Pioneer Valley Transit Authority
COMPREHENSIVE SERVICE ANALYSIS

COMPREHENSIVE SERVICE ANALYSIS
FINAL REPORT

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PVTA

NELSON NYGAARD

ASG PLANNING

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EXECUTIVE SUMMARY

OVERVIEW

The Pioneer Valley Regional Transit Authority (PVTA) is the largest of 15 regional transit authorities in the Commonwealth of Massachusetts and is 4th largest transit agency in New England. The agency serves 24 member communities, operates 47 fixed-route bus routes, and has an operating budget of more than $39 million (FY2012). In FY2012, PVTA carried 11.1 million riders, a 2% increase over the previous year.

In order to better align existing services with customer demand, PVTA retained a consulting team of Nelson\Nygaard Consulting Associates and ASG Planning to prepare a Comprehensive Service Analysis (CSA). The objective of the CSA was to conduct a detailed review of existing transit services, identify strengths and weaknesses, and develop recommendations to improve service for existing riders and attract new riders. The effort was closely coordinated with Pioneer Valley Planning Commission (PVPC), one of PVTA's partners in designing and planning transit services for the region.

Specifically the goals of this study were to ensure that PVTA services:

- Continue to meet and support community needs
- Provide an attractive transportation option for as many people as possible
- Operate in a cost effective and efficient way

Completion of this effort brings PVTA into compliance with the requirements of the Massachusetts Transportation Finance Act of 2013 which directed each regional transit authority to develop a comprehensive regional transit plan. The plan involved consultation with the Massachusetts Department of Transportation (MassDOT), local employers, business associations, labor organizations and transit authority riders.

PRPOSED FRAMEWORK

The culmination of the Comprehensive Service Analysis process is a series of recommendations to improve the PVTA transit system, or the preferred scenario. The CSA was developed according to an analytical and input process that examined the demand for transit based on quantitative measures, existing ridership and community input. The recommendations were designed to strengthen the existing system, attract more riders and eliminate unproductive parts of the system. The overarching framework designed to guide this process was built around a series of strategies:

1. **Service should be as simple and easy to understand as possible.** As a result, an effort was made to design routes so they operate out and back along the same corridor, operate on 'clock faced' schedules, and follow repeating patterns. An effort was also made to limit route deviations and changes to the primary schedule.

2. **Service should stay on the main corridor as much as possible.** An effort was made to reduce deviations off of the main roads, except in cases where key destinations, such as shopping centers were located too far off the main road to be accessible, or lacked pedestrian facilities.
3. **Existing ridership is prioritized.** In cases where existing bus routes carry a large number of riders, or neighborhoods generate a large volume of riders on existing services, these bus routes and community services were not changed. In other words, where existing routes and services are effective, they were unchanged.
4. **Service should be matched with the demand.** The preferred network is designed so that the region's most densely developed corridors will receive the most frequent service for the longest time span. Corridors and communities with large employers or densely developed residential neighborhoods will also be served with higher frequency bus service. Areas with lower density development generally speaking were assigned fixed route bus service as appropriate but with lower frequency and/or shorter spans of service.
5. **Categorize routes into a hierarchy or 'family of services' to help guide and structure how services are matched with demand.** The proposed service hierarchy was further articulated with service standards for frequency and span as well as productivity expectations. These guidelines can help PVTA add (or reduce) service in the future as needed.
6. **Each of the PVTA hubs is connected to at least one other hub.** As discussed, the regional PVTA network is built around five transit hubs or centers (Springfield, Holyoke, Northampton, Amherst and Westfield). Connections between these hubs were strengthened or added, so that each hub has connections to at least one other hub (i.e., from Northampton, riders can get to either Amherst or Holyoke.
7. **Express routes should be clearly identified and marketed as special services.** In cases where PVTA offers special services, such as express routes, these services should be clearly articulated to the general public so that the entire market – including both existing riders and potential new riders understand their choices.

PREFERRED ALTERNATIVE

The analytical and community input led to a Preferred Alternative that is developed around a core set of services, or network 'backbone', and builds the rest of the network around the core network. The option also reduces redundancies in the network, provides a clear and simple strategy for service development, and strengthens crosstown connections. It recommends eliminating most service branches, straightening routes, and scheduling services according to consistent headways. By simplifying the service, the preferred alternative also creates a structure that should make it easier for PVTA to expand or contract services as budgets require.

In total, the Preferred Alternative would create a network of 50 routes, 44 fixed route services plus six community circulators (not including the existing local circulators, such as the Palmer Shuttle). The new routes are primarily feeder and neighborhood (Flex) services that would be designed to connect people from neighborhoods to transit hubs and the key corridor network. Detail on the proposed network is documented in a map that shows the proposed routes on weekdays (see Figures ES-1). The 50 routes are categorized according to:

- **Bus Rapid Transit/Tier I Routes –** Includes two bus rapid transit services (Route 7 State Street and Route 43 Amherst to Northampton); plus four Tier I transit routes (Route 1 A Five Town Plaza, Route 1B Chicopee Big Y, Route 2A East Longmeadow, Route 2B Mass DET). These routes will operate seven days a week, with service scheduled for 18 hours a day (roughly 6:00 a.m. to 10:00 p.m.) on weekdays. During peak periods, buses will be scheduled to run with 15 or

20-minute frequencies all day and 30 minutes in the evening. The main difference between the BRT and Tier I routes is the amount of infrastructure investment proposed for the corridor.

- **Tier II Routes –** The Preferred Scenario includes eight Tier II routes all but one of which begin/end at the SBT, including routes connecting Springfield and Holyoke via Chicopee. The non-SBT route is Route 48 that connects the Holyoke Transportation Center with downtown Northampton. All tier II routes operate on weekdays and Saturdays with most also operating on Sunday. Weekday service is scheduled to operate between 6:00 a.m. and 9:00 p.m., with 30 minute service during the day and 60 minute service during the evenings.
- **Urban Radial Routes –** Six routes are proposed as urban radials. All six routes begin or end at the SBT. These routes will operate on weekdays from 6:00 a.m. to 7:00 p.m. with 30 minute service during the peak period and 60 minute service during the midday and evening. All urban radial routes operate on Saturday and most also operate on Sundays.
- **Express Routes –** The Preferred Scenario includes seven express routes. These routes operate on weekdays only, except for the new proposed Route 29X (Amherst to Springfield via Holyoke), which would provide daily express service. Express routes provide a limited number of trips trips based on demand.
- **Village Connector Routes –** Operate between and within the smaller communities and village centers in the PVTA service area. There are six routes proposed as village connections, including two in downtown Northampton (Routes 44A and 44B). These routes are recommended for operation on weekdays and Saturdays. In addition, Route 44A would operate on Sundays. The recommended weekday span of service is from 7:00 a.m. to 6:00 p.m.
- **College Shuttle Routes –** Primarily serve the UMass campus but also include some service between downtown Westfield and Westfield State University. There are a total of eight college shuttles; most operate daily, with higher service levels provided on weekdays and operate between 8:00 a.m. and 10:00 p.m.
- **Five Colleges Routes –** There are two Five Colleges Routes, plus one express route, that are funded by the Five Colleges Consortium. These routes provide daily service and on weekdays operate between 7:00 a.m. and 9:00 p.m. with hourly service.
- **Community Circulators –** Flexible routes that provide connections within a community and to PVTA fixed route service. There are six community circulators proposed as part of the Preferred Scenario, including for Granby, East Longmeadow, Agawam, Wilbraham, Westfield and East Springfield. These routes would provide service between 8:00 a.m. and 6:00 p.m. and operate on weekdays only.

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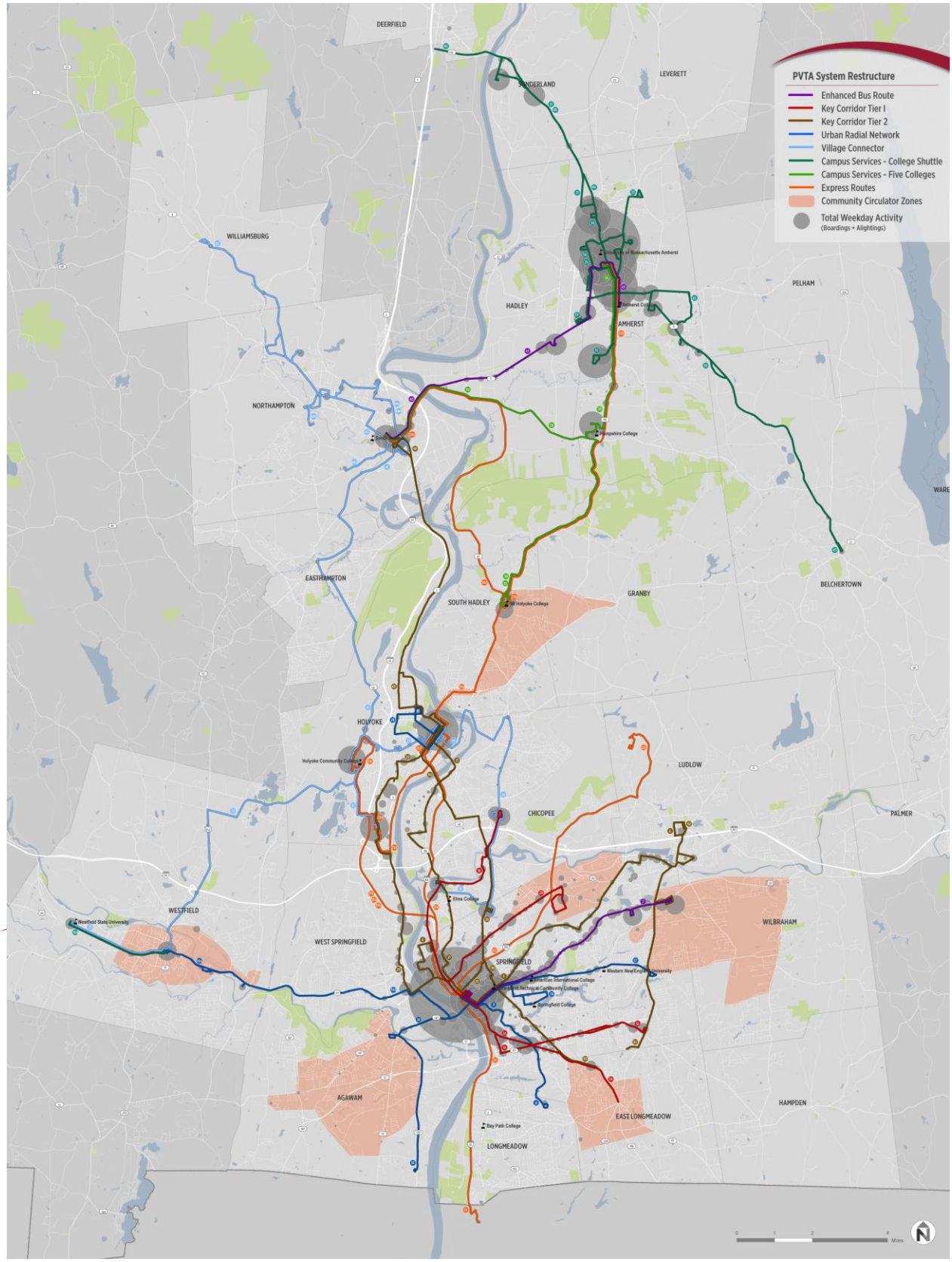
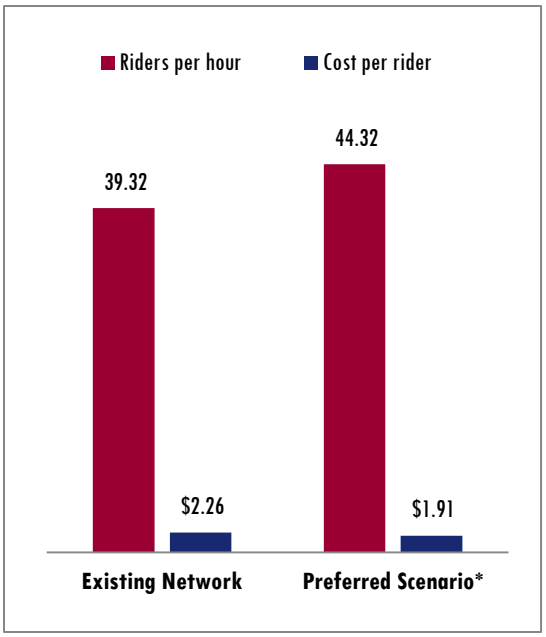
Figure ES-1 | Preferred Scenario



BENEFITS AND COSTS

Implementation of these CSA recommendations will have eight primary benefits in terms of service effectiveness and cost efficiency for PVTA and its customers. These benefits include:

1. Discontinuing unproductive and under-performing route segments and routes to increase overall service productivity.
2. Reinvesting saved resources into new services and more productive parts of the systems.
3. Simplifying the system to make PVTA routes and services easier to understand and use, and also easier for system operations.
4. Matching service types with the local market. In some cases this means increasing service levels and in others providing service that is more flexible and responsive to the local market.
5. Introducing crosstown services to support north-south travel; crosstown routes reduce the need to travel into downtown Springfield in order to travel north or south.
6. Increasing connections to and between PVTA transit hubs, and important regional destinations like the Holyoke Mall, the UMass campus and Westfield center.
7. Providing more local circulation in local communities, especially Holyoke but also Northampton and Amherst.
8. Positioning PVTA for service growth and helping the region meet the needs of new developments slated for downtown Springfield as well as growth in surrounding communities and new rail services.



The new route structure is anticipated to attract more riders to the PVTA system and increase ridership by between 10% and 15% due to the availability of faster more direct service in areas that have the highest levels of transit market demand. These improvements will increase the overall levels of service (such as measured by revenue vehicle hours (RVH)) operated by PVTA, but will do so in a more cost-efficient manner, with the overall number of passengers per hour increasing while the cost per rider decreases.

SERVICE COST ESTIMATES

The CSA was initially designed to work within PVTA's available budget in terms of both operating and capital costs. However, as additional operating funds become available, the Preferred Scenario as it is currently designed would increase service costs by an estimated 7%. In terms of operating hours, the Preferred Scenario calls for an estimated increase in operating hours from about 372,500 annual revenue hours to 398,300 annual revenue hours (also an increase of 7%).

The analysis is an estimate. Implementation will require more detailed scheduling of the routes, run-cutting and compliance with provisions of the collective bargaining agreement.

Capital Costs – Vehicles

Transit capital costs, include vehicle costs and maintenance as well as transit infrastructure. Similar to the example of operating costs, the CSA Preferred Alternative was largely intended to work within PVTA's existing fleet. The primary constraint is the number of vehicles needed to operate peak period service as this is the maximum amount of vehicles required at any one time. PVTA's current operations have a peak vehicle requirement of 100 (as of Summer 2013) and the proposed CSA has a peak vehicle requirement of 108, an increase of eight vehicles.

Full implementation of the CSA includes development of bus rapid transit service along some of the service area's strongest corridors, State Street and Route 9 between Northampton and Amherst. Implementation of these projects, however, would likely require the acquisition of new vehicles to reflect demand for higher capacity and a higher level of service overall.

Capital Costs – Infrastructure

The Preferred Alternative also assumes investment in PVTA's passenger infrastructure to realize full implementation of the concept for improvements in passenger amenities, especially at areas where passengers will wait to transfer between routes outside of the existing hubs. Locations where radial routes intersect with crosstown routes in downtown Springfield should be prioritized for the development of passenger amenities. In addition, it is also essential to support passenger transfers with a safe and accessible pedestrian environment (i.e. crosswalks, sidewalks and signalized crossings); these improvements are typically funded by individual municipalities as part of ongoing efforts to improve community livability and walkability.

1 INTRODUCTION

PURPOSE AND GOALS OF THE CSA

The Pioneer Valley Regional Transit Authority (PVTA) is the largest of 15 regional transit authorities in the Commonwealth of Massachusetts and is 4th largest transit agency in New England. The agency serves 24 member communities, operates 47 fixed-route bus routes, and has an operating budget of nearly $39 million (FY2012). In FY2012, PVTA carried 11.1 million riders, a 2% increase over the previous year[1].

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Specifically the goals of this study were to ensure that PVTA services:

- Continue to meet and support community needs
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Completion of this effort brings PVTA into compliance with the requirements of the Massachusetts Transportation Finance Act of 2013 which directed each regional transit authority to develop a comprehensive regional transit plan. The plan involved consultation with the Massachusetts Department of Transportation (MassDOT) local employers, business associations, labor organizations and transit authority riders.

Other specific requirements of this Act which have been met by PVTA include:

1. A comprehensive assessment of transit services;
2. A thorough examination of the ridership trends for each line and service provided by the regional transit authority;
3. A performance analysis of existing services;
4. The development and evaluation of alternative service scenarios;
5. The development of a recommendation to better align service with local and regional demand;
6. Compliance with the Commonwealth's environmental policies;
7. Compliance with the Commonwealth's Fare rates and collection methods;
8. Compliance with the Commonwealth's region's job creation goals and employment needs; and,

[1] PVTA 2013 Annual Report

9. A 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.

The CSA does not cover paratransit services. PVTA is performing a separate Paratransit Service Analysis to identify service improvements that provide better public transportation for existing paratransit customers and improve the operating efficiency of the PVTA Paratransit service. The Paratransit Study should be completed in 2014.

STUDY METHODOLOGY AND REPORT ORGANIZATION

The CSA study was performed in a little over a year's time and consisted of five major work tasks. The approach to performing each of these tasks, and the relevant findings and results, are described in subsequent chapters of this report and its appendices. An introductory overview of the PVTA organization and its existing services is also provided in Chapter 2.

The five primary CSA work tasks included:

- **A Market Analysis** that included a mapping and analyzing the underlying market for transit to determine the magnitude of demand based on existing population and employment densities, socio-economic and demographic characteristics, and other market forces. (See **Chapter 3.**)
- **Customer and Stakeholder Input**, which involved collecting ideas and suggestions from PVTA riders, members of the non-riding public, PVTA drivers and other stakeholders. PVTA, PVPC and the consultant team made considerable efforts to ensure the study was conducted in an open and inclusive manner, that provided numerous opportunities for these constituencies to learn about the project and provide comment. Outreach tasks included a survey with riders and non-riders, stakeholder meetings held at the beginning of the study, and a series of public meetings and rider drop-in sessions towards the end of the study. The public was also invited to make comments on a variety of projects, at any time via the project webpage. (See **Chapter 3.**)
- **Ridership and Performance Analysis of Existing Services,** including both an evaluation of the overall system as well as a detailed analysis of PVTA's individual routes. Both analyzes examined ridership trends and patterns, and helped the team assess relative route productivity. (See **Chapter 3.**)
- **Development and Analysis of Service Improvement Options** built around findings from the transit needs assessment and route evaluations described above, alternative service improvement strategies and route modifications were developed and shared with the public in the late Fall, 2013. These were also based on proposed service guidelines and performance standards, setting standards for frequency and span of service based on the specific markets served. (See **Chapter 5.**)
- **Development of Final Recommendations** setting forth a series of route improvement recommendations to better align service with local and regional demand, based largely on public and stakeholder input on proposed options and consideration of anticipated financial impact. (See **Chapter 6.**)

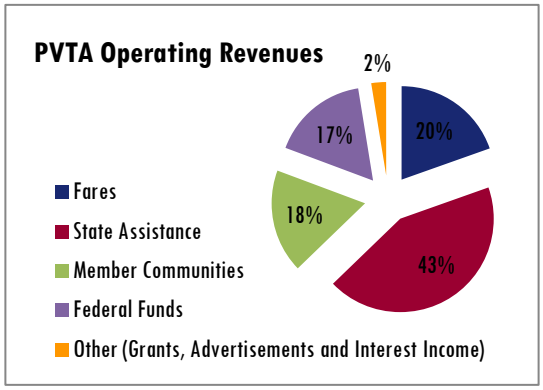
Consistency with Commonwealth environmental policy and regional goals for job creation and employment are addressed in Chapters 7. A review of fare structure and fare systems is provided in Chapter 4.

2 PIONEER VALLEY REGIONAL TRANSIT AUTHORITY (PVTA)

OVERVIEW OF PVTA

The Pioneer Valley Transit Authority (PVTA) serves 24 communities in western Massachusetts. The service area includes the cities of Springfield, Holyoke and Chicopee (see Figure 1), the college oriented communities of Amherst, Northampton and Westfield and rural communities such as Granby and Easthampton. The fixed route service area borders the Franklin Regional Transit Authority (FRTA) to the north and Connecticut Transit (CTTransit) to the south.

PVTA transports about 50,000 riders each weekday and had an annual ridership of over 11 million passengers in FY2013. PVTA operates a mix of services, including bus routes and community shuttles that operate on fixed routes and schedules, as well as flexible services and paratransit service for persons with disabilities and older adults. The Authority is governed by an Advisory Board made up of one representative from each community in the region. The Board appoints an Administrator who is responsible for management of PVTA staff and operations. An organizational chart is shown in Figure 2. PVTA also has an ADA and ridership committee that provides input to service design and operations.



PVTA's annual operating budget was approximately $27.8 million in FY2012[1], supporting driver wages, fuel, vehicle maintenance and agency administration. Capital expenditures vary each year, but are typically in the range of $5-$10 million for transit vehicles and infrastructure.

PVTA operating costs are funded through a variety of sources, including fares (20%), grants and formula funded by the Commonwealth of Massachusetts (43%), contributions from the Member communities (18%) and a variety of smaller sources, such as advertisement revenues, service contracts and interest income (see insert). Federal, state and local funds are also used to support capital projects, such as vehicles, but also passenger facilities such as Union Station. Federal participation in capital projects is typically higher and closer to 80% the Commonwealth typically contributes the remaining 20% of capital project costs.

PVTA also holds contracts with area educational institutions and other partner organizations. Colleges and universities are among the most important partners in PVTA's network; PVTA currently holds fare contracts with the Five Colleges Consortium (the University of Massachusetts, Hampshire College, Mt.

[1] *PVTA Annual Report, 2012*

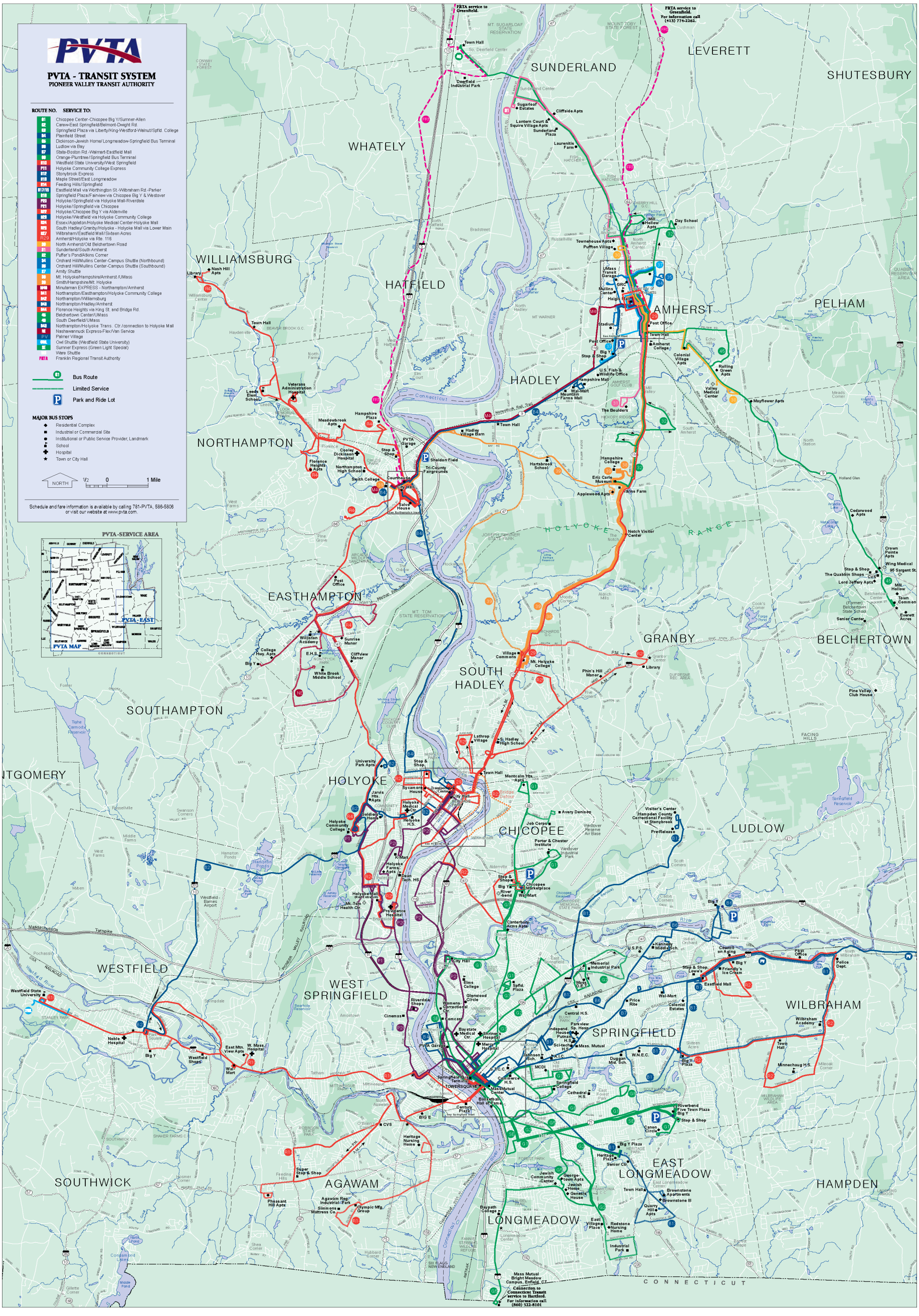
Holyoke College, Amherst College and Smith College), as well as Springfield Technical Community College (STCC), Westfield State University and Holyoke Community College (HCC). Colleges use these contracts to increase the amount of direct service provided to and from their campuses; the service, however, can be used by members of the general public traveling for any purpose. PVTA contracts with the local school districts in Holyoke and Springfield to operate "Helper" trips. The authority also contracts with the Hampden County Correctional Facility. In all cases, as mentioned, contract funds are used to augment the general public services and all routes and trips are open to all riders.

As a regional transit authority, PVTA provides service through a series of contracts with private transportation providers. Two operators – First Transit and the University of Massachusetts currently hold contacts for the fixed route service and a third operator – Hulmes Transportation – operates demand response services, including the Americans with Disabilities Act (ADA) complementary paratransit service as well as the Easthampton, Palmer and Ware shuttles. PVTA manages these contracts through a series of goals and performance measures, including:

- Monthly ridership
- Schedule Adherence / Percent of Scheduled Trips Operated
- Customer Satisfaction / Complaints
- Maintenance / Miles between Vehicle Breakdowns
- Customer Safety / Accidents per 100,000 Miles
- Cost per Passenger / State Contract Assistance per Passenger

Figure 2-1 | PVTA Service Area

Figure 2-2 | PVTA System Map

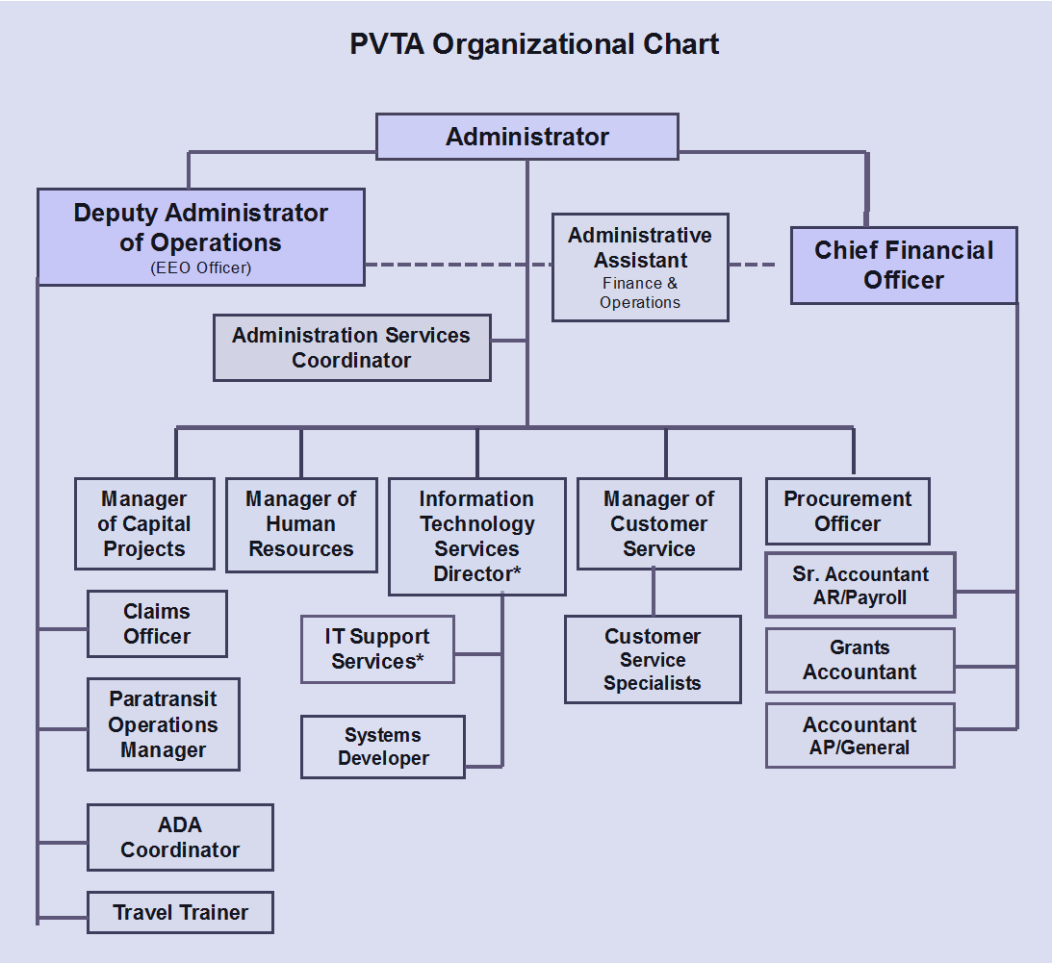


PVTA TRANSIT SERVICES

PVTA operates a total of 47 fixed-bus routes, scheduled to run on "fixed routes" at set times. A system map is shown in Figure 2-2. Most routes are operated using a fleet of mini, 30-foot, 35-foot and 40-foot standard transit buses, but the fleet also includes four larger, articulated vehicles. Buses are assigned to individual routes based on demand and operating conditions. Articulated buses, for example, are used on some of the highest ridership routes, while smaller buses are used on rural routes, local community circulators and in outlying areas where roadways are narrow. PVTA's existing garage on Main Street in Springfield cannot accommodate the articulated vehicles, so to date, they have not be used on Springfield routes. However, PVTA is moving forward with a new garage that will allow to PVTA to deploy articulated buses in the Springfield area.

Overall, PVTA's fixed-route services are organized as a multiple hub and spoke system, with routes feeding transit hubs in downtown Springfield (Springfield Bus Terminal) and Holyoke (Holyoke Transportation Center), as well as major transfer locations at UMass/Amherst, and in Northampton and Westfield. This hub and spoke design means, for the most part, if riders can get to one of the hubs, they are able to connect with the rest of the network.

Figure 2-3 | PVTA Organizational Chart



* Contracted support services.

Most urban routes in the Springfield area and the UMass shuttle routes generally operate at frequent headways, seven days a week, and many attract high levels of ridership. Outside of these two areas, most routes operate on a Monday through Saturday or Monday through Friday schedule with significantly lower frequencies. The network also includes several express routes, most of which are operated as occasional express trips that are incorporated into the regular schedule (e.g. Routes 1, 20 and 21); there are also a handful of routes that run express for all trips (e.g. Routes 12, 39E and 40).

Community Shuttles

In addition to the traditional fixed-route bus service, PVTA operates a series of community shuttles, including the Nashawannuck Express (NE), Palmer Shuttle (PS) and Ware Shuttle (WS). These shuttles operate entirely within a community and are used to provide local circulation. They typically run with one vehicle, provide weekday service and are used, in part, to supplement ADA services. Only the NE service operates on Saturday. Passengers can board the services at designated locations and timepoints in each town. Passengers may also "flag down" these vehicles in between stops, or ask the driver to make a special route deviation once on board to bring them to their final designation – as long as it is within the community.

Complementary ADA Paratransit Services

Complementary paratransit service is provided "on-demand" for individuals in accordance with the Americans with Disabilities Act (ADA) of 1990. This 'complementary' paratransit services is intended for individuals who are not able to access or use fixed route services, due to a disability. By law, ADA Complementary Paratransit service is provided to and from any destination within three quarters of a PVTA fixed-route and be available the same days and timeframes for which fixed-route service is available. PVTA, however, currently extends complementary paratransit service to anyone traveling in a community with fixed route service; this goes well beyond the minimum requires established by ADA. Trips must be scheduled at least a day in advance, and service is limited to pre-registered riders who have passed an eligibility screening.

TRANSIT HUBS AND MAJOR TRANSFER LOCATIONS

As discussed, PVTA's services are organized as a hub and spoke with multiple hubs and connecting spokes. The five transit hubs are Springfield (Springfield Bus Terminal), Holyoke (Holyoke Transportation Center), Northampton (downtown Northampton), Amherst (UMass campus) and Westfield (downtown Westfield). Springfield is the largest city in the region and also its busiest PVTA hub.

- **Springfield Bus Terminal.** Located at the intersection of Liberty and Main street, the facility provides 16 off-street bus bays, inside waiting area, public restrooms and food concessions. Additional bus stops are on-street outside the terminal and on Main Street. The terminal is also served by Peter Pan and Greyhound intercity bus services, and a local shuttle operated by the Springfield Technical Community College (STCC).

  The current Springfield Bus Terminal will soon be replaced by a new facility at Springfield Union Station, allowing for direct intermodal transfers with Amtrak and the New Haven – Springfield commuter rail service starting in 2016.

- **Holyoke Multimodal Transportation Center.** Located on Maple Street in downtown Holyoke this facility provides seven bus berths, indoor waiting space, public restrooms, a PVTA ticketing counter and a break room for PVTA drivers. Twenty public parking spaces are available and intercity bus connections (Peter Pan) can be made at this location.
- **UMass/Amherst.** Services are concentrated along North Pleasant Street and Massachusetts Avenue, effectively making these two roadways into relatively high frequency transit corridors where PVTA passengers can transfer at outdoor bus shelters. Five routes also serve Haigis Mall, effectively creating a mini-hub in the heart of campus.
- **Northampton.** PVTA buses stop at a central location along Main Street near the Academy of Music and City Hall. This creates a major transfer point where passengers may connect with other PVTA services, as well as Franklin Regional Transit Authority (FRTA) services; there is a Peter Pan Bus Terminal within walking distance on South Street.
- **Westfield.** Two PVTA routes (Routes 10 and 23) meet in downtown Westfield at Park Square, effectively creating a mini-hub with regional connections to Springfield via West Springfield, and to Holyoke via Holyoke Community College.

CONNECTIONS TO OTHER TRANSPORTATION

PVTA routes connect to a number of other bus and rail services in the Pioneer Valley:

- **Franklin Regional Transit Authority (FRTA)**. This neighboring regional transit authority operates two routes in the PVTA area, both providing connections to the FRTA hub in Greenfield. One FRTA route connects to the Amherst area at UMass' Haigis Mall, and the other terminates at PVTA's transfer hub at the Academy of Music in downtown Northampton.
- **CT Transit.** One PVTA route (G5) extends outside the formal PVTA area to Enfield, CT, serving a large MassMutual employment center and connecting with CT Transit's Enfield Express, which operates express to downtown Hartford.
- **Peter Pan Bus Lines**. Intercity bus connections may be made at four PVTA hubs: the Springfield Bus Terminal, Holyoke Transportation Center, Holyoke Mall, Amherst and Northampton. The carrier also makes stops in Chicopee, Deerfield and South Hadley. Connections can be made to Boston, Bradley International Airport in Connecticut, and New York destinations.
- **Megabus.** A second private intercity bus carrier provides service from the Hampshire Mall in Amherst to destinations in Hartford CT, Burlington VT and New York City.
- **Amtrak.** Three intercity rail routes serve Springfield's Union Station: 1) Northeast Regional service (Springfield to New York City via Hartford and New Haven, CT); 2) the Vermonter (New York City to St. Alban's, VT); and 3) the Lake Shore Limited service (Chicago to Albany with service to either New York City or Boston (via Springfield).

SERVICE INFORMATION

PVTA information is available on the agency's website (www.pvta.com). A system map and individual route schedules are also available on this site. The schedules have a somewhat

untraditional format whereby route information is laid out from start to end to start. However, PVTA is preparing to redesign its schedules, which should be available later in 2014 or 2015.

Most on-street PVTA stops are marked with a bus stop sign. The signs are generic and do not include information about the route(s) serving the stop or the time the stop is served. Since the initiation of this study, PVTA has also developed new bus stop signs that include stop identification numbers and bus route information. These will also be deployed later in 2014 and 20145.

PVTA also hosts a link to Google Transit trip planning services on its website. PVTA has released real time information for development of mobile phone applications (apps).

3 TRANSIT NEEDS ASSESSMENT

A major objective of the CSA was to understand the strengths and weaknesses of PVTA's existing transit network and identify opportunities for improvement. The Nelson\Nygaard team identified system strengths and weaknesses by conducting a transit needs assessment. This needs assessment included a variety of data sources and incorporated several different perspectives and viewpoints. The primary tools used in this assessment were:

- **Market Analysis -** an assessment of the market and demand for general travel, and for transit services in particular. This analysis was based on a detailed review of population and employment distribution, densities and growth rates, as well as economic development and travel patterns.
- **Public and Stakeholder Input** - a multi-faceted and inclusive process that included a survey of riders and non-riders and interviews with drivers, business leaders and other stakeholders to document opinions, priorities and suggested enhancements relative to PVTA services.
- **System & Route Evaluations** - a detailed examination of PVTA's individual routes to understand how riders are currently using the system, and how well each route is performing relative to the overall system.

Summary findings for each of these individual pieces of the needs assessment are presented below followed by a summary of the overall findings, including the critical themes that influence future transit service improvements.

MARKET ANALYSIS

Communities and regions, like the PVTA service area, are dynamic, reflecting every day changes that occur in communities around the country as people move to an area, while others leave. Industries close down, new ones open and others remain in place. As part of understanding and documenting these changes, Nelson\Nygaard prepared a Transit Market Analysis as one resource to understanding the size and spatial distribution of population, employment as well as the size and distribution of population groups with specific demographic characteristics that tend to be associated with increased transit ridership. The analysis also documented population and employment density, because, more than just about any other community characteristic, population and employment density influences the demand for public transportation services. Findings from the market analysis are presented in the following section; a full copy of the technical report is included as Appendix A.

PVTA's service area covers a large area geographically with widely varying development densities; the need for amount and types of transit services likewise varies throughout the service area. Population is largely concentrated in and around the City of Springfield, and along the I-91/Connecticut River corridor running north through Chicopee to Holyoke (see Figure 3-1). This is the core of the PVTA market area, with the clustering of jobs and population able to support higher levels of transit service. There are also moderate population clusters in the suburbs west and south of Springfield, including West Springfield, Westfield, Agawam, Longmeadow and East Longmeadow. The outlying towns of Amherst, Northampton

and Easthampton have strong village centers or large student populations which are also able to support higher levels of transit, despite being somewhat isolated from more populous areas.

Employment shows a similar pattern, although it is even more concentrated in and around Springfield, with smaller, yet dense, clusters of employment activity in Holyoke, Northampton, and at UMass Amherst (see Figure 3-2). The location of the region's major employers (see Figure 3-3) generally follows the distribution of employment, with most major employers located in Springfield or in the Five Colleges areas. Most major employers, especially those located in Springfield or the Five Colleges are served by PVTA. Exceptions include Hasbro Games in East Longmeadow, Wing Memorial Hospital in Palmer, C&S Wholesale Grocers in Hatfield, and the Department of Mental Retardation on the Palmer/Monson border.

Figure 3-1 | Population Density In PVTA Service Area

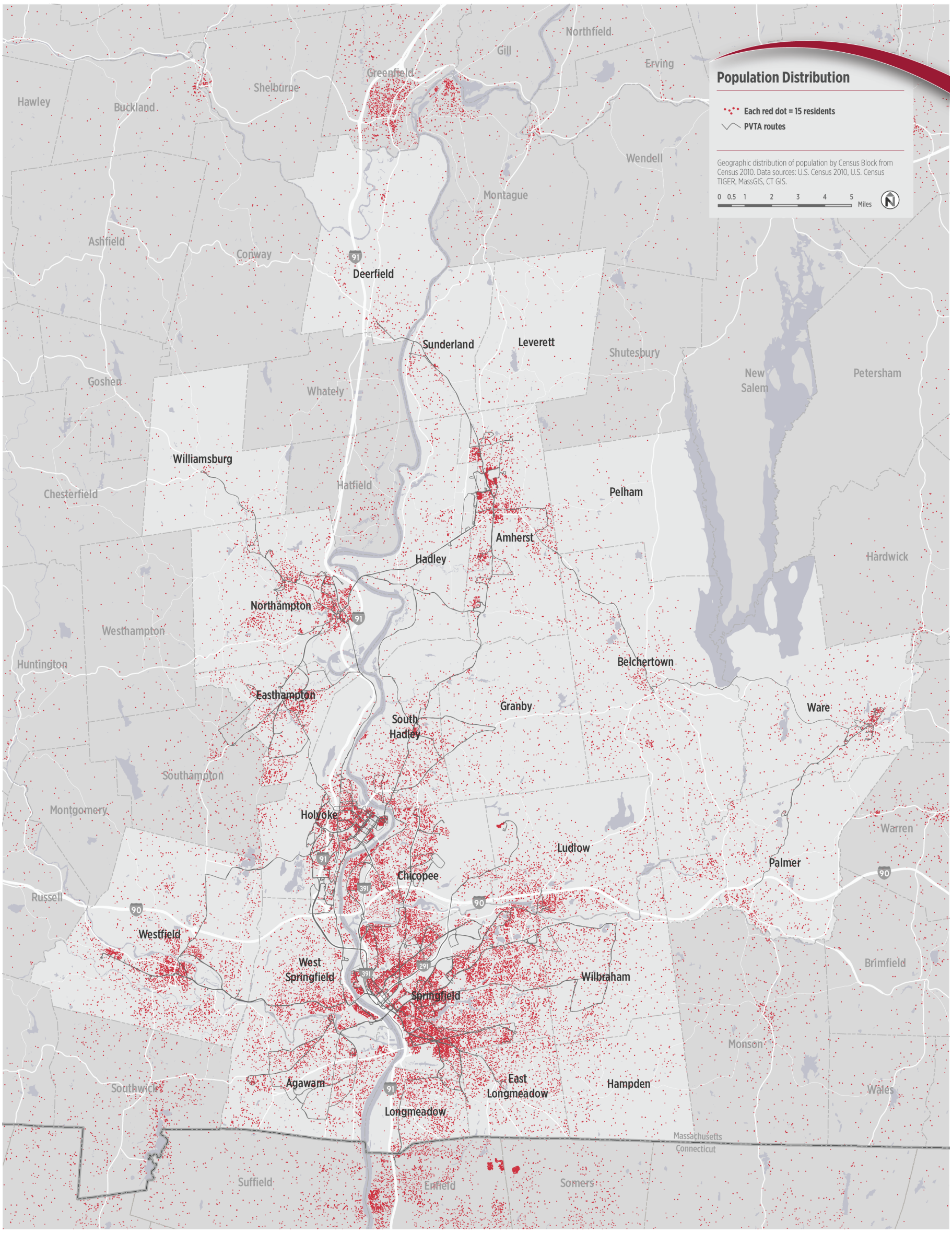


Figure 3-2 | Employment Density in PVTA Service Area

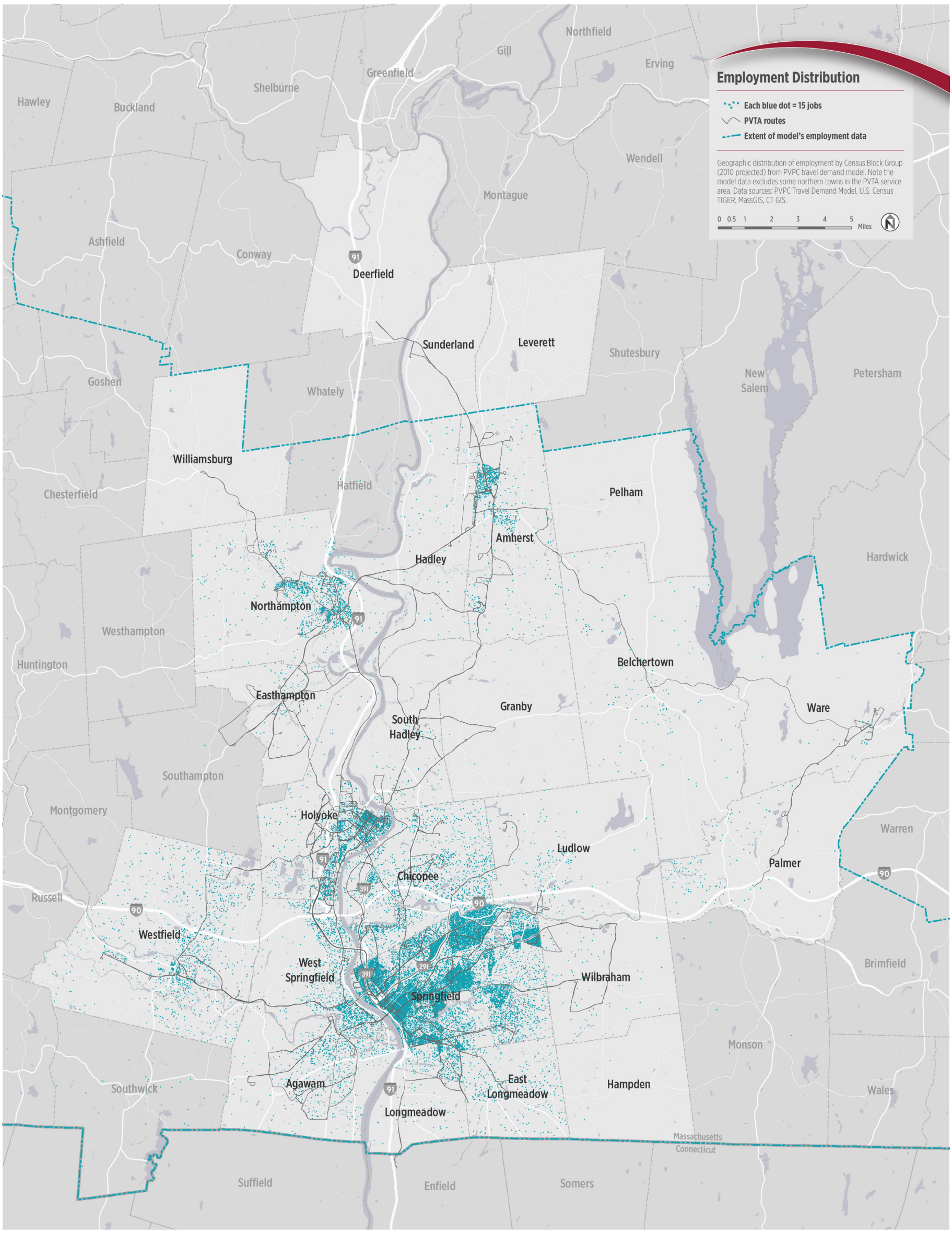
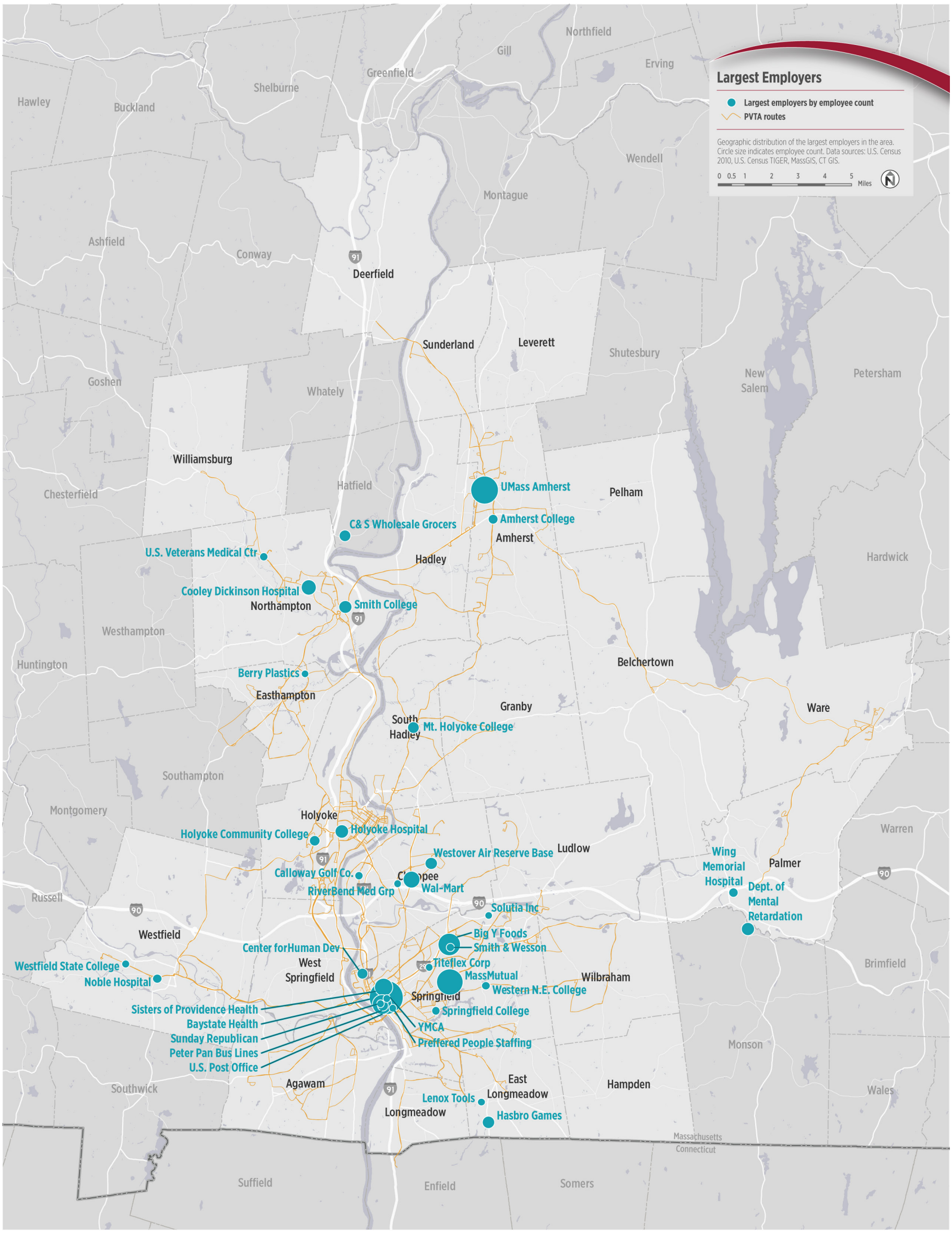


Figure 3-3 | Major Employers in PVTA Service Area



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COMPOSITE TRANSIT INDEX

To understand the overall impact of key demographic and socio-economic indicators on local transit demand, Nelson\Nygaard created and mapped a composite transit demand index (see Figure 3-4). This index reflects several of the most important determinants of transit demand including:

- ➔ ***Population and employment density,*** which are the strongest indicators of transit demand as larger numbers of people living and working in close proximity creates a strong market.
- ➔ ***Socio-economic characteristics***, such as income, auto availability, and age, which generally speaking tend to correlate with a higher use of transit.
- ➔ ***The location of major activity centers***, which indicates where people desire to travel.

While actual ridership demand is affected by a broader set of factors (e.g. land use, service quality, other travel choices, etc.), the composite transit index identifies the strongest markets for transit as well as an indication of the relative demand for transit throughout the PVTA market area. The transit index also identifies areas where, quantitatively, transit should be cost effective. Summary findings from this analysis include:

- Springfield is by far the most transit-supportive area in the PVTA service area. Most of the city has sufficient population and employment density to support a very high level of transit service, potentially as high as every 5 minutes during peak periods.
- Densities are particularly consistent to the north of Springfield along the Connecticut River/I-91 corridor to Chicopee and Holyoke, with several corridors between Holyoke and Springfield able to support frequent transit service today.
- West Springfield and Westfield also are strong markets for transit, but densities are less consistent and harder to effectively serve as routes travel west of Springfield.
- Despite being surrounded by more rural geography, Northampton, and Amherst have strong village centers and large student populations, providing relatively strong demand for transit. But routes that link these towns to other parts of PVTA network must travel through area with significantly lower demand.
- Isolated communities with lower levels of transit demand are more difficult to effectively integrate into the PVTA system, since they are separated from the core market by longer distances with minimal transit demand. Yet, certain villages such as Easthampton and/or South Hadley might be candidates for improved local community service.
- Some towns have a low demand for transit and likely can only support demand response service (i.e. Hampden, Wilbraham, Palmer, Belchertown, Pelham, Leverett, Sunderland, Deerfield, and Williamsburg). Flexible or demand response services may be considered in these communities, especially those with higher numbers of older adults, such as Ludlow, Wilbraham, and Westfield.

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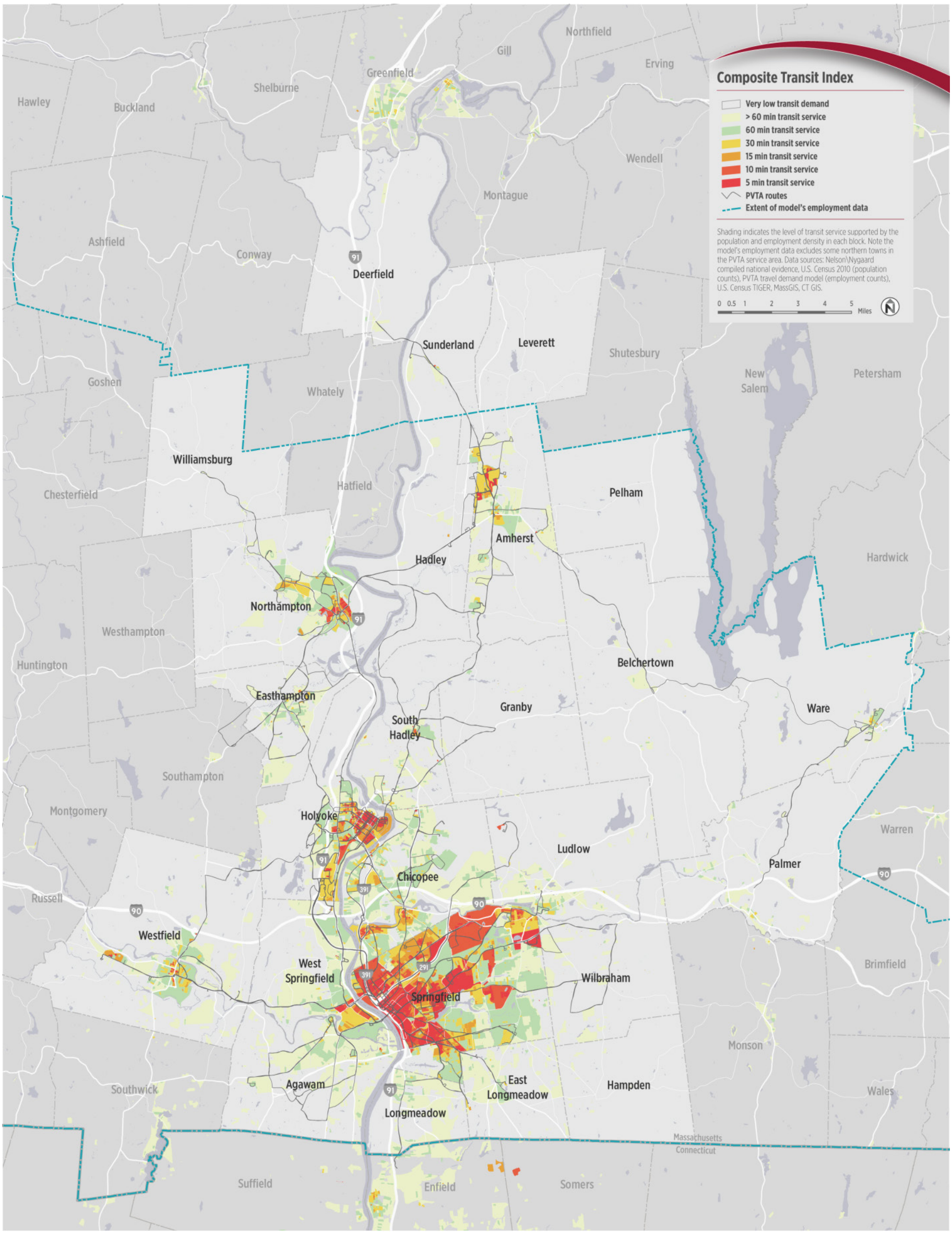
Figure 3-4 | Composite Transit Index



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OTHER MARKET CONSIDERATIONS

A number of regional development activities are underway or under consideration in the Springfield area, and should be considered for their potential future impact on transit services. These include:

- **New Haven – Springfield Commuter Rail Service:** The introduction of daily commuter rail service between Springfield and regional destinations in Connecticut will begin in 2016. PVTA is moving its downtown Springfield bus hub to Union Station to help facilitate intermodal rail-bus connections.
- **Amtrak's Knowledge Corridor – Restore Vermonter Project**: Amtrak is working to reroute the Vermonter rail service north of Springfield, which will restore intercity rail service to Holyoke and Northampton in early 2015. Both the Holyoke and Northampton rail stations are located several blocks from the current PVTA hub locations, but are served by existing PVTA routes. In addition, train service will not be diverted to the Town of Amherst, strengthening the future demand for travel between Amherst and train stations in Holyoke and Northampton.
- **Casino Development:** The Massachusetts Gaming Commission is in the final stages of considering a potential casino license to MGM Resorts International for a $800 million casino project in the South End of Springfield. As proposed, this large 14.5 acre development would have significant impacts on the transportation system, with employees and visitors needing to access the site.
- **Ongoing Growth at UMass/Amherst:** UMass/Amherst continues to increase enrollment and campus activities are no longer focused on the fall and spring semesters, but occurring on a year round basis. In addition, UMass is opening a campus is downtown Springfield, strengthening existing demand for travel between Amherst and Springfield.

PUBLIC AND STAKEHOLDER INPUT

One of the primary objectives of the CSA was to identify improvements which would make the PVTA system more convenient and attractive for both existing and new riders. PVTA periodically holds "Rider Forums" and performs other customer surveys to better understand customer needs. Findings from these past surveys were reviewed, and a number of new methods were used to gain additional public input on the development of potential service improvements. The results, as summarized below, provided the study team with a better understanding of local perceptions of PVTA services and potential opportunities for enhancement.

Stakeholder Interviews

As part of the CSA, the Nelson\Nygaard team held two stakeholder meetings at the beginning of the project (Springfield and Amherst). These meetings were primarily attended by invited guests, although some members of the public also attended. Nelson\Nygaard also met with each of the three PVTA garages (SATCo, VATCo and UMass) to discuss the project with PVTA bus drivers and transportation supervisors. Interviewees were asked to discuss their overall perceptions of PVTA and its transit services and major concerns with the existing services; they were also asked to articulate specific outcomes they hoped would be accomplished by the CSA. In addition, drivers

were asked their opinions on what works well for passengers today, as well as their ideas to make the system better.

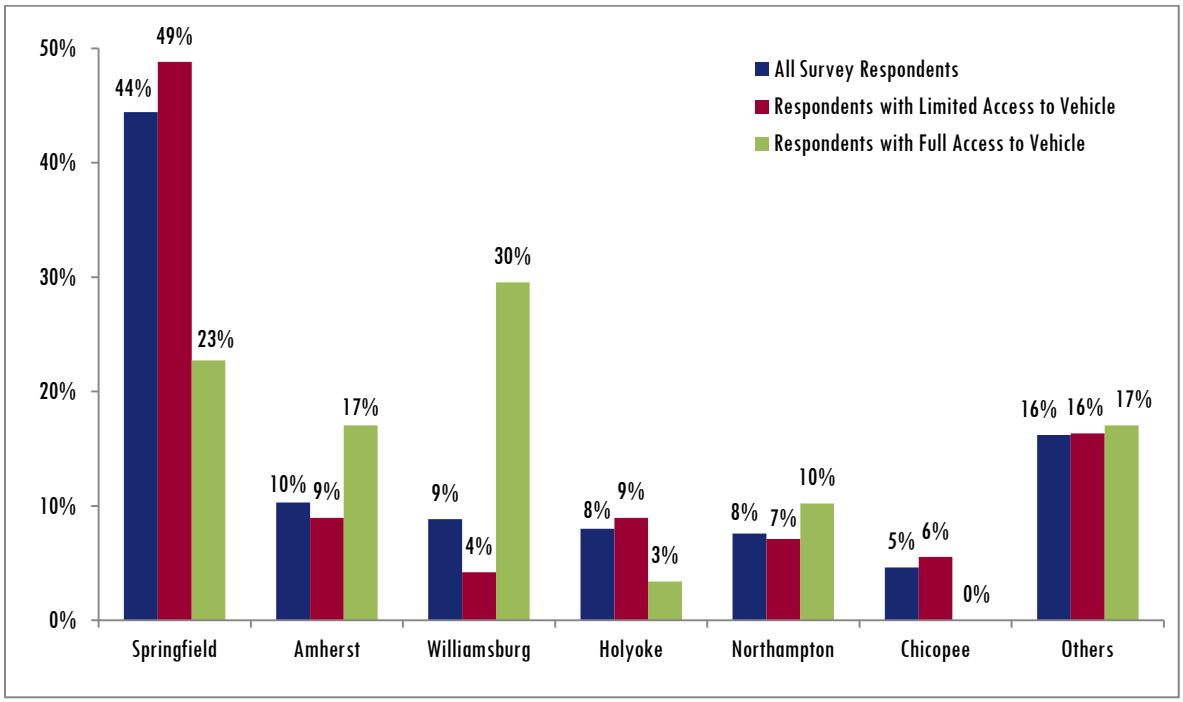
Survey of PVTA Riders and Other Local Residents

A survey of riders and other residents of the PVTA service area was administered in the spring of 2013. An online survey was posted on the PVTA website and paper surveys were distributed at bus hubs in Springfield and Holyoke; paper surveys were also distributed to senior centers in the study area. The online survey was available in Spanish and English and paper copies were available in English, Spanish and Vietnamese. A total of 609 people responded, and about 30% of these were students.

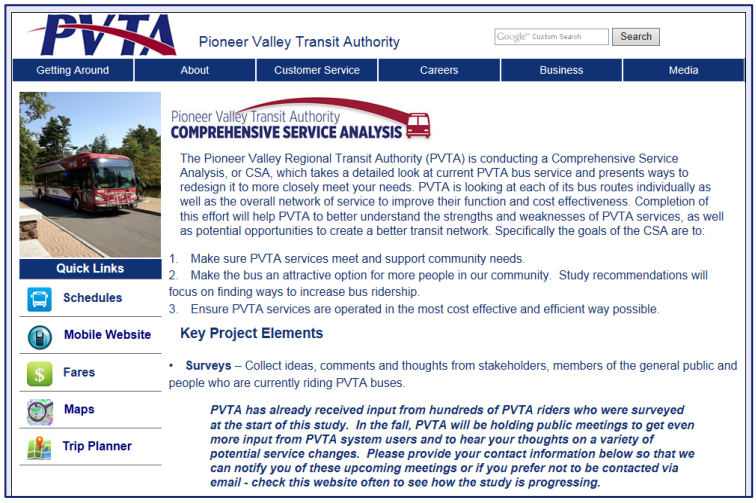
The survey collected data on travel patterns and how people get information about the PVTA system. Respondents were also asked to choose the type of improvements they believe would be most important (e.g. more frequent service to fewer destinations, or less frequent service to more destinations). Key findings include:

- The majority of the survey respondents reported being regular riders. About 70% of respondents do not always have access to a private vehicle. Figure 3-5 shows that these "transit dependent" individuals are mainly clustered in Springfield, but also found throughout the service area.
- Most PVTA riders reported having a good understanding of how to use PVTA services, and most get information about the system through traditional sources, such as printed maps and schedules. Students were the most likely to use web-based information.
  - In terms of service improvements, respondents identified fast and direct service as the most important, followed closely by improved service frequency. More bus stops and early morning service were ranked the lowest among the variables analyzed.
  - Transit dependent riders ranked increased service frequency slightly higher than faster and direct service. More bus service on weekend days was also a high priority.
  - Students ranked increased bus frequency as the highest priority, followed by fast and direct service. Students also prioritized more weekend day service.
  - Student priorities were consistent with transit dependent riders.
- Among survey respondents, the largest set of origin and destination pairs include:
  - Travel within Springfield
  - Travel within Holyoke
  - Travel between Springfield and Chicopee
  - Travel between Springfield and West Springfield

Figure 3-5 | Place of Residence by Level of Transit Dependent/Choice Riders



Project Website



Another successful outreach tool was the CSA project page hosted on the PVTA website. Riders and interested public used the website to stay informed about study progress, to share information on public meetings, and to provide a forum for public comments.

This site was particularly effective to help share alternative service improvement scenarios with the public. It provided access to the proposed improvement scenarios and allowed users to post comments and see the comments made by others. More than 200 comments were received, providing valuable input into the development of final recommendations.

Public Meetings and Drop-in Sessions

In December 2013, four public information meetings were held to share ideas for improving PVTA service and to gain input from riders and the general public. These meetings included a formal presentation of potential service improvement options being considered by the PVTA

study team, and the opportunity for attendees to discuss their ideas and concerns about particular routes. Meetings were held in Springfield, Holyoke, Northampton and Amherst; more than 75 individuals attended.

These meetings were supplemented with rider drop-in sessions at the Springfield Bus Terminal and the Holyoke Transportation Center. These were informal sessions with study team representatives who were able to describe potential changes, share maps, and answer questions. A drop-in session was also held at the Springfield garage to get input on the proposed scenarios from PVTA drivers. Finally, a presentation was made to PVTA's Springfield garage scheduling committee. This provided the study team with detailed feedback on the feasibility and potential of specific changes proposed.

Sixteen formal public meetings will be held around the service area during the Spring of 2014 to get final public input on specific route changes.

PVTA Advisory Board

The Nelson\Nygaard team also made presentations to the PVTA Advisory Board as well as the Route Committee. These presentations were used to keep the Advisory Committee informed about the project, key findings and plans to communicate with the public. The Route Committee took a more detailed look at the proposed service changes than was possible during a presentation to the overall Advisory Board.

SERVICE EVALUATION

A key part of the CSA involved evaluating PVTA's services, both from an overall systemwide perspective as well as at a route level. The systemwide evaluation included analysis of key transit productivity measures that are widely used in the transit industry as measures of productivity:

- **Cost Efficiency**: or how efficiently resources are being allocated. The industry standard for evaluating fixed route services is Cost per Revenue Hour of Service, which reflects the ratio of service inputs (e.g. operating costs) to service outputs (e.g. revenue hours or miles of service).
- **Cost Effectiveness:** or how well services are being utilized. Two indicators are commonly used: Cost per Passenger, or the ratio of operating costs to ridership, and Farebox Recovery, or the percentage of operating expenses recouped by farebox revenues.
- **Service Effectiveness:** or how well service capacity is being utilized by consumers. The most common indicator is Passengers per Revenue Vehicle Hour. However, for longer distance routes or express services that have little passenger turnover, Passengers per Trip is a more appropriate indicator. Both calculate the ratio of ridership to service outputs.

Overall system performance for 2012 was assessed by reviewing the average operating and revenue statistics (see Figure 3-6). This data shows that the average cost of each rider on PVTA was $2.05 and on average, the system carried 30 passengers per trip, or about 33 per hour.

Figure 3-6 | Average Weekday Systemwide Performance (2012)

Service Input/Outputs[1]	2012
Avg. Weekday Operating Expenses	$75,808
Avg. Weekday Revenue Vehicle Hours	1,290
Avg. Weekday Ridership	50,639
Avg. Weekday Farebox Revenue	$16,205
Performance Indicators[1]	**2012**
Cost Efficiency	
Avg. Cost per Revenue Hour of Service	$58.76
Cost Effectiveness	
Avg. Cost per Passenger	$2.05
Farebox Recovery Ratio	21.4%
Service Effectiveness	
Passengers per Vehicle Revenue Hour	33
Passengers per Trip	30

Source: PVTA adapted by Nelson\Nygaard

1. Systemwide averages do not include: Routes 00, 51, NE, OWL, PV, WS, Flex/Van or ADA/Paratransit services.
2. Farebox recovery does not reflect fare revenues paid directly by colleges to PVTA.
3. Costs reflect only the marginal cost of operating individual routes, and do not include overhead and administrative costs.

In addition to the systemwide analysis, the CSA team prepared a detailed evaluation of each fixed route in the PVTA system; this evaluation considered ridership by stop, ridership by trip, as well as productivity and performance statistics shown in the systemwide evaluation. These route evaluations allowed the team to understand – at a very detailed level – the location and time of day when ridership was highest and conversely locations and times where ridership is lowest. The Nelson\Nygaard team discussed each route evaluation with PVTA staff and reviewed the findings together. The route evaluations were a key source for identifying

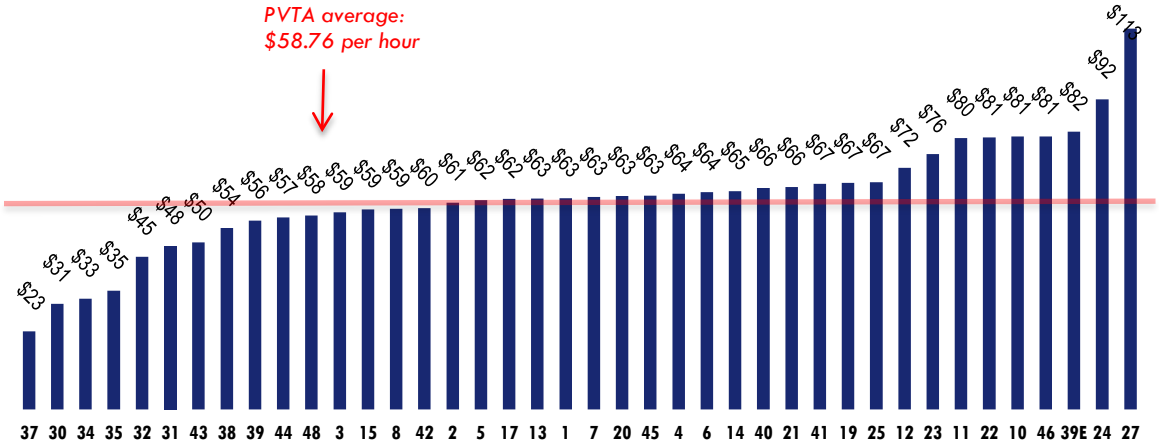
potential service improvements; the route evaluations were also posted on the project website for public review and comment.

Individual route evaluations are not included in the final report due to the volume of text and graphics created. Instead, this report includes performance metrics for the system overall and at an individual route level. The route level metrics are useful in helping to understand and interpret route strengths and weaknesses and were also a key input to the development of service standards and guidelines (see Appendix B).

Cost Efficiency

PVTA's average systemwide Cost per Revenue Hour was $58.76 in 2012.[1] When examined on a route by route basis (see Figure 3-7), the Cost per Revenue Hour ranges from less than $40 an hour for four campus shuttles, to more than $80 hour for certain rural village connector services and some express routes. Differences in cost per hour reflect the fact that the UMass Transit drivers are students, which helps to lower the cost of service. Higher costs on rural and express routes are, to a certain extent, expected due to longer travel distances.

Figure 3-7 | Cost Per Revenue Hour by Route (2012)



Cost Effectiveness

The overall systemwide Cost per Passenger for PVTA fixed routes was $2.05 in 2012, but individual routes had cost ranging from $0.39 to $6.83 per passenger (see Figure 3-8). Campus shuttles, which travel relatively short distances but that carry high passenger loads across the day, tend to have the lowest costs per rider. The highest performing route is Route 30 North Amherst/Belchertown Road, which provides campus circulator service in Amherst. Urban routes serving high ridership corridors in downtown Springfield (e.g. Routes 2, 3, 4 and 7) also perform well with Costs per Passenger of less than $1.00.

Longer distance routes and rural village connectors tend to be lower performing, such as Route 39E Smith/Mount Holyoke Express or Route 27 Wilbraham/Eastfield, which have little passenger activity in between terminals. Route 20 which connects Springfield and Holyoke is more cost effective than the system average, with a cost per passenger of $0.85. Longer distance routes tend

[1] *This overall systemwide average reflects only the direct cost of transit services. If agency administration and overhead are included, PVTA's average cost per revenue hour for 2012 was $84.43 (as reported to the National Transit Database).*

to have less passenger turnover and perform less well, but this corridor is densely populated along most of its length and generates high ridership.

PVTA's farebox recovery rate in 2012 was 21% overall, meaning fares account for about 21% of operating costs. This number does not accurately reflect all service related revenues, as individuals with identification from any of the Five Colleges ride for free, with the colleges partially reimbursing PVTA for these rides. If campus shuttle routes are not considered, the overall farebox recovery ratio would be about 28%. A general rule of thumb for an urban bus transit system is to maintain a recovery rate of approximately 20-25%.

Figure 3-8 | Cost Per Passenger by Route (2012)

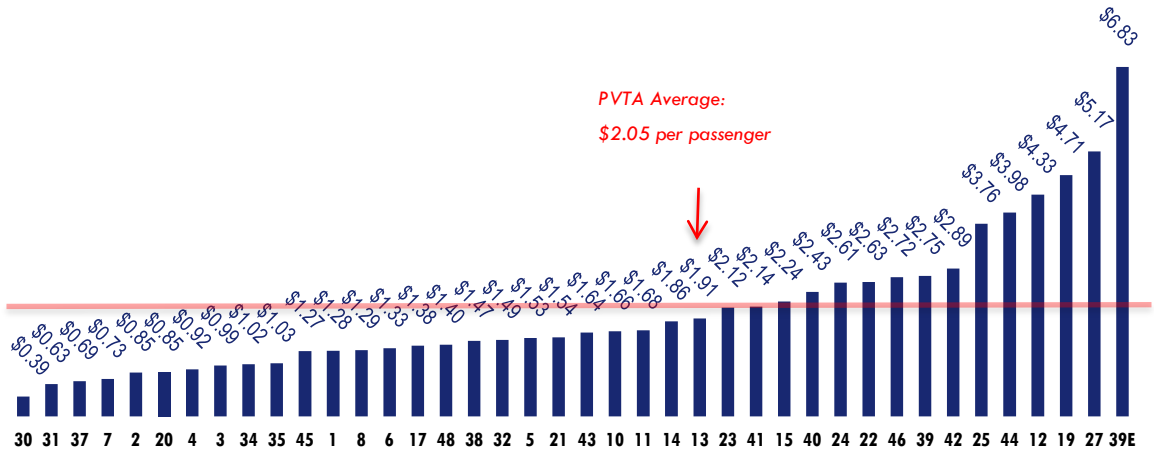
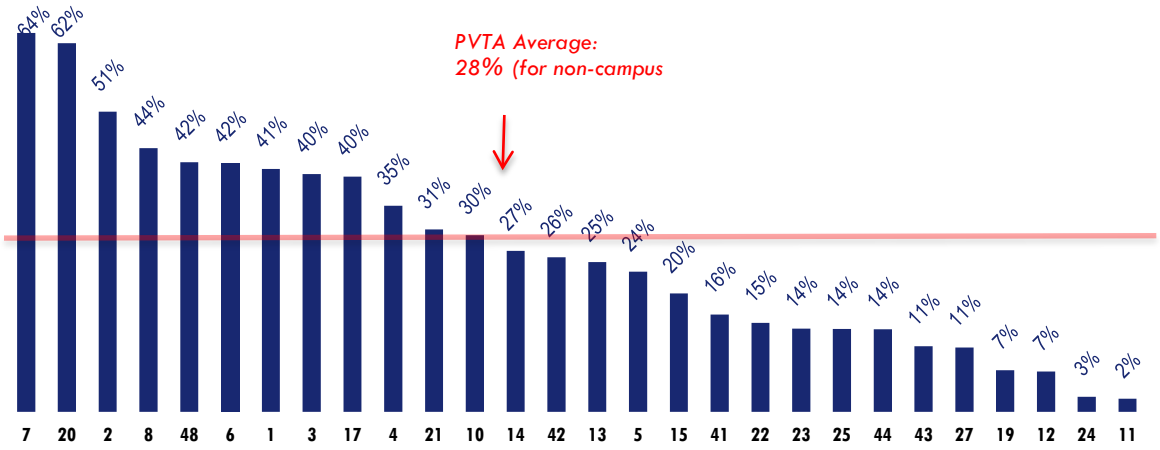


Figure 3-9 shows farebox recovery ratios for routes that are not campus related. Routes collecting the greatest percentage of operating costs from farebox receipts tend to be those operating in densely developed, high ridership corridors serving downtown Springfield such as Routes 7, 20 and 2. These routes have farebox recover ratios exceeding 50%. Village connectors and express routes tend to have lower farebox recovery rates, which again can be attributed to longer distances, higher operating costs and minimal passenger turnover.

Figure 3-9 | Farebox Recovery Ratios by Route (2012 – Non Campus Services)

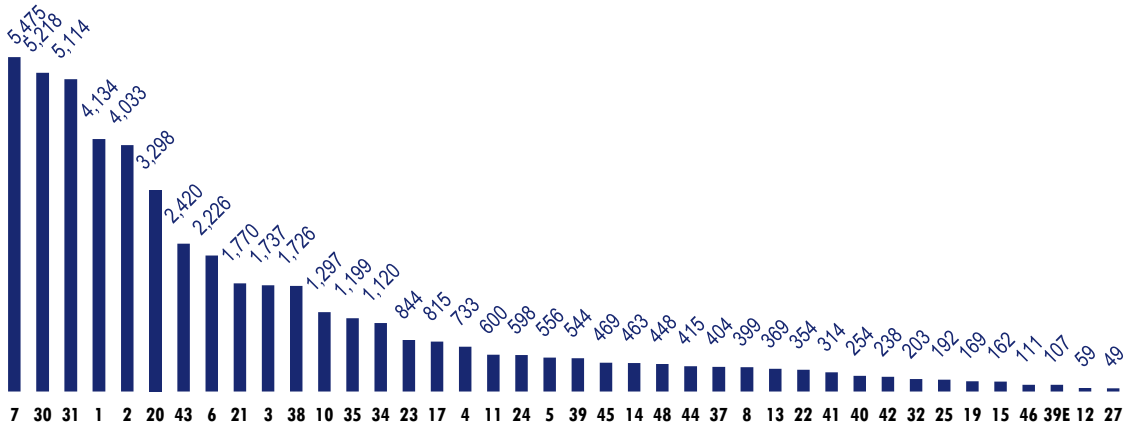


Note: College services were not shown above, as student fares are paid directly by the colleges to PVTA and do not show up in the farebox.

Service Evaluation

Ridership is one of the key indicators of an effective bus service and Average Daily Ridership by route is shown in Figure 3-10. PVTA operates three routes that carry over 5,000 passengers per day. These include three urban routes serving key corridors in downtown Springfield – Routes 1, 2 and 7, and the two primary UMass shuttles – Routes 30 and 31. Other urban Springfield routes and regional connectors carry relatively high ridership, while express services and village connectors tend to carry less riders. There are, however, a few urban Springfield routes that do not fit this pattern, with Routes 8, 13, 14, 15, and 19 carrying less than 500 riders per day.

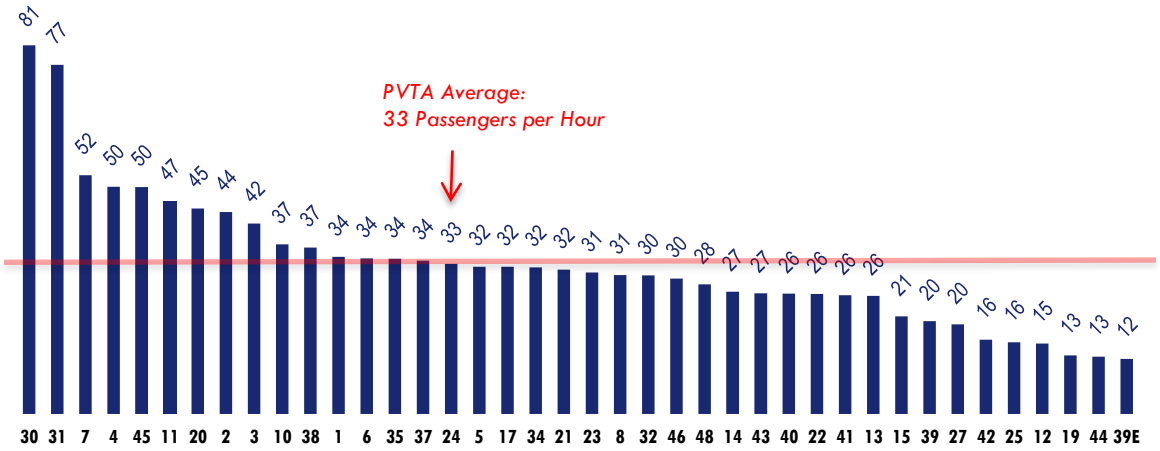
Figure 3-10 | Average Daily Ridership by Route (2012)



For most urban routes that experience a significant amount of ridership turnover along the route, service effectiveness is best expressed in terms of Passengers per Revenue Hour, or the average number of passengers that a bus carries for each hour it is in service. For express routes which travel for long distances with little ridership turnover, the minimum level of ridership is expressed in terms of Passengers per Trip. In 2012, the overall systemwide averages for these two indicators was about 33 Passengers per Revenue Hour and 30 Passengers per Trip.

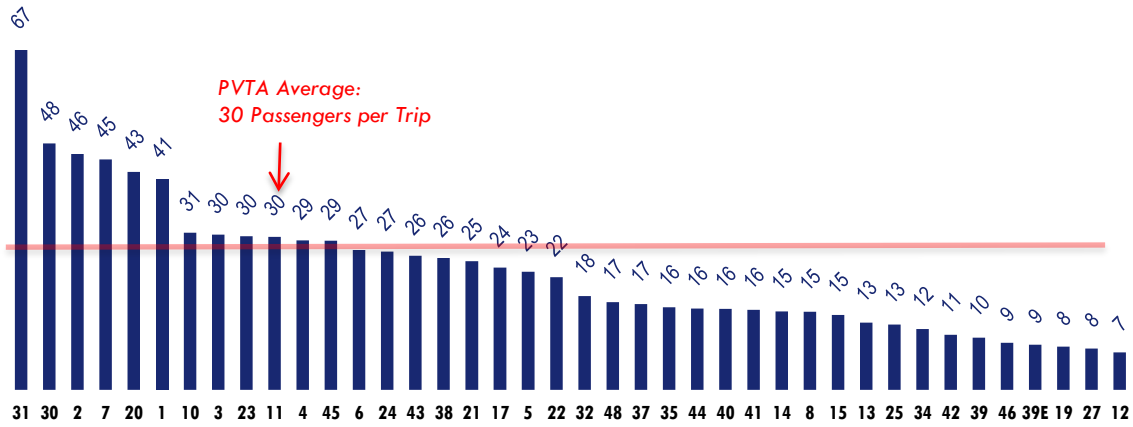
As shown in Figure 3-11, the two primary campus shuttles in Amherst greatly exceed the systemwide average for Passengers per Revenue Hour, carrying about 80 passengers per hour. While a few additional routes exceed 40 Passengers per Revenue Hour, the majority carry between 26 and 37 Passengers per Revenue Hour. In general, village connectors and community circulators are intended to provide "lifeline" service in rural areas and tend to perform less well.

Figure 3-11 | Passengers Per Hour by Route (2012)



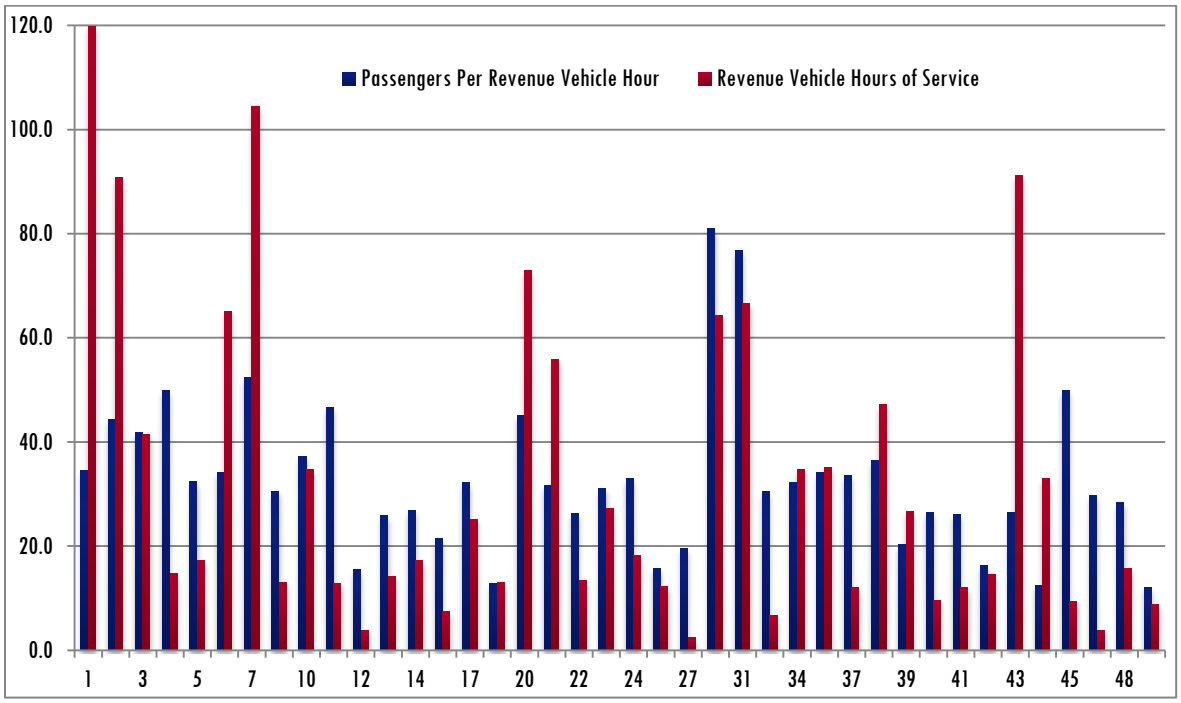
Most express and regional routes tend to perform relatively low in terms of *Passengers per Revenue Hour*, and are better evaluated by looking at *Passengers per Trip* as shown in Figure 3-12. A comparison of Figures 3-11 and 3-12 shows that certain regional routes such as Route 41 and 43, perform better in terms of Passengers Per Trip. However, some longer distance regional routes, such as Route 20, display strong overall performance similar to the busiest urban routes.

Figure 3-12 | Passengers Per Trip by Route (2012)



Another way to evaluate individual routes is to consider the relationship between service inputs (revenue hours of service) and service outcomes (ridership) (see Figure 3-13). Ideally, the inputs and outputs would be even; this would tell us that the routes where PVTA invests the most resources (hours of service) also generate the most outputs (riders). The UMass campus shuttles (Routes 30, 31, 32, 45 and 46), for example, balance these factors particularly well; part of the reason these routes are so well balances is because, as referenced, UMass Transit is operated by student drivers which results in lower operating costs for UMass Transit routes as compared to the system overall. However, most urban radial routes operating out of Springfield are also well balanced. As expected, regional routes which travel longer distances with minimal passenger turnover require higher levels of investment relative to passenger demand.

Figure 3-13 | Weedkay Ridership and Revenue Hour Comparison (2012)



SUMMARY OF TRANSIT NEEDS AND OPPORTUNITIES

The assessment of needs and opportunities described above helped PVTA and the study team to understand which parts of the PVTA system are working well today, and where there might be opportunity for improvement. The results of this assessment are broadly summarized below:

- Overall, PVTA transit services are relatively well matched to local demand. The urban Springfield core is well served and outlying regional centers at UMass/Amherst and in Holyoke and Northampton serve as hubs for connecting to and transferring between routes. Other markets and concentrations of service lie in Chicopee, Westfield, and Westfield State. Demographic data and land use patterns suggest these markets will continue to be strong.
- There are also a handful of locations, which while technically not transit hubs are locations where ridership is very high both because the destination is attractive to riders but also because riders can transfer between routes. The most significant of these is the Holyoke Mall, other examples include Chicopee Center, Springfield Plaza, the Eastfield Mall, Westfield Center and the Chicopee Marketplace.
- The PVTA service area is also characterized by large rural areas and small village centers. Where demand is sufficient, fixed-route services are provided to connect these village centers to the larger regional hubs. In areas of lower demand, community circulators are used to provide local circulation.
- PVTA currently operates a very efficient service overall. It carries roughly 33 passengers per hour and has an average (operating) cost per passenger of $2.05 system-wide. Proposed changes should strive to retain this high level of efficiency.

Results from the combined needs assessment also led to emerging themes, or opportunities to be further explored as part of a package of potential service improvements. These broad themes included:

Adjust Service to Better Meet Demand & Increase Ridership

- Demand is high on routes that operate on several key regional corridors, like State Street in downtown Springfield and Route 43 between Amherst and Northampton.
- More consistent mid-day headways, later evening service and weekend service.
- Year round service where warranted on college routes (summer service, winter sessions), and additional service on some existing routes to keep up with growth at UMass/Amherst.
- "Bus Rapid Transit" type improvements to speed service and increase capacity in key corridors with high demand, such as along State, Carew, Main, and Belmont Streets and Summer Avenue in downtown Springfield and Route 9 between Amherst and Northampton.

Consider New Routes / Serve Emerging Markets & Activity Centers

- Crosstown services in the Springfield core to more directly connect activity centers just outside the downtown.
- New community circulators in outlying communities, particularly those with strong village centers and growing senior populations.

Provide Faster and More Direct Regional Connections

- Consistent seven-day service between Springfield, Northampton, Holyoke and Amherst.
- New express services to connect outlying communities with Springfield in a fast, direct manner, including service to more directly connect the future UMass campus in downtown Springfield with Amherst.
- Stronger connections between Amherst and the Holyoke Mall.
- Connections to Bradley International Airport.
- Coordinated connections with Greenfield area transit (FRTA).
- Creation of new, smaller hubs to support transfers and increase the visibility of transit.

Make Service Faster, More Convenient & More Reliable

- More consistent schedules, eliminating gaps in service.
- Coordinated schedules at key transfer points (reducing wait time between connections).
- Corridor level improvements such as additional Transit Signal Priority (TSP) to speed service in key corridors.
- Route modifications to make routes more direct, keep buses out of parking lots, etc.
- Bus stop spacing and placement guidelines.
- Consolidation of bus stops to speed service and review of flag stop policies.
- Limited route variants and deviations

Support New Regional Initiatives

- New-Haven-Hartford-Springfield commuter rail service and the integration of PVTA services at a new Springfield Union Station hub.
- Amtrak's Knowledge Corridor – Restore Vermonter Project
- MGM Casino Development in Springfield.

4 FARE STRUCTURE & SYSTEMS

The Massachusetts Transportation Finance Act of 2013, which guides the development of Comprehensive Service Analyses in the Commonwealth, requires that fares and fare collections methods be considered as part of the service review and analysis. They key considerations for fare structures and systems are that fares are equitable and effective, as transit agencies recognize a large part of their ridership depends on public transportation as their only mode of transportation, but at the same time, fares represent an important funding source for the service. Another criteria involves ensuring that fare media be readily available and easy to use.

EXISTING FARE STRUCTURE

The adult cash fare for a one-way ride on PVTA buses is $1.25 and transfers between routes cost $0.25. PVTA offers a variety of discounts, including for people who purchase their ticket in advance at a customer service window in the Springfield Bus Terminal; the advance purchase fare is $1.15. PVTA also sells a variety of passes that offer discounts, including a one day pass ($3.00); seven day pass ($12.50); 31 day pass ($45.00). Older adults and persons with disabilities who have a PVTA statewide access card pay half-fare and are eligible for half-fare 31 day passes ($22.00). ADA fares are $2.50 to $3.50, depending on the pick-up and drop-off location. There are also bulk fare media for ADA riders, including pre-paid ticket booklets. All PVTA fare media may be purchased at the Springfield and Holyoke transit hubs, at Big Y supermarkets, on-line or by mail.

In April 2012, the Pioneer Valley Planning Commission conducted a *Fare Equity Analysis*[1] which determined PVTA's basic fare is comparable to, and in many instances lower than, other transit agencies in MA and surrounding states. While a number of other transit agencies offer free transfers, the cost of a PVTA monthly pass with unlimited transfers is lower than that of most comparable agencies.

Thus the fare structure does not deter ridership and in fact, is designed to encourage ridership by offering substantial discounts for bulk purchases, including both short and longer term passes. As a result of these discounts, PVTA's average fare (i.e. the average fare inclusive of all discounts available to older adults, persons with disabilities and youths as well as all bulk purchase discounts, is $0.65.[2] PVTA's average fare is quite low and is among the lowest in the state.[3] This demonstrates a commitment to ensure as much of the community as possible has access to the fixed-route services.

The PVTA Advisory Board recommended that a proposal for a fare increase be brought to public hearing in 2012. Nine hearings were held, but as additional state funding was anticipated, the increase was not enacted. The *Fare Equity Analysis* referenced above was conducted as part of this proposal and in accordance with Title VI of the Civil Rights Act of 1964 and federal transportation law. The analysis concluded that the proposed fare increase would be justified under Title VI and "major service

[1] PVTA Title VI Fare Impact Analysis, prepared for PVTA by the Pioneer Valley Planning Commission, April 2012.

[2] National Transit Database 2012 – fare revenue divided by the number of unlinked trips.

[3] Beyond Boston: A Transit Study for the Commonwealth, 2012

reductions, which are the only principle alternative to the proposed fare increases, would likely cause more severe adverse effects on low income and minority transit riders than the fare increases themselves."

Fare Collection Systems and Technology

PVTA uses electronic fareboxes with swipe card technology, that also accept cash fares. PVTA will be introducing "SmartCards," or stored-value, "contactless" fare payment cards. Customers would be able to load value onto these cards at existing PVTA pass sales locations, on board buses or via PVTA's website. To pay their fare, riders would then simply "tap" the SmartCard to the farebox to deduct the appropriate fare. This system would enhance customer convenience by allowing riders to retrieve value from lost/stolen cards.

5 SCENARIO DEVELOPMENT AND EVALUATION

Throughout the needs assessment process, PVTA, PVPC and the Nelson\Nygaard team identified potential service improvements, including route alignment changes, the addition and elimination of routes and changes to the hours and days of operation. The next step involved developing packages of service improvements, or service improvement scenarios, that could be presented to the public and stakeholders for their comment and consideration. These scenarios were developed as part of a two-step process. First, a set of *Service Design Guidelines* was developed to provide consistent and practical standards for bus route design and operation. These guidelines formed a framework to match transit services – including hours of operations and frequency of service – with transit markets. The study team, then developed two different options for how PVTA services could be improved, using the service design guidelines as a framework but drawing upon different recommendations and options for restructuring service.

SERVICE DESIGN GUIDELINES

The *Service Design Guidelines* (attached as Appendix B) are intended to provide PVTA with a general structure for basic service design (e.g. bus stop spacing, route layout, etc.) and to define appropriate levels of service and operations standards to appropriately align resources with the type and density of the market served.

As described in the individual *Route Profile Reports*, each PVTA route serves a specific market or plays a certain role. For example, some routes serve densely developed corridors in downtown Springfield and must operate at relatively high frequency to bring people to and from this regional center. Other routes specifically serve the Five Colleges market, connect regional hubs, or are intended to provide "lifeline" service within more rural areas.

Route Classification System

By evaluating service frequency, span, ridership trends and the market area served, a route classification system was proposed. This classification defines the role each PVTA route is intended to play, serving as a guidebook for the design of service enhancements and the evaluation of future performance. Nine classifications for PVTA routes are suggested, as shown in Figure 5-1.

Figure 5-1 | PVTA Route Classification System

Route Classification	Market Served/Primary Role
Bus Rapid Transit/ Tier 1 Key Corridors	High frequency service in other high ridership routes, operating 7 days a week and forming the core of PVTA's system. BRT routes will include limited stops in high ridership corridors (e.g. State Street). Corridor improvements such as Transit Signal Priority or queue jump lanes are recommended to improve the speed of service. These routes will operate along the main corridor with no deviations. The main difference between Bus Rapid Transit service and Tier 1 service is the investment in capital infrastructure along the route.
Key Corridors – Tier II	Similar to Tier I corridors, with predictable service 7 days a week, but at slightly lower frequency and reduced span of service. In most cases the Tier II category reflects resources, rather than demand; many Tier II routes may be operated at the Tier I level as resources become available.
Urban Radial	Radial service to and from downtown Springfield, but also introducing new cross-town routes.
Express	Fast, direct service for commuters and others traveling between regional hubs and major activity centers.
Campus Shuttles	Campus services primarily focused on UMass/Amherst, but also including other areas (e.g. OWL service at Westfield State). Service design would vary to meet each particular college market and to follow the academic calendar.
Five Colleges	Routes connecting UMass, Smith, Holyoke, Hampshire and Amherst, and operating much like Key Corridors with fast predictable service, 7 days a week. These routes are also funded by the Five Colleges Consortium.
Village Connectors	Routes connecting outlying rural village centers (e.g. Holyoke – Chicopee).
Community Circulators	Providing circulation within individual, rural communities. Smaller vehicles may be appropriate.

Service Design Principles

- **Service Should be Simple:** For people to use transit, service should be designed so that it is easy to understand.
- **Service should be Fast and Direct**: Routes should be designed to operate as directly as possible to maximize average speed for the bus and minimize travel time for passengers while maintaining access to service.
- **Route Deviations should be Minimized:** Routes should not deviate from the most direct alignment unless there is a compelling reason.
- **Stops should be Spaced Appropriately:** Services that emphasize speed (e.g. Bus rapid transit or key corridors) should have fewer stops, while services that emphasize accessibility should have more frequent stops.
- **Routes Should be Symmetrical:** Routes should operate along the same alignment in both directions to make it easy for riders to know how to return to their trip origin location.
- **Major Routes Should Operate Along Arterials:** Key Corridors, Urban Radial and Express routes should operate on major roadways and should avoid deviations to provide local circulation.
- **Routes Should Serve Well-Defined Markets:** To make service easy to understand and to eliminate service duplication, service should be developed to serve well-defined markets. For example, there should only be one Key Regional route between urban areas, and multiple Urban Arterials should only operate through the same corridor when they serve unique destinations.

- **Service Should be Consistent:** Routes should operate along consistent alignments and at regular intervals (headways), so riders can easily remember schedules and so that connecting routes may be coordinated.
- **Services Should be Well-Coordinated:** To avoid bunching of buses and to balance loads, major routes of the same route type that serve the same corridor should be scheduled to operate at the same service frequencies and should alternate trips at even intervals.
- **Service Design Should Maximize Service:** Service should be designed to maximize in-service time and minimize out-of-service time. In some cases, it may be more efficient to extend a route to pick up a few more passengers and limit the amount of layover time.
- **Vehicle Type Should be Appropriate for Service:** PVTA's owns a range a vehicle types and sizes. While standard fixed-route buses are appropriate for most services. longer articulated buses help reduce overcrowding on high ridership routes. Smaller buses are appropriate on community routes and shuttles.

Service Level Guidelines

Minimum Span of Service

The number of hours per day when transit service is provided along a route, or between two locations, plays a role in determining the effectiveness of transit service for potential users. Passenger needs and PVTA's financial capacity are key considerations in setting weekday service spans, and in deciding which routes are operated on Saturdays and Sundays. Weekday routes should permit workers and students to make their morning start times, and should end late enough to provide return trips home for second shift workers. Service oriented to non-work travel can start later and end sooner. Sunday service may not be necessary on many routes.

Minimum span of service guidelines are presented in Figure 5-2 and define the **minimum** period of time that different types of service should operate. Service could be started earlier and/or end later if demand warrants, minimum performance standards can be achieved, and funding is available.

Figure 5-2 | Minimum Span of Service Guidelines

	BRT/ Key Regional-Tier I	Key routes-Tier II	urban Radial	Express	Campus shuttles	FIVE COLLEGES	Village Connectors	Community CIRCULATORS
Weekdays								
Begin	6:00 AM	6:00 AM	6:00 AM	6:00 AM	8:00 AM	7:00 AM	7:00 AM	8:00 AM
End	10:00 PM	9:00 PM	7:00 PM	7:00 PM	10:00 PM*	9:00 PM*	6:00 PM	5:00 PM
Saturdays								
Begin	6:00 AM	7:00 AM	7:00 AM	—	8:00 AM	10:00 AM	8:00 AM	—
End	9:00 PM	8:00 PM	6:00 PM	—	10:00 PM*	9:00 PM*	5:00 PM	—
Sundays								
Begin	9:00 AM	10:00 AM	9:00 AM	—	8:00 AM	7:00 AM	—	—
End	5:00 PM 6:00 PM (BRT)	5:00 PM	5:00 PM	—	10:00 PM	9:00 PM	—	—

Notes: The beginning span of service refers to the departure of the first inbound trip, and the ending span of service refers to the departure time of the last peak direction trip. A blank or "—" indicates that the guideline does not apply, but service may be offered where demand warrants.

* Varies by night (i.e. Thursday, Friday and Saturday night may warrant later schedules).

Minimum Service Frequencies

Service frequency (the time interval between vehicles traveling in the same direction on the same route) has a major influence on transit ridership; high frequency service is considered more attractive to users

who don't need to wait as long in between buses. At the same time, frequency has a significant impact on operating costs, and service requirements increase exponentially with improvements in frequency.

Because of the expense of high frequency service, transit service frequency is normally scheduled to meet varying demand at different times of day. Minimum service frequency guidelines are presented in Figure 5-3.

Figure 5-3 | Minimum Service Frequency Guidelines (Minutes)

	BRT/ Key Regional- Tier I	Key routes - Tier II	urban Radial	Express	Campus shuttles	FIVE COLLEGES	Village Connectors	Community CIRCULATORS
Weekdays								
Early AM	30	60	60	60*	60	60	60	—
AM Peak	15/20	30	30	60*	15	60	60	60
Midday	15/20	30	60	60*	15	60	60	60
PM Peak	15/20	30	30	60*	15	60	60	60
Night	30	60	60	60*	60*	60*	60	—
Saturdays								
Day	30	30	60	—	60	60	60	—
Night	30	60	60	—	60	60	60	—
Sundays								
All Day	60	60	60	—	60	60	—	—

Note: "—" indicates that the guideline does not apply, but service may be offered where demand warrants.

* Varies by route (i.e. Thursday, Friday and Saturday night may warrant higher frequencies).

Service Scenario Development

As discussed, the study team developed two alternatives for organizing PVTA's bus network. Each option was based on the system's ridership patterns and considered the existing route structure in different levels of intensity.

- A **System Update Option** made up of relatively minor modifications to PVTA routes to align with *Service Design Guidelines* and route classifications and to better reflect the type of market served.
- The **System Restructure Option** which included more dramatic changes to the routes, added more hours of service, and introduced new service and service types to the PVTA network.

A brief summary of each option is included in the following section together with a map. A more detailed overview of each option, including a comparison of the differences between the options as presented to the public in December 2013 is included as Appendix B.

System Update Option

The System Update Option was configured to present a scenario much like today's existing PVTA network, with a multi-hub and spoke system, with several radial routes focused on Springfield. The changes considered mostly related to improved service design: removing routes or route segments where ridership is low; reducing service variants; eliminating branches; and straightening and simplifying routes (see Figures 5-4 and 5-5).

This option was intended to show how minor modifications (with relatively low incremental cost) could improve the network. Drawbacks were that, by increasing frequency and service on certain high ridership routes, there would be less service coverage in outlying areas (see Figures 5-6 and 5-7).

Service Restructure Option

The System Restructure Option included the service design improvements included in the System Update Option, but also expanded the route classification system to further tailor service design and better align individual route operations to customer demand. More specifically, a number of key corridors were identified for increased transit investment and service, including a Bus Rapid Transit corridor along State Street in Springfield. These corridors would offer higher frequency service along a direct route.

Other features of this option included developing two cross-town routes to support north-south service in the Springfield area; developing a clearer express route hierarchy; and replacing low ridership routes with "community circulators" to more efficiently meet local travel demand.

Figure 5-4 | System Update (North)

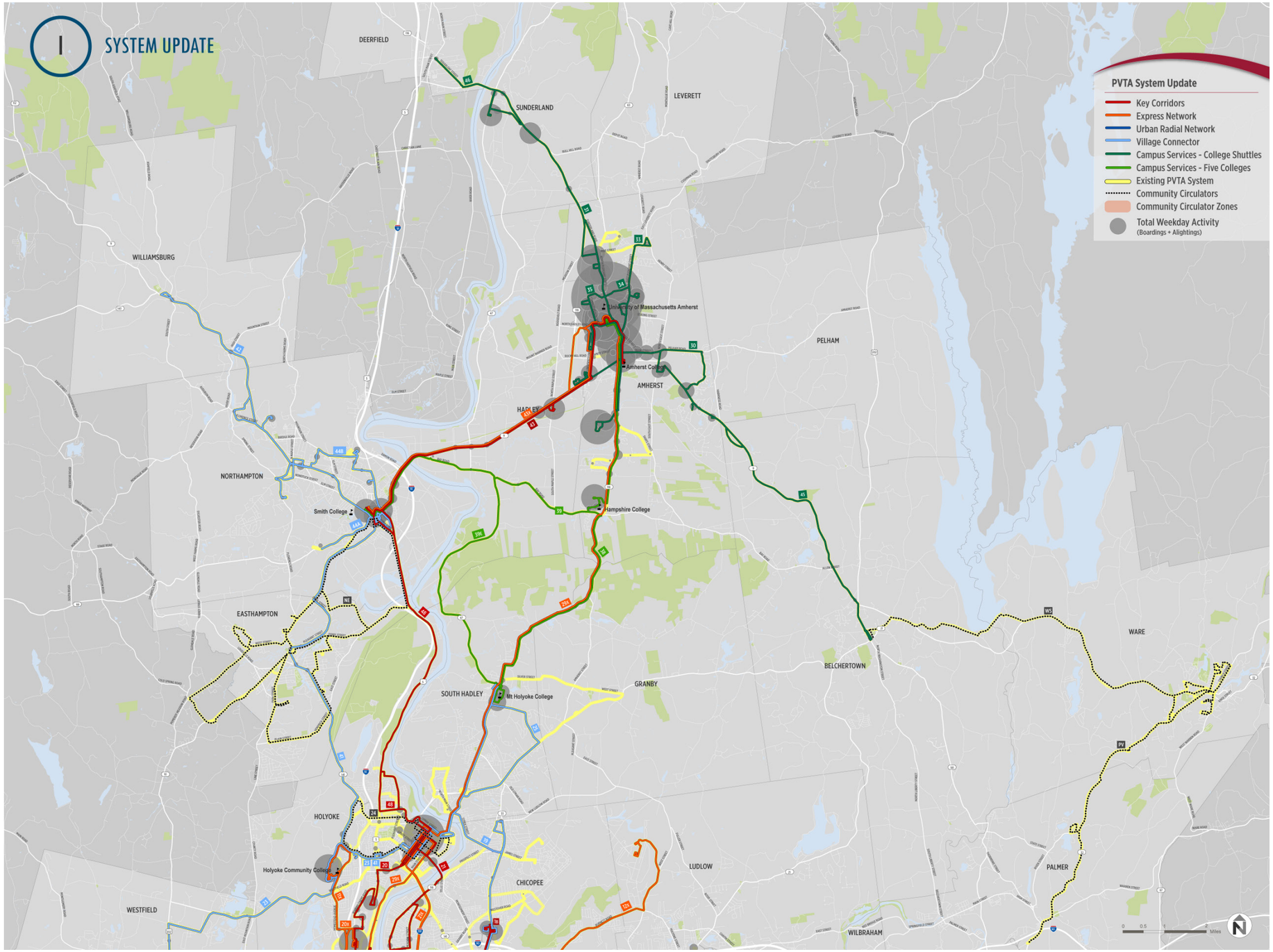


Figure 5-5 | System Update (South)

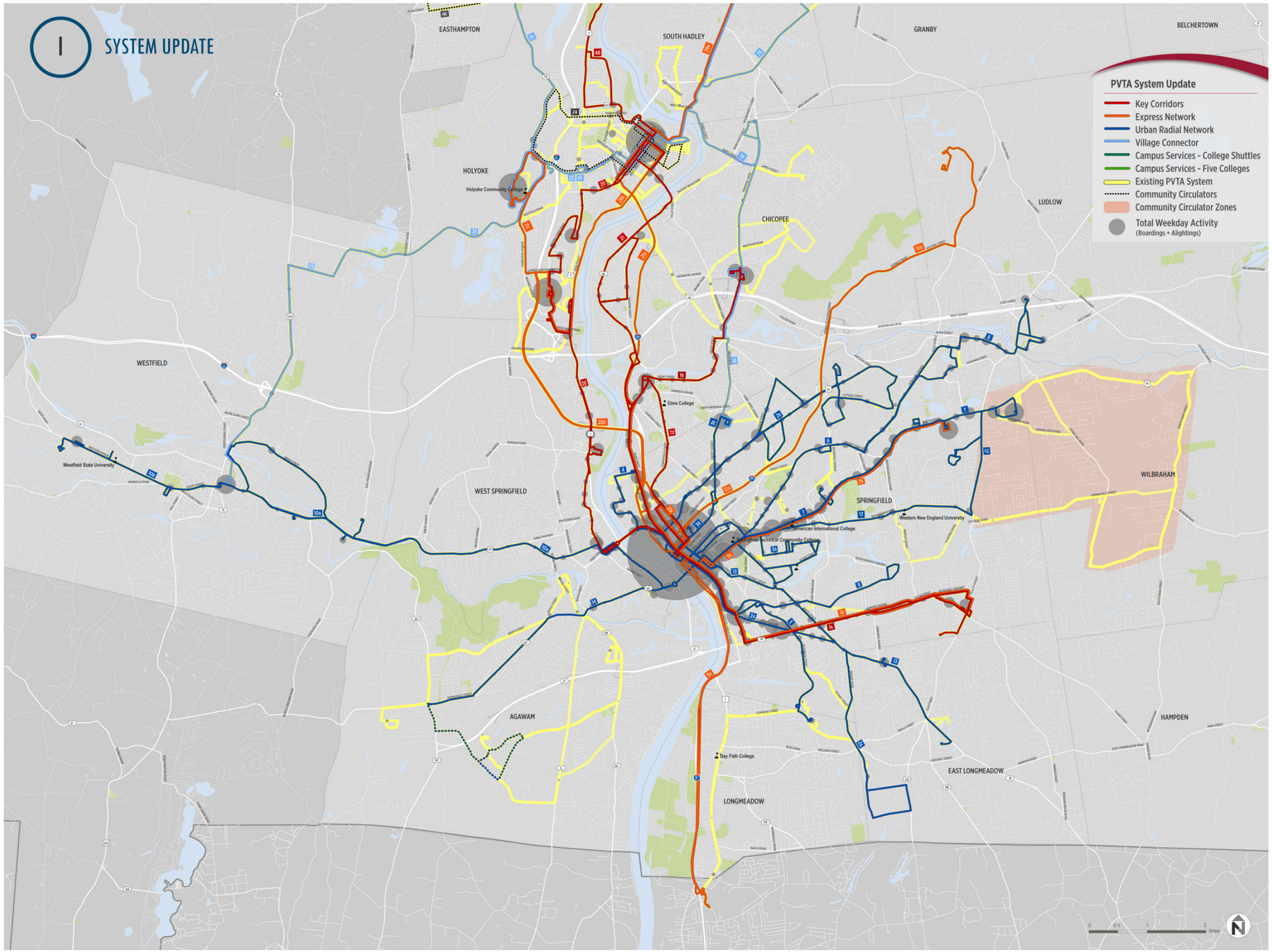


Figure 5-6 | System Restructure (North)

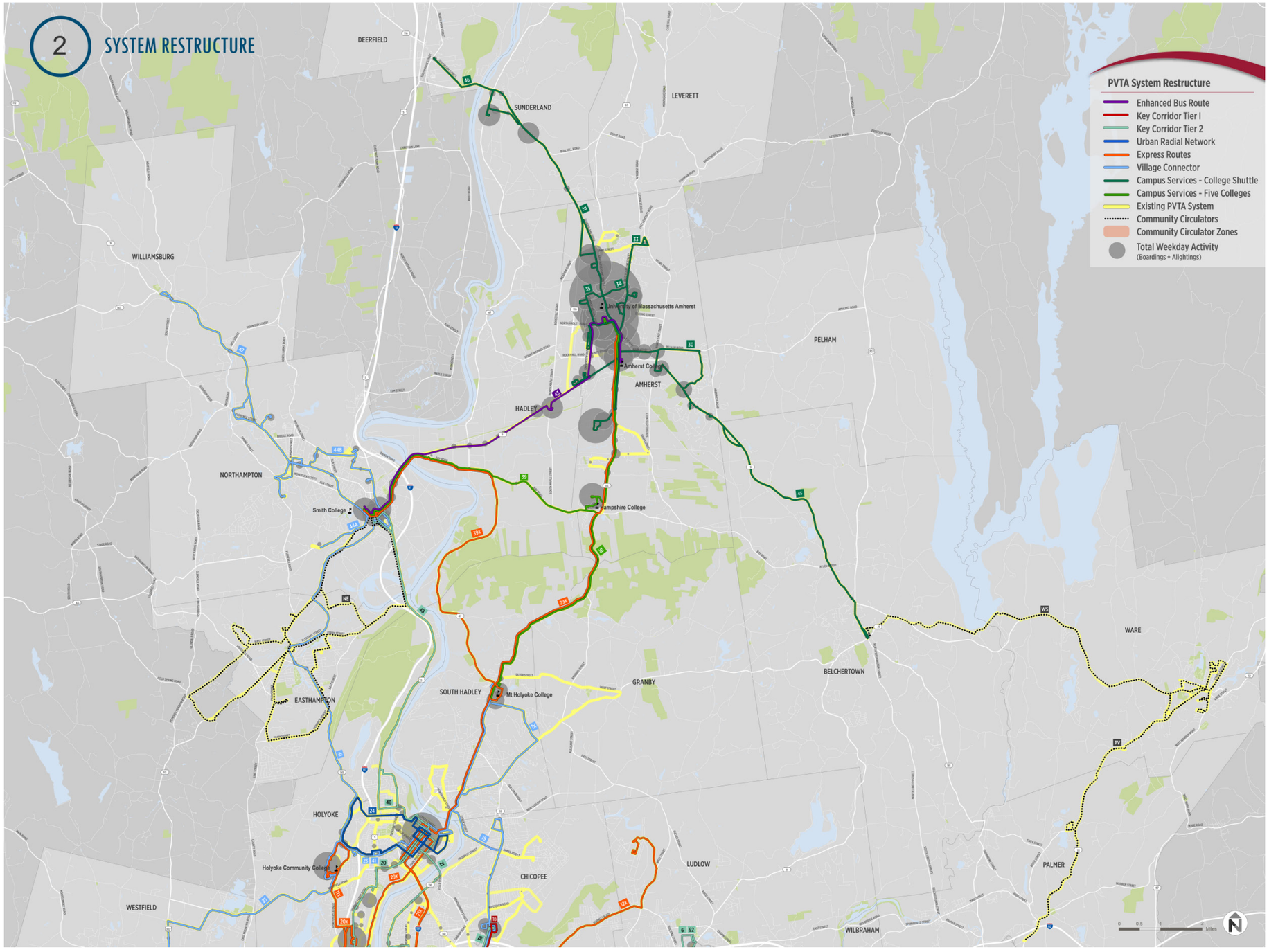
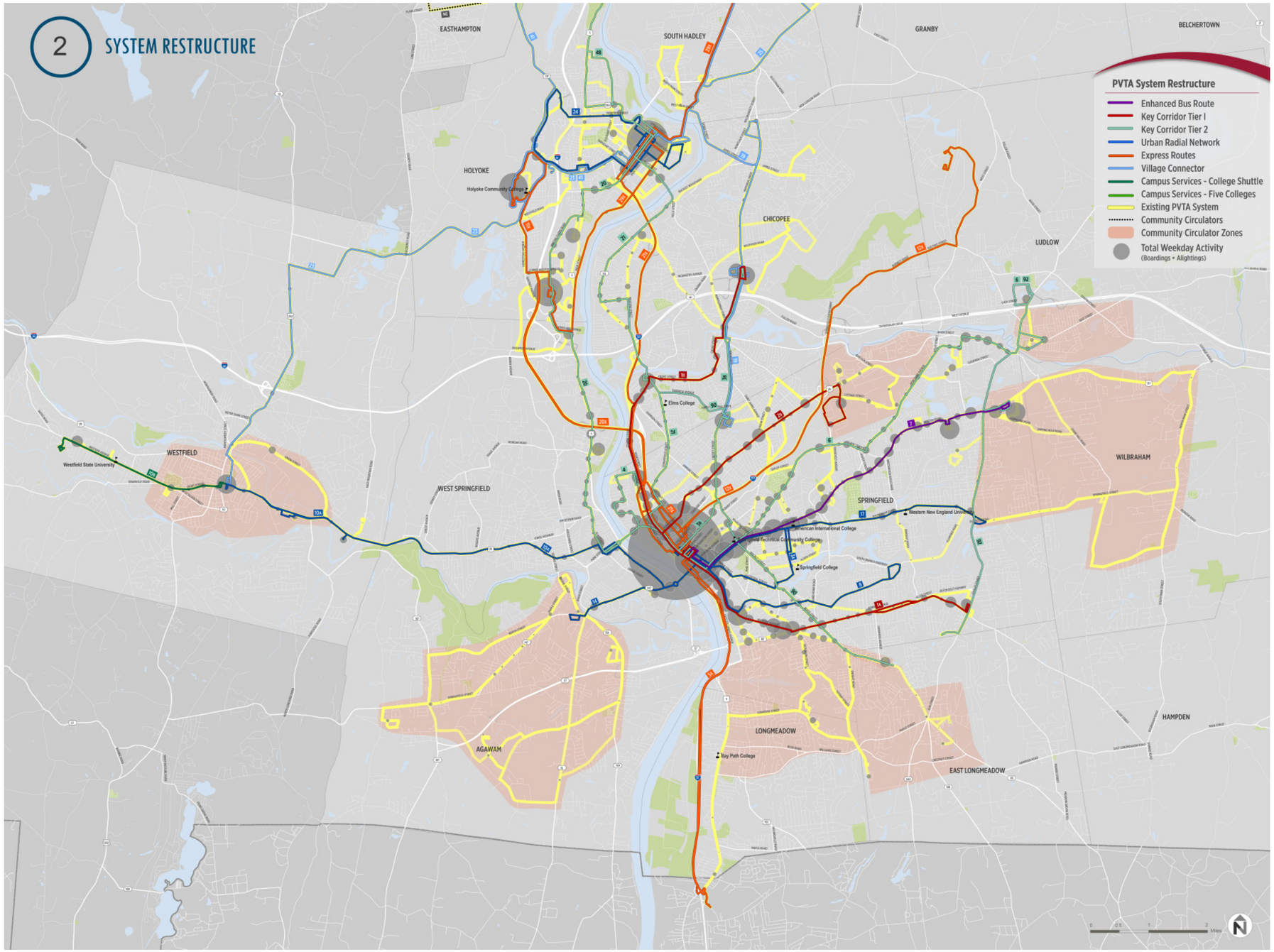


Figure 5-7 | System Restructure (South)



Stakeholder and Community Input

The study team brought the service options to riders, members of the public and stakeholders in December 2013. The outreach process included a combination of traditional public meetings and rider "drop-in" sessions (see Figure 5-8). There were four public meetings (Northampton, Holyoke, Springfield and Amherst); each meeting was open between 3:00 pm and 7:00 pm, with presentations scheduled at 4:00 pm and 6:00 pm. This format was designed to create opportunities for people who wanted to attend meetings during the weekday and those who preferred to attend in the evening. In addition, staff scheduled three drop in sessions – one each at the Holyoke Transportation Center and the Springfield Bus Terminal – plus a third at the driver break room, so people could provide comment while were waiting for the bus route, or in the case of the drivers, taking a break between shifts.

Figure 5-8 | Public Outreach on Proposed Service Scenarios

	Tuesday, December 10th	Wednesday, December 11th	Thursday, December 12th
Drop In Session: Springfield Bus Terminal		10:00 am – 12:00 pm	
Drop In Session: Holyoke Transportation Center			10:00 am – 12:00 pm
Drop In Sessions: PVTA Transit Operators			10:00 am – 12:00 pm
Evening Public Meetings	3:00 pm – 7:00 pm Holyoke (held at Holyoke Transportation Center) Northampton (held at City Council Chambers)	3:00 pm – 7:00 pm Springfield (held at PVPC)	3:00 pm – 7:00 pm Amherst (held at Bangs Community Center)

Input Received

Comments received during the public outreach process covered a wide variety of topics, including existing PVTA services as well as comments on service changes that were implemented around the same time period (December 2013). Most people who participated in the outreach process appreciated being asked and nearly all had ideas for how PVTA could improve the bus service. Comments on the proposed scenarios and potential larger scale changes for the PVTA network may be generally summarized as:

- The majority of the people who attended the meetings and drop-in sessions considered the scenarios in terms of how they personally would be affected, i.e., how their particular bus route would change.
- Despite reluctance and concern about change, many people were interested in and supportive of proposed changes. Several felt that some of the new services, such as the bus rapid transit and cross-town routes as well as the increased reliance on flexible services were good ideas.
- Riders brought very specific service requests to the study team, including requests for service to certain destinations and connections to new areas. While not every

recommendation brought by the riders was ultimately included in the plan, each suggestion was evaluated and considered.

- Riders and non-riders appreciated the benefits of keeping buses on the main roads. Many of these individuals wanted buses on all the main roads. Others, however, were skeptical about asking people to walk further to bus routes, especially considering the high portion of riders who are older adults and persons with disabilities.
- Interest in and support for several concepts in the service restructuring option, including cross town service as well as the proposed community "flex routes."
- A clear and strong desire for direction connection between Amherst and Springfield, including the Holyoke Mall.

In addition to considering comments from the public, PVTA and PVPC staff, including drivers, but also operations and planning staff, reviewed the scenarios in greater detail and in consideration of agency operations. This review also provided ideas for improvements and changes.

Evaluation Results

Generally speaking the consensus – among the riders but also PVTA drivers and PVTA and PVPC staff - was that the Service Restructuring concept was the preferred option based on preferences for the bus rapid transit services, the addition of cross town routes and the inclusion of flexible services in some of the lower density areas rather than fixed-route service. However, despite expressing clear support for the preferred scenario, riders and stakeholders as well as PVTA and PVTS staff, had a number of changes that they felt would strengthen the option. These ideas included very specific recommendations to serve important destinations as well as more general ideas for how to improve service. Each of these ideas was reviewed to determine if it should be included in the final recommendations. As an example, some of the recommendations identified through the public and stakeholder input process included:

- Restore service along Belmont Street in southwestern Springfield
- Restore service between the Springfield Bus Terminal and the East Longmeadow Big Y
- Operate express service from Amherst to Springfield daily
- Re-route some services connecting to HTC via the Holyoke Flats to increase and improve local connections
- Connect Route 31 (service to Boulders Apartments) with shopping centers on Route 9 without traveling into downtown Amherst.
- Operate Route 32 (Atkins Corner to UMass) year-round when Five Colleges Routes are not available.
- Serve the Survival Center, YMCA and Congregation B'nai Israel in downtown Northampton

6 PREFERRED SCENARIO/ RECOMMENDED APPROACH

OVERVIEW

The culmination of the Comprehensive Service Analysis process is a series of recommendations to improve the PVTA transit system, or the preferred scenario. As discussed previously, the CSA was intended to better align PVTA service with the local and regional market and ensure the system is operated as efficiently and effectively as possible. The analytical and input process, as discussed in the previous sections examined the demand for transit based on quantitative measures, existing ridership and community input. The recommendations were designed to strengthen the existing system, attract more riders and eliminate unproductive parts of the system. This was accomplished in part by following a series of strategies:

1. **Service should be as simple and easy to understand as possible.** As a result, an effort was made to design routes so they operate out and back along the same corridor, operate on 'clock faced' schedules, and follow repeating patterns. An effort was also made to limit route deviations and changes to the primary schedule.
2. **Service should stay on the main corridor as much as possible.** An effort was made to reduce deviations off of the main roads, except in cases where key destinations, such as shopping centers were located too far off the main road to be accessible, or lacked pedestrian facilities.
3. **Existing ridership is prioritized.** In cases where existing bus routes carry a large number of riders, or neighborhoods generate a large volume of riders on existing services, these bus routes and community services were not changed. In other words, where existing routes and services are effective, they were unchanged.
4. **Service should be matched with the demand.** The preferred network is designed so that the region's most densely developed corridors will receive the most frequent service for the longest time span. Corridors and communities with large employers or densely developed residential neighborhoods will also be served with higher frequency bus service. Areas with lower density development generally speaking were assigned fixed route bus service as appropriate but with lower frequency and/or shorter spans of service.
5. **Categorize routes into a hierarchy or 'family of services' to help guide and structure how services are matched with demand.** The proposed service hierarchy was further articulated with service standards for frequency and span as well as productivity expectations. These guidelines can help PVTA add (or reduce) service in the future as needed.
6. **Each of the PVTA hubs are connected to at least one other hub.** As discussed, the regional PVTA network is built around five transit hubs or centers (Springfield, Holyoke, Northampton, Amherst and Westfield). Connections between these hubs were strengthened or added, so that each hub has connections to at least one other hub (i.e., from Northampton, riders can get to either Amherst or Holyoke.

7. **Express routes should be clearly identified and marketed as special services.** In cases where PVTA offers special services, such as express routes, these services should be clearly articulated to the general public so that the entire market – including both existing riders and potential new riders understand their choices.

Creating a system hierarchy or framework of routes will allow PVTA to better align service levels with specific market demands along each route. These recommendations were developed by first classifying each PVTA route according to this new hierarchy as shown in Table 2, and using these classifications to guide system investment. For example, Bus Rapid Transit has been introduced to strong markets, while community shuttles are recommended in markets where ridership and market densities are lower.

OVERVIEW OF PREFERRED ALTERNATIVE

As discussed, the Preferred Alternative reflects a service hierarchy that would create a strong core set of services, or network 'backbone', and builds the rest of the network around the core network. The option also reduces redundancies in the network, provides a clear and simple strategy for service development, and strengthens crosstown connections. It also recommends eliminating most service branches, straightening routes, and scheduling services according to consistent headways. By simplifying the service, the preferred alternative also creates a structure that should make it easier for PVTA to expand or contract services as budgets require.

In total, the Preferred Alternative would create a network of 50 routes, 44 fixed route services plus six community circulators (not including the existing local circulators, such as the Palmer Shuttle). The new routes are primarily feeder and neighborhood (Flex) services that would be designed to connect people from neighborhoods to transit hubs and the key corridor network. Detail on the proposed network is documented in a map that shows the proposed routes on weekdays (see Figures 6-1) and a table that shows the proposed service hours and frequency by day of the week (Figure 6-2). In general, the 50 routes are categorized according to:

- **Bus Rapid Transit/Tier I Routes –** Includes two bus rapid transit services (Route 7 State Street and Route 43 Amherst to Northampton); plus four Tier I transit routes (Route 1 A Five Town Plaza, Route 1B Chicopee Big Y, Route 2A East Longmeadow, Route 2B Mass DET). These routes will operate seven days a week, with service scheduled for 18 hours a day (roughly 6:00 a.m. to 10:00 p.m.) on weekdays. During peak periods, buses will be scheduled to run with 15 or 20-minute frequencies all day and 30 minutes in the evening. The main difference between the BRT and Tier I routes is the amount of infrastructure investment proposed for the corridor.
- **Tier II Routes –** The Preferred Scenario includes eight Tier II routes all but one of which begin/end at the SBT, including routes connecting Springfield and Holyoke via Chicopee. The non-SBT route is Route 48 that connects the Holyoke Transportation Center with downtown Northampton. All of these routes operate on weekdays and Saturdays with most also operating on Sunday. Weekday service is scheduled to operate between 6:00 a.m. and 9:00 p.m., with 30 minute service all day and 60 minute service during the evenings.
- **Urban Radial Routes –** Six routes are proposed as urban radial. All six routes begin or end at the SBT. These routes will operate on weekdays from 6:00 a.m. to 7:00 p.m. with 30 minute service during the peak period and 60 minute service during the midday and evening. All urban radial routes operate on Saturday and most also operate on Sundays.
- **Express Routes –** The Preferred Scenario includes seven express routes. These routes operate on weekdays only, except for the new proposed Route 29X (Amherst to Springfield via Holyoke), which would provide daily express service. Express routes provide a handful of trips based on demand.

- **Village Connector Routes –** Operate between and within the smaller communities and village centers in the PVTA service area. There are six routes proposed as village connections, including two in downtown Northampton (Routes 44A and 44B). These routes are recommended for operation on weekdays and Saturdays. In addition, Route 44A would operate on Sundays. The recommended weekday span of service is from 7:00 a.m. to 6:00 p.m.
- **College Shuttle Routes –** Primarily serve the UMass campus but also include some service between downtown Westfield and Westfield State University. There are a total of eight college shuttles; most operate daily, with higher service levels provided on weekdays and operate between 8:00 a.m. and 10:00 p.m.
- **Five Colleges Routes –** There are two Five Colleges Routes, plus one express route, that are funded by the Five Colleges Consortium. These routes provide daily service and on weekdays operate between 7:00 a.m. and 9:00 p.m. with hourly service.
- **Community Circulators –** Flexible routes that provide connections within a community and to PVTA fixed route service. There are six community circulators proposed as part of the Preferred Scenario, including for Granby, East Longmeadow, Agawam, Wilbraham, Westfield and East Springfield. These routes would provide service between 8:00 a.m. and 6:00 p.m. and operate on weekdays only.

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Figure 6-1 | Preferred Scenario

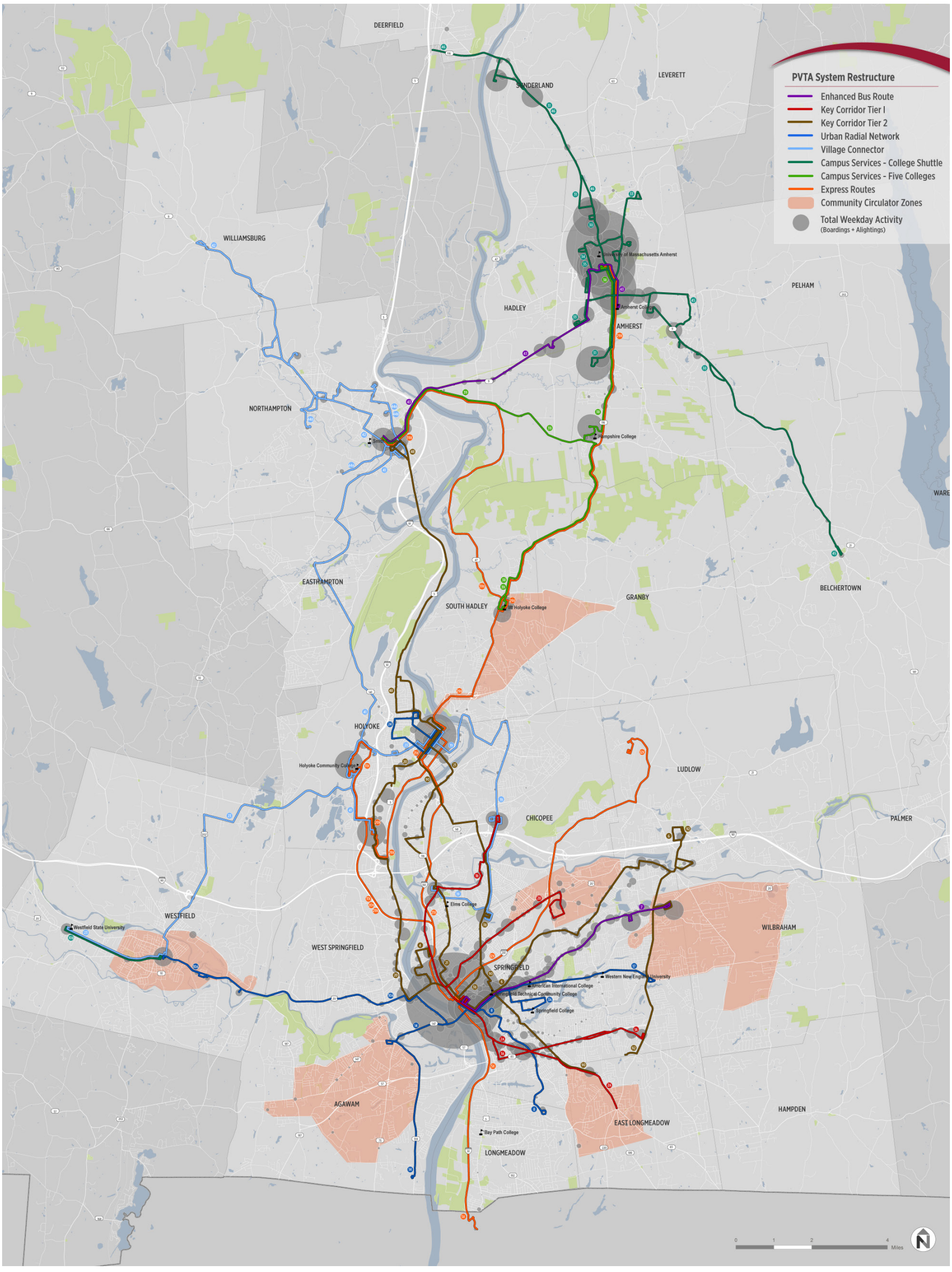

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Figure 6-2 | Preferred Alternative Routes

Routes		WEEKDAY					SATURDAY				SUNDAY		
		Service Span		Headway (min)			Service Span		Headway (min)		Service Span		Headway (min)
		Start	End	Peak	Base	Evening	Start	End	Base	Evening	Start	End	All Day
Enhanced Bus/BRT/Special Corridors													
7	State - Eastfield Mall	6:00 AM	10:00 PM	15	15	30	6:00 AM	9:00 PM	30	30	9:00 AM	6:00 PM	60
43	Northampton - Amherst	6:00 AM	12:00 AM*	20	20	30	6:00 AM	2:00 AM	30	30	9:00 AM	12:00 AM	60
Tier I – Highest Ridership Corridors													
1A	Five Town Plaza - SBT	6:00 AM	10:00 PM	20	20	30	6:00 AM	9:00 PM	30	30	9:00 AM	5:00 PM	60
1B	Chicopee Big Y - SBT	6:00 AM	10:00 PM	20	20	30	6:00 AM	9:00 PM	30	30	9:00 AM	5:00 PM	60
2A	SBT - East Longmeadow Big Y	6:00 AM	10:00 PM	20	20	30	6:00 AM	9:00 PM	30	30	9:00 AM	5:00 PM	60
2B	SBT - East Springfield/ Goodwill	6:00 AM	10:00 PM	20	20	30	6:00 AM	9:00 PM	30	30	9:00 AM	5:00 PM	60
Tier II – High Ridership Corridors													
3B	SBT - Springfield Plaza	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	10:00 AM	5:00 PM	60
4	Plainfield Street	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	10:00 AM	5:00 PM	60
6	Ludlow via Bay	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	10:00 AM	5:00 PM	60
20	SBT - HTC via Holyoke Mall	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	10:00 AM	5:00 PM	60
21	SBT - HTC via Chicopee	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	10:00 AM	5:00 PM	60
90	Springfield Inner Crosstown	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	30	60	-	-	-
92	Springfield Outer Crosstown	6:00 AM	9:00 PM	30	60	60	7:00 AM	8:00 PM	60	60	-	-	-
48	Northampton - Holyoke	6:00 AM	9:00 PM	30	30	60	7:00 AM	8:00 PM	60	60	10:00 AM	5:00 PM	60
Urban Radial Routes													
3A	Springfield College - SBT	6:00 AM	7:00 PM	30	60	60	7:00 AM	6:00 PM	60	60	9:00 AM	5:00 PM	60
8	SBT - Jewish Home	6:00 AM	7:00 PM	30	60	60	7:00 AM	6:00 PM	60	60	-	-	-
10A	Westfield Center - SBT	6:00 AM	7:00 PM	30	60	60	7:00 AM	6:00 PM	60	60	9:00 AM	5:00 PM	60
14	Six Flags	6:00 AM	7:00 PM	30	30	60	7:00 AM	6:00 PM	60	60	9:00 AM	5:00 PM	60
17	SBT - Sixteen Acres Center	6:00 AM	7:00 PM	30	30	60	7:00 AM	6:00 PM	60	60	-	-	-
24	New Holyoke circulator	6:00 AM	7:00 PM	30	30	60	7:00 AM	6:00 PM	30	30	9:00 AM	5:00 PM	30

Routes		WEEKDAY					SATURDAY				SUNDAY		
		Service Span		Headway (min)			Service Span		Headway (min)		Service Span		Headway (min)
		Start	End	Peak	Base	Evening	Start	End	Base	Evening	Start	End	All Day
Express					***One-way Trips:***				***One-way Trips:***				***One-way Trips***
5X	Enfield Express via I-91	-	-	6	2	-	-	-	-	-	-	-	-
11X	SBT - Holyoke Community College	-	-	10	9	5	-	-	-	-	-	-	-
12X	Stonybrook Express (HCCF)	-	-	1	3	4	-	-	-	-	-	-	-
20X	SBT - Holyoke Mall Express	-	-	9	6	-	-	-	-	-	-	-	-
21X	SBT - HTC Express	-	-	7	20	7	-	-	-	-	-	-	-
29X	Amherst - Holyoke Mall via HTC	-	-	4	2	4	-	-	4	2	-	-	4
39X	Smith - Mt. Holyoke Express	-	-	7	8	3	-	-	-	-	-	-	-
Village Connector													
19	Chicopee -Springfield Plaza - HTC	7:00 a.m.	7:00 p.m.	60	60	60	8:00 a.m.	5:00 p.m.	60	60	-	-	-
23	HTC - Westfield via HCC	7:00 a.m.	7:00 p.m.	60	60	60	8:00 a.m.	5:00 p.m.	60	60	-	-	-
41	Northampton - Easthampton - Holyoke Mall	6:00 a.m.	7:00 p.m.	60	60	60	-	-	-	-	-	-	-
42	Northampton - Williamsburg	6:00 a.m.	7:00 p.m.	60	60	60	8:00 a.m.	5:00 p.m.	60	60	-	-	-
44A	Hampshire Plaza - Northampton -Courthouse	6:00 a.m.	7:00 p.m.	60	60	60	8:00 a.m.	5:00 p.m.	60	60	8:00 a.m.	5:00 p.m.	60
44B	Northampton - Hampshire Plaza - Florence	6:00 a.m.	7:00 p.m.	60	60	60	8:00 a.m.	5:00 p.m.	60	60	-	-	-
College Shuttles													
10B	Westfield Center - Westfield State	6:00 a.m.	7:00 p.m.	15	15	30	7:00 a.m.	6:00 p.m.	60	60	9:00 a.m.	5:00 p.m.	60
30	N. Amherst - Old Belchertown Rd.	7:00 a.m.	1:00 a.m.	15	15	35	7:00 a.m.	1:00 a.m.	60	60	10:00 a.m.	1:00 a.m.	60
31	Sunderland - South Amherst	7:00 a.m.	12:00 a.m.	30	30	60	7:00 a.m.	12:00 a.m.	60	60	12:00 p.m.	1:00 a.m.	60

Routes		WEEKDAY					SATURDAY				SUNDAY		
		Service Span		Headway (min)			Service Span		Headway (min)		Service Span		Headway (min)
		Start	End	Peak	Base	Evening	Start	End	Base	Evening	Start	End	All Day
33	Cushman – BigY/Stop&Shop	8:00 a.m.	9:00 p.m.	30	30	60	8:00 a.m.	9:00 p.m.	60	60	8:00 a.m.	9:00 p.m.	60
34	NB- Orchard Hill – Mullins Center	7:00 a.m.	12:00 a.m.	15	15	45	-	-	-	-	-	-	-
35	SB- Orchard Hill – Mullins Center	7:00 a.m.	12:00 a.m.	15	15	45	5:00 p.m.	12:00 a.m.	60	60	5:00 p.m.	12:00 a.m.	60
45	Belchertown - UMass - Deerfield	7:00 a.m.	11:00 p.m.	40	120	120	-	-	-	-	-	-	-
46	UMass - South Deerfield	7:00 a.m.	11:00 p.m.	40	120	120	-	-	-	-	-	-	-
Five Colleges													
38	Mt. Holyoke - Amherst - UMass	6:00 a.m.	9:00 p.m.	30	30	45	9:00 a.m.	2:00 a.m.	60	60	9:00 a.m.	12:00 a.m.	60
39	Smith - Hampshire - Mt.Holyoke	7:00 a.m.	11:00 p.m.	30	30	60	9:00 a.m.	2:00 a.m.	60	60	9:00 a.m.	12:00 a.m.	60
Community Circulators													
GS	Granby-Chicopee Falls	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	--	-	-
EL	East Longmeadow	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	-	-	-
NS	Northeast Springfield	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	-	-	-
WE	Westfield	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	-	-	-
AG	Agawam	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	-	-	-
WI	Wilbraham	6:00 a.m.	6:00 p.m.	-	-	-	-	-	-	-	-	-	-

BENEFITS AND COSTS

CSA recommendations suggest a wide range of service design and scheduling changes, as well as new Bus Rapid Transit, crosstown, express, flex and urban routes. Implementation of these CSA recommendations will have eight primary benefits in terms of service effectiveness and cost efficiency for PVTA and its customers. These benefits include:

- Discontinuing unproductive and under-performing route segments and routes. Eliminating under-producing parts of the system will increase service productivity overall.
- Reinvesting saved resources into new services and more productive parts of the systems.
- Simplifying the system overall. This strategy will make PVTA routes and services easier to understand and use, and also easier for system operations.
- Matching service types with the local market. In some cases this means increasing service levels and in others providing service that is more flexible and responsive to the local market.
- Introducing crosstown services to support north-south travel; crosstown routes reduce the need to travel into downtown Springfield in order to travel north or south.
- Increasing connections to and between PVTA transit hubs, and important regional destinations like the Holyoke Mall, the UMass campus and Westfield center.
- Providing more local circulation in local communities, especially Holyoke but also Northampton and Amherst.
- Positioning PVTA for service growth and helping the region meet new developments slated for downtown Springfield (Union Station and MGM casinos) as well as growth in surrounding communities and new rail services.

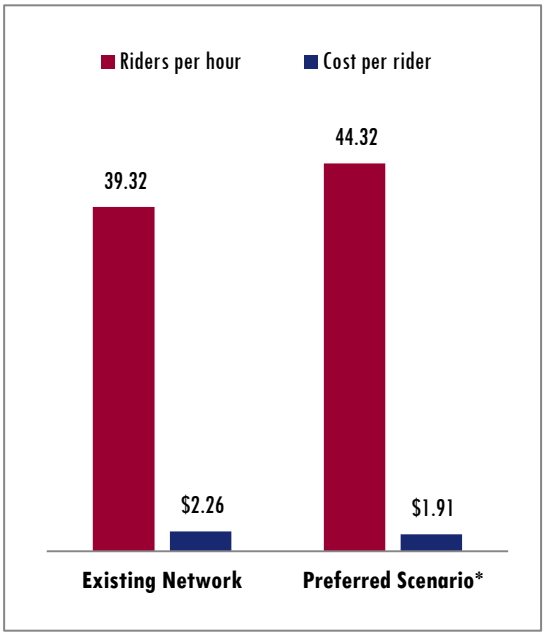
The new route structure is anticipated to attract more riders to the PVTA system and increase ridership by between 10% and 15% due to the availability of faster more direct service in areas that have the highest levels of transit market demand. These improvements will increase the overall levels of service (such as measured by revenue vehicle hours (RVH)) operated by PVTA, but will do so in a more cost-efficient manner, with the overall number of passengers per hour increasing while the cost per rider decreases.

PREFERRED SCENARIO – SERVICE COST ESTIMATES

Operating Costs

The CSA was initially designed to work within PVTA's available budget (in 2013) in terms of both operating and capital costs. However, as additional operating funds will become available, the Preferred Scenario as it is currently designed would increase service costs by an estimated 7%. Operating hours are also expected to increase in the Preferred Scenario calls – also by 7% from roughly 372,500 annual revenue hours to 398,300 annual revenue hours.

These costs estimates are based on a detailed analysis of each route with conservative operational assumptions (i.e. operating speeds and recovery time) that were reviewed with PVTA and PVPC staff. This level of effort was required to ensure that all proposals would work within the available resources. The analysis, however, remains a planning effort and implementation will require more detailed scheduling of the routes, run-cutting and compliance with provisions of the collective bargaining agreement. Therefore, the final costs of the proposal may change. If additional resources are available, they should be reinvested in the system according to some of the priorities outlined in the preferred alternative. At the time this report was prepared (2014), PVTA and PVPC were conducting a more detailed service analysis that evaluated costs and services in more detail, including running the proposals through scheduling software.



Capital Costs - Vehicles

Transit capital costs, include vehicle costs and maintenance as well as transit infrastructure. Similar to the example of operating costs, the CSA Preferred Alternative was largely intended to work within PVTA's existing fleet. The primary constraint is the number of vehicles needed to operate peak period service as this is the maximum amount of vehicles required at any one time. PVTA's current operations have a peak vehicle requirement of 100 (as of Summer 2013) and the proposed CSA has a peak vehicle requirement of 108, an increase of eight vehicles. Also similar to the analysis of operating costs, the peak vehicle requirement reflects a planning rather than operational exercise. Thus, although the estimate is based on sound analysis, there may be differences when the actual schedules are prepared and thus it is possible that full implementation could require more (or less) than 108 vehicles. The CSA, therefore, is expected to require an additional eight to ten additional vehicles, in addition to the normal replacement cycle accounted for in PVTA's normal vehicle maintenance and normal fleet replacement cycles.

Full implementation of the CSA includes development of bus rapid transit service along some of the service area's strongest corridors, State Street and Route 9 between Northampton and Amherst. Implementation of these projects, however, would likely require the acquisition of new vehicles to reflect demand for higher capacity and a higher level of service overall. Additional planning work is required to determine the full extent of the capital investment needed to

implement BRT, as infrastructure costs will vary based on community input and final service design.

Capital Costs – Infrastructure

The Preferred Alternative also assumes investment in PVTA's passenger infrastructure to realize full implementation of the concept for improvements in passenger amenities, especially at areas where passengers will wait to transfer between routes outside of the existing hubs. Locations where radial routes intersect with crosstown routes in downtown Springfield should be prioritized for the development of passenger amenities.

Funding for passenger amenities, such as additional shelters and benches, are the responsibility of PVTA. In addition, it is also essential to support passenger transfers with a safe and accessible pedestrian environment (i.e. crosswalks, sidewalks and signalized crossings); these improvements are typically funded by individual municipalities as part of ongoing efforts to improve community livability and walkability. The study team recommends that PVTA work closely with partner municipalities to communicate the importance of these projects, help prioritize particular locations and link infrastructure and transit improvements.

7 CONSISTENCY WITH COMMONWEALTH AND REGIONAL GOALS

In accordance the Massachusetts (MA) Transportation Finance Act of 2013, recommendations to better align service with local and regional demand should be consistent with the Commonwealth's environmental policies, and regional job creation goals and employment needs.

CONSISTENCY WITH MASSACHUSETTS ENVIRONMENTAL POLICY

The recommendations made within the CSA are intended to encourage the use of alternative modes of transportation and reduce overall greenhouse gas emissions through reduced reliance on the automobile. More specifically, through implementation of CSA recommendations, PVTA will help MassDOT achieve several measures outlined in their 2020 *GreenDOT Implementation Plan* (see Figure 7-1).

GreenDOT is a multi-modal, step by step plan to improve environmental practices in Massachusetts, and to achieve these improvements by promoting innovation and sustainability throughout the transportation sector. The plan is driven by three primary goals:

1. Reduce greenhouse gas (GHG) emissions
2. Promote the healthy transportation options of walking, bicycling, and public transit
3. Support smart growth development

Specific tasks for meeting these goals were identified with seven thematic areas. While the responsibility for many of these tasks falls to MassDOT or other transportation agencies, implementation of the CSA recommendations will help PVTA meet four specific GreenDOT tasks by the target date.

Figure 7-1 | Greendot Goals Accomplished by PVTA CSA Implementation

GreenDOT Theme/Goal	Task	Target Date	Measures accomplished by PVTA
Air			
Improve statewide air quality	Implement bus route efficiency measures	2015	All CSA recommendations to improve bus route efficiency to be implemented by 2015.
Planning Policy & Design			
Design a multi-modal transportation system	Improve traffic controls to reduce vehicle emissions	2020	CSA recommends PVTA and local municipalities work with MassDOT to implement traffic signal priority in two Bus Rapid Transit corridors.
	Improve transit system performance	2015	PVTA will have completed CSA by 2015. Measures to be implemented include: ▪ Bus stop consolidation on key routes ▪ New express bus services ▪ Improvements to overall service efficiency while increasing ridership ▪ Introduction of Bus Rapid Transit by 2020
Promote Healthy Transportation & Livable Communities	Encourage Walking, Biking and Transit	2015	CSA calls for pedestrian improvements (crosswalks, sidewalks and signalized crossings) and bus stop improvements to create a safer walking environment for bus riders.

CONSISTENCY WITH REGIONAL JOB CREATION GOALS / EMPLOYMENT NEEDS

The final recommendations are designed to deploy PVTA services in the most effective way possible to accommodate the transit needs of the region's workforce. More specifically the CSA will strengthen access to employment:

- By implementing new peak period/commuter oriented express services, including a new Route 5X Express to Enfield that will increase access to employment at Mass Mutual as well as connections to Connecticut Transit (CTTransit).
- Daily express service between Amherst, Holyoke, the Holyoke Mall and downtown Springfield that will increase the accessibility of employment in Amherst, Springfield and Holyoke.
- Faster, more direct service along State Street in downtown Springfield, the corridor with the highest density of employment in the region.
- More direct service to the Holyoke Mall, one of the regional employment centers especially for part-time work.
- Service to Six Flags Amusement Park in Agawam during the summer months. This new route will ensure seasonal jobs at Six Flags are accessible via a low cost mode.
- More service on Saturdays and Sundays and longer operating hours on Saturday and Sunday that increases access to weekend jobs.
- More service overall – in terms of both hours of service and service miles.
- Increase in PVTA drivers and mechanics resulting from increase in serivce.

CONSISTENCY WITH PIONEER VALLEY'S COMPREHENSIVE ECONOMIC DEVELOPMENT STRATEGY

The Pioneer Valley region is designated as an Economic Development District by the U.S. Department of Commerce. As the regional planning entity, the Pioneer Valley Planning Commission prepares annual updates to the Comprehensive Economic Development Strategy (CEDS) Report required by the Department of Commerce.

The 2013 Annual CEDS Report, *Pioneer Valley Plan for Progress*[1] provides a status report on the region's economy and sets forth a number of Strategic Goals to address local economic development challenges and to maximize economic opportunity for local residents. These goals relate to growing and expanding the region's economic base, developing a green economy, and supporting business clusters. Several goals aim to support higher education and workforce development, two areas in which access and mobility are critical and where transit can clearly play an important role.

Deploying PVTA's transit services in the most effective way possible to accommodate the transit needs of the region's workforce was one of the key objectives of the CSA. The Transit Market Analysis described in Chapter 3 mapped areas with high densities of employment, as well as the locations of major employers and employment centers. The geographical locations of low income residents and others who rely on transit service to access employment, education, training and other services were also mapped. This data was then used to identify core transit markets and where regional connections between population and employment centers should be strengthened.

Enhancing infrastructure is a stated goal of the CEDS Report which notes that PVTA is part of a well-developed regional public transit system and a vital contributor to mobility options for the region's residents.

CONSISTENCY WITH PIONEER VALLEY'S EFFORTS TO COORDINATE SERVICE WITH OTHER RTA'S

PVTA is committed to providing connections not only internally within the network but also with other regional transit authorities in Massachusetts as well as well as transit agencies operating in adjacent communities, such as Connecticut Transit (CTTransit).

As part of the CSA, PVTA explored opportunities to strengthen the connections between PVTA and the Franklin Regional Transit Authority (FRTA), a public transportation provider operating in Franklin County in western Massachusetts. FRTA serves a largely rural area, although the service area is punctuated by a handful of small towns, such as Greenfield. As a result, FRTA has designed regional services to make connections to adjacent service areas. Two of these services – Route 23 and 31 – are designed to connect Franklin County residents with regional service centers, such as UMass, Amherst and Northampton.

Routes 23 and 31 terminate at PVTA hubs where there is a convergence of routes so that riders can transfer to other transit services and reach a broad range of destinations. PVTA operate on a loose "pulse" system, so while routes are timed to facilitate connections to other services but there is no single time point that is shared by the majority of all routes. As part of understanding opportunities to strengthen connections between PVTA and FRTA, the study team considered which transfers are reasonable (as defined by the wait time between routes) and where/how they may be improved.

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[1] *2013 Annual Comprehensive Economic Development Strategy (CEDS) Report, The Pioneer Valley Plan for Progress, prepared by the Pioneer Valley Planning Commission, August 2013.*

As part of its services, FRTA operates six fixed routes, including three routes that connect to other transit systems outside of Franklin County; two of these routes connect to PVTA:

- Route 23 operating between Olver Transit Center in Greenfield and the Haigis Mall on the University of Massachusetts campus in Amherst.
- Route 31 operating from Olver Transit Center in Greenfield to the Academy of Music in downtown Northampton.

The UMass campus and downtown Northampton are both service hubs for the PVTA system and offer connections to a variety of other transit routes that bring travelers to local and regional destinations. Based on a detailed analysis of ridership on the FRTA routes (see Appendix E), the analysis suggests the following recommendations:

- **PVTA should not invest resources in providing connections to FRTA Route 23.** Ridership on this route is sufficiently low that continuation of the service should be examined.
- **FRTA Route 31 should be extended to meet PVTA Route 31 in Sunderland.** This connection will allow people from Greenfield to get to/from the UMass campus and PVTA Route 31 has very frequent service departing from Sunderland center making transfers between routes convenient. Another opportunity would be to realign PVTA Route 31 so a portion of the trips would be scheduled to meet FRTA Route 31 at the Whately/South Deerfield Park and Ride lot.
- **Schedule FRTA Route 31 so it arrives in Northampton on the hour.** Arriving on the hour will facilitate connections to Holyoke, Hadley and Amherst and destinations within Northampton.

APPENDIX A

Market Analysis and Survey

Pioneer Valley Transit Authority
COMPREHENSIVE SERVICE ANALYSIS

TRANSIT MARKET ANALYSIS

April 2013

PVTA

NELSON NYGAARD

ASG PLANNING

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FIGURE 1 | PVTA SERVICE AREA

1 INTRODUCTION

The Pioneer Valley Transit Authority (PVTA) serves the City Springfield and 24 surrounding towns in western Massachusetts (see Figure 1). PVTA retained a consulting team led by Nelson\Nygaard Consulting Associates to prepare a Comprehensive Service Analysis (CSA). A key part of this process involves understanding the underlying demand and market for transit services in PVTA's service area.

PVTA's service area in western Massachusetts, similar to regions across the country, is constantly changing. To ensure transit services adjust to changes in the local and regional communities, PVTA needs to consider these changes, assess the implications for transit services and adjust services accordingly. ***The purpose of this market analysis is to examine the underlying demographic and socio-economic conditions in the PVTA service area, as they relate to the demand and need for transit services.***

There are a series of factors that determine the demand for transit, indicate the use of transit services and influence the type of transit needed:

1. Market conditions, such as the size, distribution and density of population and employment.
2. Urban form and land uses, including how well the built environment supports pedestrians and to a lesser extent cyclists.
3. Transit service design, including the types and frequency of individual routes and the overall structure of the transit network.
4. The convenience and cost of other alternatives; this factor includes congestion and travel times as well as the supply and price of parking.

The focus of this analysis is on understanding the market and demand for transit service, which is largely defined by:

- ***Population and employment density,*** which is the strongest indicators of transit demand. Put simply, larger numbers of people living and working in close proximity leads is a stronger market for transit.
- ***Socio-economic characteristics***, such as income, auto availability, minority status, and age, are characteristics indicative of a higher propensity to use transit, and thus are an essential part of market demand.
- ***The location of major activity centers***, which indicates where people desire to travel.

It should be stressed that while each of these factors indicates demand for transit, there are other factors that will impact use of service. As discussed, these include urban form, land uses, pedestrian environments and the convenience of other alternatives. Nearly all transit riders walk to/from the bus on at least one end of their trip, thus the pedestrian environment strongly impacts ridership. Industry standards suggest that transit riders will walk one-quarter of a mile to transit; however, in comfortable pedestrian environments, riders will walk longer distances. Likewise, in areas with minimal traffic congestion and ample parking will have a more difficult time attracting transit riders. Thus, even in cases where the demand for market is strong, service must be designed appropriately to appeal to local markets and consider the broader travel environment.

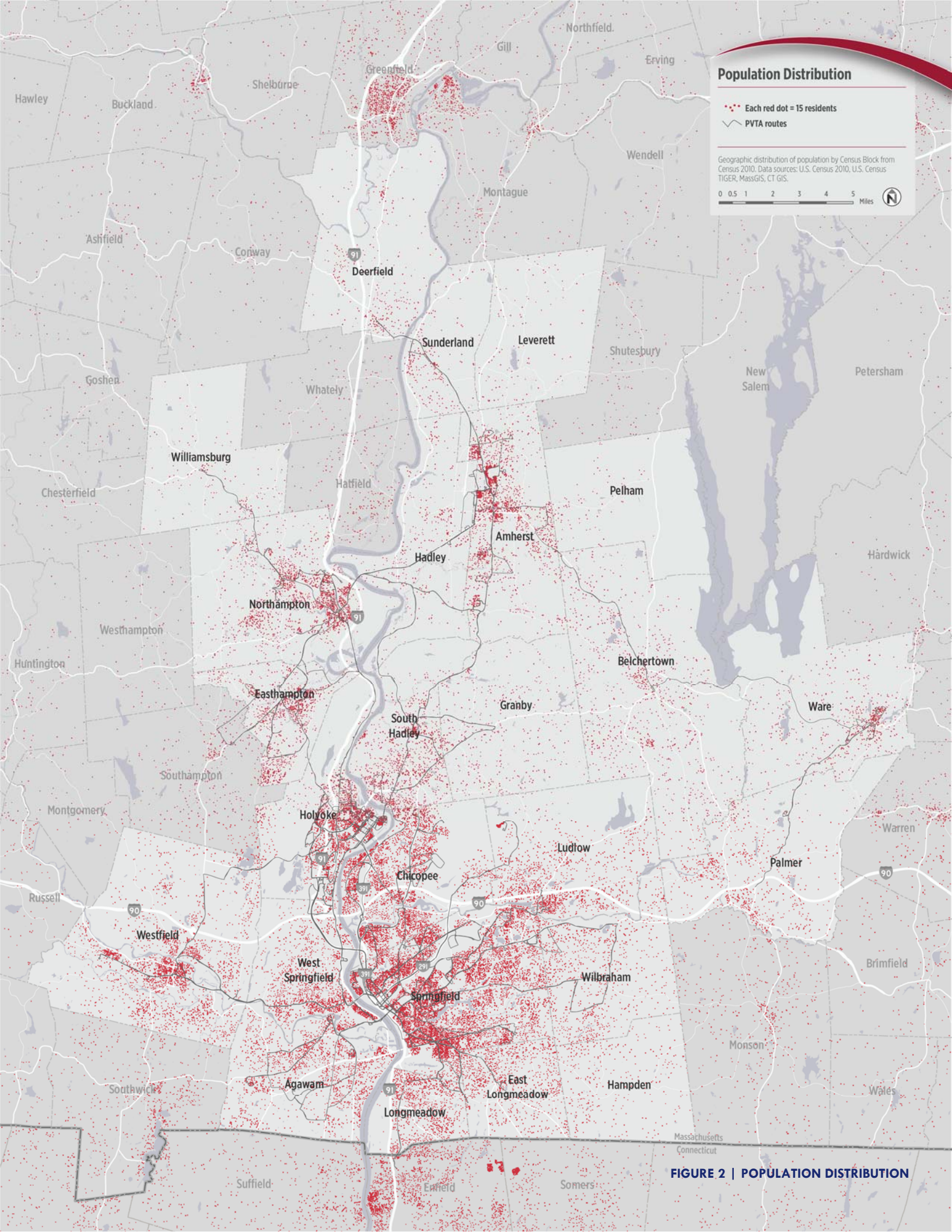


FIGURE 2 | POPULATION DISTRIBUTION

2 POPULATION

As discussed, the distribution and density of population is a key factor influencing the viability of transit service because most riders walk to/from the bus on at least one end of the trip. Higher density communities have more people within walking distance of bus routes, and thus are stronger markets for transit. Together with employment density, population density is the most important determinant of transit demand.

- Transit needs to serve sufficiently high volumes of travelers to be cost-effective, and the density of development determines the overall size of the travel market. The reach of transit is generally limited to within ¼- to ½-mile of the transit line or station, and thus the size of the travel market is directly related to the density of development in that area.
- Transit service design and service levels are closely related to population density. Areas and corridors with higher densities support higher frequencies, while lower density communities support different types of transit services, including lower frequency or demand response modes.

Nelson\Nygaard's analysis of population is based on data by census block adapted from the US Census 2010; population is shown together with PVTA's route network in Figure 2. This data shows:

- The most significant population cluster in the service area is Springfield and, secondarily the Connecticut River (and I-91 corridor) north to Holyoke. This area also has the highest concentration of PVTA service.
- There are also moderate population clusters in the immediate suburbs of Springfield, including Chicopee, West Springfield, and Westfield. While Chicopee is well served by PVTA routes, service in West Springfield and Westfield service is more limited.
- The population clusters of Springfield, Chicopee, West Springfield, and Holyoke are somewhat easier to serve because they are clustered and located along a primary north-south corridor.
- Pockets of population are also found in Amherst, Northampton and Easthampton; Amherst includes the student residents of UMass Amherst. These clusters of population are fairly isolated and separated by large areas with small populations. Transit services that connect these communities, therefore, are unlikely to travel through strong markets.
- Outlying communities such as Pelham, Williamsburg, Ware, Palmer, and Hampden have significantly fewer residents. In general, these communities have very limited fixed-route service.

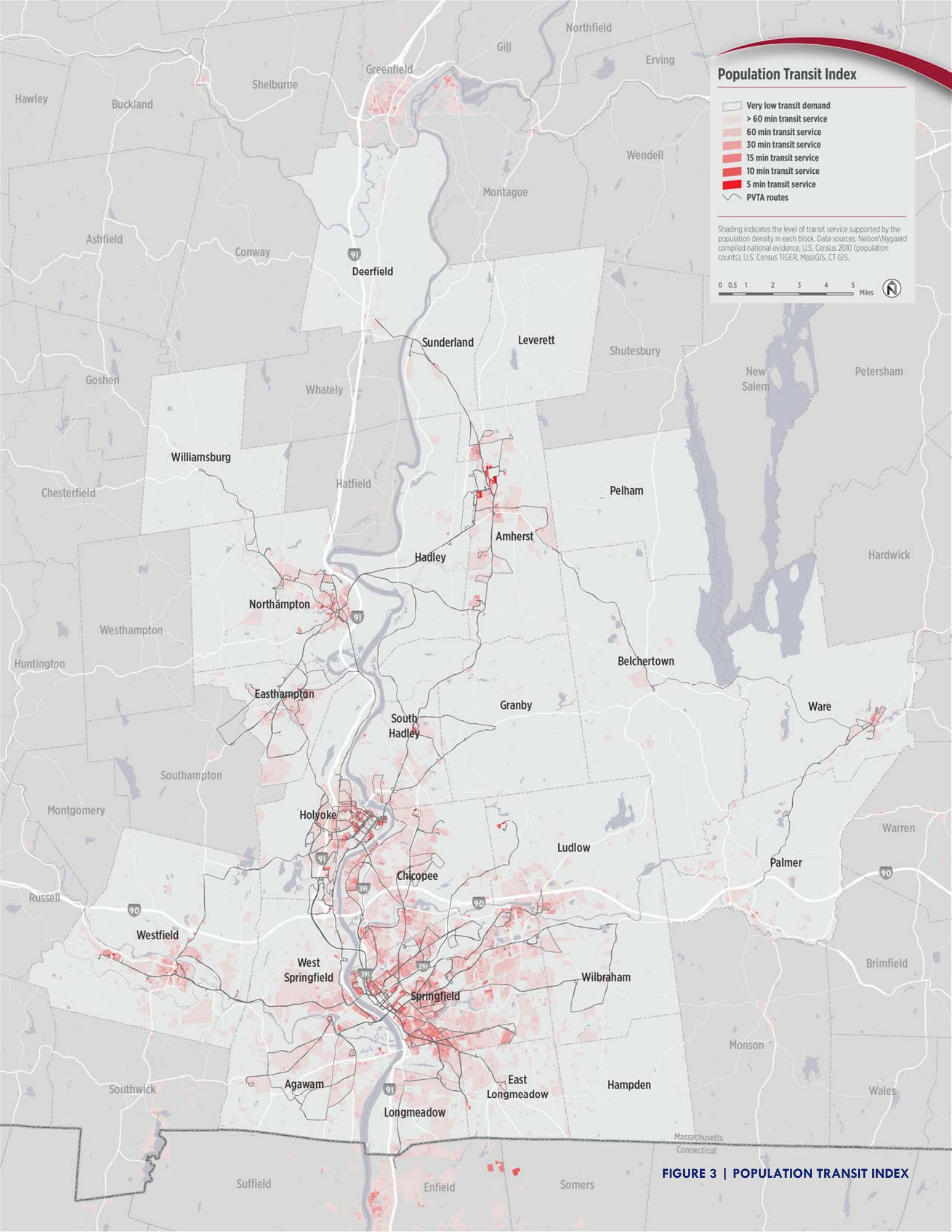


FIGURE 3 | POPULATION TRANSIT INDEX

3 POPULATION TRANSIT INDEX

Complementary to population, is population density. Nelson\Nygaard uses national evidence to tie population density to transit service demand in order to graphically show the likely demand for transit service, expressed in the frequency of service that could be supported. Nelson\Nygaard's sources for this analysis include a variety of academic studies and our national transit planning experience to create aggregated transit-supportive population densities (see Table 1); this information indicates minimum population densities required to support various levels of transit service.

TABLE 1 | TRANSIT-SUPPORTIVE POPULATION DENSITIES

TRANSIT SERVICE LEVEL	MINIMUM POPULATION/ACRE
Flex Bus	0.5
Community Circulator	2
Local Bus	
60-minute frequency	8–16
30-minute frequency	16–31
15-minute frequency	31–47
10-minute frequency	47–92
5-minute frequency	>92

Source: Nelson\Nygaard compiled from various national sources.

The population density of census blocks in the market area was indexed to the values in Table 1 and mapped for the PVTA service area (Figure 3). This analysis suggests that, based on population density:

- Springfield has sufficient population density to support moderately high levels of transit service and this density is fairly consistent along east side of the Connecticut River/I-91 corridor. Holyoke also has fairly strong population density as it relates to transit service.
- Northampton, Easthampton, Westfield, Ludlow, and West Springfield contain moderately dense town centers that are relatively transit-supportive. Data suggests parts of these communities could support transit service at 30-minute frequency; however, population densities between communities mean services traveling between town centers may sacrifice productivity.
- Population in Amherst is concentrated along the Pleasant Street / West Street corridor, which could support 60-minute fixed-route service. However, UMass Amherst residents add significant demand for transit service in Amherst.
- Much of PVTA's service area has very low population density and supports only low levels of transit service. Several communities, such as Deerfield, Leverett, Williamsburg, Granby, Pelham, and Hampden, are unlikely to support any fixed-route service at all.
- Overall, transit service appears relatively well-matched to demand. The exception may be Westfield; data suggests the community may be able to support a greater level of transit service than currently provided.

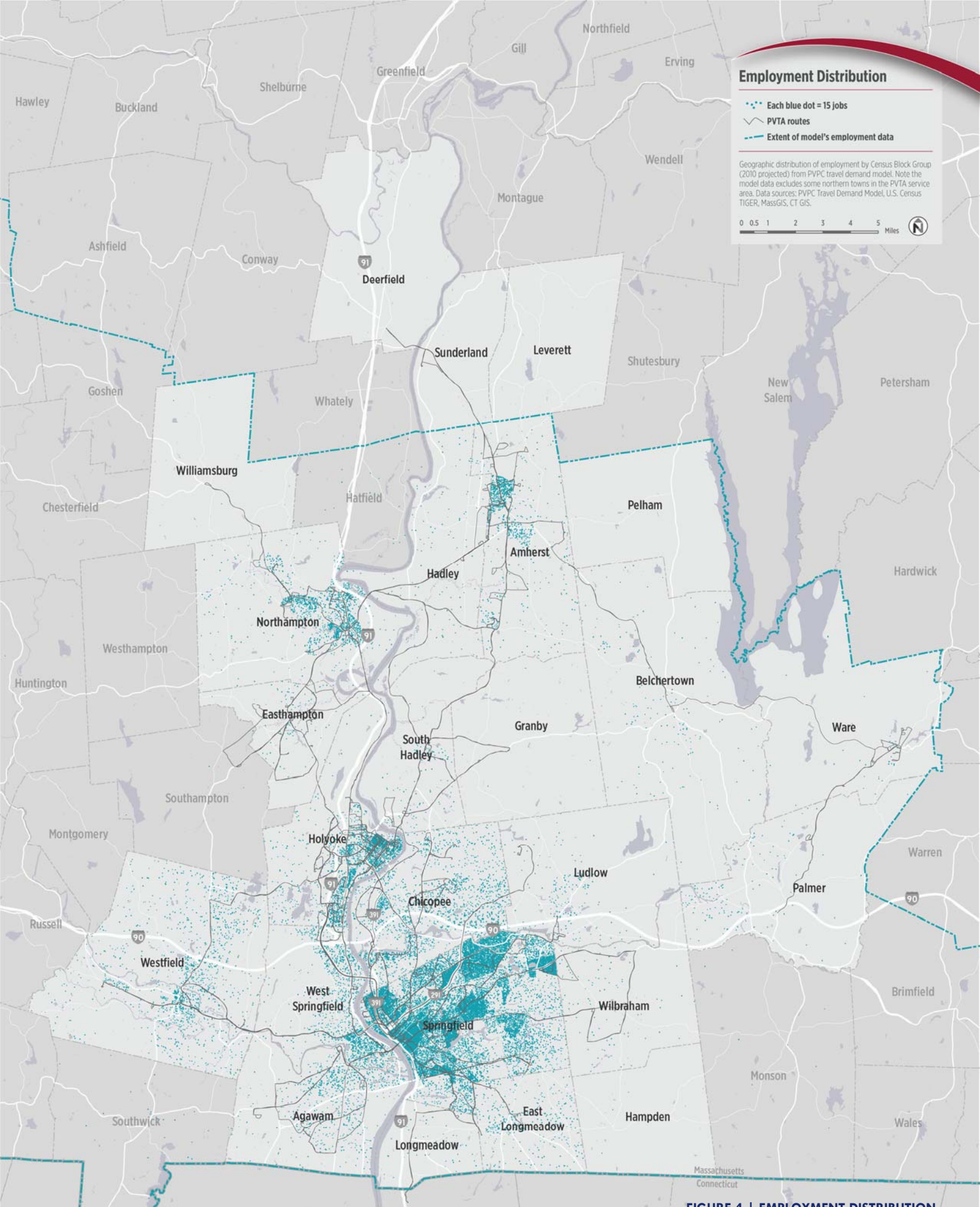


FIGURE 4 | EMPLOYMENT DISTRIBUTION

4 EMPLOYMENT

Understanding the size and distribution of employment is also a critical part of understanding travel demand and markets. This is because traveling to and from work accounts is the most frequent reason for travel and often is a fairly predictable trip that with repeating patterns. In addition, transit that serves areas of high employment density provides key connections to job opportunities.

The study team used the Pioneer Valley Planning Commission's (PVPC) travel demand model to estimate the number of employees per census block group. The model excludes three towns (Deerfield, Sunderland and Leverett) in the northern part of PVTA's service area, as shown by the boundary on the map. Also, the geographic unit of analysis for the employment data is the census block group, which is larger than the census block, leading to less detail in this data.[1]

Analysis of this information and Figure 4, reveal several findings:

- Springfield is home to the overwhelming majority of jobs in the market area. Unlike population which clusters along the I-91 corridor between communities, employment is clustered within Springfield and oriented more closely along an east-west pattern, south of I-90.
- Central Springfield has the highest concentration of jobs, though the entirety of northern Springfield (east to the Wilbraham town border) is home to a large number of jobs. This area is well-served by the PVTA network, and trips to a wide variety of destinations are possible.
- West Springfield, Holyoke, Northampton and Amherst have moderate job clusters in their community centers and also seem to have an appropriate level of service.
- Many communities have very few jobs. These include Hampden, Wilbraham, Ludlow, Palmer, Ware, Belchertown, Granby, South Hadley, Pelham, and Williamsburg.

[1] *The U.S. Census' Longitudinal Employer-Household Dynamics program publishes employment data at the block level for 49 states, excluding Massachusetts. This is why employment data is only available at the block group level.*

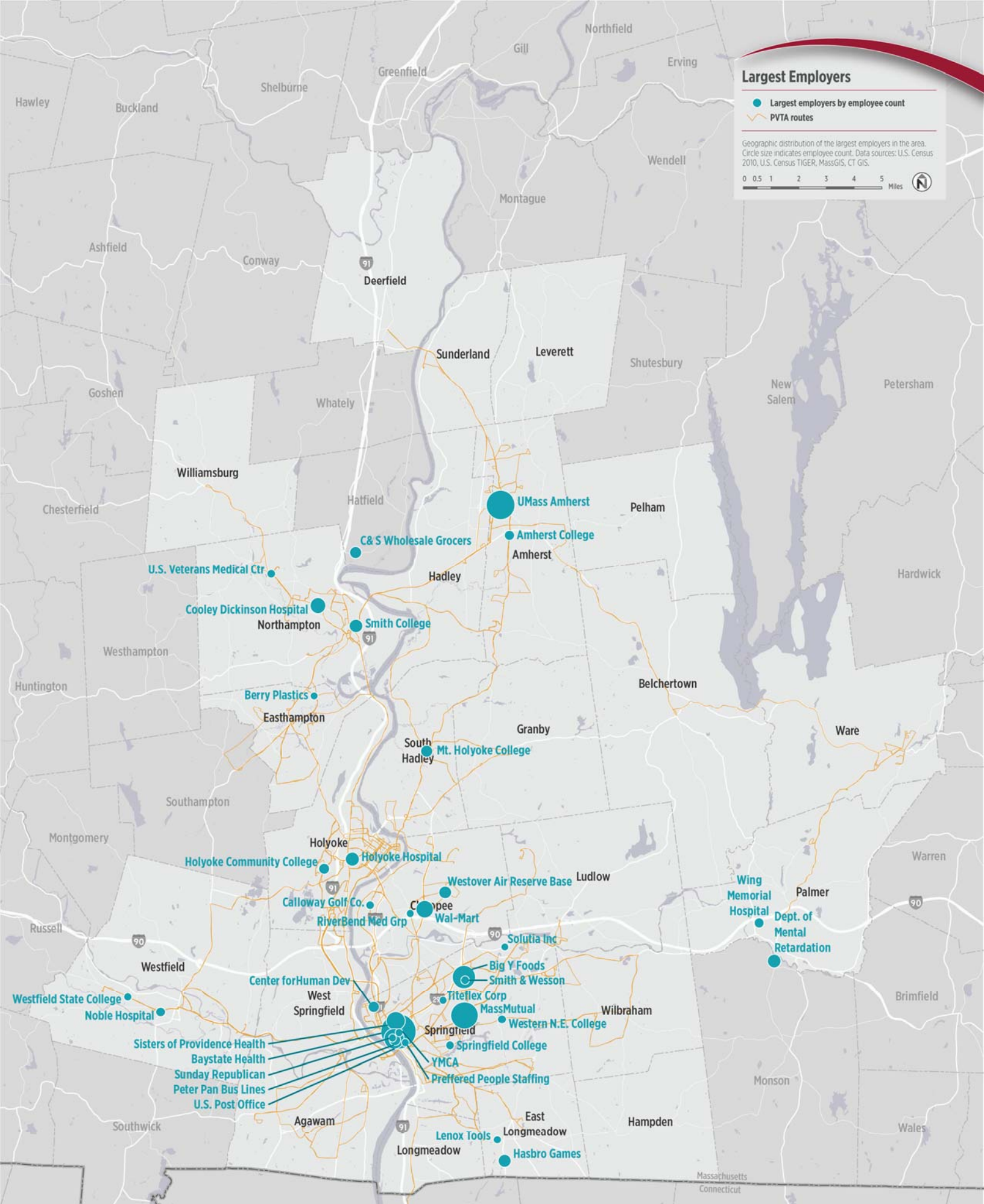


FIGURE 5 | LARGEST EMPLOYERS IN SERVICE AREA

5 MAJOR EMPLOYERS

In addition to understanding employment generally, the market analysis also considers the service area's largest employers. Discrete sites of significant employment can generate additional demand for transit beyond the underlying demand of the surrounding area. In addition, these sites are often easier to serve with transit, since a large number of workers need to travel to and from the same work site location; and in some cases at similar times.

The study team used the PVPC's *2008 Major Employers for the Pioneer Valley Region* report to identify employment sites with 500 or more employees (see Table 2 and Figure 5):

- Of the six largest employers in the market area, five are located in Springfield.
- The major employer not located in Springfield is UMass Amherst; this is also the second largest employer in the region.
- There are multiple medical institutions on the list of large employers, including the largest employer, Baystate Health Systems.
- Education is major industry in the PVTA service area. There are multiple higher-educational institutions in the region including Smith College, Mount Holyoke College, and Holyoke Community College (in addition to UMass Amherst).
- Most major employment sites are served by at least one PVTA fixed-route service. Exceptions include Hasbro games, Wing Memorial Hospital, C&S Wholesale Grocers, and the Department of Mental Retardation.

TABLE 2 | EMPLOYMENT SITES WITH 500+ EMPLOYEES

EMPLOYER	EMPLOYEES	EMPLOYER	EMPLOYEES
Baystate Health Systems	6,565	Amherst College	840
University of Massachusetts Amherst	4,776	Wing Memorial Hospital	740
MassMutual Financial Group	4,366	Noble Hospital	669
Big Y Foods	3,337	Calloway Golf Company	650
U.S. Post Office	2,520	Springfield College	650
Sisters of Providence Health System	2,253	U.S. Veterans Medical Center	640
Cooley Dickinson Hospital	1,683	Western New England College	589
Holyoke Hospital	1,404	Smith & Wesson	587
Wal-Mart Chicopee	1,386	RiverBend Medical Group	554
Smith College	1,296	Lenox Tools	550
Department of Mental Retardation	1,232	Westfield State College	550
Hasbro Games	1,100	Berry Plastics	545
Westover Air Reserve Base	1,100	Solutia	512
C&S Wholesale Grocers	1,029	YMCA	505
Mount Holyoke College	1,000	Preferred People Staffing	500
Center for Human Development	945	Sunday Republican	500
Holyoke Community College	940	Titeflex	500
Peter Pan Bus Lines	864	Wal-Mart Chicopee	500

Source: 2008 Major Employers for the Pioneer Valley Region.

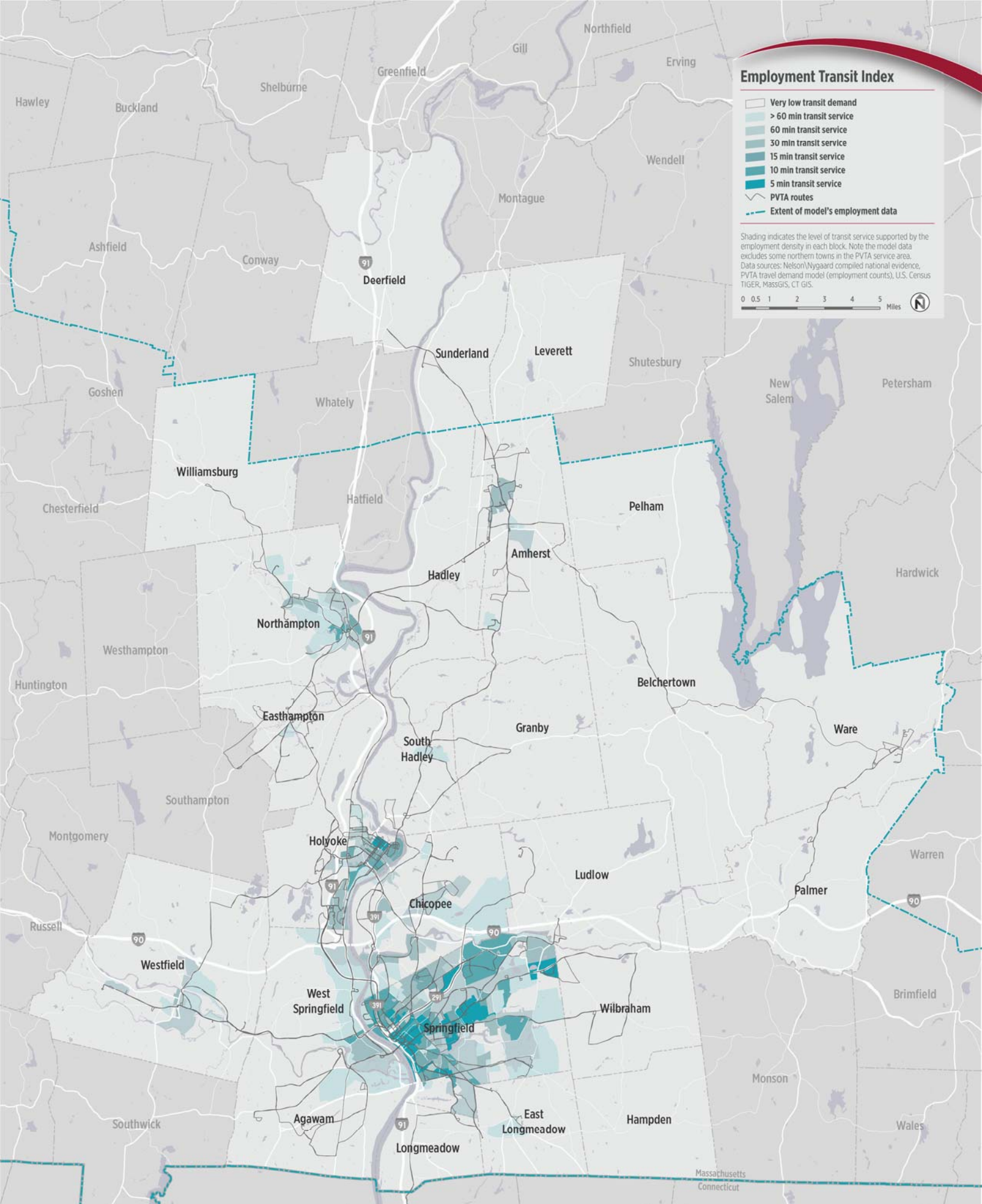


FIGURE 6 | EMPLOYMENT TRANSIT INDEX

6 EMPLOYMENT TRANSIT INDEX

Similar to the population transit index presented in Section 3, Nelson\Nygaard used national evidence to determine the level of transit service supported by the various employment densities throughout the PVTA service area (see Table 3). Similar to the population transit index, the employment density of census block groups in the market area was indexed to the values in Table 3 and mapped (see Figure 6). Note, as discussed, the limited boundary of the model's employment data and the census block group data yields less detail than the population data at the census block level.

TABLE 3 | TRANSIT-SUPPORTIVE EMPLOYMENT DENSITIES

TRANSIT SERVICE LEVEL	MINIMUM EMPLOYMENT/ACRE
Flex Bus	–
Community Circulator	–
Local Bus	
60-minute frequency	4–8
30-minute frequency	8–16
15-minute frequency	16–24
10-minute frequency	24–48
5-minute frequency	>48

Source: Nelson\Nygaard compiled from various national sources.

Employment densities suggest several findings relative to transit service:

- Even more so than population, transit-supportive employment densities are heavily clustered in Springfield. Much of Springfield has sufficient employment to support significant transit service, even service at 5-minute frequencies. This is consistent with PVTA's service structure which has the greatest concentration of transit service in Springfield and offers numerous travel options.
- Holyoke and Northampton also have moderately significant clusters of employment, though to a much lesser degree than Springfield. These town centers could support moderate transit service, though they are geographically dispersed (particularly Northampton) and, thus potentially more difficult to link efficiently.
- Much of the market area does not have sufficient employment density to support fixed route transit service. This includes the entire communities of Ware, Palmer, Belchertown, Pelham, Hadley, Williamsburg, Granby, Longmeadow, Hampden, Ludlow, and Wilbraham.

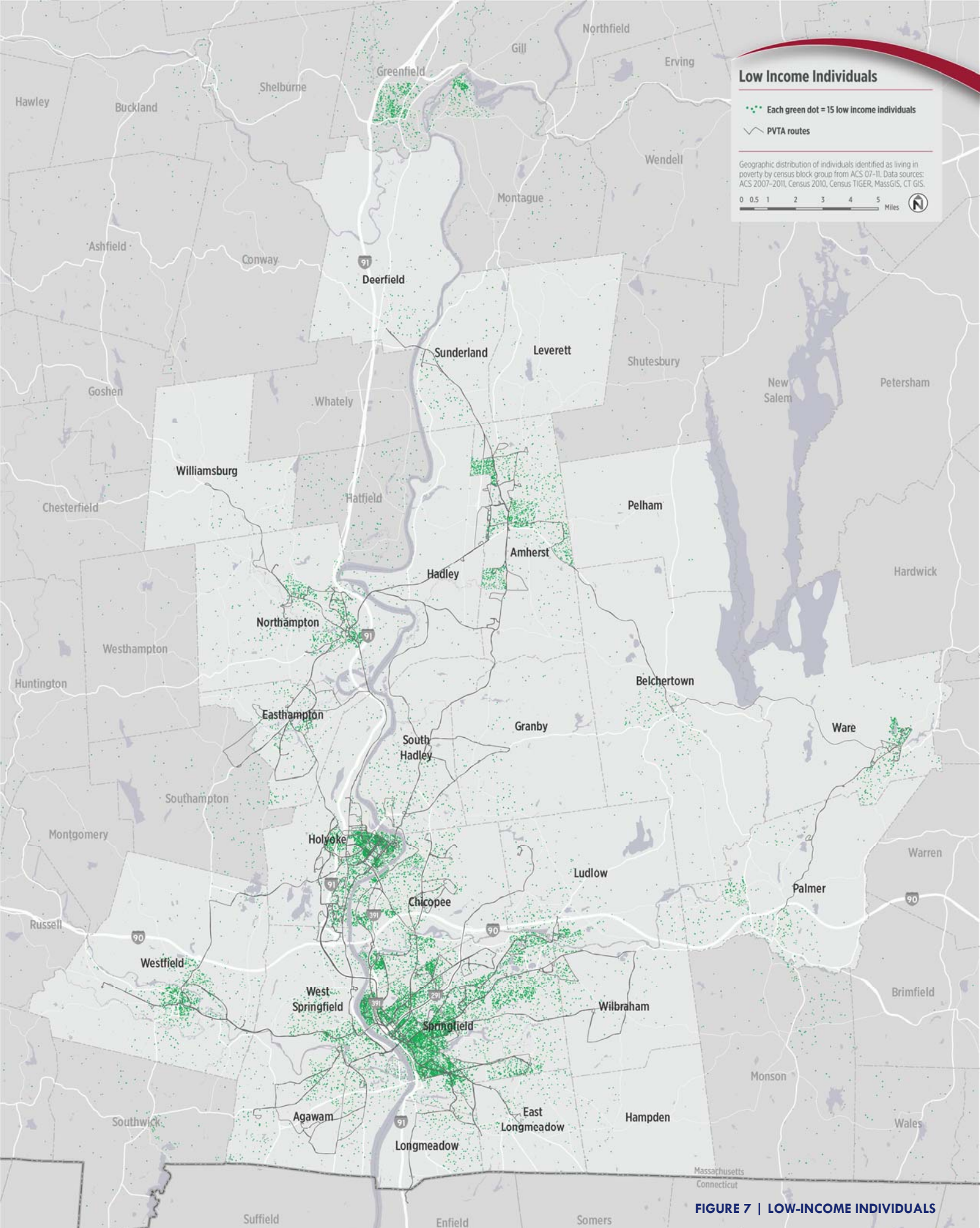


FIGURE 7 | LOW-INCOME INDIVIDUALS

7 DEMOGRAPHIC CHARACTERISTICS - LOW INCOME INDIVIDUALS

Previous sections of the market analysis considered population and employment. In this section, our analysis considers the characteristics of the underlying population and in particular looks for key characteristics that indicate a demand and need for transit service.

In general, when discussing the potential markets for transit, planners generally categorize the market into two types of riders:

- **Discretionary riders** who have sufficient resources and ability to operate private vehicles but choose to use transit because it provides a comparatively attractive option, or they make other lifestyle choices that lead them to use transit. Discretionary riders are more likely to use transit to travel to/from work, but may also use transit in other circumstances.
- **Transit-dependent riders** who use transit services because they always or sometimes are unable to travel by private vehicle. These riders may not be able to afford a private vehicle or may be unable to operate one. They tend to rely more on transit than discretionary riders and are more likely to use transit for most or all of their travel, including to/from appointments, shopping, and entertainment/recreation.

Income status is the strongest indicator of a higher-than-average propensity to use transit; people with lower incomes are less likely to be able to reliably afford a private vehicle and thus are more likely to use transit. Nelson\Nygaard used the U.S. Census' classification of poverty status to define and identify low income individuals. Disposable income is largely a factor of household size and household income, the U.S. Census considers household income and the number of members in the household in classifying a household as in poverty or not. The distribution of individuals with low incomes (those living in a household considered in poverty by the Census) is shown in Figure 7. The data is from the U.S. Census' American Community Survey at the census block group unit of analysis. Findings include:

- The largest cluster of low-income individuals is in central Springfield, primarily along the I-91 corridor east of the Connecticut River, but also on the eastern corridor, just south of I-281. This is also PVTA's densest concentration of fixed-route service
- Holyoke also contains a large cluster of low income individuals and is also well-served by PVTA.
- Some moderate clusters of low income individuals exist in towns along the perimeter of the service area, such as Easthampton, Northampton, Westfield, and Ware. With some exceptions, transit service in these areas is somewhat oriented toward travel to/from Springfield, limiting the travel choices of some of these lower income individuals and families.
- Many towns have very few low income individuals, such as Longmeadow, East Longmeadow, Wilbraham, Palmer, Belchertown, Granby, Hadley, Pelham, Leverett, and Williamsburg.

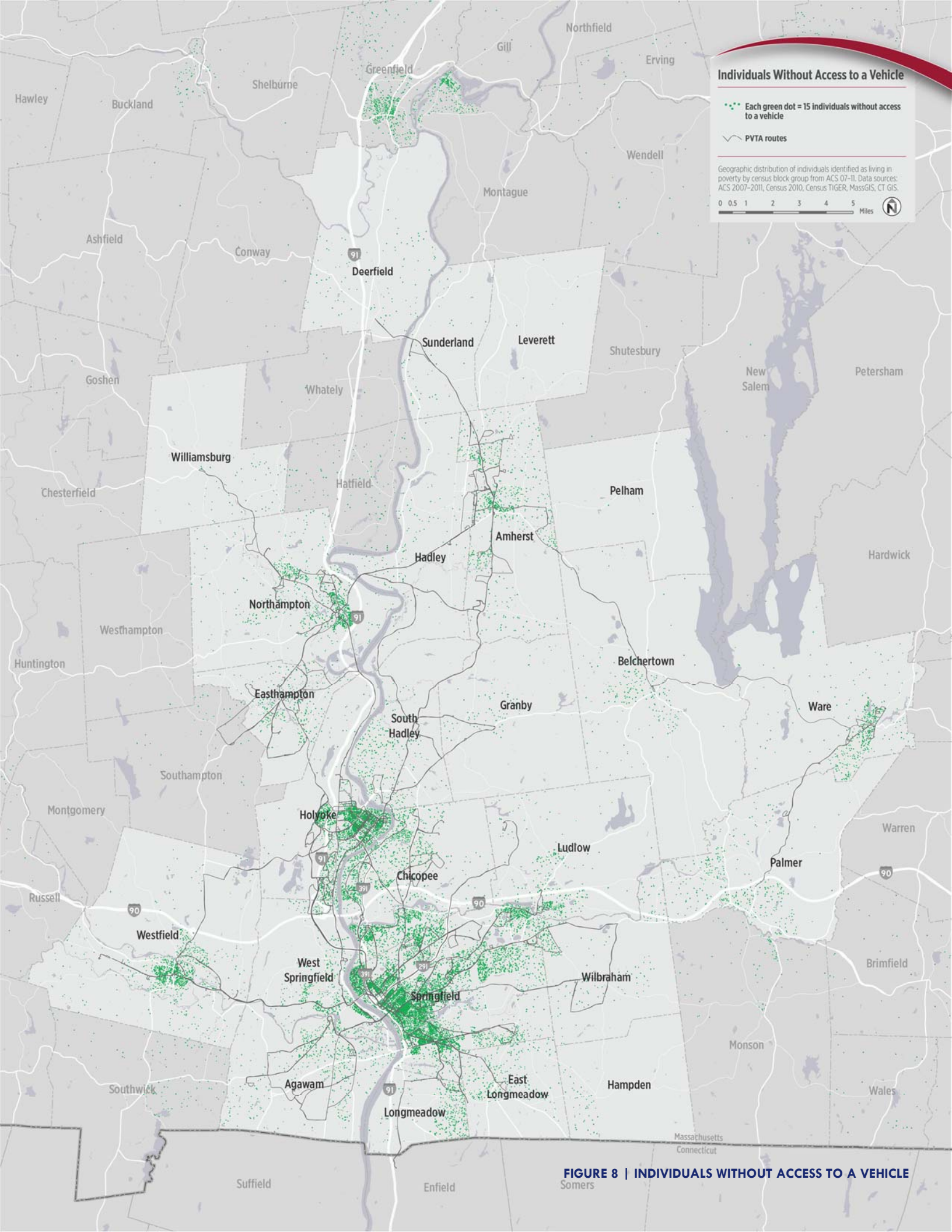


FIGURE 8 | INDIVIDUALS WITHOUT ACCESS TO A VEHICLE

8 DEMOGRAPHIC CHARACTERISTICS – INDIVIDUALS WITHOUT ACCESS TO A VEHICLE

For self-evident reasons, individuals without access to a vehicle represent a particularly strong market for transit. In many cases, individuals do not have access to an automobile, while in others; individuals do not own a car because they choose to use transit as their primary mode of transportation. Identifying clusters of this group helps identify areas that have transit-dependent riders.

The study teams used the U.S. Census' annual American Community Survey data, which collects information on individuals who do not have regular access to a vehicle. The geographic unit of analysis for this data is the census block group.

Findings include:

- Individuals without access to a vehicle are heavily clustered in densely developed and populated areas, where transit service is most readily available. This is expected, as these highly transit-dependent individuals typically choose to locate in areas where they perceive transit service to be reliably available over the long-term.
- Conversely, less densely developed areas have significantly fewer individuals without access to a vehicle. Without access to consistent and enduring transit service in these areas, having access to a vehicle becomes more of a necessity. These towns include Williamsburg, Deerfield, Sunderland, Leverett, Pelham, Belchertown, and Hampden.
- Springfield and Holyoke have the largest number of individuals without access to a vehicle. Both town centers have a high level of transit service, with good connectivity throughout the PVTA network.
- Westfield has a moderate cluster of individuals without access to a vehicle and has limited fixed route service. There may be latent demand for additional transit service due to this cluster of highly transit-dependent population.

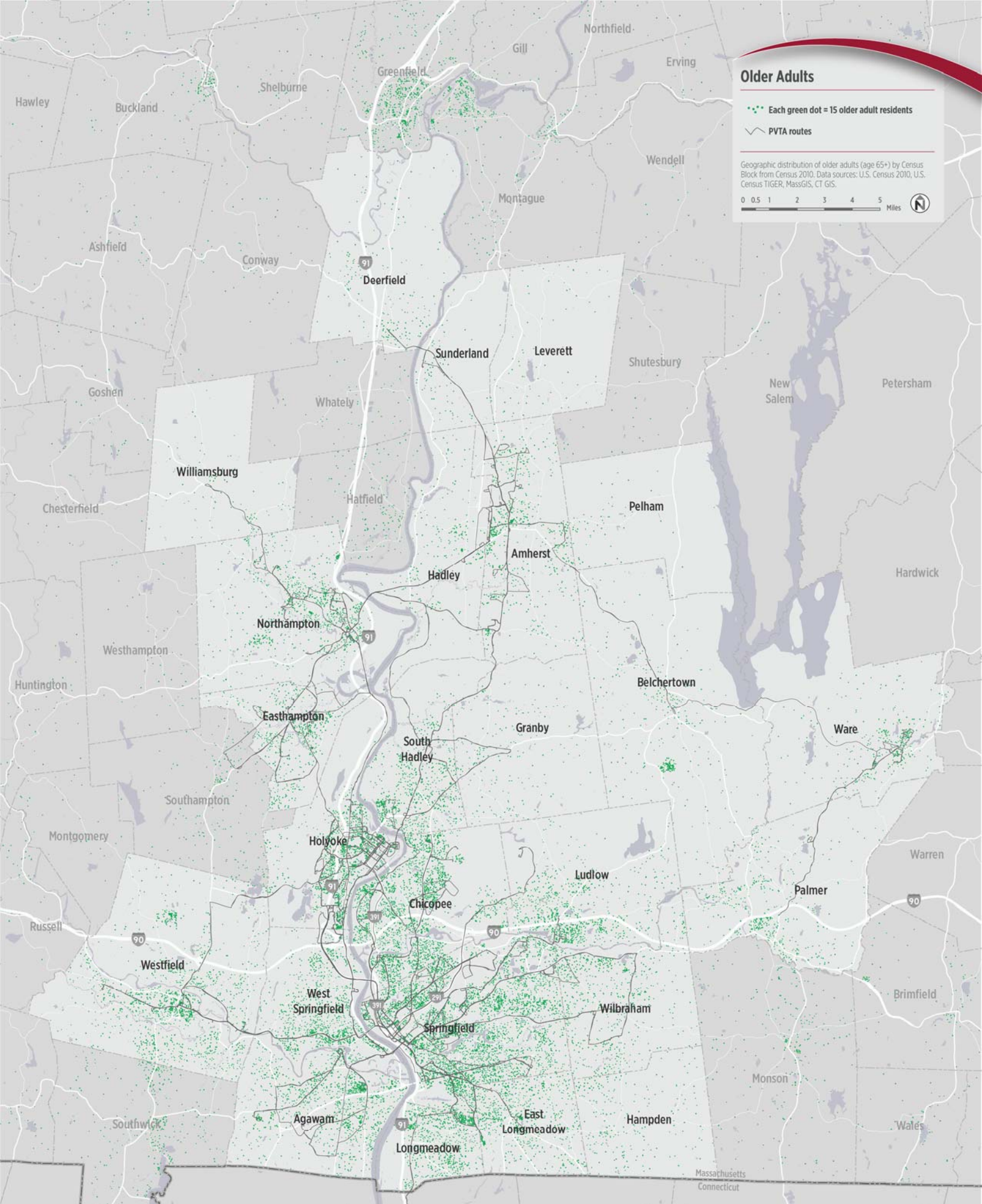


FIGURE 9 | OLDER ADULTS

9 DEMOGRAPHIC CHARACTERSITICS - OLDER ADULTS

Older adults (those 65 years and older) are more likely to ride transit than the general population. Older adults are more likely to ride transit for a variety of reasons, including increased (relative to the larger population) incidence of an inability to own or operate a private vehicle. Older adults are an important market for transit, in part because it is this demographic group is increasing so dramatically. In 2000, 35 million Americans were aged 65 and over, representing 12.4% of the total population. By 2010, older adults grew to 40 million, or 13.0% of the total population. This trend is expected to continue and accelerate as the Census Bureau projects older adults will grow to some 70 million people by 2030 and represent 20% of the total population. Understanding the distribution of older adults is therefore important in identifying areas of more transit-dependent riders.

The study team used population counts of individuals aged 65+ by census block from Census 2010 (see Figure 9). Findings include:

- Overall, the distribution of older adults roughly tracks with the population in general. However, older adults are somewhat more likely to live in suburban environments and outlying communities, and less likely to live in city centers. This is evident in downtown Springfield, which has a lower proportion of older adults to total population. Older adults are also less concentrated along the I-91 and I-281 corridors and more dispersed throughout the city.
- Since older adults tend to live outside of town centers, they tend to have less access to fixed-route transit. Outside of town centers, older adults likely rely on demand response services. The relationship between demand and supply of these demand response services need consideration, especially in communities with higher numbers of older adults, such as Ludlow, Wilbraham, and Westfield.
- Of the transit-dependent groups considered in this market analysis, older adults exhibit less clustering and are more dispersed throughout the market area. This makes this group more difficult to serve with fixed-route service.

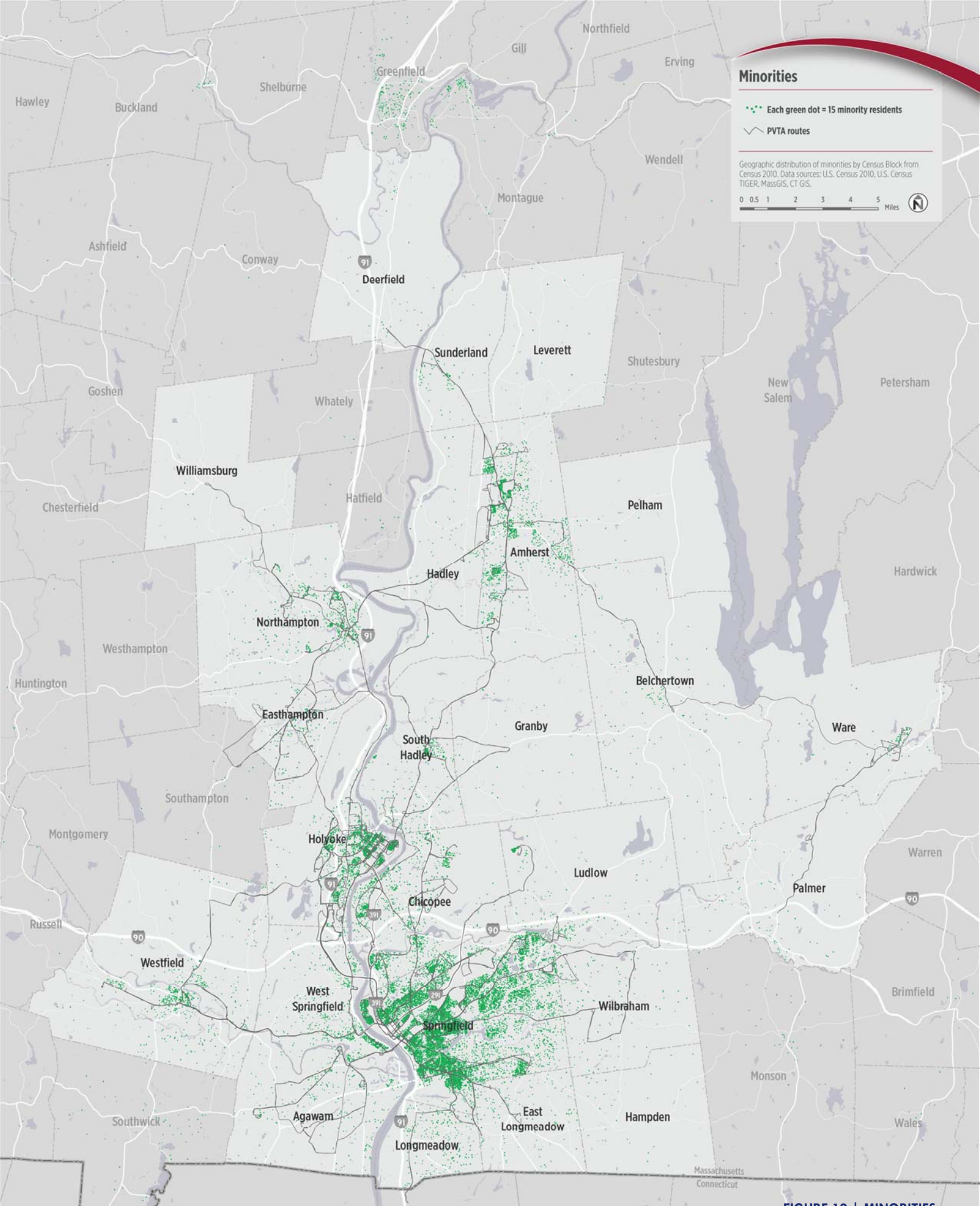


FIGURE 10 | MINORITIES

10 DEMOGRAPHIC CHARACTERISTICS - MINORITY STATUS

National research shows that minority populations use transit to a much higher extent than non-minority populations.[2] This finding largely reflects the fact that minorities, on average, have lower incomes than non-minorities, and thus there is a particularly large amount of overlap between populations of minority populations and low income households. In addition, the provision of effective transit service to minority populations is also particularly important to the Federal Transit Administration.

The study team used population counts of minority individuals by census block from Census 2010. A "minority" individual is an individual that identifies as any non-white race. Figure 10 at right shows the geographic distribution of these minorities throughout the study area. A number of findings are apparent:

- Overall, the distribution of minorities is very similar to the distribution of low income individuals.
- The largest cluster of minorities is in Springfield. As discussed, this area contains the highest density of fixed-route service in the study area.
- Another significant cluster of minorities exists in Holyoke, which is also well-served by PVTA.
- Smaller clusters of minorities exist in Easthampton, Northampton, and Westfield. The amount of fixed-route service in these communities varies and in some cases is limited to connections to/from Springfield.
- Amherst has multiple small clusters of minorities scattered throughout the town. These groups may benefit from significant service along the North Pleasant Street corridor.
- Many towns have very small minority populations, such as Hampden, East Longmeadow, Longmeadow, Palmer, Ware, Belchertown, Pelham, Granby, Williamsburg, Deerfield, and Leverett. In most cases, these towns also have low populations overall.

[2] *TCRP Report 28: "Transit Markets of the Future, The Challenge of Change"*

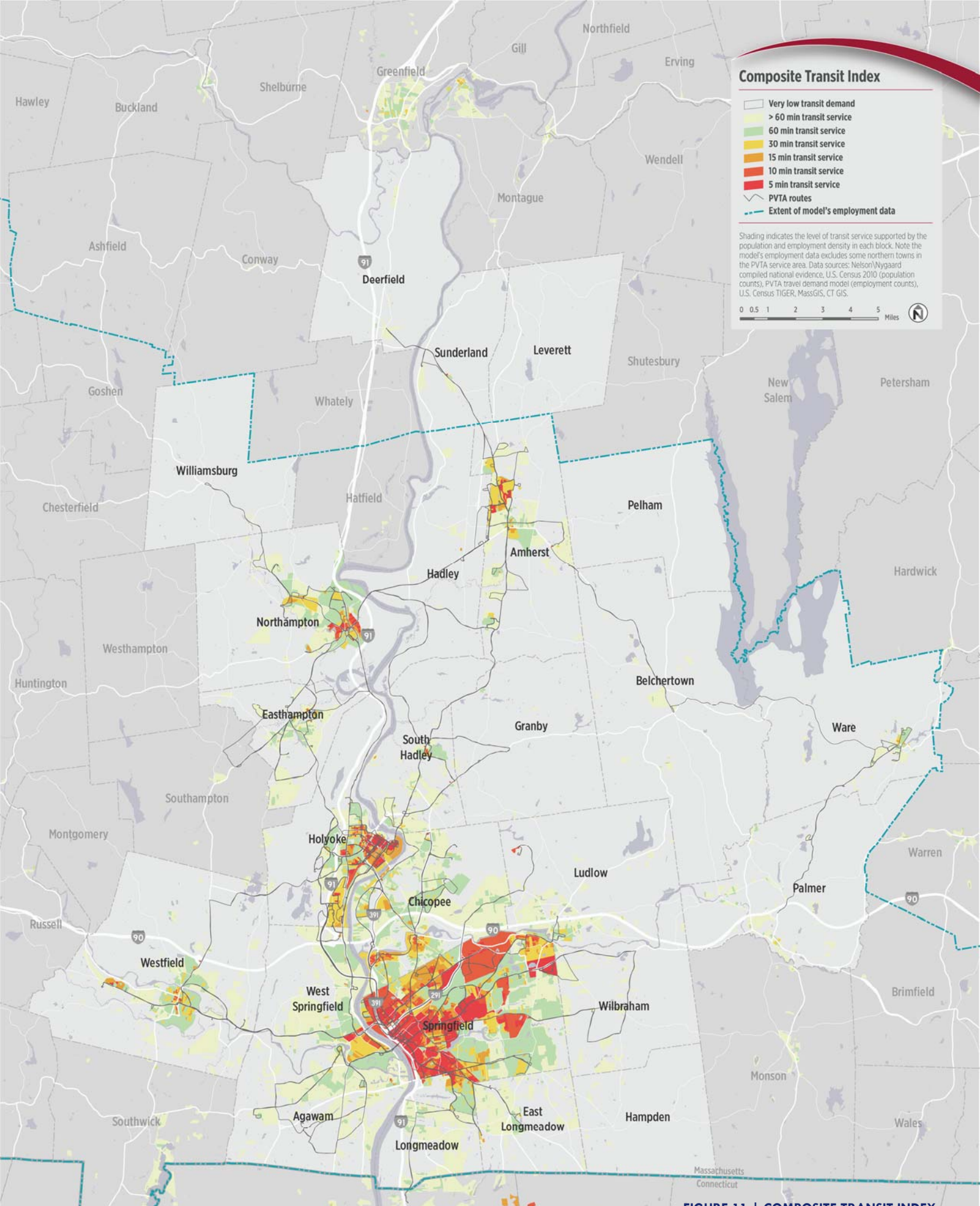


FIGURE 11 | COMPOSITE TRANSIT INDEX

11 COMPOSITE TRANSIT INDEX

The previous sections consider each of the primary demographic and socio-economic indicators of transit demand individually. We also know that many of these factors are correlated and inter-related, thus to understand the inter-play of all of these factors work, Nelson\Nygaard created an overall transit demand index. This index combines population and employment density to produce a composite transit index.

Similar to the population and employment density indices, our analysis maps densities as they relate to transit service levels. As discussed, the data is indicative only recognizing that actual ridership and demand for transit is affected by a broader set of circumstances, including land use, urban form, service quality and the relative convenience of other choices.

- While an area's propensity to use transit is high, ridership will be high only if available service offers comparative convenience to other options.
- If an area can theoretically support the operation of service every 10 minutes, if multiple routes operate in close proximity, the demand for each individual route will be proportionally lower.

Nonetheless, the composite transit index provides a strong indication of the relative demand for transit throughout the market area, and identifies areas where demand is highest and transit can be provided most effectively. Findings include:

- Springfield is by far the most transit-supportive area in the market. Most of the city has sufficient population and employment density to support a very high level of transit service, potentially as high as every 5 minutes during peak periods. The combination of population and employment strengths the market along the north-south and east-west corridors.
- Holyoke is also a strong market for transit; several pockets suggest an ability to support high frequency service. It is also worth nothing that several of the corridors from Holyoke to Springfield, through Chicopee also have relatively strong markets for transit.
- West Springfield and Westfield also are strong markets for transit, with some sections showing potential for high demand. Demand between Westfield and West Springfield, however, is more limited.
- Northampton, and Amherst have town centers that suggest moderate to strong transit and surrounding areas with lower but still potential for transit. These areas are somewhat challenged by the fact that they are geographically isolated. Services that link these towns to the PVTA network must travel through corridors with significantly lower demand.
- East Hampton, South Hadley and Ware have small town centers with potential demand, but these are fairly isolated pockets of demand.
- Some 11 or 12 towns have a low demand for transit and likely can only support demand response service, including Hampden, Wilbraham, Palmer, Ware, Belchertown, Pelham, Leverett, Sunderland, Deerfield, and Williamsburg.

12 FINDINGS

Overall, the findings of this market analysis indicate the following:

- Population and employment are overwhelmingly located in the Springfield area, including Springfield itself, West Springfield, Chicopee, and Holyoke. This area is the core of the PVTA market area, and can support the most significant levels of transit service. The clustering of jobs and population in close proximity make this area a strong market for transit service.
- Employment is particularly clustered in Springfield, Holyoke, Northampton, and at UMass Amherst. There are fewer jobs outside of these communities and they are generally more dispersed.
- Most large employment sites are served by fixed-route transit service. A few sites within the service area are not served, such as Hasbro Games and the Wing Memorial Hospital.
- Transit-dependent groups of low income individuals, individuals without access to a vehicle, and minorities generally cluster in areas with higher population density overall. Therefore, providing effective service to areas with higher population density also benefits transit dependent riders.
- Older adults do not exhibit the same level of clustering or patterns as other transit dependent groups and tend to be more dispersed throughout the PVTA service area. This makes individuals in this group more difficult to serve with fixed-route transit.
- The students at UMass Amherst are a strong market for transit; Amherst is densely populated and students have several characteristics that are consistent with transit dependent groups, including lower incomes, and less access to vehicles than the population as a whole.
- A principal challenge facing PVTA market is the geographic size of the service area and the relative isolation of several member communities, some of which are strong markets for transit such as Northampton, Amherst, and Westfield, and to a lesser extent, East Hampton and South Hadley. While these communities may be able to support moderate levels of transit service on their own, they are difficult to effectively integrate into the PVTA system, since they are separated from the core market by corridors with very low transit demand. Depending on the size and needs of the riders, however, express services may be appropriate in some cases.
- Westfield has relatively less fixed-route transit service as compared with other communities with similar characteristics.
- Much of PVTA's service area does not support even moderate levels of fixed-route transit service. Many of the outlying communities are rural in character and lack sufficient population and employment density to support transit service. However, some of these communities — Ware is a good example — may have sufficient demand for some type of limited service. For these, alternative service strategies such as flex service or limited stop express service may be feasible.

RESULTS FROM THE RIDER/ NON-RIDER SURVEY

OVERVIEW

The Pioneer Valley Regional Transit Authority (PVTA) retained a consulting team led by Nelson\Nygaard Consulting Associate to prepare a Comprehensive Service Analysis (CSA) focused on inventorying transit needs in the Pioneer Valley and reviewing existing services to ensure they are matched with demand and operate as efficiently and effectively as possible. The CSA began in the late winter 2013 and is scheduled to end in early 2014.

The CSA consists of several large tasks, including a review of existing conditions, an assessment of the demand for travel in the PVTA study area, outreach with stakeholders and members of the public, a detailed evaluation of each of PVTA's fixed-route services and the development of service improvements and recommendations. Recommendations will be developed as part of an open and transparent process, with numerous opportunities for stakeholder and public input.

This technical memo reports on the results of a survey conducted among PVTA riders and residents in the PVTA service area. The survey was administered between April and June 2013 and was designed to collect information about people's experiences with and perceptions of PVTA services. The online survey was posted on the PVTA website and paper surveys were distributed at the Springfield Bus Terminal and Holyoke Transit Center in June. Surveys were also distributed to the senior centers within the study area. The online survey was available in Spanish and English and paper coppies of the survey were available in English, Spanish and Vietnamese.

KEY FINDINGS:

- The majority of the survey respondents reported being regular riders. They also reported having a good understanding of how to use PVTA services.
- About 70% of the respondents do not always have access to a private vehicle. These individuals are considered "transit dependent" for purposes of the survey analysis.
- About 30% of the survey sample consisted of students; the student population also consisted of several transit dependent riders (i.e. individuals without reliable access to a private vehicle).
- Riders who depend on transit have a better understanding of PVTA services as compared with the other survey respondents.
- The most important way for riders to get information about PVTA services is through traditional information sources, such as printed maps and schedules.
  - Printed materials are especially important for transit depedent riders.
  - Students are also most likely to get information about PVTA services from traditional sources; however, a large portion also relies on the web-site for information.

- In terms of service improvements, respondents identified fast and direct service as the most important, followed closely by improved service frequency. More bus stops and early morning service were ranked the lowest among the variables analzed.
  - Transit dependent riders ranked increased service frequency slightly higher than faster and direct service, although the difference is minor. More bus service on weekend days was also a high priority.
  - Students ranked increased bus frequency as the highest priority, followed by fast and direct service. Students also prioritied more weekend day service.
- Among survey respondents, the largest set of origin and desintation pairs include:
  - Travel within Springfield
  - Travel within Holyoke
  - Travel between Springfield and Chicopee
  - Travel between Springfield and Agawam/West Springfield

PROFILE OF RESPONDENTS

A total of 609 people resonded to the survey, of which 384 surveys, or 63% of the surveys, were completed online and the remaining 37% collected at the transit centers or senior centers. The target audience for the survey included existing PVTA customers as well as people with limited or no experience riding PVTA. Results showed that the majority of respondents have used public transportation in the past six months (see Figure 1). A full 84% said they had used public transportation in the past six months, and among the group of people who used transit, 84% considered themselves regular PVTA riders; 16% said they were occasional riders (see Figure 2).

FIGURE 1 | USE OF PUBLIC TRANSPORTATION

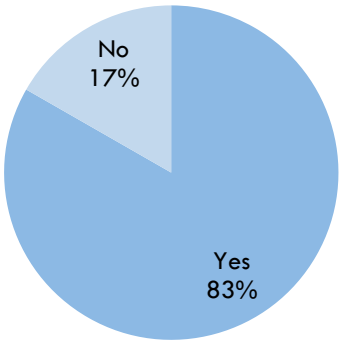
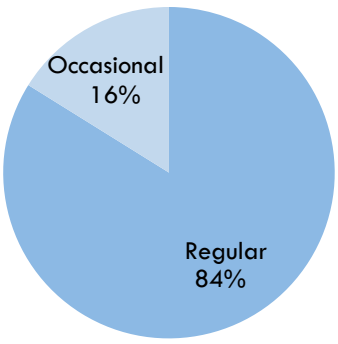


FIGURE 2 | USE OF PVTA SERVICE



The high percentage of public transit usage is consistent with level of vehicle availability among the survey respondents. Slightly less than third of of respondents reported always having access to a private vehicle (see Figure 3) and about 46% said they sometimes have access to a vehicle. This indicates that many PVTA riders are dependent on transit for all travel. The majority of respondents – 78%- also reported living within about a quarter mile of a bus stop.

Most survey respondents reporting having a good understanding of PVTA services. This finding is consistent with respondent's high use of PVTA services overall. Only about 16% of the riders said they had a low or no understanding of how PVTA services work (see Figure 4). However, there is a clear difference in the level of understanding between transit dependent riders and the rest of the survey population (see Figure 5). While 70% of transit dependent respondents have a good understanding of

PVTA service, only 23% of choice riders and non-riders felt they have a good understanding of how PVTA services operate.

FIGURE 3 | VEHICLE ACCESSIBILITY

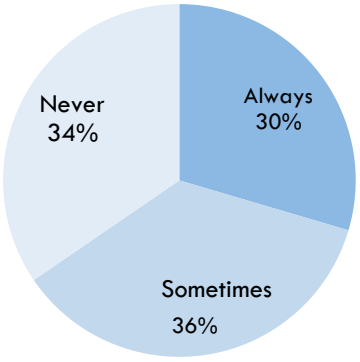


FIGURE 4 | LEVEL OF UNDERSTANDING OF PVTA SERVICE

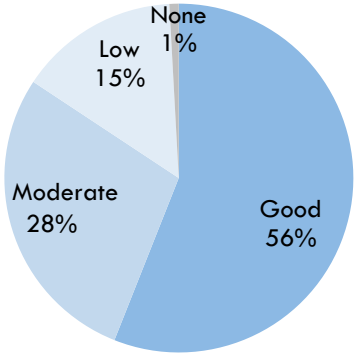


FIGURE5 | UNDERSTANDING OF PVTA SERVICE BY VEHICLE ACCESSIBILITY

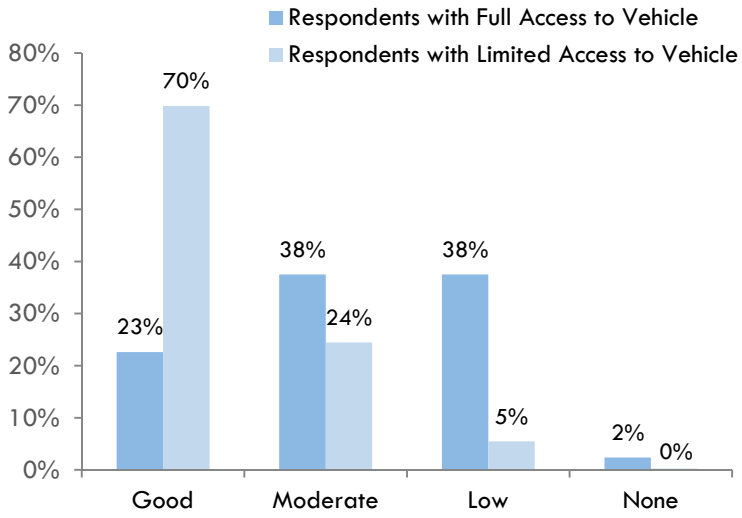


FIGURE 6 | PLACE OF RESIDENCE

City / Town	%
Springfield	44.0%
Amherst	10.2%
Williamsburg	8.8%
Holyoke	7.9%
Northampton	7.5%
Chicopee	4.6%
West Springfield	2.9%
Easthampton	2.9%
South Hadley	2.5%
Westfield	1.5%
Sunderland	0.8%
Belchertown	0.8%
Ludlow	0.8%
Deerfield	0.6%
Agawam	0.6%
Wilbraham	0.4%
Greenfield	0.4%
Ware	0.4%
Granby	0.2%
Palmer	0.2%
Hadley	0.2%
Hampden	0.2%
Chesterfield	0.2%
Longmeadow	0.2%
Arlington*	0.2%
Medfield*	0.2%
Revere*	0.2%
Duluth, GA*	0.2%
Sherman, TX*	0.2%
Total Respondents	**480**
*Lies outside study area	

Among the survey respondents, almost 40% of respondents live in Springfield, another 11% live in Amherst, and 8% live in Holyoke (see Figure 6). The sample also included residents from Williamsburg (9%), Northampton (6%), Chicopee (5%), and West Springfield, Easthampton, and South Hadley (3% from each). The remaining responses were generally spread throughout the study area, very few of respondent living in nearby towns that are not included in the study area.

As part of understanding the survey responses, our analysis also considered how the responses from transit dependent individuals (Figure 7) and students (Figure 8) were distributed geographically. As compared with the survey respondents

overall, transit dependent riders were most likely to live in Springfield (49%), followed by Amherst (9%) and Holyoke (9%). The large portion of transit dependent riders in Springfield likely reflects the fact that Springfield has a lot the greatest concentration of bus riders and also that the survey was administered at the SBT.

The student population of survey respondents was largely from Springfield (33%), Amherst (23%) and Holyoke (13%). Consistent with the transit dependent population, the geographic distribution of students in the survey sample reflects a combination of a concentration of students in each of the communities, a high portion of bus ridership among the student population and bias in the survey administration (i.e. sampling done at SBT and HTC).

FIGURE 7 | PLACE OF RESIDENCE BY LEVEL OF TRANSIT DEPENDENT/CHOICE RIDERS

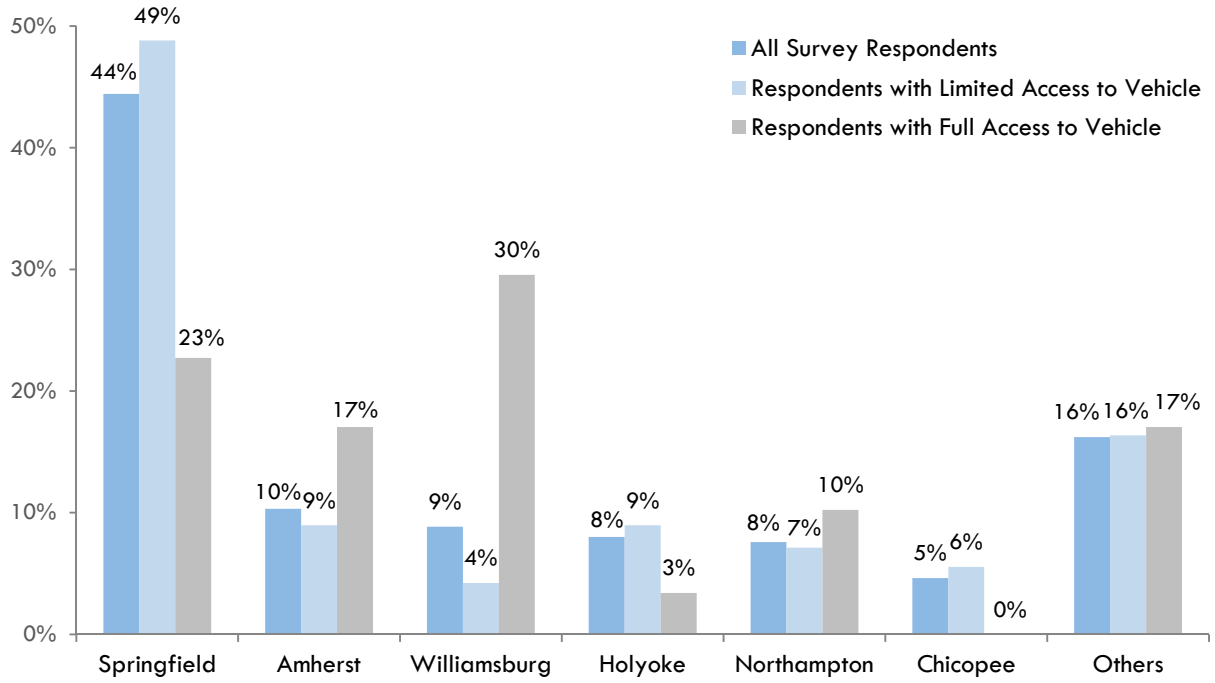
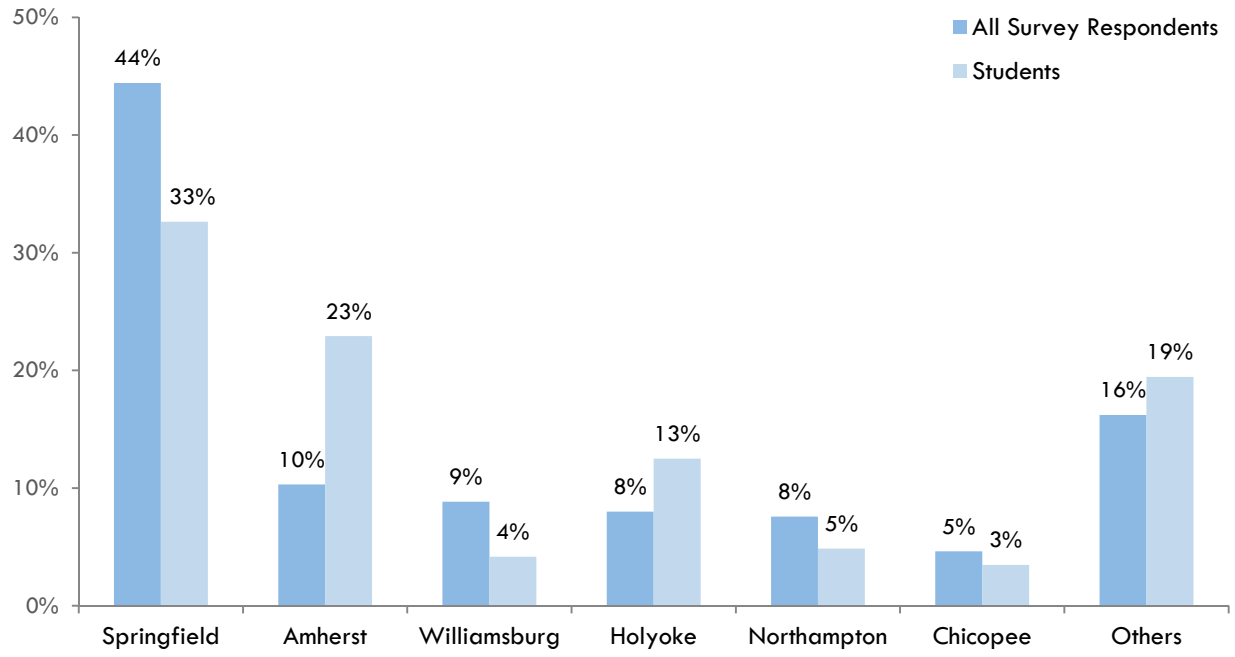


FIGURE 8 | PLACE OF RESIDENCE BY STUDENTS



More than two thirds (69%) of survey respondents indicated that they are between the ages of 25 and 64. Fifteen percent of the respondents were within the 20-24 age group, 10% were 65 or over, and 6% were 19 or under (see Figure 9).

FIGURE 9 | AGE OF SURVEY RESPONDENTS

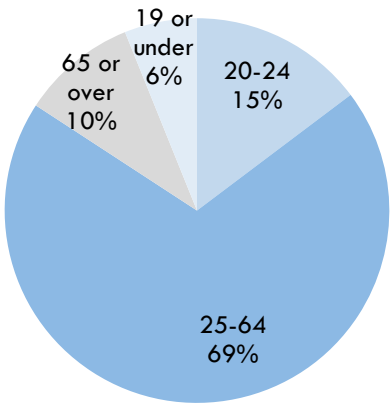
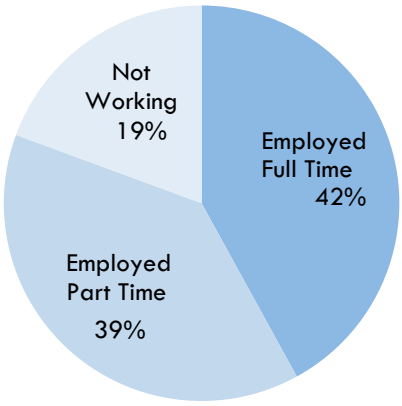


FIGURE 10 | EMPLOYMENT



Approximately 80% of respondents are employed, 42% full-time and 39% part-time. An additional 19% are not employed; these individuals include retired individuals, stay at home parents and people not in the workforce (among others). Thirty percent (n=165) of survey respondents indicated that they are students, of which about 81% of them are college school students. University of Massachusetts, Amherst, Holyoke Community College, and Springfield Techincal Community College are the three most attended schools within our study area (see Figure 12).

FIGURE 11 | PROPORTION OF STUDENTS USING PVTA SERVICE

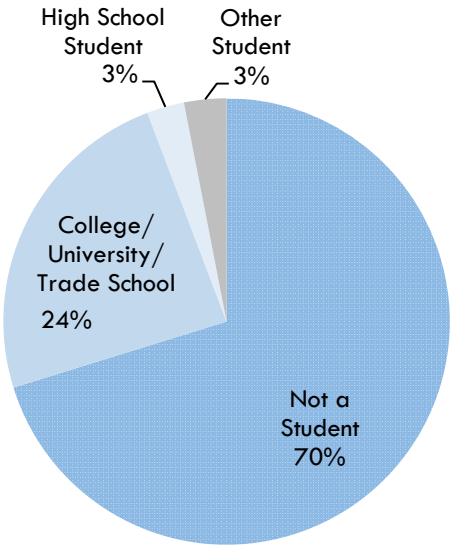


FIGURE 12 | SCHOOLS PEOPLE ATTEND

Schools	Count
University of Massachusetts Amherst	49
Holyoke Community College	28
Springfield Technical Community College	22
Mount Holyoke College	7
American International College	7
Hampshire College	5
Branford Hall Career Institute	4
Westfield State University	3
Amherst College	2
Smith College	2
Emerson College	1
Porter and Chester Institute	1
Episcopal Divinity School	1
Bay Path College	1
University of Connecticut	1
Others	10
High Schools	21
Total Respondents	**165**

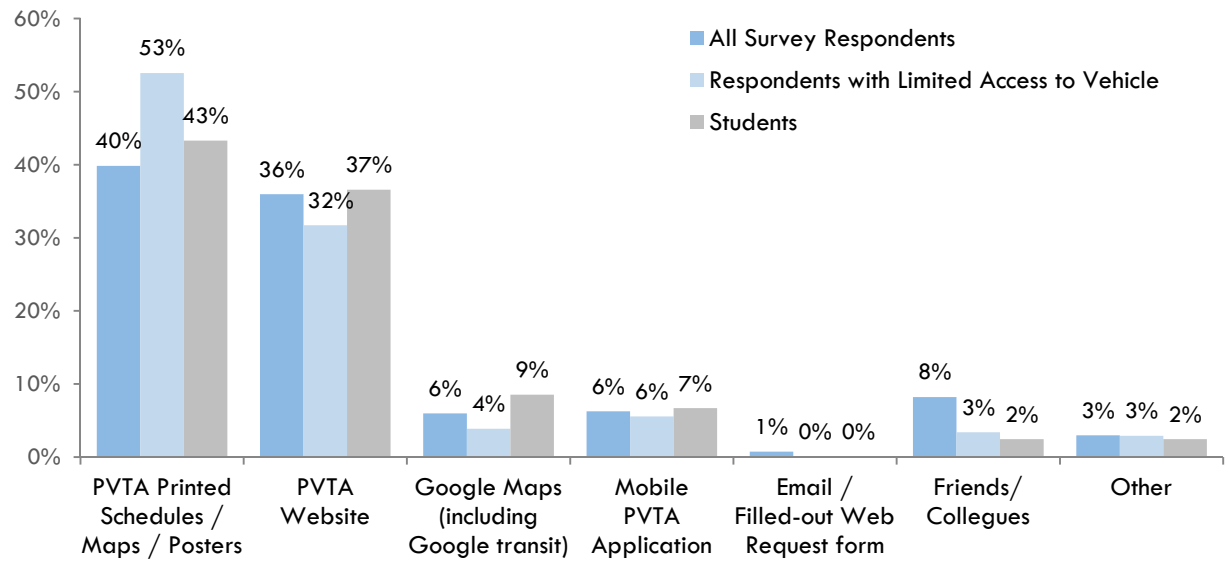
MARKETING AND RIDER INFORMATION

PVTA provides a variety of information resources about its services, including information provided through printed passenger schedules and maps, an agency website and online tools, such as Google Transit and email. PVTA is also experimenting with mobile applications about its service but this program is in development.

When asked about the most important sources of information, about 40% of the survey respondents reported receiving information through more traditional sources, such as printed schedules, maps, or posters. About a third (36%) of the respondents use PVTA website for information, while about 6% get information through Google maps and Google Transit. A similar number (8%) get information about the PVTA from people they know. Currently, only about 6% get information on the bus services through mobile PVTA applications.

Over half of the respondents who are heavily depend on transit (53%) use printed schedules as their main source of information about PVTA service. Many students also use traditional sources to find out about the service, but they are also more likely to use the website and Google maps compared to the rest of the respondents. The level of using mobile PVTA applications is similar for everyone.

FIGURE 13 | PRIMARY SOURCE OF INFORMATION ABOUT PVTA BUS SERVICE*



Respondents wer allowed to give more than one answer, thus the number of responses exceeds the number of individuals surveyed (n=636)

SERVICE PREFERENCES

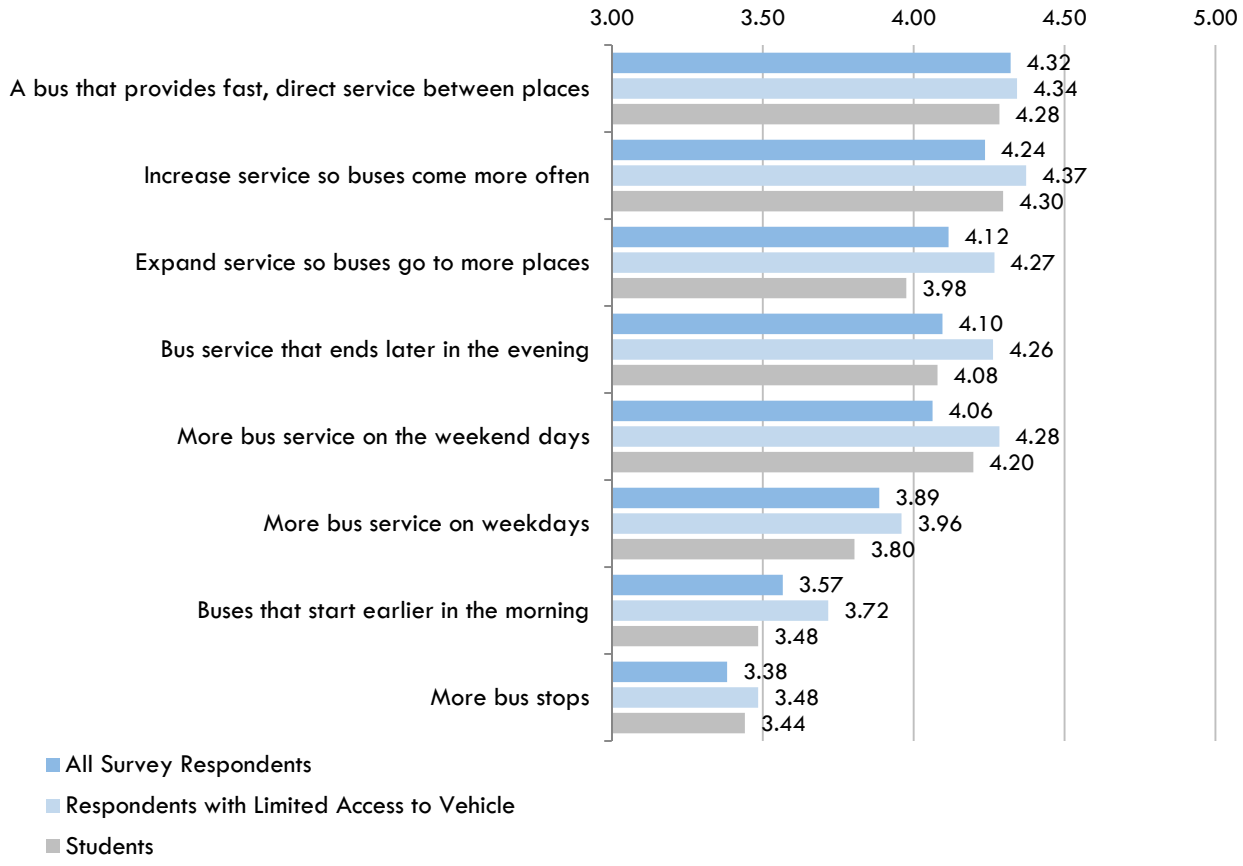
Respondents were asked to rank service improvement in order of importance to them, 5 being the most important. The average of the rank number is shown in Figure 14.

On average, the most important service priority for passengers is fast and direct transit service with frequency being the next most important priority. Expanding service to more places, late night services, and more weekend services were all important and all ranked about the same. The two least important service improvements on average were early morning services and more bus stops.

The ranking average for transit dependent individuals is higher overall than the average of all respondents (i.e. transit dependent riders were more likely to say each service attribute was more important to them). The most important service priority for transit dependent individuals is increasing the frequency of bus service, followed by having fast, direct service. The third most important service priority is having more bus service on the weekend days, although it is ranked similar to expanding service and late night services.

Students also reported increasing bus service frequency as the most important service improvement. While the averages of the rank numbers of having fast service, expanding service, and late night service are lower than the averages of the other respondents, students responded having more weekend service is important to them.

FIGURE 14 | AVERAGE RANKING OF IMPORTANT SERVICE IMPROVEMENT



TRAVEL PATTERNS

Finally, respondents were asked to write down some of the places that they would like to go that can't get to – or can't easily get to- on a PVTA bus. This information is mapped in a series of graphic: Figure 15 illustrates people's origin or place of residence; Figure 16 shows the locations people want to go; and Figure 17 shows the most common origin-destination pairs. Nelson\Nygaard also created graphs to highlight desired destinations for transit dependent riders (Figure 18) and students (Figure 19).

Survey respondents' residence, as discussed, are largely concentrated in Springfield, Amherst, Holyoke, Northampton and Williamsburg. Desired destinations are concentrated in Springfield, Northampton, Holyoke, and Williamsburg. Survey respondents also identified a series of communities as desired destinations that are not closely tied to places of residences, such as Easthampton, Agawam and Wilbraham (less than one percent of the survey respondents reported coming from those areas). While there are PVTA routes serving these communities, there may be needs to re-examine these routes to ensure they are effective and easy to use. In addition to listing some specific towns as desired destinations, some respondents also identified specific destinations, such as Six Flags, Stop-and-Shop, and the Work Opportunity Center in Springfield.

The most common origin-destination pair is for travel within Springfield, especially from downtown to destinations in the eastern part of the city, such as Indian Orchard and Eastfield Mall (see Figure 17). Springfield to Agawam and Springfield to Chicopee are also reported as top destinations in need for more PVTA service. While demand for service between communities was frequently cited, many also reported a need for better local service within Holyoke, Northampton, and Amherst.

Figures 18 and 19 highlights desired destinations for transit dependent riders and students separately. Earlier of this report showed that almost half of the transit dependent respondents live in Springfield. While destinations within Springfield are the most desired destination for more or better PVTA service, transit dependent riders also identified Holyoke, Agawam, Northampton and to a less extent Chicopee and Amherst as desired destinations for improved bus service. Choice riders and non-riders, on the other hand, identified key destinations as travel within Springfield as well as Northampton and Williamsburg.

The desired locations identified by students seemed to reflect the location of their school or other schools, since Springfield, Northampton, Holyoke and Hadley are picked as the top destinations for more or improved PVTA service (see Figure 19). Unlike other groups, students did not point out Williamsburg or Wilbraham as their most desired destination.

FIGURE 15 | SURVEY RESPONDENTS PLACE OF RESIDENCE

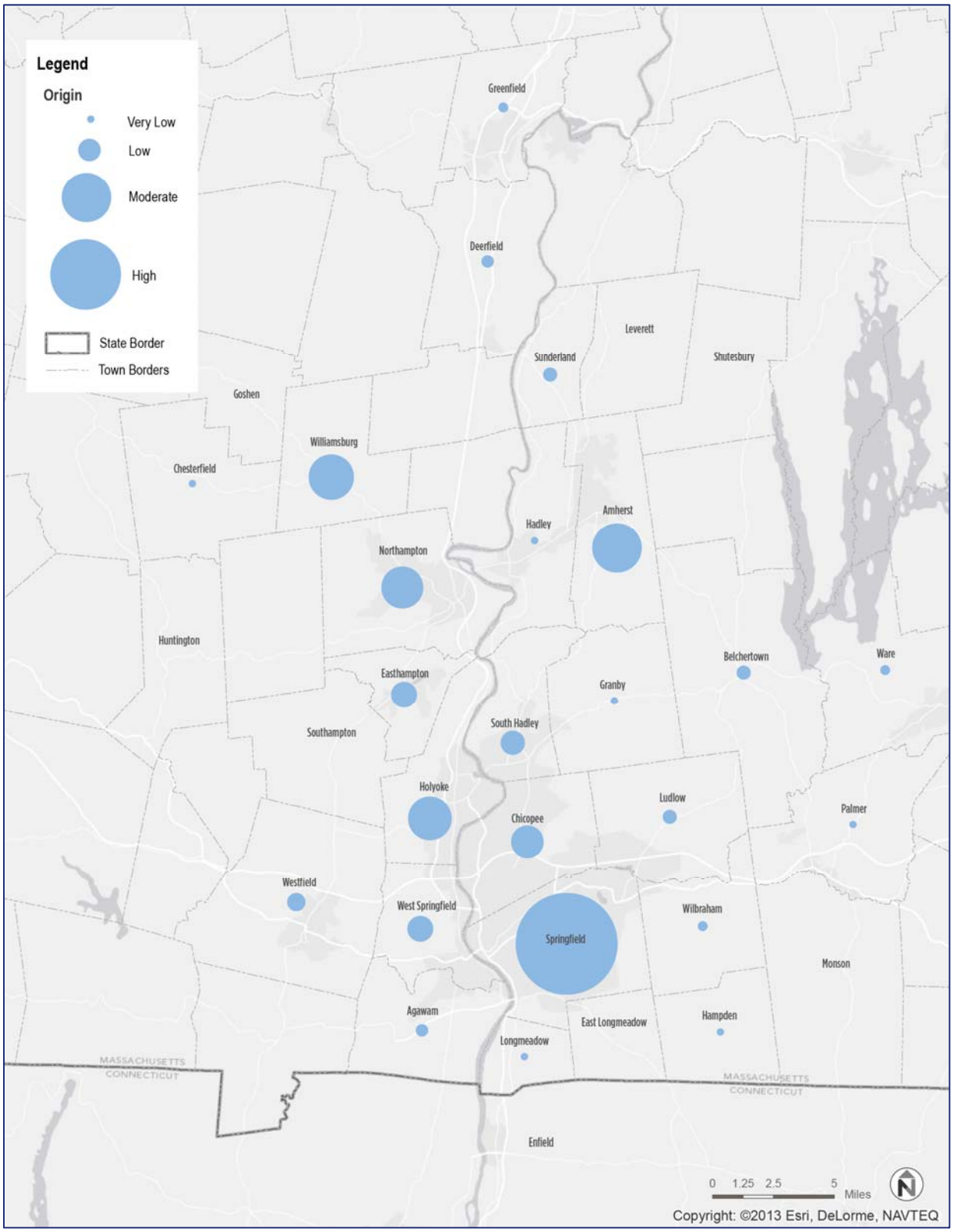


FIGURE 16 | DESIRED DESTINATIONS FOR PVTA SERVICE

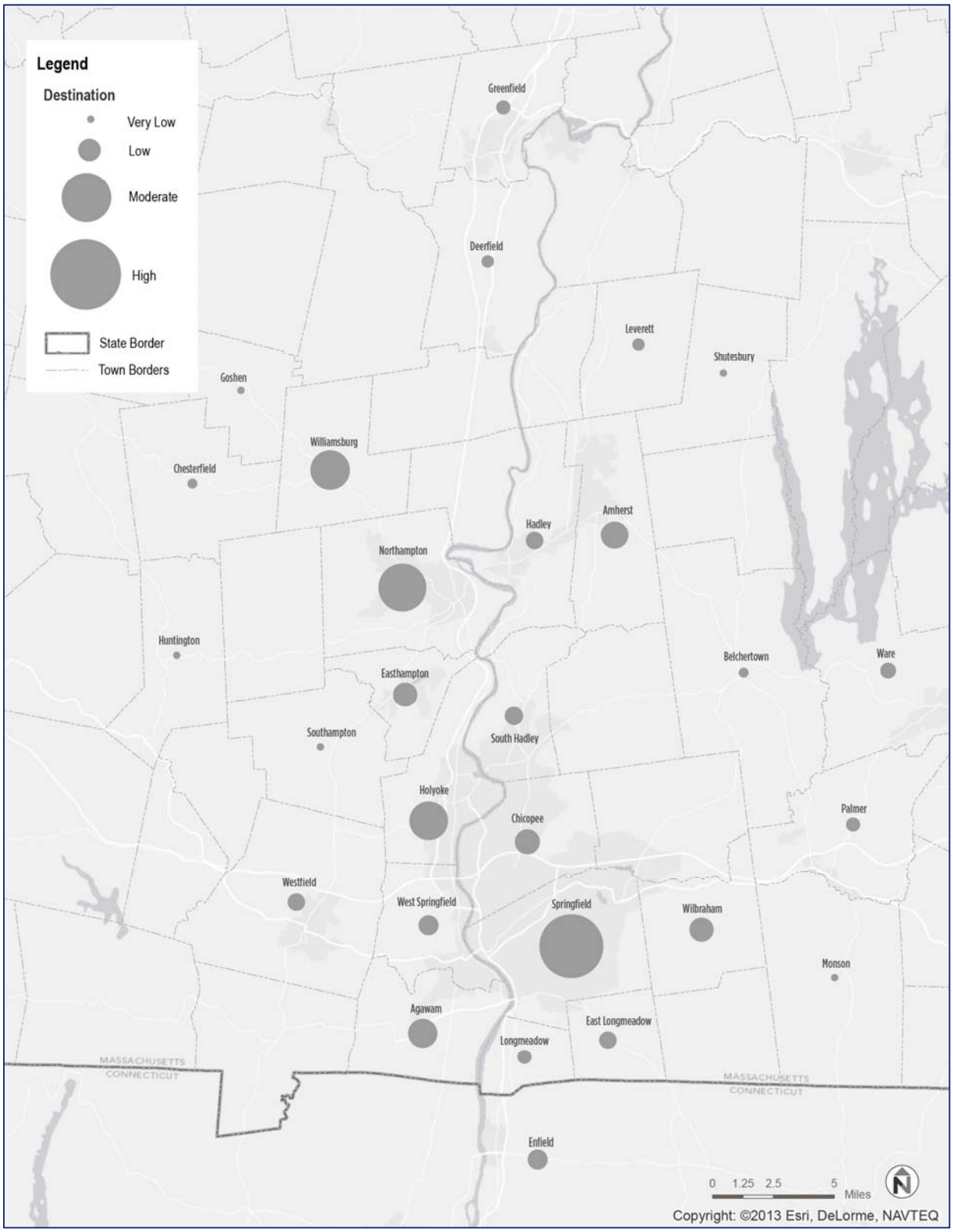


FIGURE 17 | ORIGIN AND DESTINATION PAIRS

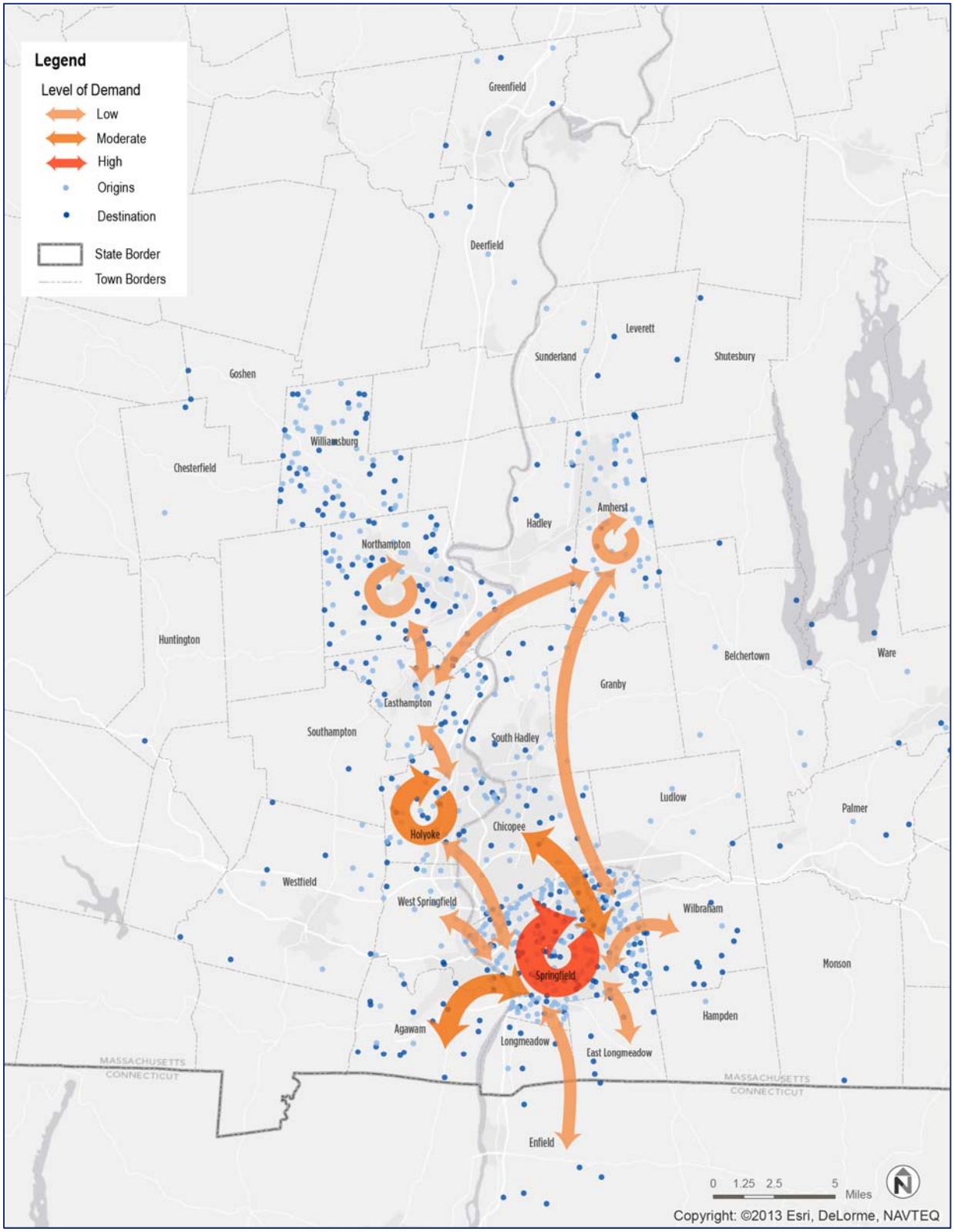


FIGURE 18 | DESIRED DESTINATIONS BY VEHICLE ACCESSIBILITY

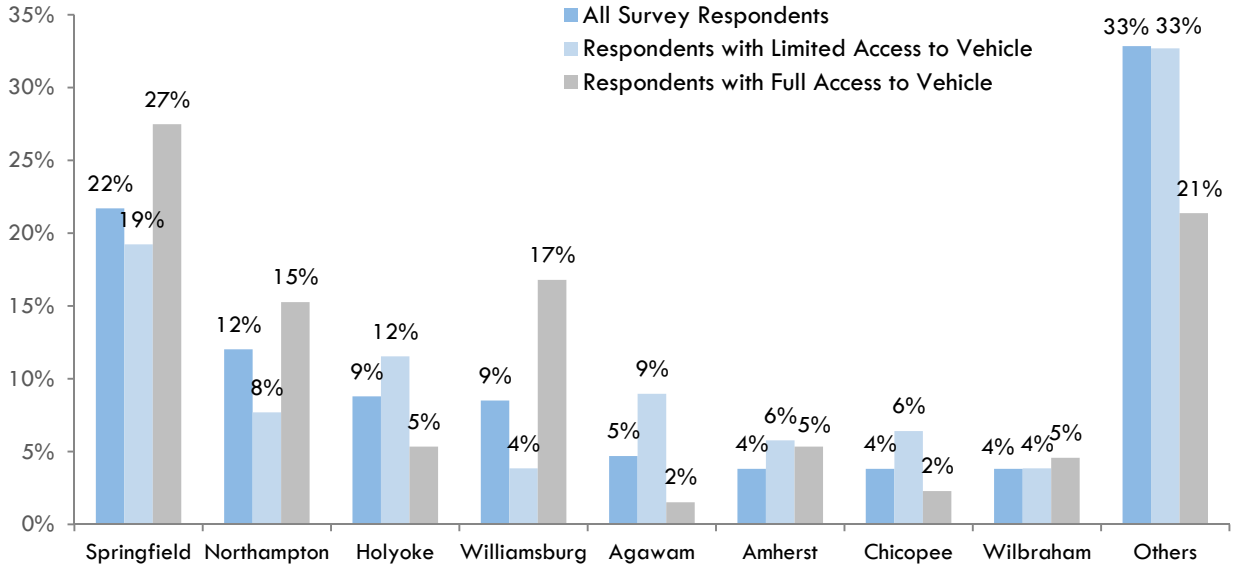
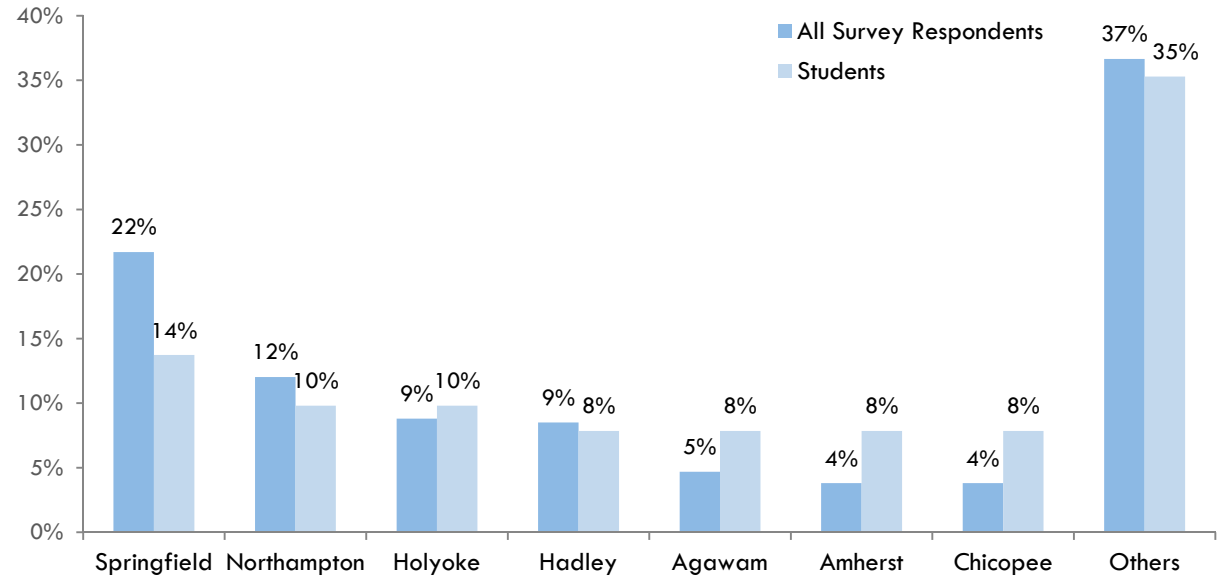


FIGURE 19 | DESIRED DESTINATIONS BY STUDENTS



Pioneer Valley Transit Authority
COMPREHENSIVE SERVICE ANALYSIS

Please help PVTA improve transit service by completing this survey

For more information on this study, please visit http://www.pvta.com/csa

1) Have you public transportation in the last 6 months?

☐ Yes ☐ No

If Yes, which service: _____

2) Do you currently live within walking distance (about a quarter mile) of a bus stop?

☐ Yes ☐ No ☐ Don't Know

3) Do you have access to a car?

☐ Always ☐ Sometimes ☐ Never

4) Which statement best describes your understanding of the existing PVTA bus service

☐ I have a good understanding of PVTA bus routes and schedules and ride the bus a lot.

☐ I generally know how PVTA operates and ride the bus occasionally.

☐ I know there are PVTA buses in the region, but don't know much about the bus routes or schedules.

☐ I am not aware of PVTA bus service.

5) What is your primary source of information about transit services?

☐ PVTA printed schedules, maps or posters

☐ Google maps (including Google transit)

☐ Mobile PVTA application

☐ PVTA website

☐ Email, filled out web request form

☐ Friends/Colleagues

☐ Other, please specify: _____

SERVICE PREFERENCES/PRIORITIES

6) These next few questions ask you about preference and priorities for bus service. Please rank the importance of each of the service characteristics on a scale of 1 (not important) to 5 (very important)

	1	2	3	4	5
A bus that provides fast, direct service between places.	☐	☐	☐	☐	☐
Increase service so buses come more often.	☐	☐	☐	☐	☐
Expand service so buses go to more places.	☐	☐	☐	☐	☐
More bus service on the weekend days.	☐	☐	☐	☐	☐
More bus service on weekdays.	☐	☐	☐	☐	☐
More bus stops.	☐	☐	☐	☐	☐
Buses that start earlier in the morning.	☐	☐	☐	☐	☐
Bus service that ends later in the evening.	☐	☐	☐	☐	☐

EXISTING TRAVEL PATTERNS

The following questions are designed to help us identify how people travel in the region. They ask you for general information about where you live and where you frequently travel

7) Are you a regular or occasional PVTA rider

☐ Yes ☐ No

8) What is your home zip code? _____

9) What are the nearest cross streets to your home (for example: Main Street and Hillard Street)

_____ & _____

10) Are there places you want to go that you can't get to on a PVTA bus - or can't get there easily? If so, where would you like to see PVTA add or improve service?

List unique location and/or town (For Example: Bay State Medical Center, Springfield, on Chestnut Street)

(a) _____ in _____ more specifically, _____
Location City/Town Street/Intersection

(b) _____ in _____ more specifically, _____
Location City/Town Street/Intersection

11) Which of the following best describes you

☐ Employed Full Time ☐ Employed Part Time

☐ Not working (Student, Unemployed, Retired, Stay at Home Parent)

12) Are you a student?

☐ No ☐ High School Student

☐ College/University/Trade School ☐ Other Student

13) Which School or College do you attend? _____

14) What is your age?

☐ 19 or under ☐ 20-24 ☐ 25-64 ☐ 65 or over

15) If you would like to be included on a contact list for more information about the PVTA project, please provide your e-mail:

_____

Thanks for your help with this survey!
For more information about this project, please go to www.pvta.com/csa

Please return surveys to the nearest PVTA office or to

PVTA CSA
c/o Ralph DeNisco
Nelson\Nygaard Associates
Ten High Street, Suite 700
Boston, MA 02110

APPENDIX B

Productivity Worksheets

WEEKDAY v9

Route	Garage	Classification	Type (E=Express)	Has Express Variant	Evaluate?	Average Daily Ridership	In-Service Minutes per Day	Layover Minutes per Day	Revenue Vehicle Hours per Day	Total Vehicle Minutes per Day	In-Service Vehicle Miles per Day	Peak Vehicles	Trips per Day	Average Fare Revenue per Day	Gross Operating Cost per Day	Average Ridership per Trip	Passengers per Revenue Vehicle Hour	Passengers per Revenue Vehicle Mile	Net Operating Cost per Rider	Average Fare	Average Subsidy per Rider	Average Speed (mph)	TVH/RVH	Avg One-Way Route Length (mi)	Avg One-Way Running Time (min)	Start Time	End Time	Total Daily Hours	Frequency					Farebox Recovery Rate	Notes
						RIDERS			RVH		RVM		TRIPS		COST	PAX/TRIP	PAX/RVH	PAX/RVM	COST/PAX	FARE		MPH							Early AM	AM Peak	Midday	PM Peak	Night		
1	SATco	K/E		Y	Y	4,134 4	6,844	347	119.9 1	7,465	1,341	9	100	$2,214	$7,505	41.3 6	34.5 12	3.1 11	$1.28 12	$0.54	$1.28	11.8 28	1.04	13.4	68.4	5:35 AM	9:45 PM	16:10	40*	20	20	20	25*	29%	
2	SATco	U			Y	4,033 5	5,300	151	90.9 4	5,531	1,020	7	87	$2,134	$5,570	46.4 3	44.4 8	4.0 7	$0.85 5	$0.53	$0.85	11.5 31	1.01	11.7	60.9	5:06 AM	9:51 PM	16:45	30*	20*	20*	20*	40*	38%	
3	SATco	U			Y	1,737 10	2,346	144	41.5 11	2,490	389	3	57	$706	$2,429	30.5 8	41.9 9	4.5 5	$0.99 8	$0.41	$0.99	9.9 37	1.00	6.8	41.2	5:25 AM	7:55 PM	14:30	30*	25	25	25	30*	29%	
4	SATco	U			Y	733 17	751	130	14.7 23	944	154	1	25	$267	$939	29.3 11	49.9 4	4.8 3	$0.92 7	$0.36	$0.92	12.3 27	1.07	6.2	30.0	6:30 AM	6:30 PM	12:00	-	30	30	30	-	28%	
5	SATco	U			Y	556 20	959	72	17.2 21	1,031	222	2	24	$215	$1,066	23.2 19	32.4 17	2.5 16	$1.53 19	$0.39	$1.53	13.9 21	1.00	9.2	40.0	6:15 AM	6:15 PM	12:00	-	60*	60	60*	-	20%	
6	SATco	U		Y	Y	2,226 8	3,809	101	65.2 7	4,095	825	5	81	$1,243	$4,199	27.5 13	34.2 13	2.7 15	$1.33 14	$0.56	$1.33	13.0 25	1.05	10.2	47.0	5:15 AM	9:30 PM	16:15	20	20	20	20	100	30%	
7	SATco	U			Y	5,475 1	5,916	346	104.4 2	6,703	972	9	121	$2,594	$6,577	45.2 4	52.5 3	5.6 2	$0.73 4	$0.47	$0.73	9.9 38	1.07	8.0	48.9	5:00 AM	10:50 PM	17:50	20	15	20	15	40	39%	
8	SATco	U			Y	399 27	735	50	13.1 28	790	130	1	26	$261	$778	15.4 29	30.5 22	3.1 12	$1.29 13	$0.65	$1.29	10.6 35	1.01	5.0	28.3	6:05 AM	6:25 PM	12:20	-	60	60	60	-	34%	
10	SATco	U			Y	1,297 12	2,023	67	34.8 13	2,090	563	3	42	$663	$2,821	30.9 7	37.2 10	2.3 21	$1.66 22	$0.51	$1.66	16.7 13	1.00	13.4	48.2	5:00 AM	10:10 PM	17:10	30	30	60	60	90*	24%	SATCo service reports include OV
11	SATco	E	E		Y	600 18	721	50	12.9 29	871	273	2	20	$26	$1,034	30.0 10	46.7 6	2.2 23	$1.68 23	$0.04	$1.68	22.7 4	1.13	13.6	36.1	7:30 AM	9:30 PM *	14:00	-	60	60	45	-	2%	
12	SATco	E	E		Y	59 39	212	17	3.8 38	229	85	1	8	$18	$274	7.4 40	15.5 37	0.7 39	$4.33 37	$0.30	$4.33	24.2 2	1.00	10.7	26.5	1:48 PM	8:15 PM	6:27	-	-	-	120	105	7%	
13	SATco	U			Y	369 28	801	52	14.2 25	888	157	1	28	$184	$890	13.2 31	26.0 31	2.4 20	$1.91 25	$0.50	$1.91	11.7 29	1.04	5.6	28.6	6:00 AM	7:15 PM	13:15	40	60	60	80	70	21%	
14	SATco	U			Y	463 23	972	61	17.2 20	1,033	269	3	30	$256	$1,114	15.4 28	26.9 26	1.7 30	$1.86 24	$0.55	$1.86	16.6 14	1.00	9.0	32.4	6:30 AM	6:50 PM	12:20	-	60	60	60	-	23%	
15	SATco	U			Y	162 36	398	56	7.6 36	459	74	1	11	$86	$449	14.7 30	21.4 32	2.2 24	$2.24 28	$0.53	$2.24	11.2 32	1.01	6.7	36.2	6:20 AM	5:50 PM	11:30	-	45	-	60	-	19%	
17	SATco	U			Y	815 16	1,502	11	25.2 18	1,518	331	2	34	$451	$1,575	24.0 18	32.3 18	2.5 18	$1.38 15	$0.55	$1.38	13.2 23	1.00	9.7	44.2	5:50 AM	6:45 PM	12:55	55	45	45	45	45	29%	
19	SATco	V			Y	169 35	750	38	13.1 27	837	193	1	20	$86	$883	8.5 38	12.9 38	0.9 38	$4.71 38	$0.51	$4.71	15.4 17	1.06	9.6	37.5	1:35 AM	6:15 PM	16:40	70	90	90	90	-	10%	
20	SATco	K		Y	Y	3,298 6	4,200	180	73.0 5	4,474	920	6	77	$1,801	$4,619	42.8 5	45.2 7	3.6 8	$0.85 6	$0.55	$0.85	13.1 24	1.02	12.0	54.5	6:00 AM	10:25 PM	16:25	30	30	30	30	30	39%	
21	SATco	K		Y	Y	1,770 9	3,100	249	55.8 9	3,506	736	4	70	$949	$3,682	25.3 17	31.7 20	2.4 19	$1.54 20	$0.54	$1.54	14.2 19	1.05	10.5	44.3	5:00 AM	7:15 PM	14:15	30	30	60	30	45	26%	
22	SATco	V			Y	354 29	770	35	13.4 26	1,025	180	1	16	$153	$1,082	22.1 20	26.4 29	2.0 27	$2.63 31	$0.43	$2.63	14.0 20	1.27	11.2	48.1	6:15 AM	5:30 PM	11:15	-	90	90	90	-	14%	
23	SATco	V			Y	844 15	1,552	79	27.2 16	1,838	470	2	28	$268	$2,058	30.1 9	31.0 21	1.8 29	$2.12 26	$0.32	$2.12	18.2 12	1.13	16.8	55.4	5:30 AM	6:45 PM	13:15	60	60	60	60	-	13%	
24	SATco	V			Y	598 19	1,043	45	18.1 19	1,583	203	1	22	$106	$1,667	27.2 14	33.0 16	2.9 13	$2.61 30	$0.18	$2.61	11.7 30	1.45	9.2	47.4	6:00 AM	5:45 PM	11:45	-	60	90	30	-	6%	
25	SATco	V			Y	192 34	703	32	12.3 30	760	191	2	15	$102	$825	12.8 32	15.7 36	1.0 36	$3.76 35	$0.53	$3.76	16.3 15	1.03	12.8	46.9	6:05 AM	5:00 PM	10:55	-	-	120	120	-	12%	
27	SATco	V		Y	Y	49 40	140	9	2.5 40	239	51	1	6	$28	$280	8.1 39	19.7 34	1.0 37	$5.18 39	$0.57	$5.18	21.9 7	1.60	8.5	23.3	6:35 AM	6:00 PM	11:25	-	-	-	45	-	10%	
30	UMass	SH			Y	5,218 2	2,644	1,218	64.4 8	3,927	661	5	108	$0	$2,018	48.4 2	81.1 1	7.9 1	$0.39 1	-	-	15.0 18	1.02	6.1	24.5	7:12 AM	1:05 AM *	17:53	-	15	15	15	30		
31	UMass	SH			Y	5,114 3	3,248	750	66.6 6	4,067	1,100	5	77	$0	$3,229	66.8 1	76.7 2	4.6 4	$0.63 2	-	-	20.3 9	1.02	14.4	42.4	7:22 AM	12:03 AM *	16:41	-	15	15	15	35		
32	UMass	SH			Y	203 33	397	3	6.7 37	415	108	1	11	$0	$302	18.4 21	30.4 23	1.9 28	$1.49 18	-	-	16.3 16	1.04	9.8	36.1	7:20 AM	6:18 PM	10:58	-	70	-	70	-		
34	UMass	SH			Y	1,120 14	2,086	0	34.8 14	2,104	389	3	94	$0	$1,142	11.9 33	32.2 19	2.9 14	$1.02 9	-	-	11.2 33	1.01	4.1	22.2	7:05 AM	11:29 PM	16:24	-	25	15	15	45		Combined evaluation 34/35
35	UMass	SH			Y	1,199 13	2,111	0	35.2 12	2,129	385	3	74	$0	$1,239	16.2 24	34.1 14	3.1 10	$1.03 10	-	-	11.0 34	1.01	5.2	28.5	7:18 AM	12:08 AM	16:50	-	15	15	15	40		Combined evaluation 34/35
37	UMass	SH			Y	404 26	540	181	12.0 32	721	92	1	24	$0	$278	16.9 23	33.7 15	4.4 6	$0.69 3	-	-	10.2 36	1.00	3.8	22.5	9:00 AM	8:35 PM	11:35	-	60	60	60	60		
38	UMass	FC			Y	1,726 11	2,275	560	47.3 10	2,890	801	3	67	$0	$2,545	25.9 16	36.5 11	2.2 25	$1.47 17	-	-	21.1 8	1.02	12.0	34.2	6:45 AM	1:00 AM *	18:15	-	30	30	30	40		
39	UMass	FC			Y	544 21	1,150	450	26.7 17	1,690	431	2	53	$0	$1,494	10.3 35	20.4 33	1.3 35	$2.75 33	-	-	22.5 6	1.06	8.1	21.7	7:30 AM	11:20 PM	15:50	-	30	30	30	60		Combined evaluation 39/39E
40	VATco	K	E		Y	254 31	504	73	9.6 33	577	159	2	16	$14	$632	15.9 26	26.4 28	1.6 31	$2.43 29	$0.05	$2.43	18.9 11	1.00	9.9	31.5	7:45 AM	5:45 PM	10:00	-	30	-	30	-	2%	
41	VATco	V			Y	314 30	647	76	12.1 31	733	204	1	20	$134	$806	15.7 27	26.1 30	1.5 32	$2.14 27	$0.43	$2.14	18.9 10	1.01	10.2	32.4	6:15 AM	6:30 PM	12:15	-	70	120	80	-	17%	Has different schedule for MTW a
42	VATco	V			Y	238 32	822	56	14.6 24	957	174	1	22	$186	$874	10.8 34	16.3 35	1.4 33	$2.89 34	$0.78	$2.89	12.7 26	1.09	7.9	37.4	5:50 AM	7:45 PM	13:55	60	65	130	75	65	21%	Has different schedule for MTW a
43	VATco	K			Y	2,420 7	5,304	170	91.2 3	5,507	739	7	92	$552	$4,516	26.3 15	26.5 27	3.3 9	$1.64 21	$0.23	$1.64	8.4 39	1.01	8.0	57.6	6:00 AM	12:15 AM *	18:15	20	25	20	20	30	12%	Has different schedule for MTW a
44	VATco	V			Y	415 25	1,955	30	33.1 15	1,985	208	2	26	$231	$1,884	16.0 25	12.5 39	2.0 26	$3.98 36	$0.56	$3.98	6.4 40	1.00	8.0	75.2	6:20 AM	6:20 PM	12:00	-	60	60	60	-	12%	Has different schedule for MTW a
45	UMass	SH			Y	469 22	488	76	9.4 34	564	188	2	16	$0	$596	29.3 12	49.9 5	2.5 17	$1.27 11	-	-	23.2 3	1.00	11.8	30.5	6:30 AM	10:31 PM	16:01	-	60*	130*	90*	-		Includes BR/BN ridership. BR/BN
46	UMass	SH			Y	111 37	167	57	3.7 39	229	84	1	12	$0	$302	9.3 36	29.8 24	1.3 34	$2.72 32	-	-	30.2 1	1.02	7.0	13.9	7:00 AM	10:15 PM	15:15	-	45	-	120*	250*		Includes SN/SD ridership. SN/SD
48	VATco	K			Y	448 24	885	60	15.7 22	971	202	1	26	$279	$906	17.2 22	28.5 25	2.2 22	$1.40 16	$0.62	$1.40	13.7 22	1.03	7.8	34.0	7:00 AM	8:00 PM	13:00	-	60	60	60	60	31%	Has different schedule for MTW a
39E	VATco	FC	E		Y	107 38	420	110	8.8 35	650	157	2	12	$0	$728	8.9 37	12.1 40	0.7 40	$6.83 40	-	-	22.5 5	1.23	13.1	35.0	7:50 AM	6:30 PM	10:40	-	60	90	70	-		Combined evaluation 39/39E
Systemwide Sum/Average						50,639	71,189	6,192	1,290	80,516	15,831	110	1,697	$16,205	$75,808	23.4	32.9	2.6	$2.05	$0.45	$2.13	15.4	1.07	9.4	38.8										

SATURDAY v9

Route	Garage	Type (E=Express)	Has Express Variant	Evaluate?	Average Daily Ridership RIDERS	In-Service Minutes per Day	Layover Minutes per Day	Revenue Vehicle Hours per Day RVH	Total Vehicle Minutes per Day	In-Service Vehicle Miles per Day RVM	Peak Vehicles	Trips per Day TRIPS	Average Fare Revenue per Day	Gross Operating Cost per Day COST	Average Ridership per Trip PAX/TRIP	Passengers per Revenue Vehicle Hour PAX/RVH	Passengers per Revenue Vehicle Mile PAX/RVM	Operating Cost per Rider COST/PAX	Average Fare FARE	Average Subsidy per Rider	Average Speed (mph) MPH	TVH/RVH	Average One-Way Route Length (mi)	Average One-Way Running Time (min)	Notes
1	SATco		Y	Y	2,143 4	3,866	72	65.6 2	3,938	800	5	52	$1,307	$4,016	41.2 4	32.7 13	2.7 10	$1.87 13	$0.61	$1.26	12.4 21	1.00	15.4	74.3	
2	SATco			Y	1,786 7	3,123	180	55.1 4	3,303	608	4	54	$1,103	$3,300	33.1 6	32.4 14	2.9 8	$1.85 11	$0.62	$1.23	11.7 23	1.00	11.3	57.8	
3	SATco			Y	1,147 9	1,883	88	32.9 8	1,971	308	3	44	$517	$1,931	26.1 9	34.9 9	3.7 6	$1.68 9	$0.45	$1.23	9.8 28	1.00	7.0	42.8	
4	SATco			Y	276 18	636	92	12.1 16	728	118	1	24	$118	$715	11.5 20	22.7 18	2.3 11	$2.59 16	$0.43	$2.16	11.1 24	1.00	4.9	26.5	
5	SATco			Y	175 23	632	26	11.0 20	658	149	1	16	$118	$688	10.9 22	16.0 23	1.2 23	$3.93 22	$0.67	$3.26	14.1 17	1.00	9.3	39.5	
6	SATco		Y	Y	815 10	2,097	44	35.7 6	2,141	478	3	48	$484	$2,208	17.0 16	22.8 17	1.7 19	$2.71 18	$0.59	$2.12	13.7 18	1.00	10.0	43.7	
7	SATco			Y	3,186 2	4,818	216	83.9 1	5,059	818	7	106	$1,883	$4,951	30.1 7	38.0 7	3.9 5	$1.55 8	$0.59	$0.96	10.2 27	1.00	7.7	45.5	
8	SATco			Y	193 22	658	0	11.0 20	658	107	1	22	$155	$646	8.8 23	17.6 21	1.8 16	$3.35 20	$0.80	$2.54	9.7 29	1.00	4.9	29.9	
10	SATco			Y	694 12	1,519	52	26.2 9	1,571	396	2	28	$373	$1,703	24.8 10	26.5 15	1.8 17	$2.45 15	$0.54	$1.92	15.6 13	1.00	14.1	54.3	
12	SATco		Y	Y	33 29	212	8	3.7 28	220	85	1	8	$6	$266	4.1 29	9.0 29	0.4 30	$8.07 29	$0.17	$7.90	24.2 3	1.00	10.7	26.5	
13	SATco			Y	203 21	679	24	11.7 18	703	109	1	24	$130	$685	8.5 25	17.3 22	1.9 15	$3.38 21	$0.64	$2.74	9.7 30	1.00	4.6	28.3	
14	SATco			Y	252 19	564	34	10.0 22	598	183	1	20	$114	$675	12.6 19	25.3 16	1.4 21	$2.68 17	$0.45	$2.23	19.4 9	1.00	9.1	28.2	
17	SATco			Y	424 16	1,250	6	20.9 12	1,256	267	2	28	$277	$1,284	15.1 18	20.3 19	1.6 20	$3.03 19	$0.65	$2.38	12.8 19	1.00	9.5	44.6	
19	SATco			Y	82 27	392	24	6.9 27	480	104	1	14	$53	$504	5.9 27	11.8 26	0.8 26	$6.15 27	$0.64	$5.51	15.9 12	1.15	7.4	28.0	
20	SATco			Y	3,225 1	3,586	231	63.6 3	3,817	927	5	82	$1,610	$4,060	39.3 5	50.7 3	3.5 7	$1.26 5	$0.50	$0.76	15.5 14	1.00	11.3	43.7	
21	SATco			Y	746 11	1,280	85	22.8 11	1,385	359	2	35	$493	$1,512	21.3 13	32.8 12	2.1 13	$2.03 14	$0.66	$1.37	16.8 11	1.01	10.3	36.6	
22	SATco			Y	110 25	541	43	9.7 23	639	135	1	13	$78	$676	8.5 24	11.3 28	0.8 25	$6.15 26	$0.71	$5.44	15.0 15	1.09	10.4	41.6	
24	SATco			Y	91 26	448	30	8.0 25	510	106	1	8	$51	$537	11.4 21	11.4 27	0.9 24	$5.91 24	$0.56	$5.35	14.2 16	1.07	13.2	56.0	
30	UMass			Y	1,882 5	719	251	16.2 15	935	204	1	34	$0	$584	55.3 2	116.4 1	9.2 1	$0.31 1	-	-	17.0 10	0.96	6.0	21.1	
31	UMass			Y	1,822 6	879	161	17.3 13	1,045	319	1	32	$0	$738	56.9 1	105.1 2	5.7 2	$0.41 2	-	-	21.8 5	1.00	10.0	27.5	
35	UMass			Y	252 20	448	0	7.5 26	454	88	1	11	$0	$340	22.9 12	33.7 11	2.9 9	$1.35 7	-	-	11.8 22	1.01	8.0	40.7	Number of trips is from public sch
37	UMass			Y	454 14	495	166	11.0 19	661	84	1	22	$0	$255	20.6 14	41.2 6	5.4 3	$0.56 3	-	-	10.2 26	1.00	3.8	22.5	
38	UMass			Y	1,411 8	1,750	250	33.3 7	2,020	616	2	50	$0	$1,843	28.2 8	42.3 5	2.3 12	$1.31 6	-	-	21.1 6	1.01	12.3	35.0	
39	UMass			Y	565 13	845	160	16.8 14	1,050	325	1	24	$0	$1,036	23.5 11	33.7 10	1.7 18	$1.83 10	-	-	23.1 4	1.04	13.6	35.2	
42	VATco			Y	112 24	528	40	9.5 24	611	184	1	18	$94	$685	6.2 26	11.8 25	0.6 29	$6.12 25	$0.84	$5.28	20.9 7	1.08	10.2	29.3	
43	VATco			Y	2,571 3	2,965	111	51.3 5	3,076	621	4	60	$534	$3,139	42.9 3	50.1 4	4.1 4	$1.22 4	$0.21	$1.01	12.6 20	1.00	10.4	49.4	
44	VATco			Y	312 17	1,352	70	23.7 10	1,422	234	2	20	$177	$1,403	15.6 17	13.2 24	1.3 22	$4.50 23	$0.57	$3.93	10.4 25	1.00	11.7	67.6	
45	UMass			Y	55 28	165	0	2.8 29	165	72	1	10	$0	$384	5.5 28	19.8 20	0.8 27	$7.04 28	-	-	26.0 2	1.00	7.2	16.5	**Belchertown Center**
46	UMass			Y	15 30	50	65	1.9 30	115	25	1	10	$0	$286	1.5 30	7.8 30	0.6 28	$19.10 30	-	-	29.5 1	1.00	2.5	5.0	
48	VATco			Y	437 15	672	44	11.9 17	716	229	1	24	$329	$816	18.2 15	36.6 8	1.9 14	$1.87 12	$0.75	$1.11	20.4 8	1.00	9.5	28.0	
Systemwide Sum/Average					**25,468**	**39,052**	**2,573**	**694**	**41,905**	**9,058**	**59**	**941**	**$10,003**	**$41,867**	**20.9**	**31.5**	**2.4**	**$3.54**	**$0.57**	**$2.80**	**15.9**	**1.01**	**9.2**	**37.5**	**Columns G–P are SUMs; colum**

SUNDAY v9

Route	Garage	Type (E=Express)	Has Express Variant	Evaluate?	Average Weekday Ridership RIDERS	In-Service Minutes per Weekday	Layover Minutes per Weekday	Revenue Vehicle Hours per Weekday RVH	Total Vehicle Minutes per Day	In-Service Vehicle Miles per Weekday RVM	Peak Vehicles	Trips per Day TRIPS	Average Fare Revenue per Weekday	Gross Operating Cost per Day COST	Average Ridership per Trip PAX/TRIP	Passengers per Revenue Vehicle Hour PAX/RVH	Passengers per Revenue Vehicle Mile PAX/RVM	Operating Cost per Rider COST/PAX	Average Fare FARE	Average Subsidy per Rider	Average Speed (mph) MPH	TVH/RVH	Average One-Way Route Length (mi)	Average One-Way Running Time (min)	Notes
1	SATco		Y	Y	704 5	1,027	32	17.7 2	1,074	247	2	16	$401	$1,128	44.0 3	39.9 6	2.8 7	$1.60 8	$0.57	$1.03	14.5 8	1.01	15.5	64.2	
2	SATco			Y	79 15	284	18	5.0 15	302	41	1	5	$34	$289	15.8 10	15.7 13	1.9 10	$3.65 14	$0.44	$3.22	8.8 19	1.00	8.3	56.8	
3	SATco			Y	103 14	280	18	5.0 16	298	51	1	5	$58	$295	20.6 6	20.7 10	2.0 9	$2.87 10	$0.56	$2.31	11.0 15	1.00	10.2	56.0	
4	SATco			Y	44 16	260	28	4.8 17	288	45	1	10	$18	$284	4.4 16	9.2 17	1.0 14	$6.46 16	$0.41	$6.05	10.3 17	1.00	4.5	26.0	
6	SATco			Y	254 10	731	31	12.7 8	762	168	2	34	$205	$793	7.5 15	20.0 11	1.5 11	$3.12 12	$0.81	$2.31	13.8 9	1.00	5.0	21.5	Number of trips is from public sch
7	SATco			Y	512 7	733	29	12.7 8	762	140	2	34	$349	$765	15.1 11	40.3 5	3.7 6	$1.49 7	$0.68	$0.81	11.4 13	1.00	4.1	21.6	
10	SATco			Y	265 8	602	26	10.5 11	628	195	1	14	$169	$711	18.9 7	25.3 9	1.4 12	$2.68 9	$0.64	$2.04	19.4 6	1.00	13.9	43.0	
20	SATco			Y	763 3	928	28	15.9 4	988	207	2	16	$582	$1,030	47.7 2	47.9 4	3.7 5	$1.35 5	$0.76	$0.59	13.4 10	1.03	12.9	58.0	
21	SATco			Y	25 17	300	10	5.2 14	310	53	1	20	$13	$308	1.3 18	4.8 19	0.5 19	$12.30 18	$0.53	$11.77	10.7 16	1.00	2.7	15.0	Sunday service is interlined (?) or
30	UMass			Y	740 4	583	208	13.2 7	796	166	1	45	$0	$474	16.4 9	56.1 3	4.5 3	$0.64 2	-	-	17.1 7	1.01	3.7	13.0	
31	UMass			Y	906 2	599	114	11.9 10	718	218	1	22	$0	$519	41.2 4	76.2 1	4.2 4	$0.57 1	-	-	21.8 4	1.01	9.9	27.2	
35	UMass			Y	111 13	448	0	7.5 12	454	88	1	11	$0	$340	10.1 14	14.9 14	1.3 13	$3.06 11	-	-	11.8 11	1.01	8.0	40.7	Number of trips is from public sch
37	UMass			Y	242 11	315	106	7.0 13	44	53	1	14	$0	$162	17.3 8	34.5 8	4.5 2	$0.67 3	-	-	10.2 18	0.10	3.8	22.5	
38	UMass			Y	610 6	840	120	16.0 3	970	296	1	24	$0	$885	25.4 5	38.1 7	2.1 8	$1.45 6	-	-	21.1 5	1.01	12.3	35.0	
39	UMass			Y	262 9	750	125	14.6 5	935	289	1	19	$0	$864	13.8 12	17.9 12	0.9 16	$3.30 13	-	-	23.1 3	1.07	15.2	39.5	
43	VATco			Y	1,702 1	1,726	62	29.8 1	1,788	332	2	32	$344	$1,795	53.2 1	57.1 2	5.1 1	$1.05 4	$0.20	$0.85	11.5 12	1.00	10.4	53.9	
44	VATco			Y	143 12	808	28	13.9 6	836	152	2	12	$80	$839	11.9 13	10.3 16	0.9 15	$5.86 15	$0.56	$5.31	11.3 14	1.00	12.7	67.3	
45	UMass			Y	22 18	99	0	1.7 18	99	43	1	6	$0	$230	3.6 17	13.2 15	0.5 17	$10.58 17	-	-	26.0 2	1.00	7.2	16.5	**Belchertown Center**
46	UMass			Y	7 19	30	37	1.1 19	67	15	1	6	$0	$172	1.2 19	6.5 18	0.5 18	$23.71 19	-	-	29.5 1	1.00	2.5	5.0	
Systemwide Sum/Average					**7,494**	**11,343**	**1,020**	**206**	**12,119**	**2,800**	**25**	**345**	**$2,252**	**$11,882**	**19.4**	**28.9**	**2.3**	**$4.55**	**$0.56**	**$3.30**	**15.6**	**1.0**	**8.6**	**35.9**	**Columns G–P are SUMs; colum**

APPENDIX C

Service Guidelines

Pioneer Valley Transit Authority
COMPREHENSIVE SERVICE ANALYSIS

SERVICE GUIDELINES

July 2013

PVTA

NELSON NYGAARD

ASG PLANNING

Table of Contents

1 INTRODUCTION

The Pioneer Valley Transportation Authority (PVTA) strives to serve the most riders in its area as cost-effectively, reliably and equitably as possible. To do so, PVTA must make a number of competing decisions on where demand is greatest, on which types of service would work best and be most appropriate, and how limited resources can and should be used.

As a framework to guide system development, PVTA developed this set of service guidelines to:

- Determine where service should be provided
- Design service
- Determine appropriate service levels
- Measure and establish minimum levels of service performance

PVTA is the largest regional transit authority in Massachusetts serving 24 towns and communities. Given the size of its service area and diversity of communities, PVTA operates a variety of services intended to meet local needs. These services include urban fixed-route routes, university shuttles, express bus routes, regional connectors, community circulators and ADA paratransit. From a service design perspective, PVTA service is organized around four main hubs located in Springfield, Holyoke, Northampton and at the University of Massachusetts Amherst. PVTA anticipates that ridership growth experienced over the last few years will continue over the near-term as systemwide improvements are introduced.

The service guidelines will be applied to the entire family of services provided by PVTA and are intended to bring clarity and consistency to the process of continually adjusting and improving transit services to meet varied and changing customer needs. This document addresses the design and scheduling of service and does not address amenities at transit stops and stations.

The service guidelines define the types of service that should be provided to meet the needs of specific local markets – whether densely populated urban corridors or connections between two regional activity centers. The intent is to identify minimum thresholds that should be met in order to provide attractive and effective service within these market areas, and to use the guidelines to continually monitor and adjust service to meet customer needs. In many cases, PVTA services may exceed these minimum thresholds; in others they may not. If a route continues to attract new riders and perform well, it may warrant additional service. Conversely, if a route is not performing well, PVTA must reassess the market being served, the purpose of the service, and make adjustments to improve overall effectiveness.

Finally, it should be noted that these guidelines are also designed to—within limits—provide flexibility to respond to varied customer needs and community expectation in an accountable, equitable, and efficient manner.

Adherence to these service guidelines is dependent upon resource availability, and in particular, the amounts of funding provided by the Commonwealth of Massachusetts and other PVTA partners. In the event of constrained resources, PVTA will strive to meet these guidelines as closely as possible and will work to achieve consistency as resources permit.

2 PVTA SERVICES

A hierarchy of PVTA services has been developed to reflect the array of travel markets and customer needs within the greater Springfield area. Eight different route classifications have been identified to help guide the design and scheduling of service for general public transit services route. These categories include:

1. Bus Rapid Transit/ Key Regional Routes: Tier I
2. Key Regional Routes: Tier II
3. Urban Radial Routes
4. Campus Services – Shuttles
5. Campus Services – Five College Routes
6. Village Connectors
7. Community Circulators / Flex Services
8. Express Routes

The specific routes included in each class are shown in Appendix A. Complementary ADA paratransit services must be designed in accordance with specific federal guidelines and are not addressed in this document.

BUS RAPID TRANSIT (BRT) / TIER I KEY REGIONAL ROUTES

Bus Rapid Transit (BRT) and Tier I key regional routes form the "backbone" of PVTA's system and provide connections between the system's four primary hubs. BRT or enhanced bus service entails increased investment for corridor improvements such as transit signal priority or queue jump lanes. The service is recommended on the corridors along State Street in Springfield and Route 9 between Amherst and Northampton. Tier I key corridor routes operate along primary arterials and offer direct service between Springfield, Amherst, Northampton and Holyoke. These routes play an important role by connecting major urban centers and other activity centers in the greater Springfield area. These routes should offer frequent and consistent weekday service, as well as weekend service where warranted.

TIER II KEY REGIONAL ROUTES

Similar to Tier I corridors, Tier II has high ridership but includes slighltly less dense corridors and a correspondingly slightly reduced frequency. Transit services along these corridors would be increased from the existing sytem with predictable service 7 days a week, but at slightly lower frequency than Tier I routes.

URBAN RADIAL ROUTES

Urban radial routes are those that operate to and from downtown Springfield. Certain urban radials may extend outside of Holyoke to other urban centers (e.g. Westfield, Ludlow, etc.), but their primary role is to serve the downtown core. In several locations, urban radial routes come together in downtown Springfield and operate in a relatively high intensity transit corridor (e.g. State, Liberty or Main Streets). These key corridors may be targeted for passenger amenities, and roadway/corridor improvements in cooperation with MassDOT and local communities on a case by case basis.

There may also be a need to create two tiers of the urban radial routes to recognize key corridors within the Springfield network.

CAMPUS SERVICES - SHUTTLES

Campus shuttle routes serve the University of Massachusetts (UMass) Amherst campus, providing frequent connections between dormitories, other residential areas, campus buildings and Amherst center. Due to the large student population, these routes display relatively high ridership throughout the day and frequent daily service is provided. Evening and weekend service is provided where warranted and very late night service may be provided to ensure student safety. While the routes have a fare, students, faculty and staff associated with any of the Five Colleges can ride the routes for free.

Most campus services adjust service levels to reflect academic calendars and times when fewer students are on campus. This means there may time periods when no service is provided, such as the winter break, and times when reduced service are provided, such as the summer time.

CAMPUS SERVICES – FIVE COLLEGE ROUTES

Five College routes connect the Five Colleges network, serving UMass, Smith, Holyoke, Hampshire and Amherst. These routes operate much like key regional routes, but adhere to separate guidelines as they are designed to specifically to meet the unique needs of the student and college market. Students, faculty and staff associated with any of the Five Colleges can ride the routes for free.

Most campus services adjust service levels to reflect academic calendars and times when fewer students are on campus. This means there may time periods when no service is provided, such as the winter break, and times when reduced service are provided, such as the summer time.

VILLAGE CONNECTORS

Village Connectors operate primarily outside of the Springfield core. While some may serve the Springfield Bus Terminal, their primarily function is to serve passengers outside of the urban core. Village Connectors are designed to serve connect outlying rural village centers without going through downtown Springfield (e.g. Holyoke – Chicopee).

COMMUNITY CIRCULATORS / FLEX

Community circulators and Flex services are designed to provide flexible transportation and circulation within individual communities and lower density areas, especially those with relatively high populations of seniors and/or registered ADA paratransit users. Ideally, these routes also provide connections to Village Connectors or Regional routes in order to integrate rural areas with the larger PVTA service area.

Both services travel between fixed bus stops according to a regular schedule. Passengers must make reservations in order to be picked up at locations other than fixed bus stops, and may also request to be dropped off at locations that are not directly on the scheduled route, as long as they are in the service zone. On Village Circulators, passengers may also "flag down" a vehicle to be picked up along the route.

EXPRESS ROUTES

Express routes are designed primarily to provide fast direct service for commuters and others traveling between the region's key downtown cores and other major activity centers. Express routes provide high-speed service, use freeways or major arterials, and make direct connection to provide more predictable, faster trips.

These routes generally operate on weekdays only, and many operate only during peak periods. However, depending upon demand, some express routes operate for longer hours or provide a mid-day trip.

3 SERVICE DESIGN GUIDELINES

PVTA strives to serve as many local area residents, students, workers, and visitors as it can with its available resources. Service features that attract one type of rider to transit can deter other riders, and PVTA must balance these types of competing demands. However, there are certain service design principles that will improve service for nearly all riders; this section describes the guidelines PVTA aims to follow in order to attract the most riders and balance competing demands.

SERVICE SHOULD BE SIMPLE

For people to use transit, service should be designed so that it is easy to understand. In this way, current and potential riders can grasp and use the transportation options available to take them where and when they want to go with ease. Most of the guidelines in this section are aimed at making service intuitive, logical, and easy to understand.

SERVICE SHOULD BE FAST AND DIRECT

Passengers and potential passengers alike prefer faster, more direct transit services. In order to remain competitive with the automobile, special attention should be placed on designing routes to operate as directly as possible to maximize average speed for the bus and minimize travel time for passengers while maintaining access to service. Travel times and directness of service are affected by a series of factors, some under PVTA's control, and others related more to the environment in which service operates. Some of these factors include:

SERVICE FACTORS WITHIN PVTA'S CONTROL

- Directness of individual routes Length of route
- Connectivity throughout route network (transfers)
- Operating characteristics (number of stops, express/local operation, etc.

ENVIRONMENTAL FACTORS BEYOND PVTA'S CONTROL

- Traffic congestion
- Geography
- Accessibility of streets from adjacent areas
- Street geometry and turning movements
- Traffic signals and controls

ROUTE DEVIATIONS SHOULD BE MINIMIZED

Routes should not deviate from the most direct alignment unless there is a compelling reason. The use of route deviations—the deviation of service off of the most direct route—should be minimized.

However, there are instances when the deviation of service off of the most direct route is appropriate, for example to avoid a bottleneck or to provide service to major shopping centers, employment sites, schools, etc. In these cases, the benefits of operating the route off of the main route must be weighed against the inconvenience caused to passengers already on board. Route deviations should be implemented only if:

1. The deviation will result in an increase in overall route productivity.
2. The number of new passengers that would be served is equal to or greater than 25% of the number of passengers who would be inconvenienced by the additional travel time on any particular deviated trip.

3. The deviation would not interfere with the provision of regular service frequencies and/or the provision of coordinated service with other routes operating in the same corridor.

In most cases, where route deviations are provided, they should be provided on an all day basis. Exceptions are during times when the sites that the route deviations serve have no activity—for example route deviations to shopping centers do not need to serve those locations early in the morning before employees start commuting to work.

STOPS SHOULD BE SPACED APPROPRIATELY

The distance between stops is of key concern to PVTA. More closely spaced stops provide customers with more convenient access as they are likely to experience a shorter walk to the nearest bus stop. However, transit stops are also the major reason that transit service is slower than automobile trips, since each additional stop with activity requires the bus to decelerate, come a complete stop, load and unload riders, and then accelerate and re-merge into traffic. Since most riders want service that balances convenience and speed, the number and location of stops is a key component of determining that balance.

PVTA provides different types of transit services that are tailored toward serving different types of trips and needs. In general, services that emphasize speed (e.g. Key Regional or Express routes) should have fewer stops, while services that emphasize accessibility should have more frequent stops.

The minimum stop spacing (or maximum stops per mile) is shown in Table 1. Where multiple routes operate in the same corridor, the standard for the higher service type applies. Express/commuter services are not required to serve every stop in a corridor. Exceptions to these guidelines should only be made in locations where walking conditions are particularly dangerous, significant topographical challenges impede pedestrian access, and factors compromise safe bus operations and dwelling.

TABLE 1 | BUS STOP SPACING GUIDELINES

	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIER II	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	VILLAGE CONNECTOR	COMMUNTY/ FLEX	EXPRESS
Minimum Stop Spacing (feet)								
Moderate to High Density Areas	900	900	900	660	900	660	660	900
Low Density Areas	1,100*	1,300	1,300	1,100	1,100	1,100	1,100	1,100
Maximum Stops per Mile								
Moderate to High Density Areas	6	6	6	8	6	8	6	6
Low Density Areas	4	4	4	5	5	5	5	5

Notes: Moderate to high density = greater than or equal to 4,000 persons per square mile; low density = less than 4,000 persons per square mile
**BRT stops vary by type and the surrounding environment*

ROUTES SHOULD BE SYMMETRICAL

Routes should operate along the same alignment in both directions to make it easy for riders to know how to return to their trip origin location. For example, if a route follows State Street into downtown, it should use State Street on its outbound trip. Exceptions can be made in cases where such operation is not possible due to one-way streets or turn restrictions. In those cases, routes should be designed so that the opposite directions parallel each other as closely as possible.

MAJOR ROUTES SHOULD OPERATE ALONG ARTERIALS

Key Regional, Urban Radial and Express routes should operate on major roadways and should avoid deviations to provide local circulation. The operation of bus service along arterials makes transit service

faster and easier for riders to understand and use. Current and potential riders typically have a general knowledge of an area's arterial road system and use that knowledge for geographic points of reference.

ROUTES SHOULD SERVE WELL-DEFINED MARKETS

To make service easy to understand and to eliminate service duplication, service should be developed to serve well-defined markets. For example, there should only be one Key Regional route between urban areas, and multiple Urban Arterials should only operate through the same corridor when they serve unique destinations.

SERVICE SHOULD BE CONSISTENT

Routes should operate along consistent alignments and at regular intervals (headways). People can easily remember repeating patterns but have difficulty remembering irregular sequences. For example, routes that provide four trips an hour should depart from their terminals every 15 minutes. Limited exceptions can be made to reduce overcrowding on individual trips (e.g. where demand spikes during a short period).

Most routes intersect with other routes at transfer centers, stations, and street intersections. At major transfer locations, schedules should be coordinated to the greatest extent possible to minimize connection times for the predominant transfer flows.

SERVICES SHOULD BE WELL-COORDINATED

When multiple routes operate through the same corridor but to different destinations, service should be coordinated to maximize its utility and minimize redundancy. To avoid bunching of buses and to balance loads, major routes of the same route type that serve the same corridor should be scheduled to operate at the same service frequencies and should alternate trips at even intervals.

SERVICE DESIGN SHOULD MAXIMIZE SERVICE

Service design can significantly impact schedule efficiency. Service should be designed to maximize in-service time and minimize out-of-service time. In other words, the length of the route and the time it takes to make each trip impacts how long of a layover is required at each end and how many buses are needed to provide the service. Often, it may be more efficient to extend a route to pick up a few more passengers and limit the amount of layover time.

VEHICLE TYPE SHOULD BE APPROPRIATE FOR SERVICE

PVTA's owns a range a vehicle types and sizes. Standard fixed-route buses range from 30' to 40' in length and seat anywhere from 23 to 45 passengers, and are appropriate for most services. Four 60' articulated buses have recently been added to the fleet to reduce overcrowding on high ridership routes; these vehicles seat 55 passengers. Smaller 24' mini-buses are used on the Route 39E service between Mount Holyoke and Smith, and as Flex/Vans. These vehicles seat 22 passengers.

4 SERVICE LEVEL GUIDELINES

Service level guidelines define when service should be provided and how often it should be provided. Four types of guidelines are used:

1. Service Coverage
2. Minimum Span of Service
3. Minimum Service Frequencies
4. Maximum Passenger Loadings

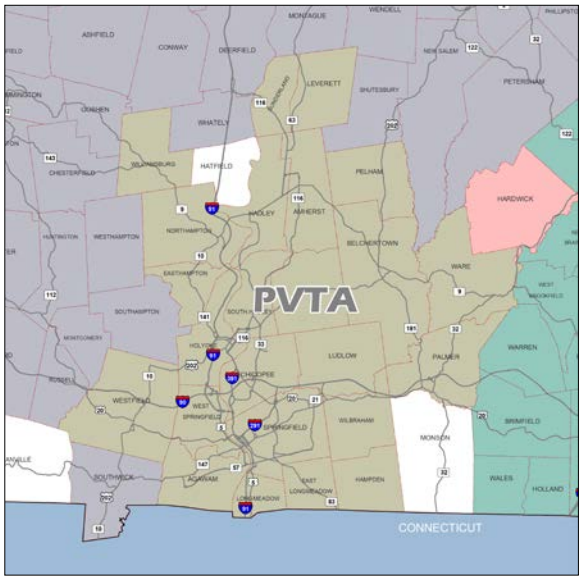
These guidelines, in combination with the productivity guidelines presented in Section 5, are used to determine appropriate service levels for each route. At a minimum, service should be provided to meet the minimum span of service and minimum service frequency guidelines. Beyond that, additional service may be added to meet passenger loading guidelines and to extend the span of service earlier in the morning and later at night, as long as minimum productivity guidelines (see Section 5) can still be met.

On an ongoing basis, service should be added when ridership increases to levels that exceed maximum passenger loading guidelines. Conversely, service should also be reduced when ridership falls below the minimum productivity guidelines.

SERVICE COVERAGE

PVTA currently serves 24 communities:

> Agawam, Amherst, Belchertown, Chicopee, Easthampton, East Longmeadow, Granby, Hadley, Hampden, Holyoke, Leverett, Longmeadow, Ludlow, Northampton, Palmer, Pelham, South Hadley, Springfield, Sutherland, Ware, Westfield, West Springfield, Wilbraham and Willamsburg.

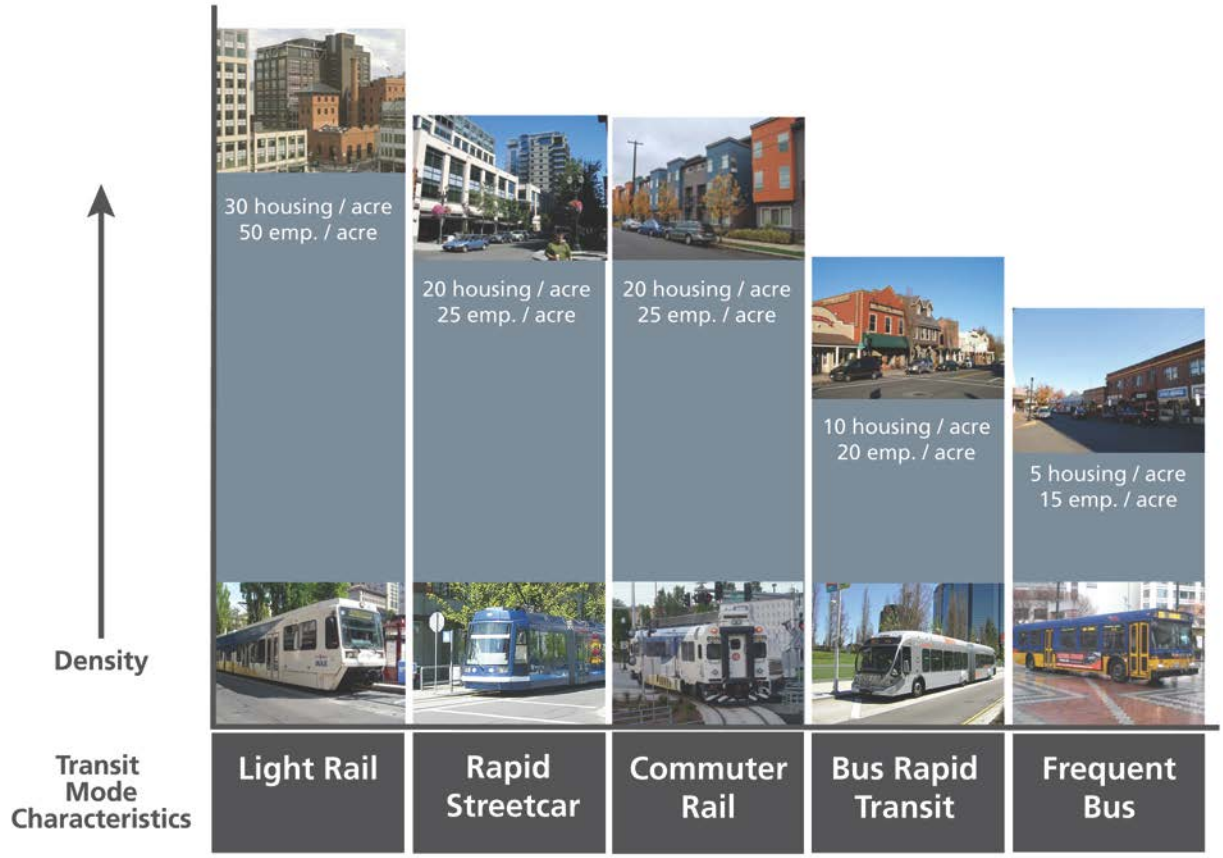


These communities range from densely populated urban areas to traditional New England villages, and are generally separated by relatively low density rural areas. PVTA often receives requests for service from citizens who are not within walking distance of any route, or who desire that existing routes be expanded to serve new destinations. And, it is possible that, in the future, other adjacent communities could join the Authority. While PVTA strives to provide services to those who need it the most, transit cannot be effective and productive in all environments. It is challenging to provide attractive and effective service in minimally populated areas. These service coverage guidelines provide a basis to help identify those areas likely to be most transit-supportive.

Population and employment densities are two of the strongest indicators of potential transit demand, and can be used to evaluate the potential for new transit services. Figure 1 provides a general guideline for where different levels of transit service may be warranted. Once densities begin to exceed 3 to 6 households per acre or 4 jobs per acre, fixed route bus services may be viable. More densely developed areas may warrant higher levels of transit service.

If densities are relatively high along a continuous corridor, or if the corridor connects major activity centers or hubs, a higher level of service may be warranted. If densities meet the minimum guidelines, but only exist in small or scattered areas, travel demand may not be sufficient to support transit. Or, a lower level of transit – such as Flex/Van services – may be warranted.

FIGURE 1 | TRANSIT SUPPORTIVE POPULATION AND EMPLOYMENT DENSITIES



Source: Composite data compiled by Nelson\Nygaard from various sources.

Other factors must also be considered when deciding whether an area can support productive transit service. These include demographic data within the corridor, such as the number of transit dependant individuals and household incomes. Local conditions, such as the cost of parking, can increase transit demand. Note that these guidelines only apply to the evaluation of potential service; existing service should not be evaluated with these service coverage guidelines, but according to actual performance.

MINIMUM SPAN OF SERVICE

The number of hours per day when transit service is provided along a route, or between two locations, plays a role in determining the effectiveness of transit service for potential users. Transit service must be

available near the time a trip needs to be made in order for transit to be a travel option. Ideally, transit service should operate according to the standard time periods specified (peak rush hours, midday, night, etc.) to minimize customer uncertainty.

Passenger needs and PVTA's financial capacity are key considerations in setting weekday service spans, and in deciding which routes are operated on Saturdays and Sundays. Weekday routes should permit workers and students to make their morning start times, and should end late enough to provide return trips home for second shift workers. Service oriented to non-work travel can start later and end sooner. Sunday service may not be necessary on many routes.

Minimum span of service guidelines are presented in Table 2 and define the **minimum** period of time that different types of service should operate. Service could be started earlier and/or end later if demand warrants, but the extra service would be subject to the minimum performance guidelines presented in Section 5. Also, these guidelines may not apply to some services on certain days (e.g. no express service on weekends). Service may still be provided on these days (to meet other guidelines, for example), though it would not be subject to minimum span of service guidelines.

TABLE 2 | MINIMUM SPAN OF SERVICE GUIDELINES

	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIER II	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	VILLAGE CONNECTORS	COMMUNTY / FLEX	EXPRESS
Weekdays								
Begin	6:00 AM	6:00 AM	6:00 AM	8:00 AM	7:00 AM	7:00 AM	8:00 AM	6:00 AM
End	10:00 PM	9:00 PM	7:00 PM	10:00 PM*	9:00 PM*	6:00 PM	5:00 PM	7:00 PM
Saturdays								
Begin	6:00 AM	7:00 AM	7:00 AM	8:00 AM	10:00 AM	8:00 AM	—	—
End	9:00 PM	8:00 PM	6:00 PM	10:00 PM*	9:00 PM*	5:00 PM	—	—
Sundays								
Begin	9:00 AM	10:00 AM	9:00 AM	8:00 AM	7:00 AM	—	—	—
End	5:00 PM 6:00 PM (BRT)	5:00 PM	5:00 PM	10:00 PM	9:00 PM	—	—	—

Notes: The beginning span of service refers to the departure of the first inbound trip, and the ending span of service refers to the departure time of the last peak direction trip. A blank or "—" indicates that the guideline does not apply.

** Varies by night (i.e. Thursday, Friday and Saturday night may warrant later schedules).*

MINIMUM SERVICE FREQUENCIES

Service frequency (the time interval between two vehicles traveling in the same direction on the same route) has a major influence on transit ridership; high frequency service is considered more attractive to users who don't need to wait as long in between buses. At the same time, frequency has a significant impact on operating costs, and service requirements increase exponentially with improvements in frequency.

Because of the expense of high frequency service, transit service frequency is normally scheduled based upon existing or potential demand. This often translates into variations in service frequency throughout the day, with higher frequency in peak periods, and less frequent service outside of the peak.

In general, frequencies are established to provide enough vehicles (past the maximum load point) on a route to accommodate the passenger volume and stay within recommended loading standards. Minimum service frequency guidelines are presented in Table 3. Note that when a corridor is served by multiple routes, the overall service frequency in the corridor is effectively more frequent than for individual routes. For certain routes serving outlying areas, service frequencies may be reduced to maintain satisfactory

farebox recovery ratios. As with all standards, this service frequency matrix should be considered a guide, not an absolute measure.

Clock-face service intervals (e.g. every 10, 12, 15, 20, 30 or 60 minutes) are easier for passengers to remember and can help facilitate better transfer connections between routes. Whenever possible, frequencies should be set at regular clock-face intervals. However, there are two key exceptions:

- Where individual trips must be adjusted away from clock-face intervals to meet shift times, work times, transfer connections, or other special circumstances;
- Where the desired frequency of service causes round trip recovery time to exceed 20% of the total round trip vehicle time, leading to inefficient service.

TABLE 3 | MINIMUM SERVICE FREQUENCY GUIDELINES (MINUTES)

	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIER II	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	VILLAGE CONNECTORS	COMMUNTY/ FLEX	EXPRESS
Weekdays								
Early AM	30	60	60	60	60	60	—	60*
AM Peak	15/20	30	30	15	60	60	60	60*
Midday	15/20	30	60	15	60	60	60	60*
PM Peak	15/20	30	30	15	60	60	60	60*
Night	30	60	60	60*	60*	60	—	60*
Saturdays								
Day	30	30	60	60	60	60	—	—
Night	30	60	60	60	60	60	—	—
Sundays								
All Day	60	60	60	60	60	—	—	—

Note: "—" indicates that the guideline does not apply.

** Varies by route (i.e. Thursday, Friday and Saturday night may warrant higher frequencies).*

VEHICLE LOADING

PVTA will design its services to keep the number of passengers on its vehicles at a comfortable level, always within the limits of safety. In peak periods, this means that some passengers may be expected to stand for part of the trip. In off-peak periods and for service that operates for long distances, service will be designed to try to provide a seat to all customers.

Two different techniques are used to keep passenger loads within acceptable levels. The first is to match vehicle types with ridership levels, and to use larger vehicles on higher ridership routes. The second method is to provide more frequent service at times of high demand, with service frequencies set to keep passenger loads within the limits presented in Table 4.

The vehicle load standard is calculated on the basis of an average for the both the peak and off-peak periods, at the busiest point on the route. For instance, if a service operates at 15-minute frequency, then 4 buses would pass the busiest point in an hour. The average number of passengers for these 4 buses must fall within the service standards, even though any one bus may be more crowded than the average. If the standard is exceeded for the average calculation, PVTA will consider more frequent service or larger vehicles to improve the situation.

TABLE 4 | AVERAGE VEHICLE LOADING MAXIMUMS

	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIER II	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	VILLAGE CONNECTORS	COMMUNTY/ FLEX	EXPRESS
Peak	120%	120%	120%	120%	120%	120%	100%	100%
Off-Peak	100%	100%	100%	100%	100%	100%	100%	___

Note: Maximums are averages over one-hour periods; individual trips may exceed averages.

TABLE 5 | VEHICLE CAPACITIES

	60' ARTICULATED BUS	40' BUS	35' BUS	30' BUS	24' MINI-BUS
100% of Seating Capacity	55	40	32	23	18
120% of Seating Capacity	66	50	39	28	22

5 PERFORMANCE GUIDELINES

PVTA must use its resources effectively and all routes should achieve a minimum level of productivity. The two primary guidelines to assess performance are:

1. Productivity in terms of "Passengers per Revenue Vehicle Hour" for most services, and "Passengers per Trip" for Regional and Express services that typically carry passengers for long distances with little passenger turnover.
2. Cost-Effectiveness, in terms of Farebox Recovery, which is the percentage of operating expenses recouped by farebox revenues.

PASSENGERS PER REVENUE HOUR

With limited exceptions, all service should attract a minimum level of ridership. For routes that experience a significant amount of ridership turnover along the route (all services except Regional and Express routes), this minimum level of ridership is expressed in terms of Passengers per Revenue Service Hour, or in simpler terms, the average number of passengers that a bus should serve for each hour it is in service. For Regional and Express routes, which often travel for long distances with little ridership turnover, the minimum level of ridership is expressed in terms of Passengers per Bus Trip. These minimum productivity levels are presented in Table 6.

TABLE 6 | MINIMUM PRODUCTIVITY LEVELS (PASSENGERS PER REVENUE VEHICLE HOUR)

	PASSENGERS PER REVENUE SERVICE HOUR				PASSENGERS PER TRIP		
	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	COMMUNITY/ FLEX	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIERII	EXPRESS
Weekdays							
All Day	20	20	15	5	20	20	25
Early Morning	10	10	10	5	15	15	15
Late Night	10	10	10	5	15	15	15
Saturdays							
All Day	15	15	10	5	15	15	–
Early Morning	10	10	10	5	15	15	–
Late Night	10	10	10	5	15	15	–
Sundays							
All Day	15	15	10	5	15	15	–
Early Morning	10	10	10	5	15	15	–
Late Night	10	10	10	5	15	15	–

*Note: "Early morning" and "Late Night" refers to service before and after the minimum span of service. All day refers to the complete span of service, including early morning and late night service. "—" indicates that the standard does not apply. Productivity for Regional and Express routes is measured as a minimum number of passengers per **trip**.*

FAREBOX RECOVERY

The second performance measure is farebox recovery, which is the percentage of operating expenses recouped by farebox revenues. Minimum farebox recovery percentages are shown in Table 7.

TABLE 7 | MINIMUM FAREBOX RECOVERY

	BRT/ KEY REGIONAL TIER I	KEY REGIONAL TIER II	URBAN RADIAL	CAMPUS SHUTTLES	FIVE COLLEGES	VILLAGE CONNECTORS	COMMUNTY / FLEX	EXPRESS
Weekday	20%	20%	20%	n/a	n/a	20%	5%	n/a
Saturday	15%	15%	15%	n/a	n/a	15%	5%	n/a
Sunday	15%	15%	15%	n/a	n/a	15%	5%	n/a

APPLICATION OF PERFORMANCE GUIDELINES

In cases where routes do not meet minimum performance guidelines, changes should be made to improve route performance. These changes can include a variety of measures, including reconfiguring the route alignment to attract more passengers, targeted marketing, eliminating particularly unproductive segments, and reducing service levels. If no changes can be identified that improve performance, steps may be taken to discontinue the route unless it serves a demonstrable critical need that is not served by other routes or services (including paratransit service).

In cases where service expansion is considered, ridership and productivity estimates should be developed that indicate that there is a reasonable certainty that the new service will meet the performance guidelines within 12 months of implementation.

APPENDIX A:
PVTA ROUTE CLASSIFICATIONS

BUS RAPID TRANSIT

- 7 State – Eastfield Mall
- 43 Northampton – Amherst

KEY REGIONAL ROUTES: TIER I

- 1A Five Town Plaza – Springfield Plaza
- 1B Chicopee Big Y – Springfield Plaza
- 2A SBT – East Longmeadow Big Y
- 2B SBT – East Springfield / Mass DET/ Goodwill

KEY REGIONAL ROUTES: TIER II

- 3B SBT – Springfield Plaza
- 4 Plainfield Street
- 6 Ludlow via Bay
- 20 Holyoke – Springfield via Holyoke Mall
- 21 Holyoke – Springfield via Chicopee
- 90 Springfield Inner Crosstown
- 92 Springfield Outer Crosstown
- 48 Northampton – Holyoke

URBAN RADIAL ROUTES

- 3A Springfield College – SBT
- 8 SBT – Jewish Home
- 10 Westfield Center – SBT
- 14 Six Flags
- 17 Eastfield Mall– Sixteen Acres Center
- 24 Holyoke Circulator

EXPRESS ROUTES

- 5X Enfield Express via I-91
- 11X SBT – Holyoke Community College
- 12X Stonybrook Express (HCCF)
- 20X SBT – Holyoke Mall Express
- 21X SBT – HTC Express
- 29X Amherst – Holyoke Mall via HTC
- 39X Smith College – Mt. Holyoke Express

CAMPUS SERVICES – SHUTTLES

- 10B Westfield Center – Westfield
- 30 North Amherst – Old Belchertown Road
- 31 Sunderland – South Amherst
- 33 Cushman – Big Y/Stop & Shop
- 34 Orchard Hill – Mullins Center - Northbound
- 35 Orchard Hill – Mullins Center - Southbound
- 45 Belchertown – UMass – Deerfield
- 46 UMass – South Deerfield

CAMPUS SERVICES – FIVE COLLEGES ROUTES

- 38 Mt. Holyoke – Amherst – UMass
- 39 Smith College – Hampshire – Mt. Holyoke

VILLAGE CONNECTORS

- 19 Chicopee – Springfield Plaza – HTC
- 23 HTC – Westfield via HCC
- 41 Northampton – Easthampton – Holyoke Mall
- 42 Northampton – Williamsburg
- 44A Hampshire Plaza – Northampton – Courthouse
- 44B Northampton – Hampshire Plaza – Florence

COMMUNITY CIRCULATORS / FLEX

- PS Palmer Village Shuttle
- WS Ware Shuttle
- NE Easthampton Nashawannuck Express
- GS Granby/Chicopee Falls Circulator
- EL East Longmeadow Circulator
- NS Northeast Springfield Circulator
- WE Westfield Circulator
- AG Agawam Circulator
- WI Wilbraham Circulator

APPENDIX D

Summary of Service Options

PVTA SERVICE IMPROVEMENT PROPOSALS

As part of the CSA, the study team created two options for PVTA service improvements.

- A **System Update** or "System Tweak" Option, which consists of relatively minor modifications to the existing routes based on existing ridership and service costs.
- The **System Restructure Option**, which includes more dramatic changes to the routes and introduces new service and new service types to the PVTA network.

SUMMARY OF PRPOSED CHANGES

System Update Option

The System Update Option includes relatively minor modifications to the network based on existing demand and productivity. It also creates a set of service guidelines to set service frequency (how often the bus comes) and span of service (when service begins and ends) based on the demand for service and route productivity (the number of passengers carried). Other general changes include:

- In cases where route are very long, routes would split into two independent routes. This strategy reflects existing ridership patterns (most riders begin or end service in downtown). Splitting them would also allow PVTA to adjust service levels to best meeting the unique area served. It affects Routes 1, 2, 3, 10 and 44.
- Change service types to better meet local demand and ridership. In three communities (Holyoke, Wilbraham and Agawam), existing routes try to cover large areas but service is very infrequent. In each case, the proposed changes involve shortening routes, so while they serve a smaller area, they come more often.
- Make sure riders understand their express service options. In cases where express services are available, the routes would be branded as independent services; they would all share the same route number but identified with an "X". This strategy affects routes 1X, 7X, 11X 20X, 21X and 40X, among others.
- Add two new express services: Route 5X operating from downtown Springfield to Enfield via I-91 and Route 25X, which would operate between Amherst and the Holyoke Mall on weekend days only.
- Combine routes with very low ridership to create new services designed to attract more riders. This strategy affects Routes 32 and 37, which would be combined into a new Route 33 and Route 19, which combines Route 19 with Route 22.
- Discontinue routes with very low ridership that operate in corridors near other services (Route 15).
- Straighten routes to make them more direct and adjusting schedules to offer more consistent service throughout the day.
- Offer higher levels of weekend service.

Service Restructure Option

The System Restructure Option includes changes included in the System Update Option and also identifies a series of corridors for increased transit investment and service. These corridors would offer increased service but would not deviate off the main corridors, thus in many cases service to front doors would be eliminated. It also introduces elements of a grid system to the PVTA network.

- Identifies two corridors for increased "enhanced bus" or bus rapid transit (BRT) for increased investment. These corridors are State Street in Springfield and Route 9 between Amherst and Northampton.
- Recommends a network of "Key Corridor" routes that are the highest ridership corridors and are high density environments conducive to transit use. Transit services along these corridors would be increased, so buses operate seven days a week, start earlier and end later and have higher frequencies. Bus stops with 50 or more riders per day (on average) in Springfield are along a Key Corridor bus route.
- Introduces two new crosstown routes that offer opportunities to travel north-south in Springfield without going into downtown. These routes include 1) a new "Inner Crosstown Route" (Chicopee Center to East Longmeadow Big Y via White Street, Walnut Street, Liberty Street, and Fairview Avenue); and 2) a new "Outer Crosstown Route" (Ludlow Big Y to East Longmeadow Big Y via Center Street, Parker Street, and Cooley Street). Development of crosstown services would require investment in bus shelters because some passengers would transfer between routes.
- Serves lower density communities with flex or demand respone services rather than fixed-route service. PVTA already successfully operates two community shuttles; this option would add an additional eight community shuttles for a total of ten routes.

The following two tables summarize proposed changes included in each of the two options. Table 1 provides overview statistics, comparing the existing system with each of the two options. Table 2 highlights the proposed changes on a route by route basis.

Table 1: Comparison of Existing System to System Update and System Restructure Options

	BASE CASE/EXISTING SYSTEM	SYSTEM UPDATE "TWEAK" OPTOIN	SYSTEM RESTRUCTURE OPTION
Weekday Revenue Hours	1275	1312	1357
Saturday Revenue Hours	754	858	790
Sunday Revenue Hours	214	308	383
Weekday Costs (RVH)	$107,700	$110,800	$114,600
Saturday Costs (RVH)	$63,700	$72,500	$66,700
Sunday Costs (RVH)	$18,000	$26,000	$32,300
Annual Costs (RVH)	$31,400,000	$33,200,000	$34,200,000
Total Number of Routes* - Weekday - Saturday - Sunday	 41 30 17	 46 39 25	 50 36 28
Weekday Vehicles - Commute Times - Mid-day - Early/late (before 6 am and after 6 pm)	 100 91 64	 99 95 67	 108 104 69

Source: Nelson\Nygaard

*Notes: *Does not include Ware, Palmer, NE or OWL community shuttles, or Flex.*

Assumes an hourly operating cost of $84.43 for all routes; non-revenue hours and other indirect costs excluded.

Savings in peak weekday vehicles above can be attributed to the straightening of certain routes, allowing for faster service.

Comparison of Proposed Changes by Option

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
	System Update	System Restructuring	System Update	System Restructuring
1A – Springfield Bus Terminal to Five Town Plaza	Splits Route 1 into two routes (1A and 1B). Route 1A would operate from downtown to Five Town Plaza.	Split into two routes (1A and 1B) Route 1A would operate along Belmont instead of Fort Pleasant/Sumner. The area around Cannon Circle would be served by a new "Outer Crosstown" route	No change **Extended** Sunday service hours from 8 am to 7 pm	Buses arrive approximately every 15 minutes during daytime hours 30 minutes during evening and early morning
1B – Springfield Bus Terminal to Chicopee Big Y	Splits Route 1 into two routes (1A and 1B). Route 1B would operate from downtown to Chicopee Big Y.	Split into two routes (1A and 1B) Route 1B would travel via Main Street, Front Street and Memorial Drive to Chicopee Big Y.	No change **Extended** Sunday service hours from 8 am to 7 pm	Buses arrive approximately every 15 minutes during daytime hours 30 minutes during evening and early morning
1X Springfield Bus Terminal to Five Town Plaza	Uses Sumner Express alignment.	**Discontinued**	Two mid-day trips would be added.	
2A Springfield Bus Terminal to Big Y/East Longmeadow	Split into two routes (2A and 2B). Route 2A would operate from downtown to East Longmeadow Big Y.	Splits Route 2 into two routes (2A and 2B). 2A would operate to East Longmeadow Big Y. **Discontinued** service to Longmeadow/East Longmeadow along Dwight Street. Service replaced by community circulators.	No change	Buses arrive approximately every 15 minutes during daytime hours 30 minutes during evening and early morning
2B Springfield Bus Terminal to Mass DET	Splits Route 2 into two routes (2A and 2B). Route 2B would operate from downtown to Mass DET.	Splits Route 2 into two routes (2A and 2B). Route 2B operate both ways along St. James Street and eliminates one-way service along Carew Street, East Street and Page Street	No change	Buses arrive approximately every 15 minutes during daytime hours 30 minutes during evening and early morning
3A Springfield Bus Terminal to Springfield College	Split into two routes (3A and 3B). Route 3A would operate from downtown to Springfield College.	Split into two routes (3A and 3B) Route 3A would serves downtown, Central Street, Springfield College, and American International College.	**Extended** Saturday service hours from 7 am to 6 pm. **Increased** Sunday service frequency to every 60 minutes.	Buses arrive approximately every 30 minutes during rush hour 60 minutes during mid-day and evening
3B Springfield Bus Terminal to Springfield Plaza via Liberty	Split into two routes (3A and 3B). Route 3B would operate from downtown to Springfield Plaza.	Split into two routes (3A and 3B) Route 3B extends to Chicopee Marketplace and eliminates deviations	**Extended** Saturday service hours from 7 am to 6 pm. **Increased** Sunday service frequency	Buses operate every 30 minutes in daytime 60 minutes in evening and

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
		off of Liberty Street including Saab Court and Tri Towers.	to every 60 minutes.	early morning
4 Plainfield Street	Route 4 would end route at Watson/Main	Route 4 would travels to Baystate Health Center on Main Street	**Extended** Saturday service hours to 6 pm.	Bus operate every 30 minutes In daytime and 60 minutes in evening
5 Dickinson-Longmeadow	Operates to Jewish Community Center via Dickinson Road **Discontinued Area** - Tiffany/Dwight/ Converse loop. Service to Connecticut provided by new Route 5X.	**Discontinued** – area served by East Longmeadow circulator	**Extended** Saturday service hours 7 am to 6 pm.	*No service*
5X Mass Mutual Express	**NEW** - Springfield Bus Terminal to Mass Mutual (Enfield CT) via I-91	**NEW** - Springfield Bus Terminal to Mass Mutual (Enfield CT) via I-91	8 weekday trips, timed to meet CT TRANSIT in Enfield	8 weekday trips, timed to meet CT TRANSIT in Enfield
6 Ludlow via Bay	*No alignment changes*	Consider simplifying route by selecting single alignment between Page Boulevard and Myrtle Street	**Increased** weekday evening service to 30 min. frequency. **Reduced** Sunday frequency reduced to 90 minutes, but operated independently from Route 7.	30 minute daytime 60 minute evening
7 State – Eastfield Mall	*No alignment changes*	Operate as bus rapid transit (BRT) service Eliminate deviations off State Street, so bus does not go to front door of Independence House, Price Rite or Wal-mart	**New** Sunday service (independent of Route 6) operated every 60 minutes. **Reduced** Saturday service to 30 minute frequency	15 minutes daytime 30 minutes evening
8 Orange/Plumtree	*No alignment changes*	*No alignment changes*	**Extended** weekday service starting at 5:30 am (+ 30 mins)	30 minute daytime 60 minute evening
NEW - Springfield Inner Crosstown Route	*Not in service proposal*	Creates new service between Chicopee Center and East Longmeadow Big Y via White Street, Walnut Street, Liberty Street, and Fairview Ave.	*Not in service proposal*	30 minute daytime 60 minute evening
NEW - Springfield Outer Crosstown Route	*Not in service proposal*	New service between East Longmeadow Big Y and Ludlow Big Y via Center Street, Parker Street, and Cooley Street. Also serve Cannon Circle in East Longmeadow and Eastfield Mall.	*Not in service proposal*	30 minutes during rush hour 60 minutes during mid-day and evenings
10A Springfield Bus Terminal to	Split into two routes (10A and 10B).	Split into two routes (10A and 10B)	**Reduced** service during peak	30 minutes during rush hour

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
Westfield Center	Route 10A would operate from downtown Springfield to Westfield Center.	Route 10A would operate from downtown Springfield to Westfield Center. It eliminates deviation to Union Street and Western New England Hospital (replace with community shuttle).	periods. Operates hourly all day. **Increased** Sunday service, operates at 60 minutes all day.	60 minutes during mid-day and evening
10B Westfield Center to Westfield State University (WSU)	Split into two routes (10A and 10B). Route 10B would operate from Westfield Center to WSU.	Split into two routes (10A and 10B). Route 10B would operate from Westfield Center to WSU.	Increased mid-day service to 20 minute frequency. **Increased** Sunday service operates at 60 minutes all day.	30 minute service all day
11X Holyoke Community College (HCC) Express	*No alignment changes*	*No alignment changes*	12 southbound/10 northbound trips	12 southbound/10 northbound trips
12X Stonybrook Express (HCCF)	*No alignment changes*	*No alignment changes*	*No schedule changes*	*No schedule changes*
13 Maple/East Longmeadow	Operate to Quarry Hills Apartments only. **Discontinued** service to Brownstone Apartments	**Discontinued**. White Street served by new Inner Crosstown Route, Central Street served by 3A, and East Longmeadow served by community circulator	**Expanded** service on Saturday, starts 1 hour earlier at 7 AM	*No service*
14 Feeding Hills	Operate from Springfield Bus Terminal to Super Stop & Shop via Springfield St. and Memorial Drive. Includes two deviations to serve Agawam Industrial Park. Serve Century Plaza with on-street stop only.	Operate from Springfield Bus Terminal to Agawam Town Square via Memorial Drive Other areas served by Agawam Community Circulator	**Expanded** service to start earlier start 6 AM on weekdays (+30 mins) and 7 AM on Saturday (+90 mins). **NEW** Sunday service (60 min headway).	30 minute daytime 60 minute evening
15 Oak Grove	**Discontinued**	**Discontinued**	*No service*	*No service*
17 Eastfield Mall- Worthington	Operate to Eastfield Mall via Wilbraham Rd. and Parker St. Discontinue service to Bradley and Plumtree Roads	Operate to 16 Acres Center via State Street and Wilbraham Road Coverage to Eastfield Mall provided by new Outer Crosstown Route	Expanded service to start 30 minutes earlier on Saturday at 7 AM.	30 minute daytime 60 minute evening
19 Springfield Plaza to HTC	Operate from Springfield Plaza to HTC via Broadway and Memorial Drive, with service to Mountcalm Apartments Eliminate service to Westover Industrial Park/Combined with Route 22	Operate from Springfield Plaza to HTC via Broadway and Memorial Drive, with service to Mountcalm Apartments Eliminate service to Westover Industrial Park/Combined with Route 22	**Increased** mid-day and evening frequency from 90 to 60 minutes	60 minute service all day
20 Holyoke Mall	Serve South Street Plaza with on-street stop only	Limit deviations off main route and provide street level access to Riversdale Shops and K-Mart. Eliminate service to Providence	**Expanded** Saturday service start 1 hour earlier at 6 AM. Expanded Sunday service with an extra evening trip.	30 minute daytime 60 minute evening

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
		Hospital and Interstate/Bobala Drive.		
20X Springfield to Holyoke Mall	**NEW** – Route 20 express trips to be branded as separate route: SBT/Union to Holyoke Mall to HTC	**NEW** – Route 20 express trips to be branded as separate route: SBT/Union to Holyoke Mall to HTC	Same as today (Mon-Sat) - 13 peak period trips - 6 mid-day trips	15 daily trips
21 Holyoke via Chicope	Eliminate service to Baystate Medical Center and Lindent Towers Use Route 116 to Holyoke	Eliminates service along Center and Cabot Street in Chicopee (served by Route 1B); Operate two-way service along Meetinghoue Road Ave between Chicopee and Meadow Streets. Serve Southern Portion of Meadow Street to provide access to Rite Aid Use Cabot Street bridge between Chicopee and Holyoke.	Increase mid-day service to 30 minute frequency (up from 60 minutes) Monday - Saturday. Extend service to 9 pm (M-Sat). Start 2 hours earlier on Saturday.	30 minute daytime 60 minute evening
21X Springfield to HTC	**NEW** – Route 21 express trips to be branded as separate route: Travels via I-391.	**NEW** – Route 21 express trips to be branded as separate route: Travels via I-391.	Same as today, but schedule trips more consistently throughout the day. - 8 peak period trips - 13 mid-day trips - 6 early/late trips	34 daily trips
22 Holyoke – Chicopee – Big Y	**Discontinued** (combined with Route 19)	**Discontinued** (combined with Route 19)	*No service*	*No service*
23 Holyoke/Westfield	HTC to Westfield Center Eliminate service to University Park Apartments (served by Routes 24 and 41)	HTC to Westfield Center Eliminate service to University Park Apartments (served by Routes 24 and 41)	**Increased** service at 60 minute frequency all day	60 minute service all day
24 Essex Appleton "Holyoke Circulator"	In town loop with alignment via HTC, Holyoke Flats, Soldiers Home, Sycamore House, Jarvis/ University Park Apts. **Discontinued Area** - service to Holyoke Mall provided by Route 20	Two loops serving The Flats and key destinations in Holyoke. Anchored at HTC	**Increased** mid-day frequency, with circulator designed to run at 45 minute frequency all day. Run 6 am to 6 pm, same as today. Same Saturday service, 9 to 5 pm. No Sunday service.	45 minute service all day
25 Holyoke/S. Hadley/Granby	HTC -- Granby Road –Mt. Holyoke College. Smaller loop via Granby Road/East/Morgan to Newton Street	HTC -- Granby Road –Mt. Holyoke College. Smaller loop via Granby Road/East/Morgan to Newton Street	**Increased** weekday frequency at 60 minutes all day (up from 120 mins.) **Expanded** weekday service operate to 6 pm (+ ½ hour)	60 minute service all day
27 Wilbraham Mall/Sixteen Acres	**Discontinued** (replaced by Wilbraham Circulator)	**Discontinued** (replaced by Wilbraham Circulator)	*No service*	*No service*
NEW - 29X Amherst to HTC to	Operates via SR 116	Operates via SR 116	Operates weekends only	Operates weekends only

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
Holyoke Mall			Hourly between 8 AM and 5 PM	Hourly between 8 AM and 5 PM
30 N. Amherst/ Old Belchertown Road	*No change*	*No alignment changes*	No change	15 minute daytime 30 minute evening
31 Sunderland/S. Amherst	*No change*	*No alignment changes*	No change	15 minute daytime 45 minute evening
32 Puffers Pond/Atkins	**Discontinued** (see Route 33)	**Discontinued** (combined with Route 37; renamed Route 33)	*No service*	*No service*
33 Cushman Center to Big Y/Stop and Shop	**NEW** route – Cushman Center, Henry Street, East Pleasant Street, Route 9/Northampton Road Operate year round	**NEW** route – Cushman Center, Henry Street, East Pleasant Street, Route 9/Northampton Road Operate year round	Operates 8 am to 9 pm (M-Sun) with 30 minute frequency in daytime and 60 minute frequency in evenings and weekends	30 minute daytime 60 minute evening
34/35 Orchard Hill/Mullins	Eliminate service to Haigis Mall	Eliminate service to Haigis Mall	No change	15 minute daytime 45 minute evening
37 Amity Shuttle	**Discontinued (see Route 33)**	**Discontinued** (combined with Route 32; renamed Route 33)	*No service*	*No service*
38 Mt. Holyoke/Hampshire/Amherst/ UMass	*No change*	*No alignment changes*	No change	30 minute daytime 45 minute evening
39 Smith/Hampshire/Mt. Holyoke	*No change*	*No alignment changes*	No change	30 minute daytime 60 minute evening
39E Smith/Mt. Holyoke Express	*No change* *Brand as 39X*	*No alignment changes* *Brand as 39X*	No change	18 daily trips
40 Northampton to Amherst	*No alignment changes* Rebrand former Route 40 Minute Man Express as 43X.	**Discontinued** (consolidated with Route 43; service continues to operate in same corridor)	**NEW** - hourly Saturday service	*No service*
41 Northampton/ Easthampton/HCC	Northampton to HCC to HTC Add summer service Extend service to HTC	Northampton to HCC to HTC Add summer service Extend service to HTC	**Increased** weekday frequency to 60 minutes all day (currently at 90 minutes)	60 minutes all day
42 Northampton/Wiliamsburg	*No alignment changes*	*No alignment changes*	**Increased** weekday frequency to 60 minutes all day	60 minutes all day
43 Northampton – Amherst	*No alignment changes*	Operate as bus rapid transit – no aligment changes but requires capital investment in corridor	**Increased** Saturday evening service to every 60 minutes (now 120 mins) **NEW** Sunday service 9 am – 5 pm	20 minute daytime 30 minute evening
44A Hampshire Plaza – Northampton Center - Courthouse	Split into two routes – 44A and 44B to double service between Hampshire Plaza and Northampton Center	Split into two routes – 44A and 44B to double service between Hampshire Plaza and Northampton Center	60 minutes all day	60 minutes all day

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
44B Northampton Center – Hampshire Plaza – Florence Heights	Split into two routes – 44A and 44B to double service between Hampshire Plaza and Northampton Center	Split into two routes – 44A and 44B to double service between Hampshire Plaza and Northampton Center	60 minutes all day	60 minutes all day
45 Belchertown /UMass/Deerfield	*No alignment changes*	*No alignment changes*	**Expanded** mid-day frequency to 120 minutes **Discontinued**: Weekend service.	40 minute peak periods 120 minute off-peak periods
46 Umass/S. Deerfield	*No alignment changes*	*No alignment changes*	**Expanded** mid-day and evening frequency to 120 minutes. **Discontinued**: Weekend service.	40 minute peak periods 120 minute off-peak periods
48 Northampton-Holyoke	*No alignment changes*	*No alignment changes*	**Increased** peak period and mid-day frequencies to 30 minutes (up from 60 minutes) Expanded service from 6 AM to 9 PM (+2 hours weekdays and +5 hours on Saturday). **NEW** Sundays 9am to 5 pm	30 minute daytime 60 minute evening
OWL Westfield State Shuttle	*No change*	*No alignment changes*	No change	*No change*
NE Easthampton/Nashawannuck	*No change*	*No alignment changes*	No change	*No change*
PS Palmer Shuttle	*No change*	*No alignment changes*	No change	*No change*
WS Ware Shuttle	*No change*	*No alignment changes*	No change	*No change*
WI Wilbraham Shuttle	**NEW** service replacing Route 27 – serve Big Y, Springfield Street, Main Street to Stop & Shop.	**NEW** service replacing Route 27 – serve Big Y, Springfield Street, Main Street to Stop & Shop.	Design route at 60 min frequency Operate 6 am to 6 pm weekdays and Saturday - same as today.	On-demand - anchored at 16 Acres Square
PS Palmer Shuttle	*No change*	*No change*		
WS Ware Shuttle	*No change*	*No change*		
AG Agawam Circulator		**NEW** – Agawam demand response zone		Anchored at Agawam Town Square
EL East Longmeadow Circulator		**NEW** – East Longmeadow demand response zone		Anchored at Big Y East Longmeadow
LM Longmeadow Circulator		**NEW** - Longmeadow demand response zone		Anchored at The "X"
LU Ludlow Circulator		**NEW** - Ludlow demand response zone		Anchored at Ludlow Big Y
NS Northeast Springfield Employment Circulator		**NEW** - Northeast Springfield demand response zone		Anchored at Career Institute
WF Westfield Circulator		**NEW** - Westfield demand response zone		Anchored at Super Stop & Shop Westfield

BUS ROUTE	PROPOSED ALIGNMENT CHANGES		PROPOSED SCHEDULE CHANGES	
WI Wilbraham Circulator		**NEW** - Wilbraham demand response zone		Anchored at 16 Acres Square

APPENDIX E

PVTA-FRTA Service Coordination Analysis

NELSON
NYGAARD

M E M O R A N D U M

To: FRTA (Michael Perreault) and PVTA (Mary MacInnes, Nicole Rohan)

From: Boris Palchik

Date: February 3, 2014

Subject: FRTA / PVTA Coordination Analysis

Background

The Franklin Regional Transit Authority (FRTA) is a public transportation provider operating in Franklin County in western Massachusetts. FRTA serves a largely rural area, although the service area is punctuated by a handful of small towns, such as Greenfield. As part of its services, FRTA operates six fixed routes, including three routes that connect to other transit systems outside of Franklin County; two of these routes connect to PVTA:

- Route 23 operating between Olver Transit Center in Greenfield and the Haigis Mall on the University of Massachusetts campus in Amherst.
- Route 31 operating from Olver Transit Center in Greenfield to the Academy of Music in downtown Northampton.

The UMass campus and downtown Northampton are both service hubs for the PVTA system and offer connections to a variety of other transit routes that bring travelers to local and regional destinations. The objective of this analysis is to identify opportunities to improve coordination and connectivity between FRTA and PVTA for the greatest number of passengers. FRTA's Routes 23 and 31 are the primary focus of the analysis.

Recommendations

Based on a review of ridership patterns and route scheduling, our analysis suggests the following:

- Eliminate FRTA Route 23 due to low ridership.

- Extend FRTA Route 31 to meet PVTA Route 31 in Sunderland. This connection will allow people from Greenfield to get to/from the UMass campus and PVTA Route 31 has very frequent service departing from Sunderland center making transfers between routes convenient.

- Another opportunity may be to extend PVTA Route 31 to the Whately/Deerfield Park and Ride lot. If this option is pursued, it is more likely that PVTA would only be able to assign

select trips to meet the FRTA route rather than route all Route 31 trips through the park and ride facility.

- Schedule FRTA Route 31 so it arrives in Northampton on the hour. Arriving on the hour will facilitate connections to Holyoke, Hadley and Amherst and destinations within Northampton.

Service Coordination Analysis

FRTA operates in a largely rural area which, with the exception of Greenfield, has limited employment and services. As a result, FRTA has designed regional services to make connections to adjacent service areas. Two of these services – Route 23 and 31 – are designed to connect Franklin County residents with regional service centers, such as UMass, Amherst and Northampton.

Routes 23 and 31 terminate at PVTA hubs where there is a convergence of routes so that riders can transfer to other transit services and reach a broad range of destinations. However, PVTA operate on a loose "pulse" system, so while bus routes are timed to converge at major transfer locations at similar times, there is no single time point that his shared by the majority of all routes. The purpose of this analysis, therefore, is to assess which transfers are reasonable (as defined by the wait time between routes) and where/how they may be improved. An evaluation of each of the FRTA services is provided in Appendix A.

UMass Campus

The University of Massachusetts at Amherst and the town of Amherst is a significant regional center with a large number of jobs as well as services and shopping. People traveling between Greenfield and the UMass/Amherst area have two opportunities to get to the UMass campus – travel directly via Route 23 (one morning and one afternoon trip) or use Route 31 to transfer to PVTA services in South Deerfield or Sunderland.

FRTA Route 23 travels between Greenfield and UMass via Leverett and Montague. It provides one round trip in the morning and one in the afternoon. Ridership on Route 23 is very low with an average of between two and three riders per one-way trip. A one-way trip between Greenfield and UMass takes an hour to complete on the bus thus without more riders, the route is not viable and should be discontinued.

People traveling between Greenfield and UMass can also make the trip by transferring at South Deerfield Center. Currently, FRTA Route 31 and PVTA Route 46 meet at the South Deerfield Center. However, both FRTA Route 31 and PVTA Route 46 have fairly low frequencies with six trips a day, which makes timing the routes to connect challenging. Currently, there are a handful trips where connections are efficient (buses arrive within 15 minutes of each other), but most routes do offer such efficient transfers. As a result, it is difficult for people to rely on this connection.

An opportunity to increase service coordination would be to extend FRTA Route 31 to Sunderland Center. FRTA 31 currently travels along Sugarloaf Street to Sunderland Road (Route 116) as part of its normal alignment; continuing to the intersection of North Main Street and Amherst Road (Sunderland Center) is less than 1.5 miles round trip and would add approximately 5 minutes to the total trip time. While is possible to extend the PVTA Route 31 into Deerfield rather than the FRTA route, PVTA Route 31 operates at a high frequency throughout the day and carries more riders. Recognizing that extending route would be disruptive to either operators, given PVTA's more extensive service and higher ridership, our assessment is the adjustment would be more disruptive to PVTA than FRTA.

Traveling into Sunderland Center would allow FRTA Route 31 to meet PVTA Route 31; PVTA Route 31 offers very frequent services with buses arriving and departing every 15 minutes for most of the day, making connections between routes easy[1]. The only exception to this would be the first trip of the day. FRTA Route 31 has a 5:15 AM departure from downtown Greenfield, arriving in South Deerfield Center at 5:35 AM. This bus should not be extended into Sunderland because PVTA Route 31 doesn't begin operations until 7:22 AM.

Northampton

Coordinating Route 31 service with PVTA is more challenging because there are multiple PVTA routes that serve downtown Northampton, but no single time point when all PVTA buses arrive in downtown Northampton. The best opportunity to improve coordination is by adjusting the scheduled arrival times for FRTA routes so each trip arrives at the same time. In particular, if FRTA schedules each of the six trips to arrive in downtown Northampton on the hour, or just before the hour, Route 31 would meet:

- Route 43 to Hadley and Amherst (departures on the hour and 0:20)
- Route 48 to Holyoke (departures on the hour)
- Route 44 local trips around Northampton (0:15).

Route 31's schedule is currently slightly different for each trip depending on where the bus stops in between Greenfield and Northampton[2]. If the recommendation to bring Route 31 into Sunderland is carried forward, however, the trips times would likely be extended slightly for all trips but there would be less variation between trips. This schedule would ensure FRTA routes met the majority of PVTA's most frequent services to the region's most commonly used destinations (see Figure 1). Implementation would require shifting the entire FRTA schedule earlier and likely increasing recovery times on some of the trips (assuming the whole schedule is operated with a single vehicle). This would increase service costs slightly for FRTA, but any increase in costs should be offset by savings associated with reduced service on Route 23.

Figure 1: Proposed FRTA Route 31 Schedule

Greenfield	Deerfield	Northampton	Deerfield	Greenfield
5:10 AM	5:30 AM	6:00 AM	6:30 AM	6:50 AM
7:10 AM	7:30 AM	8:00 AM	8:30 AM	8:50 AM
9:10 AM	9:30 AM	10:00 AM	10:30 AM	10:50 AM
1:10 PM	1:30 PM	2:00 PM	2:30 PM	2:50 PM

[1] Travelers making a southbound trip (from Greenfield to UMass) would not need to time their transfer because when the FRTA route drops them off, PVTA Route 31 would nearly always arrive within 15 minutes. People traveling north however would need to time their trip to meet one of the six FRTA Route 31 trips heading north. There are lots of buses heading north from UMass to Sunderland, however, so riders will have a handful of choices to get to the FRTA route.

[2] Route 31 stops in different locations in Deerfield based on work shift times and facility opening hours. Travel times in turn vary slightly depending on the number of stops.

3:10 PM	3:30 PM	4:00 PM	4:30 PM	4:50 PM
5:10 PM	5:30 PM	6:00 PM	6:30 PM	6:50 PM

Appendix A: FRTA Route Profiles

All FRTA routes operate out of the Olver Transit Center in Greenfield, MA. Service is available on weekdays and given the rural nature, FRTA allows passengers to board and alight buses along their respective routes at marked bus stops, or at intermediate "flag" stops by request. Fares vary by route. Fares for Route 23 and Route 31 are $3.00 and $1.50 per trip, respectively. PVTA and FRTA do not currently have a reciprocal fare agreement, so passengers must purchase a new fare when transferring from one system to the other.

Route 23

Route 23 operates with two weekday round-trips between Greenfield and Amherst (see Figure 1). The bus travels via Route 63 through the towns of Montague and Leverett. Buses depart Olver Transit Center at 6:45 AM and 3:05 PM, arriving at Haigas Hall at 7:45 AM and 4:10 PM. No layover time is scheduled for Haigas Mall, and buses return to Olver Transit Center by 8:45 AM and 5:15 PM. Travel time between downtown Greenfield and the UMass campus is one hour.

Several PVTA routes connect at the UMass campus, with routes meeting at one of two locations: the Haigis Mall or the Fine Arts Center/Studio Arts Building (see Figure 2). These two locations are located within a three-minute walk of each other. PVTA routes serving the UMass campus include:

- **Route 31 Sunderland South Amherst** – operates between Sunderland, UMass, downtown Amherst and to major residential areas along Route 9 south of downtown Amherst
- **Route 32 Puffer's Pond Atkins Corner** – provides limited service between residential areas north and south of the UMass campus and the UMass campus
- **Route 37 Amity Shuttle** – is largely a shopping shuttle that provides circulation between campus shopping areas on Route 9 (Big Y and Super Stop and Shop)
- **Route 34/35 Orchard Hill Mullins Center Campus Shuttle** – provides circulation around the UMass campus
- **Route 38 Mt. Holyoke/Hampshire/Amherst/UMass** – is a Five College Consortium route that provides connections between UMass and Hampshire, Amherst, Smith and Mt. Holyoke Colleges.
- **Route 40 (Minuteman Express) and 43 (Northampton Hadley Amherst)** – operates frequent service between downtown Amherst and the UMass campus and downtown Northampton
- **Route 45 Belchertown Center UMass** – provides limited service between Belchertown and the UMass campus operating through downtown Amherst
- **Route 46 South Deerfield UMass** – provides limited service between South Deerfield and Sunderland and the UMass campus.

Generally speaking ridership on Route 23 is very low and carries an estimated ten riders per day. Given that the route takes one hour per one-way trip, the riders per hour are 2.5, or about $26.50 for each rider[3] (see Figures 1 and 3).

[3] Includes flag stop riders. Cost per hour for FRTA fixed route service is estimated as $64.50; data drawn from FRTA Agency Profile published as part of the Beyond Boston reports.

Figure 1- Southbound Boardings/Alightings Activity on FRTA Route 23

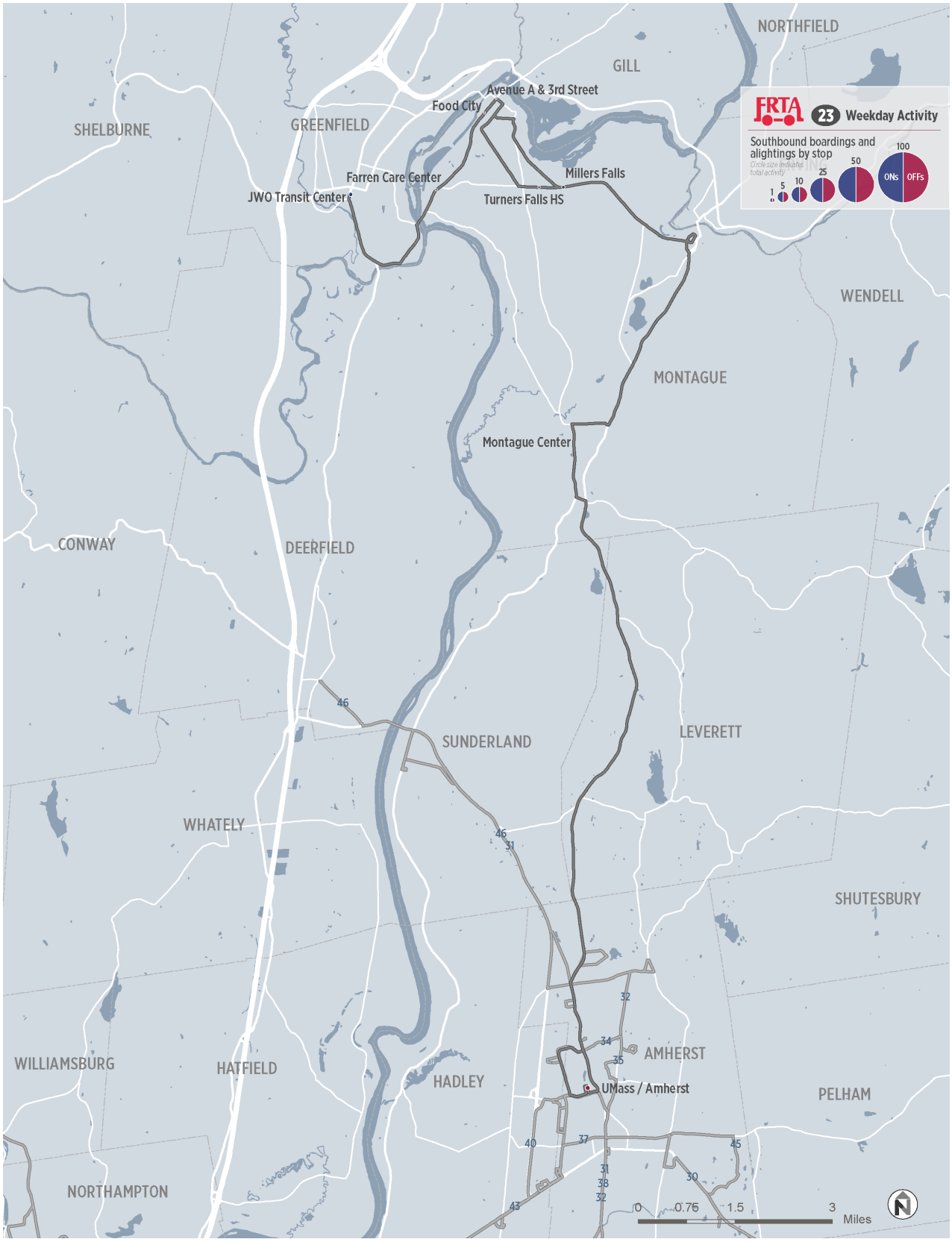
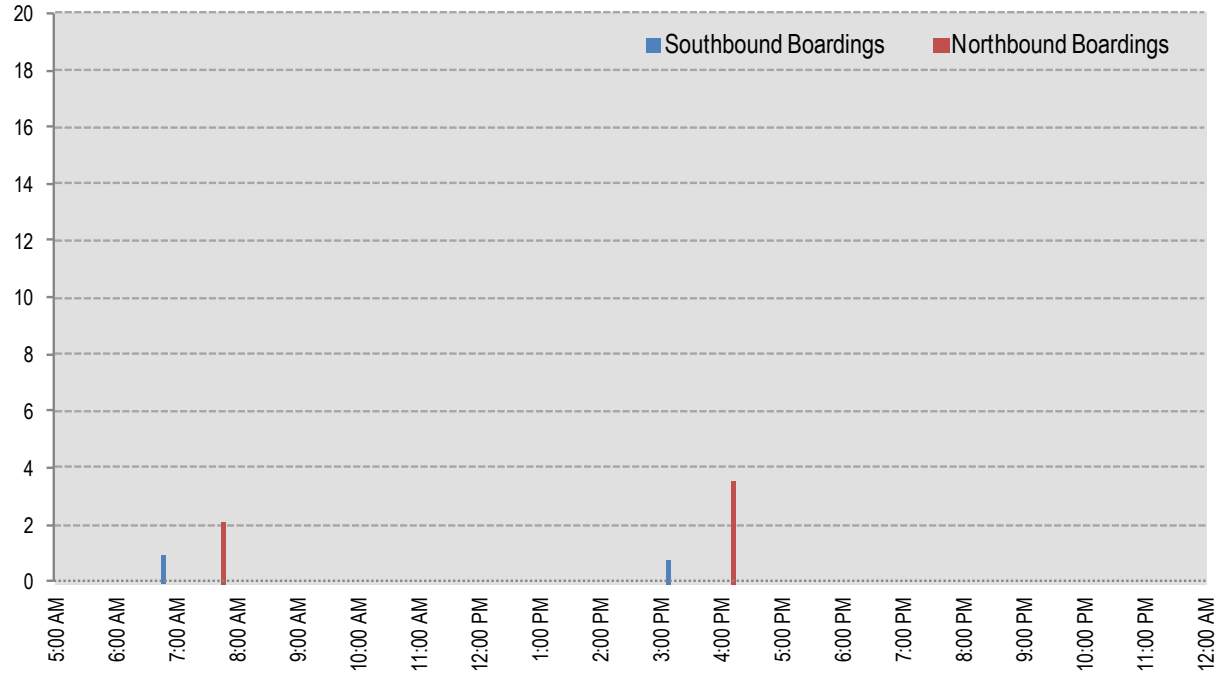


Figure 2 - UMass Bus Stop Locations

Figure 3 - Average Weekday Boardings per Trip for Route 23[4]



[4] Data is based on a two-week data sample collected by FRTA. Data is recorded by stop for all trips but flag stops were recorded separately and not attributed to a specific direction.

Route 31

Route 31 operates on weekdays and travels between Greenfield, Deerfield, Whately, Hatfield and downtown Northampton via Route 5, which is a fairly fast and direct route between communities. The bus takes an hour and 15 minutes (75 minutes) to travel one-way between Greenfield and Northampton, allowing time for stops and minor deviations in Deerfield. Buses terminate at the Academy of Music in Northampton. The Academy of Music is a transfer point PVTA bus routes and passengers can transfer at the Academy of Music to the following services:

- **Route 38 Mt. Holyoke/Hampshire/Amherst/UMass** – is a Five College Consortium funded route that provides connections between UMass and Hampshire, Amherst, Smith and Mt. Holyoke colleges.
- **Route 39/39E Smith Hampshire Mt**. **Holyoke** – is also a Five College Consortium funded route. Route 39 travels between Smith, Hampshire, and Mt. Holyoke colleges. Route 39E (express) travels directly between Smith College and Mt. Holyoke College.
- **Route 40 (Minuteman Express) and 43 (Northampton Hadley Amherst)** – operates frequent service between downtown Amherst and the UMass campus and downtown Northampton
- **Route 41 Northampton/Easthampton/HCC** – provides roughly hourly service to Holyoke Community College via Easthampton
- **Route 42 Northampton Williamsburg** – operates large hourly service between Williamsburg and downtown Northampton
- **Route 44 Florence Heights** – is a local service that provides connections to destinations within the Town of Northampton
- **Route 48 Northampton Veterans Park** – provides hourly service between Northampton and Holyoke.

Route 31 also stops in Deerfield at the South Deerfield Center, a stop that is also served by PVTA Route 46 and offers connections to UMass and Amherst. Riders can also transfer from FRTA Route 31 to PVTA Route 42 at the Northampton Big Y (Figure 4).

Route 31 has relatively high ridership with most trips (except for the early morning trip) carrying between eight and 14 riders (see Figure 5)[5]. The ridership by stop data shows a handful of riders use Route 31 to get to/from Deerfield, but most travel all the way to Northampton, getting off at the Hampshire Plaza stop (Big Y and Wal-Mart) or downtown Northampton.

[5] As with Route 31, the ridership graph slightly undercounts riders because flag stop requests lack directional data.

Figure 4 – Southbound Boardings/Alightings Activity on FRTA Route 31

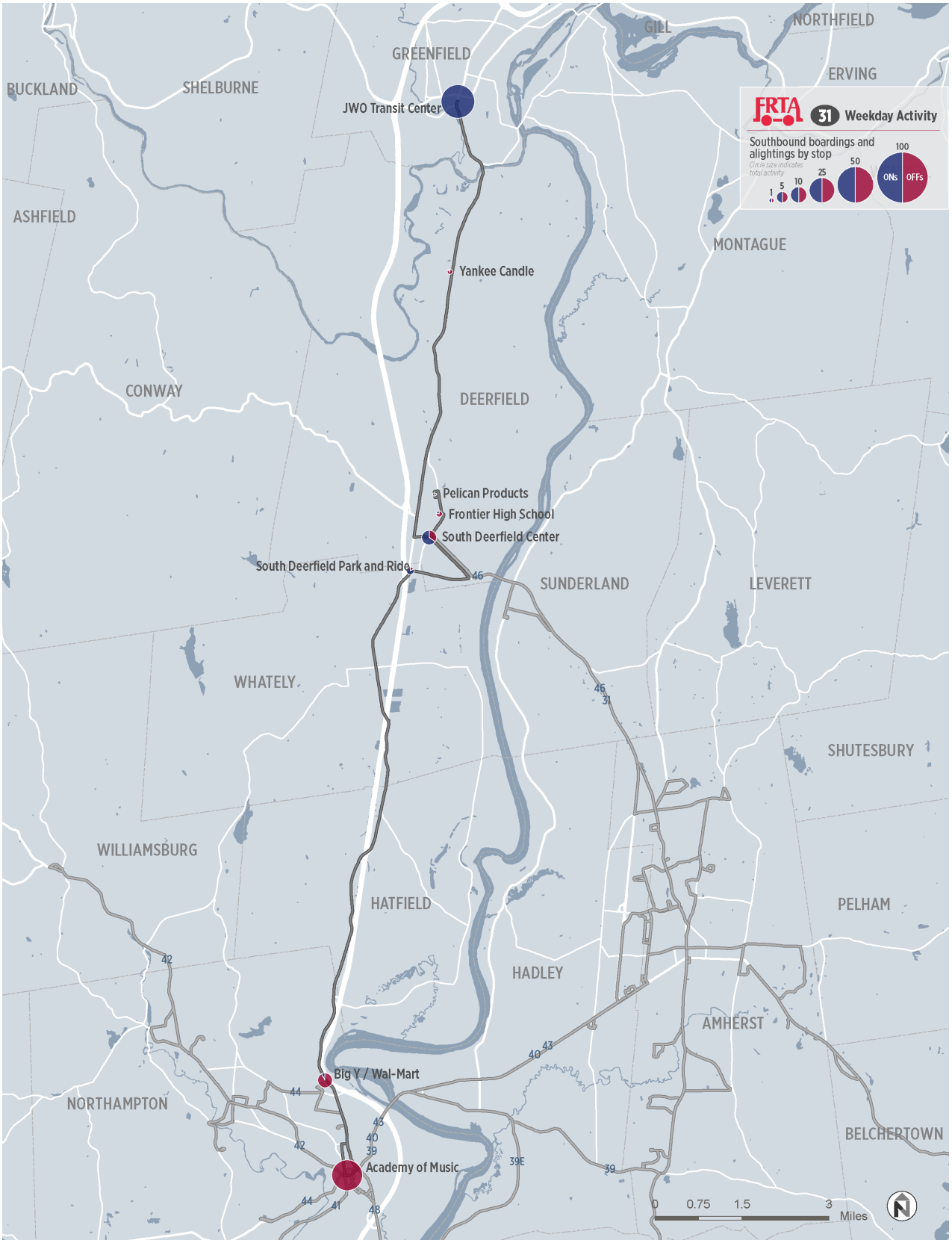


Figure 5 - Average Weekday Boardings per Trip for Route 31