 to FY 2014

3.5 Financial Performance

3.51 System Farebox Recovery Ratio

The farebox recovery ratio is the ratio of fare revenue to operating costs. Higher ratios indicate higher cost-effectiveness and measure the portion of operating costs covered by passenger fares. The higher the farebox recovery ratio, the lower the subsidy a route needs to operate, leaving more revenue available to operate more service.

A decline in financial performance follows a decline in service productivity. Figure 15 shows that farebox recovery has decreased slightly over the past three fiscal years. The average farebox recovery ratio was 14.1 percent in FY 2012, 14.2 percent in FY 2013, and 13.8 percent in FY 2014. The decrease in farebox recovery is correlated with the increase in revenue service operated following the service expansion in August 2013.

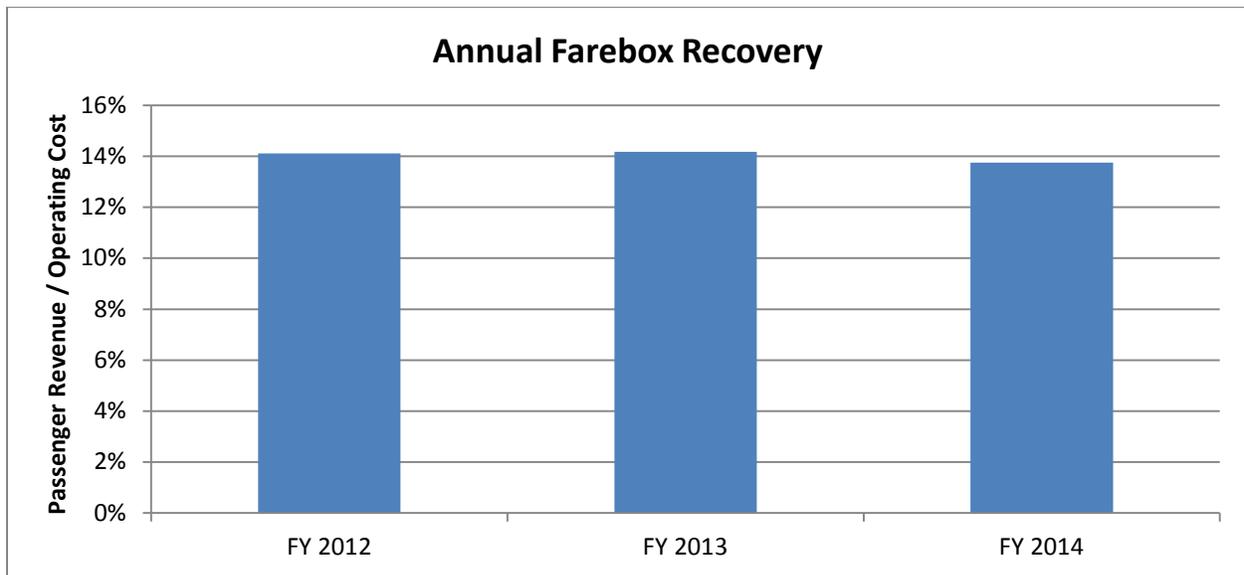


Figure 15. LRTA Annual Farebox Recovery

3.52 System Subsidy per Passenger

Subsidy per passenger measures how much it costs to operate transit service for every passenger carried. It is calculated by subtracting passenger revenue from operating cost and dividing by the total number of passengers. Lower passenger subsidy values indicate that a greater portion of operating costs are recovered through passenger fares, and are more desirable for financial sustainability.

Figure 16 shows that subsidy per passenger has increased slightly over the past three fiscal years. The average subsidy per passenger was \$4.60 in FY 2012, \$4.61 in FY 2013, and \$4.82 in FY 2014.

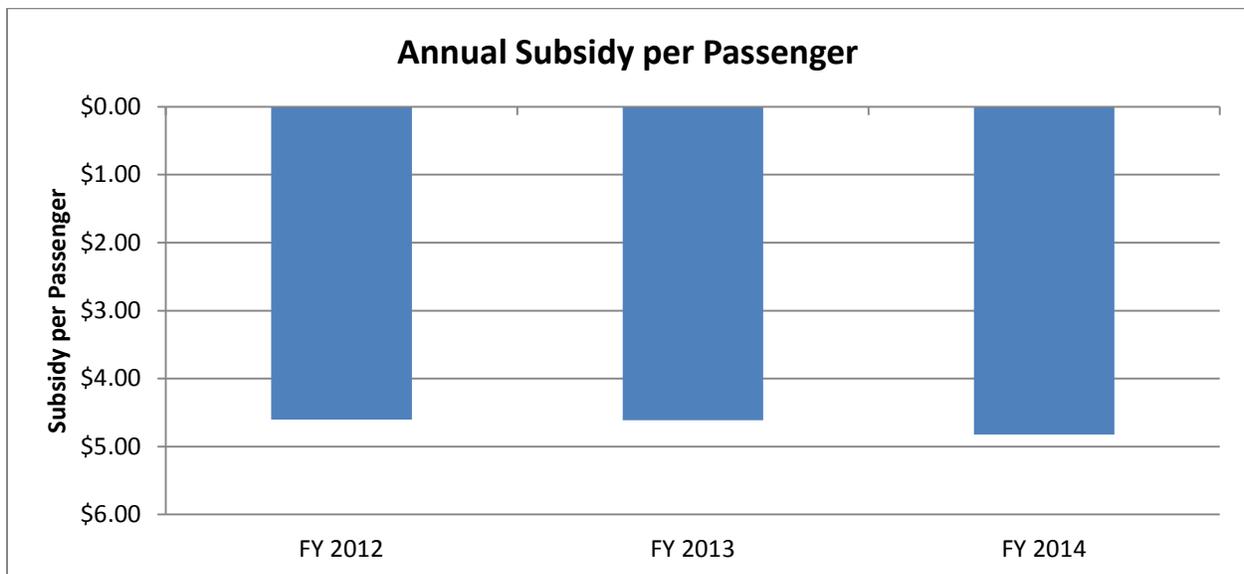


Figure 16. LRTA Annual Subsidy per Passenger



3.53 Weekday Subsidy per Passenger

Average weekday subsidy per passenger is \$4.75 for city routes, \$6.62 for suburban routes, and \$3.93 for the Downtown Shuttle. Route 5 had the lowest subsidy overall at \$2.19 per passenger. Route 10 had the largest subsidy at \$9.97 per weekday passenger carried. Figure 17 shows average subsidy per passenger by route on weekdays.

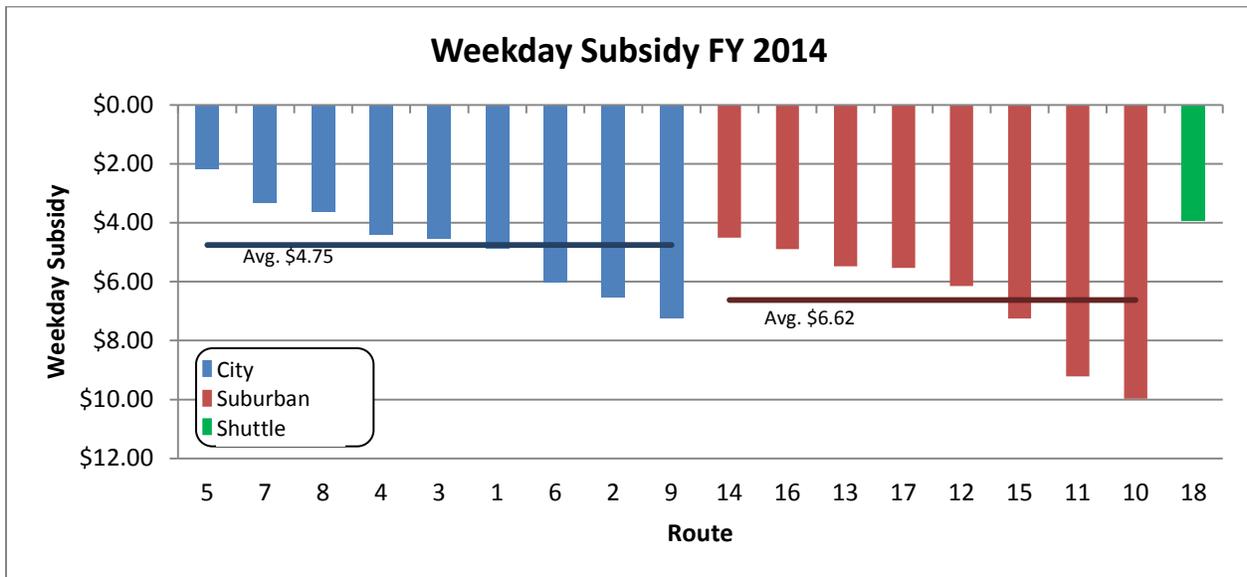


Figure 17. LRTA Weekday Subsidy per Passenger

3.54 Saturday Subsidy per Passenger

Average Saturday subsidy per passenger is \$6.36 for city routes, \$10.51 for suburban routes, and \$5.48 for the Downtown Shuttle. Route 5 has the lowest subsidy of \$2.19 per passenger while Route 15 has the highest subsidy of \$22.92 per passenger. All routes had higher subsidies for Saturday service compared to weekday service. Figure 18 shows average Saturday subsidy per passenger by route in FY 2014.

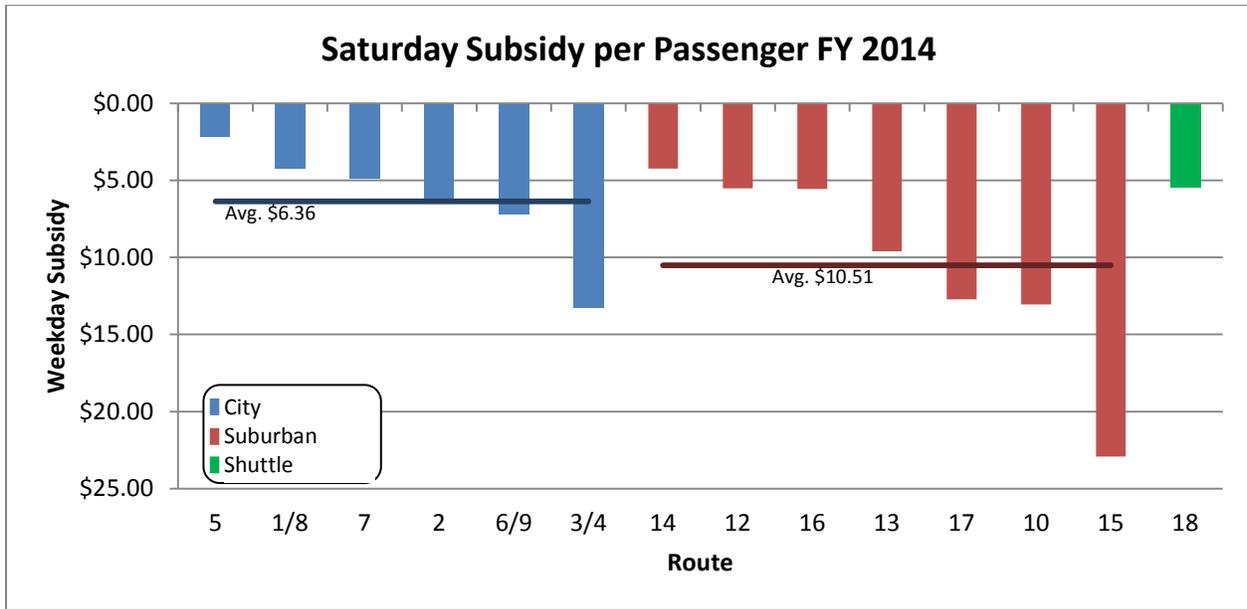


Figure 18. LRTA Saturday Subsidy per Passenger

3.6 Service Frequency

Frequency refers to how often a bus serves a particular route. Service frequencies affect how passengers use the system and the flexibility they can have when making travel plans. During peak periods, most routes run every 30 or 60 minutes. Exceptions include the following: the Downtown Shuttle runs every 15 minutes, suburban Route 15 every 90 minutes, Routes 9 and 16 every 40 minutes, and Route 6 every 35 minutes.

Figure 19 shows the relationship between service frequency and performance. Overall, routes with 30 minute frequency have much higher productivities than routes with 60 minute frequency. Route 2 may benefit from a service reduction as it has the worst productivity out of the 30 minute frequency routes.

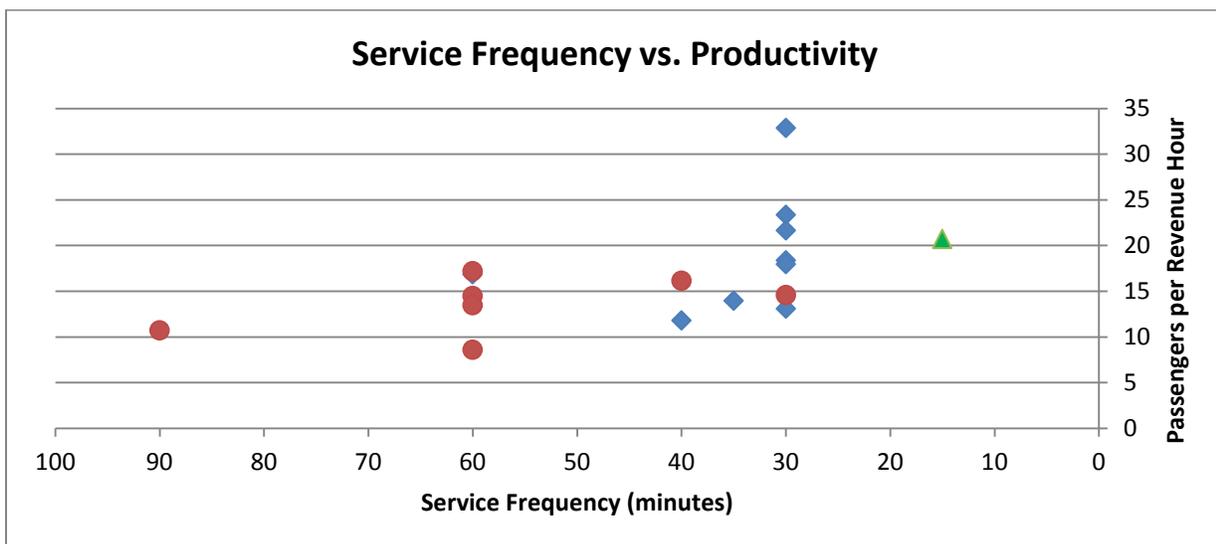


Figure 19. LRTA Service Frequency vs. Productivity



3.7 Ranking of Weekday Route Performance

In order to evaluate investment priorities, the routes were given a score based on how their performance compared with system averages, regardless of service type. Routes were scored based on ridership, passengers per revenue hour, and subsidy per passenger. For each route, each performance indicator was evaluated as a percentage of the system average. For example, if the system average was 100 passengers and a given route has 200 passengers, it would score 200% for that category. The composite score was calculated by taking the averages of the percentages for each category. The routes were then divided into four tiers based on their composite score: Highest performers (150% or greater), above average performers (149%-100%), below average performers (99%-50%), poor performers (49% or lower). Table 3 shows each route in LRTA and its composite score and ranking.

Table 3. LRTA Weekday Route Performance Ranking

Rank	Route	Route Description	Score
1	5	Westford Street	203%
2	7	Pawtucketville / UMass Lowell North	171%
3	18	Downtown Shuttle	148%
4	14	Burlington Mall / Lahey Clinic	123%
5	8	Centralville	116%
6	2	Belvidere	99%
7	4	Highlands via Stevens	97%
8	3	South Lowell	94%
9	16	Chelmsford Center via Chelmsford St.	91%
10	17	North Chelmsford via Middlesex	91%
11	13	Billerica	88%
12	1	Christian Hill	83%
13	12	Tewksbury via Route 38	82%
14	6	Broadway / UMass Lowell	72%
15	9	Lowell Circulator	63%
16	15	Chelmsford / Westford	63%
17	10	Dracut / Tyngsboro	52%
18	11	IRS/Raytheon via Route 133	39%

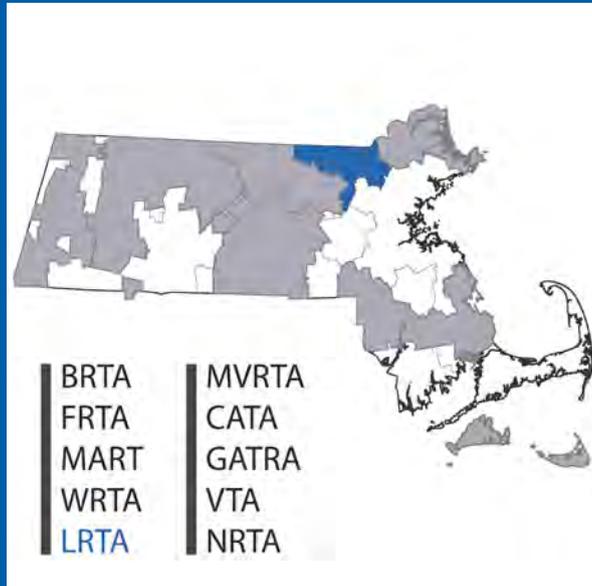
Investment strategies for routes will vary based on their performance tier. The three routes with the highest performances are top priorities for service investment and may benefit from increased service frequencies or service spans. The other routes that perform above average are candidates for further service investment as resources become available.

For routes that perform below average, further analysis is required to determine what is causing the routes to have low performance. More in depth analysis could look at inefficiencies in route alignments, service frequencies and spans, and duplicity with other routes. Routes with exceptionally low performance may be candidates for discontinuation of service and will be examined in later sections.



3.8 Key Findings

- Overall, ridership increased between FY 2012 and FY 2014. Ridership increases were seen both in weekday ridership and in Saturday ridership.
- LRTA service improvements in August 2013 have translated to increased ridership, but performance metrics such as subsidy per passenger and passengers per revenue hour have declined.
- Daily average ridership and service performance is significantly lower on Saturdays compared to weekdays.
- City routes had higher ridership compared to suburban routes, both on weekdays and on weekends.
- The Downtown Shuttle is a strong route, but recent service changes have reduced the productivity both on weekdays and on weekends.



Chapter 4

Determining Demand

AECOM / URS
TMD
Burke & Company





4. DETERMINING DEMAND

In order to evaluate a transit system and identify possible ways to strengthen it, it is important to understand the surrounding market, how this market is evolving, and who the riders of the system are. Demographics, land use, and socioeconomics – all of which impact ridership – are constantly changing. To align service to meet the needs of these potential riders, it is important to understand the level of transit demand that they represent.

This chapter is divided into two parts. The first section examines regional job creation goals and employment needs to demonstrate the economic context of the region and to identify potential ridership growth areas. The second section seeks to determine how the current service offered by the Lowell Regional Transit Authority (LRTA) aligns with its regional transit demand.

4.1 Regional Job Creation Goals and Employment Needs

This section will examine economic growth in the region to determine job creation goals and employment needs as well as the role transit plays in accommodating these needs. To determine the region's job creation goals and employment needs, the Strategic Plan of the Commonwealth of Massachusetts Executive Office for Housing and Economic Development (EOHED) was reviewed to examine the overarching goals for the state. The Northern Middlesex Council of Governments (NMCOG) Comprehensive Economic Development Strategy was also reviewed to determine economic context and how the region is expected to grow as well as to identify major regional employers/industries. This information was supplemented by site visits and interviews with LRTA Staff.

4.11 EOHED Strategic Plan

The EOHED plays a crucial role in supporting the growth of the economy, vibrant communities, and competition for consumers and businesses. The office, led by the Secretary of Housing and Economic Development, is focused on steering Massachusetts towards smart growth, a development approach that recognizes the interactions between land use, energy, and transportation. To achieve this, the EOHED has outlined a three-year strategic plan that focuses on the following four goals:

1. Accelerated job creation
2. Stabilized housing
3. Enhanced consumer awareness
4. Improved regulatory solutions

As the economy transitions from health care, higher education, technology, financial services, and tourism to one that includes life sciences, clean energy, and the creative economy, more jobs will be added. Accelerating job creation in conjunction with compact land use development patterns that



promote sustainability and increase the number of affordable housing units will change residential patterns and transportation needs. To serve the needs of the new emerging clusters of employment and housing, the transportation system as a whole must change and adapt. The new environments, which will be comprised of small and mid-sized businesses, must be served by public transit in order to meet the demands of the new workforce. While the public transit system must adapt to the changing economy, it should be noted that no two regions of the state are the same. As such, job creation goals and employment needs – and thus transportation needs – will differ.

4.12 Lowell Economic Development

The Lowell Regional Transit Authority service area covers 312.18 square miles and includes the following communities: Acton, Billerica, Carlisle, Chelmsford, Dracut, Dunstable, Groton, Pepperell, Lowell, Maynard, Tewksbury, Townsend, Tyngsborough and Westford. Nine of the fourteen communities (Billerica, Chelmsford, Dracut, Dunstable, Pepperell, Lowell, Tewksbury, Tyngsborough and Westford) are located in the Northern Middlesex Council of Governments region, three are located in the Metropolitan Area Planning Commission (Acton, Carlisle and Maynard) and two in the Montachusett Regional Planning Commission (Groton and Townsend). LRTA connects to the Nashua region through the Nashua Transit System at the Pheasant Lane Mall during the holidays and Merrimack Valley with MVRTA

Population Characteristics

The population in the Lowell Regional Transit Authority service area increased by 2.4% between 2000 and 2010, which was less than the growth rate of Middlesex County (2.6%) and the Commonwealth of Massachusetts (3.1%). As outlined in Table 4, the population in every community, with the exception of Chelmsford (-0.17%), Maynard (-3.1%) and Townsend (-3.0%), increased between 2000 and 2010. The population in the City of Lowell increased by 1.29% to 106,519, while its share of the total population in the region decreased slightly, from 31.4% in 2000 to 31.0% in 2010. The greatest percentage growth was experienced in Dunstable (12.37%), Acton (7.80%), Groton (11.50%) and Westford (5.77%), while Tewksbury (0.38%) had the smallest percentage growth in the region. Billerica (3.24%), Carlisle (2.90%), Dracut (3.135) and Pepperell (3.19%) exceeded the regional growth rate.



Table 4. Population Change in the LRTA Service Area (2000 and 2010)

Community	2000 Population	2010 Population	Percent Change
Acton	20,331	21,929	7.80
Billerica	38,981	40,243	3.24
Carlisle	4,717	4,852	2.90
Chelmsford	33,858	33,802	-0.17
Dracut	28,562	29,457	3.13
Dunstable	2,829	3,179	12.37
Groton	9,547	10,646	11.50
Lowell	105,167	106,519	1.29
Maynard	10,433	10,106	-3.10
Pepperell	11,142	11,497	3.19
Tewksbury	28,851	28,961	0.38
Townsend	9,198	8,926	-3.00
Tyngsborough	11,081	11,292	1.90
Westford	20,754	21,951	5.77
LRTA Service Area	335,451	343,360	2.4

Source: U.S. Census Bureau, 2000 U.S. Census and 2010 U.S. Census

Regional Transit Needs

It is difficult to quantify the transit needs of the region. Existing data sources and statistical analyses do not accurately indicate the level of dependence certain socioeconomic groups have on public transportation. As such, many of the MPO policies and programs deal with larger groups, such as low-income families, families without automobile access, and the elderly and disabled. A large percentage of the region's minority population often falls into one or more of these larger groups. In addition, much of the region's minority population resides in the central area of the City of Lowell.

As discussed in the 2012 Regional Transportation Plan, the transit dependent population in the Northern Middlesex region may be defined as elderly, disabled, minority and lower income households with no automobile available, as well as the population in the ten to fifteen year old age group. Table 5 provides statistics on the population over 60 years of age in each community. There are over 58,000 elderly persons residing within the Lowell Regional Transit Authority service area, and more than a quarter of these individuals reside within the City of Lowell. Chelmsford, Carlisle and Tewksbury have the highest percentage of seniors, with 22.3%, 21.2% and 21.1% of the residents, respectively, falling within the over sixty age group.



Table 5. Elderly Persons in the LRTA Service Area

Community	Residents 60+ Years	% of Residents
Acton	3,661	16.7
Billerica	7,262	18.1
Carlisle	1,030	21.2
Chelmsford	7,552	22.3
Dracut	5,387	18.3
Dunstable	509	16.0
Groton	1,635	15.4
Lowell	15,200	14.3
Maynard	1,883	18.6
Pepperell	1,864	16.2
Tewksbury	6,128	21.1
Townsend	1,412	15.8
Tyngsborough	1,629	14.4
Westford	3,536	16.1
TOTAL	58,688	17.1

Source: 2010 U.S. Census

Table 6 below provides statistics on the population 10 to 15 years of age in each community. Nearly 25,000 individuals or 7.2% of the region’s population fall within the 10 to 15 year age group. The towns of Dunstable, Groton and Westford have the highest populations in this age group (as a percent of overall population) relative to other communities within the region.

Table 6. Population Ten to Fifteen Years of Age in the LRTA Service Area

Community	10 to 15 Years Old	Percentage of Total
Acton	2,105	9.6
Billerica	2,810	7.0
Carlisle	455	9.4
Chelmsford	2,345	6.9
Dracut	1,991	6.8
Dunstable	335	10.5
Groton	1,056	9.8
Lowell	6,325	5.9
Maynard	541	5.1
Pepperell	914	7.9
Tewksbury	2,020	7.0
Townsend	688	7.7
Tyngsborough	951	8.4
Westford	2,153	9.8
TOTAL	24,689	7.2

Source: 2010 U.S. Census



Table 7 outlines number of vehicle available to households within each community and the Lowell Regional Transit Authority service area. There are over eighty-five hundred households that do not have a vehicle available, representing 7.0% of the household units in the region. Nearly 70% of these households are located within the City of Lowell.

Table 7. Vehicle Availability per Household

Community	Number of Vehicles Per Household							
	None		One		Two		Three or More	
Acton	280	3.3%	2,484	29.3%	4,129	48.7%	1,586	18.7%
Billerica	369	2.7%	3,490	25.2%	6,650	48.0%	3,350	24.2%
Carlisle	10	0.6%	246	14.1%	949	54.4%	539	30.9%
Chelmsford	608	4.6%	7,083	53.2%	2,186	16.4%	2,438	18.3%
Dracut	534	4.8%	3,514	31.5%	4,755	42.6%	2,370	21.2%
Dunstable	9	0.8%	152	14.0%	539	49.6%	387	35.6%
Groton	85	2.2%	620	16.0%	2,167	55.9%	1,004	25.9%
Lowell	6,034	15.3%	15,899	40.4%	12,871	32.7%	4,595	11.7%
Maynard	112	2.6%	1,673	38.7%	1,924	44.5%	610	14.1%
Pepperell	49	1.2%	993	24.1%	1,878	45.5%	1,205	29.2%
Tewksbury	408	3.8%	3,053	28.6%	4,685	43.9%	2,524	23.7%
Townsend	88	2.7%	720	22.0%	1,456	44.5%	1,011	30.9%
Tyngsborough	72	1.9%	752	19.8%	1,852	48.8%	1,121	29.5%
Westford	81	1.1%	1,251	17.1%	4,186	57.3%	1,790	24.5%
TOTAL	8,740	7.0%	41,931	33.4%	50,228	40.0%	24,530	19.6%

Source: ACS 2008 - 2012

Industry Composition

The transformation of the Greater Lowell region’s economic to a more service-based economy has continued since the Five-Year CEDS was published in 2009. In analyzing the industry composition for the Greater Lowell region, data provided by the Executive Office of Labor and Workforce Development for the Greater Lowell Workforce Investment Area (WIA) and Pepperell has been used in Table 8.

As of June 2013, the region consisted primarily of industries in the service-providing domain. The total number of service-providing establishments has increased to 6,318, which represents 3.6% growth since 2011 and 17.5% growth since 2009 when the Five-Year CEDS reported a total of 5,377 service-providing establishments.

Between 2011 and June 2013 the number of establishments in the goods-producing domain declined by 6.1% or 87 establishments. As of the June 2013, service-providing industries outnumbered goods-producing industries by nearly 5 to 1. This shows the continuing growth of the region’s service-based economy, which was also outlined in the Five-Year CEDS. Every industry sector in the goods-producing



domain, with the exception of Natural Resources and Mining, declined between 2011 and June 2013. The construction sector was most impacted with a 7.9% reduction in the number of establishments in the region.

While overall there has been growth in service-providers, several individual sectors experienced a decrease in the number of establishments across the region between 2011 and June 2013. The Other Services sector, which includes activities such as machinery repairs, religious activities, advocacy, dry-cleaning and laundry services and personal care services, has seen the greatest decrease in establishments with a decline of 56.6%. There were also minor declines in Financial Activities, Trade, Transportation and Utilities, Leisure and Hospitality, and Professional and Business Services. These declines are, however, marginal indicating that there has been little change since 2011. Overwhelmingly, the greatest growth in establishments has occurred in the Education and Health Services sector, which increased by 153.4%. According to the Executive Office of Labor and Workforce Development, all of this growth has occurred in the Healthcare and Social Assistance subsector. The Public Administration sector has also experienced growth of 15.4% in the number of establishments.



Table 8. Industry Composition of the Greater Lowell Region: 2011 to June 2013

Description	No. of Establishments		% Change between 2011 - June 2013	Average Monthly Employment		% Change between 2011 - June 2013	Average Weekly Wages		% Change between 2011 - June 2013
	2011 (Q2)	2013 (Q2)		2011 (Q2)	2013 (Q2)		2011 (Q2)	2013 (Q2)	
Goods-Producing Domain	1,423	1,336	-6.1	23,240	24,219	4.2	\$1,564	\$1,583	1.2
Natural Resources and Mining (incl. Agriculture, fishing)	10	15	50.0	85	91	7.1	\$392	\$379	-3.2
Construction	1027	946	-7.9	6,443	7,152	11.0	\$1,005	\$1,019	1.4
Manufacturing	384	375	-2.3	16,696	16,976	1.7	\$1,787	\$1,828	2.3
Service-Providing Domain	6,100	6,318	3.6	90,708	92,979	2.5	\$1,085	\$1,050	-3.2
Trade, Transportation and Utilities (includes wholesale, retail trade)	1,301	1,286	-1.2	20,148	20,809	3.3	\$869	\$813	-6.5
Information	126	126	0	4,721	3,632	-23.1	\$1,995	\$1,730	-13.3
Financial Activities	426	415	-2.6	3,483	3,294	-5.4	\$1,230	\$1,274	3.6
Professional and Business Services	1,286	1,281	-0.4	18,833	18,586	-1.3	\$1,753	\$1,690	-3.6
Education and Health Services	702	1,779	153.4	25,115	27,732	10.4	\$919	\$980	6.7
Leisure and Hospitality	689	681	-1.2	10,034	11,225	11.9	\$335	\$338	0.7
Other Services , Excludes Public Admin	1,473	639	-56.6	4,541	3,621	-20.3	\$703	\$796	13.3
Public Administration	91	105	15.4	3,765	4,015	6.6	\$1,198	\$1,221	1.9
Total, All Industries	7,523	7,654	1.7	113,948	117,198	2.9	\$1,183	\$1,160	-1.9

Source: Executive Office of Labor and Workforce Development, ES-202 2011 Annual Report and 2013 Second Quarter Report for Greater Lowell Work Investment Area and Pepperell



In terms of Average Monthly Employment, employment in the service-providing domain was almost 4 times greater than in the goods-producing domain. While there is a large difference in the average number of people employed in each domain, the goods-producing domain still managed a 4.2% increase in monthly employment levels. From 2011 to June 2013 monthly employment in Construction grew by 11.0% and Manufacturing increased by 1.7%. The Service-Providing domain added on average 2,271 jobs between 2011 and June 2013 representing a 2.5% increase in average monthly employment levels. The greatest change in employment levels occurred in the Information sector, which declined by 23.1% followed by the Other Services sector, which reduced by 20.3%. Growth in average monthly employment levels of the service-providing domain has occurred most in the Leisure and Hospitality, and Education and Health Services sectors.

Despite signs of business growth and higher employment levels generally across the region and more specifically within several sectors, the average weekly wage in the Greater Lowell region decreased from \$1,183 in 2011 to \$1,160 in June 2013. Wages in the service-providing domain decreased by 3.2%, while those in the goods-producing domain increased by 1.2%. All sectors of the goods-producing domain, except natural resources and mining, experienced an increase in average weekly wages, while the service-providing domain varied across sectors. The Trade, Transportation and Utilities (-6.5%), Information (-13.3%), and Professional and Business Services (-3.6%) sectors experienced declines in average weekly wages. Increases in average weekly wages occurred in Financial Activities (3.6%), Education and Health Services (6.7%) Leisure and Hospitality (.7%), Other Services (13.3%), and Public Administration (1.9%) sectors.

In June 2013, the highest weekly wages were paid in Manufacturing (\$1,828), Information (\$1,730), and Professional and Business Services Sectors (\$1,690), as shown in Table 8 above. This is consistent with information provided in the 2009 Five-year CEDS, which found that most of the higher paying jobs in the region fell into the 'knowledge economy' sector. It is however noted that, other than the manufacturing sector, these sectors have experienced a decline in employment levels between 2011 and June 2013.

Priority Development Areas

The Northern Middlesex Council of Governments identified priority development areas for both economic development and housing within the *Greater Lowell Comprehensive Economic Development Strategy* and the various housing production plans. Table 6 identifies that the majority of the economic development priority areas are located along a corridor that is currently served by LRTA bus service.

The economic development areas are displayed in Figure 20 and the housing development areas are displayed in Figure 21.

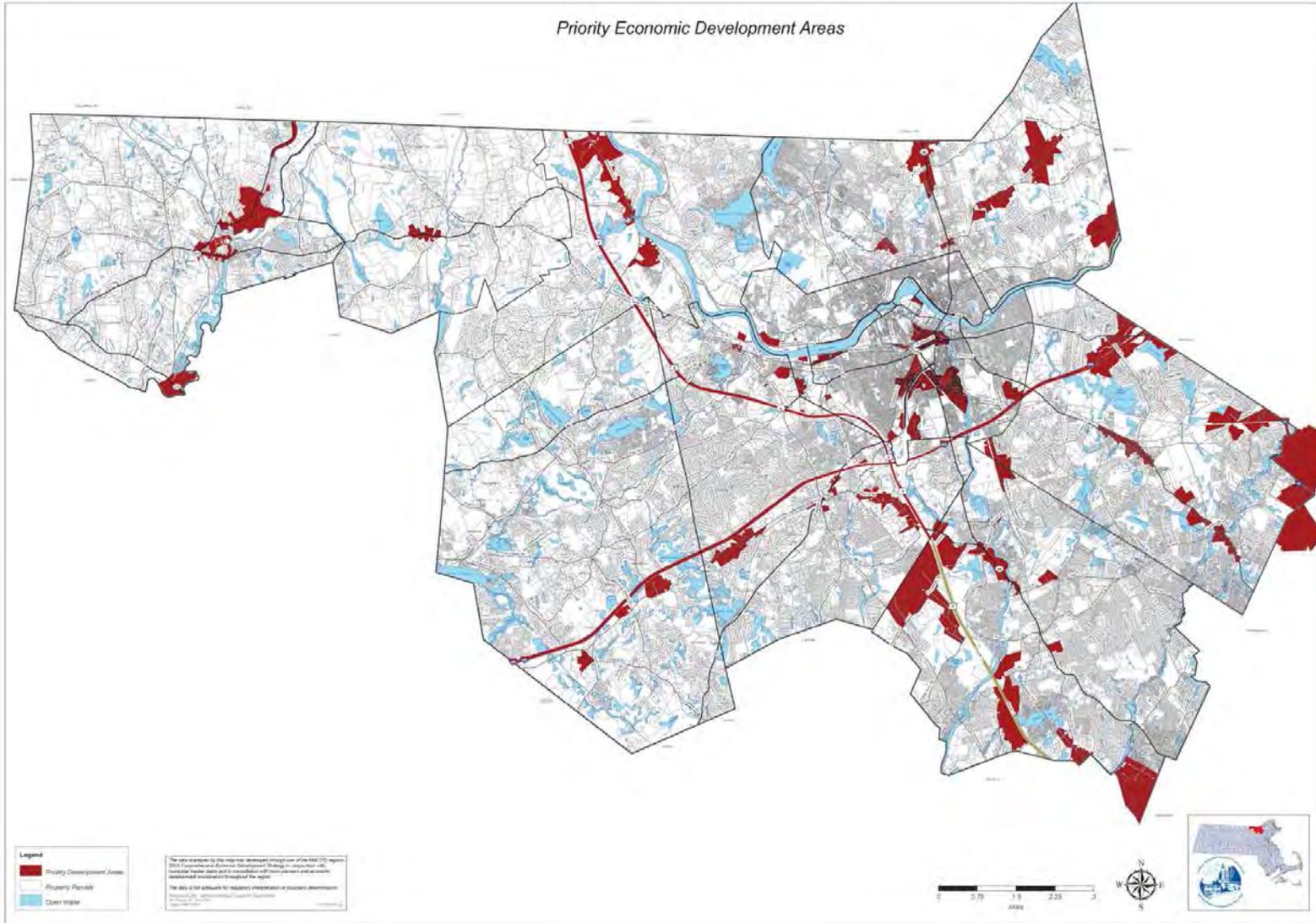


Figure 20. Priority Economic Development Area Map

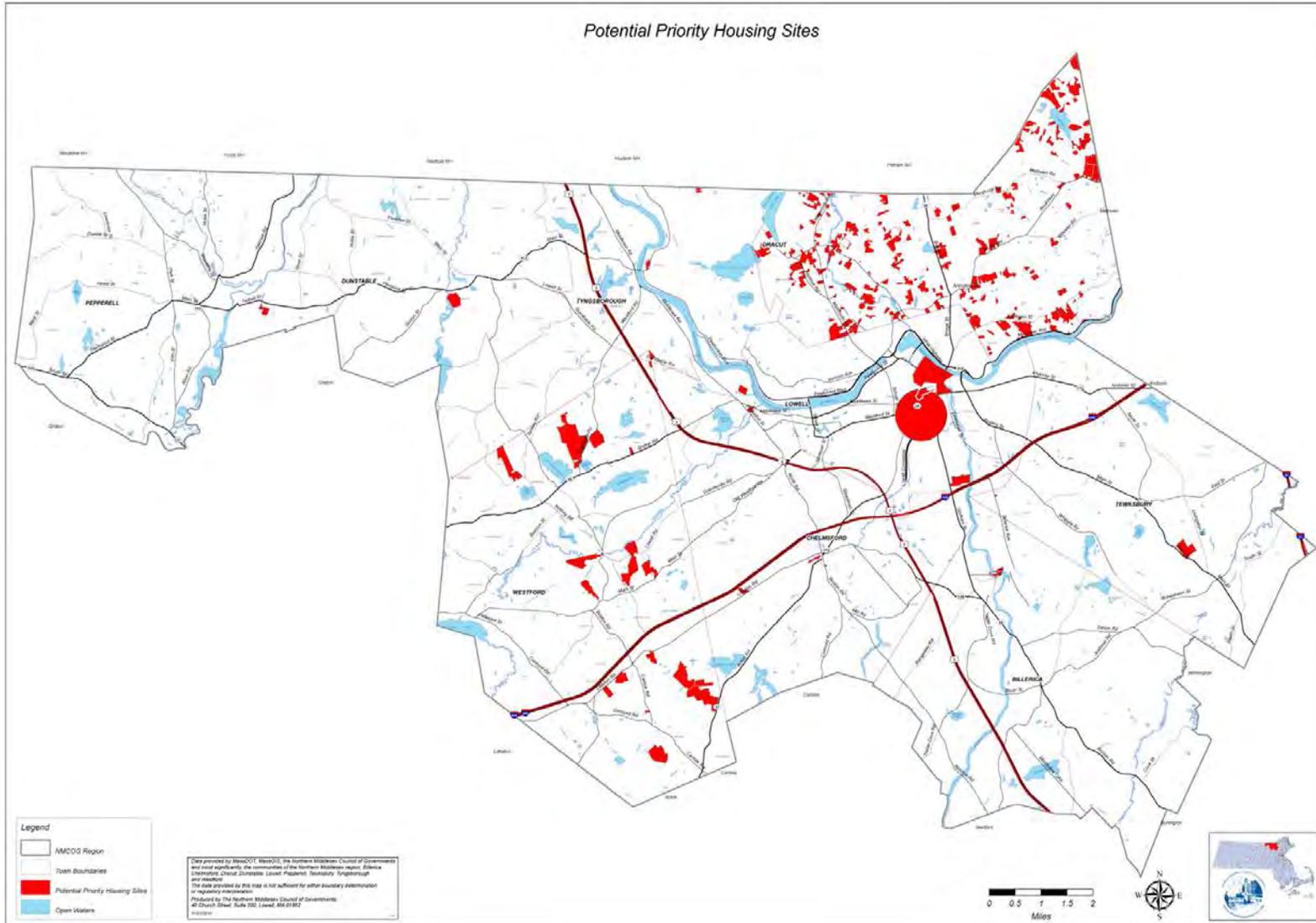


Figure 21. Potential Priority Housing Sites



Table 9. Priority Economic Development Areas

Description	Parcels	Acres	Fixed Route Bus Service	
			On Route	Within 3/4 Mi
Billerica				
29 Dunham Road	1	6.28	No	Yes
45 Middlesex Turnpike - EMD Serono	1	33.93	Yes	Yes
Billerica Mall	1	29.24	Yes	Yes
Non-residentially zoned tracts in the Billerica Avenue Corridor	13	56.21	Yes	Yes
Non-residentially zoned tracts in the Concord Road Corridor	1	401.31	No	No
Non-residentially zoned tracts in the Middlesex Turnpike corridor	57	396.38	Yes	Yes
Rangeway, Sterling and Esquire Road area	92	745.84	No	No
Route 3 at Route 129 interchange	8	30.96	Yes	Yes
Route 3A Corridor from Floyd/Pollard Streets to Treble Cove Road	50	139.22	Yes	Yes
Talbot & Faulkner Mills in North Billerica	2	10.95	Yes	Yes
Treble Cove Road west of Route 3	3	4.04	Yes	Yes
Chelmsford				
122 Chelmsford Street	1	0.35	Yes	Yes
123 Brick Kiln Road	1	10.27	Yes	Yes
152 Stedman Street	1	1.71	No	Yes
16-20 Boston Road	1	8.47	Yes	Yes
25 Katrina Road	1	3.98	No	Yes
299 Chelmsford Street	1	6.69	Yes	Yes
3 Chelmsford Street	1	0.38	Yes	Yes
Billerica Road Corridor (Route 129) from Billerica town line to Turnpike Road	44	162.43	Yes	Yes
Littleton Road Corridor	49	149.20	Yes	Yes
UMass Lowell West Campus, Princeton St.	1	34.00	Yes	Yes
Vinal Square	23	9.58	Yes	Yes
Dracut				
970 Broadway	1	15.41	No	No
Beaver Brook Mill	5	8.17		Yes
Industrially zoned areas on Routes 110 & 113	54	450.60	No	No
Navy Yard Mill 96-100 Pleasant St	2	5.68	No	No
Route 38 from New Hampshire to Chuck Drive	49	192.70	No	No
Town Center at Bridge and Arlington	20	10.05	Yes	Yes
Pleasant Street from Groton Street to Cross Street (MUD District)	24	72.30		Yes
Lowell				
1001 Pawtucket Boulevard (Cobham)	1	42.27	No	Yes
120 Stedman Street	1	6.25	No	Yes
121 Hale Street	1	4.42	No	Yes
150 Western Avenue	1	4.21	No	Yes
2 Prince Ave	1	14.28	Yes	Yes
229 Stedman Street	1	0.81	No	Yes
38 Prince Street	1	0.18	No	Yes
585 Middlesex Street	1	1.16	Yes	Yes



59 Lowes Way (Connector Park)	1	13.52	Yes	Yes
663 Lawrence Street	1	2.13	Yes	Yes
70 Industrial Ave East	1	2.49	Yes	Yes
81 Old Ferry Road	1	1.48	No	Yes
900 Chelmsford Street (Cross Point, formerly Wang Towers)	1	14.98	Yes	Yes
92-98 Middle Street	2	0.14	Yes	Yes
Acre Urban Renewal Plan (Pawtucket Canal)	65	21.37	Yes	Yes
Bridge Street Gateway, 18-36 First Street	3	0.81	Yes	Yes
Hamilton Canal	81	38.62	Yes	Yes
Hamilton Crossing?	3	3.97	Yes	Yes
Jackson Street	12	7.56	Yes	Yes
Land between the Merrimack River and Middlesex Street and east and west of Wood Street	31	37.89	Yes	Yes
Lawrence Mills	3	10.01	Yes	Yes
Lowell South CDB	215	43.84	Yes	Yes
Meadowcroft Street	625	128.37	No	Yes
Meadowcroft/Bolt Street	21	45.61	No	Yes
Phoenix Avenue	14	53.52	Yes	Yes
Tanner Street	61	53.50	No	Yes
Technology Drive	4	26.16	Yes	Yes
Thorndike/Plain/Powell/Smith/Shaw/Chelmsford (Thorndike-Plain)	249	79.59	Yes	Yes
Pepperell				
128 Main Street (former Pepperell Paper Mill)	1	8.79	No	No
Hollis Street from Main to Groton	43	47.39	No	No
Intersection of Hollis/River/Main Street	13	13.34	No	No
Lomar Industrial Park	23	89.17	No	No
Main Street corridor from Railroad Square to River Street	65	32.57	No	No
Nashua Road from Hollis to Merrimac	82	209.16	No	No
Route 119 from the Groton Town Line to River Street	10	119.05	No	No
Tewksbury				
East Street	31	257.49	No	No
Five (5) overlay districts on Route 38, including the Town Center, Village Res, S. Village, Village Mixed-use and Comm. Village	11	300.88	Yes	Yes
Route 133 (as delineated on the map prepared for the Town targeted economic development project)	2	360.40	Yes	Yes
Woburn Street corridor	22	79.65	Yes	Yes
Tyngsborough				
50 Westford Road (former Sycamore Networks parcel)	1	106.34	No	No
Middlesex Road corridor	54	344.09	No	No
Town Center area	35	32.71	No	No
Westford				
Cornerstone Square	5	24.28	Yes	Yes
Tech Park East & West on Littleton Road (Route 110)?	12	92.00	Yes	Yes



4.2 Transit Market Analysis

Certain groups, such as older adults, the young, low income populations and those without access to a vehicle, are more likely to use transit, and quite often their trips are for work purposes. By analyzing and examining such factors as age, population density, employment density, income levels, and vehicle availability, transit dependent populations within the region were identified (Section 4.21). This information was then combined with additional attributes such as land use and amenities to determine an overall market and demand for transit in the region (Section 4.22). To determine if service was currently deployed in the most effective way to accommodate the transit needs of the region's workforce, each route was mapped and overlaid on maps displaying employment and socio-economic data (Section 4.23).

4.21 Transit Dependent Populations

Transit-dependent populations are those exhibiting socioeconomic and demographic characteristics that make them more likely to use public transit than others, such as level of income, access to a vehicle, and age. Transit systems are often designed with a focus on serving such populations. In addition, population and employment densities can also provide an indication to the feasibility of providing service industry standards indicate that at least 2,000 households are needed per square mile to support a fixed-route transit system. It is important to match the level of demand with the level of service maximize the number of persons served by the system and to be more efficient.



Older Populations

According to the American Public Transportation Association (APTA), individuals aged 65 and above represent the second largest transit user group. This group's high level of transit ridership, however, is disproportional to the relatively small percentage of the population that the group represents. Senior population typically correlates with areas of low income levels and vehicle ownership. These individuals are often on fixed incomes reducing their desire to own a vehicle. In addition, health issues such as poor eyesight can deter them from driving. There appears to be no real pattern to where this age group tends to live in the LRTA service area (Figure 22). Thus, it can be challenging to institute transportation services that meet their needs. Within the LRTA service area, 11.6% of the population is made up of individuals over the age of 65.

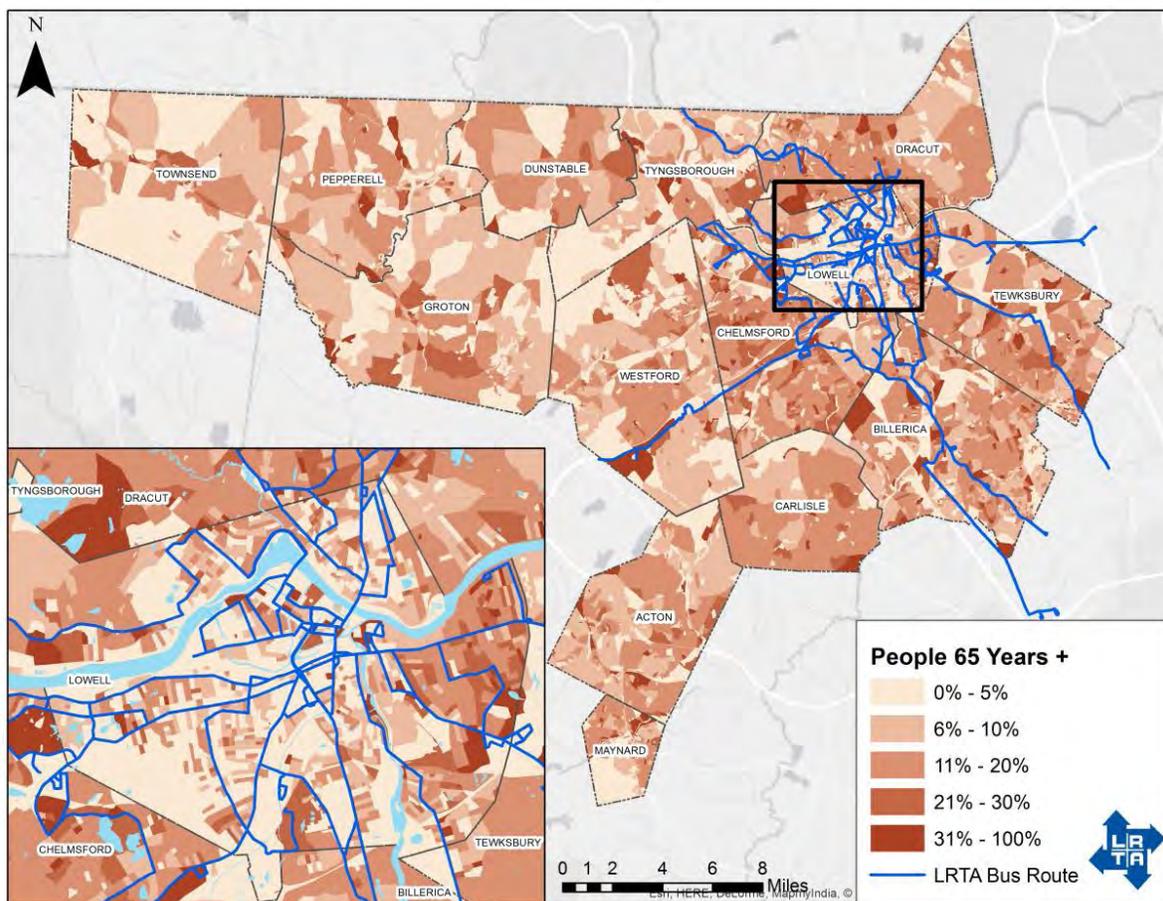


Figure 22. Older Populations



Population Density

The majority of trips (transit or non-transit) originate or end at the home, making population an important indicator of potential transit use. Population density is used in this analysis instead of the total population because it accounts for varying area sizes. High density areas are typically found in urban centers consisting of multifamily units, mixed-use developments, limited parking, and walkable environments, all of which generate higher transit ridership. The average population density in the Lowell Region is 1,130 persons per square mile, which is higher than the state average of 858 persons per square mile. The densest areas are located in Lowell and Dracut along Lakeview Ave. The communities surrounding Lowell have a moderate level of density which is an indicator of sprawl and hard to service via transit. As shown on the following map (Figure 23), the majority of the highly dense population areas are served by LRTA routes.

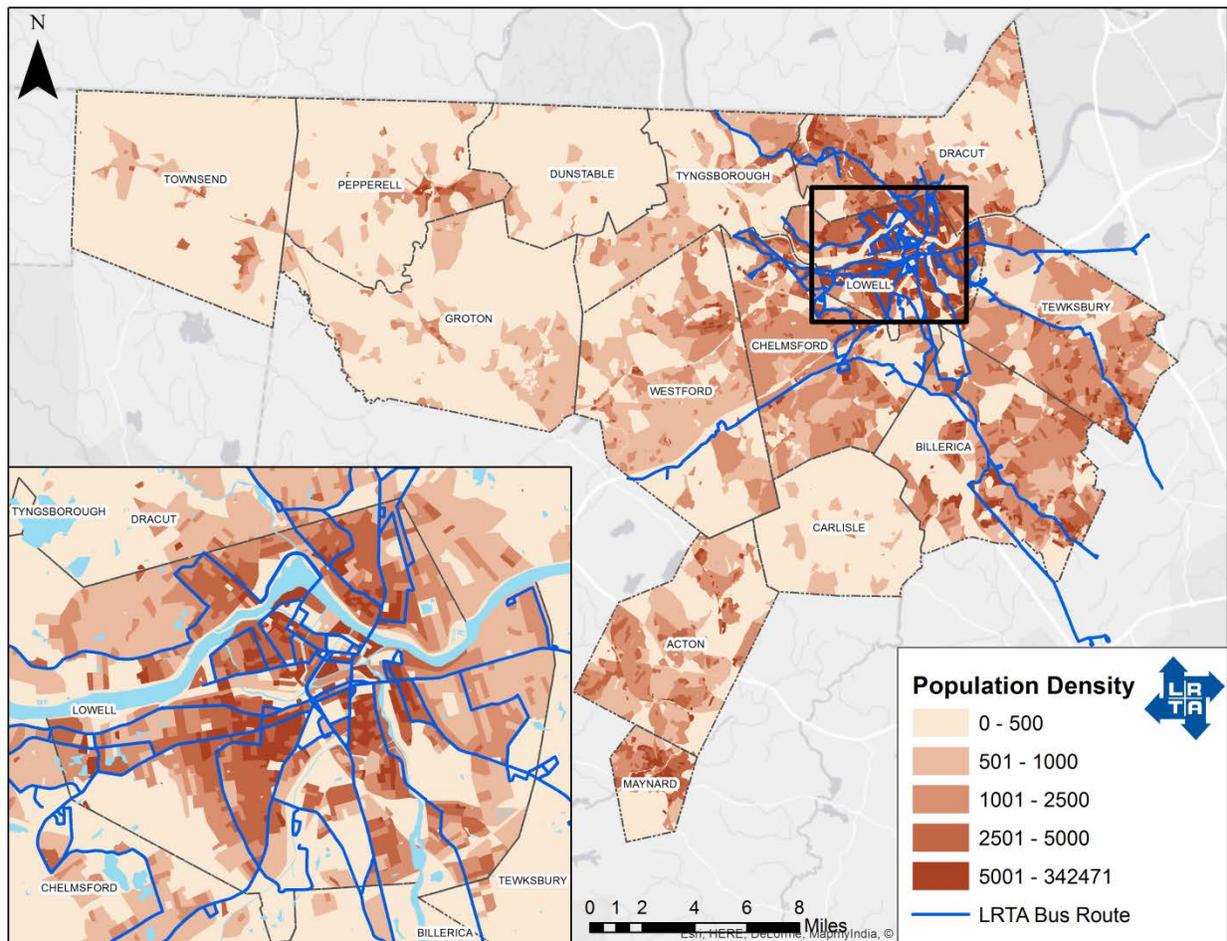


Figure 23. Population Density

Employment Density

According to APTA, commuting for work purposes is the number one reason people take transit. As such, it is imperative that transit systems serve areas with high concentrations of employment. Within the LRTA service area, there are 149,432 jobs which equates to an average of 491 jobs per square mile. The mismatch in population and employment density indicates that the region is a net exporter of workers, most likely to the Boston region. These employment centers tend to be concentrated in the city centers or along major corridors. Many of the dense employment areas are served by LRTA (Figure 24).

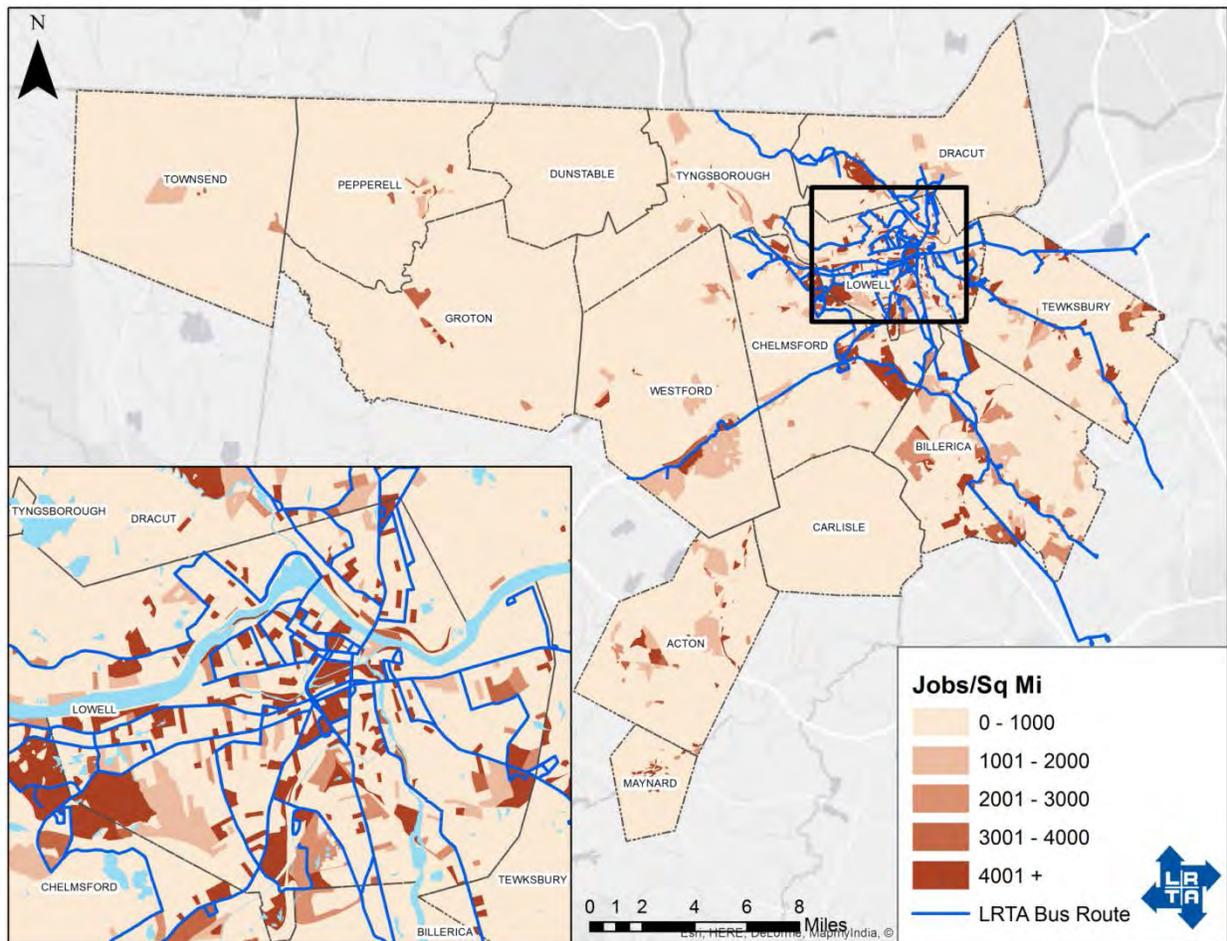


Figure 24. Employment Density

Home and work are the most common origin and destinations according to APTA. Since population and employment densities are the best approximation for determining the level of demand, these two variables have been combined to examine service frequencies based on thresholds.⁴ As job and

⁴ These estimates are based on data from the *Urban Development Intensities in the Washington DC Metropolitan Area* by Terry Holzheimer, *Public Transportation and Land Use Policy* by Boris Pushkarev, and *TCRP Report 111 Elements Needed to Create High Ridership Transit Systems*.



population densities increase, the headway for transit service should decrease (Table 10). Densities above 250,000 are candidates for alternative modes such as bus rapid transit (BRT) or rail. Figure 25 indicates that the demand for more frequent service is concentrated in the urban core of Lowell, along major corridors in the east and in the town centers of the western communities such as Pepperell.

Table 10. Frequency Thresholds

Jobs & Population per Square mile	Fixed-Route Headway
3,000-6,500	60 Min
6,501-16,000	30 Min
16,001-250,000	15 Min
250,001+	5 Min

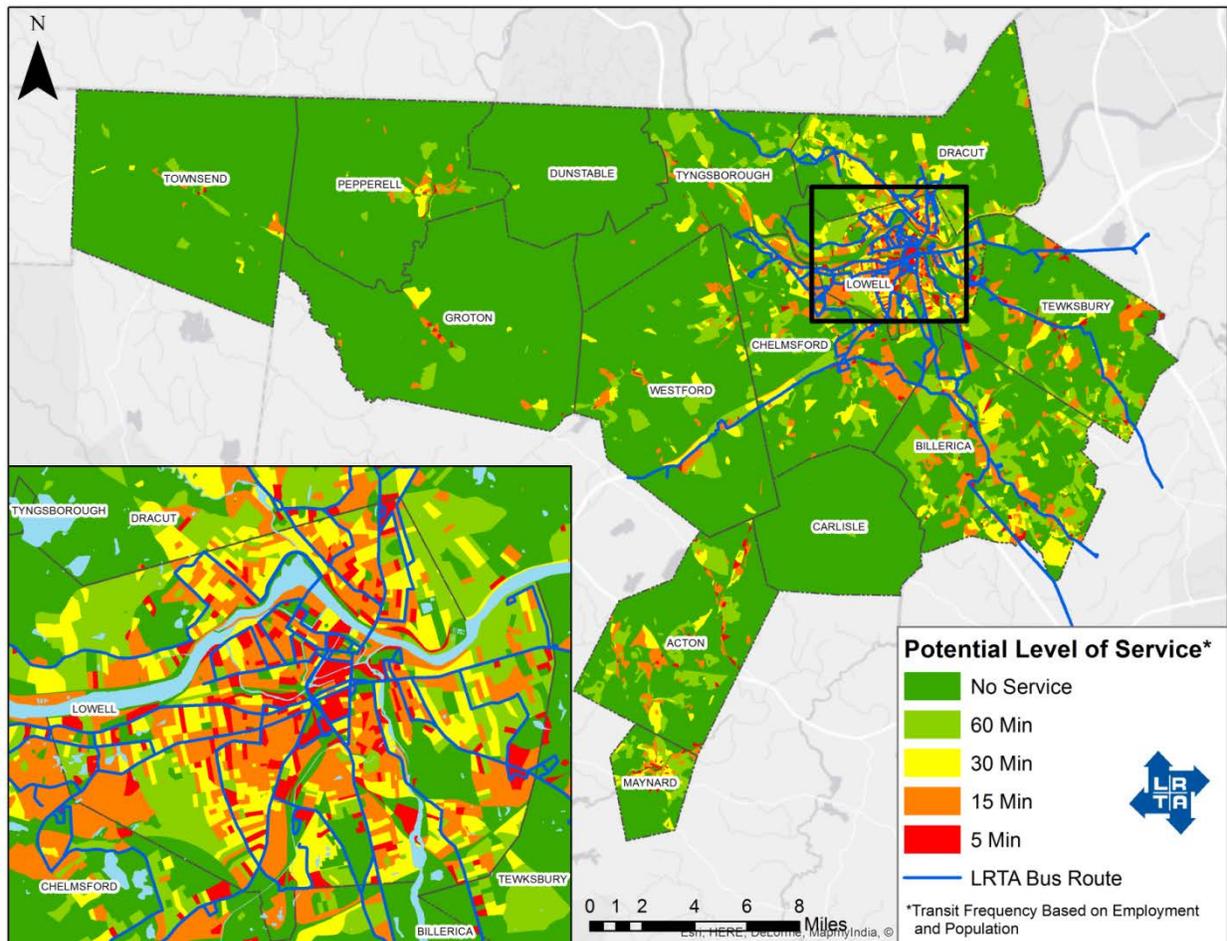


Figure 25. Transit Demand - Level of Service

Income Level

Median household income is used as a measure for propensity to use transit. Automobile ownership is expensive and as household incomes decline so does the likelihood of having access to a private vehicle. Work-trip market shares from the American Community Survey show that as income rises, the percentage of people using transit decreases. The average median household income in the LRTA region is \$85,511, much higher than the state average of \$66,658. Despite this average, however, there are some areas, especially Lowell, with substantially lower income levels. These are depicted on the following map (Figure 26).

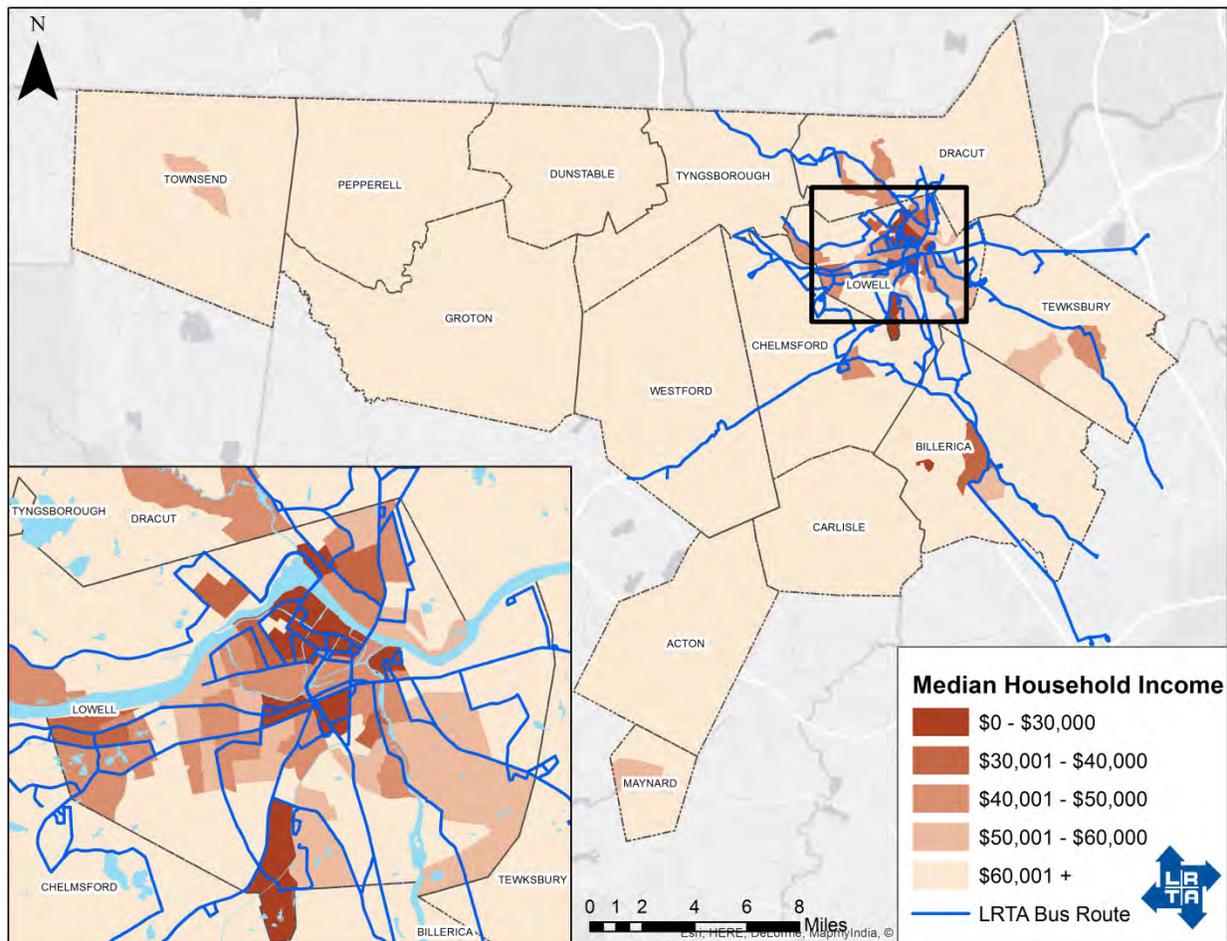


Figure 26. Median Household Income

Zero-Vehicle Households

The LRTA system serves an area where 7% of households do not have access to a personal vehicle. This rate is lower than the state average of 12.5%, which is expected as the Metro Boston area skews the average higher.⁵ Concentrations of these households coincide with low-income and dense population areas shown on the previous maps. Figure 27 depicts these zero-vehicle household areas concentrated in Lowell, Dracut, and Chelmsford. The highest levels of no-vehicle ownership are around the University of Massachusetts – Lowell.

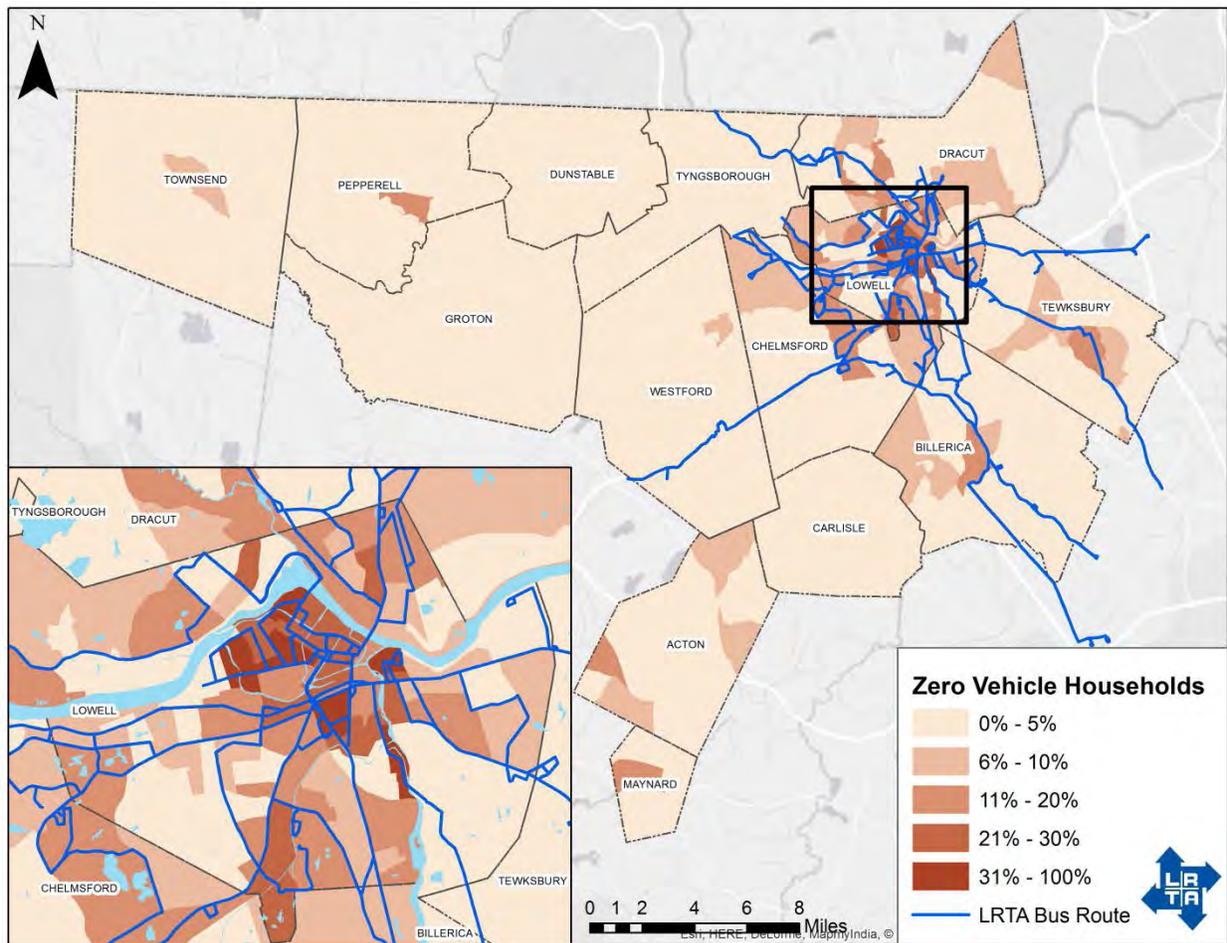


Figure 27. Zero-Vehicle Households

4.22 Methodology

To determine if LRTA’s service is deployed in the most effective way possible to accommodate the transit needs of the regions workforce, the level of potential demand was calculated. The level of

⁵ The state average without Suffolk county (Boston) is 9.7%.



potential demand is based on the following: population density, number of jobs, percent of zero-vehicle households, proximity to schools and hospitals, median household income, the enrollment at local colleges and universities, park and ride lots, commuter rail stations, the percent of households with people with disabilities, and the percent of the population above the age of 65⁶. The data was derived from the 2008-2012 American Community Survey (ACS) 5-Year Estimate and the MassGIS website (Table 11). The level of demand was analyzed at the census block level.

Table 11. Transit Demand Data Variables and Sources

Variable	Source
Population	ACS 5 Year table 2008-2012 SF 3 Table B00001
Area	Cartographic boundary files US census
Zero-Vehicle household	ACS 5 Year table 2008-2012 SF 3 Table B25044
Schools	MassGIS from Mass - DOE
Hospitals	MassGIS from the DPH - OEMS
Median Household Income	ACS 5 Year table 2008-2012 SF 3 Table B19013
Colleges and Universities	MassGIS from National Center for Education Statistics
Disabled Households	ACS 5 Year table 2008-2012 SF 3 Table B22010
Employment	MAPC statewide employment data
Park and Ride Lots	NMCOG GIS layers
Commuter Rail	MassDOT
Elderly Populations	MassGIS from CTPS
Population	ACS 5 Year table 2008-2012 SF 3 Table B00001

To compile the data, all GIS shape file layers and tables were loaded into ArcGIS and joined on the appropriate variables. Data was then transformed to the census block level if it did not exist in this form already and then clipped to the RTA service area. A model was then run in ArcGIS to calculate the population density, percent of zero-vehicle households, percent of households with people with disabilities, percent of the population older than 65, and employment density within each block. This data along with the median household income, school, hospitals, park and ride lots, commuter rail, and colleges and universities was then extracted into Excel for each block within the service area of LRTA.

Using the Jenks natural breaks optimization method⁷, the data for the population density, number of jobs, percent of zero-vehicle households, percent of households with people with disabilities, percent of the population older than 65 and median household income were arranged into five classes. Clipping the data during the first step allows for the evaluation of only the RTA service area, so the values for the class breaks differ among the RTAs. This is important as it minimizes the data being skewed by areas not serviced by the RTA and allows for a more accurate picture of whether the RTA’s service is deployed in the most effective way possible for that region.

⁶ Priority development area data was not included because there are no officially designated PDAs in this region.

⁷ The Jenks method is a way of arranging data into different classes by minimizing the average deviation from the mean and maximizing each class’s deviation from the means of other groups. It is based on standard deviation.



Population density, number of jobs, percent of the population older than 65, percent of zero-vehicle households, and percent of disabled households all have a positive correlation with transit demand, and thus higher values were placed into higher classes. Those that fell into class 1 were given a score of 1; class 2 received a score of 2, etc. up to class five. Income has a negative correlation with ridership, so those that fell into class 1 were given a score of 5, class 2 a score of 4, class 3 a score of 3, class 4 a score of 2, and class 5 a score of 1. The scores were then weighted based on highly recognized research done by Brian D. Taylor on the determinants of transit ridership⁸. The study uses a two stage regression model to look at more than fifteen census variables in 265 urbanized areas to determine which characteristics impact the level of transit use the most. The parameter estimates found in the study were used to weight the classification value given in the previous step for population density, percent of zero-vehicle households, and median household income. These weights represent the relative impact each variable has on transit demand, with higher weights being assigned to variables that have a higher likelihood of increasing the demand for transit within an area.

Taylor’s research showed that the percent of college students has a positive correlation to ridership. A weighted score was calculated by dividing the number of enrolled students according to the National Center for Education Statistics by 1,000. For the commuter rail stations, schools, and hospitals one point was given for each located within the block. Work trips are one of the primary trips taken by individuals so weight of 1.5 was applied to the classification score for the number of jobs located in a block. Park and ride lots were scored by dividing the number of spaces by 100 to provide a weighted score for ridership. Research has also shown that people with disabilities are more likely to use transit than those without as it may be their only mean of motorized transport. A complete set of variables and method for calculating its value can be seen in Table 12.

Table 12. Transit Demand Variables and Formulas

Variable	Value Calculation
Population Density	Classification score * 0.76
Zero-Vehicle Households	Classification score * 1.75
Schools	Number of Locations
Hospitals	Number of Locations
Median Household Income	Classification score * 0.92
Colleges and Universities	Number of Students/1,000
Disabled Households	Classification score * 0.25
Employment	Classification score * 1.5
Park and Ride Lots	Number of spaces/100
Commuter Rail	Number of Locations
Older Populations	Classification score * 1.31
Population Density	Classification score * 0.76

⁸ Taylor, B.D. et al, Nature and/or nurture? Analyzing the determinants of transit ridership across US urbanized areas, Transport. Res. Part A (2008), doi:10.1016/j.tra.2008.06.007



The scores for each variable were then summed for each block to get an overall score for transit demand by block. This data was then put into GIS and displayed to show demand for the entire region. Features such as schools, hospitals, park and ride lots, commuter rail stations, key destinations, and important features were overlaid on the map to provide a frame of reference and to act as supporting material.

4.23 Transit Demand

Following the methodology outlined above, the analysis of the LRTA system shows that overall the system is successfully serving the areas of the region that demonstrate the highest levels of transit. LRTA provides some level of fixed-route service to all but five areas that were determined to have a higher demand for service but which do not receive service (Figure 28). These underserved regions include areas of Townsend, Pepperell, Maynard, Acton, and Billerica. A further analysis of these areas explores why these areas have medium-high transit demand.

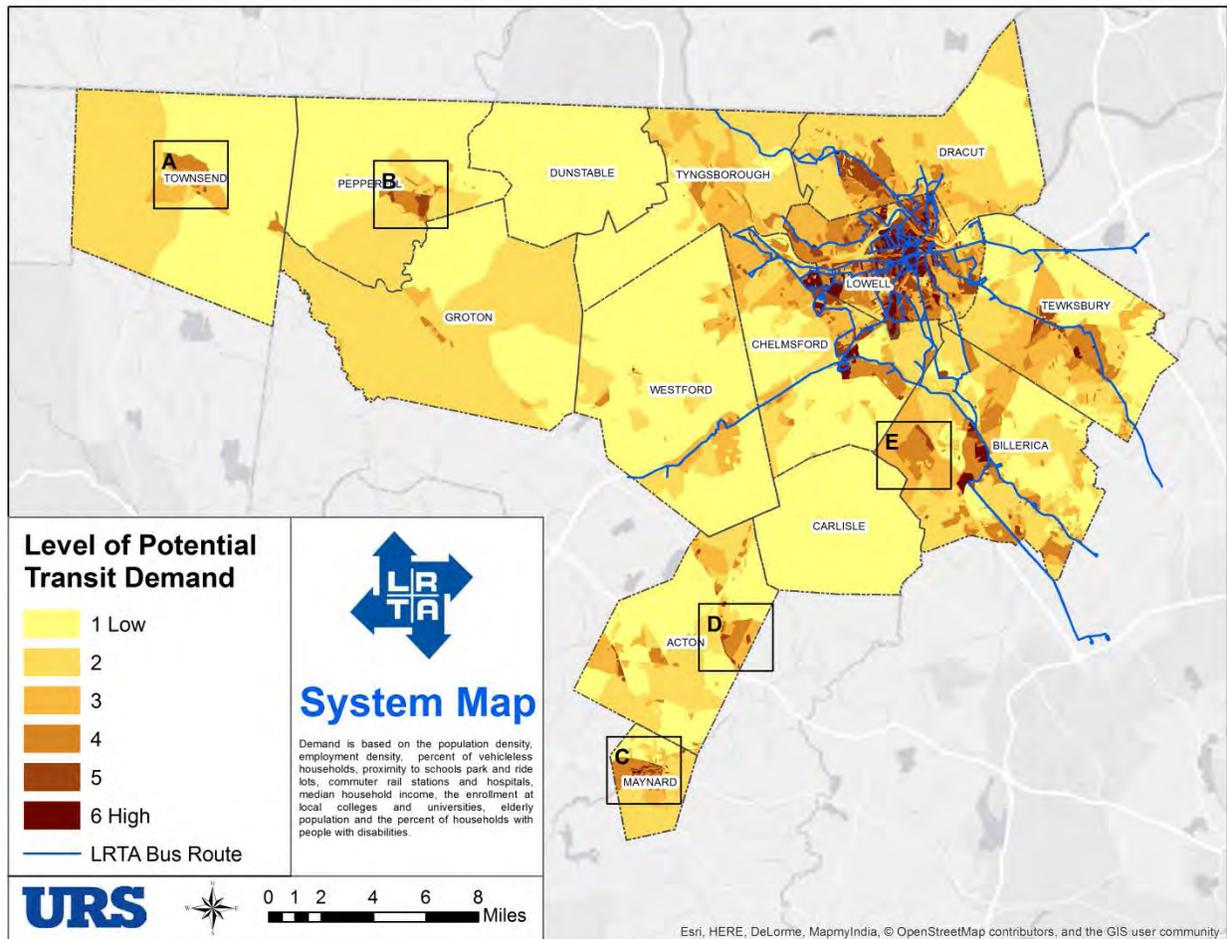


Figure 28. Underserved Areas



Area A (Figure 29) in Townsend town center has transit demand because of a high percentage of households without access to a vehicle, a low median household income, a significant number of jobs, and the presence of two schools. In the overall LRTA service area, 7% of households do not have a vehicle, but in this area of Townsend the zero-vehicle rate is 8.2%. The area also has a median household income of \$53,983, which is more than \$30,000 less than the regional average of \$85,511. This area represents a large employment center, with nearly 500 jobs. Approximately 25% of the jobs are at local small employers with 20 employees or fewer and the remaining majority are with Sterilite, a plastic container manufacturer. Outside the town center there is minimal demand for service. Given this, this area is not a candidate for fixed-route service, but an alternative service option such as dial-a-ride may be an option.

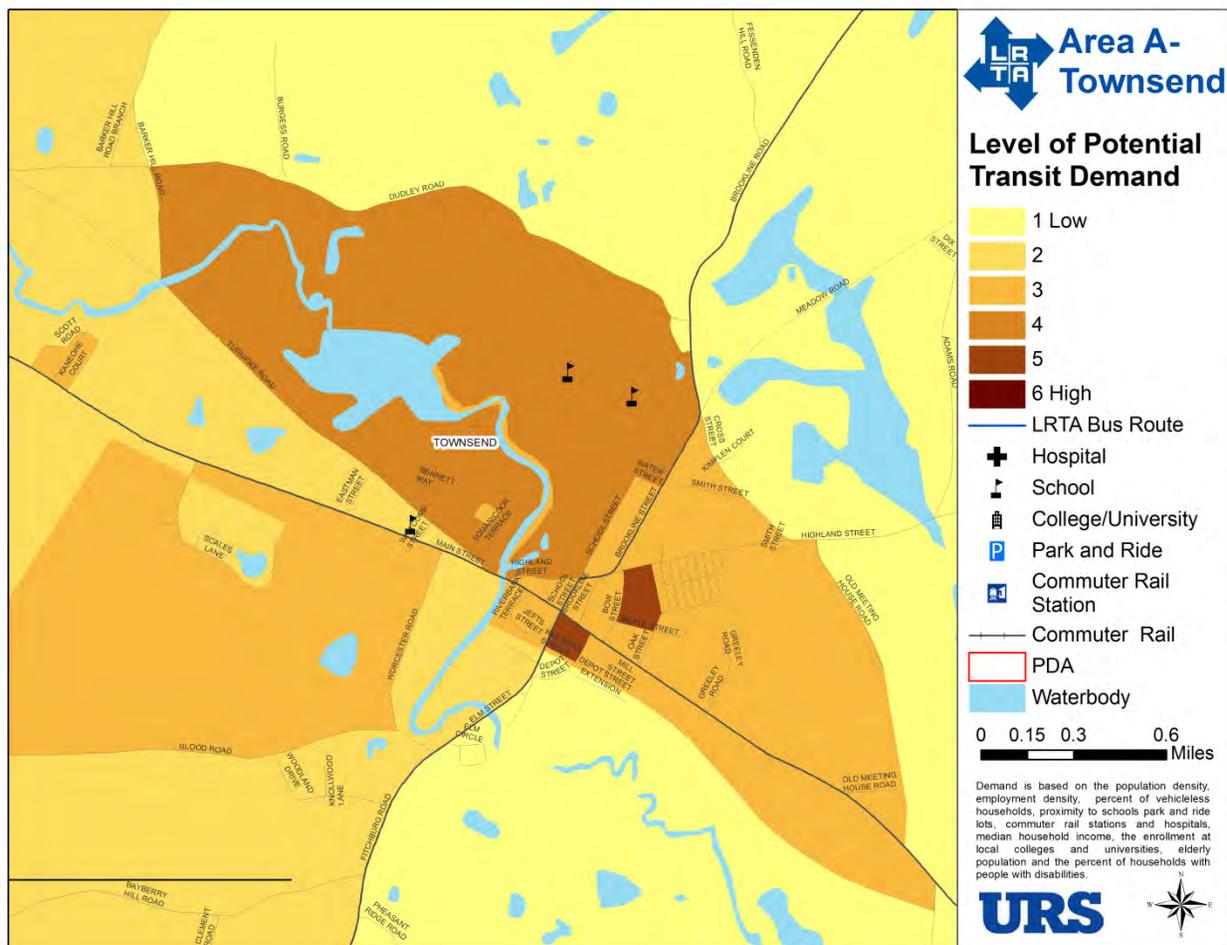


Figure 29. Area A: Townsend



Area B (Figure 30) in Pepperell has potential transit demand because of the percentage of households without access to a vehicle, low median household income, the number of jobs, and the presence of priority development areas. In this area of Pepperell the zero-vehicle rate is 11.2%. The area also has a median household income of \$61,818, which is more than \$20,000 less than the regional average of \$85,511. Job density is high due to the numerous small businesses along Route 113. This corridor, along with Tucker Street and Route 111 to the north, has been identified as priority economic development areas.

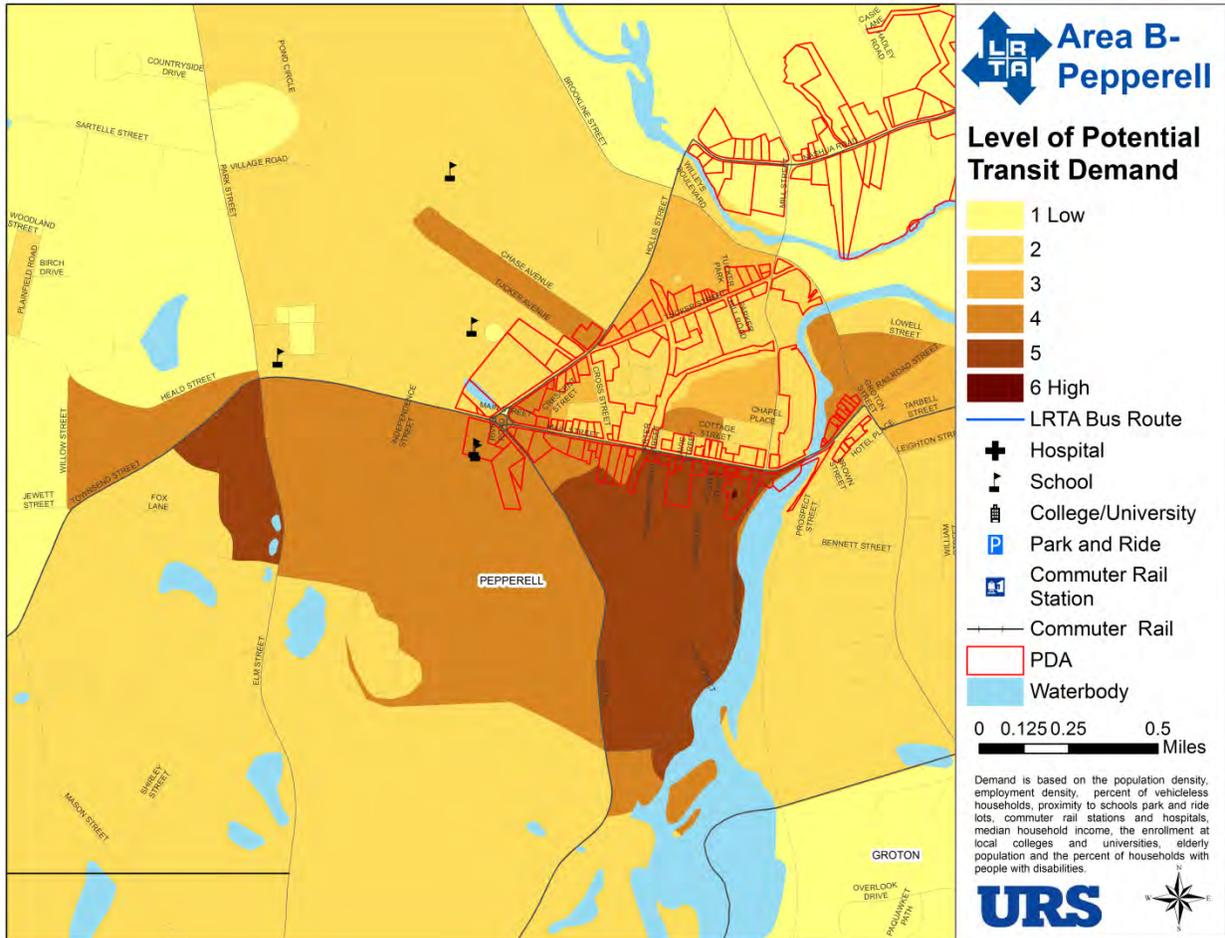


Figure 30. Area B: Pepperell



Area C (Figure 31) in Maynard has a high demand for transit service because of the percentage of households without access to a vehicle, low median household income, the number of jobs, and a high population density. In this area of Maynard the zero-vehicle rate is 13.9%-14.5%, which is higher than the state and regional averages. The area also has a median household income of \$53,000 to \$60,000, which is more than \$20,000 less than the regional average of \$85,511 and less than the state average of \$66,000. Population density in this area averages 3,000 people per square mile, more than twice the regional average. There are nearly 2,500 jobs in this town center which has more than 100 small employers. This area is also home to the redeveloped Assabet Woolen Mill, which is now the Clock Tower Place Office park with multiple offices and light industry businesses. Based on these attributes, this area should be considered for future LRTA service. Maynard is part of the CrossTown Connect (CTC) Transportation Management Association (TMA) which connects commuter rail stations to businesses where fixed route service does not exist in order to solve the “last mile problem”. The TMA provides services such as ride matching for carpools, vanpool/shuttles for reverse commuters and act as advocates for transportation in the region.

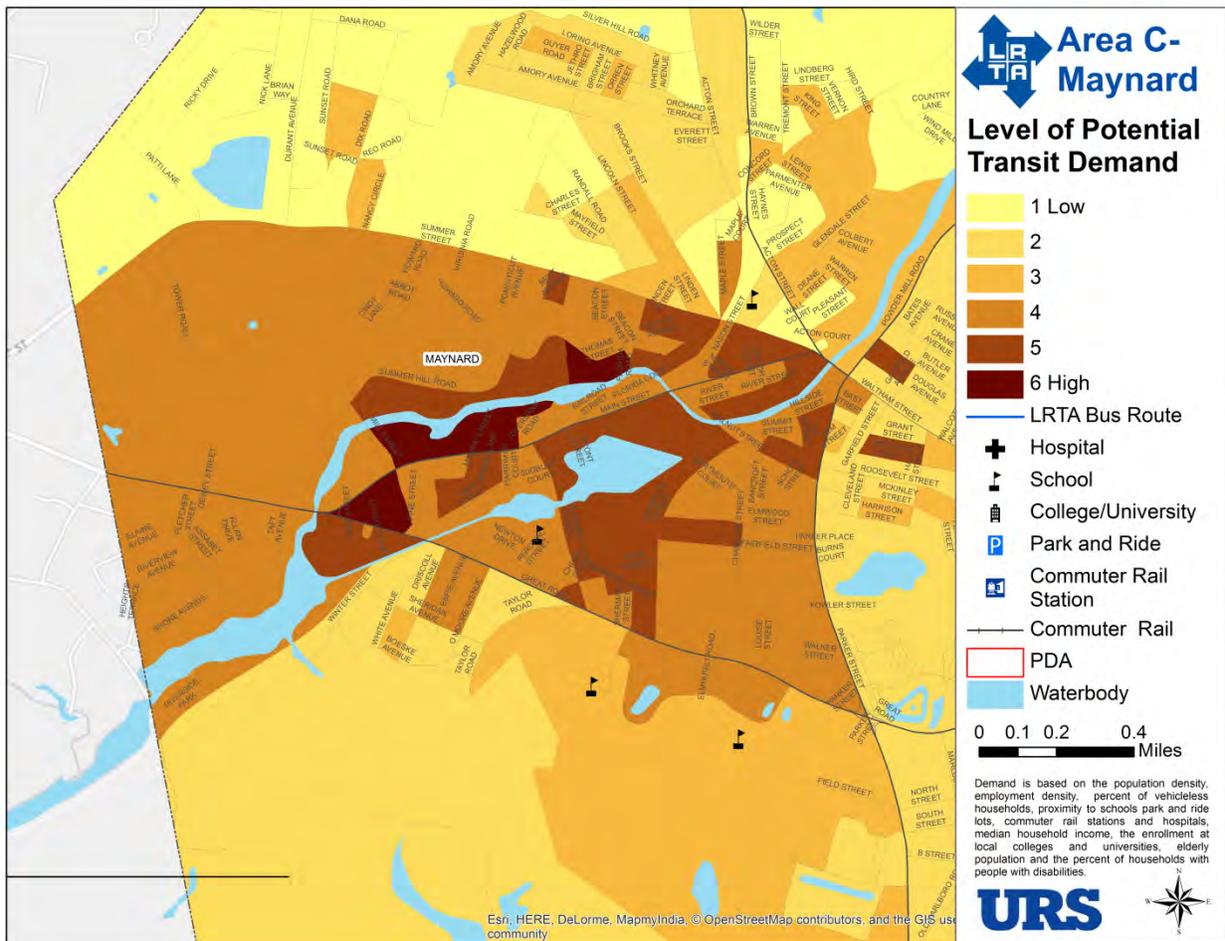


Figure 31. Area C: Maynard



Area D (Figure 32) in Acton is one of numerous potential areas for service, but due to urban sprawl service outside of the main corridors (Routes 27 and 119) would be difficult. There are several shopping plazas, small businesses, and apartment complexes; one park-and-ride lot; and a few big box stores along these corridors. Along Route 119 there are approximately 1,500 jobs. The median income along this corridor is \$68,000, but the suburban developments adjacent to the corridor have income levels that are more than twice that. Vehicle access is high, indicating a less transit-dependent population. Similar situations exist along the Route 27 corridor, though there are fewer jobs (1,000). The park-and-ride has 25 spaces and is serviced by the Yankee Line, a commuter bus to Boston with three trips daily. Acton is also part of the CrossTown Connect TMA. One attribute of the TMA is the MinuteVan Rail Shuttle which provides scheduled shuttles between the West Acton Fire Station parking lot and the Mt. Calvary Church lot to the Acton commuter rail station. Neither one of these locations are within Area D.

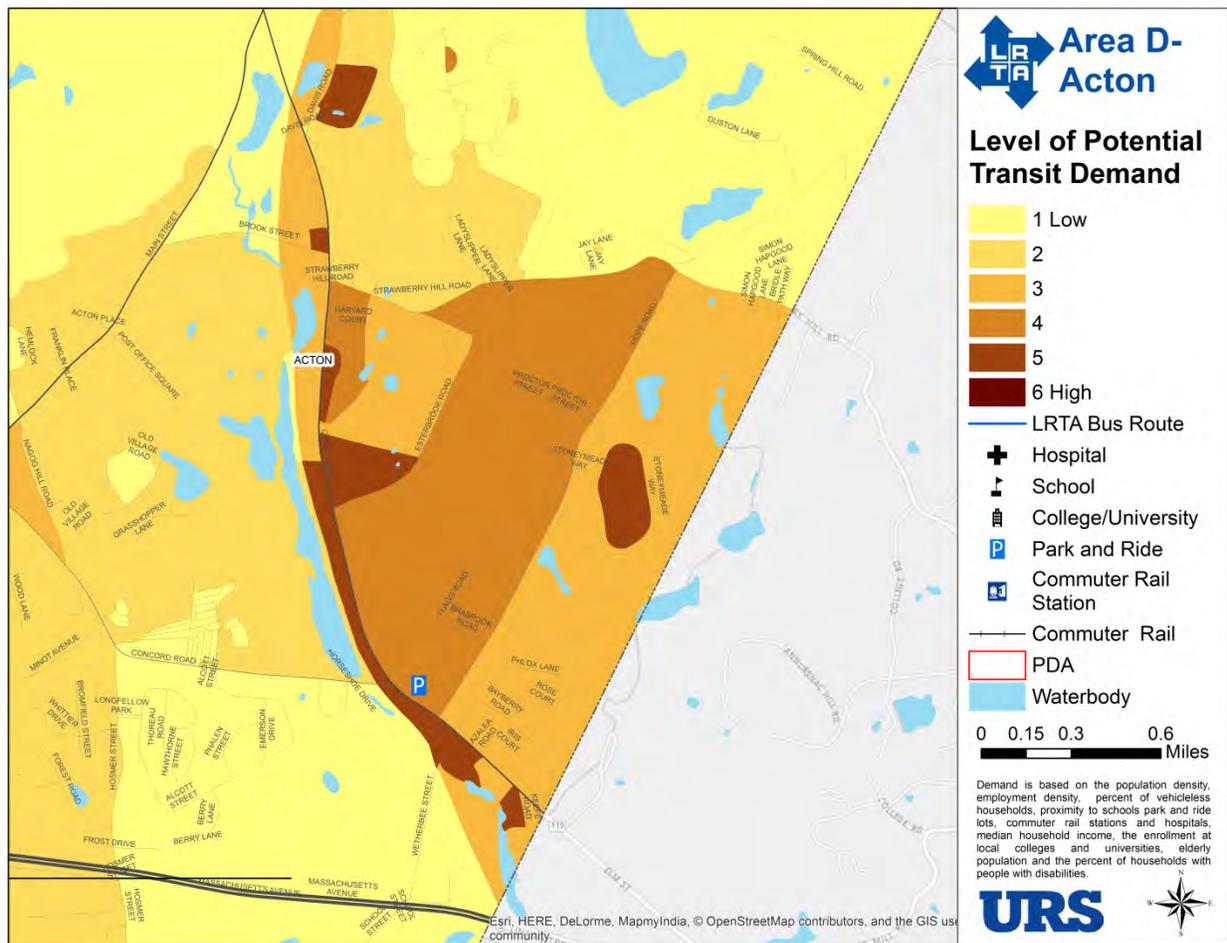


Figure 32. Area D: Acton

Area E (Figure 33) in Billerica has transit demand because of the number of jobs and the presence of a PDA. There are approximately 2,000 jobs in this area, many of which are with either Middlesex House of Correction or the numerous industries along Sterling and Esquire Roads. The corridor along Sterling and Esquire Roads has been identified for economic development as a PDA.

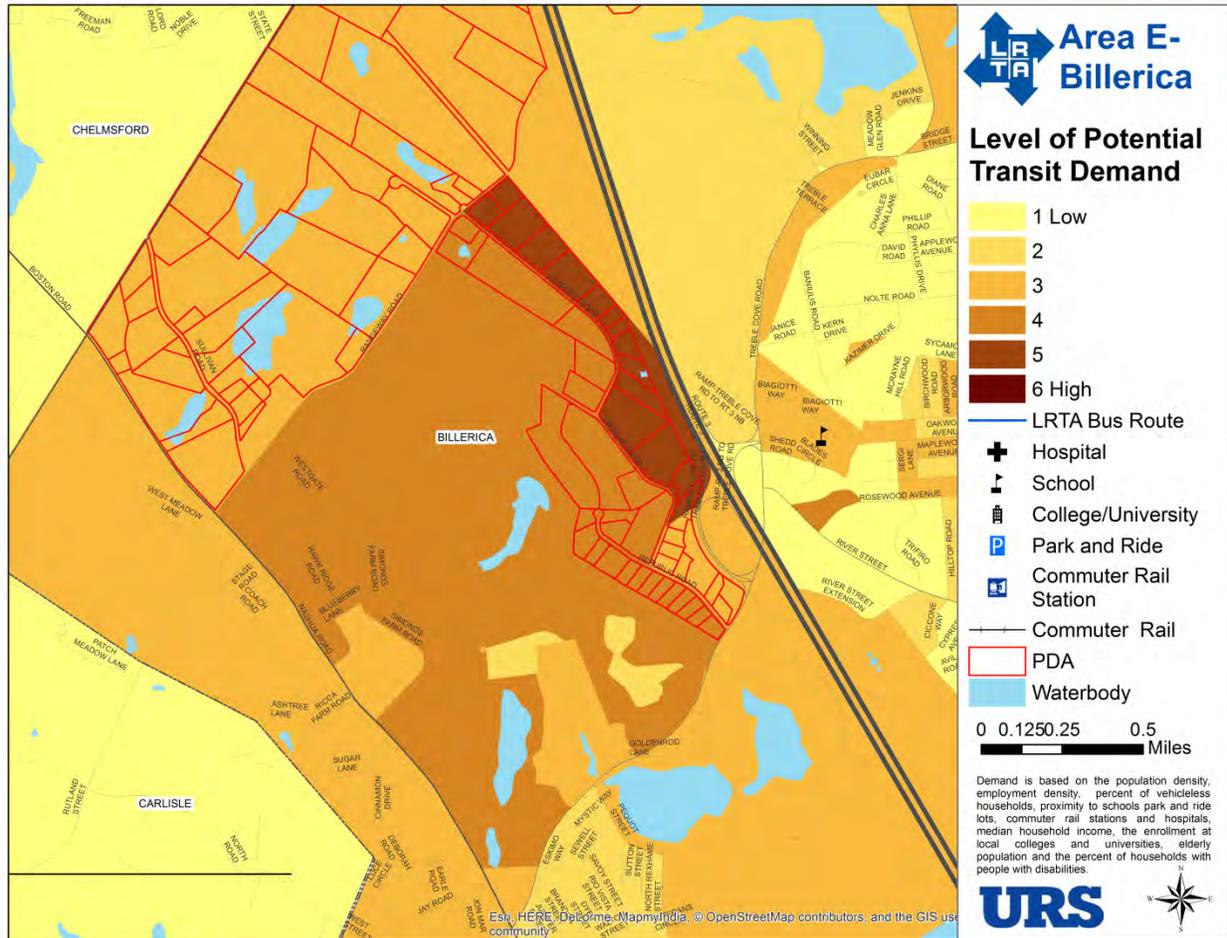


Figure 33. Area E: Billerica

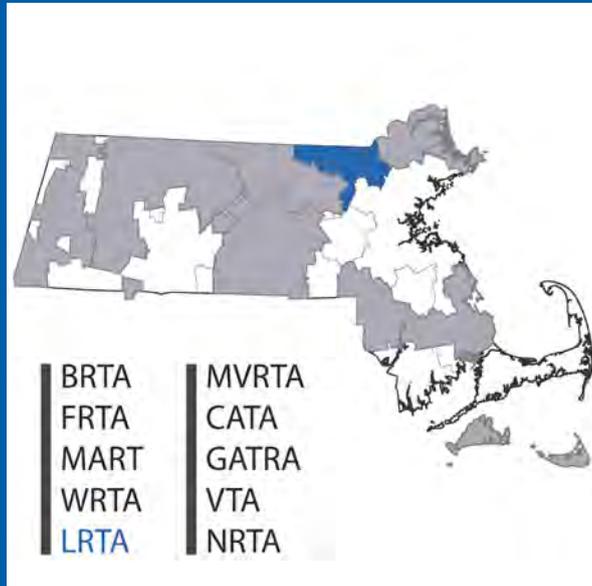
There are places in the LRTA service area that are possible candidates for service modifications to better deploy service to meet the needs of the region’s workforce and improve access to employment. Operating late night service⁹ on many of the routes would allow for second and third shift employees to use transit. Providing service outside of traditional days and times would allow for additional trips besides those for work. LRTA has demonstrated success at creating an intermodal system through providing connecting services at commuter rail stations to bring riders to their final destination. While

⁹ Night service is defined as service that runs between 7 PM and 11 PM. Late night service is any service that ends after 11 PM.



this helps to connect people to employment, more can be done. To understand what the system can achieve, we must first understand what the current demand is. The following are profiles and maps of each LRTA route depicting the transit demand within ¼-mile of each route. Recommendations in the following chapters will be designed to strengthen job access and develop even better connections.

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Chapter 5

Fare Analysis

AECOM / URS
TMD
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5. FARE RATES AND COLLECTION METHODS

5.1 Collection Methods

The Lowell Regional Transit Authority (LRTA) purchased and installed the Scheidt & Bachmann Fare Collection system which went into service November 2011. This new system replaced the outdated GFI electronic Fare Collection system. Fareboxes are installed in all fixed route buses allowing passengers to pay for their ride with a simple tap of the CharlieCard. CharlieCard debit as well as the monthly passes can be purchased at the Sales Outlet Terminal (SOT) located at the information booth at Gallagher Intermodal Transportation Center in Lowell. A second SOT is brought out to the Lowell High School on the last two days of the month for sales of Students Passes. Cards for debit and passes can also be purchased directly from the Ticket Vending Machine (TVM) located in the Gallagher passenger terminal. A brief description of these devices is provided listed below.

Farebox

Each Farebox includes a Smartcard target. This target allows a passenger the ability to pay for their fare, to load value onto their Stored Value card directly on the bus or transfer from one Route to another by simply tapping their Charlie Card on the target. In addition, the farebox is capable of electronically validating and registering (verifying) all coins and bills inserted for payment. All coins and bills are automatically identified by denomination, without operator action. All invalid coins and bills are automatically rejected and returned to the passenger. The VARE point Farebox assists operators with verification of the fare deposited by showing on the Operator Control Unit (OCU) and on the customer display the value of coins and bills inserted. All accepted coins and bills will be deposited into a single Cashbox, securely compartmentalized to separate the coins and bills. Partially damaged bills can be processed by the driver on the OCU using the “Accept next bill” command, entering the amount and bypassing the validation process.

Sales Outlet Terminal (SOT)

The Sales Outlet Terminal (SOT) is an agent-operated Point-of-Sale system. With the SOT, an agent can add Stored-value onto a Smartcard or sell Monthly passes. The SOT communicates with external devices through a network (Ethernet LAN). The device has a touch screen interface that allows an agent to specify the type of Smart Card to be sold. The user interface also allows the agent to display details of the data stored on a Magnetic Change Ticket or Smart Card and to execute certain service functions. The SOT has no module to accept coins, bills, or bankcards. Agents are expected to use SOTs as stand-alone units and to use separate cash registers, and bankcard terminals to collect payment for SOT transactions.

Ticket Vending Machine (TVM)

The Ticket Vending Machine (TVM) is customer-operated Point-of-Sale system. With the TVM, a customer can purchase a Charlie Card, add Stored-value to the card or purchase Monthly passes. The



TVM communicates with external devices through a network (Ethernet LAN). The device has a touch screen interface that allows a customer to specify the type of Smart Card to be purchased. The TVM accepts both cash and credit cards for payment.

5.2 Fare Structure

The Lowell Regional Transit Authority offers a range of fares. Currently, there is no financial incentive for using the Charlie Card stored value over cash; however, the LRTA has not had a fare increase since 2002 and a review of fares for a potential increase is presently being studied.

Table 13. Fares

Charlie Card (Stored Value) and Cash Fares	
Local - Adult	\$1.00
Local - Senior/Disabled	\$0.50
Suburban – Adult	\$1.50
Suburban - Senior/Disabled	\$0.75
Transfers	
Local - Adult	\$0.25
Local - Senior/Disabled	\$0.10
Suburban – Adult	\$0.50
Suburban - Senior/Disabled	\$0.25
Monthly Passes	
Adult	\$35.00
Senior/Disabled/Student	\$20.00

5.3 National Best Practices

This chapter provides an overview of different fare policies and fare media that are used throughout the United States. While the fare policies and practice of LRTA reflect local needs and practices, the comparison with national standards can provide helpful insight and guidance regarding ways to improve available fare media and policies. The fare policy and standards section describes various policies and fare pass types employed by transit agencies and represent standard fare practices on a national level. A wealth of information regarding best practices in fare policy, technology, and fare media is presented by the Transit Cooperative Research Program (TCRP) and forms the basis of this section. Information is also supplemented by research on specific fare practices of transit agencies throughout the country.



An overall summary of TCRP Report 94, the update on Fare Policies, Structures, and Technologies shows that¹⁰:

- Overall fare levels are increasing, specifically the base cash fares
- Agencies are moving towards a more simplified fare structure
- Many agencies are moving away from a policy of free or reduced cost transfers and replacing the transfer policy with a day pass that can be purchased onboard vehicles
- Pre-paid and multi-trip fare media is growing
- Many agencies have either implemented or are exploring Smart Card technologies
- Regional fare integration, where multiple operators within a metropolitan region, are moving towards a common fare policy and media improving the customer experience

5.31 Fare Technology and Media

Fare technology and media represent the primary hardware and software for collecting passenger fares onboard transit vehicles. Transit agencies throughout the country use a variety of different fare technology and media (how the fare is paid). The technology and media have evolved greatly over the years. Current fare technology runs the range from non-registering fareboxes which are literally just containers that house the fare revenue deposited by passengers all the way up to SmartCard technologies that allow passengers to pay their fare with a quick pass of a credit card size fare instrument. Technology is evolving in such a way that some agencies have been experimenting with paying fares using SmartPhone applications. Some systems, primarily rail and Bus Rapid Transit systems, have off-board fare collection technology with a proof of payment system. Below is a description of different fare technology and media.

Non-registering fareboxes are the simplest fare technology. These fareboxes are little more than containers where passengers are able to deposit fares. These fareboxes can only accept cash fares or, if the system utilizes them, fare payment coupons. Flash passes, coupons, and punch cards are used for prepaid fare media. These fareboxes do not have the ability to track ridership payment characteristics. Many operators who use these fareboxes will have a separate passenger counter device that the operator manual “clicks” for each fare type. Very few systems use non-registering fareboxes nowadays.

Registering fareboxes allow for fares to be paid and data to be collected regarding fare types. These fareboxes can collect the number of passengers boarding a bus by each fare type for each trip operated. Registering fareboxes can be designed to accept different types of fare media including flash or punch passes or even magnetically coded fare cards. With magnetically coded fare cards, the fare type can be read automatically by the farebox. For punch and flash passes, operators can manually enter information regarding fare type paid. These are currently the most common types of fareboxes.

¹⁰ Transit Cooperative Research Program Report 94: Fare Policies, Structures, and Technologies pages 2 through 5



The newest fare technology used by transit agencies are known as a SmartCard system. The SmartCard fare instrument is the size of a credit card and can be loaded with any kind of pass or stored value passes. SmartCard readers are needed on fareboxes in order to process fares. Similar to the magnetically coded fare media, many different fare types are available and are automatically counted by the farebox itself. By installing SmartCard readers at each door of a transit vehicle, multiple door boarding can be facilitated. Another advantage of SmartCards is that they can be used by multiple systems. The Massachusetts Bay Transportation Authority (MBTA) Charlie Card, which is also accepted by ten of the fifteen Regional Transit Authorities¹¹, is an example of a SmartCard. There is a high cost to transit agencies when implementing SmartCards as they require new or modified fareboxes, and the fare media itself is rather expensive.

SmartCard technologies are constantly evolving such as with contactless technology where a user no longer swipes a farecard but simply taps the card on a reader and enters and mobile ticketing where ones pays their fare from their smartphone. An example of a contactless card is the Washington METRO SmarTrip card. Transit agencies are also starting to experiment with fare payment through cellular telephone. With this, the cellular telephone operates as a SmartCard and has the ability to store multiple pass options and fare types. This works by riders downloading an application onto their cell phone, payment is processed through the app and a transit pass is produced on the person's phone¹². This mobile ticketing system is currently used by TriMet in Portland, OR, the first agency in the US to pilot this for fixed route. The user simply selects their rider and mode type to purchase a ticket, then when they want to use it they select the ticket which generates a QR code that the fare inspector can scan. The technology was developed by GlobeSherpa, a Portland based software company. Similar technology, developed by Bytemark, was deployed in 2014 at Capital Metro in Austin, TX. Locally the MBTA uses technology developed by Masabi for mobile payments on their commuter rail and ferry systems.

In the future, other technologies such as the Magic Band which Disney uses as admission to the park, connects to your credit card for easy payment and unlocks your hotel room, may be possible for travel on transit. The band contains a short range RFID chip similar to the read-only RFID¹³ chip found in contactless SmartCard technology. The Disney Magic Band is similar to the UBand made by IDenticard.

¹¹ Charlie Card is accepted for fare payment by the following operators: Massachusetts Bay Transportation Authority, Berkshire Regional Transit Authority, Brockton Area Transit Authority, Cape Ann Transportation Authority, Cape Cod Regional Transit Authority, Lowell Regional Transit Authority, Merrimack Valley Regional Transit Authority, MetroWest Regional Transit Authority, Montachussetts Regional Transit Authority, Southeastern Regional Transit Authority, and Worcester Regional Transit Authority

¹² <http://trimet.org/mobiletickets/>

¹³ Radio-frequency identification cards (RFID) is a wireless chip which uses electromagnetic fields to transfer data,

The UBand uses MIFARE¹⁴ technology to provide contactless access and payment and is currently being used by Mohawk College in Ontario. In the United Kingdom, Barclaycard launched the bPay band a similar wrist band which users can link any VISA or MasterCard debit or credit card to and can be used at any establishment that accepts contactless payments (300,000 locations). Amongst the many things the band can be used to pay for is the fare (bus or rail) on Transport for London¹⁵.



Figure 34. SmartCard Technologies. Left WMATA Smartrip contact-less; Center TRI MET mobile ticketing; Right Disney's Magic Band

Fare media has evolved drastically over the last 100 years for transit from entirely cash based system to the new innovative contact technology merging today. The first fare media was the token followed by the ticket. These allowed transit agencies to offer discounts over the cash fare. Tickets were used until magnetic stripe cards were introduced, this allowed for the development of passes. Tap cards were developed next with RFID technology and had the capability of operating as a stored value card and as a daily, weekly monthly, etc pass. The newest technology is contactless “open” fare payments which are directly linked to debit or credit cards and can be in plastic card form, on a mobile device and now a wrist band. Regardless of the type of technology used reducing cash transfers benefits the transit system all around. The overhead cost to process cash as opposed to cards can be as much as double due to the security measures and personal needs to empty vaults and count money. Improved farebox technologies not only can improve operating costs but can speed up the boarding time of passengers thus reducing the overall travel time.

In Helsinki, an innovative fare strategy is being implemented through a new market approach viewing Mobility as a Service (MaaS). The principle of the MaaS approach focuses on door-to-door service and mobility as a whole package, instead of each mode individually. Through this method, users are able to plan their trip through one portal and payment system. Different packages provide riders with unique

¹⁴ MIFARE is the name of the technology (chip) that is created by NXP. It complies with international standard ISO/IEC 14443 for data security and transmission protocols for communication with contactless integrated circuit cards , proximity cards and identification cards.

¹⁵ The agency who oversees the London rail and bus network.

options to meet their transit needs. For example, an urban commuter package, available for purchase at a set price point, may include free public transport in the rider’s home city, up to 60 miles in taxi services, 300 miles for rental cars, and 1,000 miles in domestic public transport. Packages are flexible and can be adjusted to meet the needs of different service areas. Incorporating all transport modes into one, user-friendly interface will provide seamless service to the rider and encourage the use of public transportation over personal vehicles.

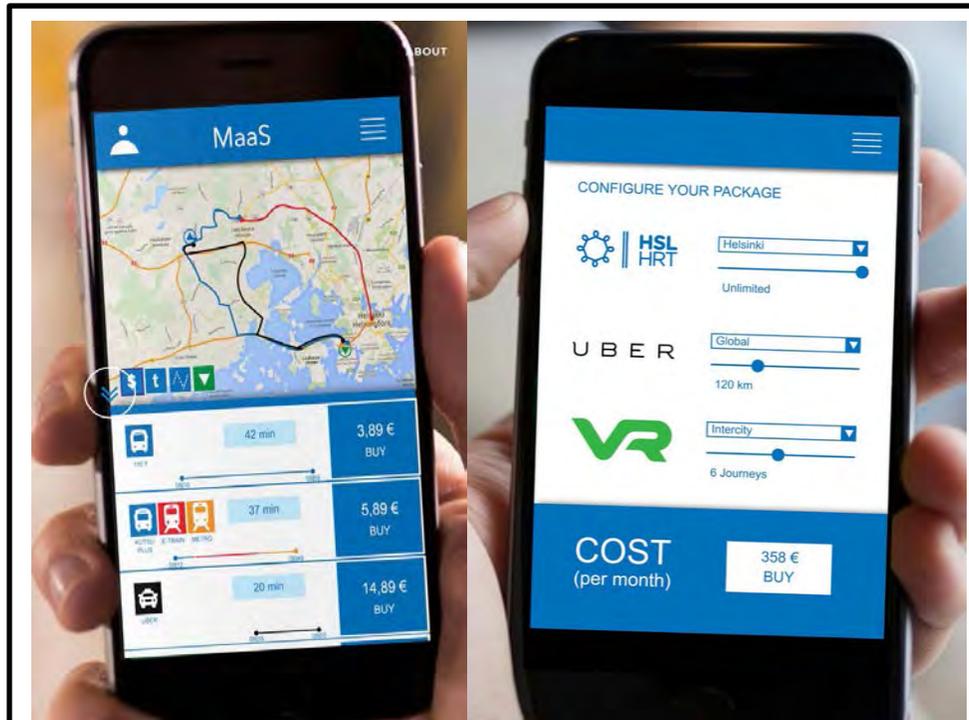


Figure 35. Helsinki Mobility as a Service App

Some systems have implemented off-board fare collection/proof of payment fare payment. Off board fare collection requires fare equipment located at stops and stations and allows for faster boardings. Passengers pay their fare off-board and are issued a receipt or their farecard is validated for the trip. Fare inspectors randomly check to see if passengers have paid their fares by scanning farecards or looking at the receipts. Those who have not paid fares are issued a citation.

5.32 Fare Policy and Standard Practices

A review of fare policies around the country provides a myriad of different fare types and fare media. Fare media types include unlimited ride passes and multi-ride/stored value transit fares. A description of cash fares and transfer policies are included in this section. Fare policies and standard practices vary amongst various transit agencies and are suited to meet individual local conditions.



Fare Policies

Cash fares are accepted by almost all transit agencies. Most transit agencies accept only exact fare and will not make change. A small number of agencies will make change for passengers on some or all services. Some agencies have limitation with their fare collection equipment that only allows the farebox to accept coins, while most operators are able to accept both bills and coins.

Unlimited ride passes allow users to take as many rides as needed over a set period of time. These passes are a pre-paid fare media and come in many increments. Most agencies have either a 30-day, 31-day or “monthly” pass. For a shorter duration, agencies may have a week pass or even a two-week pass. The shortest duration pass is a one-day pass and agencies that sell a one-day typically do not have free or discounted transfers. Unlimited ride passes provide a discount over cash fares, with the discount related to the number of times the pass is used as it represents a single payment over a time period. The issue with unlimited ride passes is that it typically requires a large upfront payment by customers to take advantage of the discount, which may be difficult for lower income users.

Multi-ride passes or stored value cards allow for passengers to buy a set number of transit trips ahead of time usually at a discount. These pass/stored value cards allow for the pre-paid purchase of discounted fares. Similar to the unlimited ride passes; these fares require a large upfront payment, although not as large as the unlimited ride passes, in order to take advantage of discounts. Multi-ride passes/Stored value cards can come in a variety of different types of media and formats including ticket books, tokens, punch cards, or as stored values on a fare card or SmartCard.

Some agencies have instituted free fares. Free fares primarily exist in places where the primary generator in the area is a major university. In these areas, funding sources for transit services come from the university. In other locations, college students are provided a free transit pass that is funded by student service fees, parking revenues at the college, general fund revenue, or a combination of these sources. An example of a system that has a free fare policy is Chapel Hill Transit in North Carolina, which serves the University of North Carolina¹⁶.

Transfer policies are a very important consideration and part of any fare policy and fare media. Transit passengers have varied origin and destination locations so it is impossible to serve all passengers without requiring passengers to transfer. Many systems are designed around bringing passengers to a central location where they can connect to another bus to reach their destination. Other systems have transfers occur at points where two or more routes intersect. Regardless of transfer location, transfer policies have an impact on ridership. The existing transfer policies include allowing transfers to occur for free, transfers to occur at a low cost, or requiring passengers to pay full fare when transferring. Some

¹⁶<http://www.townofchapelhill.org/town-hall/departments-services/business-management/fee-schedules/transit-policies-fee-schedules>



systems have different policies based on fare media used, for example a free transfer if using a SmartCard while cash passengers have to pay full fare when transferring.

Standard practices

Fare policies typically respond to local needs. In some locales the fare policy and changes to fare policies are well codified. In other locations, fare policies change only in response to an identified issue; otherwise fare policies may not change at all for a long time. Fare policies need to be responsive to local needs. The fare policy has to be cognizant of the need to provide an adequate local share of operating costs. That being said the fare policy has to also strike a balance between being equitable to all users, encourage pre-paid fares, encourage ridership, and the need to raise local revenue.

Federal rules and guidelines need to be taken into account in fare policy discussions. Environmental justice concerns also need to be taken into account as part of fare policy and fare policy changes as it relates to Title VI of the Civil Rights Act of 1964. Legal proceedings have forced modifications to fare policies and fare policy changes due to environmental justice concerns¹⁷. Environmental justice concerns are addressed by ensuring that fare policy changes are equitable for all services an agency operates. Fare policies also need to be consistent with rules and guidelines with the American’s with Disabilities Act.

As stated previously, very few agencies have a policy regarding fare changes. Primarily, agencies adjust fare levels based on a specific need, usually the need for additional directly generated revenue. This could be in response to cuts in funding from other sources, changes in cost structure, or overall cost increases. On a philosophical level many agencies prefer to increase fares along with improvements in service so that passengers are receiving “better service” as part of higher fares.

The key elements of a fare policy include a base cash fare, multi-ride fare media, unlimited ride passes, and a transfer policy. Ten out of fifteen RTA’s in Massachusetts use the Charlie Card SmartCard for fare payment which does have the ability to store unlimited ride passes. Beyond this fare policy, transit agencies have been partnering with colleges and universities to fund UPass programs which provide free trips for students and guaranteed revenues for the transit agency.

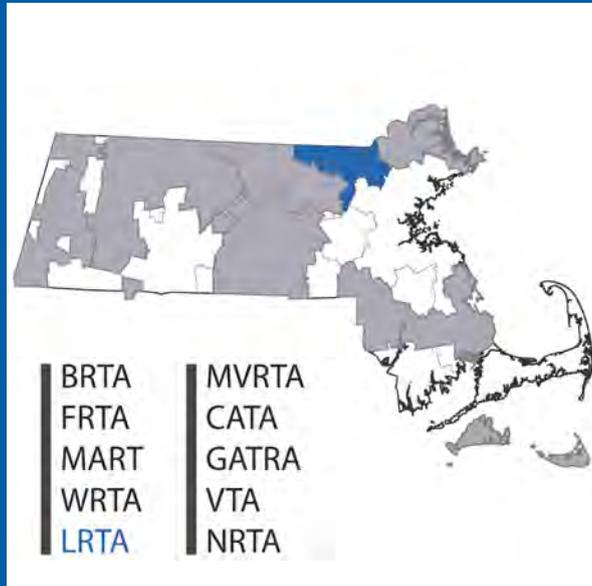
5.4 Conclusion

Moving forward, the best plan of action involves each of the RTA’s joining together to research and develop innovative fare policies and media for the next generation. Through collaboration, the RTA’s have the chance to implement fare strategies that can function collectively across Massachusetts and be a model for innovation. As the Sheidt & Bachmann fareboxes and CharlieCard technology, that many of the RTAs have, becomes outdated and must be replaced this present an opportunity for the RTAs to explore alternative technology such as the MaaS project in Helsinki, mobile payments, or the

¹⁷ Transit Cooperative Research Program Report 94: Fare Policies, Structures, and Technologies page 5



bPay/Magic Band/Uband. A system-wide approach, as opposed to individual fare strategies for each RTA, will foster a cohesive transit system and provide riders an easier opportunity to travel between the RTA's.



Chapter 6

Environmental

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6. ENVIRONMENTAL

6.1 GreenDOT Policy

In 2010, MassDOT launched their sustainability and environmental responsibility initiative to “green” the state transportation system, called GreenDOT. All branches of the Commonwealth’s transportation system (transit, air, highway and planning) are subject to the policies contained within the GreenDOT initiative. The policy is driven by three primary objectives: (1) reduce greenhouse gas emissions, (2) promote healthy transportation options, and (3) support smart growth and development. In order to meet these objectives and to become a national leader in sustainability and transportation, MassDOT created an implementation plan in 2012 that outlines 7 themes (Air, Energy, Land, Materials, Planning Policy & Design, Waste, Water) and 16 sustainability goals. As part of the GreenDOT policy, each indicator was given a priority for implementation. Indicators for immediate implementation are those that were to be implemented by 2013, medium-term by 2015 and long-range policy targets for 2020.

While the concept of improving sustainability and environmental responsibility would prove beneficial for Massachusetts, coordination and input from the 15 RTAs across the state has not yet occurred. In addition, while the GreenDOT policy outlines 331 indicators applicable to the rail and transit division, not all of these are relevant to the fifteen RTAs across the state¹⁸. Those that are not relevant are often the responsibility of the MBTA, Bay State Roads, metropolitan planning organizations, and/or MassDOT but not the RTA. Many of the policies extend beyond the responsibility and reach of any of the RTAs and the timeline for achieving the indicators are not realistic or necessarily right sized for the RTA’s. Many of the RTA’s (either individually or collectively) will require more time to implement these environmental initiatives. A logical step is for each RTA to coordinate and confirm with MassDOT which initiatives are the most appropriate and achievable actions that can be taken and how best to achieve them.

In addition to GreenDOT, Massachusetts recently passed regulation *310 CMR 60.05: Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation*. The purpose of the act is to assist the state in achieving their goals of reduced greenhouse gas emissions (GHG). There are various parts to the regulation that require interagency coordination between MassDOT, Metropolitan Planning Organizations (MPOs), Regional Transit Authority’s (RTAs), the Department of Environmental Protection and the Executive Office of Energy and Environmental Affairs. The RTAs are specifically given 4 tasks:

- Conduct comprehensive service reviews (CSRs),
- Identify service enhancements to increase passenger ridership
- Identify vehicle technology and operational improvements that can reduce GHG emissions
- Work within the MPO process to prioritize and fund GHG reduction projects and investments

¹⁸ Mass GreenDOT policy <http://www.massdot.state.ma.us/GreenDOT.aspx>



The RTAs along with MassDOT and the MPOs will be required to calculate GHG impacts on all RTP projects, consider GHG impacts when prioritizing and selecting projects, and report GHG impacts of all projects. Spreadsheet calculation tools have been developed for calculating GHG emissions and air quality analysis on bus replacements, new bus services, complete street programs and park and ride lots. The Department of Environmental Protection requires that the GHG impacts be measured for all projects and reported annually.

This section of the LRTA plan examines how the policy’s themes and goals are being applied to regional transit authorities and which ones in particular LRTA is currently meeting. There are a total of 331 indicators identified in the GreenDOT policy for the rail and transit division of MassDOT, of which only 224 or 68% are applicable to the LRTA. Of the 224 applicable indicators, 108 are short term indicators which are recommended to be in place by 2013, 89 are medium term indicators to be implemented by 2015 and the remaining 27 indicators should be implemented by 2020. LRTA has met 81 (75%) of the short term, has met or is working towards meeting 72 (81%) of the medium term and 19 (70%) of the long-range indicators (Figure 37). Overall, the LRTA is meeting 162 (72%) of the 224 applicable indicators (Figure 36), even though 36% are not required to be met until the end of 2015 or 2020 according to GreenDOT.

The LRTA is working continuously to achieve the indicators and has accomplished many of them ahead of schedule. Some of the applicable indicators are joint responsibilities of the LRTA, MassDOT, the planning commission or the municipality and they must work collaboratively to achieve success. Additionally, of the 107 indicators that do not apply, some reasons may be because they are specific to the MBTA, specific to rail, require that there has been or will be new construction, they are for MassDOT owned facilities, they are for environmentally sensitive land areas, and/or there may be other constraints beyond the LRTAs control.

Table 14. GreenDOT Goals, Objectives and Indicators

Theme	Goals	Objectives	Indicators	Applicable Indicators
Air	2	11	49	35
Energy	2	7	39	23
Land	2	9	45	28
Materials	3	14	63	43
Planning, Policy & Design	3	12	56	39
Waste	2	9	33	30
Water	2	9	46	26
Total	16	71	331	224

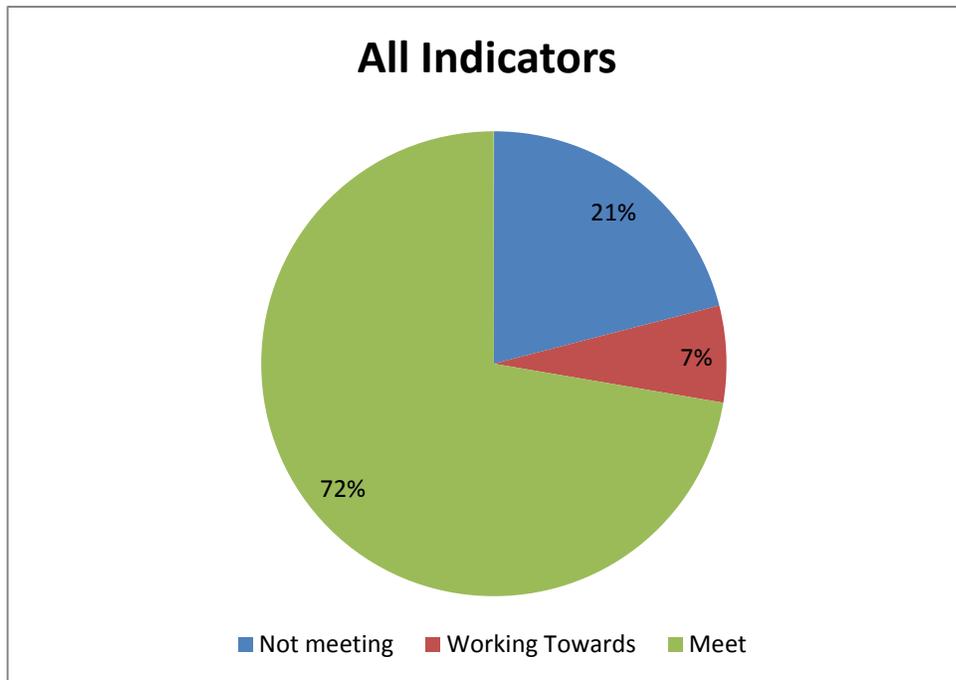


Figure 36. All indicators Level of Attainment

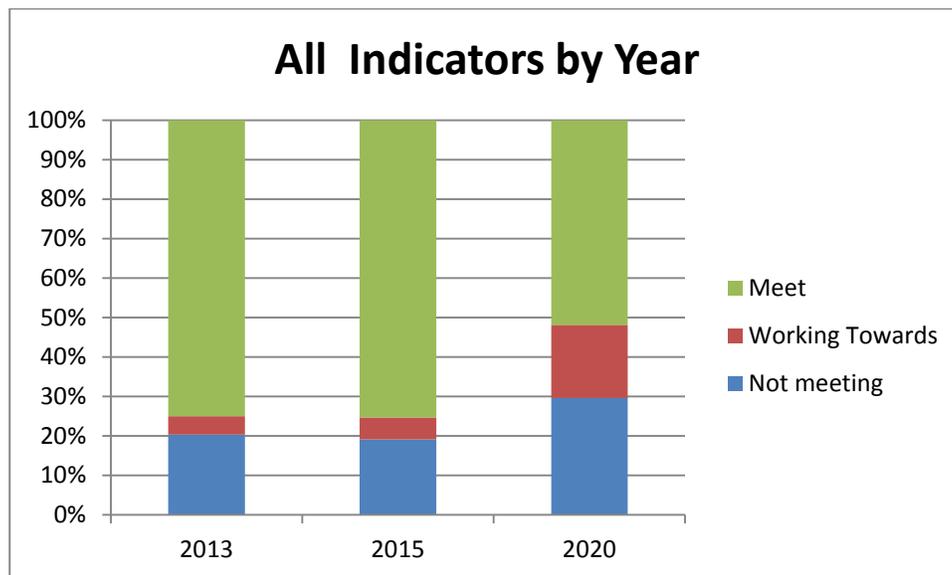


Figure 37. All Indicators Attainment by Year

6.21 Air

Air goals include improving the state’s air quality and reducing greenhouse emissions. There are 49 indicators for air but only 35 (71%) are applicable to LRTA. LRTA is meeting 15 (43%), working towards 0 (0%) and not meeting 20 (57%) of the applicable air indicators as seen in Figure 38. Figure 39 outlines the air indicators by implementation time and level of achievement. There are 14 indicators in the air



theme which are not applicable to LRTA. For the applicable indicators 13 are short term indicators, 14 are medium-term, and 8 long-range. Of those that are applicable to LRTA they have met 6 (46%) of the immediate implementation (2013) indicators, and are working towards or meeting 7 (50%) of the medium-term (2015) indicators and 2 (25%) of the long-range indicators.

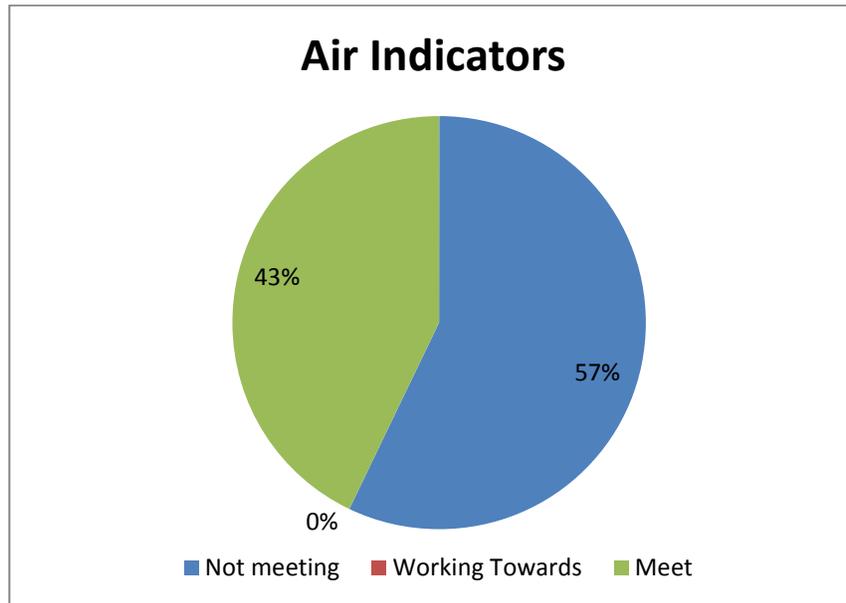


Figure 38. Air Indicators Level of Attainment

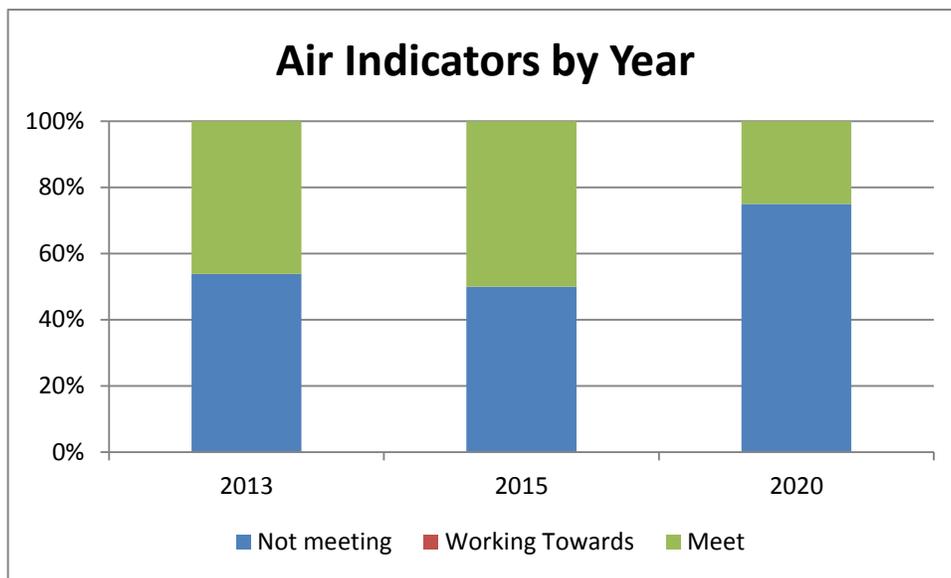


Figure 39. Air Indicators Attainment by Year



Table 15. Air Goal Achievement

Goal 1: Improve Statewide Air Quality	
Objective: Reduce emissions from maintenance & construction equipment	
Indicator	Contribution
Retrofit + use of hybrid engine system for each vehicle class piloted	No
Diesel retrofit program for on and off-road vehicles expanded	Not Applicable - Do not have a retrofit program
Hours of non-revenue vehicle operation reduced by 5% through operations streamlining	Yes
Electric and/or full exhaust cycle motors have replaced 2-stroke equipment	No
All new heavy equipment purchased run hybrid, CNG, or other high efficiency engines	Yes
Objective: Decrease total engine idling	
Indicator	Contribution
On-board electrification of maintenance equipment for each vehicle type piloted	Not Applicable
MassDOT compliance with anti-idling laws ensured	Yes
On + off-road anti-idling policies included in all construction, maintenance + service contracts	Yes
Anti-idling policies, more restrictive than state law developed to eliminate unnecessary idling	Yes
Anti-idling technology in transit vehicle + maintenance truck operations utilized	Yes
90% of MassDOT over-road maintenance vehicles run hybrid engines or have on-board electrification	Not Applicable – Not MASS DOT
Objective: Decrease volatile organic compound discharge from facilities	
Indicator	Contribution
Spray painting restricted to permitted booths + emissions controls installed at spray shops	Not Applicable - no spray shop on site
All maintenance yard gasoline fueling pumps retrofitted with vapor recovery systems	Yes
Technologies for diesel + jet fuel vapor recovery explored + implemented where feasible	No
Air emission control training provided to all maintenance employees	No
Objective: Increase fuel efficiency of operating transit fleet	
Indicator	Contribution
100% of transit bus fleet replaced or retrofitted with hybrid systems or best in class fuel efficiency vehicles	Yes
Statewide diesel transit + school bus retrofit program optimized + balanced with efficient vehicle purchases	Yes
20 new high efficiency commuter rail diesel locomotive in service	Not Applicable - Do not operate Commuter rail
40 new high efficiency commuter rail locomotives purchased	Not Applicable - Do not operate Commuter rail



Objective: Increase efficiency of transportation systems operations	
Indicator	Contribution
Bus route efficiency measures implemented by all transit operators	Yes
Planned bridges and ROWs designed to increase options for double tracked lines + allow double-stack cars	Not Applicable - Do not operate rail
Six rail corridors upgraded to increase speed including separated grade crossings or other improvements	Not Applicable - Do not operate rail
Dwell time of commuter rail trains at stations decreased	Not Applicable - Do not operate Commuter rail
Program initiated to increase the number of high level commuter rail platforms	Not Applicable - Do not operate Commuter rail
Electronic tolling facility of road and parking facilities launched	No

Goal 2: Reduce Greenhouse Gas Emissions

Objective: Increase vehicle electrification facilities	
Indicator	Contribution
At least 30 electric vehicle (EV) chargers installed along state highway system + transit parking areas	Not Applicable – Not MASS DOT
All major park and ride, + transit parking lots (>50 vehicles) have charging stations	No
Feasibility analysis of expanding the use of battery + fuel cell powered buses completed	No
Optimal Statewide EV plug-in station network planned + implemented	Not Applicable - State Initiative
The feasibility of electric commuter rail locomotives studied within the Commuter Rail Master Plan	Not Applicable - Do not operate Commuter rail

Objective: Increase use of alternative + renewable fuels	
Indicator	Contribution
Bio-fuel (such as B10-B20 biodiesel) tested in oil heated buildings	No
20% biodiesel (B20) blend purchased for oil heated buildings	No
Recycled vegetable oil / non-food stock impairing fuel purchased for biodiesel blends	Not Applicable - no biodiesel
Volume purchasing of alternative fuels established across facilities + divisions	Yes
B10 + B20 biodiesel pilot begun in all diesel vehicle types	No
B10 to B20 biodiesel utilized in all diesel vehicles, depending on availability, vehicle type + season	No

Objective: Increase fuel efficiency of light duty vehicles	
Indicator	Contribution
Vehicle fleet inventoried + prioritized for replacement and retrofit based on emissions reduction	Yes
A portion of light duty fleet in urban areas integrated with car-share programs	No
Light duty fleet downsized with carpooling, interdepartmental vehicle use, + car-sharing	No
All light duty vehicles replaced or retrofitted with hybrid, electric, CNG or best in class technology	No
50% of DOT light vehicle fleet replaced or retrofitted with zero or partially zero emission vehicles	Not Applicable - No DOT vehicles



Objective: Increase fuel efficiency of maintenance + construction equipment	
Indicator	Contribution
Performance measures added to maintenance + construction contracts for green fleets	No
15% of maintenance fleet replaced with best in class emission ratings	Yes
Objective: Increase telecommuting + meetings by web conference	
Indicator	Contribution
Teleconference technology capabilities installed at all offices	Yes
Take home vehicle fleet for office employees eliminated	No
Telecommuting + flex time options expanded for employees	No
Peak hour single occupancy vehicle trips by employees reduced by 20%	No
Objective: Track progress toward statewide GHG reduction + other sustainability goals	
Indicator	Contribution
All resource use + purchases reported for performance monitoring	Yes
MassDOT's GHG emissions target of 40% reduction from a 2002 baseline is met	Yes

6.22 Energy

Energy goals are focused on consuming less energy and increasing the percentage of energy which comes from renewable sources. There are 39 indicators for energy but only 23 (59%) are applicable to LRTA. LRTA is meeting 17 (74%), working towards 5 (22%) and not meeting 1 (4%) of the applicable energy indicators as seen in Figure 40. Figure 41 outlines the energy indicators by implementation time and level of achievement. There are 16 indicators in the energy theme which are not applicable to LRTA. For the applicable indicators 8 are short term indicators, 9 are medium-term, and 6 long-range. Of those that are applicable to LRTA they have met 7 (88%) of the immediate implementation (2013) indicators, and are working towards or meeting 9 (100%) of the medium-term (2015) indicators and 6 (100%) of the long-range indicators.

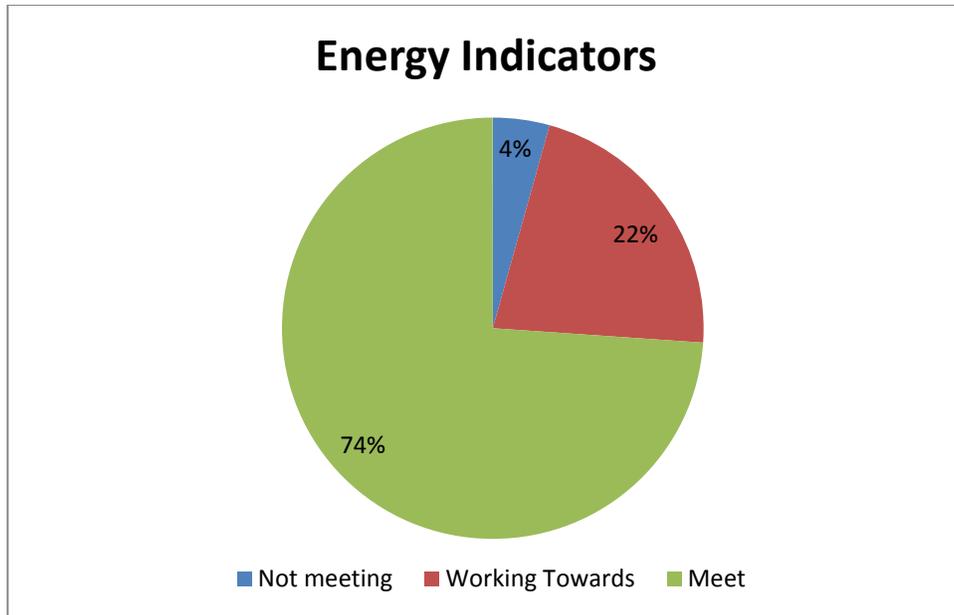


Figure 40. Energy Air Indicators Level of Attainment

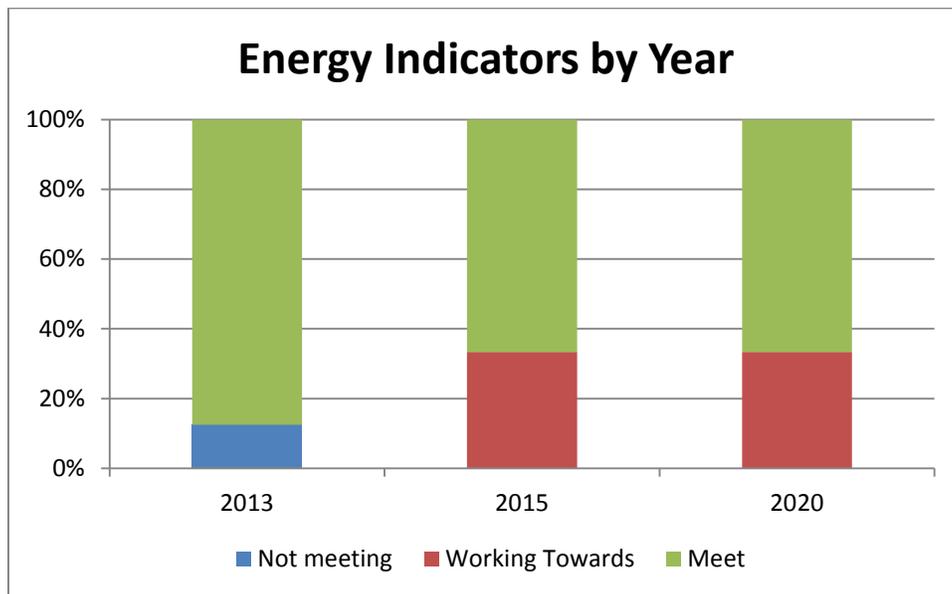


Figure 41. Energy Indicators Attainment by Year



Table 16. Energy Goal Achievement

Goal 1: Consume Less Energy	
Objective: Reduce building electricity use	
Indicator	Contribution
Electrical + HVAC use of all buildings + facilities audited	Yes
Office electrical equipment shutdown program implemented	Yes
Employee education and incentive programs established to encourage energy use reduction	Yes
All buildings not updated in 10 years renovated / overhauled / consolidated	Yes
Motion sensor/occupancy lighting installed in all buildings	Working towards - Some but not all
Electricity purchased by the MBTA reduced by 20% per passenger mile	Not Applicable - Not the MBTA
Objective: Reduce electricity use by outdoor lighting	
Indicator	Contribution
Use of incandescent bulbs eliminated	Working towards - Some but not all
Outdoor lighting assets + technology inventoried	Yes
50% of all outdoor lighting (ROW, parking lots, tunnels, runways, airfields) retrofitted	Yes
100% of all outdoor lighting retrofitted	Working towards - Some but not all
Electricity consumption for lighting reduced by 50% through retrofits and operations	Working towards - some but not 50%
All traffic signals replaced with LED bulbs	Not Applicable - No traffic lights
Objective: Reduce fuel use for heating buildings + water	
Indicator	Contribution
Audit of all heating systems + water fixtures conducted + opportunities for retrofit identified	Yes
Temperatures of all adjustable boilers/heaters reduced	Yes
All inefficient / electric water heaters replaced with high efficiency tanks or tankless systems	Yes
Oil heating systems converted to natural gas or renewable alternatives where feasible	Yes
Geothermal + cogeneration heating systems studied for all new buildings	Not Applicable - No construction on buildings
Envelops of all buildings are evaluated and prioritized for insulation upgrades	Yes
Total heating fuel + costs for MassDOT-owned buildings reduced by 20%	Not Applicable - Not is MassDOT building
Total heating fuel + costs for MassDOT-owned buildings reduced by 35%	Not Applicable - Not in MassDOT building
Insulation of all heated / air conditioned buildings assessed and replaced as needed	Yes
All MassDOT-owned HVAC systems +/- or windows retrofitted or replaced	Not Applicable - Not in MassDOT building
Shade tree planting around MassDOT buildings increased to improve building energy performance	Not Applicable - Not is MassDOT building
50% of all inefficient / electric water heaters replaced with high efficiency tanks or tankless systems	yes



Objective: Reduce electricity consumption by subways + trolleys	
Indicator	Contribution
Evaluation of on-board and/or wayside energy recapture conducted for all subway lines	Not Applicable - Do not operate rail
Electrical systems of all subway lines evaluated and retrofitted where cost effective	Not Applicable - Do not operate rail
All outdated transit vehicles replaced with high efficiency cars	Not Applicable - Do not operate rail
New subway car purchases contain regenerative braking technology	Not Applicable - Do not operate rail
RFR issued for wayside station regeneration installation	Not Applicable - Do not operate rail

Goal 2: Increase Reliance on Renewable Energy

Objective: Participate in MassDOT Energy Initiative	
Indicator	Contribution
Create a MassDOT energy management plan	Not Applicable - MassDOT responsibility
All energy consumption (electricity / heating / fleet fuel) tracked + centrally reported	Working towards - Some but not all
Feasibility study completed for additional wind power generation sites on MassDOT properties	Not Applicable - Not is MassDOT building

Objective: MassDOT GreenDOT Implementation Plan Increase energy produced at MassDOT facilities	
Indicator	Contribution
Comprehensive feasibility assessment and renewable energy generation plan completed	No
4 RFR's issued by MassDOT for additional renewable generation sites	Not Applicable - MassDOT responsibility
10 new renewable energy projects installed at MassDOT facilities	Not Applicable - Not is MassDOT building
At least 5% of electricity demand generated by MassDOT renewable projects	Yes

Objective: Purchase more renewable energy	
Indicator	Contribution
Bulk purchasing of green electricity portfolio with other state agencies initiated	Yes
12% of electricity needs met through production or green energy purchases	Yes
25% of electricity needs met through production or green energy purchases	Yes

6.23 Land

Land goals are aimed at using sustainable vegetation maintenance practices and protecting significant habitat areas and natural landscapes. There are 45 indicators for land but only 28 (62%) are applicable to LRTA. LRTA is meeting 23 (82%) applicable land indicators as seen in Figure 42. Figure 43 outlines the land indicators by implementation time and level of achievement. There are 17 indicators in the land theme which are not applicable to LRTA. For the applicable indicators 15 are short term indicators, 12 are medium-term, and 1 long-range. Of those that are applicable to LRTA they have met 13 (87%) of the immediate implementation (2013) indicators, are working towards or meeting 9 (75%) of the medium-term (2015) indicators, and have met 1 (100%) of the long-term indicators.

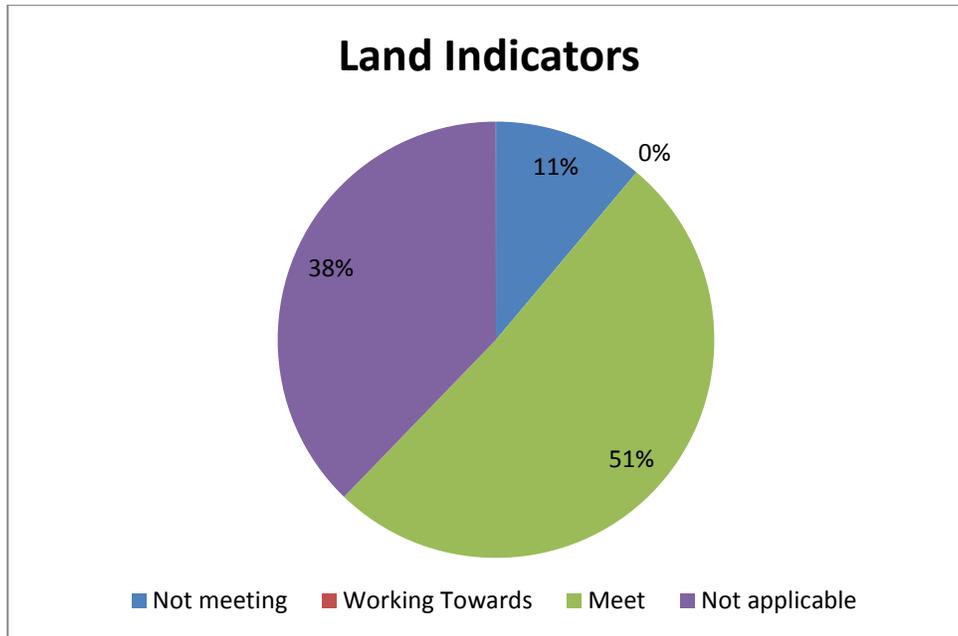


Figure 42. Land Indicators Level of Attainment

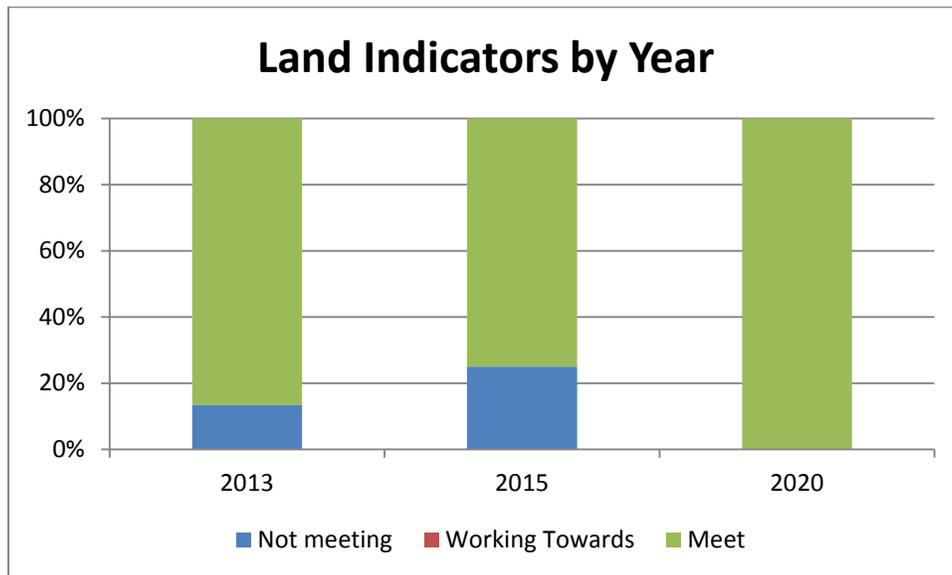


Figure 43. Land Indicators Attainment by Year



Table 17. Land Goal Achievement

Goal 1: Minimize Energy + Chemical Use in Maintenance	
Objective: Increase acreage of land planted with native / low maintenance vegetation	
Indicator	Contribution
New facilities planted with sustainable, minimally managed native landscape	Yes
Lawn installations around five facilities replaced with natural (low maintenance) vegetation	Not Applicable – Do not have 5 facilities
Native plant restoration or managed fallow habitat restoration increased 25% along ROWs	Yes
Available land surrounding all rural depots and offices planted with native vegetation	Yes
Objective: Decrease area + frequency of land mowed	
Indicator	Contribution
Inventory of grassed area conducted	Yes
Turf grass replaced with broad spectrum blend of grasses including warm season + slow growing for low maintenance	Yes
Mowing frequency reduced by 25%	Yes
Mower blades raised in turtle habitat + areas contiguous with natural areas as standard operating procedure	Not Applicable - No natural areas
Mowing + brush cutting jobs are scheduled around animal nesting season to the maximum extent possible	Yes
Objective: Implement an integrated vegetation management approach for ROWs + facilities	
Indicator	Contribution
Landscape areas inventoried by habitat area + maintenance regime	Yes
Adopted Vegetation Management Plans focus on integrated management approach	Yes
Soil augmentation utilize organic landscape techniques + minimize nutrient loads to water supplies	Yes
Compost materials used as the preferred soil amendment in all maintenance + construction projects	Yes
Objective: Require intelligent use herbicides + pesticides in construction + maintenance	
Indicator	Contribution
Mechanical weed control utilized to minimize traditional herbicide use	Yes
Herbicides used only in conjunction with integrated + sustainable roadside/railway vegetation management plans	Yes
Increase number of employees trained for herbicide application to allow more selective application	Not Applicable - do not use herbicide
Integrated pest management (IPM) implemented for all maintenance projects + construction sites	Yes
Ongoing training for employees + technical assistance for municipalities on organic/IPM practices established	No



Objective: Protect, preserve + enhance woodland + urban tree coverage	
Indicator	Contribution
2 to 1 tree replacement policy implemented where woodland preservation desired	Not Applicable - no woodland preservation area
Mature, healthy tree preservation is maximized in maintenance and project design where feasible	Yes
Trees and naturalized landscaping emphasized in revised Project Development + Design Guide	Yes
Sustainable roadside woodland management plan established for construction and maintenance	No
Urban street tree coverage enhanced during improvement projects	Yes
Coordinated tree planting policy established to encourage locally supported urban forestry practices	Yes
100,000 trees planted along roadways as part of MassDOT's Complete Streets practices	Not Applicable - not MASSDOT

Goal 2: Enhance Ecological Performance of MassDOT Impacted Land

Objective: Increase habitat preservation + enhancements	
Indicator	Contribution
Proactively coordinate project development with MA Department of Fish + Game	Not Applicable - no impact to fish and game
Restored + maintained areas increased for non-urban construction projects	Yes
25 nest boxes installed at appropriate locations	Not Applicable - no need for nest boxes
Surplus land with high natural resource value evaluated for transfer to appropriate state agencies	Not Applicable - no surplus land
Grassland and/or Woodland Management Plans in place for all appropriate facilities	Not Applicable - No appropriate locations
Wildlife + endangered species training program provided for applicable employees	No
Ten rare species habitat management/ enhancement projects initiated within right-of-way	Not Applicable - no rare species habitat

Objective: Increase wildlife accommodation along ROWs + facilities	
Indicator	Contribution
Wildlife hazard mitigation plan(s) implemented for all facilities	No
Reptile + amphibian + fish passage structures incorporated into maintenance activities	Not Applicable - no special structures
Project forms revised to include wildlife accommodations measures early in design review	No
Wildlife fencing along ROWs/properties within all critical habitat areas evaluated + installed	Not Applicable - no critical habitats



Objective: Decrease quantity of invasive + noxious species	
Indicator	Contribution
Planting of all listed noxious or invasive species prohibited	Not Applicable - no additional planting
All stockpiled materials screened for noxious or invasive species	Not Applicable - no stockpiled materials
Transportation of cut wood materials limited to avoid beetle + other pest transportation	Not Applicable - no cut wood
Aggressive species early detection + rapid response program in place	Yes
Invasive species control on sites are managed with minimal adverse impact on other species	Not Applicable - no invasive species
Active invasive species management programs in place within priority habitat areas	Not Applicable - no priority habitats
All maintenance crews trained on invasive species detection	Yes
Objective: Decrease outdoor light pollution	
Indicator	Contribution
New lighting designed to conserve energy + avoid light pollution	Yes
Light shields installed in coordination with roadway + parking lot lighting fixture retrofits	Yes

6.24 Materials

Material goals include using environmentally friendly products; using innovative materials and construction techniques that leave smaller environmental footprints; and having green facilities.

There are 63 indicators for materials but only 43 (68%) are applicable to LRTA. LRTA is meeting 31 (72%), working towards 3 (7%) and not meeting 9 (21%) of the applicable material indicators as seen in Figure 44. Figure 45 outlines the material indicators by implementation time and level of achievement. There are 20 indicators in the materials theme which are not applicable to LRTA. For the applicable indicators 25 are short term indicators, 15 are medium-term, and 3 long-range. Of those that are applicable to LRTA they have met 19 (76%) of the immediate implementation (2013) indicators, and are working towards or meeting 11 (73%) of the medium-term (2015) indicators and 1 (33%) of the long-range indicators.

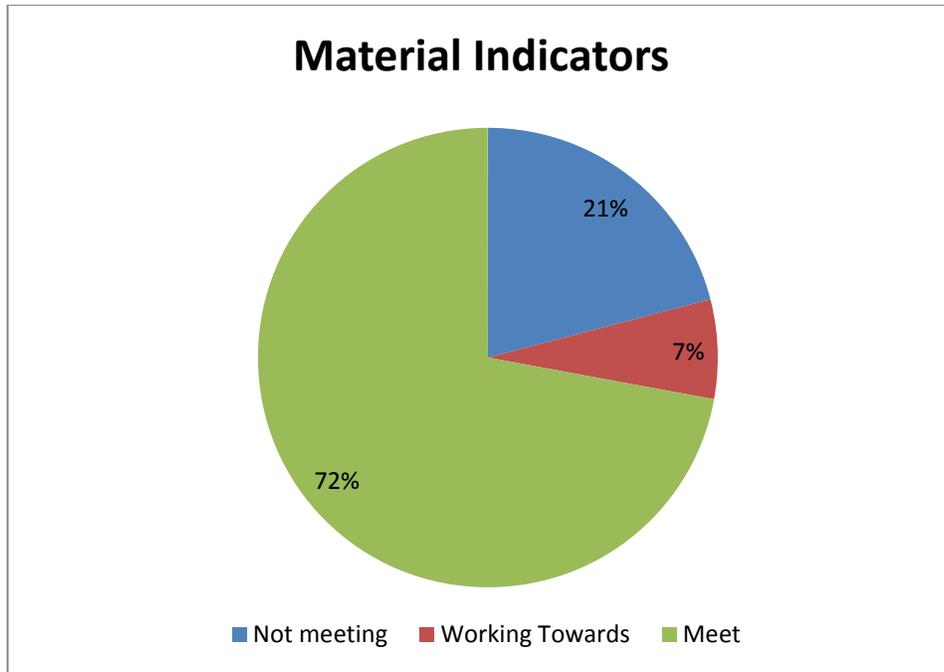


Figure 44. Materials Air Indicators Level of Attainment

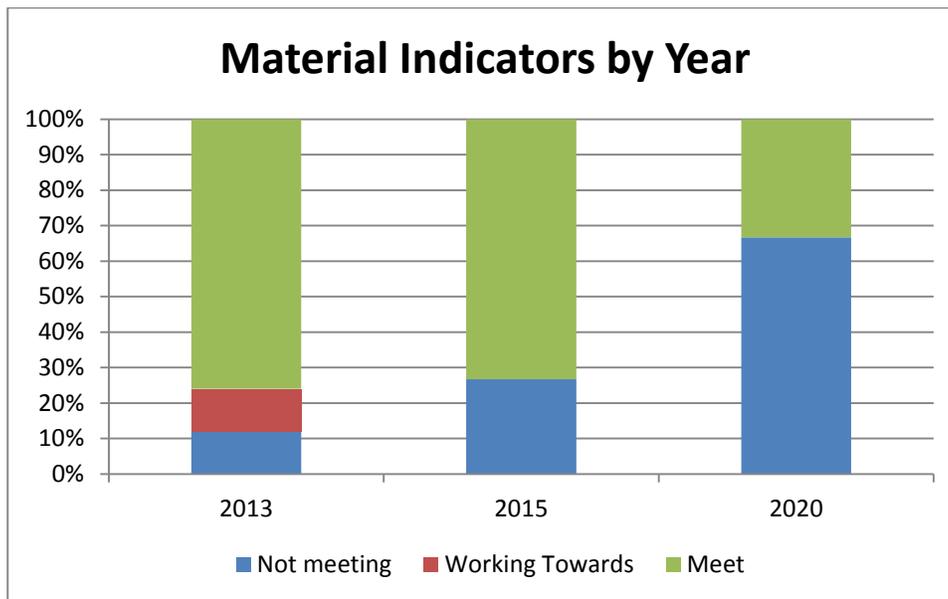


Figure 45. Material Indicators Attainment by Year



Table 18. Material Goal Achievement

Goal 1: Purchase Environmentally Preferred Products	
Objective: Implement an environmentally preferred materials purchasing program	
Indicator	Contribution
Environmentally preferred materials purchasing programs implemented in collaboration with OSD	No
Low or no volatile organic compound furniture + flooring purchased	Yes
100% recycled content paper products purchased	Working towards - Some but not all
Reclaimed + recycled materials utilized for landscaping + earthwork	Yes
Only refrigerators with low Global Warming Potential (GWP) refrigerants and insulation purchased	Yes
Sustainable Forestry Certified wood for permanent or temporary construction utilized	Not Applicable - nonwooden structures
Standards for recycled content of traffic control/safety devices developed	Not Applicable - No traffic control devices
Sustainability practices integrated into all construction and service contract evaluation criteria	Yes
Objective: Purchase energy efficient equipment	
Indicator	Contribution
Only Energy Star or Electronic Product Environmental Assessment Tool certified electronic products purchased	Yes
Total electronic appliances within office locations reduced	Yes
Energy efficient criteria utilized for shop equipment + machinery purchases	Yes
Objective: Use environmentally friendly cleaning products + procedures	
Indicator	Contribution
Maintenance products + procedures utilized that pose least harm to humans + the environment	Yes
Protocols for disposal of all cleaning product waste established	Yes
Environmentally friendly cleaning products purchased when available	Yes
Environmental friendly cleaning products required to be used within vendor service contracts	Not Applicable – No vendor service contracts



Objective: Reduce hazardous chemical use in operations + maintenance	
Indicator	Contribution
Hazardous materials substitution program developed	Yes
Hazardous materials spill prevention control and countermeasures plan created	Yes
Lead free wheels purchased and steel weighted wheels phased in to replace older wheels	Yes
Natural or organic fertilizers, pesticides, + landscaping materials purchased	Working towards - in most cases, rubber mulch in use
Low or no volatile organic compound paints applied on indoor facilities	Yes
Purchasing lists + disposal protocols for engine service + maintenance standardized	Yes
Technology implemented reducing the quantity of salt applied to roadways proportional to weather conditions	Yes
Objective: Increase opportunities for local vendors or locally sourced products sold at facilities	
Indicator	Contribution
Vendor solicitation for MassDOT facilities written to encourage local ownership / sourced products	Not Applicable - Not in MassDOT building
Lease language for MassDOT facilities written to encourage locally sourced products	Not Applicable - Not in MassDOT building
Local vendors + locally sourced products sold at MassDOT facilities doubled	Not Applicable - Not in MassDOT building

Goal 2: Improve Life-Cycle Impacts of Investments

Objective: Reduce energy inputs into paving operations	
Indicator	Contribution
Warm asphalt mix chosen as the standard state specification and hot mix asphalt eliminated	Yes
Two pilots of cold in-place paving completed	Not Applicable - No paving jobs
Standard specifications + guidelines for expansion of cold in-place paving established	Not Applicable - do not use cold patch
Two pilots of full depth reclamation advertised	Not Applicable - No paving jobs
Standard specifications + guidelines for expansion of full depth reclamation projects established	No
Research to increase the recycled content, reduce energy inputs, and improve vehicle efficiency of paving completed	Not Applicable - MassDOT responsibility
Objective: Increase total volume of materials sourced within 200 miles of construction site	
Indicator	Contribution
Total weight/volume/cost of material purchased locally (within 200 miles) measured in all projects	No
Product source information added to bidding requirements	Yes
Cost share of locally sourced materials increased 20% on state funded projects	No



Objective: Increase % of recycled materials in paving + concrete installations	
Indicator	Contribution
20% of recycled paving material content used in road resurfacing projects	Not Applicable - no resurfacing projects
25% recycled paving material content used in road reconstruction projects	Not Applicable - no pavement reconstruction projects
The highest recycled content paving and base material available utilized for shared-use paths	Not Applicable - no pavement reconstruction projects
Use of recycled rubberized asphalt + rubberized asphalt sealer increased	Yes
Minimum 25% fly ash, slag concrete, or silica flume utilized	No
Innovative sustainable concrete construction techniques encouraged in contracts	Yes
20% recycled course aggregate concrete used in all suitable applications	Yes
Objective: Increase albedo factor in hardscapes, rooftops + paving	
Indicator	Contribution
Solar Reflectivity Index minimum of 78 instituted for all roofing projects	Working towards - some but not all
Two innovative roofing (green, vegetation or blue water) projects piloted	Not Applicable - Don't have two roof projects
All new roofing installations utilize high measured albedo factor materials	Yes
Albedo factor increased in paving surfaces + hardscape materials	Not Applicable - some but not all
Urban roadways + parking lots designed to maximize shade coverage of asphalt + concrete surfaces	Yes
Solar Reflectivity Index of at least 30 required for paving projects	Yes
Objective: Design for deconstruction + reuse	
Indicator	Contribution
Road rehabilitation standards developed for reuse of existing installations	Yes
Expertise in designing for deconstruction specified in all RFRs for design contracts	Yes
Procurement criteria include incentives to contractor bids utilizing higher recycled content materials	No
Lifecycle analysis in design, project alternative + material selection included	No
Readily reusable + renewable materials encouraged in design specifications	Yes



Goal 3: Build Green Facilities for MassDOT	
Objective: Design all new facilities to green building standards	
Indicator	Contribution
New facilities funded or built by MassDOT over 20,000 sq. ft. designed to MA LEED Plus	Not Applicable - no new facilities
New facilities funded by MassDOT designed to LEED Gold or Net Zero Energy Building standard	Not Applicable - no new buildings
Objective: Retrofit existing facilities to meet environmental design criteria	
Indicator	Contribution
All window AC units removed from office buildings or replaced with Energy Star units	Not Applicable - no window units
Three building retrofits to LEED Existing Buildings Operations + Maintenance (EBO+M) initiated	Yes
Air circulation/filtration of MassDOT owned indoor facilities improved	Not Applicable - Not MassDOT employees
Objective: Relocate offices + encourage healthy transportation options	
Indicator	Contribution
Offices in town or city centers relocated to be served by transit, walking + bicycling	Yes
Provide transit pass exchange for employees with subsidized parking benefits	Yes
Free parking + take home vehicles for MassDOT urban office employees eliminated	Not Applicable - Not MassDOT employees
Objective: Consolidate office + maintenance facilities where feasible	
Indicator	Contribution
MassDOT office + maintenance facility consolidation opportunity study completed	Not Applicable - Not MassDOT
One office consolidation site piloted	Yes
Three pilot consolidation and/or cross utilization maintenance sites piloted	Not Applicable - Not MassDOT

6.25 Planning, Policy & Design

Planning, policy and design goals are aimed at developing a multi-modal system designed to promote healthy transportation and livable communities. There are 56 indicators for planning, policy and design but only 39 (70%) are applicable to LRTA. LRTA is meeting 35 (90%), working towards 2 (5%) and not meeting 2 (5%) of the applicable indicators as seen in Figure 46. Figure 47 outlines the planning, policy and design indicators by implementation time and level of achievement. There are 17 indicators in the theme which are not applicable to LRTA. For the applicable indicators 18 are short term indicators, 20 are medium-term, and 1 long-range. Of those that are applicable to LRTA they have met 15 (83%) of the immediate implementation (2013) indicators, and are working towards or meeting 20 (100%) of the medium-term (2015) indicators and 1 (100%) of the long-range indicators.

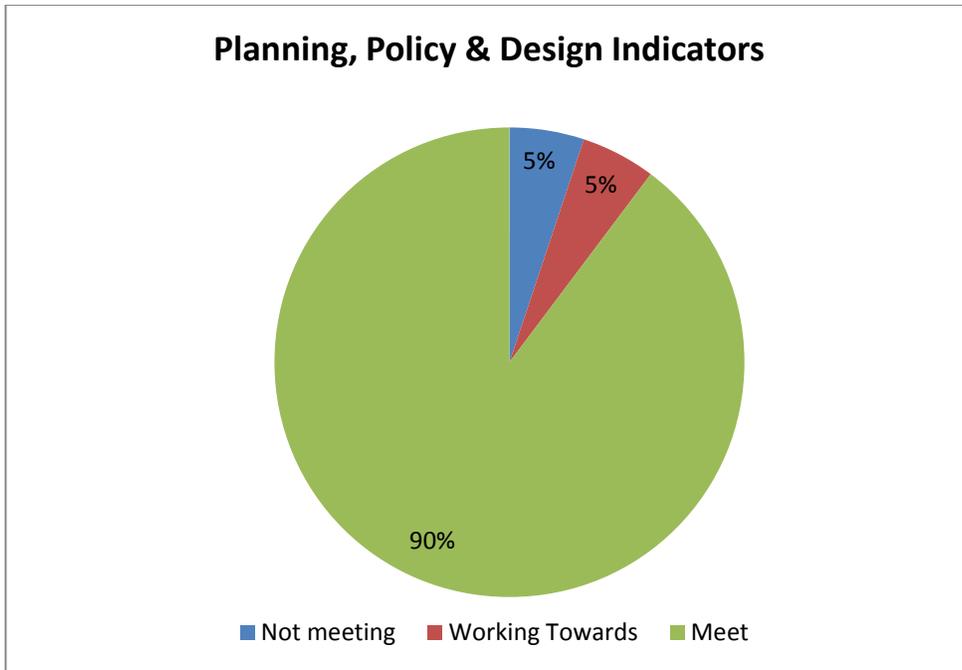


Figure 46. Planning Indicators Level of Attainment

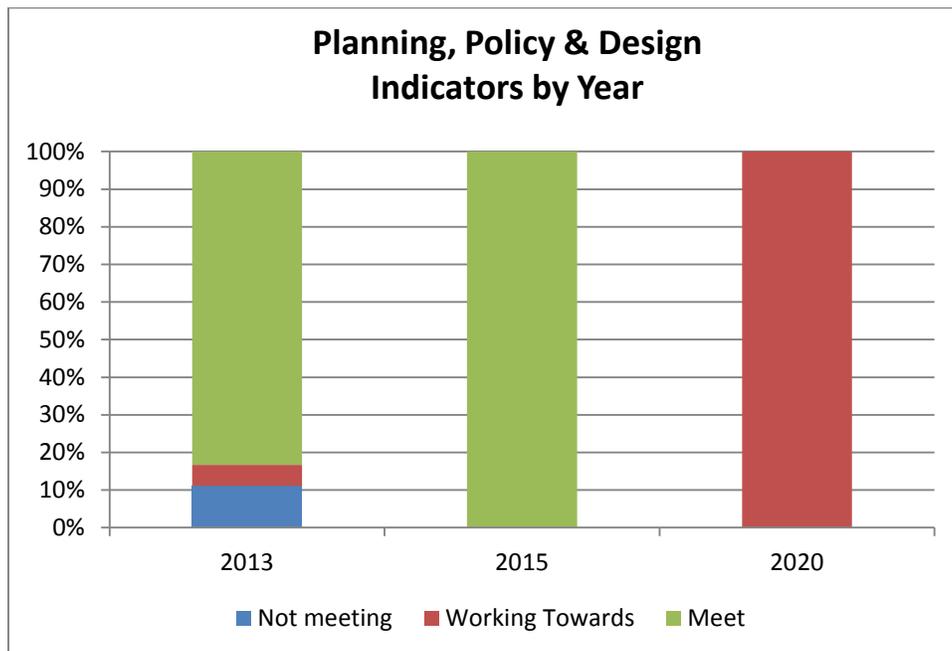


Figure 47. Planning Indicators Attainment by Year



Table 19. Planning, Policy & Design Goal Achievement

Goal 1: Design a Multi-Modal Transportation System	
Objective: Increase delivery of Complete Streets projects	
Indicator	Contribution
Bicycle + pedestrian facilities featured + prioritized in designs, rather than simply accommodated	Yes
Project forms + databases revised to track Complete Streets + sustainability measures	Yes
Update of Project Development + Design Guide underway to reflect evolution of Complete Streets	Yes
Surfaces and facilities of at-grade rail crossings improved for pedestrian + bicycle travel	Not Applicable - no at grade crossings
All 'driveway' approaches to MassDOT airports, rail stations + MassDOT provide bicycle + pedestrian access	Yes
Objective: Increase bicycle parking + access to transit	
Indicator	Contribution
Transit stations with significant customer car parking (>50 spaces) have covered +/- secure bicycle parking	Yes
All MBTA + RTA buses equipped with bicycle racks	Yes
Study + pilot programs completed evaluating options for eliminating peak hour restrictions of bikes on transit	Not Applicable - no bikes inside vehicles, outside racks
Bike stations at North, South, and Back Bay stations established with showers + locker facilities	Not Applicable - Do not operate these stations
High capacity bicycle coaches operated on all commuter rail lines + peak-hour access restrictions lifted	Not Applicable - Do not operate Commuter rail
Bicycle access to heavy rail lines expanded to all hours except two 1-hour peak periods	Not Applicable - Do not operate rail
Objective: Improve traffic controls to reduce vehicle emissions, + to support walking + biking	
Indicator	Contribution
Inventory of traffic signals + grade crossing signal conducted	Not Applicable - no traffic signals
All signals evaluated and adjusted for optimal operations for all users	Not Applicable - no traffic signals
Objective: Improve transit system performance statewide	
Indicator	Contribution
Bus stop consolidation on key routes assessed	Yes
All RTA's have conducted comprehensive service analysis to improve system connectivity + efficiency	Yes
Opportunities for express bus lanes + regional bus services analyzed	Yes
Transit operation efficiency improved while maintaining/increasing ridership	Yes
Transit Signal Priority for all new traffic signals implemented	Not Applicable - Do not have traffic signal projects
Payment + boarding system for MBTA light rail + vehicles + buses improved	Yes
Green Line extension + South Coast Rail service completed	Not Applicable - Do not operate rail



Goal 2: Promote Healthy Transportation + Livable Communities	
Objective: Encourage walking, biking, + transit as active transportation	
Indicator	Contribution
MassDOT Bay State Bike Week facilitated + promoted annually in partnership with MassBike	Yes
All office locations have visible bicycle parking locations for visitors near entrances	Yes
Selection of public meeting venues prioritizes locations with transit, pedestrian + bicycle access	Yes
Information on transit, bicycle + pedestrian travel provided on public meeting announcements	Yes
MassDOT sidewalks + bicycle facilities are cleared of snow + ice simultaneously with vehicle lanes	Yes
Navigational signage to transit stations expanded along local roads and highways	Yes
Employees + contractors required to use transit, walk, bike or carpool to meetings whenever location + service schedules allow	Yes
40% of elementary + middle schools reached through Safe Routes to Schools program	Not Applicable - Statewide initiative
Objective: Promote eco-driving + programs to reduce reliance on single occupancy vehicles	
Indicator	Contribution
Eco-driving promoted through digital display boards + customer facilities	Working towards - installing message boards in future project
Expand commuter options programs	
Objective: Indicator	Contribution
Commuter options programs through digital displays promoted statewide	Not Applicable - Do not operate statewide
Parking spots at major transit stations with parking reserved for car sharing	No
Covered +/- or secure bicycle parking installed at major park + ride facilities	Yes
Secure indoor bicycle parking + shower facilities provided at all major MassDOT employment centers	Not Applicable - Not MASSDOT Center
Objective: Utilize surplus land, parking lots + air rights for transit-oriented developments	
Indicator	Contribution
All properties, including air-rights, studied for development feasibility	Yes
Large parking lots at transit stations analyzed for TOD redevelopment in the Commuter Rail Master Plan	Yes
Four new RFP's issued for land development	Not Applicable - don't have 4 land development projects
At least two mixed use developments on MBTA properties initiated	Not Applicable - Not the MBTA



Goal 3: Triple Bicycling, Transit + Walking Mode Share

Objective: Connect land use planning with transportation planning + investments	
Indicator	Contribution
Transit authorities participate in all MassDOT and MPO corridor studies	Yes
RTA's participate in MassDOT MEPA review and mitigation formation	Yes
Land use + transportation planning strategies to support mode shift incorporated into 2016 RTPs	Yes
GreenDOT Implementation Plan activities incorporated into MPO's Unified Planning Work Programs	Yes
Project evaluation criteria that prioritize mode shift, GreenDOT + GHG reduction adopted by MPOs	Yes
Complete Commuter Rail Master Plan to evaluate options to expand capacity + increase ridership along each line	Not Applicable - Do not operate commuter rail
Priority Development Areas (PDAs) + Priority Protection Areas (PPAs) approved by HED established in all MPOs	Yes
Strategic regional visions for 'zero' SOV growth + GHG reduction adopted by MPOs	Yes
State-of-the-practice metric for measuring bicycle and pedestrian quality of roadways utilized in corridor planning + design	Yes
Objective: Stabilize travel demand growth on roadways from single occupancy vehicles	
Indicator	Contribution
All rail stations are accessed by Complete Streets	Working towards - some components but not all
Objective: Collect data regarding factors influencing mode choices + utilize better planning tools	
Indicator	Contribution
Person Miles Travelled (PMT) for all modes measured and/or estimated annually at state and regional levels	Yes
Public health impacts of major transportation projects considered in project selection criteria	Yes
New methods for collecting travel data for bicycles and pedestrians piloted	Yes
Scenario planning methods utilized by MassDOT and MPOs instead of traditional growth trend forecasts	Yes
Traffic model assumptions for road design revised to assume limited traffic growth rather than historic VMT growth trends	Yes
MassDOT conducts travel demand forecasts with an activity based model	Not Applicable - This is a MassDOT responsibility, not RTA
Objective: Increase training opportunities on GreenDOT and Mode Shift	
Indicator	Contribution
Coordinated information gateway for shuttles and inter-city bus travel implemented	Yes
Programs for healthy transportation education and travel training for young + elderly travelers developed statewide	Yes
Bay State Roads technical assistance offers materials on sustainability, mode shift, Complete Streets, and parking policies	Not Applicable - Not Bay State Roads



6.26 Waste

Waste goals aim to reduce the exposure to hazardous waste and minimize the disposal of waste. There are 33 indicators for waste but only 30 (91%) are applicable to LRTA. LRTA is meeting 21 (70%), working towards 4 (13%) and not meeting 5 (17%) of the applicable waste indicators as seen in Figure 48. Figure 49 outlines the waste indicators by implementation time and level of achievement. There are 3 indicators in the waste theme which are not applicable to LRTA. For the applicable indicators 16 are short term indicators, 10 are medium-range and 7 are long-range. Of those that are applicable to LRTA they have met 12 (75%) of the immediate implementation (2013) indicators, are working towards or meeting 9 (90%) of the medium-range indicators and 4 (100%) of the long-range indicators.

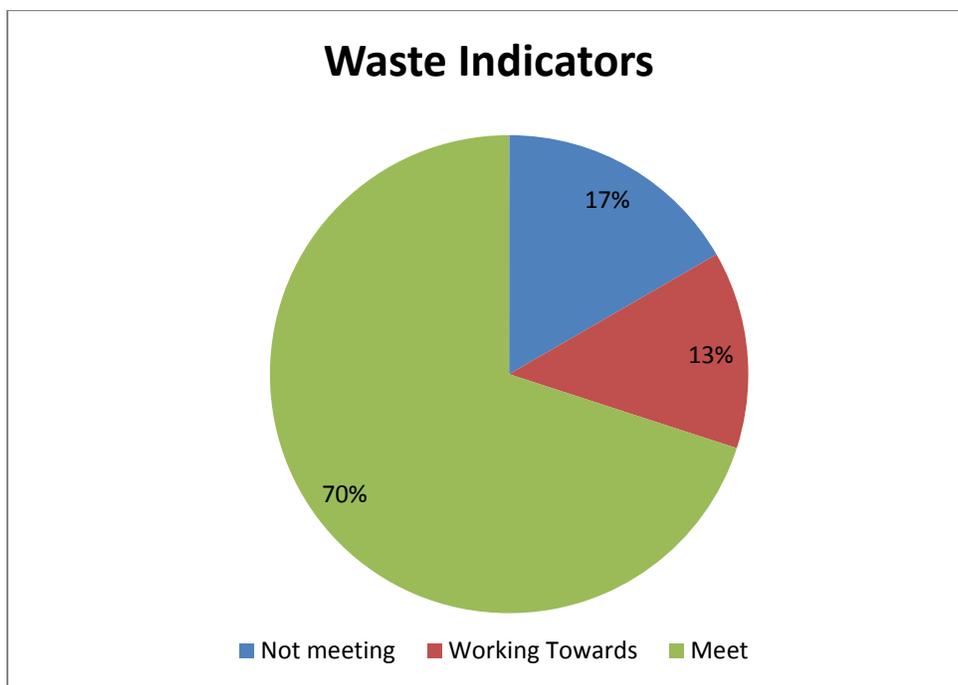


Figure 48. Waste Indicators Level of Attainment

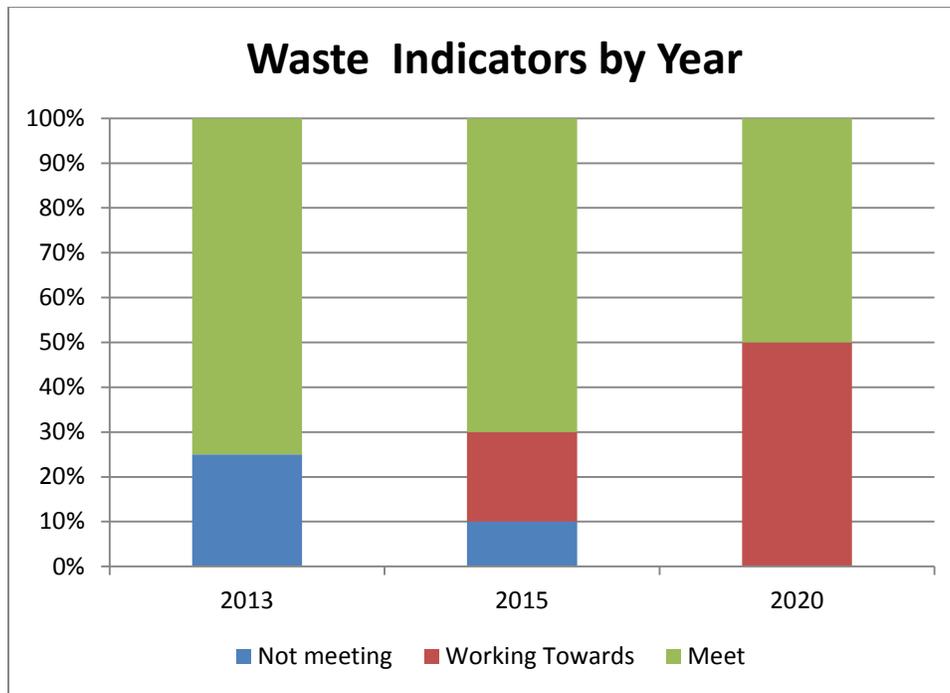


Figure 49. Waste Indicators Attainment by Year

Table 20. Waste Goal Achievement

Goal 1: Achieve Zero Solid Waste Disposal	
Objective: Increase the diversion rate of office waste	
Indicator	Contribution
Zero waste plan developed for MassDOT	Not Applicable - non-MA DOT department
Full "single stream" recycling provided at all buildings	Yes
All electronics, cartridges, batteries, + accessories recycled	Yes
Employee education program on recycling + waste reduction underway	Yes
15% reduction in solid waste from offices achieved	Yes
Office building composting or biomass heating piloted at two facilities	No
Waste reduction / recycling program emphasized in all janitorial service contracts	Not Applicable - no janitorial contracts
30% reduction in solid waste disposal achieved	Yes
Objective: Eliminate litter accumulation in ROWs + stations	
Indicator	Contribution
Litter control programs initiated in all corridors	Yes
Litter prevention information provided at all rest areas + stations	Yes



Objective: Provide "full-stream" recycling opportunities at all customer facilities	
Indicator	Contribution
Container + paper recycling installed at all rest area, airports, transit stations + RMV branches	Yes
Mobile electronics + license plate recycling drop off provided at key locations	Working towards- will work with State to be key location
Objective: Decrease amount of waste generation during construction + maintenance	
Indicator	Contribution
Waste management plans developed for all construction projects	Yes
At least 65% of construction debris is reused or recycled	Yes
At least 80% of construction debris is reused or recycled	Yes
At least 90% of landscaping waste material is reused or composted	Yes
Objective: Decrease paper use	
Indicator	Contribution
Paperless office procedures and equipment piloted in all offices	Yes
Paper use is cut in half	Working towards - some but not half
A paper-free office program adopted + implemented	Working towards- making efforts to accomplish goal
Other paper products consumption (paper towels, napkins, etc.) reduced in all facilities	Yes

Goal 2: Reduce all Exposure to Hazardous Waste	
Objective: Implement Environmental Management System	
Indicator	Contribution
EMS systems adopted + implemented for all divisions	No
All waste is managed in compliance with a hazardous waste management plan	Yes
Metrics of recycling + disposals reported from all sites	No
EMS data from all Divisions compiled annually into a central performance management system	No
Best management practices for salt and sand storage in place at all depot facilities	Yes
Objective: Comply with waste ban + eliminate on-site storage	
Indicator	Contribution
100% compliance with state waste bans met at office + maintenance facilities	No
Long-term storage of hazardous waste minimized	Yes



Objective: Increase recycling rate of hazardous materials	
Objective: Indicator	Contribution
Refrigerants with high global warming potential from HVAC + refrigerators recycled	Yes
80% of all hazardous waste generated is recycled where possible	Yes
100% of hazardous waste with recycling potential is diverted	Working towards - some but not all
Objective: Evaluate + remediate brownfield sites	
Indicator	Contribution
An assessment of all brownfield properties is completed	Yes
Remediation / redevelopment of at least four properties underway	Not Applicable - don't have 4 brownfield sites
Remediation / redevelopment at all known brownfield sites initiated	Yes

6.27 Water

Water goals look to use less water and improve water systems. Many of these are not applicable as there is no open water flow on any of the properties. Where possible water has been conserved, such as with recycling rain water to wash the vehicles. LRTA is also working hard to reduce stormwater runoff and non-point pollutant discharge.

There are 46 indicators for water but only 26 (56%) are applicable to LRTA. LRTA is meeting 20 (77%), working towards 1 (4%) and not meeting 5 (19%) of the applicable water indicators as seen in Figure 50. Figure 51 outlines the water indicators by implementation time and level of achievement. There are 20 indicators in the water theme which are not applicable to LRTA. For the applicable indicators 13 are short term indicators, 9 are medium-term, and 4 long-range. Of those that are applicable to LRTA they have met 9 (69%) of the immediate implementation (2013) indicators, and are working towards or meeting 7 (78%) of the medium-term (2015) indicators and 4 (100%) of the long-range indicators.

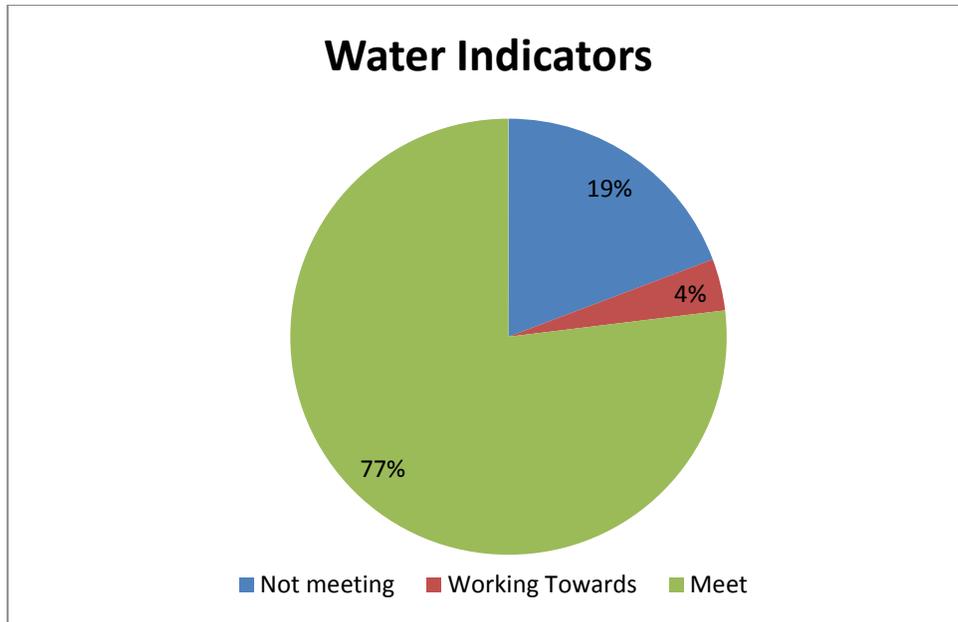


Figure 50. Water Indicators Level of Attainment

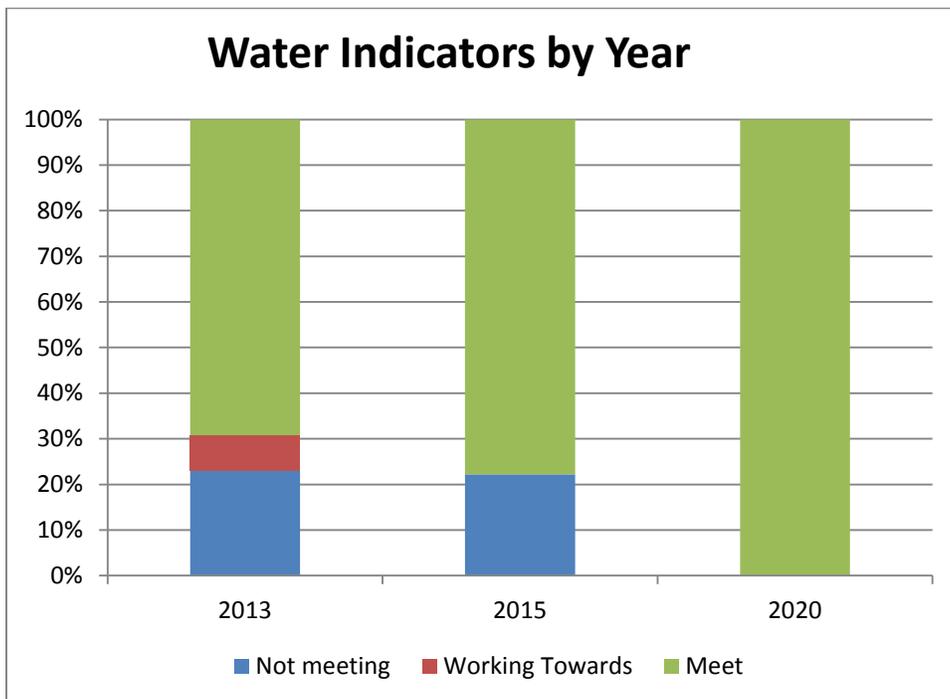


Figure 51. Water Indicators Attainment by Year



Table 21. Water Goal Achievement

Goal 1: Use Less Water	
Objective: Decrease potable water use in buildings	
Indicator	Contribution
The efficiency of all water fixtures in buildings evaluated	Working towards - some but not all
Fixtures retrofitted to gain a 10% reduction in water use	Yes
Plumbing system retrofitted to gain 20% reduction in water use	Yes
Objective: Decrease water use for irrigation	
Indicator	Contribution
Water conservation integrated into vegetation management plans	Not Applicable - do not water vegetation
Potable water use for irrigation reduced by 25%	Not Applicable - do not water vegetation
Objective: Increase utilization of recycled water + rainwater	
Indicator	Contribution
Water conservation practices at bus, vehicle, or airplane washing facilities required	Yes
All new vehicle/bus/rail vehicle washing facilities designed and built with recycled water technologies	Yes
All existing vehicle washing facilities evaluated for recycled or recaptured rain water alternatives	Yes
Study of rooftop rainwater use for toilets / HVAC of largest office facilities completed	No
Rain barrels or other means to reuse rainwater + disconnect drain spouts from sewage systems installed	No
Objective: Install innovative dual plumbing water systems in facilities	
Indicator	Contribution
Water use innovations required in all new building proposals	Yes
Three new pilot structures or building retrofits utilizing dual plumbing completed	Not Applicable - no new pilot structures
Goal 2: Improve Ecological Function of Water Systems	
Objective: Minimize impacts + enhance wetlands + impaired waters	
Indicator	Contribution
Preservation + enhancement of wetlands is adopted in design instead of replacement	Not Applicable - no current or future design plans
Environmental benefits of impact mitigation through watershed planning improved	Yes
Natural buffers between wetland resources + transportation infrastructure increased whenever possible	Yes
Alternative deicer agents utilized in areas with wetlands, cold-water fisheries, and water supplies	Yes
Five wetland restoration projects not considered mitigation completed	Not Applicable - We have no wetland restoration projects



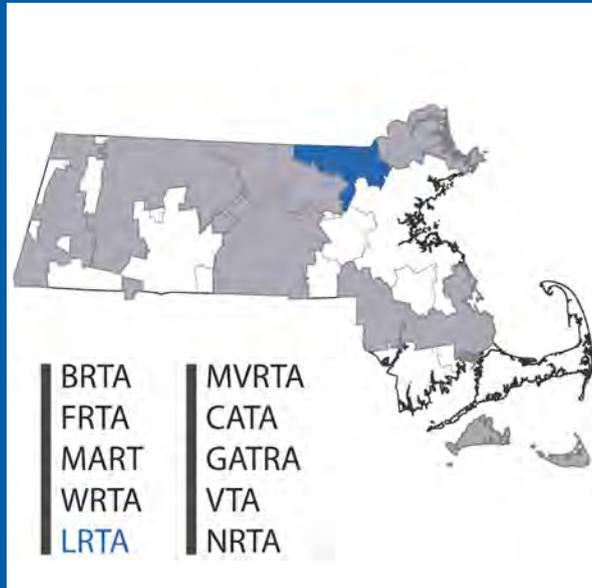
Objective: Adapt facilities for climate change resilience	
Indicator	Contribution
Climate change adaptation strategies initiated between local and federal parties	No
Revised extreme precipitation data utilized for rainfall, flood flow + stormwater calculations	No
Climate Adaptation Plan applicable to all MassDOT facilities adopted	No
Statewide climate change vulnerability assessment for MassDOT facilities completed	Not Applicable - Not MassDOT facility
Critical roadway or rail segments targeted for culvert replacement + rearming for scour protection	Not Applicable - no culverts
Fish passage structures which meet state crossing standards included in maintenance activities	Not Applicable - no open waters
All reconstruction projects crossing tidal habitats include measures to eliminate tidal flow restrictions	Not Applicable - no tidal waters
Objective: Minimize impacts of ROWs + bridges on fluvial processes	
Objective: Indicator	Contribution
New roadways + bridges designed to maximize natural fluvial processes including tidal flushing	Not Applicable - no new roads
At minimum 12 bridge replacement projects improving water flow under construction or completed	Not Applicable - no open water flow
All railroad bed reconstruction projects retrofitted with enhanced stream crossing standards	Not Applicable - Do not operate rail
The standards within MA Stream Crossing Handbook utilized in all project development processes	Not Applicable - no stream crossings
A minimum of five culverts redesigned + rebuilt for improved fish migration	Not Applicable - no culverts
All projects crossing tidal habitats evaluated for restriction of tidal flow	Not Applicable - no tidal waters
Objective: Reduce stormwater volumes + increase permeable surface areas	
Indicator	Contribution
Environmentally sensitive site design in new construction projects utilized	Yes
Post peak discharge rates held to less than pre-project discharge rates to the maximum extent possible	Yes
All projects designed to remove solids + pollutants to the maximum extent possible	Yes
All projects designed to include measures to increase infiltration + reduce stormwater volumes	Yes
Permeable paving or other infiltration installations included in parking lot resurfacing projects	Yes
Design charrette conducted for creating "green roof" bus shelters for the MBTA and/or major RTA	Not Applicable - Non-Major RTA
Green roof installed on at least one large bus or rail maintenance garage	Yes - 1900 panel solar installation at storage facility



Objective: Decrease non-point source pollutant discharges	
Indicator	Contribution
All structural best management practices inspected annually + cleaned as necessary	Yes
Illicit discharges from MassDOT structures eliminated upon detection	Not Applicable - Not MassDOT structures
Long-term pollution prevention programs implemented at all maintenance sites	Yes
Environmentally sensitive design / Low Impact Design (LID) utilized in all construction projects	Yes
New best management practices installed at all facilities identified by Impaired Waters Program	Yes
Phytotechnology as part of stormwater evaluation + constructed stormwater controls utilized	Yes
Assessment protocol developed to evaluate water quality functions of roadside vegetation	Not Applicable - no roadside vegetation
Stormwater 'Low Impact Design' integrated into revised Project Development + Design Guide	Not Applicable - MassDOT responsibility
Commuter ferries follow best practices for fuel handling, bilge water, sanitary waste + trash disposal	Not Applicable - Do not operate ferries

6.2 Conclusion

With over 300 indicators, as identified in the GreenDOT policy 68% are applicable to LRTA, overall LRTA is meeting 72% of the applicable indicators. They are working continuously to achieve the indicators and have achieved many indicators ahead of schedule. Some of the indicators which are applicable are joint responsibilities of MRTA and either MassDOT, the planning commission or the town and they must work collaboratively to achieve success. Additionally many of the indicators just do not apply because they are specific to the MBTA; rail; require there has been or will be new construction; they are for MassDOT owned facilities, or they are for environmentally sensitive land areas.



Chapter 7

Recommendations

AECOM / URS
TMD
Burke & Company





7. RECOMMENDATIONS

7.1 Introduction

Recommendations were developed using a cumulative process that incorporated public outreach, a diverse steering committee, operational input from LRTA, and analysis of existing transit service as well as LRTA's local and regional market. Strategies to improve the system were developed based on the goals and objectives outlined at the beginning of the plan. The recommendations are intended to better align service with local and regional demand using a three phase process that will serve to strengthen the LRTA system and attract more riders. A phased approach was used in order to establish the immediacy and prioritization of needs and was based on an incremental approach and available resources.

- Phase 1 – implement immediately
- Phase 2 - implement as resources and funding are available
- Phase 3 - implement as resources and funding are available

To be able to evaluate whether or not transit services are meeting system goals and objectives, an effective monitoring program should first be in place. A service monitoring program is important both in terms of gauging whether the goals of the community are being accomplished with the service and that the service is both effective and efficient. Without specific measures, success is difficult to measure from year to year. Service monitoring should be part of the daily operation based on specific data collection procedures. Data collection is essential to evaluating the service performance and to determining if changes should be made in the service delivery. To assist in developing a service monitoring program, recommended service guidelines and performance measures have been developed.

7.2 Strategies for Service Recommendation

For transportation planning purposes, a goal is defined as a purpose or need that should be attained to address a transportation issue. An objective is a specific, measurable method or activity that is designed to achieve the identified goal. The goals and objectives were developed at the onset of the planning process with LRTA and have guided the development of the plan throughout.

Goal #1: Provide 21st Century Fleet and Facilities for its Customers

Objective 1.a: Ensure that the LRTA Bus and Paratransit Fleets are modern, safe, accessible and in a state of good repair.

Objective 1.b: Maintain and improve service reliability, the preventative maintenance schedules and a mid-life overhaul program.

Objective 1.c: Provide a fleet that continually improves vehicle mileage and reduces carbon dioxide emissions.



Objective 1.d: Pursue alternative bus technologies such as compressed natural gas (CNG), electric and hybrid electric for the 21st Century.

Objective 1.e: Maintain and upgrade all LRTA facilities to a 21st Century condition. This includes the Gallagher Intermodal Center, parking garages, Kennedy Bus Hub and operation and maintenance centers.

Goal #2: Expand Transit Services

Objective 2.a: Generally 60 minute headway service on approximately 12 routes for fixed routes and complimentary Paratransit service to the Fixed Route service.

Objective 2.b: To offer later night service to corridor routes servicing dense populated areas, shopping and medical facilities.

Objective 2.c: Add service to core routes and economic development areas.

Goal #3: Improve the Current Transit Services

Objective 3.a: Improve frequency of service on high performing routes from 60 to 30 minutes during the weekday and Saturday.

Objective 3.b: To work with other RTAs and the MBTA to further the coordination of inter-regional connections between the LRTA, adjacent RTAs and the MBTA.

Goal #4: Maintain a Strong Financial Plan

Objective 4.a: Maintain a strong balance of funding from all local, state and federal sources.

Objective 4.b: Maximize all non-fare income. Included within this area is parking revenue, rents at Gallagher Terminal, vending machines and bill board opportunities.

Objective 4.c: Periodic adjustments to fare revenue as required.

Aside from the goals and objectives several other strategies/guiding principle were used in designing recommendations:

1. **Simplify** – Routes should be designed along main corridors with minimal schedule deviations. For routes that are not linear, service should be provided in both directions.
2. **Service should match demand** – The denser (both in terms of employment and population) areas should have a higher level of service with either higher frequency routes or multiple lower frequency routes. Major corridors often warrant higher frequencies.
3. **Standardized frequency** – Frequencies should be standardized using clock-face schedules to create 30, 60 and 120 minute headways.
4. **Priority to existing ridership** – Service should be increased in areas that warrant it over servicing new areas if limited resources are available.
5. **Connections** – No route should be designed in isolation. If possible it should connect to at least one hub. Where connections to hubs are not possible the route should connect with at least one other route to facilitate transfers.



6. **Efficiency** – Where possible routes should be designed to be the most efficient. Decisions to deviate off the main corridor and add time to the route are only warranted where key destinations like shopping centers are too far off the main road, there are a lack of pedestrian facilities or the benefit (due to demand) of servicing the deviation outweighs the additional time incurred to others on the route.
7. **Consistency** – Except where warranted by peak only routes or increased peak hour service, service should have consistent headways throughout the day using clock-face schedules.
8. **Regional network** – Regional connections should be improved to provide access outside of the LRTA service area through transfers with other systems such as MVRTA or MBTA, to areas identified as common destinations through the market analysis and public outreach process.

7.3 Recommendations Overview

Recommendations are categorized by route and phase. A three phase process was used in order to prioritize recommendations. Priority was based on demand, route performance, public feedback and resource availability. Phase 1 focuses on streamlining service, creating consistent clock face frequencies, and enhancing connectivity. Phase 2 adds service to previously underserved areas and implements a limited Sunday service schedule. In Phase 3 Sunday service has been expanded. In general Phase 1 can be implemented immediately as it does not require an increase in the current fleet size, but Phase 2 and Phase 3 can only be implemented as resources and capital equipment become available.

Phase 1:

- Streamline service and eliminate redundancy
- Establish clockface schedules
- Improve connections and transfers with MBTA and MVRTA

Phase 2:

- Implement limited Sunday service
- Expand holiday service routes to year round
- Implement new routes

Phase 3

- Expand Sunday service
- Improve frequencies
- Expand service areas

A summary of the overall recommendations is in Table 22 and Table 3 breaks down the recommendations by phase. Figure 52-Figure 53 are maps depicting system wide alignment changes for each phase of the plan. The recommendations presented are for the fixed route service only and not the school tripper service. For detailed individual route recommendation profiles see section 7.7



Table 22. Service Recommendations

LRTA Proposed Service Recommendations				Weekday				Saturday				Sunday	
Route	Name	Proposed Changes	Alignment Changes	Existing		Proposed		Existing		Proposed		Proposed	
				Frequency	Span								
1	Christian Hill	Realign to straighten in Christian Hill, deviates to serve Hospital	From Downtown: Thorndike, Highland, Gorham, Prescott, E. Merrimack, James Ct, Hunts Falls Bridge, MA-38, Bridge, 3rd, Beacon, 19th, Bridge, Pleasant, Broadway, Fox, Bonnie, Stanley	60	6:45 AM - 6:45 PM	60	6:45 AM - 6:45 PM	See 01/08				See 01/08	
2	Belvidere	Consider service on Raven Rd for loop	No change	30	6:15 AM – 8:15 PM	30	6:15 AM – 8:15 PM	60	7:45 AM - 6:15 PM	60	7:45 AM - 6:15 PM	60	7:45 AM - 6:15 PM
3	South Lowell	Combine with Route 15 for same coverage	Combined with 15	30/60	6:00 AM – 6:30 PM	---	---	See 03/04					
4	Highlands via Stevens	Operationally interlined with new route 6 on weekends	No change	30/60	6:15 AM – 6:30 PM	30/60	6:15 AM – 6:30 PM	See 03/04		60	8:00 AM - 5:30 PM	60	8:00 AM - 5:30 PM
5	Westford Street	Extend span	No change	30	6:00 AM – 8:30 PM	30	5:30 AM – 9:30 PM	60	7:45 AM - 6:15 PM	60	7:45 AM - 6:15 PM	60	7:45 AM - 6:15 PM
6	Broadway/UMass Lowell	New route covers existing Route 6 and 9; frequency improved to every 30 minutes	Combined with 9	35	6:00 AM – 6:00 PM	30	6:00 AM – 8:00 PM	See 06/09		60	8:00 AM - 5:15 PM	60	8:00 AM - 5:15 PM
7	Pawtucketville/UMass Lowell North	Extend span	No change	30	6:00 AM – 9:00 PM	30	5:30 AM – 9:30 PM	60	7:45 AM - 6:30 PM	60	7:45 AM - 6:30 PM	60	7:45 AM - 6:30 PM
8	Centralville	No change	No change	30/60	6:15 AM – 8:00 PM	30/60	6:15 AM – 8:00 PM	See 01/08				See 01/08	
9	Lowell Circulator	Combined with Route 6; frequency improved to every 30 minutes	Combined with 6	40	6:15 AM – 8:30 PM	---	---	See 06/09		---	---		
10	Dracut/Tyngsboro	No change	No change	60	6:30 AM – 7:30 PM	60	6:30 AM – 7:30 PM	60	8:30 AM - 6:15 PM	60	8:30 AM - 6:15 PM		
11	IRS Raytheon via Route 133	No change	No change	4 trips		4 trips							
12	Tewksbury via Route 38	Sunday service	No change	60	7:00 AM – 7:00 PM	60	7:00 AM – 7:00 PM	60	7:00 AM - 5:45 PM	60	7:00 AM - 5:45 PM	60	7:00 AM - 5:45 PM
13	Billerica	No change	No change	30/60	6:30 AM – 7:00 PM	30/60	6:30 AM – 7:00 PM	60	7:30 AM - 5:15 PM	60	7:30 AM - 5:15 PM		



LRTA Proposed Service Recommendations				Weekday				Saturday				Sunday	
Route	Name	Proposed Changes	Alignment Changes	Existing		Proposed		Existing		Proposed		Proposed	
				Frequency	Span								
14	Burlington Mall/Lahey Clinic	Improve frequency	No change	60	6:00 AM – 8:00 PM	30	6:00 AM – 8:00 PM	60	8:00 AM - 6:00 PM	60	8:00 AM - 6:00 PM	60	8:00 AM - 6:00 PM
15	Chelmsford/Westford via Route 129/110	Improve weekday frequency to hourly service, realign to cover parts of Route 3	Eliminate Marshalls Plaza deviation & Combine with Route 3	90	6:00 AM – 8:00 PM	60	6:00 AM – 8:00 PM	90	8:00 AM - 5:45 PM	90	8:00 AM - 5:45 PM		
16	Chelmsford Center via Chelmsford St.	Improve to 30 minute peak, 60 minute offpeak weekday, 60 minute weekend	Run only between Chelmsford and Lowell, segment between Chelmsford and Walmart covered by proposed 20	40/90	6:15 AM – 8:30 PM	30/60	6:15 AM – 8:30 PM	60	8:00 AM - 5:30 PM	60	8:00 AM - 5:30 PM	60	8:00 AM - 5:30 PM
17	North Chelmsford via Middlesex	Split into two routes (See 20 for other portion of existing 17)	New routing: North Chelmsford - Chelmsford: Groton, Middlesex, Broillette, Princeton, Wood, Westford, Drum Hill, N, Parkhust, Smith Stedman, Dalton, MA 4	60	6:00 AM – 7:00 PM	60	6:00 AM – 7:00 PM	60	8:00 AM - 6:00 PM	60	8:00 AM - 6:00 PM		
18	Downtown Shuttle	No change	No change	15	5:30 AM – 9:30 PM	15	5:30 AM – 9:30 PM	30	7:15 AM - 7:00 PM	30	7:15 AM - 7:00 PM	30	7:15 AM - 7:00 PM
01/08		No change	No change					60	8:00 AM - 5:15 PM	60	8:00 AM - 5:15 PM	60	8:00 AM - 5:15 PM
03/04		Discontinue interline	See Route 4					60	8:00 AM - 5:30 PM	---	---		
06/09		This interline is discontinued	See Rout 6					60	8:00 AM - 5:15 PM	---	---		
19	Pheasant Lane Mall via Middleboro Road	Expand Saturday holiday service to year round Mon-Sat service	No change			90	8:00 AM - 6:45 PM			90	9:30 AM - 5:00 PM		
20	North Chelmsford via Middlesex	Proposed Service to replace existing Route 17 between Lowell and Walmart in Chelmsford, replaced by Route 19 when that route is introduced	Lowell-Chelmsford Walmart: Thorndike, Middlesex, Branch, Middlesex, Brouillette, Route 3A, N Rd, Technology, Research Dr, Technology, Westford			60	6:00 AM – 7:00 PM			60	8:00 AM - 6:00 PM		
22	Bedford VA	New Route to service Bedford VA, Middlesex Community College, Billerica Technology Park	From Lowell : Lowell Connector, US-3, Concord Rd., Billerica Technology Park, Technology Park Drive, Orchard Rd, Middlesex Community College, Springs Rd, Bedford V.A.			90	6:00 AM – 7:00 PM			90	8:00 AM – 6:00 PM		

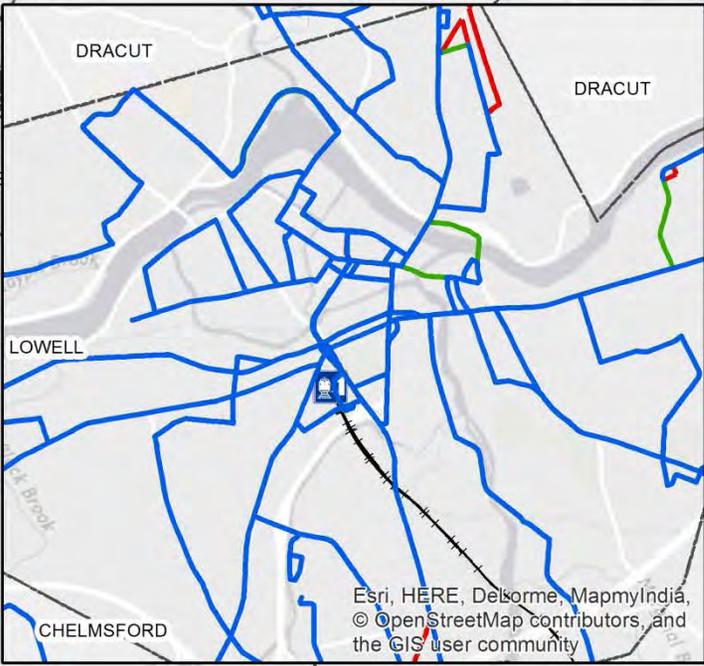


Table 23. Recommendations by Phase

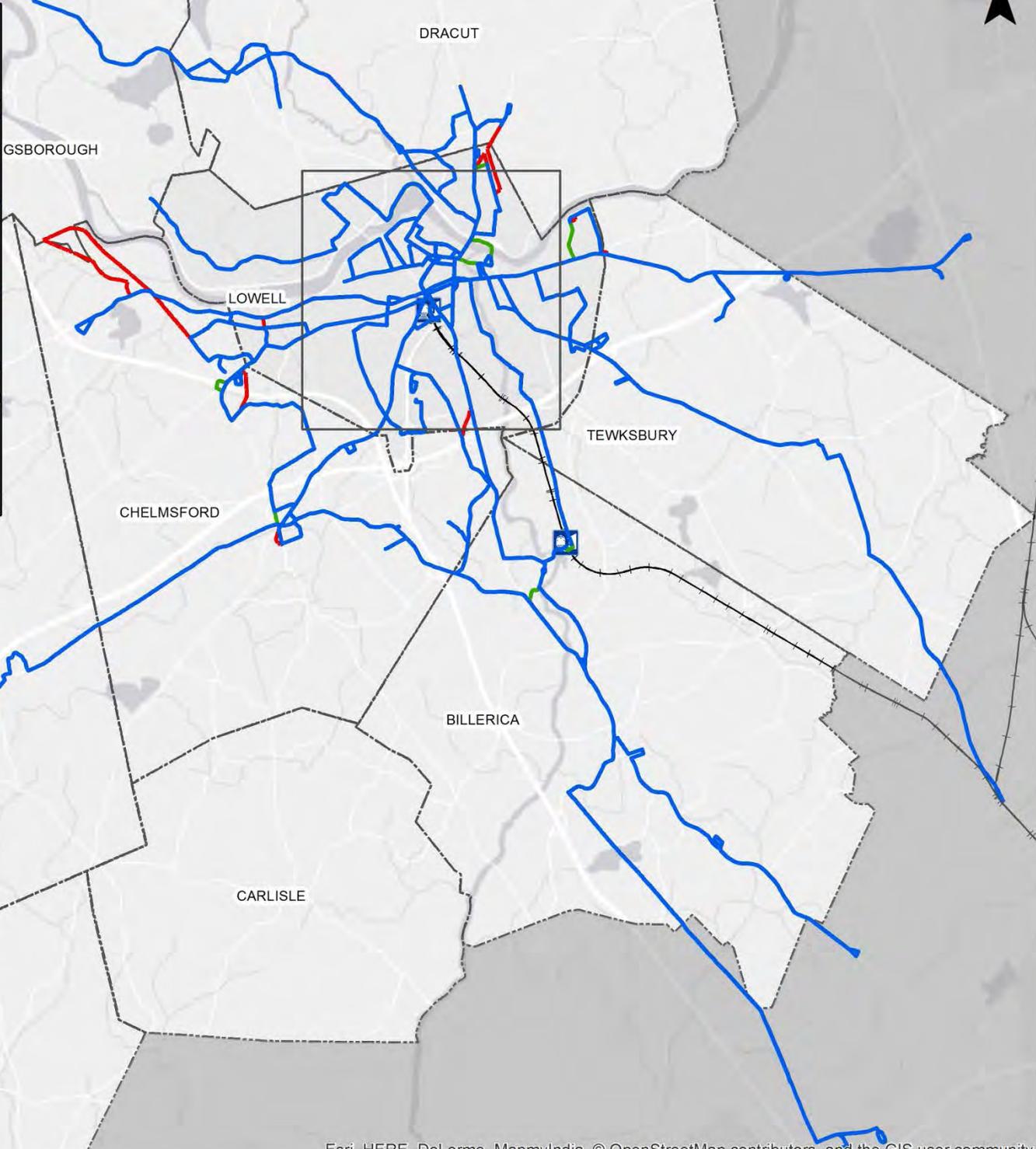
Bus Route	Alignment	Schedule	Phase 1	Phase 2	Phase 3
1 Christian Hill	Service has been streamlined, one-way service eliminated and service adjusted in the southern portion to cover the former Route 9 service to Saint Mary Hospital	No change	-Alignment change		
2 Belvidere	Consider service on Raven Road for Loop	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency		-Sunday service	
3 South Lowell	Route discontinued, consolidated with route 15	No Service	-Discontinue route		
4 Highlands via Stevens	No change	-Sunday service 8 AM to 5:30 PM with 60 minute frequency			-Sunday service
5 Westford Street	No change	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency -Extend weekday service 5:30 AM to 9:30 PM	-Extend weekday service	-Sunday service	
6 Broadway / UMass	Route covers existing route 6 and 9	-30 minute weekday frequency -Sunday service 8 AM to 5:30 PM with 60 minute frequency -Extend weekday service to 8 PM		-Weekday frequency -Alignment change -Extend weekday service	-Sunday service
7 Pawtucketville	No change	-Sunday service 7:45 AM to 6:30 PM with 60 minute frequency -Extend weekday service to 9:30 PM	-Extend weekday service	-Sunday service	
8 Centralville	No change	No change			
9 Lowell Circulator	Route discontinued, consolidated with route 6	No Service		-Discontinue route	
10 Dracut / Tyngsboro	No change	No change			
11 IRS via Rte. 133	No change	No change			
12 Tewksbury via Rte38	No change	-Sunday service 7 AM to 5:45 PM with 60 minute frequency			-Sunday service
13 Billerica	No change	No change			
14 Burlington Mall	No change	-Sunday service 8 AM to 6 PM with 60 minute frequency -30 minute weekday frequency		-Sunday service	-Weekday frequency
15 Chelmsford / Westford	Eliminate Marshalls Plaza deviation & Combine with Route 3	-60 minute weekday frequency	-Weekday frequency -Alignment change		
16 Chelmsford Center	Run only between Chelmsford and Lowell, segment between Chelmsford and Walmart covered by proposed 20	-30 minute peak, 60 minute off-peak weekday frequencies -Sunday service 8 AM to 5:30 PM with 60 minute frequency	-Weekday frequency -Alignment change		-Sunday service
17 North Chelmsford	Split into two routes (See 20 for other portion of existing 17). New routing is North Chelmsford - Chelmsford. When Route 19 is implemented the alignment will follow 3A instead of Middlesex Street to reduce duplication with the 19	-No change	-Split into two routes	-Adjust alignment with the implementation Of route 19	
18 Downtown Shuttle	No change	-Sunday service 7:15 AM to 7 PM with 30 minute frequency		-Sunday service	
19 - Pheasant Lane Mall via Middleboro Road	No change	-Expand Saturday holiday service to year round Mon-Sun service -Weekday service 8 AM to 6:45 PM with 90 minute frequency -Saturday service 9:30 AM to 5 PM with 90 minute frequency		-Implement Weekday and Saturday service	



Bus Route	Alignment	Schedule	Phase 1	Phase 2	Phase 3
20 - North Chelmsford via Middlesex	Proposed Service to replace existing Route 17 between Lowell and Walmart in Chelmsford until Route 19 is established	-Weekday service 6 AM to 7 PM with 60 minute frequency -Saturday service 8 AM to 6 PM with 60 minute frequency	-Implement route	-Discontinue Route	
22 - Bedford VA	New Route to service Bedford VA, Middlesex Community College, Billerica Technology Park	-Weekday service 6 AM to 7 PM with 90 minute frequency -Saturday service 8 AM to 6 PM with 90 minute frequency			Implement route
03/04 Combo Loop	Interline discontinued, the 3 is now part of the 15 and 04 will operate on its own	No service	-Discontinue route combination		
06/09 Combo Loop	Interline discontinued, the 6 and 9 have been merged into one route	No Service		-Discontinue route combination	
01/08 Combo Loop	No change	-Sunday service 8 AM to 5:15 PM with 60 minute frequency			-Sunday service



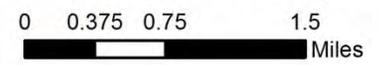
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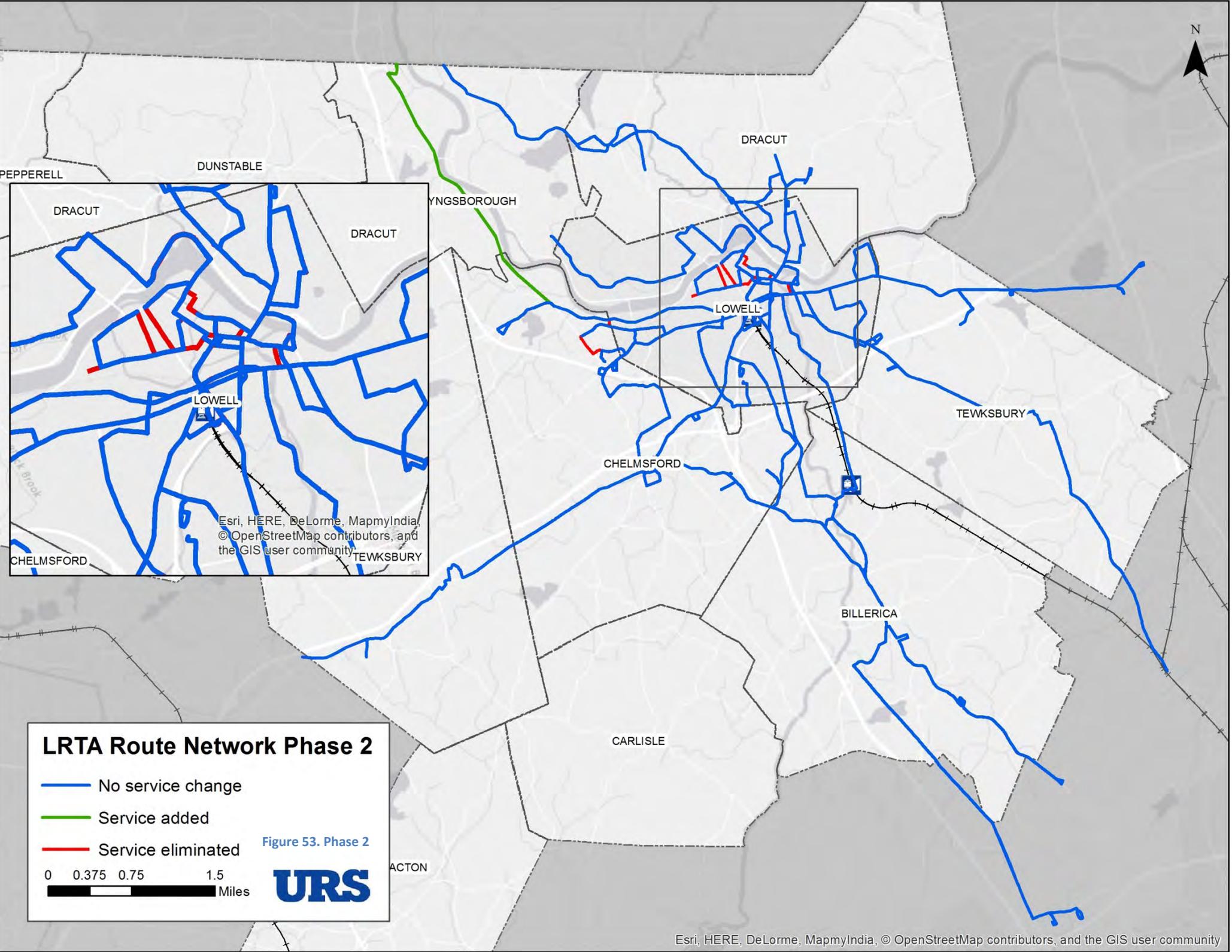


LRTA Route Network Phase 1

-  Service added
-  Service eliminated
-  No service change

Figure 52. Phase 1



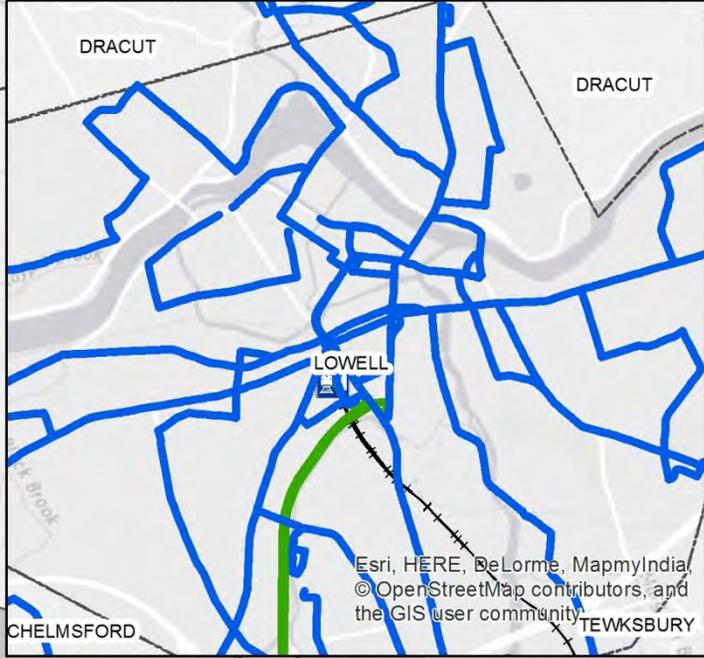
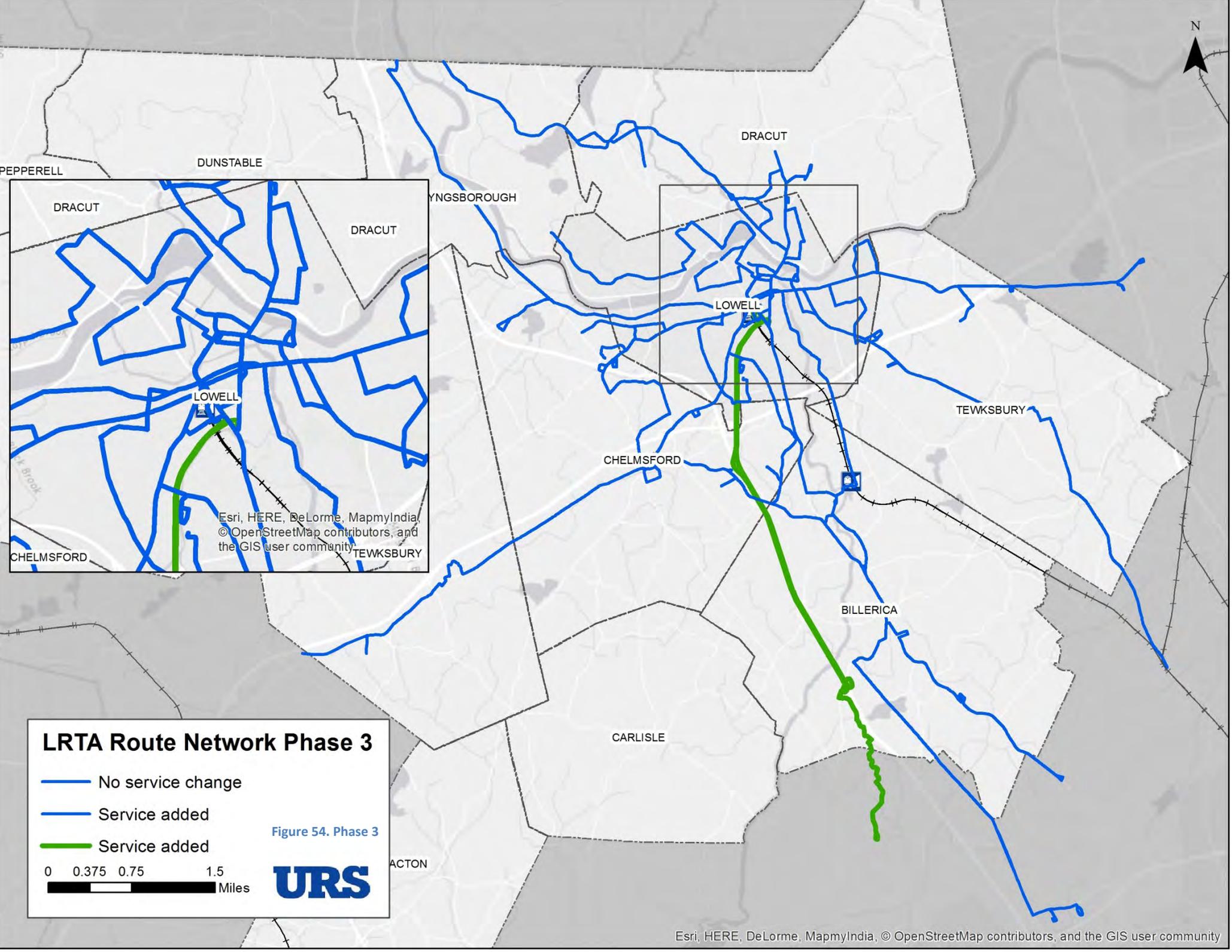


LRTA Route Network Phase 2

- No service change
- Service added
- Service eliminated



Figure 53. Phase 2



LRTA Route Network Phase 3

-  No service change
-  Service added
-  Service added

0 0.375 0.75 1.5 Miles



Figure 54. Phase 3



7.4 Cost Estimation

7.4.1 Operating Costs

Operating costs are based on the average cost per hour of \$93.98 and incorporate all of the recommendations for each route and phase. The cost can be adjusted by implementing some but not all of the recommendations or interlining routes to improve efficiency; therefore the final costs may differ slightly from what is proposed. Figure 55 charts the total operational cost for the existing system and the additional costs associated with the service improvements in each phase. Phase 1 has a net zero cost, primarily due to the rearrangement of routes. For a breakdown of the cost/savings for each route and phase see the recommendation profiles in section 7.7.

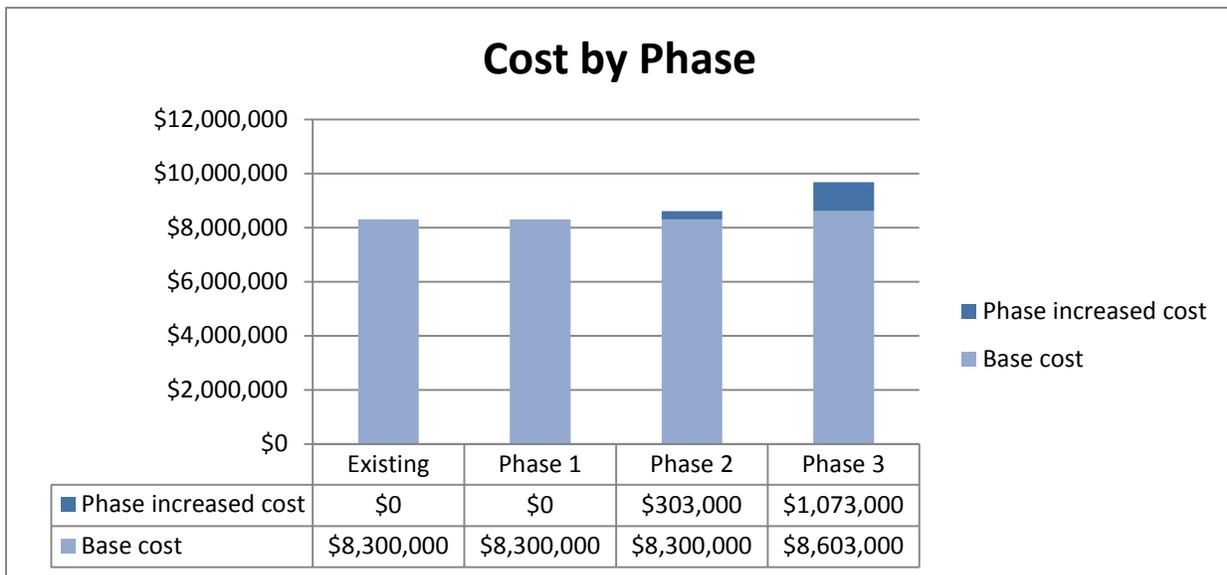


Figure 55. Cost by Phase

7.4.2 Capital Costs

Capital costs include vehicle and infrastructure costs. In Phase 1 the primary constraint was based on the number of vehicles required in peak service and minimizing cost increases. LRTA currently has a fleet of 50 buses to provide fixed route service. In peak service there are currently 42 vehicles in use, of which 13 are school trippers and the remaining 29 are for all day fixed route service. Phase 1 was designed with these constraints (Figure 56). Future phases will require additional vehicles and the procurement process can take up to two years from the time the process begins until the vehicles are delivered and put into service. LRTA must begin to plan now for future expansion of the fleet.

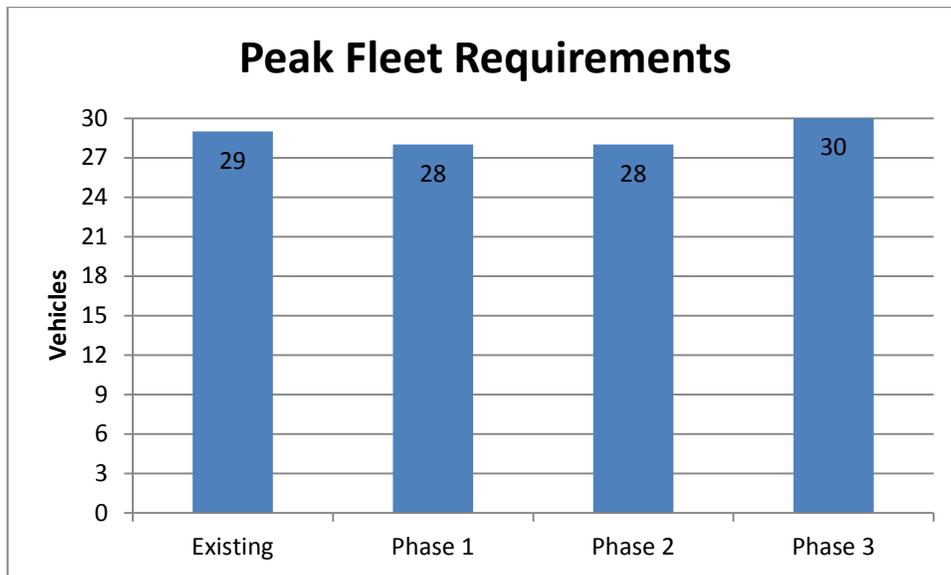


Figure 56. Fleet Requirements by Phase¹⁹

7.5 Recommended Service Guidelines

In order to establish service guidelines in the pursuit of establishing a monitoring program in the future, service must first be monitored and data collected. Routes should be defined by the function they service in order to accurately measure the health of a route. Three types of routes are recommended for LRTA: (1) City, (2) Suburban, (3) Shuttle. Each route type will have in turn different performance measures to monitor existing service and evaluate new service. Table 24 provides an overview of the suggested route type and pairing for existing and recommended LRTA routes.

City Routes – These are routes that service densely populated areas. They typically begin and end in Lowell.

Suburban Routes- These routes typically serve a surrounding suburban community and originate in Lowell. They usually exhibit higher operating speeds and longer trips.

Shuttle Routes – Shuttle routes are designed to connect transportation hubs with the urban core of Lowell through circulators.

¹⁹ Does not include school tripper vehicle requirements



Table 24. LRTA Route Types

Route Type	Routes
City	1, 2, 3, 4, 5, 7, 8, 9(Phase 1-2)
Suburban	10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 22
Shuttle	18, 6

Categories of data to be collected and used in the monitoring program include the following, which are discussed in detail below:

- Ridership
- On-time performance
- Financial
- Service coverage
- Service levels – span and frequency

Passenger boarding data should be collected continually on a time-specific basis. There is a trade-off between data collection efforts and the value of information. It is just as easy to collect too much data as it is to collect insufficient data. Passenger boardings should be recorded daily by route, fare category, and by trip; this information can often be generated through farebox reports. One goal all transit agencies should strive to reach is the implementation of Automatic Passenger Counters (APCs). APCs include capabilities such as recording each passenger by fare category as they board. This function should be programmed into the software as it is implemented. However, even without the benefit of APCs, passenger data can still be collected and recorded by drivers for numerous variables.

With any transit system, it is important to monitor on-time performance. An on-time performance goal should be established (e.g. an attainable on-time goal of 95 percent may be considered). Minor adjustments to routes may be needed to ensure that schedule and headway adherence can be maintained. If automatic vehicle location (AVL) software is not available to track on-time performance, drivers should report actual arrival and departure times at designated bus stops along the routes and at major stops. It should be emphasized that drivers should not leave prior to a scheduled stop time to make up time along a route. Leaving early could cause riders to miss a bus. The dispatcher should then record this information so that the number of trips running late can be determined.

Financial data are required to evaluate performance measures such as the operating cost per hour of service and the cost per passenger-trip. Financial monitoring should continue as part of the performance monitoring program. Important data to collect and report include operating revenue by source, farebox revenue by fare category, maintenance costs, gas and oil expenditures, and employee-related costs (including salary and benefits).



Service coverage should be based on demand as the area has a wide range of employment and population density. Before service is expanded to new areas or frequencies increased, density thresholds should be examined (Table 25).

Table 25. Service Thresholds

Jobs & Population per Square mile	Fixed-Route Headway
<2,000	No service
2,000-3,000	120 min or peak only
3,001-6,500	60 Min
6,501-16,000	30 Min
16,001-250,000	15 Min
250,001+	5 Min

It is also important to establish minimum levels of service for each route type. These include service span and frequency. Table 26 below outlines suggested minimum service spans (or number of trips) for each route type. Service can begin earlier or end later if demand warrants. Adjustments to the times can also be made based on the hours of centers served and the passengers needs but should be within the financial capacity of LRTA.

Table 26. Minimum Service Spans

	City Routes	Suburban Routes	Shuttle Routes
Weekday	6:00 AM – 8:00 PM	6:00 AM - 7:00 PM	6:00 AM – 8:00 PM
Saturday	8:00 AM – 5:00 PM	8:00 AM – 5:00 PM	8:00 AM – 5:00 PM
Sunday	8:00 AM – 5:00 PM	8:00 AM – 5:00 PM	8:00 AM – 5:00 PM

Frequency often has a direct correlation with ridership; higher levels are more attractive to riders but cost more to operate; therefore it is critical to establish frequencies that are high enough to attract riders but not so high that the subsidy is greater than the need. Higher frequency routes require more vehicles and drivers. Clock-face schedules should be used except for under unique circumstances. These circumstances can include trips that are: designed to meet work shifts or school bell times; that include clock-face schedules that would require excessive recovery time (inefficient service); or that disallow interlining with other routes or miss key transfers. Minimum service frequencies are presented in

Table 27 and should correlate to service thresholds established in Table 25. These frequencies represent minimums based on the service spans in Table 26 but can have variations throughout the day such as added service during the peak hours or reduced service at night.



Table 27. Minimum frequencies

Route Type	Frequency
City	30 Minutes (peak) 60 Minutes (off-peak)
Suburban	60 Minutes
Shuttle	30 Minutes

Regardless of service type if a route has over 400 riders a day it should have a 30 minute weekday frequency all day.

7.51 New Service Warrants

LRTA often receives requests for new service; new service warrants will help LRTA evaluate proposals and determine service levels. Section 7.63 outlines how to monitor and measure new services. The development of the new services should follow the new service warrants and after two years be able to meet or exceed the performance measures outlined in Section 7.63.

When analyzing new service requests and proposals the following should be considered:

- **Area coverage** – When service is proposed the new route should be evaluated for its ability to connect to other routes, meet service thresholds, and operate cost effectively. Routes extend the service area may have a demand but the increased miles/hours may cause the subsidy to be greater than those recommended in the performance measures.
- **Transit dependent populations** – The presence of transit dependent populations should be considered when evaluating new service proposals. If there is a high but remote transit dependent population, alternative service types such as Dial-A-Ride or flex routes might be warranted.
- **Special markets** – New service is often proposed for special markets such as a new shopping center, university campus, or employment center. These markets often produce demand but the cost to service them can be high and ridership potential undetermined. LRTA should work with these destinations to secure some dedicated funding which can help bring down the cost of the route.

7.6 Performance Measures

Performance measures serve as a guide to evaluate the success of a transit service. Performance measures include the types of data to be collected and give the tools necessary to identify transit system opportunities and deficiencies. Performance measures should:

- Be easily measurable
- Have a clear and intuitive meaning so that it is understandable to those who will use it and to non-transportation professionals
- Be acceptable and useful to transportation professionals



- Be comparable across time and between geographical areas
- Have a strong functional relationship to actual system operations so that once changes occur in service operations, changes to the system can readily be determined
- Provide the most cost-effective means of data collection
- Where appropriate, be based on statistically sound measurement techniques
- Be consistent with measures identified for other systems

Recommended performance measures to monitor existing and future routes could include:

- **Passengers/Hour:** Number of total monthly and annual passengers divided by the corresponding revenue-hours.
- **Subsidy/Passenger:** Total expenses minus fare revenue divided by ridership.
- **Farebox Recovery:** The percentage of operating costs covered by fares collected, calculated by the fares collected divided by the cost to operate the route.
- **Cost/Revenue-Hour:** An excellent indicator of efficiency is cost per revenue-hour of service. Costs per hour should be analyzed by route and compared to overall system averages.
- **Late Trips:** The percentage of fixed-route trips which operate late or are missed should be recorded and reported. The recommended standard for late trips is any trip that is more than five minutes behind schedule.
- **Service/Road Calls:** the number of service/road calls divided by the number of revenue miles. This measure is typically measured for the entire system and not individual routes. This monitors routine maintenance and vehicle performance.
- **Accidents/100,000 miles:** Measure of driver safety. There must be a standard practice for defining what an accident is.

7.61 Service Benchmarks

The aforementioned performance measures can be used to create benchmarks for service operation. The benchmarks will help LRTA track progress and set goals for the performance of the route. These benchmarks should be seen as short-term goals that should be re-evaluated at set intervals—at least every five years—to ensure that the expectations for the route are consistently evolving. If a specific benchmark has been greatly exceeded during the first two years of operation, the criteria should be changed to provide a progressive target for the service. The following benchmarks were determined by the base type of service, national best standards and the current performance.

Passengers per Hour

Passengers per hour measures ridership as a function of the amount of service provided and will vary based on the type of route. Table 28 outlines the threshold for route/service types which can be used to monitor the route. As system-wide service improves these values should be adjusted to reflect the change and reevaluated every 3-5 years. They are based on current performance and best practices. If routes are performing at 75% or below of the benchmark then the route may need to be evaluated to determine remedies to improve performance.



Table 28. Passenger per Hour

Route Type	Passengers per Hour
City	18
Suburban	13
Shuttle	20

Subsidy per Passenger

Subsidy per passenger measures the cost of providing service, taking into account fare revenue collected. As with passengers per hour, as system-wide service improves these values should be adjusted to reflect improvements and should be reevaluated every 3-5 years. LRTA should strive to have a subsidy per passenger less than **\$5** on all routes. If subsidies are more than 50% higher than the benchmark and the route does not have a dedicated source of funding, then the route may need to be evaluated to determine remedies to improve performance.

Farebox Recovery

Long term LRTA should strive to achieve a 20% farebox recovery ratio. To achieve this goal LRTA should set an intermediate goal of a recovery ratio of **15%** on all routes for the next five years. If the ratio drops on a route to below 8% then the route may need to be evaluated to determine remedies to improve performance.

Cost per Revenue Hour

Cost per revenue hour by route should be related to the average of the system so that it can change as service is added or subtracted or funding sources change. Table 29 provides a guideline for monitoring this benchmark.

Table 29. Cost per Hour Performance Standard Criteria

Performance	Percentage of Average	Action
Very Low	0%-50%	Immediate action
Low	51%- 75%	Subject to review
Average	75%-150%	No action needed
High	150%+	Evaluate for service improvements

For those routes performing under 50% immediate actions are listed in section 7.62. Routes falling within the 50%-75% range are routes that are candidates for monitoring service. Routes falling within the 75%-150% range are routes that are performing well and require no action. 150%+ routes indicate high performing routes which may benefit from increased service.

Late Trips

Late trips measure on-time performance and help evaluate a vehicle’s adherence to a schedule. A trip is considered on-time if it departs a timepoint no more than five minutes late; no trips should leave early. The recommended best practice for on-time performance nationwide is **95%**; LRTA should strive to meet this benchmark.



Service/Road Calls

Vehicle breakdowns are inevitable. This measure tracks the distance traveled between mechanical breakdowns. Although frequent occurrences can create disruptions in a transit system, it is important to track the frequency and type of mechanical failures of each vehicle in addition to monitoring a fleet's age. Monitoring of vehicle breakdowns is one method of reducing system disruptions and may allow an agency to improve monitoring of vehicle replacement schedules and preventative maintenance practices. Data collection efforts should include date, time of day, type of failure, age of vehicle, vehicle number, vehicle mileage, and how the situation was rectified. Monitoring of these items will allow LRTA to recognize patterns in repeated types of mechanical breakdowns; breakdowns related to vehicle type, age or mileage; and assist with preventative maintenance programs. Wheelchair lift failures should also be monitored. LRTA should strive for **20,000 miles** between road calls.

Accidents per 100,000 Miles

The FTA suggests that at a minimum transit providers strive towards the goal of six accidents or less per 100,000 miles. LRTA should seek to exceed that minimum with no more than **three (3) accidents per 100,000 miles**. The measure can be calculated by dividing the number miles by the number of accidents in a given time period. Values lower than 33,333 indicate that the indicator is not being met.

7.62 Action for Low Performing Routes

If routes are not meeting at least two out of the three main indicators (passenger per hour, subsidy per passenger, farebox recovery) or fall beyond the minimum suggested values (8% farebox recovery, \$7.5 subsidy per passenger, 75% of the passenger per hour by service type or "very low" performance score for cost per hour), they should be evaluated for possible modification. The following actions may help improve route performance:

Change service level – Some low performing routes may not warrant increased service frequency; yet routes with very few trips may not attract riders. High frequency routes that are low performing should be evaluated for service changes. Low frequency routes can be evaluated for trip additions to determine if the low performance is related to minimal service. This analysis should be done in conjunction with outreach to determine if extra trips would garner higher ridership

Segment identification – A segment level analysis of a route might highlight a portion of the route that causes the overall poor performance. This segment can be modified to help improve the overall route.

Marketing – Marketing can help raise the public awareness of a route. Ridership can be poor because the public lacks knowledge of the service. A marketing/educational campaign can help improve performance statistics.



Public outreach – On-board surveys or rider interviews can help gain information about how the route can be improved.

Span identification – Evaluating the performance at different time periods throughout the day may help identify time periods or trips that garner very little ridership. For example the last trip of the day may have very low productivity and bring down the performance of the entire route.

Subsidy reduction – If the subsidy per passenger is high one way to reduce it is to explore cost sharing partnerships with external funding sources. Examples include schools/colleges, large housing complexes, shopping centers, and places of employment. Another method is to work with local employment centers to coordinate the sale of passes with employee incentives.

Discontinuation – Discontinuation is the last option for dealing with a low-performing route and should only be implemented once other measures have been tried but the route is still under performing. A whole route or segment can be discontinued. Routes should not be discontinued until other remedial actions have been tried and the service has been monitored for at least sixth months and there is still no improvement on the route.

7.63 New Service Performance Evaluation

Once a new route or service has been implemented, it should be monitored for an initial period to evaluate its performance. At the onset the route may not meet the benchmarks set forth for existing routes, but as the service becomes more popular it may. New services should be implemented for a period of at least one year in order to garner ridership and monitor monthly fluctuations. While minor changes such as timing can be made to the route within the initial period, large changes should be avoided. On-time data should be checked randomly to ensure that performance remains acceptable; a new service that has low on-time performance will have a difficult time attracting ridership. Approximately halfway through the initial period (6 months) a passenger survey of the route should be conducted to understand the effectiveness of the route. The route should continue to be monitored as a 'new route' beyond one year if ridership has had continual growth. Once ridership has plateaued the route can be evaluated against the aforementioned benchmarks with the other routes.

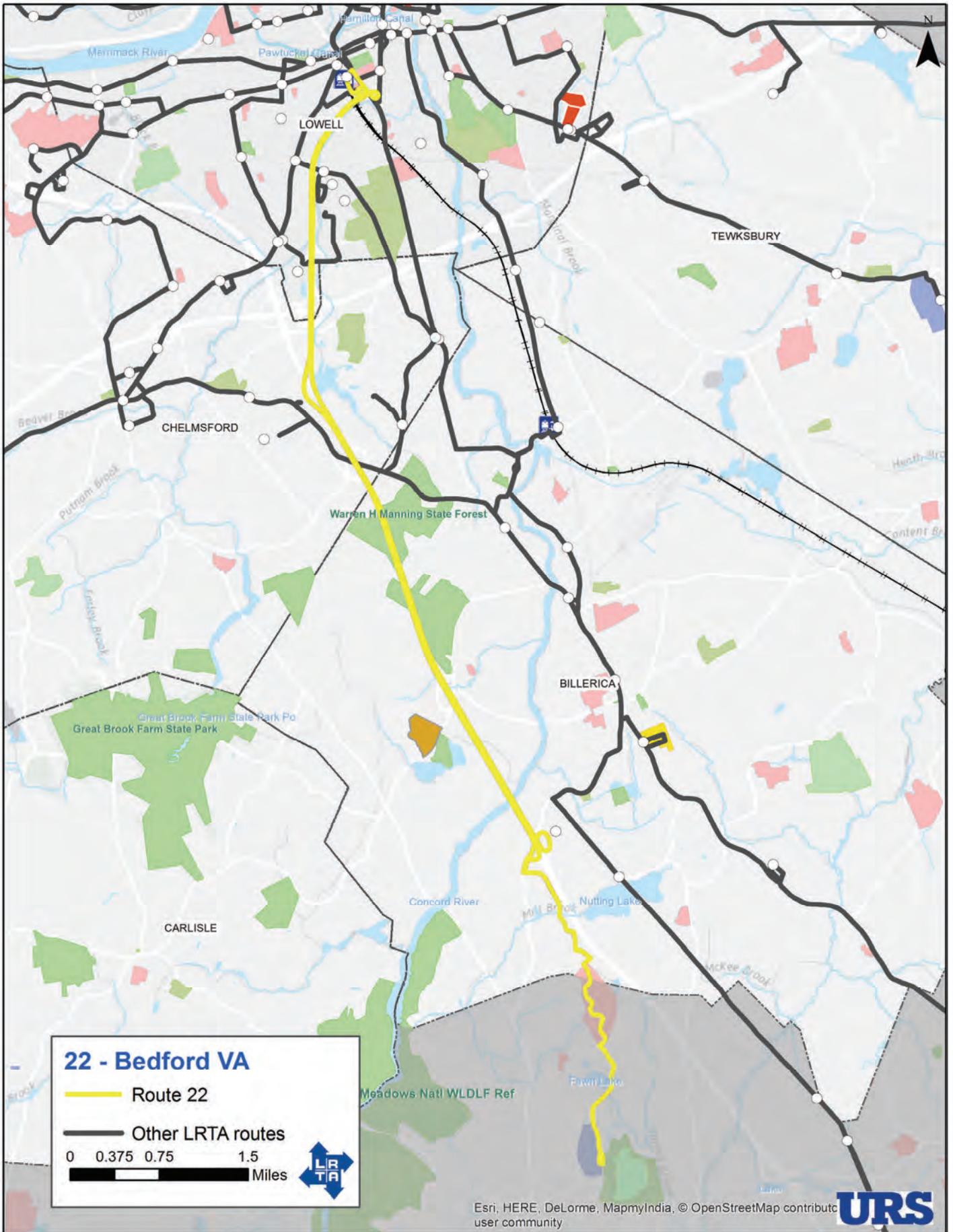
7.7 Recommendation Profiles

The following route profiles depict the proposed recommendation changes.



Route 22

Bedford VA



22 - Bedford VA

 Route 22

 Other LRTA routes

0 0.375 0.75 1.5
 Miles






Current Route Performance

Productivity	Route 22	System Average
Daily Weekday Ridership	N/A	283
Saturday Ridership	N/A	140
Sunday Ridership	N/A	N/A
Weekday Productivity	N/A	16.48
Saturday Productivity	N/A	13.8
Sunday Productivity	N/A	N/A

Financials	Route 22	System Average
Farebox Recovery	N/A	13.8%
Weekday Subsidy per passenger	N/A	\$5.54
Saturday Subsidy per passenger	N/A	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Proposed Service Changes

	Current	Proposed
Days Operated	N/A	Mon—Sat
Route Length	N/A	22.1
Route Run—Time	N/A	66 min
Peak Headway	N/A	90 min
Off-Peak Headway	N/A	90 min
Saturday Headway	N/A	90 min
Sunday Headway	N/A	N/A
Hours of Operations M-F	N/A	6:00 AM—7:00 PM
Hours of Operation Saturday	N/A	8:00 AM—6:00 PM
Hours of Operation Sunday	N/A	N/A

Route Alignment Changes:

New route to service Bedford VA, Middlesex Community College, Billerica Technology Park.

Environmental Justice Policy:

Analysis required in Phase 2 with new service.

Phase 1:

- No change

Phase 2:-

No change

Phase 3:

-Implement route

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	0	+2,825
Annual Change in Revenue Miles	0	0	+56,502
Estimate Change in Cost	0	0	+\$267,000
Additional vehicle requirements:	0	0	+1
Capital Requirement: Other	None		

Other Notes:

Implementation of new route will increase mobility in the region by providing service to areas with higher population and employment densities.

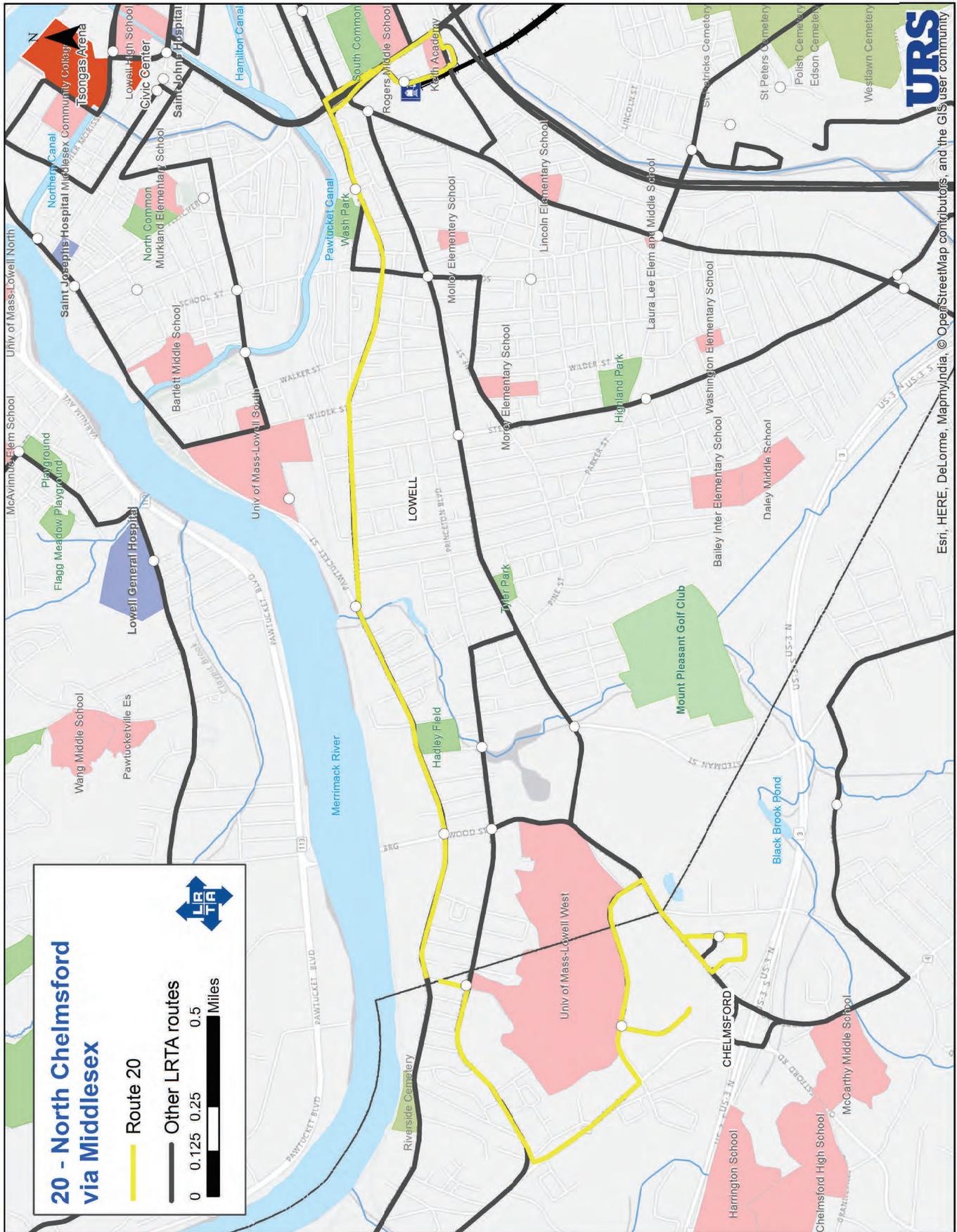
ADA Impact:

High impact—new route will expand the existing ADA service area.



Route 20

North Chelmsford via Middlesex



20 - North Chelmsford via Middlesex

— Route 20

— Other LRTA routes

0 0.125 0.25 0.5 Miles



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Route 20

North Chelmsford via Middlesex

Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	N/A	283
Saturday Ridership	N/A	140
Sunday Ridership	N/A	N/A
Weekday Productivity	N/A	16.48
Saturday Productivity	N/A	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	N/A	13.8%
Weekday Subsidy per passenger	N/A	\$5.54
Saturday Subsidy per passenger	N/A	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Proposed Service Changes

	Current	Proposed
Days Operated	N/A	Mon—Sat
Route Length	N/A	10.70
Route Run—Time	N/A	40 min
Peak Headway	N/A	60 min
Off-Peak Headway	N/A	60 min
Saturday Headway	N/A	60 min
Sunday Headway	N/A	N/A
Hours of Operations M-F	N/A	6:00 AM—7:00 PM
Hours of Operation Saturday	N/A	8:00 AM—6:00 PM
Hours of Operation Sunday	N/A	N/A

Route Alignment Changes:

Proposed service to replace existing Route 17 between Lowell and Walmart in Chelmsford until Route 19 is established.

Environmental Justice Policy:

Analysis required in Phase 1 and 2.

Phase 1:

-Implement route

Phase 2:

-Discontinue route.

Phase 3:

-No service

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+2,544	-2,544	-
Annual Change in Revenue Miles	+41,035	-41,035	-
Estimate Change in Cost	+\$239,000	-\$239,000	-
Additional vehicle requirements:	1	-1	-
Capital Requirement: Other	None		

Other Notes:

This proposed route covers what was eliminated during the split of Route 17 and will remain in service until Route 19 is implemented in Phase 2.

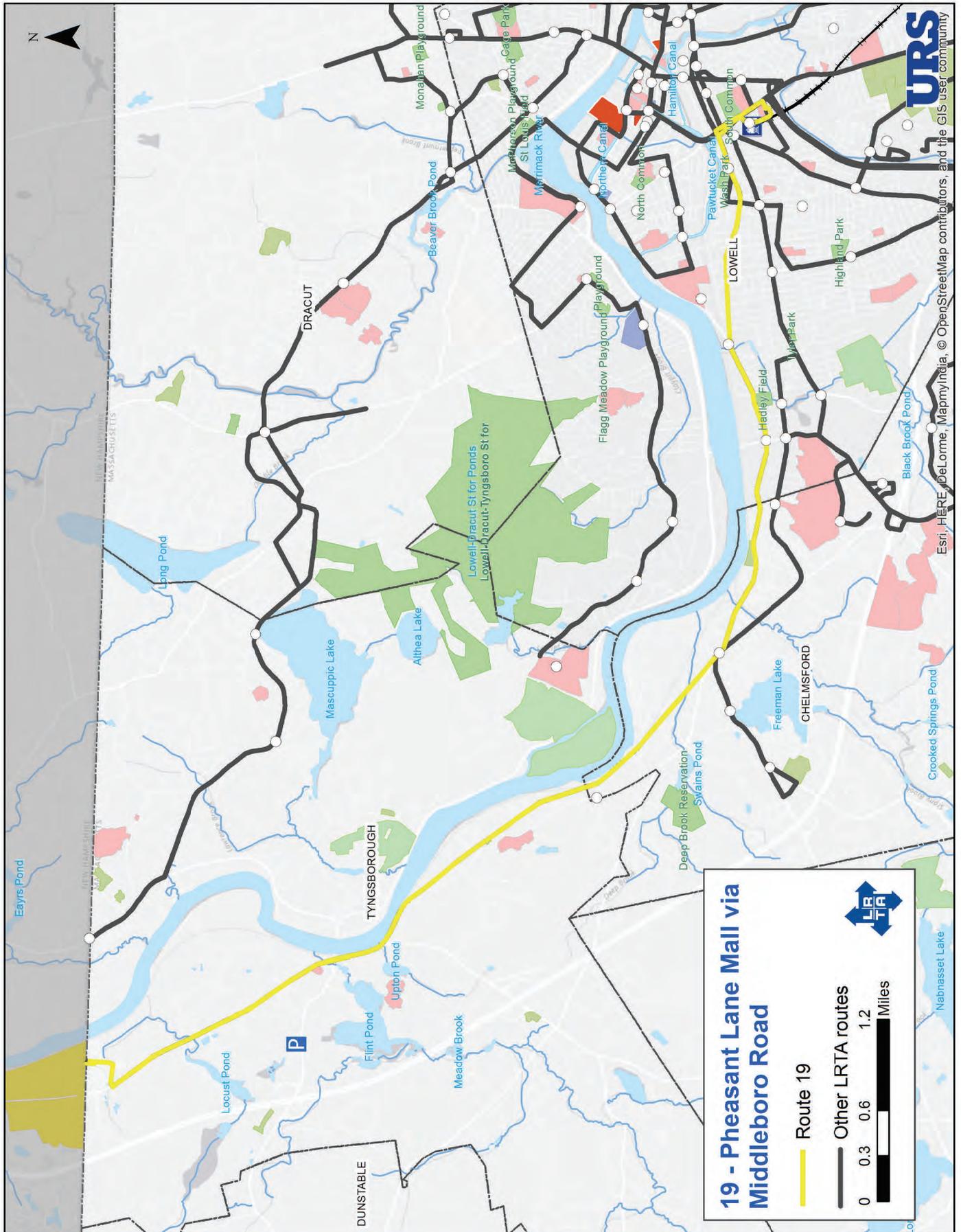
ADA Impact:

No impact, already in the ADA service area.



Route 19

Pheasant Lane Mall via Middleboro Road



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Route 19

Pheasant Lane Mall via Middleboro Road

Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	N/A	283
Saturday Ridership	N/A	140
Sunday Ridership	N/A	N/A
Weekday Productivity	N/A	16.48
Saturday Productivity	N/A	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	N/A	13.8%
Weekday Subsidy per passenger	N/A	\$5.54
Saturday Subsidy per passenger	N/A	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Proposed Service Changes

	Current	Proposed
Days Operated	N/A	Mon—Sat
Route Length	N/A	18.9
Route Run—Time	N/A	70 min
Peak Headway	N/A	90 min
Off-Peak Headway	N/A	90 min
Saturday Headway	N/A	90 min
Sunday Headway	N/A	N/A
Hours of Operations M-F	N/A	8:00 AM—6:45 PM
Hours of Operation Saturday	N/A	9:30 AM—5:00 PM
Hours of Operation Sunday	N/A	N/A

Route Alignment Changes:

This route will run to the Pheasant Lane Mall from Lowell.

Environmental Justice Policy:

Analysis required in Phase 2.

Phase 1:

-No change

Phase 2:

-Implement weekday and Saturday service.

Phase 3:

-No change

ADA Impact:

Large impact due to new service area

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	+2,435	0
Annual Change in Revenue Miles	0	+39,454	0
Estimate Change in Cost	0	+\$229,000	0
Additional vehicle requirements:	0	1	0
Capital Requirement: Other	None		

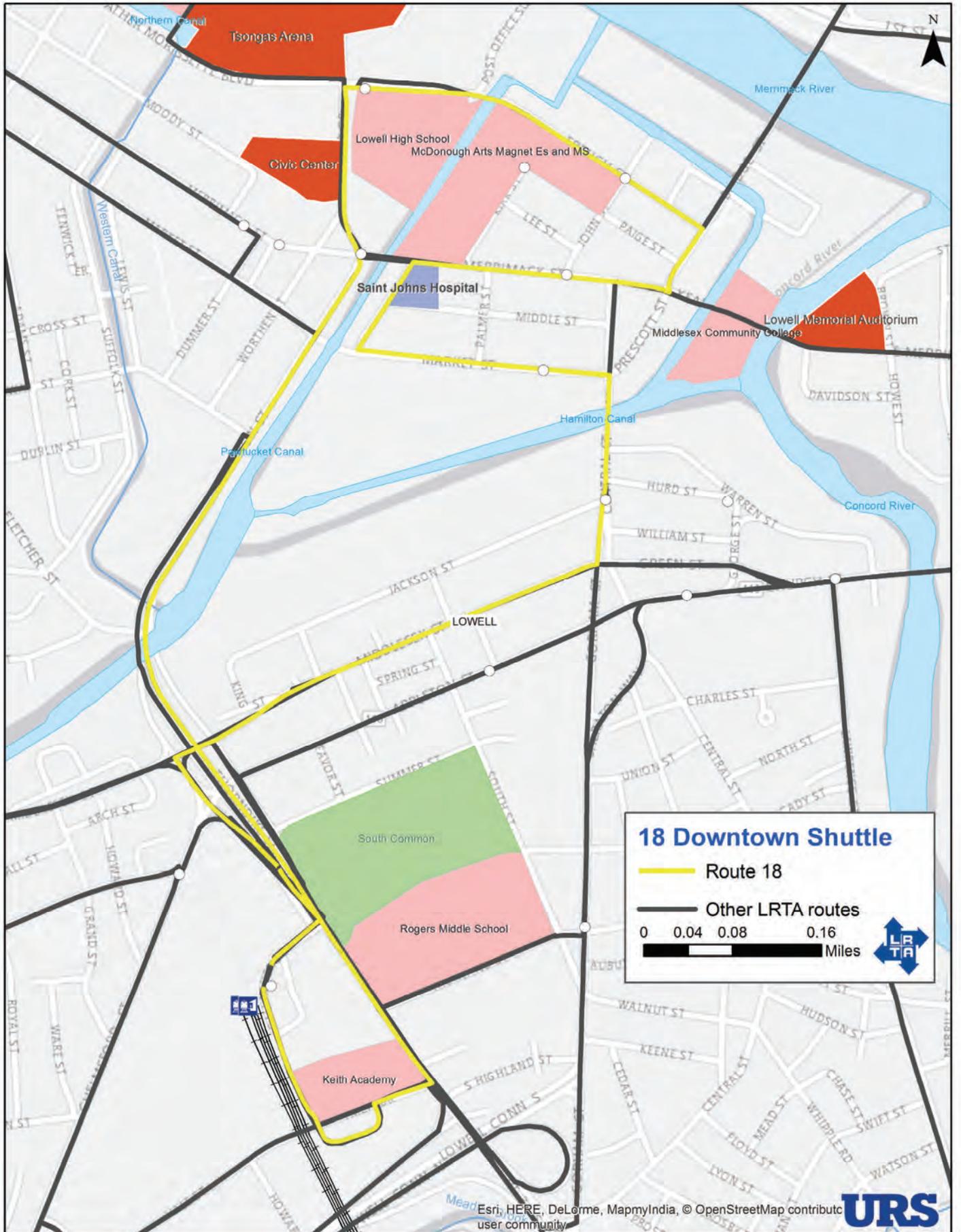
Other Notes:

This route will be expanded from an existing Saturday/seasonal service to year round service Monday through Saturday.



Route 18

Downtown Shuttle





Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	608	283
Saturday Ridership	130	140
Sunday Ridership	N/A	N/A
Weekday Productivity	20.7	16.48
Saturday Productivity	10.8	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	13.8	13.8%
Weekday Subsidy per passenger	\$3.93	\$5.54
Saturday Subsidy per passenger	\$5.48	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Shuttle

Route Ranking: 3/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	3.2	3.2
Route Run—Time	30 min	30 min
Peak Headway	15 min	15 min
Off-Peak Headway	15 min	15 min
Saturday Headway	30 min	30 min
Sunday Headway	N/A	30 min
Hours of Operations M-F	5:30 AM—9:30 PM	5:30 AM—9:30 PM
Hours of Operation Saturday	7:15 AM—7:00 PM	7:15 AM—7:00 PM
Hours of Operation Sunday	N/A	7:15 AM—7:00 PM

Route Alignment Changes:

No change.

Environmental Justice Policy:

Analysis required for Sunday service Phase 2.

Phase 1:

-No change

Phase 2:

-Add Sunday service.

Phase 3:

-No change

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	+594	0
Annual Change in Revenue Miles	0	+4,293	0
Estimate Change in Cost	0	+\$56,000	0
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

Other Notes:

This is a strong performing route with high ridership and will benefit from the addition of Sunday service.

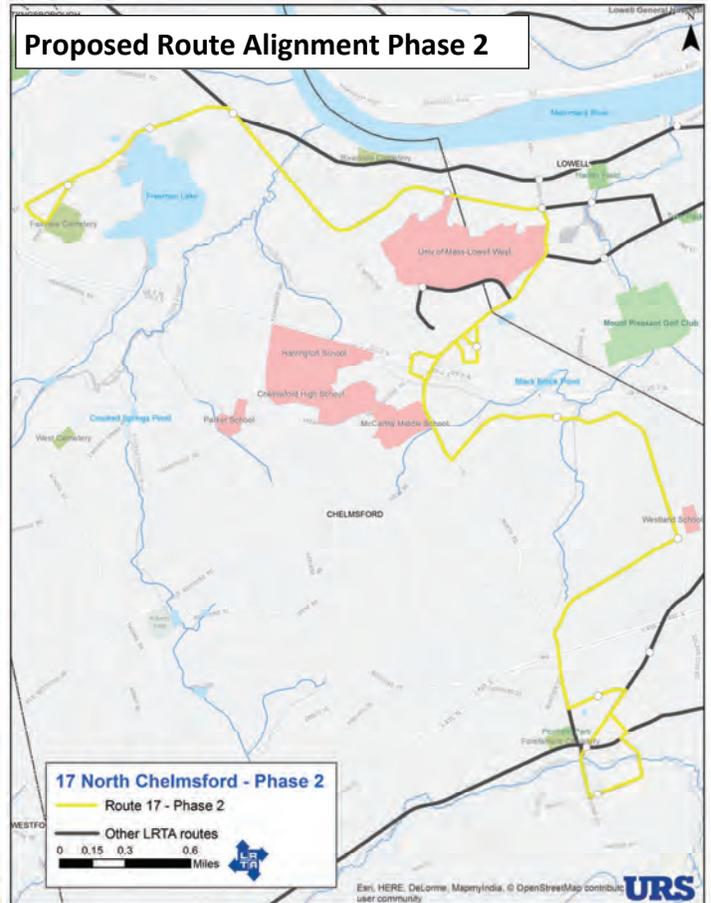
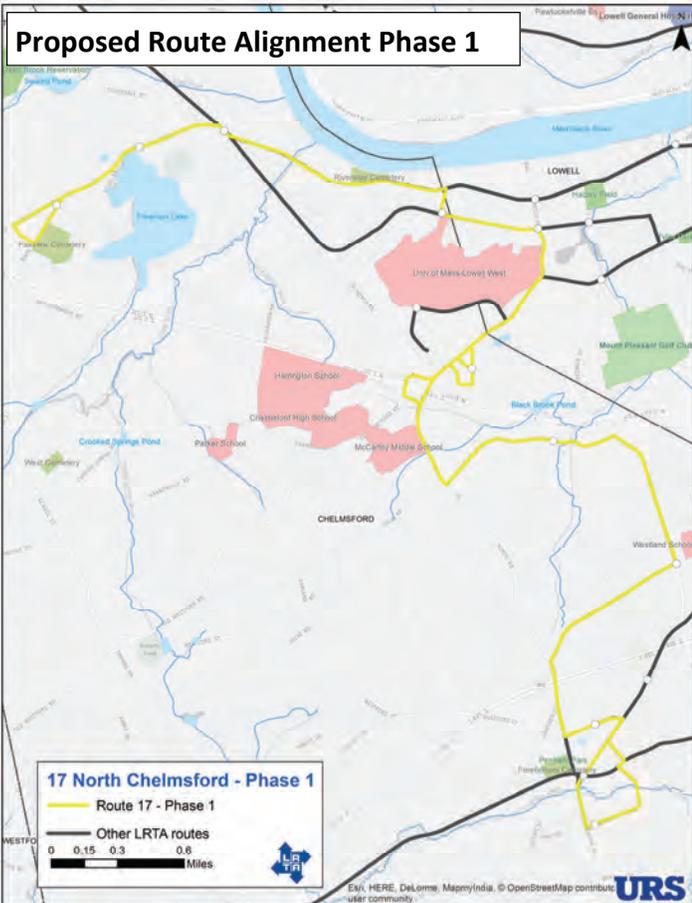
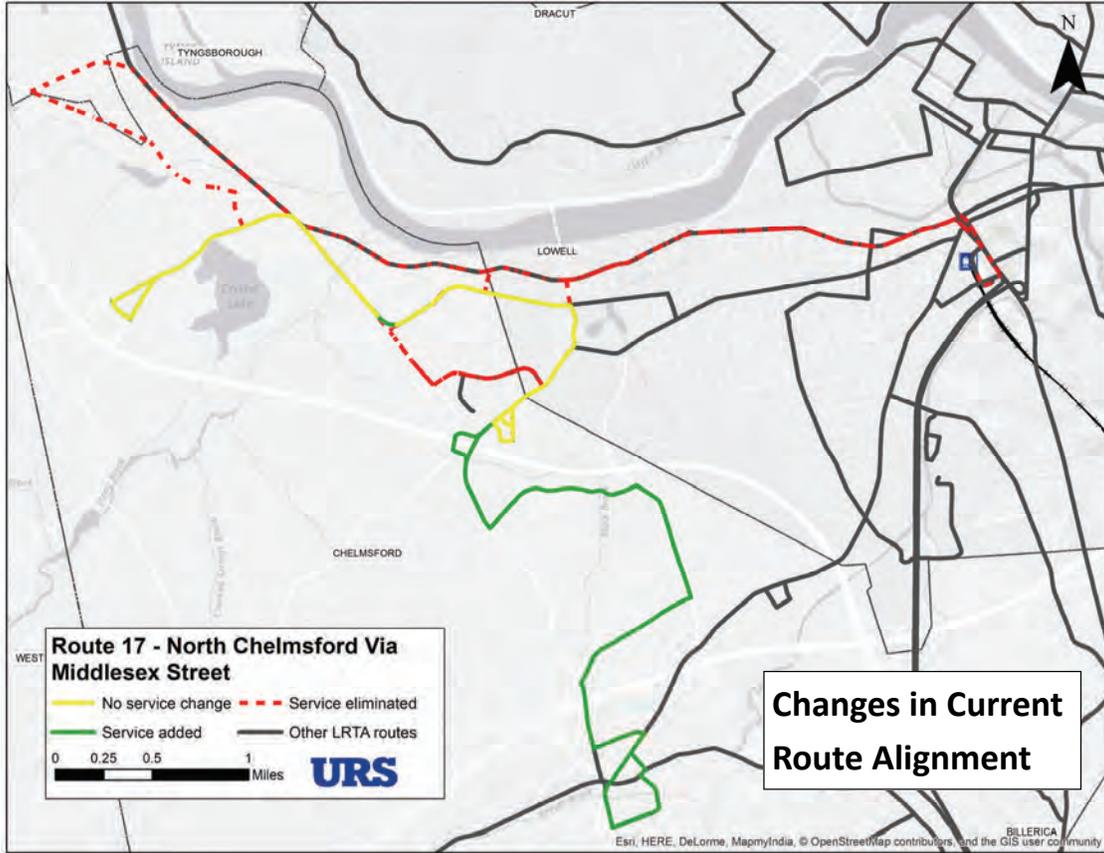
ADA Impact:

Moderate impact with addition of Sunday service.



Route 17

North Chelmsford





Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	302	283
Saturday Ridership	83	140
Sunday Ridership	N/A	N/A
Weekday Productivity	14.5	16.48
Saturday Productivity	5.2	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	15%	13.8%
Weekday Subsidy per passenger	\$5.54	\$5.54
Saturday Subsidy per passenger	\$12.71	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Suburban

Route Ranking: 10/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sat
Route Length	19.1	17.1
Route Run—Time	90 min	64 min
Peak Headway	60 min	60 min
Off-Peak Headway	60 min	60 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	N/A
Hours of Operations M-F	6:00 AM—7:00 PM	6:00 AM—7:00 PM
Hours of Operation Saturday	8:00 AM—6:00 PM	8:00 AM—6:00 PM
Hours of Operation Sunday	N/A	N/A

Route Alignment Changes:

Split into two routes—New routing is North Chelmsford—Chelmsford.

When Route 19 is implemented the alignment will follow 3A instead of Middlesex Street to reduce duplication with the 19.

Environmental Justice Policy:

Required phase 1, change in route miles is greater than 25%.

Phase 1:

-Split into two routes.

Phase 2:

-Adjust alignment with the implementation of Route 19.

Phase 3:

-No change

ADA Impact:

High impact—alignment adjustments will increase ADA service area.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	-1,329	+213	0
Annual Change in Revenue Miles	-17,836	+2,860	0
Estimate Change in Cost	-\$125,000	+\$20,000	0
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

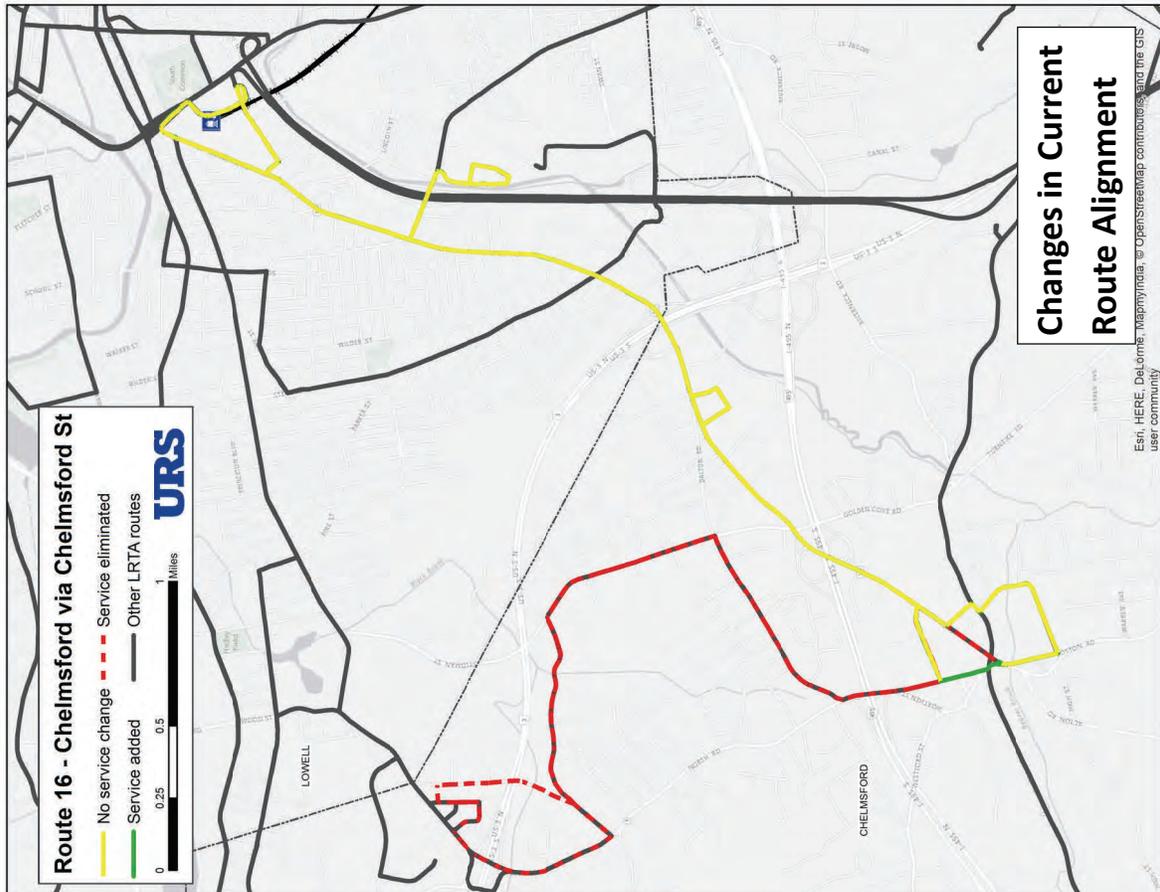
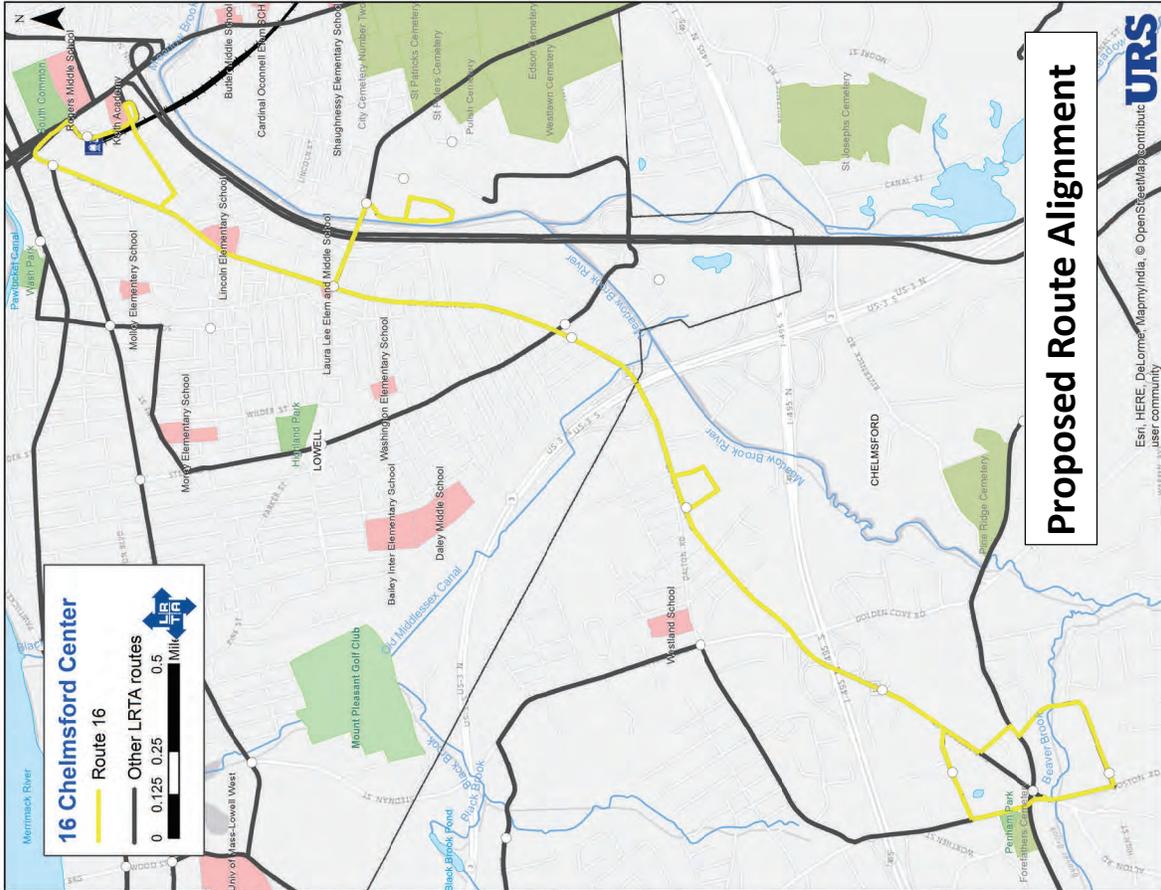
Other Notes:

Eliminated part of route will be serviced by the proposed Route 20.



Route 16

Chelmsford Center





Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	245	283
Saturday Ridership	118	140
Sunday Ridership	N/A	N/A
Weekday Productivity	16.1	16.48
Saturday Productivity	11.8	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	17%	13.8%
Weekday Subsidy per passenger	\$4.90	\$5.54
Saturday Subsidy per passenger	\$5.55	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Suburban

Route Ranking: 9/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	18.8	10.7
Route Run—Time	58 min	34 min
Peak Headway	40 min	30 min
Off-Peak Headway	90 min	60 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:15 AM—8:30 PM	6:15 AM—8:30 PM
Hours of Operation Saturday	8:00 AM—5:30 PM	8:00 AM—5:30 PM
Hours of Operation Sunday	N/A	8:00 AM—5:30 PM

Route Alignment Changes:

This route will run only between Chelmsford and Lowell, the segment between Chelmsford and Walmart will be covered by the proposed 20.

Environmental Justice Policy:

Public participation process required, change in route miles is greater than 25% in Phase 1 and new service phase 2.

Phase 1:

- Increase weekday frequency to every 30 min in peak and 60 min in off-peak
- Alignment change

Phase 2:

- No change

Phase 3:

- Add Sunday service

ADA Impact:

Moderate impact with addition of service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	-1,815	0	+314
Annual Change in Revenue Miles	-30,980	0	+5,896
Estimate Change in Cost	-\$171,000		+\$29,000
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

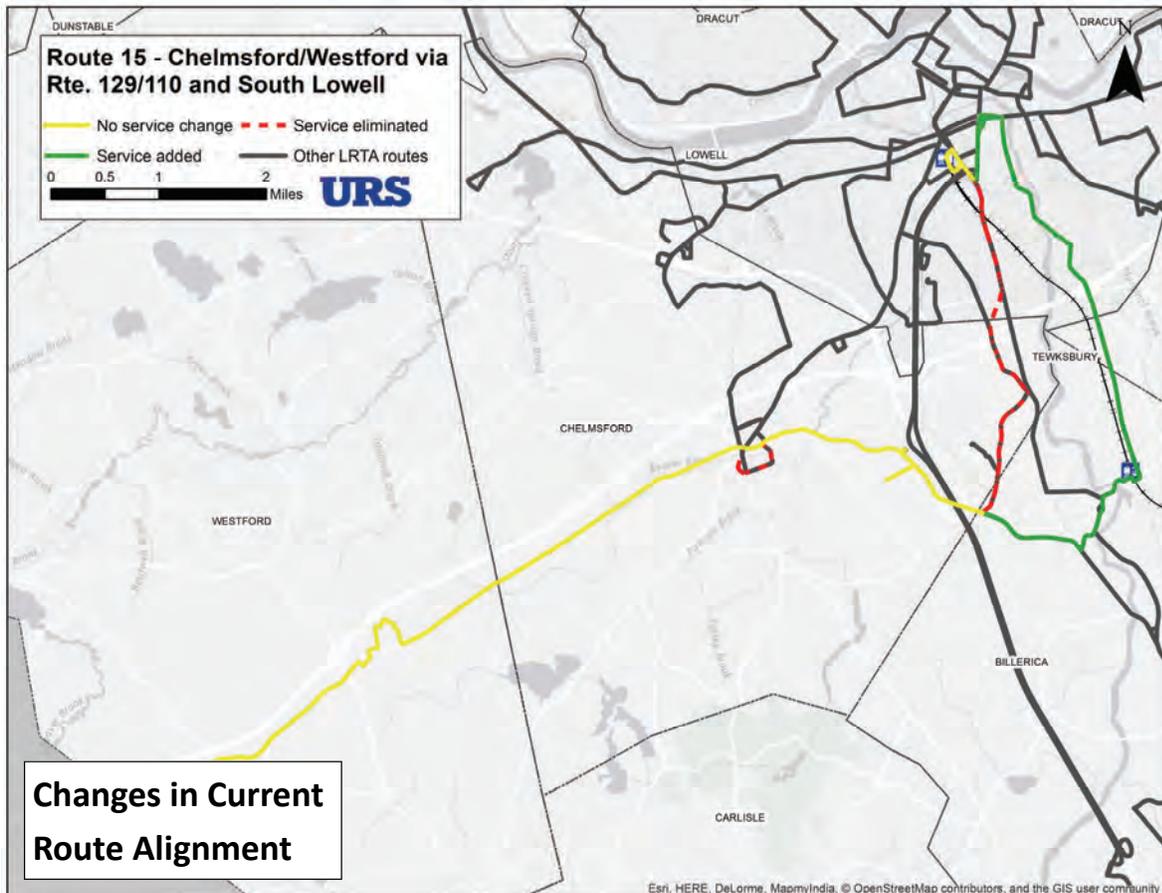
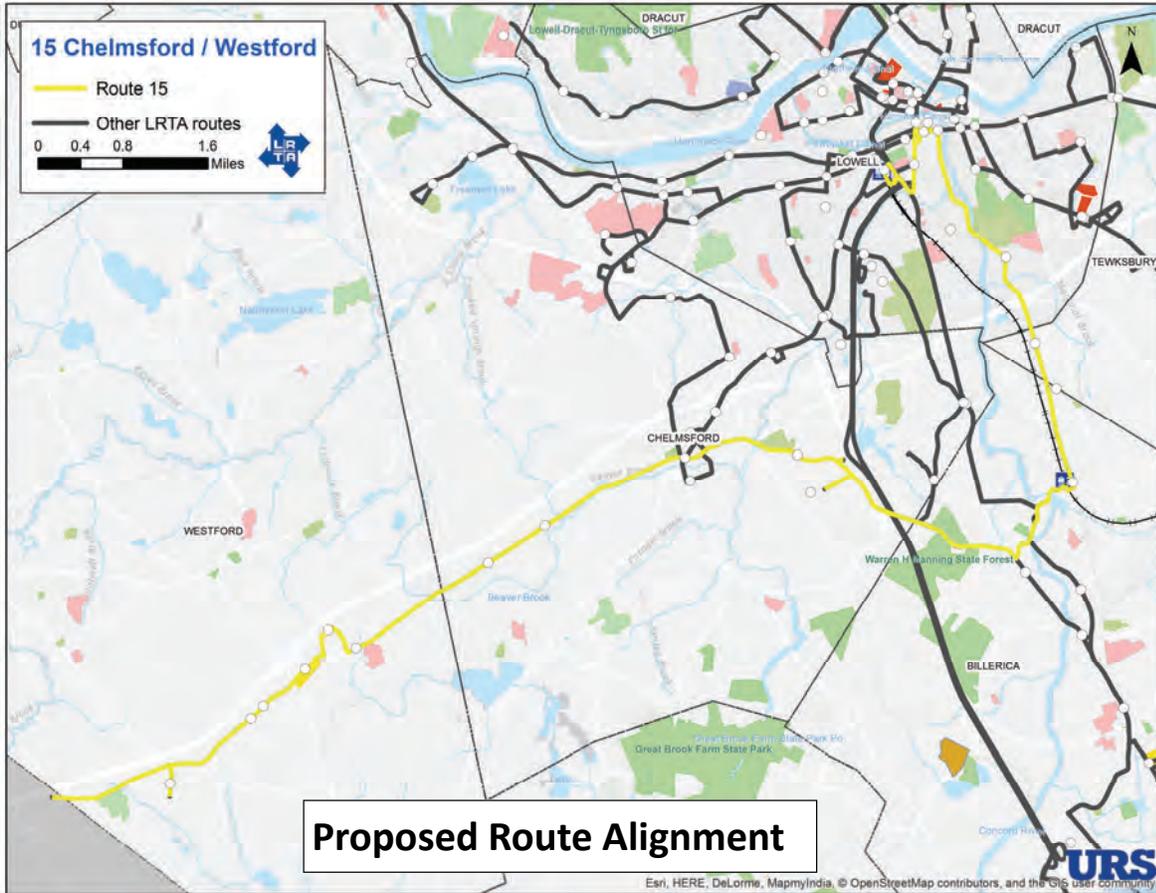
Other Notes:

Adding service on Sunday will increase mobility in the region. Clockface schedules during the weekday will simplify schedules.



Route 15

Chelmsford/Westford





Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	156	283
Saturday Ridership	40	140
Sunday Ridership	N/A	N/A
Weekday Productivity	10.7	16.48
Saturday Productivity	3.8	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	12%	13.8%
Weekday Subsidy per passenger	\$7.25	\$5.54
Saturday Subsidy per passenger	\$22.92	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Suburban

Route Ranking: 16/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sat
Route Length	31.1	34.2
Route Run—Time	90 min	99 min
Peak Headway	90 min	60 min
Off-Peak Headway	90 min	60 min
Saturday Headway	90 min	90 min
Sunday Headway	N/A	N/A
Hours of Operations M-F	6:00 AM—8:00 PM	6:00 AM—8:00 PM
Hours of Operation Saturday	8:00 AM—5:45 PM	8:00 AM—5:45 PM
Hours of Operation Sunday	N/A	N/A

Route Alignment Changes:

Eliminate Marshals Plaza deviation & combine with Route 3

Environmental Justice Policy:

Analysis required, change in miles greater than 25%.

Phase 1:

- Increase weekday frequency to 60 min
- Alignment change

Phase 2:

- No change

Phase 3:

- No change

ADA Impact:

None.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+1,728	0	0
Annual Change in Revenue Miles	+39,872	0	0
Estimate Change in Cost	+\$171,000	0	0
Additional vehicle requirements:	1	0	0
Capital Requirement: Other	None		

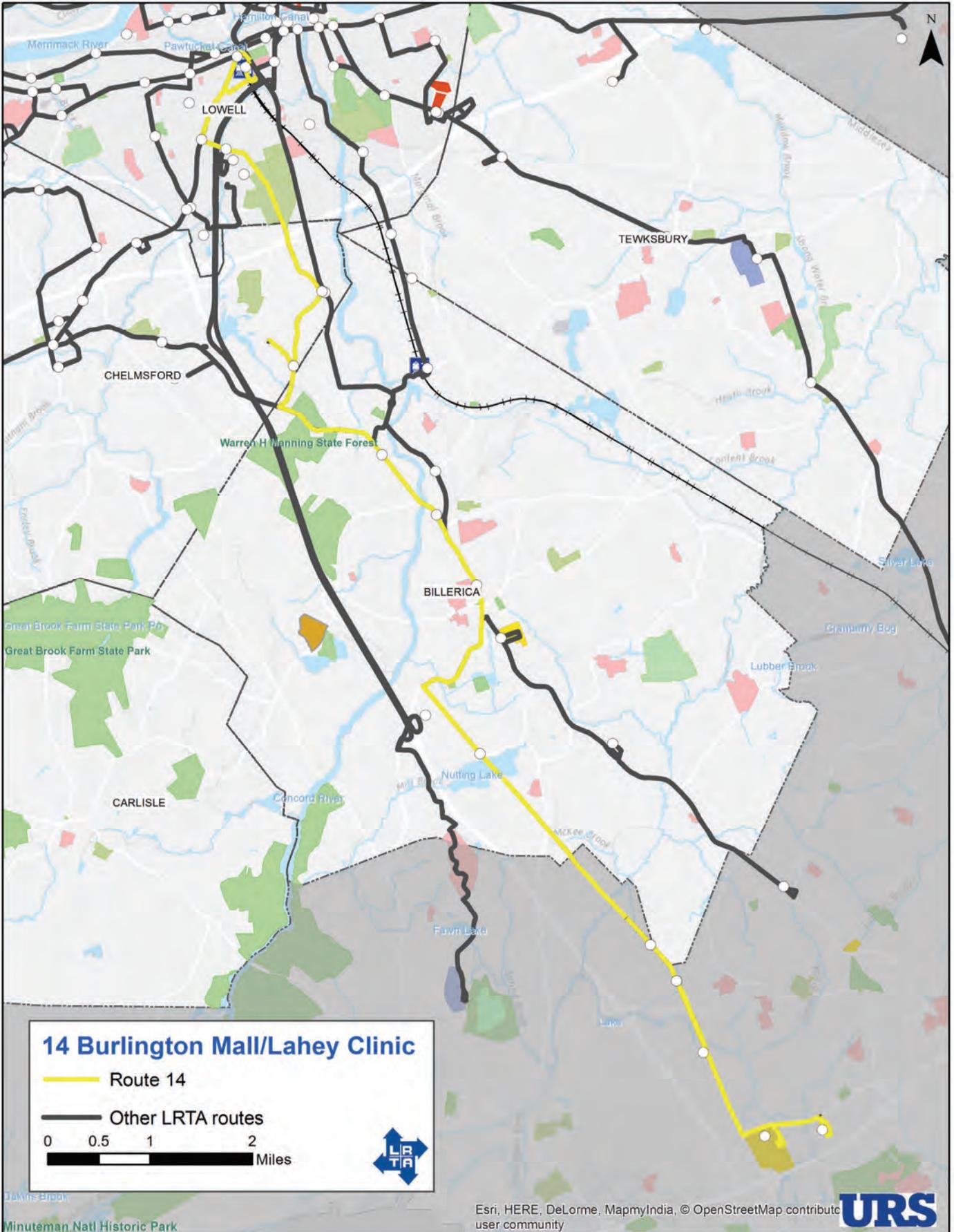
Other Notes:

Implementing clock face frequencies during the weekday will add service and simplify schedules.



Route 14

Burlington Mall/Lahey Clinic





Route 14

Burlington Mall/Lahey Clinic

Current Route Performance

Productivity	Route 15	System Average
Daily Weekday Ridership	489	283
Saturday Ridership	220	140
Sunday Ridership	N/A	N/A
Weekday Productivity	17.2	16.48
Saturday Productivity	15.3	13.8
Sunday Productivity	N/A	N/A

Financials	Route 15	System Average
Farebox Recovery	18%	13.8%
Weekday Subsidy per passenger	\$4.50	\$5.54
Saturday Subsidy per passenger	\$4.23	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Suburban

Route Ranking: 4/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	34.2	34.2
Route Run—Time	89 min	89 min
Peak Headway	60	30 min
Off-Peak Headway	60 min	30 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:00 AM—8:00 PM	6:00 AM—8:00 PM
Hours of Operation Saturday	8:00 AM—6:00 PM	8:00 AM—6:00 PM
Hours of Operation Sunday	N/A	8:00 AM—6:00 PM

Route Alignment Changes:

No changes

Environmental Justice Policy:

Required for Phase 2 Sunday service.

Phase 1:

-No change

Phase 2:

-Add Sunday service

Phase 3:

-Increase weekday frequency to every 30 minutes

ADA Impact:

Moderate impact with the addition of service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	+823	+2,867
Annual Change in Revenue Miles	0	+19,836	+116,484
Estimate Change in Cost	0	+\$77,000	+\$269,000
Additional vehicle requirements:	0	0	1
Capital Requirement: Other	None		

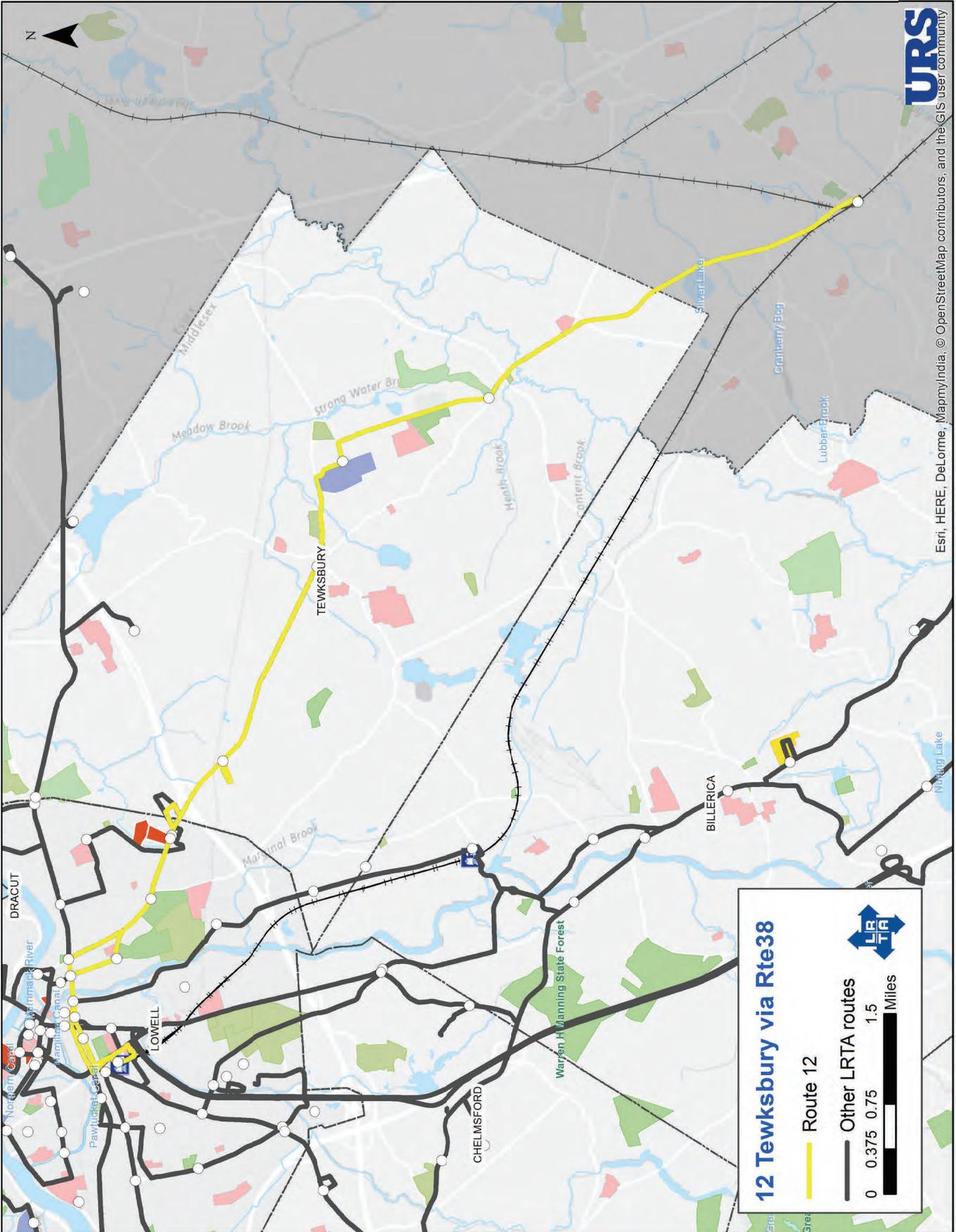
Other Notes:

This route has high ridership and will benefit from increased frequency during the weekdays. Adding Sunday service will increase mobility in the region.



Route 12

Tewksbury via Rt. 38



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Route 12

Tewksbury via Rt. 38

Current Route Performance

Productivity	Route 231	System Average
Daily Weekday Ridership	274	283
Saturday Ridership	152	140
Sunday Ridership	N/A	N/A
Weekday Productivity	13.5	16.48
Saturday Productivity	10.8	13.8
Sunday Productivity	N/A	N/A

Financials	Route 231	System Average
Farebox Recovery	14%	13.8%
Weekday Subsidy per passenger	\$6.15	\$5.54
Saturday Subsidy per passenger	\$5.50	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Suburban

Route Ranking: 13/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	23.1	23.1
Route Run—Time	85 min	85 min
Peak Headway	60 min	60 min
Off-Peak Headway	60 min	60 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	7:00 AM—7:00 PM	7:00 AM—7:00 PM
Hours of Operation Saturday	7:00 AM—5:45 PM	7:00 AM—5:45 PM
Hours of Operation Sunday	N/A	7:00 AM—5:45 PM

Route Alignment Changes:

- No change

Environmental Justice Policy:

Analysis required in Phase 3 with Sunday service.

Phase 1:

-No change

Phase 2:

-No change

Phase 3:

-Add Sunday service

ADA Impact:

Moderate impact with addition of Sunday service.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	0	+880
Annual Change in Revenue Miles	0	0	+14,403
Estimate Change in Cost	0	0	+\$83,000
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

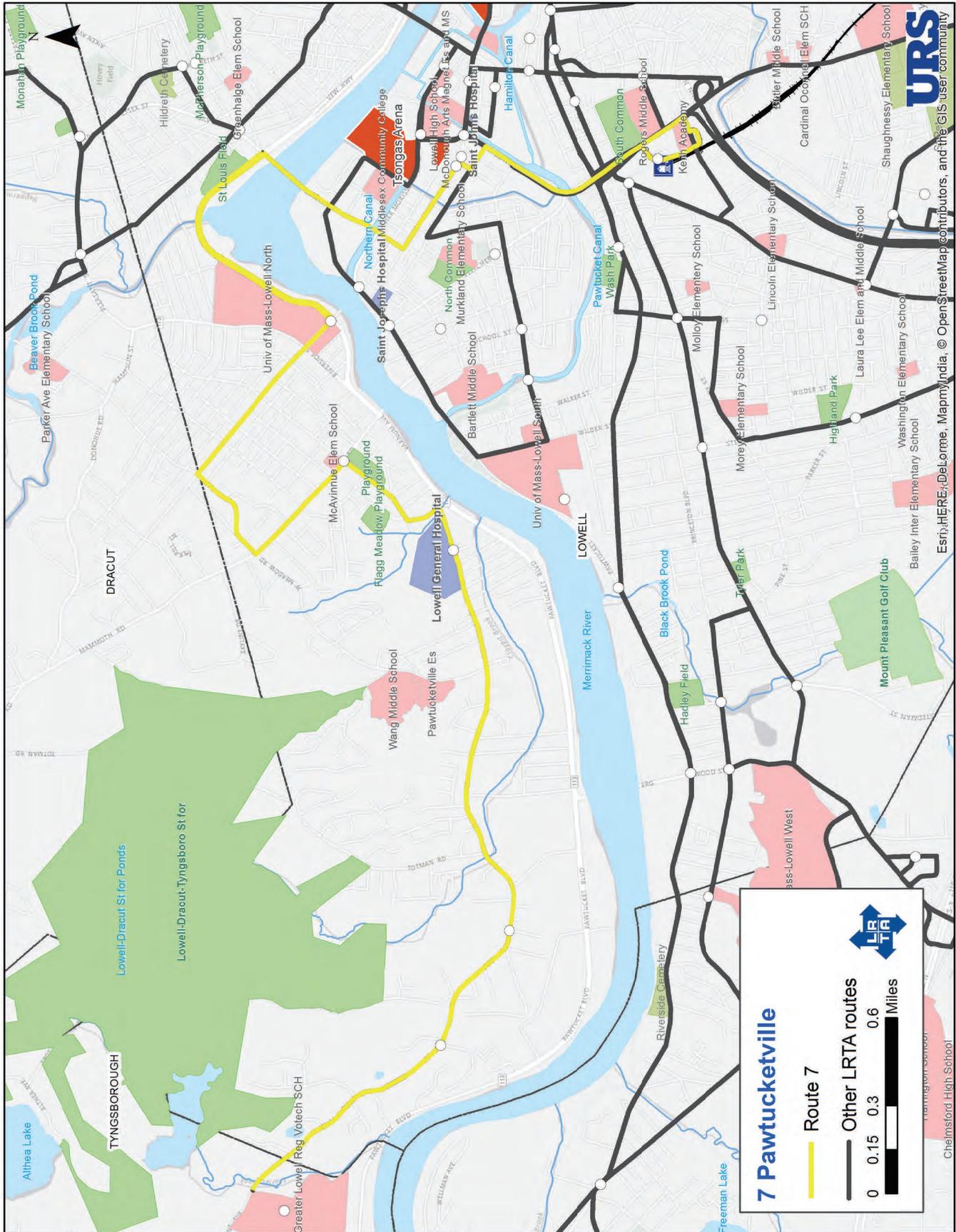
Other Notes:

Adding service on Sunday will increase mobility in the region.



Route 7

Pawtucketville/ UMass Lowell North





Route 7

Pawtucketville/ UMass Lowell North

Current Route Performance

Productivity	Route 7	System Average
Daily Weekday Ridership	687	283
Saturday Ridership	161	140
Sunday Ridership	N/A	N/A
Weekday Productivity	23.3	16.48
Saturday Productivity	14.6	13.8
Sunday Productivity	N/A	N/A

Financials	Route 7	System Average
Farebox Recovery	16%	13.8%
Weekday Subsidy per passenger	\$3.34	\$5.54
Saturday Subsidy per passenger	\$4.87	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: City
Route Ranking: 2/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	13.1	13.1
Route Run—Time	54 min	54 min
Peak Headway	30 min	30 min
Off-Peak Headway	30 min	30 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:00 AM—9:00 PM	5:30 AM—9:30 PM
Hours of Operation Saturday	7:45 AM—6:30 PM	7:45 AM—6:30 PM
Hours of Operation Sunday	N/A	7:45 AM—6:30 PM

Route Alignment Changes:

- No change

Environmental Justice Policy:

Analysis required in Phase 2 with Sunday service.

Phase 1:

-Extend weekday service

Phase 2:

-Add Sunday service

Phase 3:

-No change

ADA Impact:

Moderate impact from extending week-day hours and adding service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+656	+560	0
Annual Change in Revenue Miles	+11,692	+8,168	0
Estimate Change in Cost	+\$61,000	+\$53,000	0
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

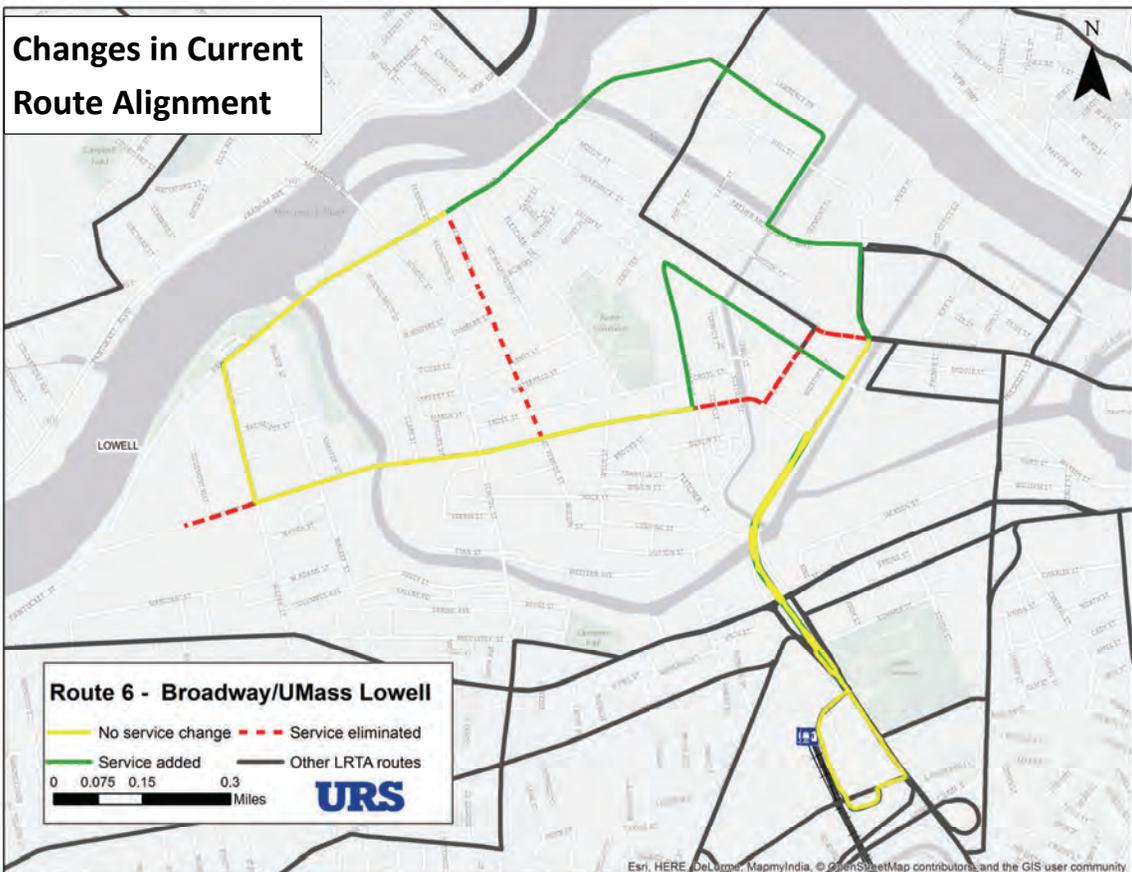
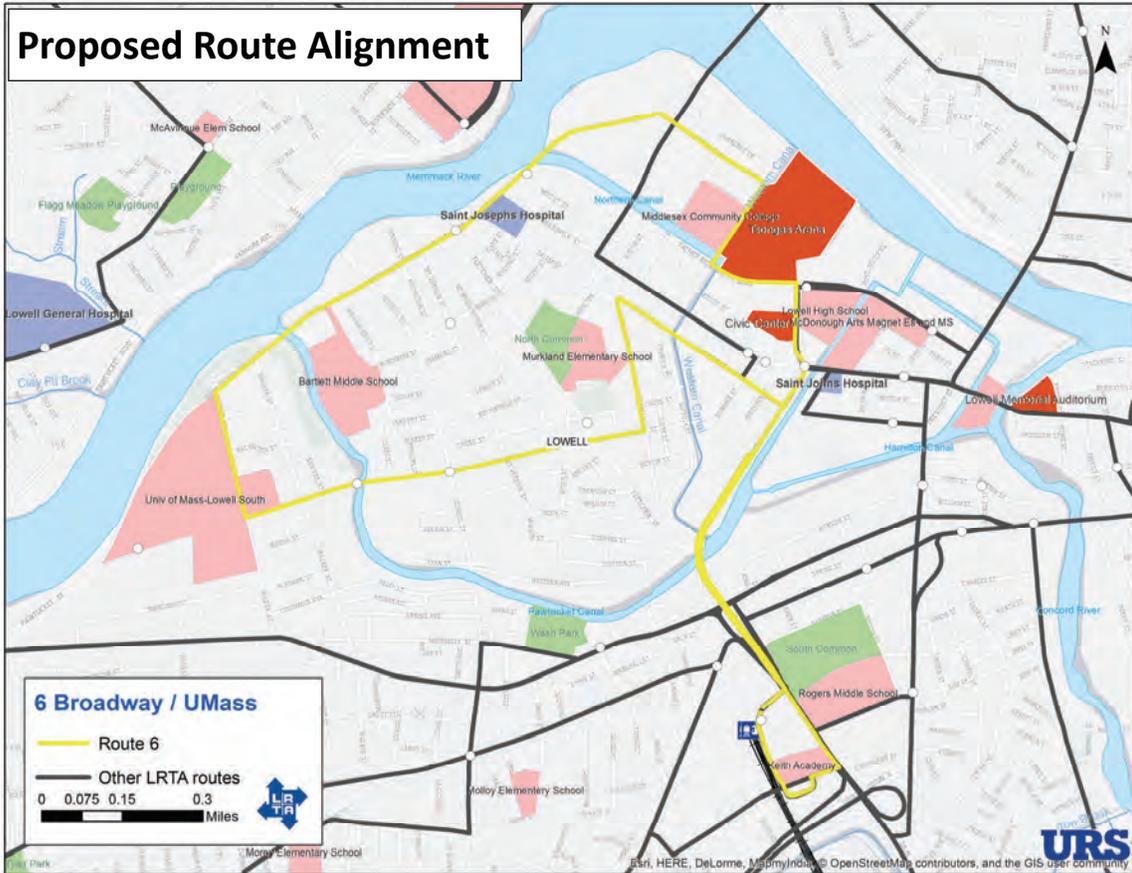
Other Notes:

Extending weekday service and adding service on Sunday will improve mobility in the region.



Route 6

Broadway/UMass





Current Route Performance

Productivity	Route 6	System Average
Daily Weekday Ridership	161	283
Saturday Ridership	78	140
Sunday Ridership	N/A	N/A
Weekday Productivity	13.9	16.48
Saturday Productivity	11	13.8
Sunday Productivity	N/A	N/A

Financials	Route 6	System Average
Farebox Recovery	10%	13.8%
Weekday Subsidy per passenger	\$6.02	\$5.54
Saturday Subsidy per passenger	\$7.24	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: City

Route Ranking: 14/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	5.94	5.24
Route Run—Time	26 min	23 min
Peak Headway	35 min	30 min
Off-Peak Headway	35 min	30 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:00 AM—6:00 PM	6:00 AM—8:00 PM
Hours of Operation Saturday	8:00 AM—5:15 PM	8:00 AM—5:15 PM
Hours of Operation Sunday	N/A	8:00 AM—5:15 PM

Route Alignment Changes:

Route covers existing Route 6 & 9.

Environmental Justice Policy:

Analysis required in Phase 3 with Sunday service.

Phase 1:

- No changes

Phase 2:

- Increase weekday frequency to 30 min
- Alignment change
- Extend weekday service

Phase 3:

-Add Sunday service

ADA Impact:

Moderate impact from extending week-day hours and adding service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	0	+286	+211
Annual Change in Revenue Miles	0	+5,268	+2,887
Estimate Change in Cost	0	+\$27,000	+\$20,000
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

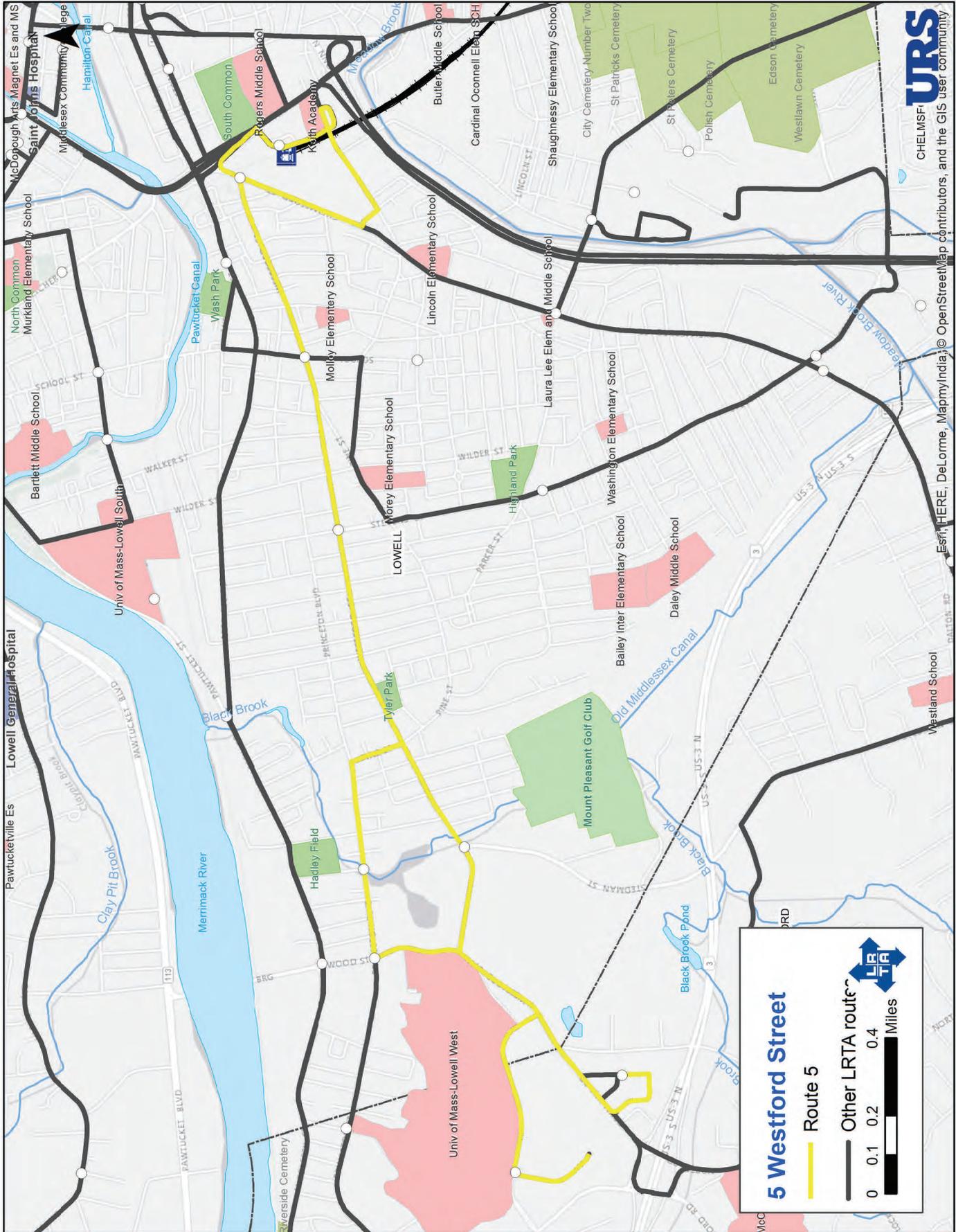
Other Notes:

Extending weekday and weekend service will cover the elimination of Route 6&9 and improve mobility in the region.



Route 5

Westford Street



CHELMERS
URS

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Current Route Performance

Productivity	Route 5	System Average
Daily Weekday Ridership	573	283
Saturday Ridership	166	140
Sunday Ridership	N/A	N/A
Weekday Productivity	32.9	16.48
Saturday Productivity	29.3	13.8
Sunday Productivity	N/A	N/A

Financials	Route 5	System Average
Farebox Recovery	23%	13.8%
Weekday Subsidy per passenger	\$2.19	\$5.54
Saturday Subsidy per passenger	\$2.19	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: Commuter

Route Ranking: 1/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	8.47	8.47
Route Run—Time	28 min	28 min
Peak Headway	30 min	30 min
Off-Peak Headway	30 min	30 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:00 AM—8:30 PM	5:30 AM—9:30 PM
Hours of Operation Saturday	7:45 AM—6:15 PM	7:45 AM—6:15 PM
Hours of Operation Sunday	N/A	7:45 AM—6:15 PM

Route Alignment Changes:

- No change

Environmental Justice Policy:

Analysis required in Phase 2 with Sunday service.

Phase 1:

- Extend weekday service

Phase 2:

-Add Sunday service

Phase 3:

-No change

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+218	+282	0
Annual Change in Revenue Miles	+3,240	+5,158	0
Estimate Change in Cost	+\$21,000	+\$27,000	0
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

Other Notes:

Extending weekday service and adding service on Sunday will improve mobility in the region. This route has the highest performance in the region and can benefit from increased service.

ADA Impact:

Moderate impact from extending week-day hours and adding service on Sunday.



Route 4

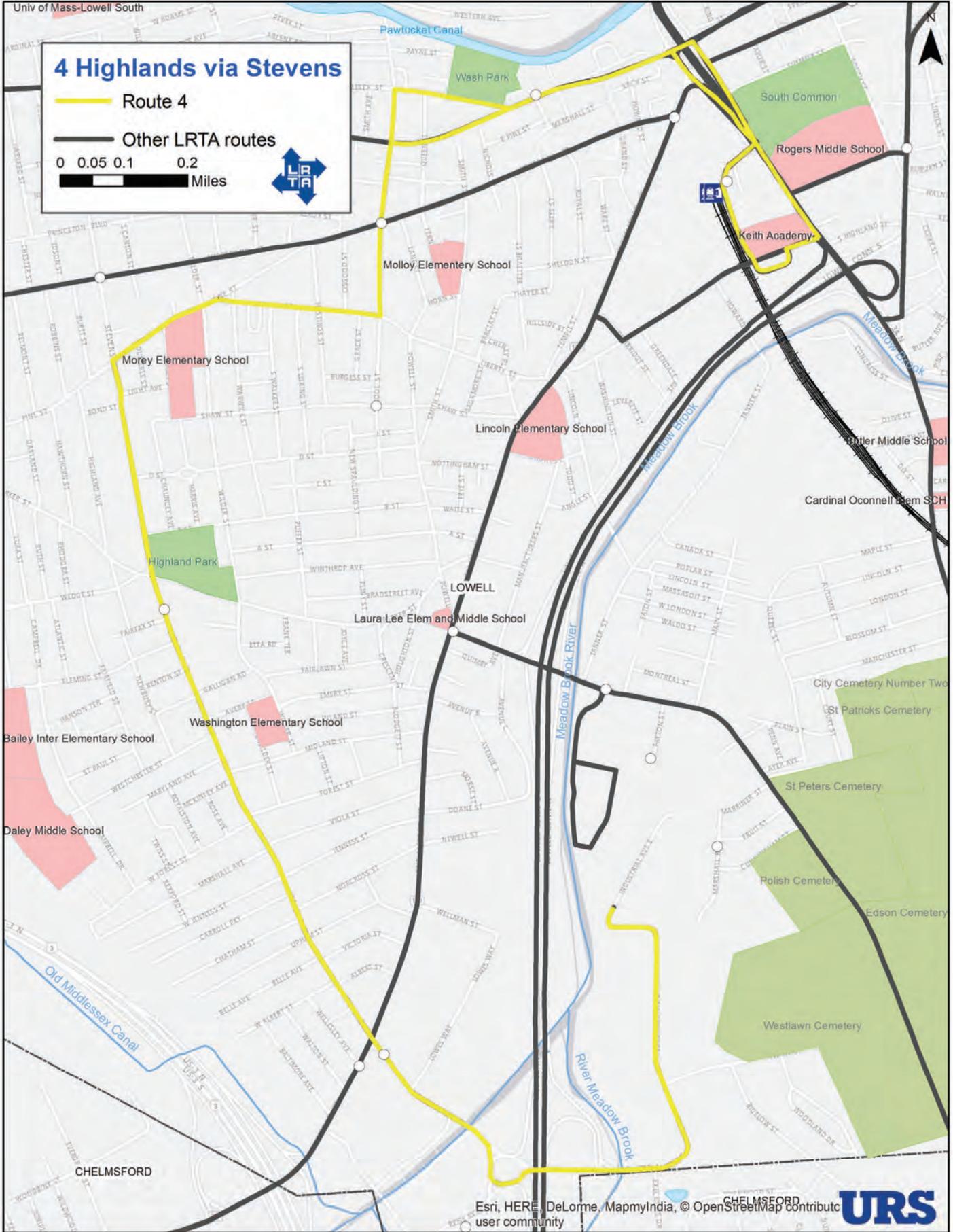
Highlands via Stevens

4 Highlands via Stevens

Route 4

Other LRTA routes

0 0.05 0.1 0.2 Miles





Route 4

Highlands via Stevens

Current Route Performance

Productivity	Route 2	System Average
Daily Weekday Ridership	216	283
Saturday Ridership	56	140
Sunday Ridership	N/A	N/A
Weekday Productivity	18.4	16.48
Saturday Productivity	6.7	13.8
Sunday Productivity	N/A	N/A

Financials	Route 2	System Average
Farebox Recovery	13%	13.8%
Weekday Subsidy per passenger	\$4.41	\$5.54
Saturday Subsidy per passenger	\$13.23	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: City

Route Ranking: 7/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	8.05	8.05
Route Run—Time	29 min	29 min
Peak Headway	30 min	30 min
Off-Peak Headway	60 min	60 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:15 AM—6:30 PM	6:15 AM—6:30 PM
Hours of Operation Saturday	8:00 AM—5:30 PM	8:00 AM—5:30 PM
Hours of Operation Sunday	N/A	8:00 AM—5:30 PM

Route Alignment Changes:

There is no change to the alignment but on Saturday the 3 and 4 will no longer be interlined into a special weekend route. The 4 will operate along the same path on weekends as it does weekday.

Environmental Justice Policy:

Analysis required in Phase 3 with Sunday service.

Phase 1:

-Bidirectional Saturday service

Phase 2:

-No change

Phase 3:

-Add Sunday service

ADA Impact:

Moderate impact with addition of service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+119	0	+258
Annual Change in Revenue Miles	+1,988	0	+4,319
Estimate Change in Cost	+\$11,000	0	+\$24,000
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

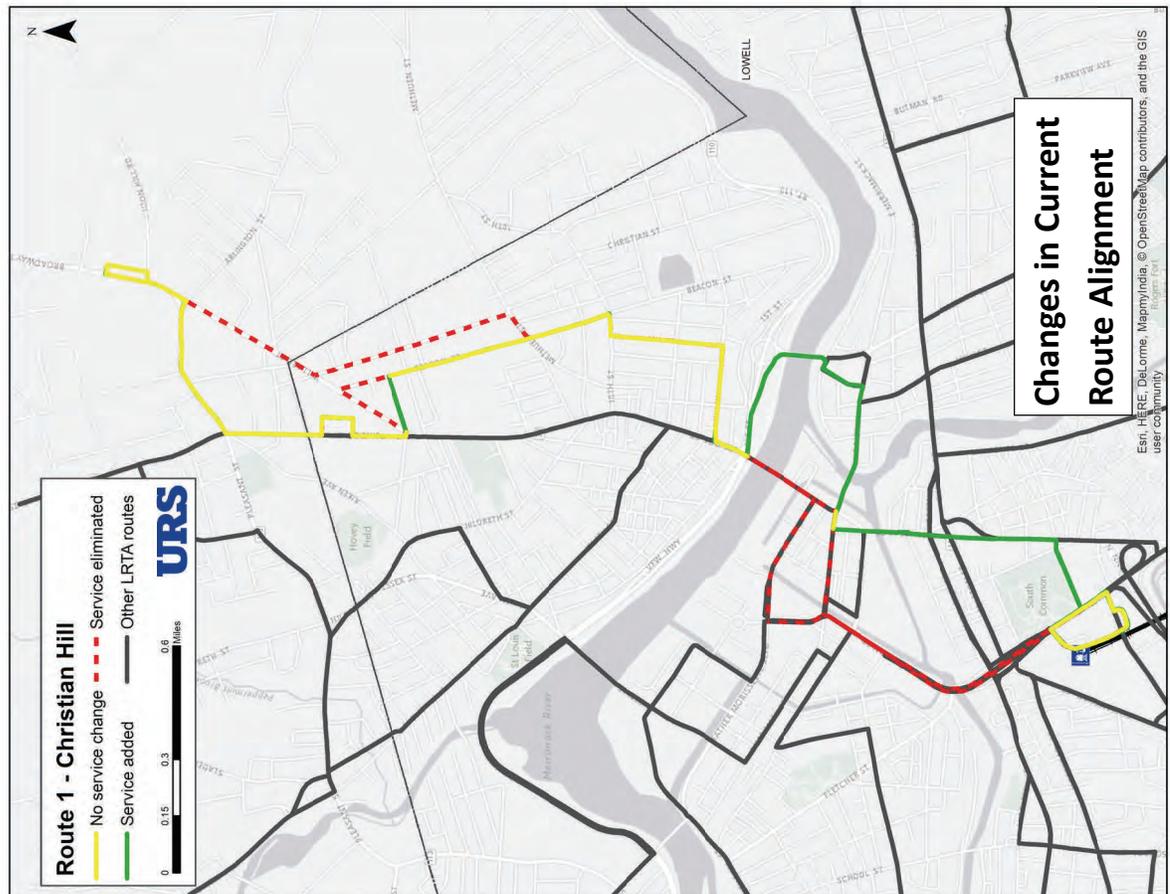
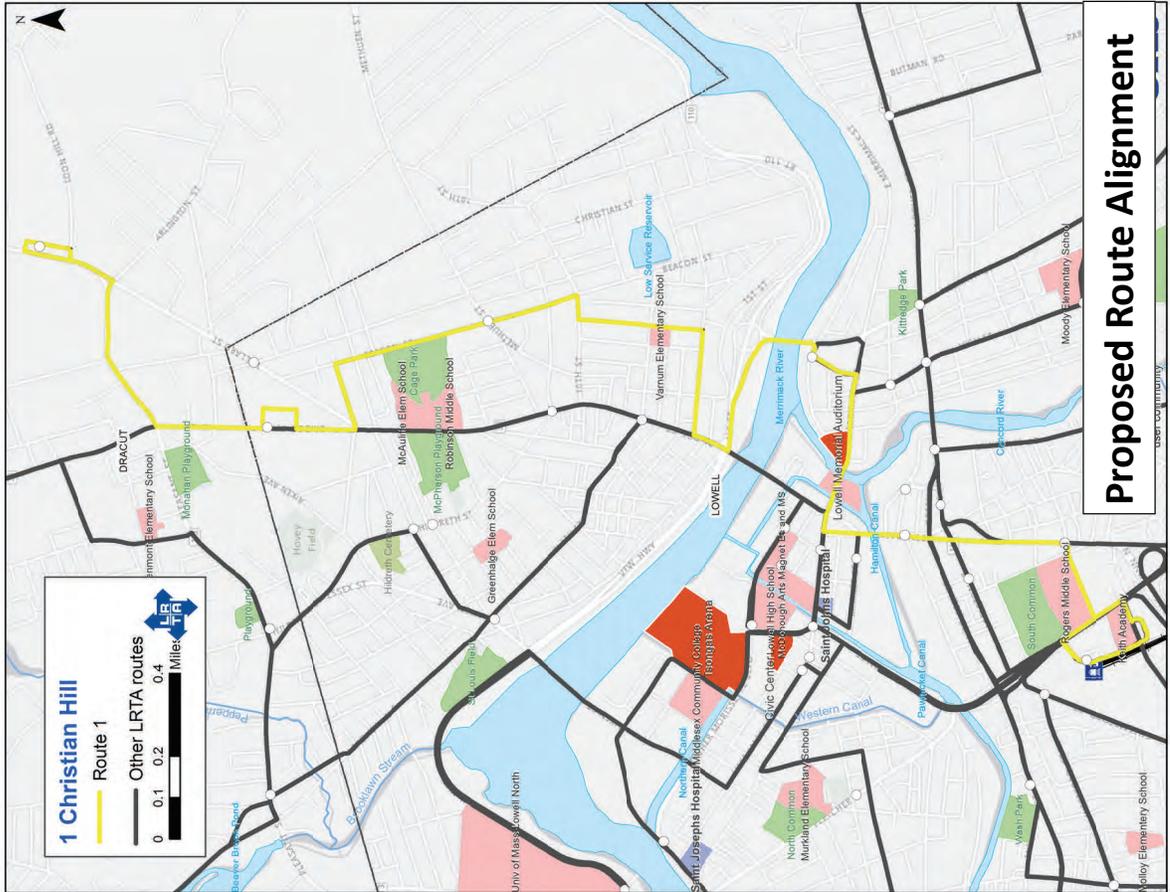
Other Notes:

Addition of service on Sunday will increase mobility in the region.



Route 1

Christian Hill



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Current Route Performance

Productivity	Route 1	System Average
Daily Weekday Ridership	149	283
Saturday Ridership	119	140
Sunday Ridership	N/A	N/A
Weekday Productivity	16.8	16.48
Saturday Productivity	19.6	13.8
Sunday Productivity	N/A	N/A

Financials	Route 1	System Average
Farebox Recovery	12%	13.8%
Weekday Subsidy per passenger	\$4.87	\$5.54
Saturday Subsidy per passenger	\$4.22	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: City
Route Ranking: 12/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	7.95 miles	9.32 miles
Route Run—Time	32 min	38 min
Peak Headway	60 min	60 min
Off-Peak Headway	60 min	60 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:45 AM—6:45 PM	6:45 AM—6:45 PM
Hours of Operation Saturday	8:00 AM—5:15 PM	8:00 AM—5:15 PM
Hours of Operation Sunday	N/A	8:00 AM—5:15 PM

Route Alignment Changes:

Service has been streamlined, one-way service eliminated and service adjusted in the southern portion to cover the former Route 9 service to Saint Mary Hospital

Environmental Justice Policy:

Required for Phase 3, Sunday service.

Phase 1:

- Alignment change

Phase 2:

- No change

Phase 3:

- Sunday service

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	+349	0	+310
Annual Change in Revenue Miles	+4,649	0	+4,609
Estimate Change in Cost	+\$33,000	0	+\$29,000
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

Other Notes:

Sunday service will be combined with the Route 8 as it currently is on Saturday. Adding service on Sundays will increase mobility in the region.

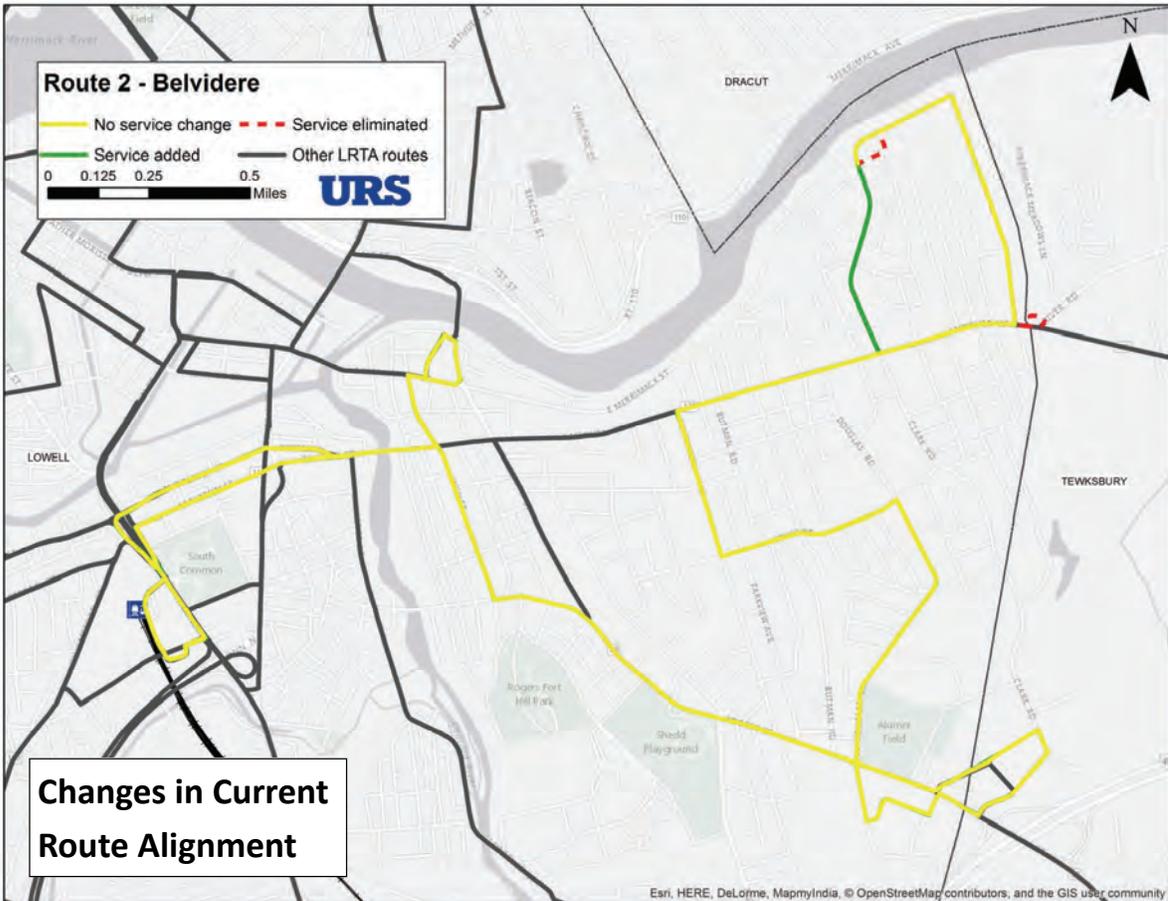
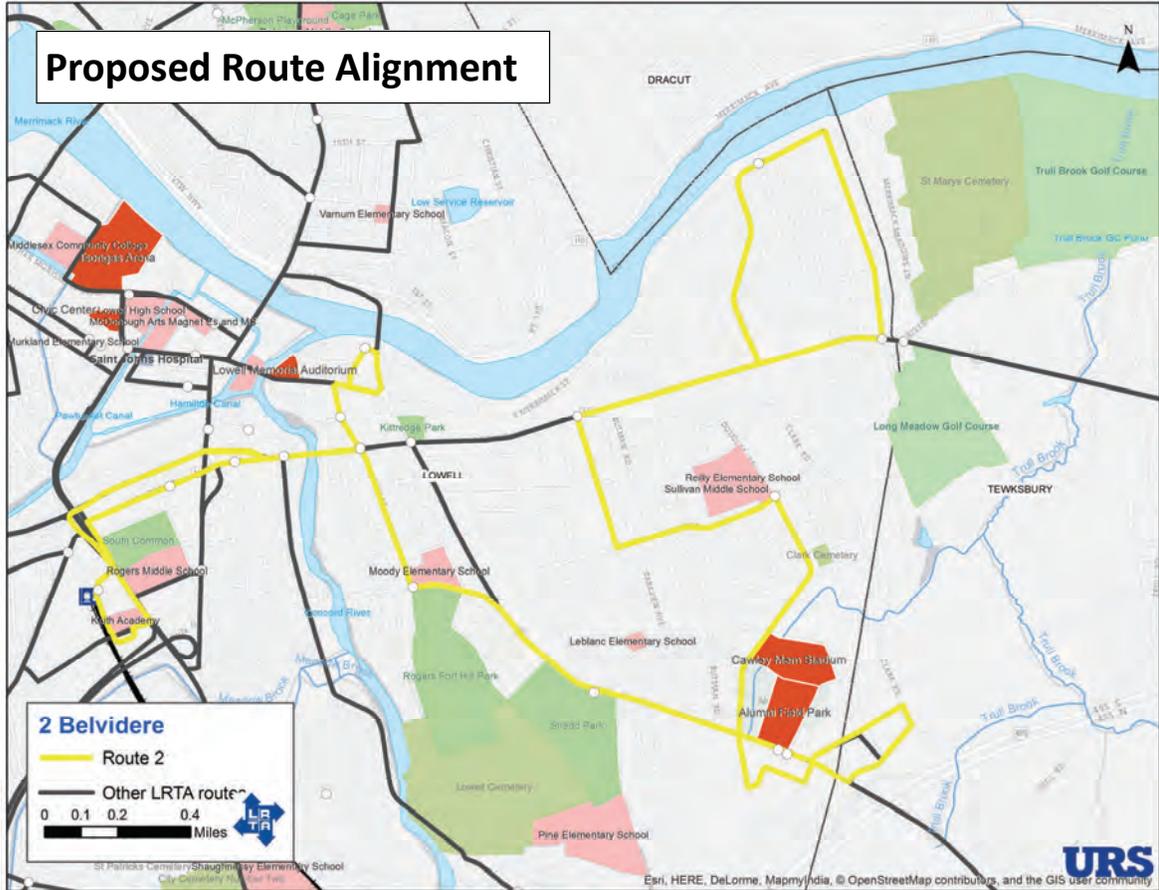
ADA Impact:

Moderate impact with the addition of Sunday service.



Route 2

Belvidere





Current Route Performance

Productivity	Route 2	System Average
Daily Weekday Ridership	438	283
Saturday Ridership	117	140
Sunday Ridership	N/A	N/A
Weekday Productivity	13.1	16.48
Saturday Productivity	10.7	13.8
Sunday Productivity	N/A	N/A

Financials	Route 2	System Average
Farebox Recovery	9%	13.8%
Weekday Subsidy per passenger	\$6.53	\$5.54
Saturday Subsidy per passenger	\$6.43	\$8.37
Sunday Subsidy per passenger	N/A	N/A

Route Type: City
Route Ranking: 6/18

Proposed Service Changes

	Current	Proposed
Days Operated	Mon—Sat	Mon—Sun
Route Length	16.3	15.3
Route Run—Time	60 min	56 min
Peak Headway	30 min	30 min
Off-Peak Headway	30 min	30 min
Saturday Headway	60 min	60 min
Sunday Headway	N/A	60 min
Hours of Operations M-F	6:15 AM—8:15 PM	6:15 AM—8:15 PM
Hours of Operation Saturday	7:45 AM—6:15 PM	7:45 AM—6:15 PM
Hours of Operation Sunday	N/A	7:45 AM—6:15 PM

Route Alignment Changes:

Service added on Raven Road.

Environmental Justice Policy:

Analysis required in Phase 2 with Sunday service.

Phase 1:

-Change alignment

Phase 2:

-Add Sunday service

Phase 3:

-No change

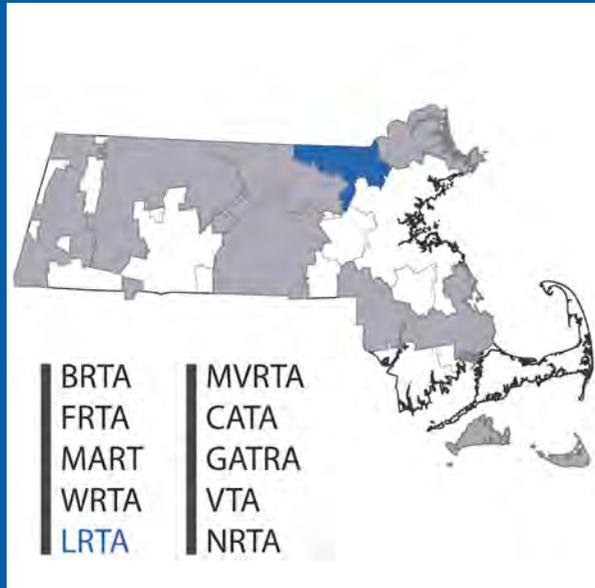
ADA Impact:

Moderate impact with addition of service on Sunday.

Financial	Phase 1	Phase 2	Phase 3
Annual Change in Revenue Hours	-33	+572	0
Annual Change in Revenue Miles	-2,624	+9,318	0
Estimate Change in Cost	-\$3,000	+\$54,000	0
Additional vehicle requirements:	0	0	0
Capital Requirement: Other	None		

Other Notes:

Addition of service on Sunday will increase mobility in the region.



Chapter 8

Conclusion

AECOM / URS
TMD
Burke & Company





8. CONCLUSION

Recommendations were developed using a cumulative process that incorporated public outreach, a diverse steering committee, operational input from LRTA, an analysis of existing transit service and the local/regional market. Strategies to improve the system were developed based on the goals and objectives outlined in Chapter 2.

The proposed recommendations will help improve mobility in the region, and improve service efficiency. The three phase approach allows LRTA to plan for future service and seek the necessary funding and equipment that would be needed. Phase 1 would require no increase in funding. Savings were identified by combining redundant routes and adjusting alignments. This savings allows LRTA to extend weekday service on certain routes and improve frequencies on others. Phases 2 and 3 would require more funding (Table 30) and phase 3 additional vehicles. Phase 2 would add limited Sunday service, consolidate the Routes 6 and 9, and expand service to Pheasant Lane Mall. Phase 3 would expand Sunday service, introduce service to the Bedford VA and improve frequency on additional routes. These improvements would help LRTA achieve their goals of establishing Sunday service, offering more evening service, improve frequency, service new areas, and better coordinate with the MBTA and other RTA's.

Table 30. Phase Requirements

Phase	Additional funding needed	New cost of service	Percent increase from previous
Phase 1	\$0	\$8,300,000	0%
Phase 2	\$303,000	\$8,603,000	3.7%
Phase 3	\$1,073,000	\$9,676,000	12.9%
Total	\$1,376,000	N/A	16.6%

Service guidelines have been established to monitor service in the future with performance measures to evaluate a route's health. Recommended performance measures to monitor existing and future routes include:

- **Passengers/Hour:** Number of total monthly and annual passengers divided by the corresponding revenue-hours.
- **Subsidy/Passenger:** Total expenses minus fare revenue divided by ridership.
- **Farebox Recovery:** The percentage of operating costs covered by fares collected, calculated by the fares collected divided by the cost to operate the route.
- **Cost/Revenue-Hour:** An excellent indicator of efficiency is cost per revenue-hour of service. Costs per hour should be analyzed by route and compared to overall system averages.



- **Late Trips:** The percentage of fixed-route trips which operate late or are missed should be recorded and reported. The recommended standard for late trips is any trip that is more than five minutes behind schedule.
- **Service/Road Calls:** the number of service/road calls divided by the number of revenue miles. This measure is typically measured for the entire system and not individual routes. This monitors routine maintenance and vehicle performance.
- **Accidents/100,000 miles:** Measure of driver safety. There must be a standard practice for defining what an accident is.

The performance measures can be used to create benchmarks for LRTA service operation. These benchmarks will help LRTA track progress and set goals for the performance of the route. They will also assist LRTA in measuring the impact of the proposed recommendations on service. The recommendations include later night service, Sunday service, added service, improved frequencies, and clockface schedules (Table 31).

Table 31. Summary of Recommendations

Bus Route	Alignment	Schedule
1 Christian Hill	Service has been streamlined, one-way service eliminated and service adjusted in the southern portion to cover the former Route 9 service to Saint Mary Hospital	No change
2 Belvidere	Consider service on Raven Road for Loop	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency
3 South Lowell	Route discontinued, consolidated with route 15	No Service
4 Highlands via Stevens	No change	-Sunday service 8 AM to 5:30 PM with 60 minute frequency
5 Westford Street	No change	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency -Extend weekday service 5:30 AM to 9:30 PM
6 Broadway / UMass	Route covers existing route 6 and 9	-30 minute weekday frequency -Sunday service 8 AM to 5:30 PM with 60 minute frequency -Extend weekday service to 8 PM
7 Pawtucketville	No change	-Sunday service 7:45 AM to 6:30 PM with 60 minute frequency -Extend weekday service to 9:30 PM
8 Centralville	No change	No change
9 Lowell Circulator	Route discontinued, consolidated with route 6	No Service
10 Dracut / Tyngsboro	No change	No change
11 IRS via Rte. 133	No change	No change



Bus Route	Alignment	Schedule
12 Tewksbury via Rte38	No change	-Sunday service 7 AM to 5:45 PM with 60 minute frequency
13 Billerica	No change	No change
14 Burlington Mall	No change	-Sunday service 8 AM to 6 PM with 60 minute frequency -30 minute weekday frequency
15 Chelmsford / Westford	Eliminate Marshalls Plaza deviation & Combine with Route 3	-60 minute weekday frequency
16 Chelmsford Center	Run only between Chelmsford and Lowell, segment between Chelmsford and Walmart covered by proposed 20	-30 minute peak, 60 minute off-peak weekday frequencies -Sunday service 8 AM to 5:30 PM with 60 minute frequency
17 North Chelmsford	Split into two routes (See 20 for other portion of existing 17). New routing is North Chelmsford - Chelmsford. When Route 19 is implemented the alignment will follow 3A instead of Middlesex Street to reduce duplication with the 19	-No change
18 Downtown Shuttle	No change	-Sunday service 7:15 AM to 7 PM with 30 minute frequency
19 - Pheasant Lane Mall via Middleboro Road	No change	-Expand Saturday holiday service to year round Mon-Sun service -Weekday service 8 AM to 6:45 PM with 90 minute frequency -Saturday service 9:30 AM to 5 PM with 90 minute frequency
20 - North Chelmsford via Middlesex	Proposed Service to replace existing Route 17 between Lowell and Walmart in Chelmsford until Route 19 is established	-Weekday service 6 AM to 7 PM with 60 minute frequency -Saturday service 8 AM to 6 PM with 60 minute frequency
22 - Bedford VA	New Route to service Bedford VA, Middlesex Community College, Billerica Technology Park	-Weekday service 6 AM to 7 PM with 90 minute frequency -Saturday service 8 AM to 6 PM with 90 minute frequency
03/04 Combo Loop	Interline discontinued, the 3 is now part of the 15 and 04 will operate on its own	No service
06/09 Combo Loop	Interline discontinued, the 6 and 9 have been merged into one route	No Service
01/08 Combo Loop	No change	-Sunday service 8 AM to 5:15 PM with 60 minute frequency



Note the following recommendations have changed during the progress of this report:

- The Route 1 bus will continue its current routing over the Bridge Street bridge due to traffic over the Hunts Falls Bridge in the afternoon.
- The Route 1 bus will stay on proposal to Willard Street.
- The Route 17 will continue to serve the Tyngsborough Road area.

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Appendix A

Market Demand Maps



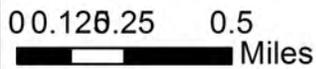
Route 1



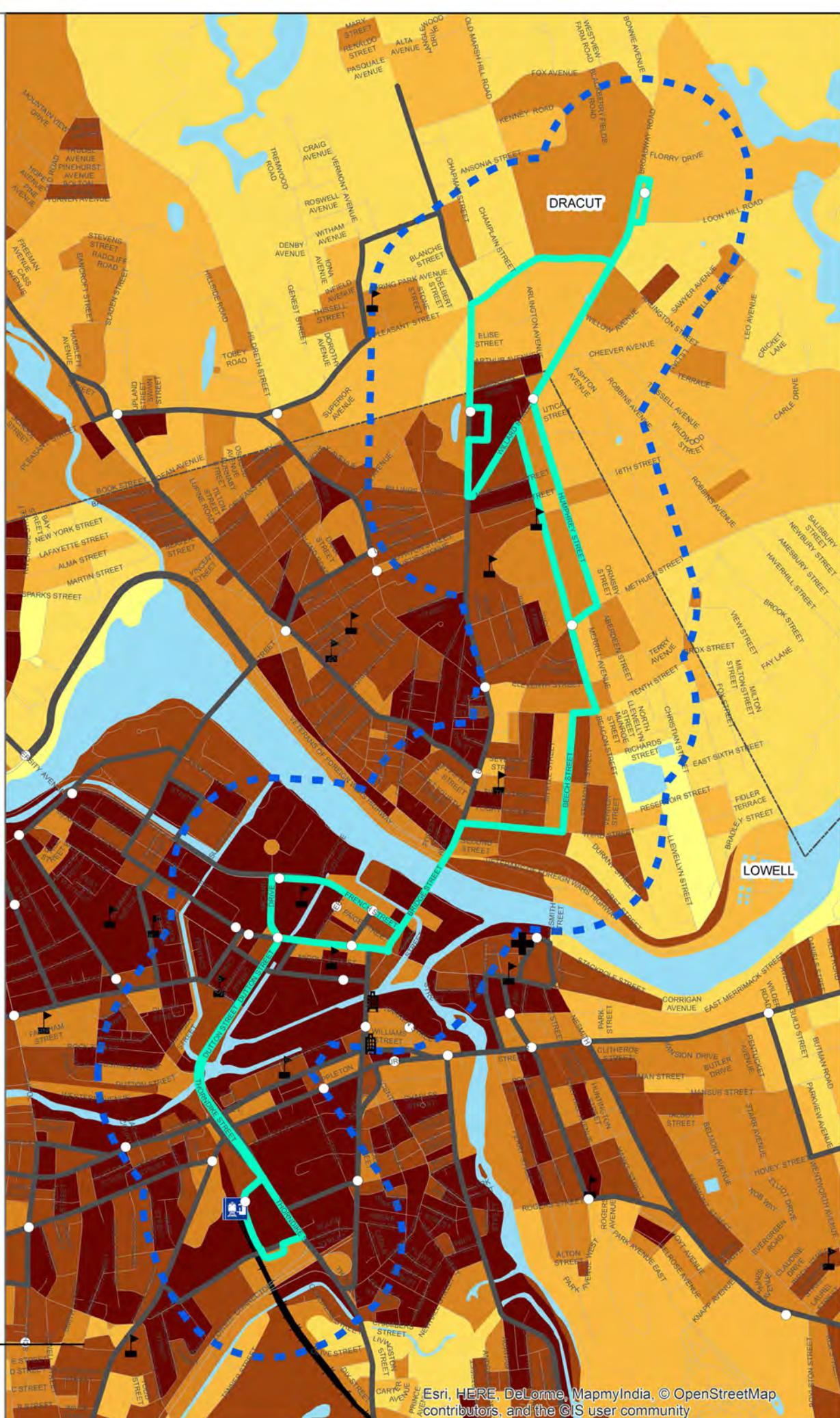
Level of Potential Transit Demand



- LRTA Bus Stop
- Route 1
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



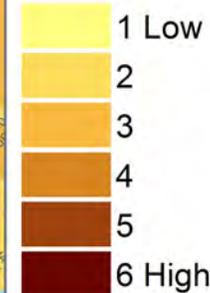
Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





Route 1 & 8 Sat - only

Level of Potential Transit Demand

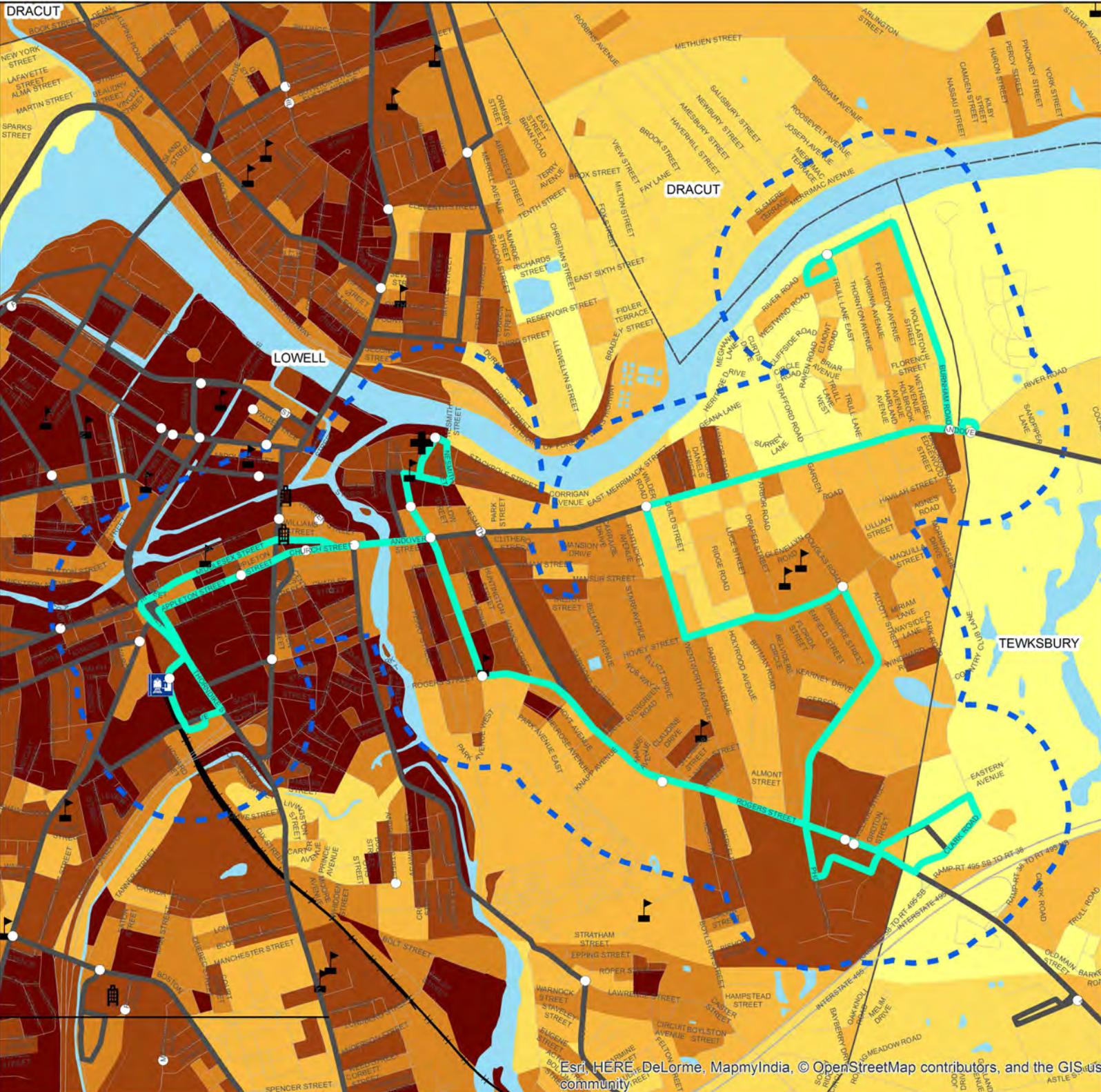


- LRTA Bus Stop
- Other LRTA Bus Route
- Route 1 and 8 Sat
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.

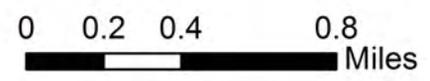




Route 2

Level of Potential Transit Demand

- 1 Low
- 2
- 3
- 4
- 5
- 6 High
- LRTA Bus Stop
- Route 2
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





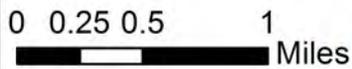
Route 3 & 4 Sat. - only



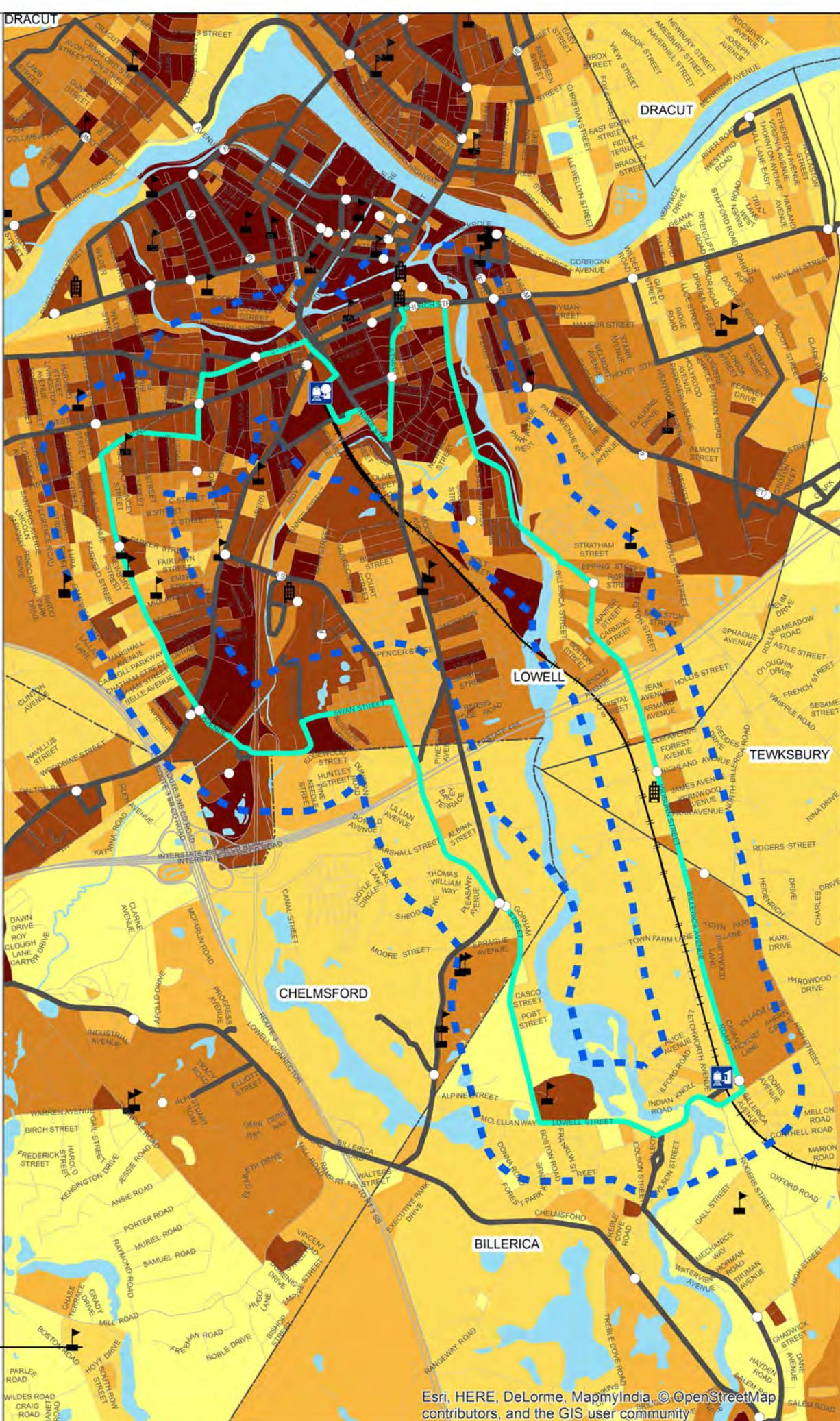
Level of Potential Transit Demand

- 1 Low
- 2
- 3
- 4
- 5
- 6 High

- LRTA Bus Stop
- Other LRTA Bus Route
- Route 3 and 4 Sat
- 1/4 Mile Buffer
- + Hospital
- ▲ School
- 🏛️ College/University
- P Park and Ride
- 🚆 Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





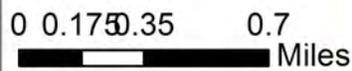
Route 3



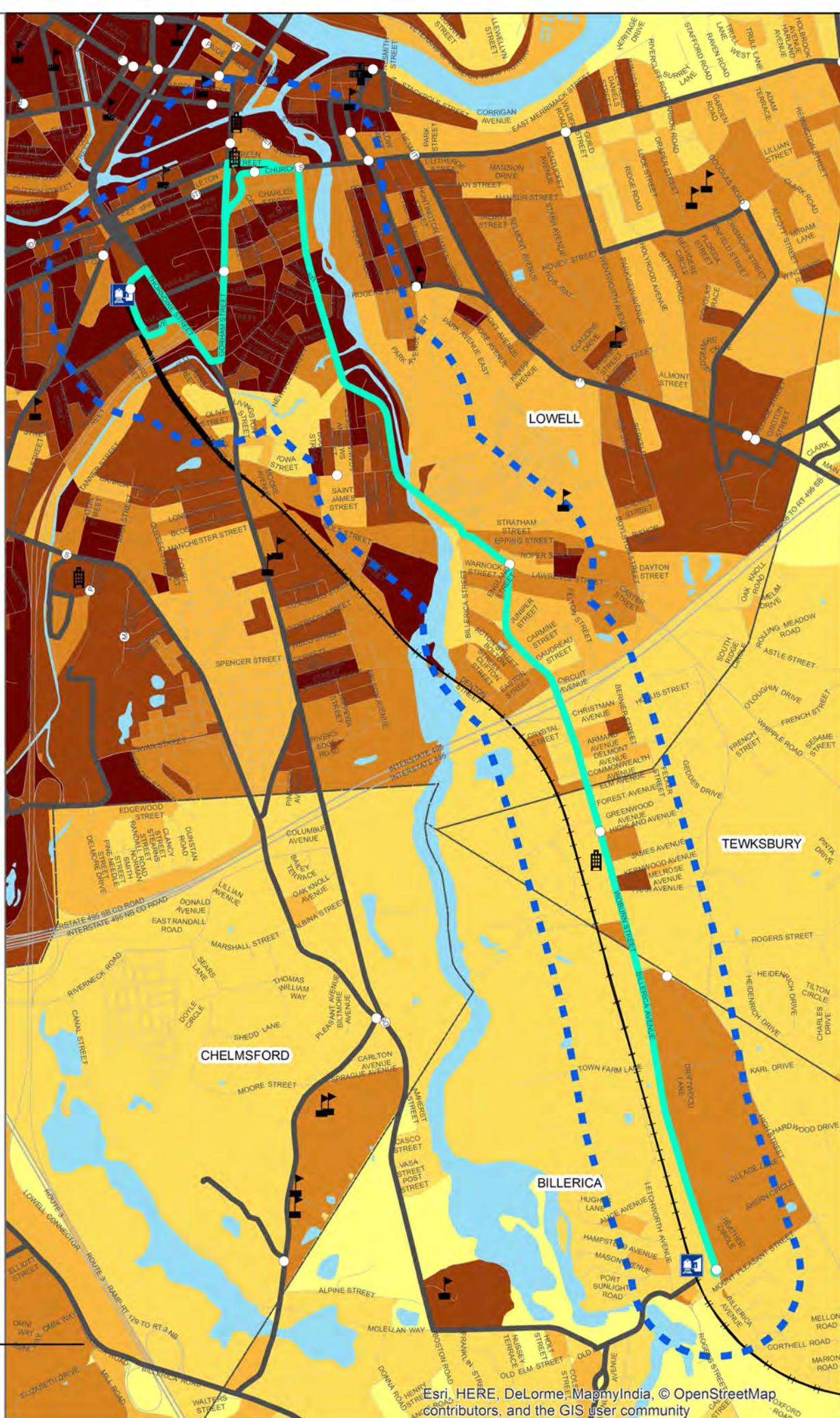
Level of Potential Transit Demand



- LRTA Bus Stop
- Route 3
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.



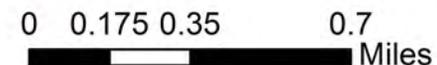


Route 4

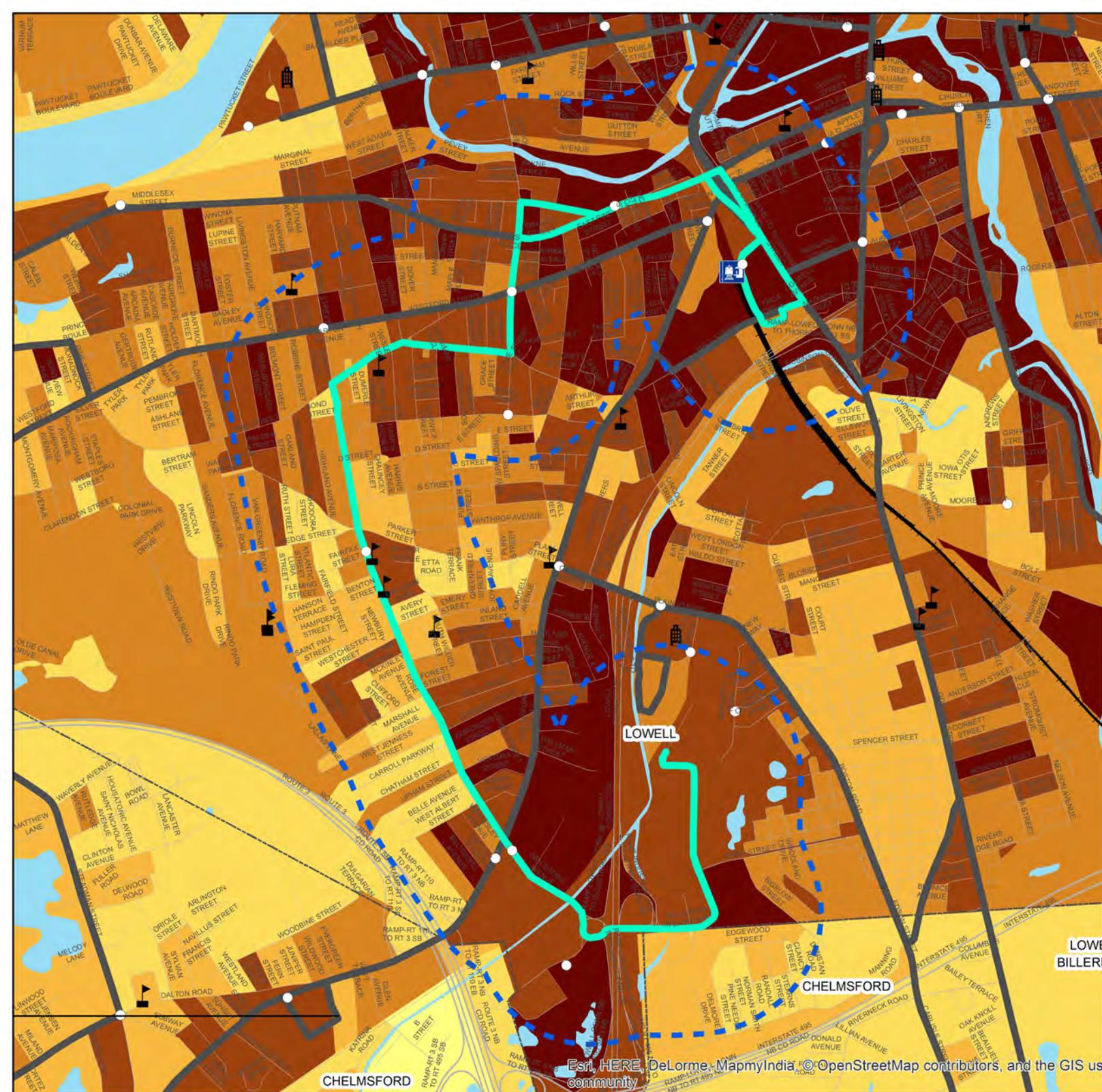
Level of Potential Transit Demand

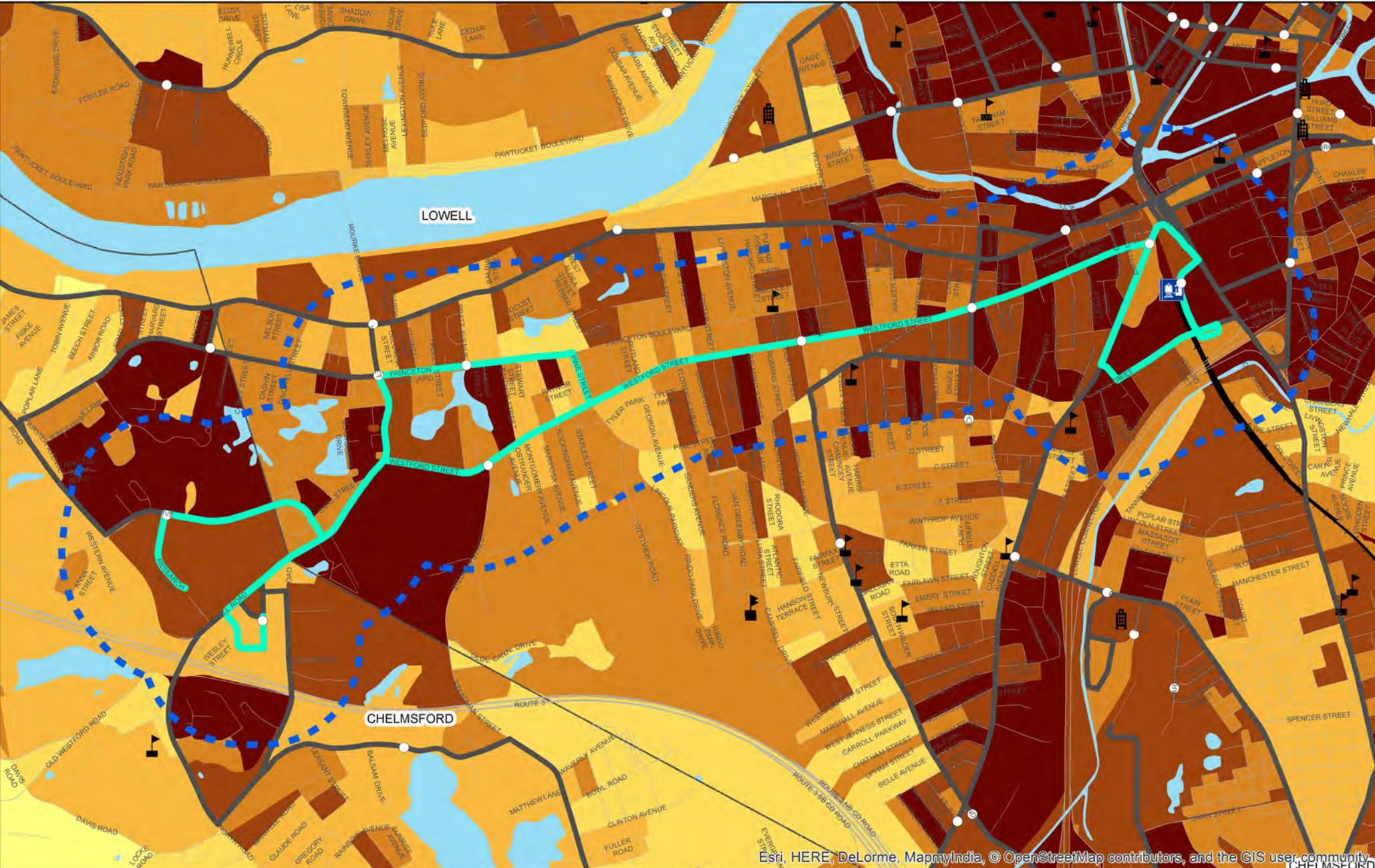


- LRTA Bus Stop
- Route 4
- Other LRTA Bus Route
- - - 1/4 Mile Buffer
- ⊕ Hospital
- 🏫 School
- 🏛️ College/University
- P Park and Ride
- 🚊 Commuter Rail Station
- Commuter Rail
- 🌊 Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





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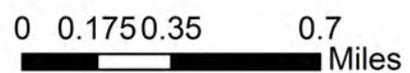
Route 5

Level of Potential Transit Demand

- | | | | | | |
|--|--------|--|----------------------|--|-----------------------|
| | 1 Low | | LRTA Bus Stop | | College/University |
| | 2 | | Route 5 | | Park and Ride |
| | 3 | | Other LRTA Bus Route | | Commuter Rail Station |
| | 4 | | 1/4 Mile Buffer | | Commuter Rail |
| | 5 | | Hospital | | Waterbody |
| | 6 High | | School | | |



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.



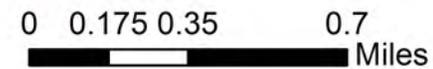


Route 6 & 9 Sat - only

Level of Potential Transit Demand



- LRTA Bus Stop
- Other LRTA Bus Route
- Route 6 & 9 Sat
- - - 1/4 Mile Buffer
- ⊕ Hospital
- 🏫 School
- 🏛️ College/University
- P Park and Ride
- 🚆 Commuter Rail Station
- Commuter Rail
- 🌊 Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.

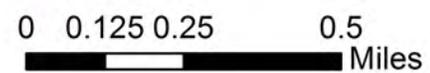




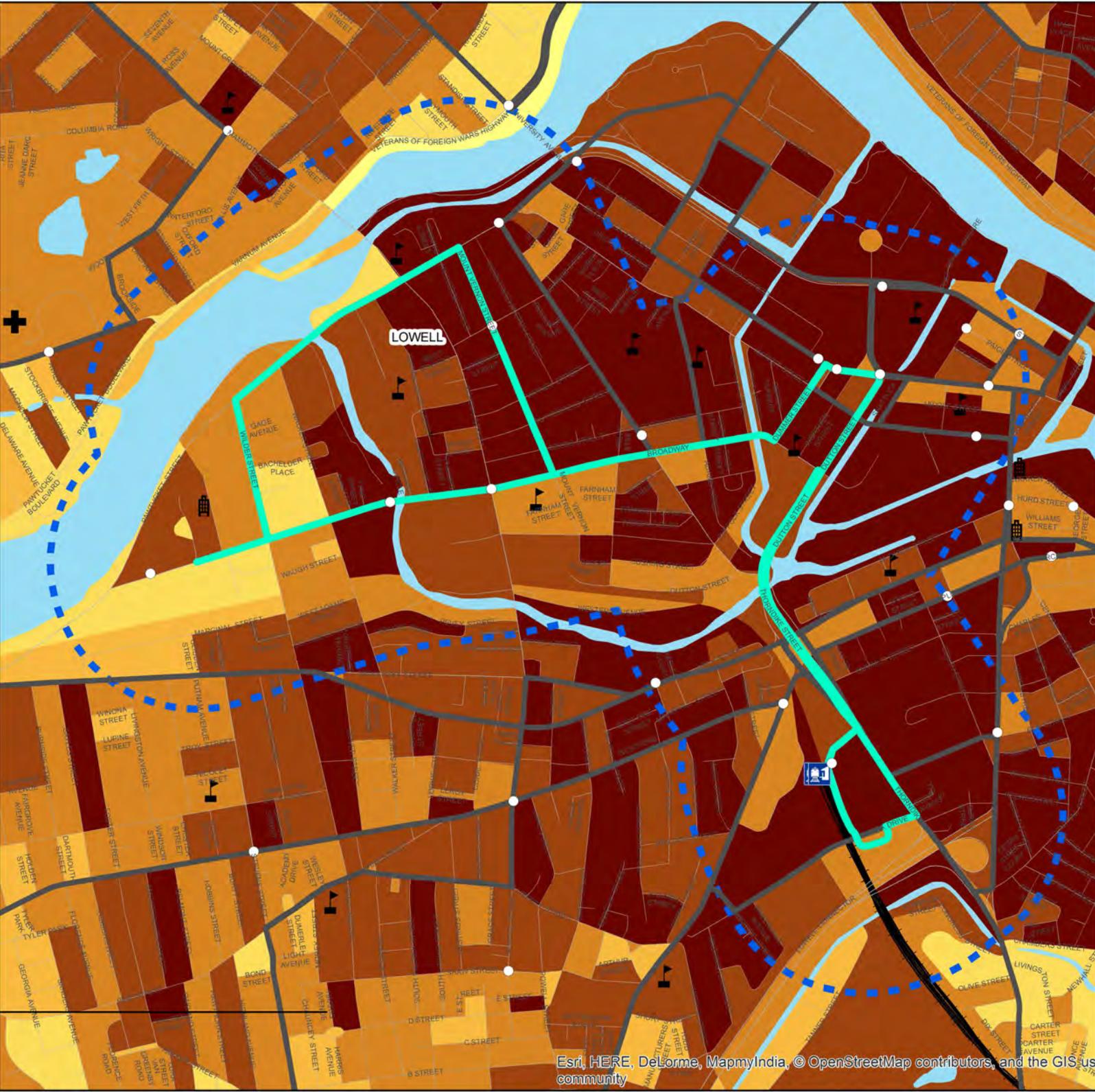
Route 6

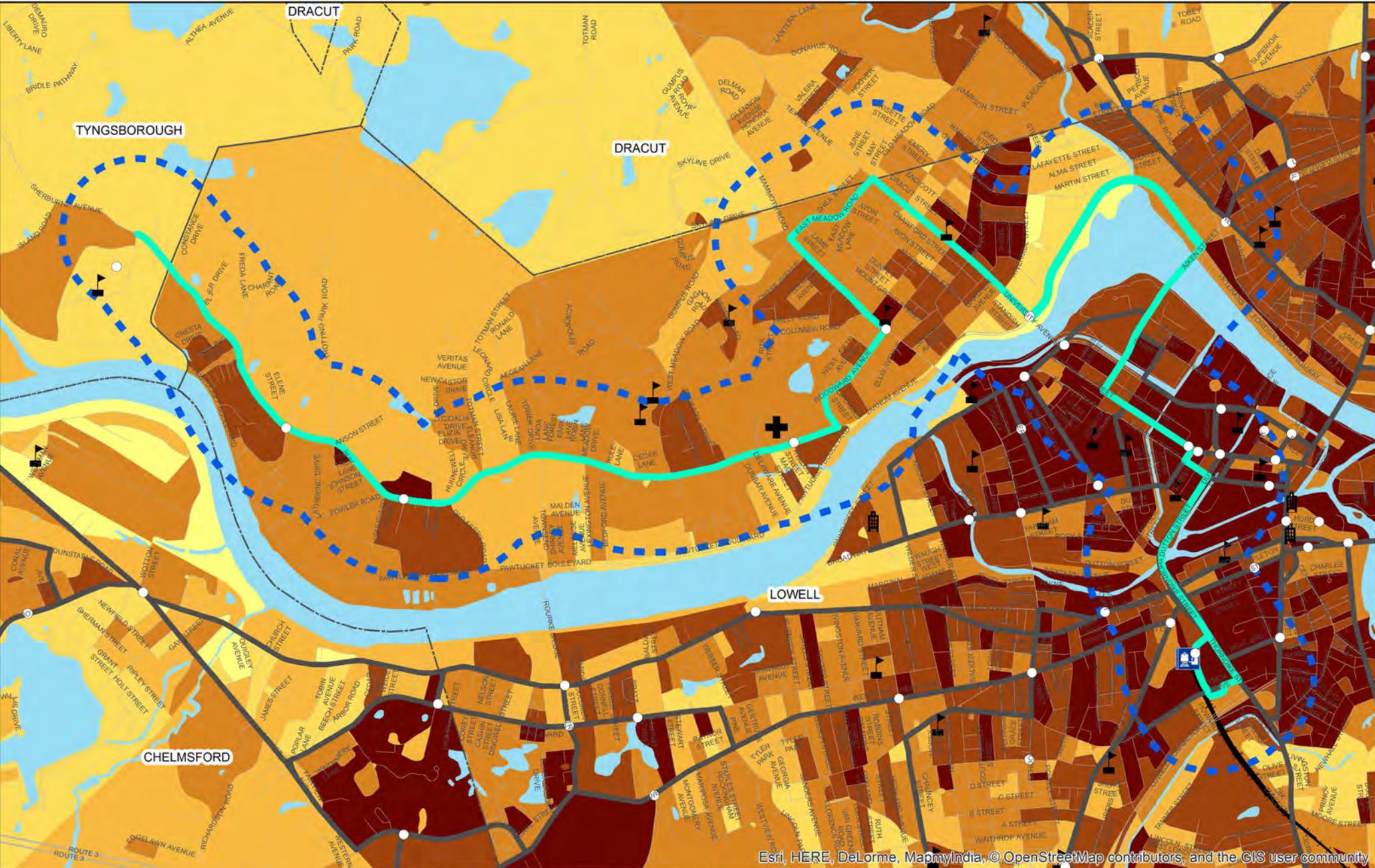
Level of Potential Transit Demand

- 1 Low
- 2
- 3
- 4
- 5
- 6 High
- LRTA Bus Stop
- Route 6
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





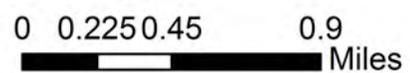
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Level of Potential Transit Demand

- | | | | | | |
|---|--------|---|----------------------|---|-----------------------|
|  | 1 Low |  | LRTA Bus Stop |  | College/University |
|  | 2 |  | Route 7 |  | Park and Ride |
|  | 3 |  | Other LRTA Bus Route |  | Commuter Rail Station |
|  | 4 |  | 1/4 Mile Buffer |  | Commuter Rail |
|  | 5 |  | Hospital |  | Waterbody |
|  | 6 High |  | School | | |



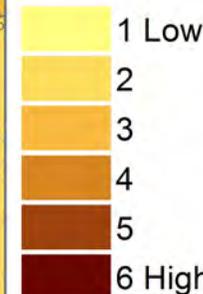
Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.



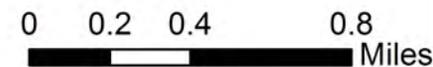


Route 8

Level of Potential Transit Demand



- LRTA Bus Stop
- Route 8
- Other LRTA Bus Route
- - - 1/4 Mile Buffer
- ⊕ Hospital
- 🏫 School
- 🏛 College/University
- P Park and Ride
- 🚊 Commuter Rail Station
- Commuter Rail
- 🌊 Waterbody



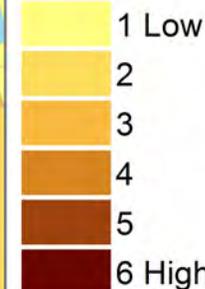
Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.



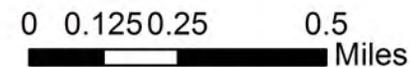


Route 9

Level of Potential Transit Demand

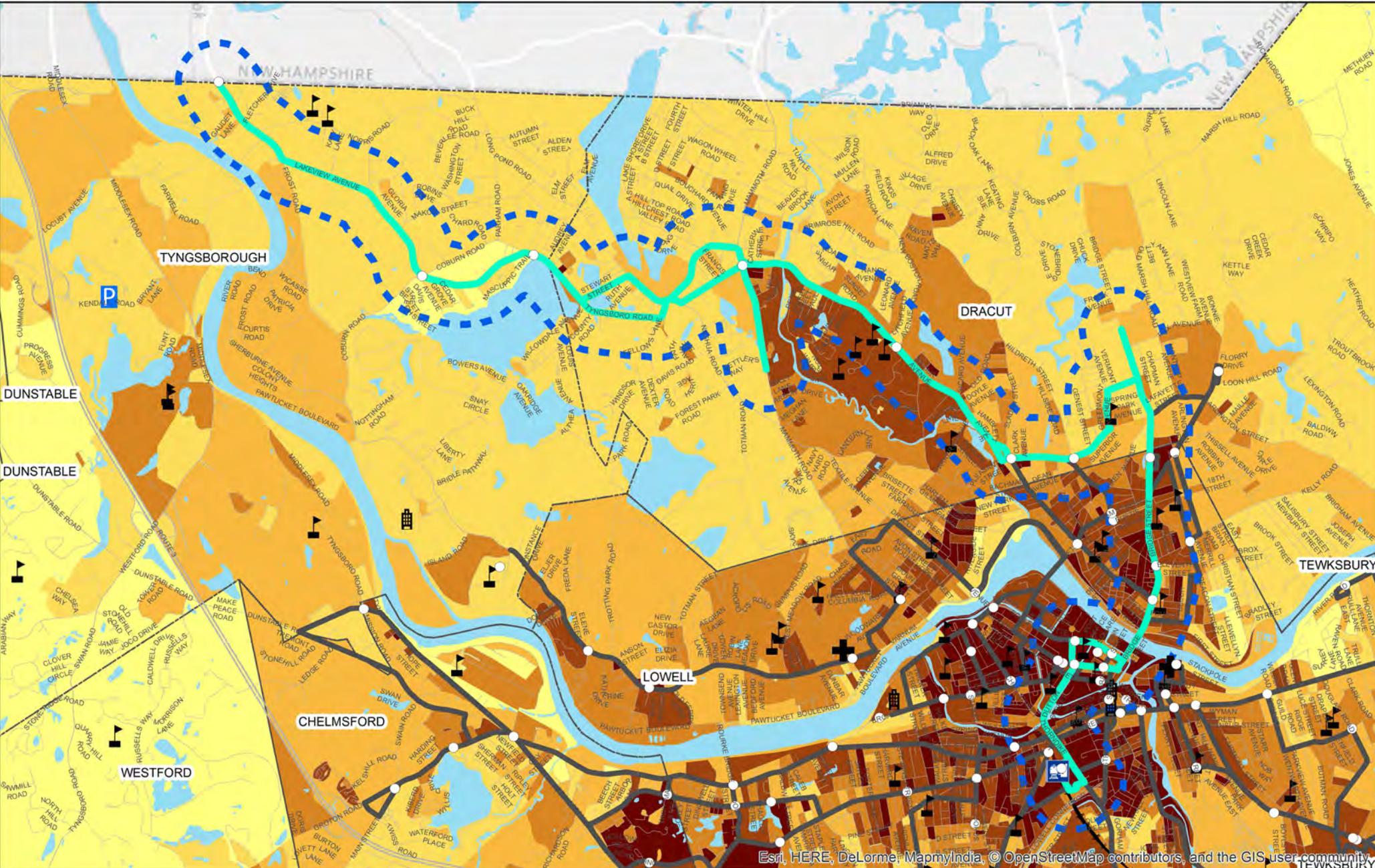


- LRTA Bus Stop
- Route 9
- Other LRTA Bus Route
- - - 1/4 Mile Buffer
- ⊕ Hospital
- 🏫 School
- 🏛️ College/University
- P Park and Ride
- 🚆 Commuter Rail Station
- Commuter Rail
- 🌊 Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





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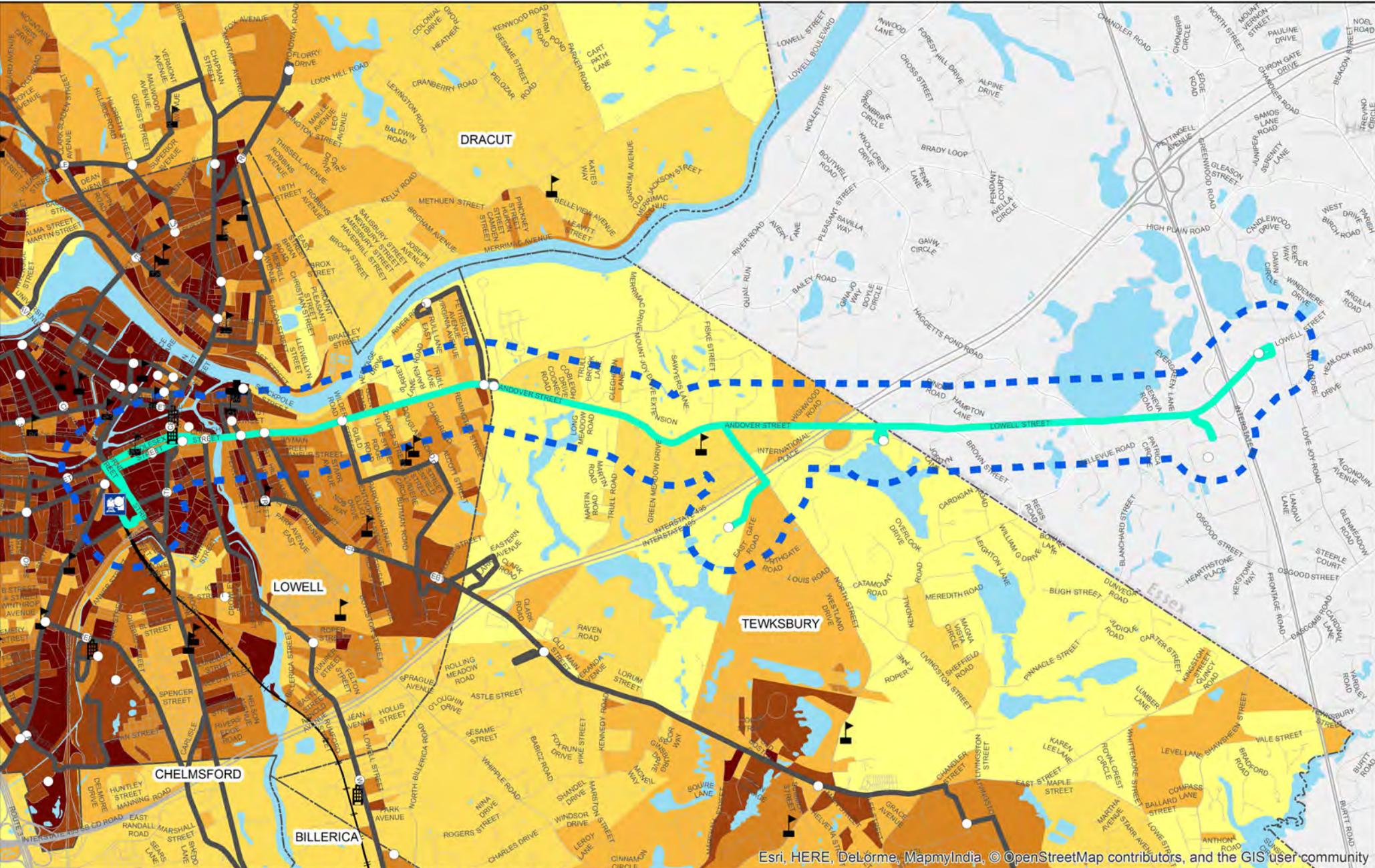
Level of Potential Transit Demand

- | | | | | | |
|--|--------|--|----------------------|--|-----------------------|
| | 1 Low | | LRTA Bus Stop | | College/University |
| | 2 | | Route 10 | | Park and Ride |
| | 3 | | Other LRTA Bus Route | | Commuter Rail Station |
| | 4 | | 1/4 Mile Buffer | | Commuter Rail |
| | 5 | | Hospital | | Waterbody |
| | 6 High | | School | | |



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





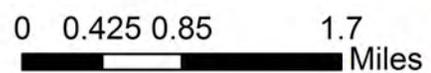
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Level of Potential Transit Demand

- | | | | | | |
|--|--------|--|----------------------|--|-----------------------|
| | 1 Low | | LRTA Bus Stop | | College/University |
| | 2 | | Route 11 | | Park and Ride |
| | 3 | | Other LRTA Bus Route | | Commuter Rail Station |
| | 4 | | 1/4 Mile Buffer | | Commuter Rail |
| | 5 | | Hospital | | Waterbody |
| | 6 High | | School | | |



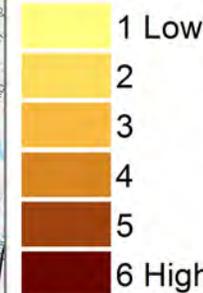
Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





Route 12

Level of Potential Transit Demand



- LRTA Bus Stop
- Route 12
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





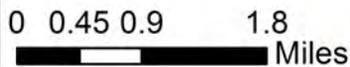
Route 13



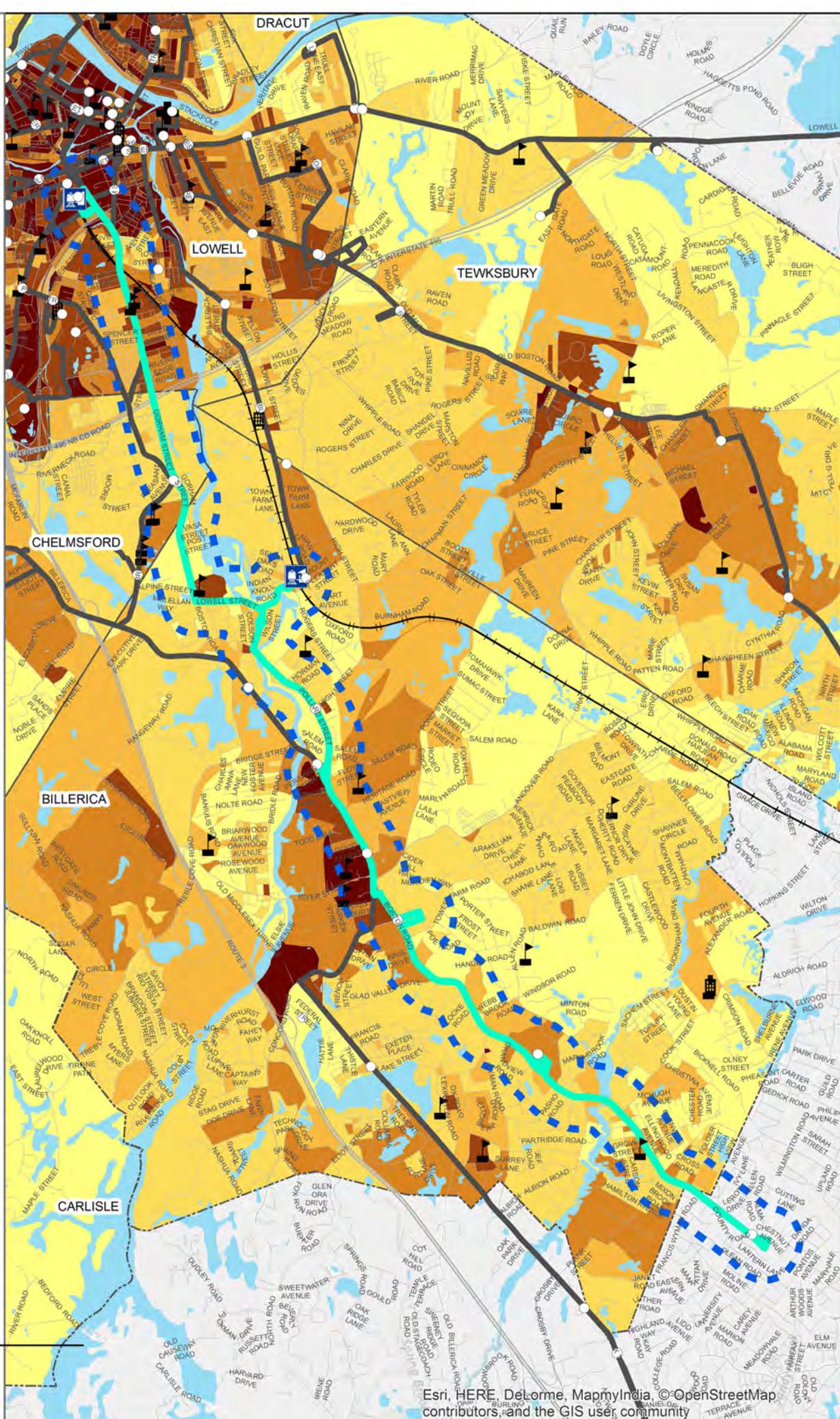
Level of Potential Transit Demand

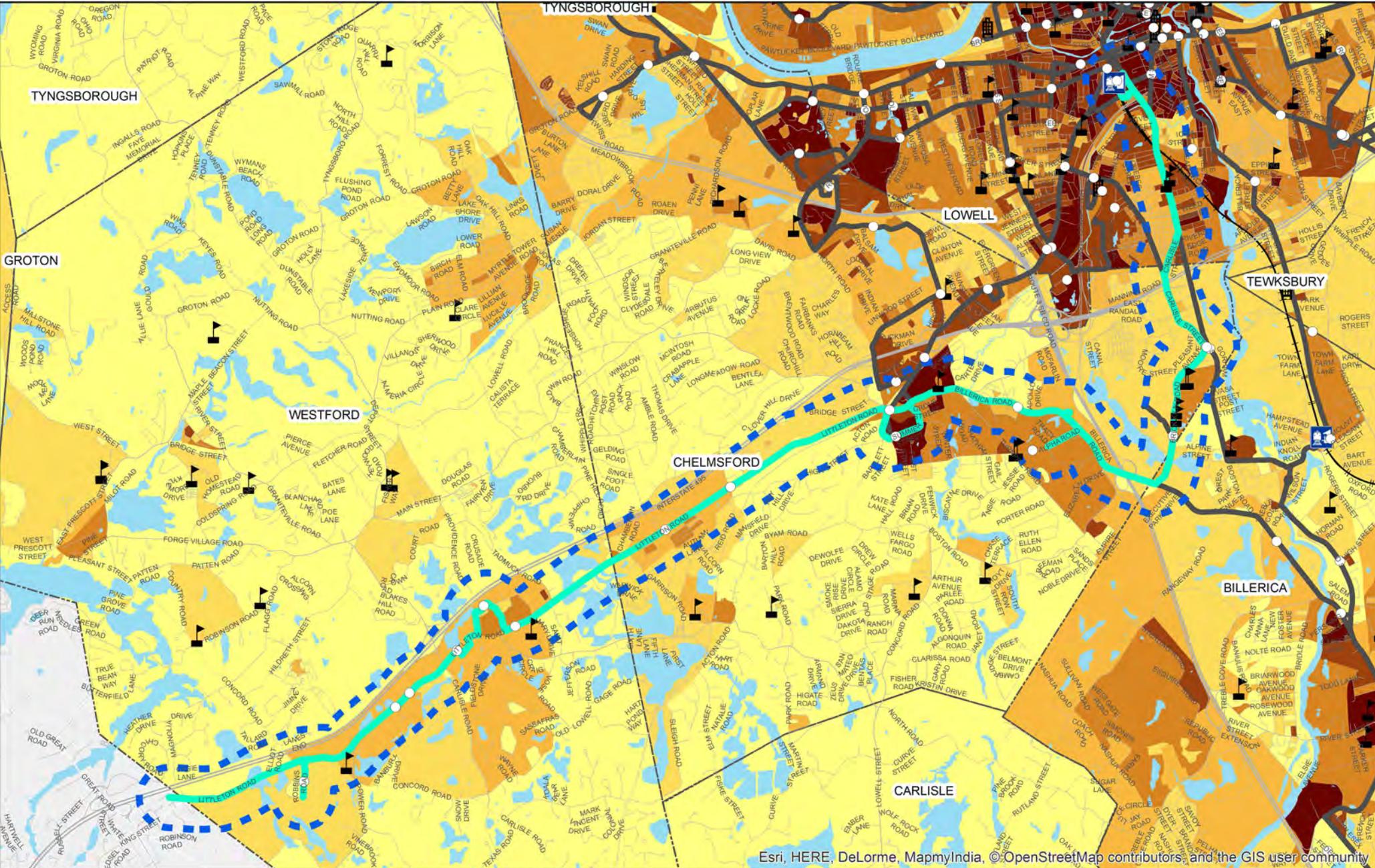


- LRTA Bus Stop
- Route 13
- Other LRTA Bus Route
- ⋮ 1/4 Mile Buffer
- ⊕ Hospital
- 🏫 School
- 🏛️ College/University
- P Park and Ride
- 🚊 Commuter Rail Station
- Commuter Rail
- 🌊 Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





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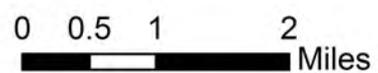
Route 15

Level of Potential Transit Demand

- | | | | | | |
|--|--------|--|----------------------|--|-----------------------|
| | 1 Low | | LRTA Bus Stop | | College/University |
| | 2 | | Route 15 | | Park and Ride |
| | 3 | | Other LRTA Bus Route | | Commuter Rail Station |
| | 4 | | 1/4 Mile Buffer | | Commuter Rail |
| | 5 | | Hospital | | Waterbody |
| | 6 High | | School | | |



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





Route 16

Level of Potential Transit Demand

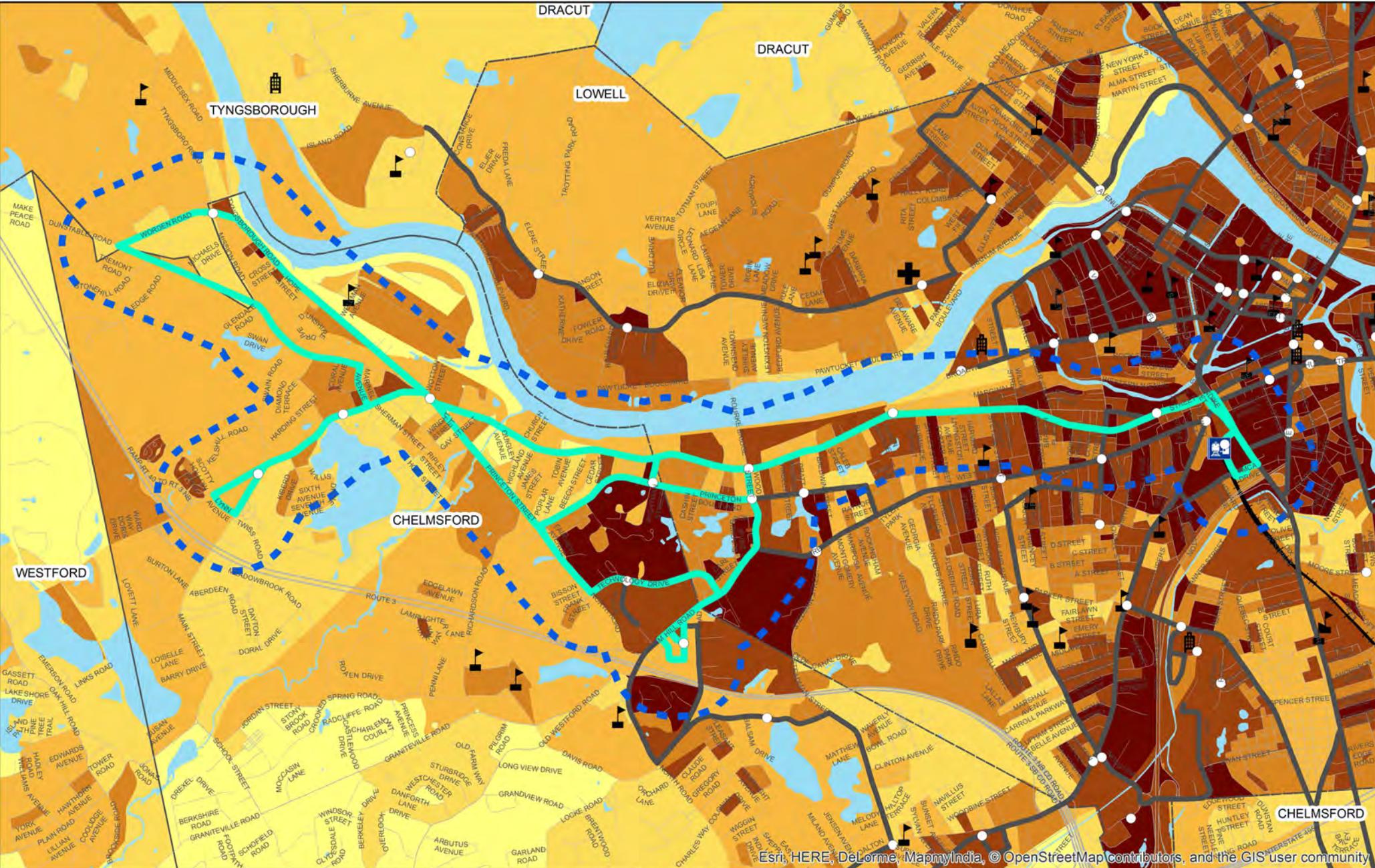


- LRTA Bus Stop
- Route 16
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





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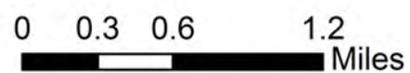
Route 17

Level of Potential Transit Demand

- | | | | | | |
|--|--------|--|----------------------|--|-----------------------|
| | 1 Low | | LRTA Bus Stop | | College/University |
| | 2 | | Route 17 | | Park and Ride |
| | 3 | | Other LRTA Bus Route | | Commuter Rail Station |
| | 4 | | 1/4 Mile Buffer | | Commuter Rail |
| | 5 | | Hospital | | Waterbody |
| | 6 High | | School | | |



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.





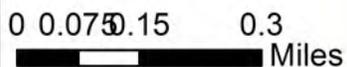
Route 18



Level of Potential Transit Demand



- LRTA Bus Stop
- Route 18
- Other LRTA Bus Route
- 1/4 Mile Buffer
- Hospital
- School
- College/University
- Park and Ride
- Commuter Rail Station
- Commuter Rail
- Waterbody



Demand is based on the population density, employment density, percent of vehicleless households, proximity to schools park and ride lots, commuter rail stations and hospitals, median household income, the enrollment at local colleges and universities, elderly population and the percent of households with people with disabilities.



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Appendix B

Recommendation Memo

Client: Lowell Regional Transit Authority
Project Name: Comprehensive Service Assessment
Issue Date: April 08, 2014
To: James Scanlon and LRTA
From: Stephen Gazillo, *URS Corporation*

LRTA Comprehensive Service Assessment – Recommendations

The following outlines the recommendations and alternatives to improve service for LRTA based on the comments received from the November 2014 workshop. Opportunities were identified to improve connectivity, streamline service, and add service. A table can be found at the end which outlines all recommendations by route, additional information and maps have been provided for select routes.

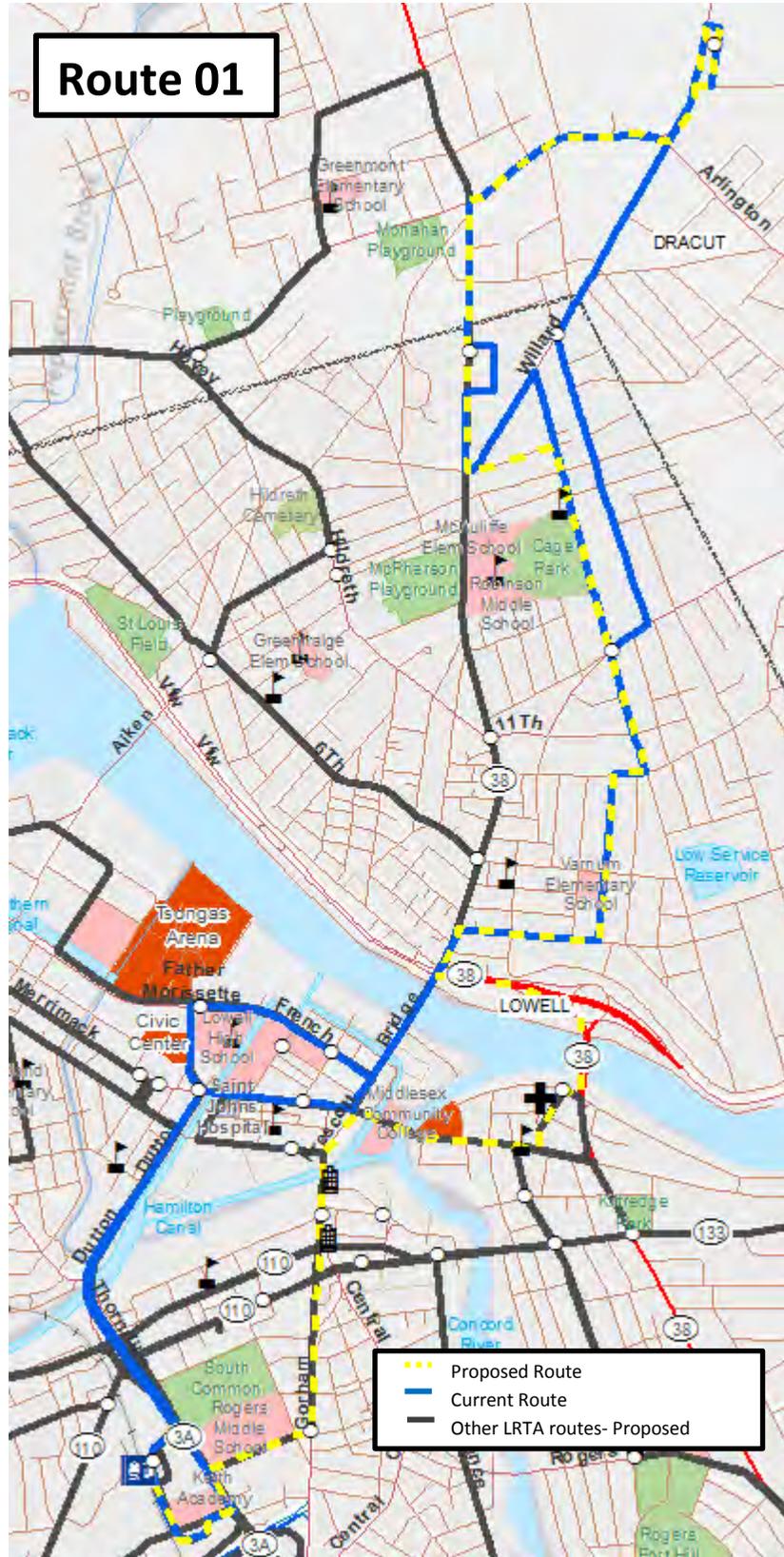
Phasing Plan

Phase 1 focuses on streamlining service, creating consistent clock face frequencies, and enhancing connectivity. Weekday frequency recommendations were based on ridership. City routes with over 200 passengers a day were candidates for 30 minute frequencies. All Suburban routes were candidates for 60 minute frequency unless ridership was higher than the average city route ridership of 318. Phase 2 adds service to previously underserved areas and implements a limited Sunday service schedule. Frequency to these underserved areas was dependent on the cycle time for one vehicle. The routes chosen for the limited Sunday service were based on ridership. In Phase 3 Sunday service has been expanded to Saturday routes that had modest ridership and productivity but were experiencing performing Saturday routes that service major destinations.

Recommendation Changes, February 2015

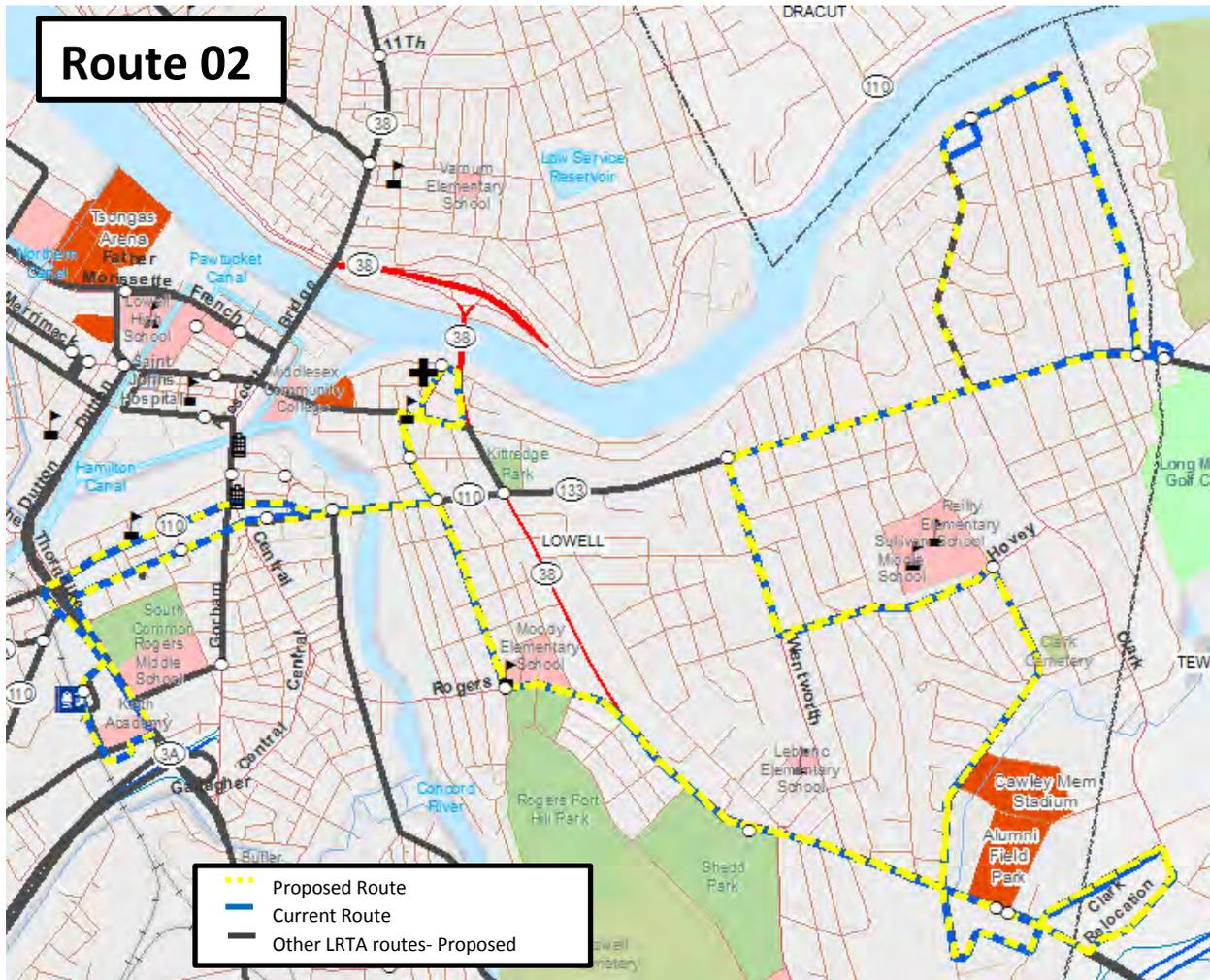
Route 01

This route was streamlined to remove deviations and minimize duplication with Route 10. Service would be eliminated from Willard Street but it would be within a ¼ mile of the Route 1. 27 passengers boarded or alighted on Willard Street, but due to the one way loop some may have to walk over from Bridge or Arlington St. stops. The adjustment in the southern portion is to cover the former Route 9 service to the hospital near the Route 38 Bridge; the segments lost by the Route 01 are covered by other LRTA routes. Service is consolidated on Bridge Street to eliminate one-way service through Christian Hill. For weekend service see the Route 01/08.



Route 02

This route has been altered slightly to provide service along Raven Rd. Service has been eliminated from the intersection of Andover St and River Rd but is serviced by the Route 11. Service recommendations include implementing Sunday service in Phase 2 as it is one of the top three ridership routes for city routes on Saturday.



Route 03

This route has been discontinued and consolidated with Route 15 due to redundancy with the Routes 13, 14 and 15. It is also the route with the lowest ridership and productivity and highest subsidy on the weekend. The new Route 15 will cover all portions of the Route 03 with 60 minute headways.

Route 04

Service recommendations include implementing Sunday service in Phase 3. This would no longer be interlined with the Route 3 on the weekend but would operate as a standalone route using the weekday alignment. This route does have a high productivity but ridership data from when school is in session verse when it is not shows that over half of the ridership is attributed to high school student ridership

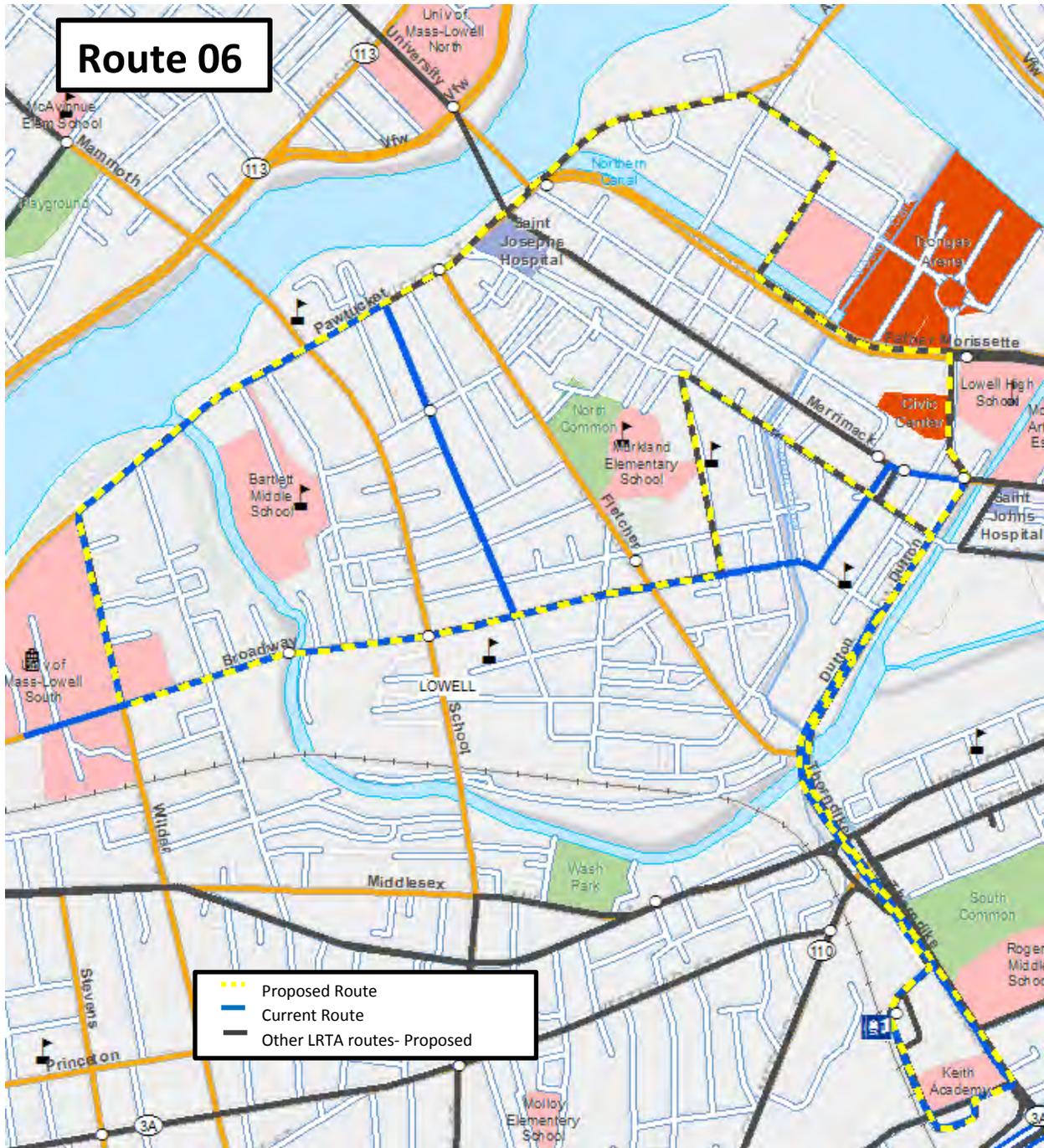
because the City of Lowell does not have a busing system for High School students. Due to this no change in frequency is recommended.

Route 05

Service recommendations include implementing Sunday service in Phase 2 and expanding weekday service from 5:30 AM to 9:30 PM in Phase 1. Service was expanded to match that of the Route 18 because this route has the highest productivity and second highest ridership. On Saturday this is the most productive route.

Route 06

The Route 6 and 9 have been combined into one circulator. Service eliminated east of the Western Canal in the vicinity of E. Merrimack Street will be covered by the modified Route 01. Over 80% of the service eliminated from Fletcher St and Mt. Vernon Street is within ¼ mile of the new Route 6. This route cannot be implemented until the Broadway Bridge and Pawtucket Street Bridge have completed reconstruction. Service recommendations include implementing Sunday service (Phase 3) and creating consistent 30 minute frequencies during the weekday. 30 minute frequencies would be an improvement to both the Route 6 and 9 current frequencies.



Route 07

Service recommendations include implementing Sunday service and expanding weekday service from 5:30 AM to 9:30 PM. Service has been expanded to match that of the Route 18 circulator because the Route 7 has the highest weekday ridership.

Route 08

There are no proposed recommendations for this route. This route does have a high productivity but ridership data from when school is in session verse when it is not shows that over half of the ridership is attributed to high school student ridership because the City of Lowell does not have a busing system for High School students. Due to this no change in frequency is recommended. See Route 01/08 for weekend recommendations.

Route 09

This route has been discontinued and consolidated with Route 6. For more information see the Route 6 recommendations.

Route 10

There are no proposed recommendations for this route. A straightened alignment was examined to provide more direct service into Lowell but it was determined that the regional connection to Market Basket outweighed an operational gains.

Route 11

There are no proposed recommendations for this route.

Route 12

Service recommendations include establishing service in Phase 3 as it is a high performing Saturday suburban route and has experienced over 100% growth in ridership between FY 2012 and FY 2014.

Route 13

There are no proposed recommendations for this route. This route does have a high productivity but ridership data from when school is in session verse when it is not shows that over half of the ridership is attributed to high school student ridership because the City of Lowell does not have a busing system for High School students. Due to this no change in frequency is recommended.

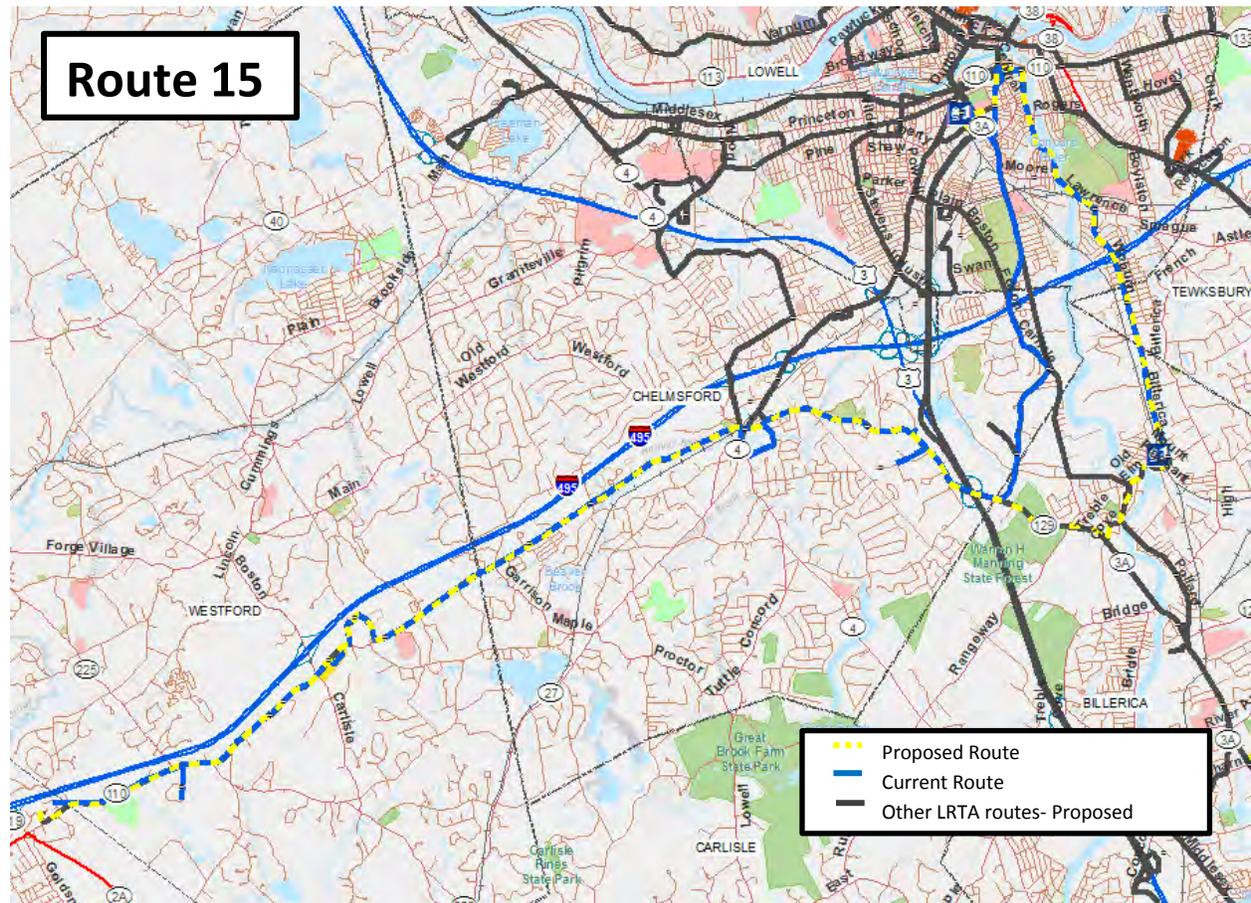
Route 14

Service recommendations include implementing Sunday service and improving weekday frequency to 30 minutes in Phase 3. This route has the highest ridership and productivity of the suburban routes during the weekday. Interlining the Route 14 and Route 15 using 3 vehicles to supply a 60 minute frequency on each would provide operational savings in Phase 1. This is not possible in Phase 2 due to proposed changes in the Route 14.

Route 15

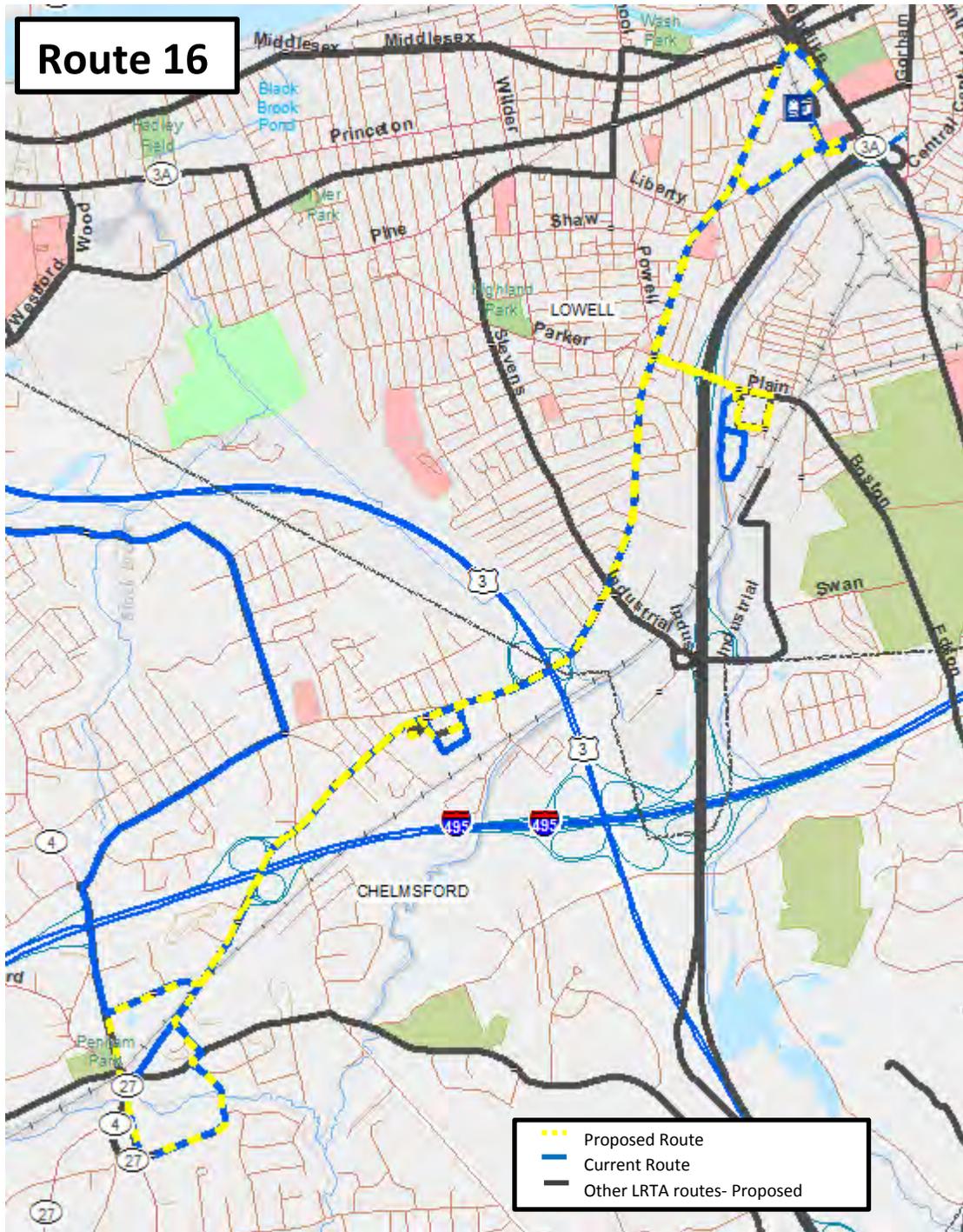
To eliminate duplication of service it is recommended to discontinue the deviation into the Market Place Shopping Center and combine this route with the Route 3. The segments lost along State Route 3A, Carlisle St and Brick Kiln Rd will be covered by the Routes 13 and 14. The shopping center will be serviced by both the revised Routes 16 and 17. Service recommendations include establishing consistent 60 minute frequencies in Phase 1 to help improve this route which experienced the largest growth in ridership between 2012 and 2014. Interlining the Route 14 and Route 15 using 3 vehicles to supply a 60

minute frequency on each would provide operational savings in Phase 1 and 2. This is not possible in Phase 3 due to a proposed increase in frequency for Route 14.



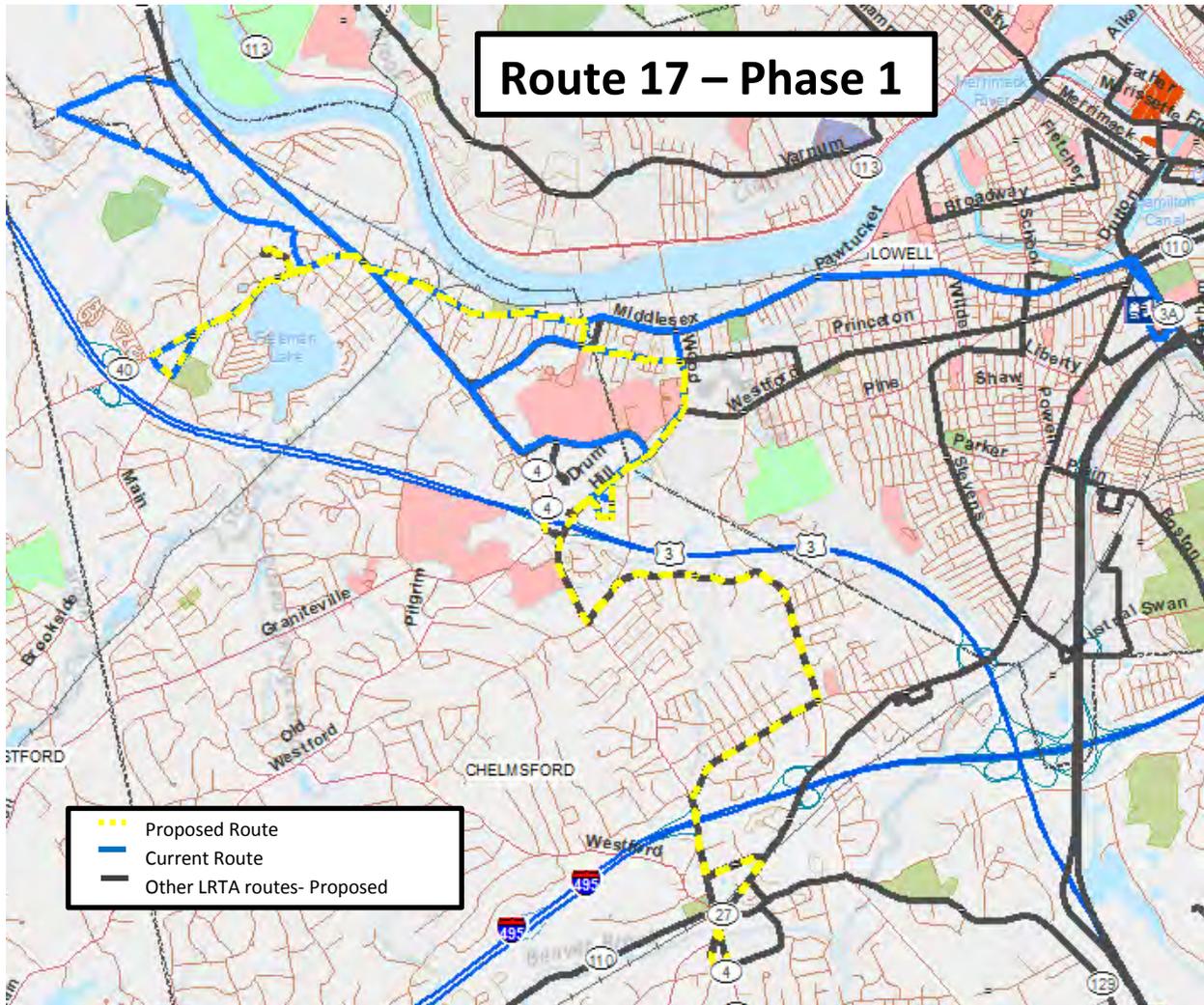
Route 16

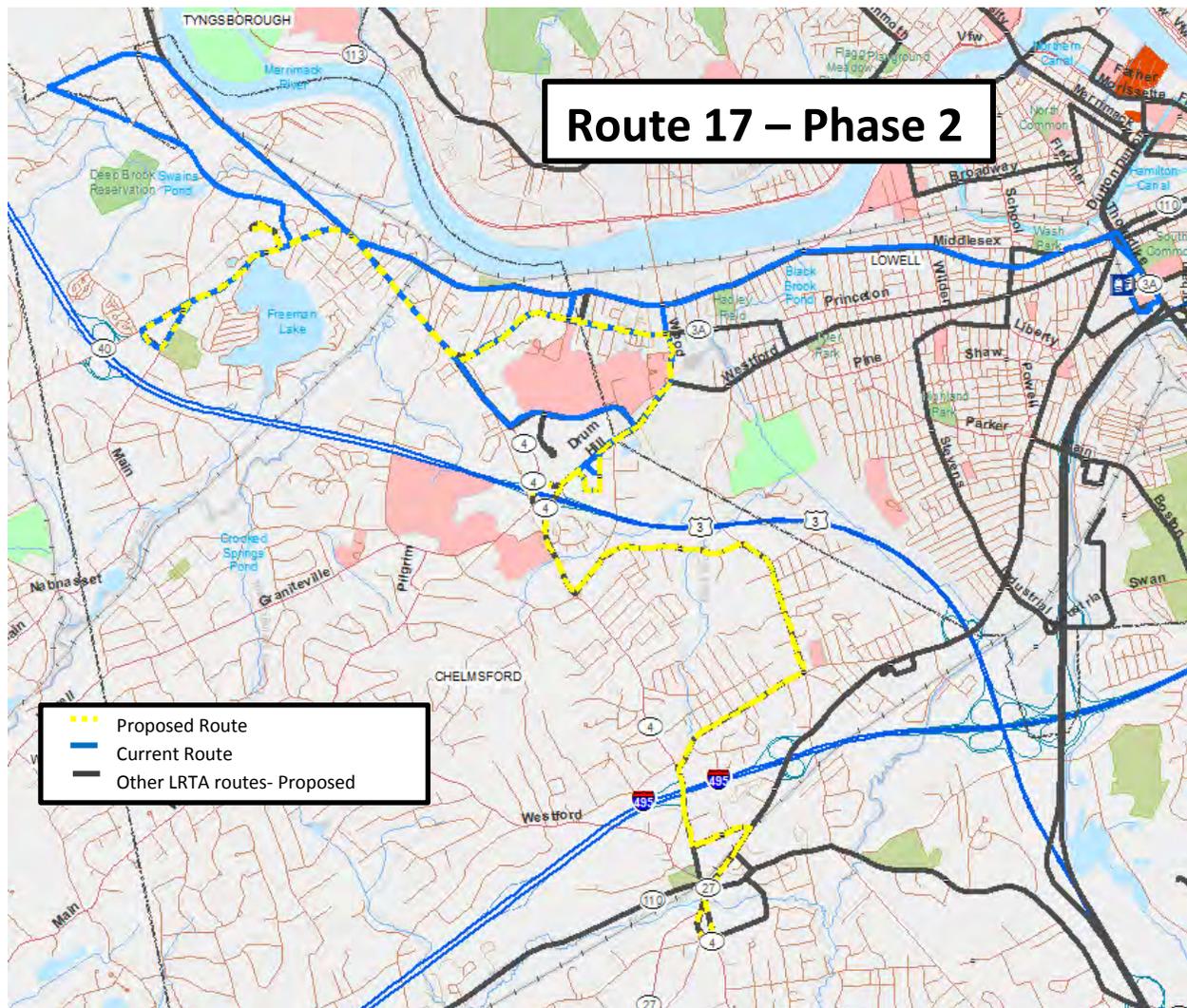
The recommendation for this route is to terminate service at the Market Place Shopping Center in Chelmsford. The segment between the Shopping center and Walmart will be covered by the new Route 20. Direct service to Walmart from downtown Lowell is available via the Routes 5 and new Route 19. Service recommendations include 30 minute peak and 60 minute off-peak frequencies during the weekday and Sunday service. Clock face frequencies will improve ridership and it is the second most productive weekday suburban ridership. On Saturdays this route is the 3rd highest in ridership and productivity which makes it a candidate for Sunday service in Phase 3.



Route 17

The Route 17 has been split into two routes, the 17 and 20. This revised route will provide cross town service from the Market Place Shopping Center to Triangle Store via Walmart. One way service on Mission Road has been eliminated. It will operate with the same service span and headways as the current route. When route 19 is implemented the alignment will follow state route 3A to reduce duplication with the Route 19.



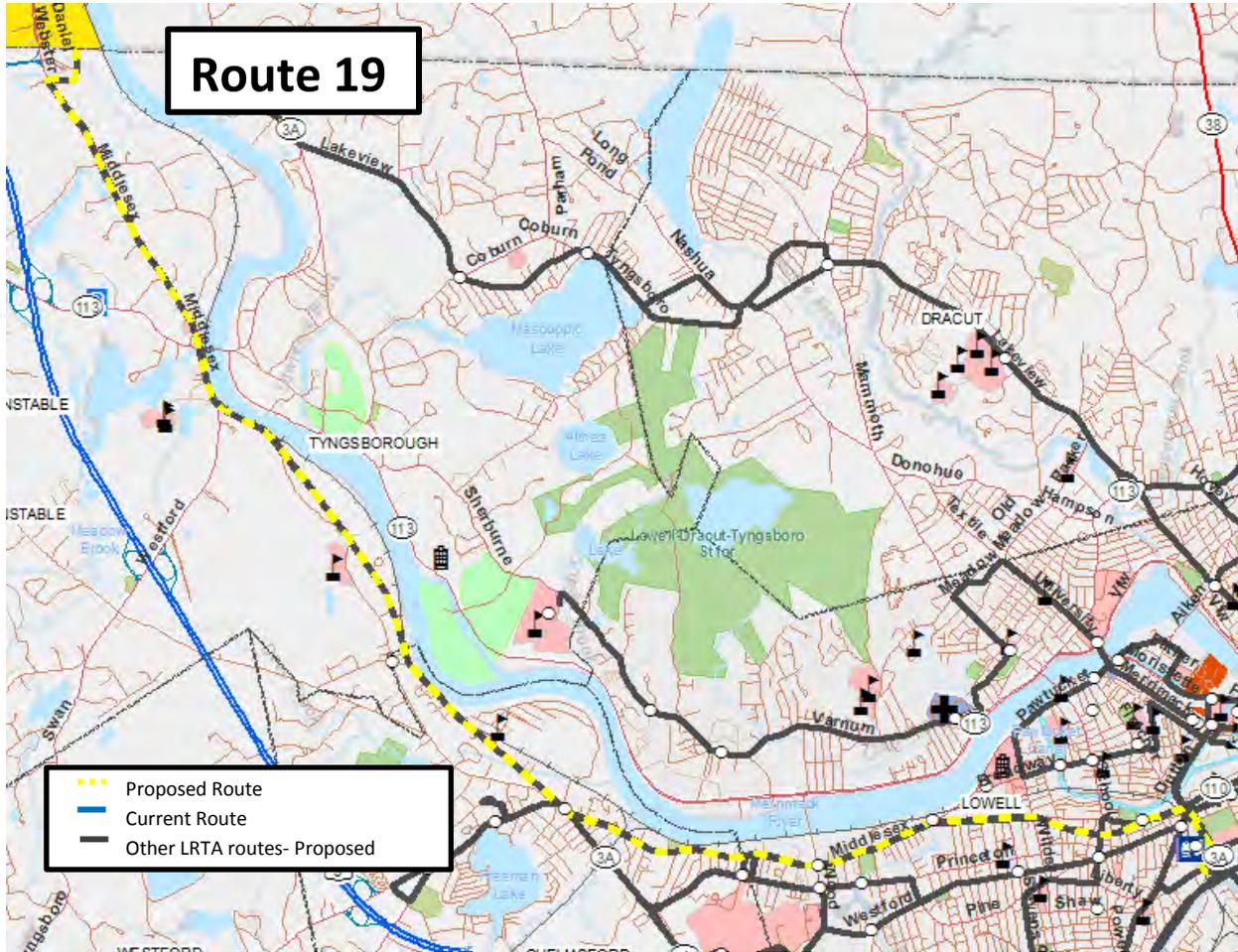


Route 18

Service recommendations include implementing Sunday service in Phase 2 from 7:15 AM to 7:00 PM with 30 minute frequencies. The route has above average Sunday ridership and productivity.

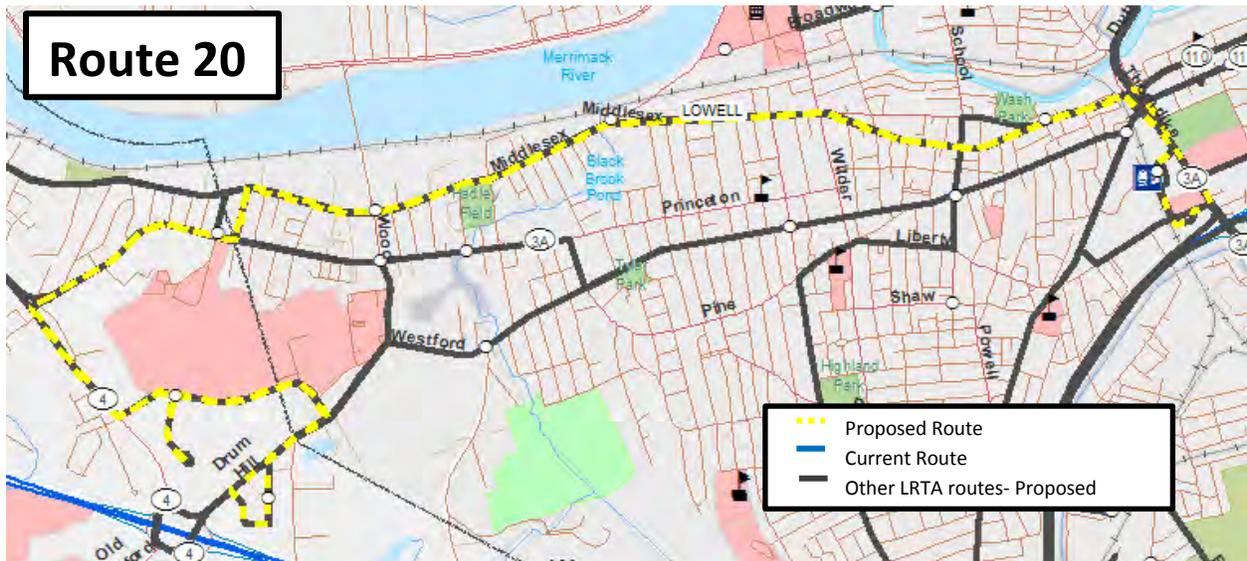
Route 19

Currently the Route 19 operates during the holiday season only on Saturdays. We recommend providing service year round with 90 minute frequencies on weekdays and Saturdays. If Saturday ridership and productivity are above average for the suburban routes Sunday service may be explored.



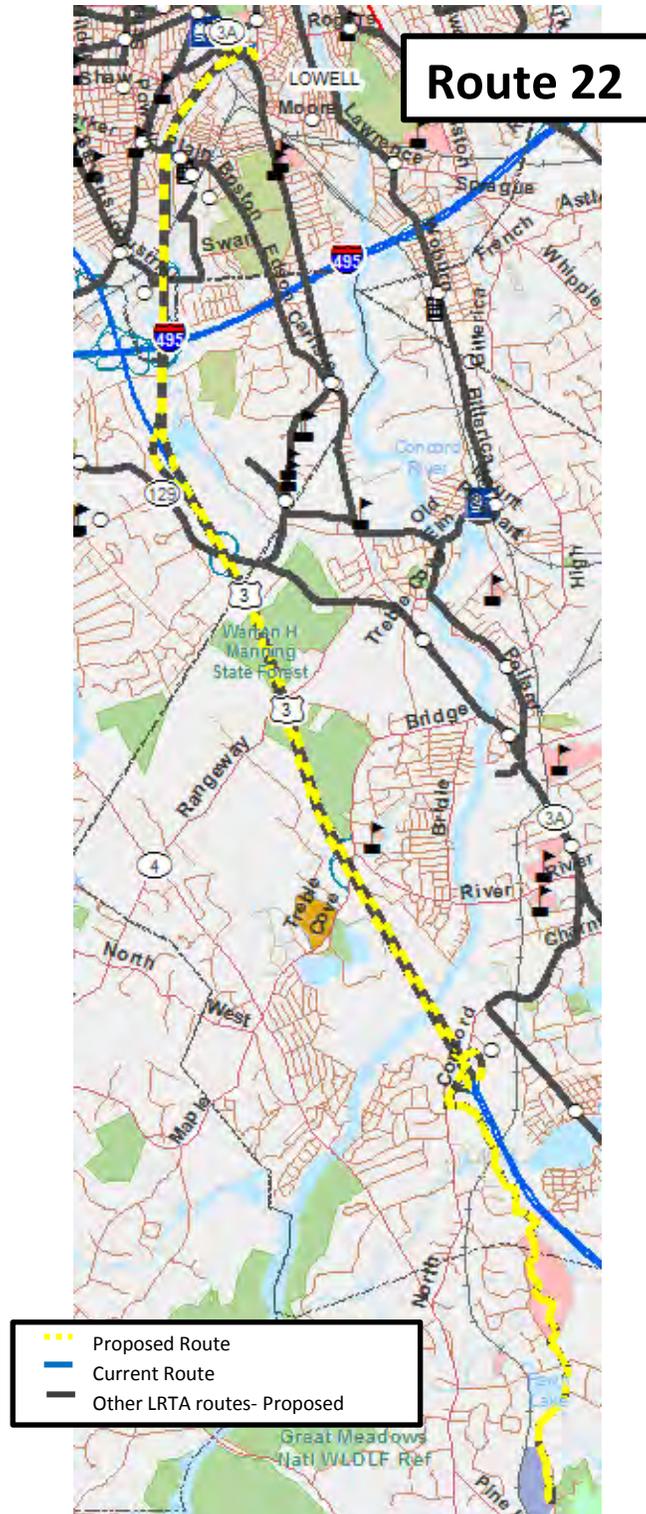
Route 20

This new route will replace segments of the revised Route 17. It will operate during the weekday from 6 AM to 7 PM and on Saturdays from 6 AM to 8 PM.



Route 22

This is a new route to service the Bedford VA, Middlesex Community College and Billerica Technology Park. It would operate on weekdays between 6 AM and 7 PM and on Saturdays 8 AM to 6 PM.



Route 03/04

This interline has been discontinued. The Route 03 is now part of the Route 15 and the Route 04 can operate on its own.

Route 06/09

This interline has been discontinued as the 06/09 have merged into 1 Route.

Route 01/08

Service recommendations include implementing Sunday service.

Bus Route	Alignment	Schedule	Phase 1	Phase 2	Phase 3
1 Christian Hill	Service has been streamlined, one-way service eliminated and service adjusted in the southern portion to cover the former Route 9 service to Saint Mary Hospital	No change	-Alignment change		
2 Belvidere	Consider service on Raven Road for Loop	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency		-Sunday service	
3 South Lowell	Route discontinued, consolidated with route 15	No Service	-Discontinue route		
4 Highlands via Stevens	No change	-Sunday service 8 AM to 5:30 PM with 60 minute frequency			-Sunday service
5 Westford Street	No change	-Sunday service 7:45 AM to 6:15 PM with 60 minute frequency -Extend weekday service 5:30 AM to 9:30 PM	-Extend weekday service	-Sunday service	
6 Broadway / UMass	Route covers existing route 6 and 9	-30 minute weekday frequency -Sunday service 8 AM to 5:30 PM with 60 minute frequency -Extend weekday service to 8 PM		-Weekday frequency -Alignment change -Extend weekday service	-Sunday service
7 Pawtucketville	No change	-Sunday service 7:45 AM to 6:30 PM with 60 minute frequency -Extend weekday service to 9:30 PM	-Extend weekday service	-Sunday service	
8 Centralville	No change	No change			
9 Lowell Circulator	Route discontinued, consolidated with route 6	No Service		-Discontinue route	
10 Dracut / Tyngsboro	No change	No change			
11 IRS via Rte. 133	No change	No change			
12 Tewksbury via Rte38	No change	-Sunday service 7 AM to 5:45 PM with 60 minute frequency			-Sunday service
13 Billerica	No change	No change			
14 Burlington Mall	No change	-Sunday service 8 AM to 6 PM with 60 minute frequency -30 minute weekday frequency		-Sunday service	-Weekday frequency
15 Chelmsford / Westford	Eliminate Stop & Shop deviation & Combine with Route 3	-60 minute weekday frequency	-Weekday frequency -Alignment change		
16 Chelmsford Center	Run only between Chelmsford and Lowell, segment between Chelmsford and Walmart covered by proposed 20	-30 minute peak, 60 minute off-peak weekday frequencies -Sunday service 8 AM to 5:30 PM with 60 minute frequency	-Weekday frequency -Alignment change		-Sunday service
17 North Chelmsford	Split into two routes (See 20 for other portion of existing 17). New routing is North Chelmsford - Chelmsford. When Route 19 is implemented the alignment will follow 3A instead of Middlesex Street to reduce duplication with the 19	-No change	-Split into two routes	-Adjust alignment with the implementation Of route 19	
18 Downtown Shuttle	No change	-Sunday service 7:15 AM to 7 PM with 30 minute frequency		-Sunday service	
19 - Pheasant Lane Mall via Middleboro Road	No change	-Expand Saturday holiday service to year round Mon-Sun service -Weekday service 8 AM to 6:45 PM with 90 minute frequency -Saturday service 9:30 AM to 5 PM with 90 minute frequency		-Implement Weekday and Saturday service	

Bus Route	Alignment	Schedule	Phase 1	Phase 2	Phase 3
20 - North Chelmsford via Middlesex	Proposed Service to replace existing Route 17 between Lowell and Walmart in Chelmsford until Route 19 is established	-Weekday service 6 AM to 7 PM with 60 minute frequency -Saturday service 8 AM to 6 PM with 60 minute frequency	-Implement route	-Discontinue Route	
22 - Bedford VA	New Route to service Bedford VA, Middlesex Community College, Billerica Technology Park	-Weekday service 6 AM to 7 PM with 90 minute frequency -Saturday service 8 AM to 6 PM with 90 minute frequency		Implement route	
03/04 Combo Loop	Interline discontinued, the 3 is now part of the 15 and 04 will operate on its own	No service	-Discontinue route combination		
06/09 Combo Loop	Interline discontinued, the 6 and 9 have been merged into one route	No Service		-Discontinue route combination	
01/08 Combo Loop	No change	-Sunday service 8 AM to 5:15 PM with 60 minute frequency			-Sunday service

Appendix C

Public Outreach

PUBLIC OUTREACH

One of the primary goals of the Regional Transit Plan (RTP) was to identify alternatives and recommendations that would result in improvements to the system for existing riders and potentially attract new riders. In order to meet the needs of the riders, LRTA reached out to the public through a series of “Community Conversations” in order to better understand what the public’s transit needs and priorities are. The public input received from these efforts helped form the goals of the Regional Transit Plan, guide the alternative service scenarios to be examined, and prioritize LRTA service strategies. In addition LRTA formed a Steering Committee. This committee represented key stakeholder groups within the LRTA communities and provided review, comments and guidance on existing service and future service improvements.

Steering Committee

The LRTA has formed and supported the development of a Steering Committee to guide the development of this plan. Its members include local business members, staff of the Northern Middlesex Council of Governments, disabled community, rider representation, LRTA Advisory Board members and LRTA operational personnel. A complete list of committee members and the organization/group they represent can be found in Table 1

Table 1 Study Advisory Committee Members

Steering Committee Members	Organization
Lou Battle	LRTA Operations
Danielle Bergeron – McFadden	Greater Lowell Chamber of Commerce
Thomas Bomil	LRTA Advisory Board
Christopher Curry	NMCOG Transit Planner
David Ellingson	LRTA Advisory Board
James Good	LRTA Operations
Michael McGovern	Assistant City Manager
Kevin McGuire	LRTA Operations
Frances Osman	LRTA Advisory Board
Phillip Shea	LRTA Advisory Board
Patricia Wojtas	LRTA Advisory Board

Over the course of preparation of the Regional Transit Plan, the steering committee met on two occasions, as well as attended the public outreach meetings. The times, dates and locations of these meetings can be found in Table 2.

Table 2. Study Advisory Committee Meetings

Date	Time	Location
4/14/2015	10:00 am	Hale Street
4/28/2015	10:00 am	Hale Street

Public Involvement

For the initial public outreach effort, the LRTA partnered with the Northern Middlesex Council of Governments (NMCOG) to conduct a series of public input sessions. The timing of LRTA's Comprehensive Service Analysis coincided with the NMCOG update to its Regional Transportation Plan. The NMCOG began updating this Plan in the fall of 2014 and examined all modes of transportation, including transit. The Comprehensive Service Analysis focused solely on fixed route services. However, the NMCOG Regional Transportation Plan was able to complement this by examining and making planning recommendations regarding the LRTA fixed route and demand response services.

NMCOG began their Regional Transportation Plan outreach in early March 2015 by attending several Lowell neighborhood association meetings and presenting issues related to transportation, as well as proposed changes to the LRTA bus routes as prescribed by the service plan. At these neighborhood meetings, minority and limited English populations were included and translators provided by the neighborhood groups were available. Additionally, the transit recommendations specific to that neighborhood were discussed in detail. The dates and times of the neighborhood meetings were as follows:

- March 11, 2015 – Belvidere Neighborhood Council, Lowell, MA 6:30-8:00 pm
- March 16, 2015 – Centerville Neighborhood Action Group, Lowell, MA 6:30-8:30 pm
- March 18, 2015 – Acre Coalition Improve Our Neighborhood, Lowell, MA 6:00-8:00 pm
- March 23, 2015 – Lowell Downtown Neighborhood Association, Lowell, MA 7:00-9:00 pm
- April 6, 2015 – Pawtucket Citizens Council, Lowell, MA 7:00-8:30 pm

Simultaneously, the NMCOG staff attended meetings of the regionally significant business and public sector organizations in order to gain additional input and feedback. At each of these meetings, public transit and the proposed LRTA route alignments were discussed. These organizations included the following:

- United Teen Equity Center
- Greater Lowell Chamber of Commerce
- Greater Lowell Workforce Investment Board
- Northern Middlesex Community Economic Development Strategy Committee (CEDS)
- Middlesex3 Coalition
- NAACP meeting at Community Teamwork (CTI)
- Merrimack Valley Regional Coordinating Council (MVRCC)
- Minuteman Regional Coordinating Council (MRCC)

The Northern Middlesex Council of Governments also held three Regional Transportation Plan public input sessions. During these public input sessions, members of the public were invited to discuss with the Council staff, the RTP topics, including Transportation, Environment and Land Use, Bicycle and Pedestrian, and Public Transit. The dates and times of these public input sessions were as follows:

- March 26, 2015 – Tyngsborough Town Hall, Tyngsborough, MA 4:30-7:30 pm
- March 30, 2015 – Chelmsford Senior Center, Chelmsford, MA 12:30-2:00 pm
- April 8, 2015 – Lowell City Hall, Lowell, MA 4:30-7:30 pm

Additionally, the Lowell Regional Transit Authority attended the three neighborhood association meetings in the impacted areas, to discuss proposed route changes specific to the each of the three Lowell neighborhoods. At these neighborhood meetings, minority and limited English populations were included and translators provided by the neighborhood groups were available. The dates and times of the neighborhood meetings were as follows:

- June 10, 2015 – Belvidere Neighborhood Council, Lowell, MA 6:30-8:00 pm
- June 15, 2015 – Centerville Neighborhood Action Group, Lowell, MA 6:30-8:30 pm
- June 17, 2015 – Acre Coalition Improve Our Neighborhood, Lowell, MA 6:00-8:00 pm

The Lowell Regional Transit Authority also held two suburban public input sessions. These sessions were held to garner feedback from community members and transit riders with regards to the Regional Transit Service Plan proposed route changes. The dates and times of these public outreach sessions were as follows:

- June 24, 2015 – Chelmsford Senior Center, Chelmsford, MA 10:00 am-12:00 pm
- June 24, 2015 – Chelmsford Town Hall, Chelmsford, MA 2:00-4:00 pm

Finally, the LRTA held a Public Hearing in the City of Lowell. The public hearing was well attended by the transit riding public as well as several transit operators and union officers. The detailed transit service plan presentation and follow up question and answers were beneficial to all in attendance. The following is the date, time and location of the Public Hearing:

- July 1, 2015 – Pollard Memorial Library, Lowell, MA 5:00-7:00 pm

Summary of Feedback

The feedback provided by participants at the Public Input sessions and the Public Hearing was very constructive and informative. In general, the participants supported an expanded transit system that has greater frequency of service, a more robust Saturday service, Sunday service and extended evening hours. Summarized below is the input received on each of the bus routing proposals at the public forums. “IS” indicate comments received at the public Input sessions and “PH” indicate Public Hearing comments.

Route 01 Christian Hill

Participants all supported the general proposed changes in route alignment. However, several suggestions were made to improve the proposed routing. These suggestions are listed below:

- Traffic over the Hunts Falls Bridge in the afternoon is very bad and will likely cause delays. The bus should continue its current routing over the Bridge Street bridge. (IS & PH)
- The proposal to move the bus off Willard Street and onto 19th Street would be difficult as 19th is a very steep hill. Also, the section near Willard Street is more densely populated. (IS & PH)
- The remaining route realignments that direct the bus along the same outbound and inbound streets of Beacon, Bridge and Arlington as rather than the current loop was supported by the general public. (IS)

Route 02 Belvidere

The Route 02 proposal is a very limited change that would bring the bus down a residential street (Raven Road) on the inbound trip. There were no participants from Raven Road at any of the public meetings. A couple alternative proposals were offered by customers:

- Concern about River Road residents not wanting the street being used on every inbound trip was raised, due to the fact that it is a quiet residential street. (IS)
- Travel into River and Raven roads could be restricted to the morning and afternoon school trippers. (IS & PH)
- To save some on a tight route, skipping the hospital on either the inbound or outbound trip was proposed. (PH)

Route 03 South Lowell and Route 15 Chelmsford Westford

Participants supported the proposal to combine the routes 03 and 15. However, there was a concern raised about the combined routing. This concern is identified below:

- The additional 10 minutes that the bus would require to complete the trip may not work for the commuters rail passengers who travel from Lowell to Chelmsford in each morning for work. (IS)
- This change may be feasible if the LRTA schedule the morning trips not limit the impacts to those riders. (PH)

Route 06 Broadway and Route 09 Circulator

Participants generally supported the proposal to combine the routes 06 and 09. However, there were several concerns raised about the proposal. The concerns are identified below:

- The senior residents at several housing projects near the Saint's Campus of Lowell General Hospital would no longer be able to make a single seat ride to the Senior Center and the Market Basket grocery store on Broadway. (IS)
- The route will not provide direct access from the UMass Lowell East campus and South Campus to the downtown of Lowell. (PH)
- The combining of these two routes cannot be undertaken until the Enel owned bridges are repaired or replaced to handle the proper weight. (IS)

Route 07 Pawtucketville

Participants were asked about the LRTA proposal to send the inbound route down Salem Street and into the UMass Campus Crossing transit hub. The route change is very minor and would provide 30 minute access from the University transit hub to the commuter rail station at Gallagher Intermodal Transportation Center (GITC). Participants unanimously supported the route realignment.

Route 16 Chelmsford Center and Route 17 North Chelmsford

Participants generally supported the proposal to truncate the Rte 16 at Chelmsford Center and provide service by way of the Rte 17. Several issues were raised at the public forums regarding this proposal. The comments were identified below:

- The route change would greatly help those in North Chelmsford who go to the medical facilities in Village Square. Currently, the connection from the #17 North Chelmsford bus to the #16 Chelmsford Center bus at the Drum Hill Wal-Mart is not timed well. (PH)
- There are currently 6 to 8 morning riders who travel from #08 route in Lowell to the #17 bus into North Chelmsford. Currently this available with only one seat ride as the two bus routes are interlined. (PH)
- This proposal would require two transfers if traveling from any route to the north and east of the Kennedy Center. (PH)
- The proposal is to shorten the inbound route by serving state route 40 and not going north the Tyngsborough Road area. This area has seen a steady growth in ridership over the last few years and should remain served by the #17 bus route. (IS & PH)

Route 20 Middlesex Street

Participants supported the proposal for the Route 20 to serve the area left without service due to the realignment of Route 17. The participants supported this route, provided that it would be replaced by the #19 Tyngsborough / Pheasant Lane Mall route, in the near future. (IS & PH)

Route 19 Tyngsborough / Pheasant Lane Mall

Participants unanimously supported the proposal to operate the #19 Tyngsborough / Pheasant Lane Mall route six day per week on a year round basis. This route has a proven track record during the Thanksgiving through New Year's holiday season and is the most requested route that the LRTA receives from the public. (IS & PH)

Other Comments and Suggestions from the Public Outreach Sessions and Public Hearing

Participants were asked at the public forums of any additional transit services that would be helpful in their towns or neighborhoods, as well as issues that the LRTA should address. The following is a brief discussion of customer feedback:

- Service along Pawtucket Boulevard in Lowell – There were a number of residents in the Pawtucketville neighborhood who express interest in a service that would run along the Boulevard from School Street to Old Ferry Road in Lowell. (IS)
- Service to Tyngsborough Middlesex Road Area and New Senior Center – A Tyngsborough Selectman brought up the lack of service to the most densely populated area of Tyngsborough, as well as the new Senior Center that relocated to the west side of the Merrimack River and is no longer served by LRTA fixed route bus service. The Route 19 proposal would help resolve much of this issue. (IS)
- Service in East Dracut - A Dracut Selectman suggested a bus route that would serve the East Dracut area. The proposed route would run along Rte 110, Merrimack Avenue to Stuart Ave (or Leavitt Street or Varnum Ave.), left onto Methuen Street and right on to Arlington Street. (IS)

- Littleton Commuter Rail Station Connection – Members of the Minuteman Regional Coordinating Council were interested extending the Route 15 Westford bus three miles to the Littleton Commuter Rail Station. The road is a narrow collector road and would add approximately ten minutes to the route in each direction. (IS)
- On-Time Performance - Several monthly pass-holders complained about the delays that many riders cause by paying with cash. They reported that some passengers intentionally crumple the dollar bills in order to get a free ride. They were very much supportive of a fare increase for cash customers in order to move those riders onto the Charlie Card system. (PH)
- Destination Displays on Buses – One customer requested that the buses add a system map to Plexiglas panel behind the driver. This would give riders a view of all locations that are accessible by the different bus routes, as many riders are unfamiliar with the overall bus system. (IS)
- Traveler Information at the Terminal – A customer complained that the announcements made at the Gallagher Terminal were difficult to hear. She was very happy to hear that with the installation of the AVL/GIS system in 2015, that passengers will be able to visually see the arrival and departures of all LRTA buses. (PH)
- Earlier Service on the Route 12 – One customer complained that he was unable to get to his employment on the earliest 6:45 Tewksbury bus and requested that inbound service begin at 5:30 am. (Email Comment)

Surveys

The Northern Middlesex Council of Governments (NMCOG), as part of the public input for the Regional Transportation Plan, developed a 25-question survey to gather input on transportation issues such as commuting, parking, roadway conditions, public transit service, and bicycle and pedestrian facilities. Print and online versions of the survey were available in English, Spanish, and Khmer. It was distributed to local communities, elected officials, special interest groups, neighborhood and civic organizations, and business groups throughout the planning process. The deadline for the survey was April 15, 2015. NMCOG collected close to 200 responses, which were submitted from all across the study area. The majority of the responses came from the City of Lowell.

The following survey information is directly related to the public transit questions. These survey results can be used to identify issues and priorities for the Lowell Regional Transit Authority.

The majority of respondents (76%) were between the ages of 21 and 59 years old, while 24% were 60 years or older. There were no survey respondents under the age of 21 years old. Table 7.1 describes that most (49%) of the respondents live in Lowell, while 15% live and 30% work outside the Northern Middlesex region.

Table 7.1: Places of Residence and Work for Survey Respondents

Community	Percentage of Respondents Living in Community	Percentage of Respondents Working in Community
Lowell	48.6%	50.6%
Westford	13.1%	6.0%
Billerica	5.7%	4.8%
Dracut	9.1%	3.0%
Chelmsford	3.4%	3.0%
Tewksbury	2.3%	1.8%
Tyngsborough	2.3%	1.2%
Pepperell	0.6%	0.0%
Dunstable	0.0%	0.0%
Outside of Region	14.8%	29.6%
Total	100%	100%

In terms of where respondents shop, 49% shop within the Northern Middlesex region. A significant number of respondents (37%) shop across the border in New Hampshire and another 10% shop in Burlington, Massachusetts. The majority of respondents (90%) receive medical services in the Northern Middlesex region, with 54% receiving these services in Lowell.

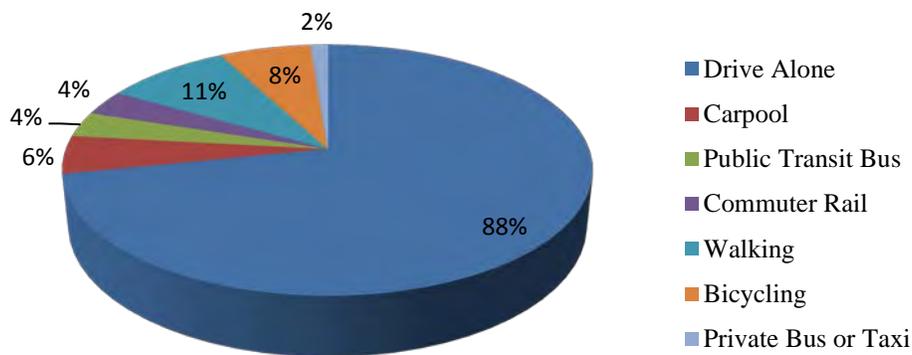
Commuting

Most respondents (67%) leave home to go to work between 7am and 8am, while another 22% leave home after 8am. Only 11% of respondents leave home to go to work before 7am. Fifty five percent (55%) of respondents leave work to return home between 5pm and 7pm. An additional 36% leave work between 4pm and 5pm, while 9% leave work after 7pm.

Thirty one percent (31%) of respondents have less than a 5 mile commute one way to work, while fewer (21%) have more than a 20 mile commute one way to work. The remaining (48%) have between a 5 and 20 mile commute one way to work. In addition, 62% of respondents have a one way commute that is less than 30 minutes. Twenty nine percent (29%) of commuters have a one way commute that takes between 30 and 60 minutes, and 9% of respondents have a one way commute that takes more than 60 minutes.

The majority of respondents (88%) drive alone to work while 4% carpool with others. Alternative transportation modes such as public transit bus service (4%), commuter rail (6%), walking (11%), and bicycling (8%) are also used by commuters in the Northern Middlesex region. Less than 2% of survey respondents commute by private bus or taxi.

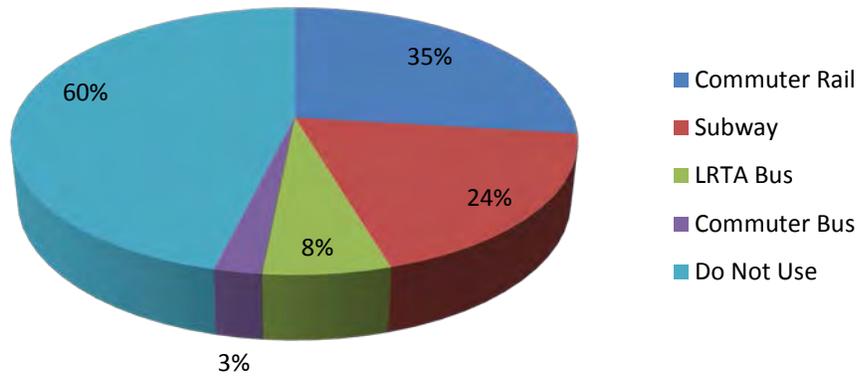
Figure 7.2: Modes of Travel to Work Among Survey Respondents



Public Transit

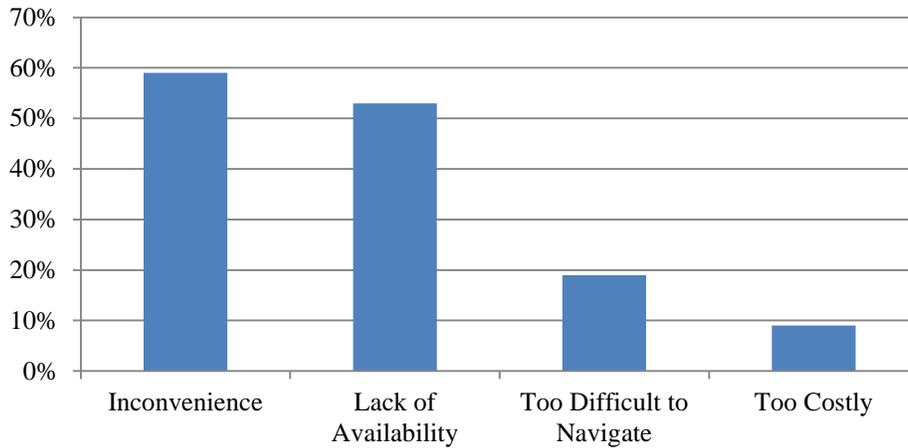
The majority of respondents (60%) do not use public transit. Thirty five percent (35%) use commuter rail, while others use the subway (24%) and the LRTA bus (8%). Few respondents (3%) use commuter buses such as Boston Express, Peter Pan, or Greyhound Lines.

Figure 7.3: Public Transit Usage Among Survey Respondents



The main reasons that respondents do not use public transit center around its inconvenience (59%) and its lack of availability near home or work (53%). Others claim it is too difficult to navigate (19%) and too costly (9%).

Figure 7.4: Reasons for Not Using Public Transit Among Survey Respondents



Of those respondents using public transit, most (73%) use it to access recreational destinations, shopping or dining (51%), and employment (40%). Others use it to visit friends or relatives (25%), go to medical appointments (18%), run errands (9%), and attend school (4%) or church (1.3%).

Sixty eight percent (68%) of respondents feel that public transit services currently offered are not adequate to meet their needs. When asked about additions and enhancement to transit service that would make it a more attractive option, the following improvements were often cited:

- Improved bus service (expanded, logical, and more frequent routes; coordinated with commuter rail schedule)
- Gallagher terminal enhancements (cleanliness, safety, convenience, more taxi service)
- Reduced delays, wait times, and crowded conditions on trains and subways
- Expanded commuter rail service beyond Lowell (including New Hampshire)
- Reliable and reasonably priced passes and parking at transit stations
- Easy and convenient access to Downtown Lowell from transit stations
- Additional transit options (local light rail, expanded trolley service)
- Increased public education and communication (updated websites, social media presence, signage, GPS technology)
- Location of jobs near transit to spur economic growth

Transportation Priorities

Respondents were asked to prioritize transportation issues specific to the Northern Middlesex region. Table 7.5 indicates the top transportation priorities among respondents (based on a weighted average). Note that the expansion of commuter rail service to New Hampshire is the most important issue to respondents.

Table 7.5: Top Transportation Priorities in the Northern Middlesex Region

Priority	Transportation Issue	Weighted Average
1	Expanding commuter rail service to New Hampshire	2.57
2	Repairing poor pavement conditions	2.22
3	Creating off- and on-road facilities for bicycling	2.14
4	Providing additional public transit services	2.02
5	Reducing traffic congestion and delay	1.90
6	Reducing the number of traffic accidents	1.81
7	Rehabilitating and repairing structurally deficient bridges	1.80
8	Providing additional sidewalks and pedestrian facilities	1.68

Source: NMMPO RTP 2040 Transportation Survey

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Appendix D

Public Hearing Comments

Public Hearing Held

- July 1, 2015 – Pollard Memorial Library, Lowell, MA 5:00-7:00 pm

Comments were as follows:

Route 01 Christian Hill

- Traffic over the Hunts Falls Bridge in the afternoon is very bad and will likely cause delays. The bus should continue its current routing over the Bridge Street bridge.
- The proposal to move the bus off Willard Street and onto 19th Street would be difficult as 19th is a very steep hill. Also, the section near Willard Street is more densely populated.

Route 03 South Lowell and Route 15 Chelmsford Westford

- This change may be feasible if the LRTA schedule the morning trips not limit the impacts to those riders.

Route 06 Broadway and Route 09 Circulator

- The route will not provide direct access from the UMass Lowell East campus and South Campus to the downtown of Lowell.

Route 16 Chelmsford Center and Route 17 North Chelmsford

- The route change would greatly help those in North Chelmsford who go to the medical facilities in Village Square. Currently, the connection from the #17 North Chelmsford bus to the #16 Chelmsford Center bus at the Drum Hill Wal-Mart is not timed well.
- There are currently 6 to 8 morning riders who travel from #08 route in Lowell to the #17 bus into North Chelmsford. Currently this available with only one seat ride as the two bus routes are interlined.
- This proposal would require two transfers if traveling from any route to the north and east of the Kennedy Center.
- The proposal is to shorten the inbound route by serving state route 40 and not going north the Tyngsborough Road area. This area has seen a steady growth in ridership over the last few years and should remain served by the #17 bus route.

Route 20 Middlesex Street

Participants supported the proposal for the Route 20 to serve the area left without service due to the realignment of Route 17. The participants supported this route, provided that it would be replaced by the #19 Tyngsborough / Pheasant Lane Mall route, in the near future.

Route 19 Tyngsborough / Pheasant Lane Mall

Participants unanimously supported the proposal to operate the #19 Tyngsborough / Pheasant Lane Mall route six day per week on a year round basis. This route has a proven track record during the Thanksgiving through New Year's holiday season and is the most requested route that the LRTA receives from the public.

Other Comments and Suggestions from the Public Outreach Sessions and Public Hearing

- On-Time Performance - Several monthly pass-holders complained about the delays that many riders cause by paying with cash. They reported that some passengers intentionally crumple the dollar bills in order to get a free ride. They were very much supportive of a fare increase for cash customers in order to move those riders onto the Charlie Card system.
- Traveler Information at the Terminal – A customer complained that the announcements made at the Gallagher Terminal were difficult to hear. She was very happy to hear that with the installation of the AVL/GIS system in 2015, that passengers will be able to visually see the arrival and departures of all LRTA buses.
- Earlier Service on the Route 12 – One customer complained that he was unable to get to his employment on the earliest 6:45 Tewksbury bus and requested that inbound service begin at 5:30 am.



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