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# North Reading Satellite Shuttle Study

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This study was completed by the Metropolitan Area Planning Council (MAPC) for the Town of North Reading. MAPC is Greater Boston's regional planning agency whose mission is to promote smart growth and regional collaboration.

This document was produced with input from the Town of North Reading, led by Danielle McKnight, AICP, Town Planner/Community Planning Administrator. Professional technical assistance provided by MAPC was led by Travis Pollack, AICP, Senior Transportation Planner, with support from Liana Banuelos, Avery Lavalley, Alaa Mukahhal, Lily Perkins-High, and Kit Un. Travis Pollack, AICP, was the lead author for this document.

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## **North Reading Satellite Shuttle Study**

### **Executive Summary**

The Town of North Reading initiated this study to explore ways to connect to MBTA services to improve connectivity and mobility for its residents, particularly for commuters accessing jobs. The North Reading Satellite Shuttle Study evaluated several options for creating a shuttle linking North Reading to commuter rail stations in adjacent municipalities including Wilmington, Woburn, and Reading. The study evaluated routing and operational options and costs, as well as costs to lease or construct a park and ride facility for North Reading residents to catch the shuttle. The study included a town-wide survey to gauge resident interest in using a shuttle to connect with rail.

### **Background**

North Reading is an abutter to communities with MBTA service but does not have any of its own MBTA transit stops or MBTA paratransit services. The lack of access to public transit limits the mobility of the town's residents, particularly those without access to an automobile and/or who cannot drive. North Reading's senior population is projected to grow, which will increase the number of residents who will need improved mobility services. In 2017, the Town entered an agreement with the Merrimack Valley Regional Transit Authority (MVRTA) to provide on-demand service to seniors and veterans to out-of-town medical appointments. North Reading's Council on Aging (CoA) also has a van and a full-time driver to provide in-town transportation to seniors. While very important, neither service addresses the needs of residents who are neither seniors nor disabled veterans, and who need better ways of accessing MBTA commuter services in North Reading's neighboring communities.

Previous studies that recognized North Reading's need for better transit include the Town 2004 Master Plan; a recent survey conducted by the Boston North Regional Coordinating Council, the 2017 North

Reading senior and paratransit study, and the 2018-2109 North Reading Master Plan Update.

### **Study Findings and Recommendations**

The study found a considerable level of interest for a shuttle connecting North Reading to the Reading commuter rail station. The suitability analysis shows that a potential shuttle service in North Reading should be concentrated in the more densely populated areas along Park Street/Route 62 and Main Street/Route 28. These were also the corridors that had the greatest concentration of requested stops noted in the Town-wide survey. The study found potential locations for a park and ride lot, with options for either leasing sites or constructing a new lot on Town-controlled property. Three shuttle options – to Reading station, to Anderson/Woburn station and direct between North Reading and downtown Boston -- were recommended. Shuttle operating costs could cost the Town between \$142,000 and \$162,000 annually, depending on the number of trips offered and destinations served. The study finally suggested the Town look at technical and implementation assistance programs available from MassDOT and others.

## North Reading Satellite Shuttle Study

### 1. Study Purpose, Existing Conditions and Projections

This chapter outlines the purpose of the study, existing conditions in land uses, demographics, employment as well as projections or anticipated changes. The purpose of this chapter is to better understand the Town's existing land use and commuting patterns, and potential transportation needs.

#### 1.1 Study Purpose and Need

North Reading is an abutter to communities with MBTA service but does not have any of its own MBTA transit stops. The lack of access to public transit limits the mobility of the town's residents, particularly those without access to an automobile and/or who cannot drive; and also limits options for commuters into Boston. In 2017, the Town entered an agreement with the Merrimack Valley Regional Transit Authority (MVRTA) to provide on-demand service to seniors and veterans to out-of-town medical appointments. This new service supplements the other in-town transportation services offered by North Reading's Council on Aging (CoA) to seniors. However, neither service addresses the needs of residents who are neither seniors nor disabled veterans, and who need better ways of accessing MBTA commuter services in North Reading's neighboring communities.

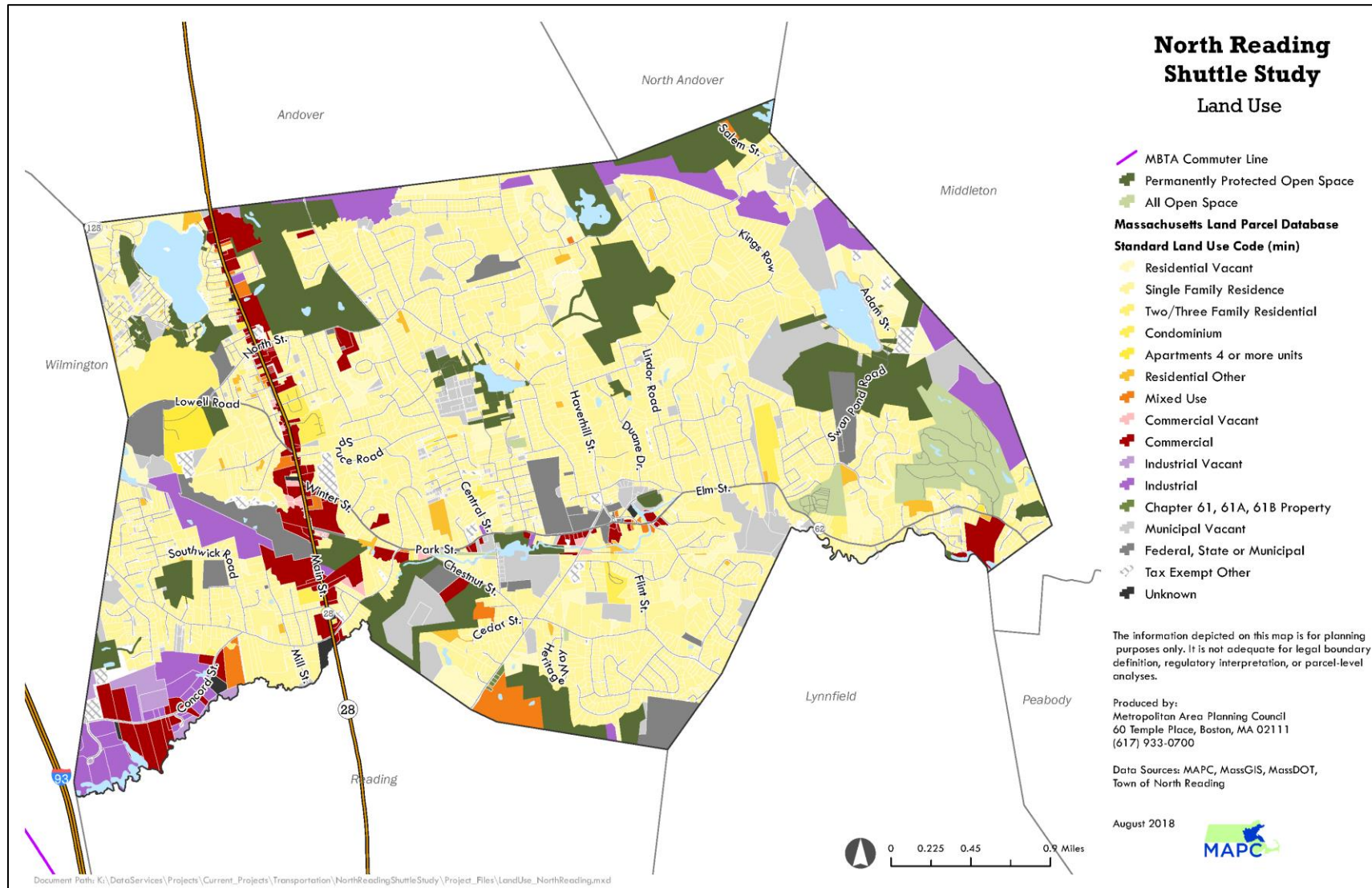
The Town initiated this study to explore ways to connect to MBTA services to improve connectivity and mobility for its residents, particularly for commuters to access jobs. Previous studies that recognized North Reading's need for better transit include the Town 2004 Master Plan; a recent survey conducted by the Boston North Regional Coordinating Council, the 2017 North Reading senior and paratransit study, and the 2018-2109 North Reading Master Plan Update.

#### 1.2 Existing and Projected Land Uses

North Reading is primarily residential, with lower density single family homes. Most of the commercial uses are located along Main Street/Route 28, Park Street/Route 62 and Concord Street, along with some industrial sites along Concord Street. The Town also has a large areas of protected open space. **Figure 1.1** shows existing land uses.



Figure 1.1. Existing Land Uses





The Town is low density, with 5,687 housing units listed in the 2010 Census data and 1.72 persons per acre. In comparison, the North Suburban<sup>1</sup> subregion is 3.29 persons per acre, while the Boston Inner Core<sup>2</sup> is 12.14 persons per acre. **Figure 1.2** shows the existing residential densities for North Reading.

The most recent development approved by the Town is the new multi-unit senior housing on Lowell Road adjacent to Edgewood Apartments. The Town is also updating its Master Plan, anticipated to be completed in Fall 2019.

### **1.3 Existing and Proposed Transportation Network**

The Town is served by state Routes 28 and 62, with close proximity to I-93. Most of the street network consists of local residential streets. A recently adopted Complete Streets Prioritization Plan found that while 66 percent of the Town streets have sidewalks, several important streets including Haverhill Street, Central Street, Main Street, North Street, and Elm Street have incomplete or no sidewalks. The Town has no bicycle facilities, though there is a limited trail network that connect some of the parks and open space in the Town. The 2017 Complete Streets Prioritization Plan recommended 19 specific sidewalk and bicycle projects on Town streets as well as three sidewalk and wheelchair ramp projects along Route 28/Main Street.

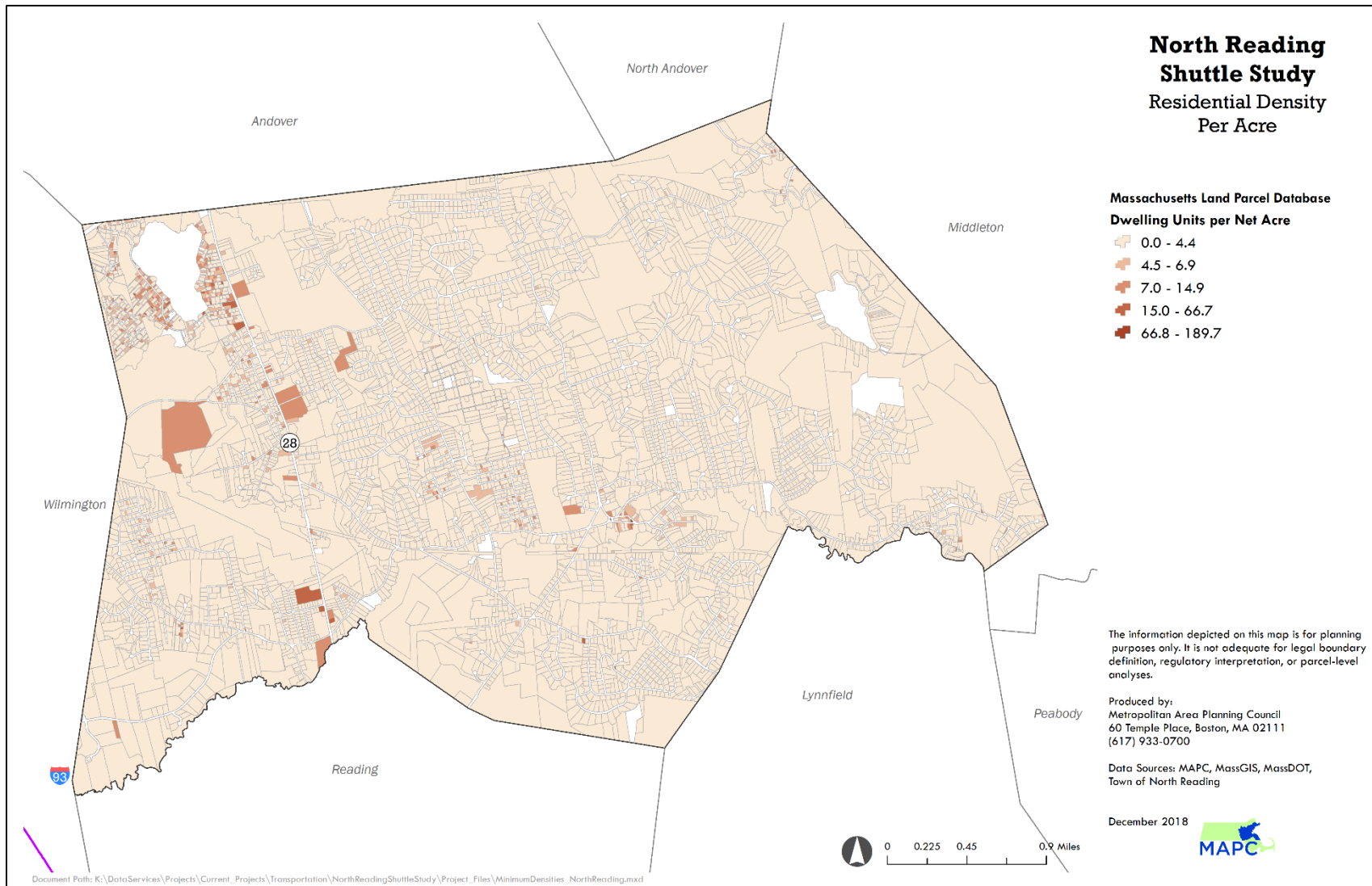
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<sup>1</sup> Burlington, Lynnfield, North Reading, Reading, Stoneham, Wakefield, Wilmington, Winchester, Woburn.

<sup>2</sup> Arlington, Belmont, Boston, Brookline, Cambridge, Chelsea, Everett, Lynn, Malden, Medford, Melrose, Milton, Needham, Newton, Quincy, Revere, Saugus, Somerville, Waltham, Watertown, Winthrop.



Figure 1.2. Existing Residential Densities



North Reading has no public transportation services through the MBTA. The nearest public transportation include MBTA bus and commuter rail services in Reading and Woburn, and commuter rail and Lowell transit connections in Wilmington. The Town's Council on Aging (CoA) agency provides transportation for seniors for trips within the Town limits. In 2017, North Reading entered a partnership with the Merrimack Valley Regional Transit Authority (MVRTA) to provide in- and out-of-town medical trips to seniors and disabled veterans.

MAPC is aware of at least one private shuttle system that is funded by Amazon Robotics, connecting their facility on Concord Street in North Reading to MBTA transit stations at Wellington, Alewife, and South Station.

## 1.4 Existing Employment and Commuting Patterns

### 1.4.1 Employment in North Reading

North Reading has approximately 7,800 jobs<sup>3</sup>, with manufacturing and transportation/warehousing as the largest industry sectors at around 20 percent each. Most of the jobs in Town are located along Main Street/Route 28 and along Concord Street near I-93. Of the approximately 7,800 jobs in North Reading, less than 10 percent are filled by North Reading residents, meaning that over 7,000 people commute into North Reading. Of those commuting into North Reading the largest number commute in from Lawrence (458 workers), Lowell (275), Boston (270), Lynn (262), Methuen (259), Haverhill (225) and Wilmington (218).

**Figure 1.3** shows the employment concentrations in North Reading from the Census Bureau's OnTheMap website.

### 1.4.2 Commute Patterns for North Reading Residents

MAPC used a variety of data sources to better understand the commuting and employment patterns for North Reading residents. AS seen in **Table 1.1**, the greatest number of Town's residents commute into Boston, while others work in communities such as Woburn and Wilmington. **Figure 1.4** shows the job locations by Census block for North Reading residents who work.

*Table 1.1. Commuter Destinations for North Reading Resident Workers, 2015*

Commute Destination	Commuters	Percent
Boston	1,541	18.8%
North Reading	709	8.6%
Woburn	388	4.7%
Cambridge	360	4.4%
Wilmington	289	3.5%
Burlington	287	3.5%
Andover	270	3.3%
Danvers	194	2.4%
Reading	192	2.3%
Peabody	177	2.2%
Wakefield	164	2.0%
Waltham	161	2.0%
Other Locations	3,472	42.3%
Total	8,204	

Source: 2015 US Census Bureau Longitudinal Employer-Household Dynamics (LEHD) Origin Destination Employment Statistics

<sup>3</sup> U.S. Census Bureau, OnTheMap Application and Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2015).

Figure 1.3. Employment Density in North Reading

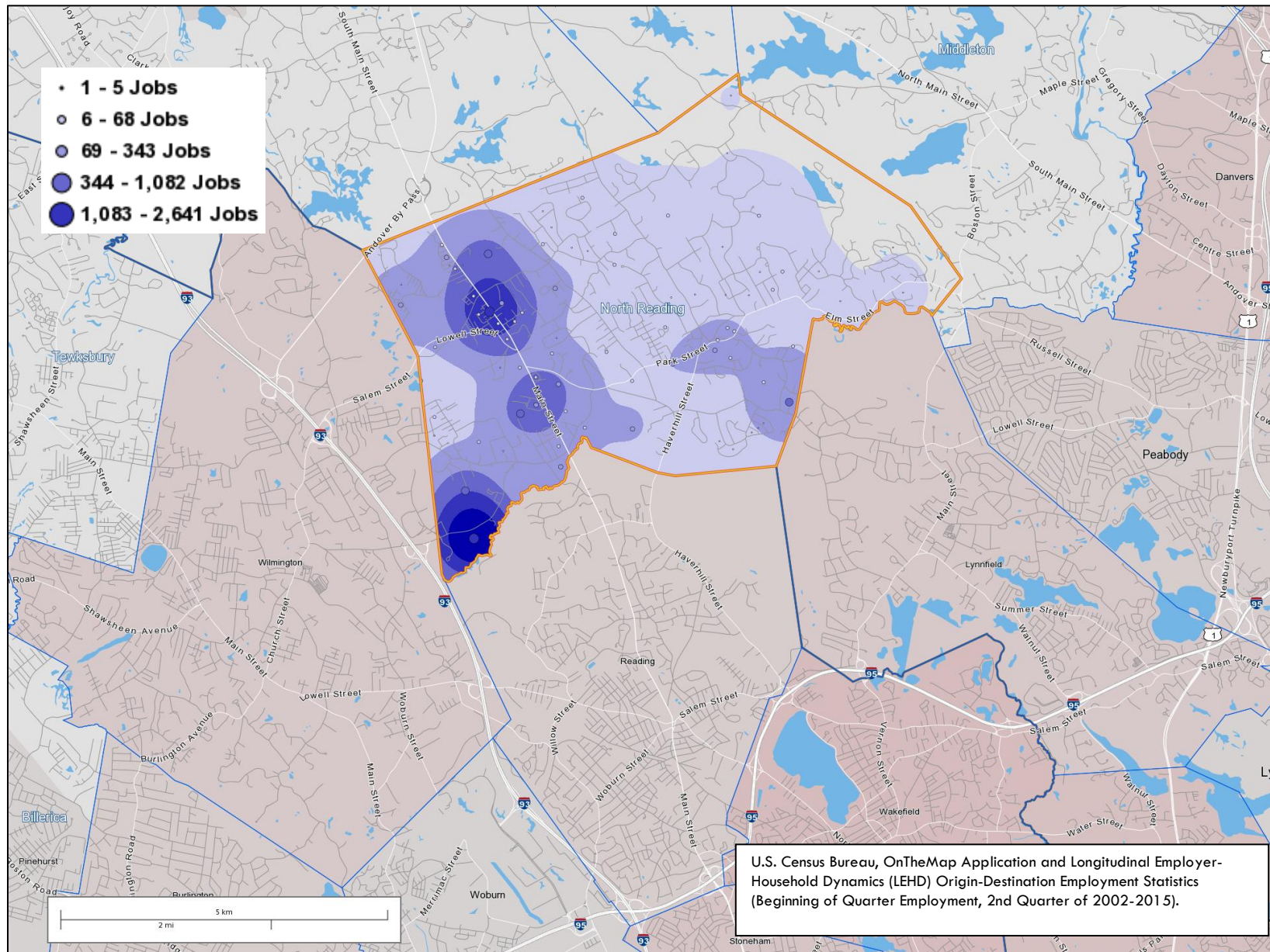
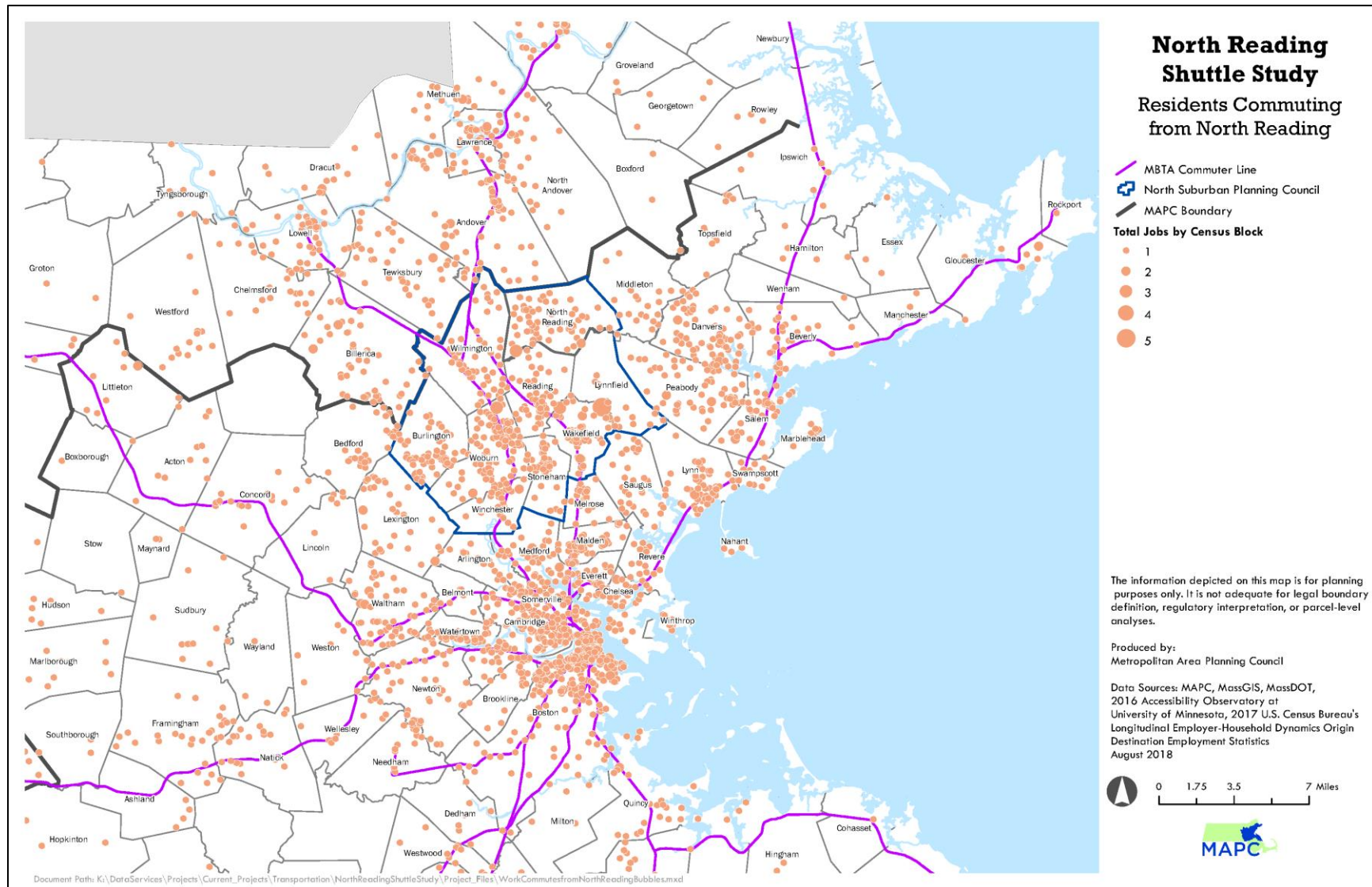




Figure 1.4. Job Locations for Residents Commuting from North Reading



According to the American Community Survey (ACS) data,<sup>4</sup> nearly 90 percent of North Reading residents drive alone to work, while around five percent work from home and the same percent take transit. These results indicate that most workers in North Reading commute to destinations outside of the town limits, and given the lack of transit options, must drive to their jobs.

American Community Survey data on travel time to work show that North Reading residents are more likely to have longer commutes than the averages for workers in the North Suburban subregion and in Massachusetts, with over half of commuters having trips over 30 minutes (see **Table 1.2**).

*Table 1.2. Journey-to-Work Data (Typical Commute Travel Time), 2016*

	Fewer than 30 minutes	30-59 minutes	60+ minutes
North Reading	45%	38%	18%
North Suburban Subregion	56%	33%	12%
Massachusetts	53%	34%	13%

Source: 2012-2016 American Community Survey (ACS)

There are limited data on the number of North Reading transit users and their origins and destinations. Commuter rail passenger surveys in 1993 found that the station used most often for North Reading trips was Reading. This was also the case with the last comprehensive survey of commuter rail riders in 2008-2009. Currently there are three stations within a few miles of North Reading -- Reading, Wilmington, and Anderson/Woburn. All three have lots controlled by MBTA that charge \$6 to \$7 per day for parking, with Anderson/Woburn having the largest available lot. Reading has two lots, one controlled by MBTA on the northwest end of the station, and

the other operated by the Town that requires residents to purchase a \$150 annual sticker. Given the increased demand for parking at the Reading station, and the requirement to be a Reading resident with a sticker to use the town-controlled spaces, North Reading residents riding commuter rail today are likely choosing to use other stations.

#### *1.4.3 Commuters to North Reading*

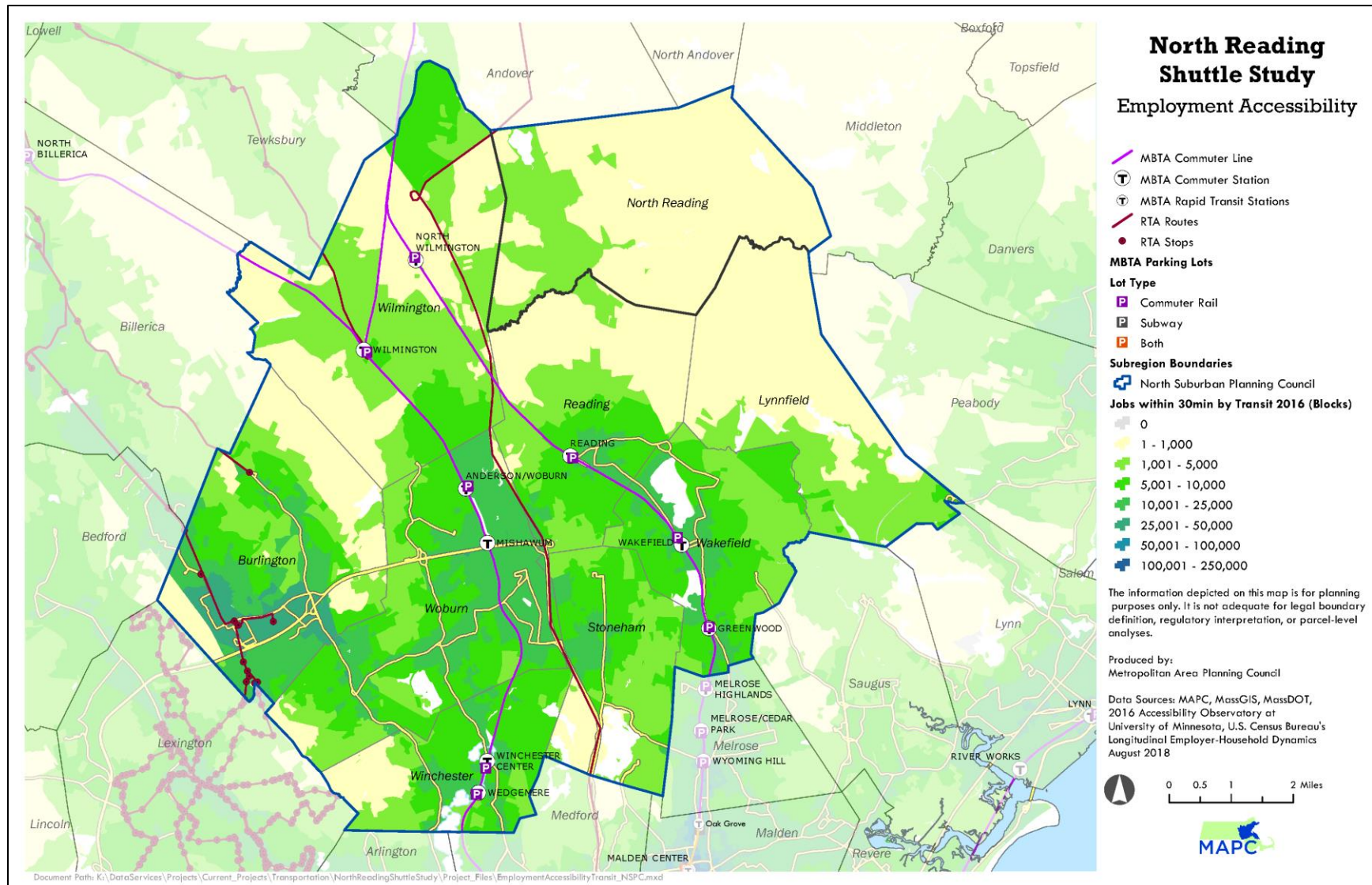
Of the approximately 7,800 jobs in North Reading, around 10 percent of those are filled by North Reading residents. When examining LEHD data, there are no large concentrations of commuters from any single location into North Reading. The largest counts of commuters into North Reading are from Lawrence at 6 percent, Lowell, at 3.5 percent, Boston at 3.5 percent and Lynn at 3.4 percent.

#### *1.4.4 Job Accessibility*

Another method for comparing job access across a region is to determine the number jobs that are accessible by transit or walking. MAPC used an online mapping tool developed by the University of Minnesota that shows the concentration of employment accessible by transit or walking in North Reading and surrounding municipalities. As seen by **Figure 1.5**, the areas in the North Suburban subregion with bus and rail access have more jobs accessible within 30 minutes by walking or transit than those without transit such as North Reading. The light green areas in North Reading are the limited number of jobs accessible by walking to and from residences.

<sup>4</sup> The American Community Survey (ACS) is undertaken by the Census Bureau and findings are released annually with a five year average of survey results. Most data used in this study are from 2011-2015 and/or 2012-2016 ACS datasets.

Figure 1.5. Employment Accessibility by Transit and Walking





#### 1.4.5 Vehicle Ownership and Access

North Reading averages 2.14 vehicles per household, which is higher than the statewide average of 1.67 vehicles.<sup>5</sup> **Figure 1.6** shows the average number of vehicles per household by Census block group in North Reading. North Reading residents average 65 miles per day of driving, more than the Commonwealth average of 48 miles per day. This higher average of daily miles driven is due to the low-density nature of development in North Reading and the need to drive outside of Town for most employment, medical, and shopping needs.

### 1.5 Existing Demographics and Projections

North Reading has experienced modest population growth in recent years. As of the 2010 US Census, the Town's population was 14,892, with a 2017 estimated population of 15,735. Because the transportation needs for a community can vary by several factors including age, income, transit, walk/bicycle access, and vehicle availability, MAPC looked at the details of the demographic data for North Reading.

*Senior Population* – According to US Census and 2011-2015 ACS data, the Town's over 60 year old population nearly doubled between 1990 and 2015, and the median age for North Reading has increased from 34.7 years to 43.7 years in that same time period. According to MAPC, the number of seniors in North Reading is projected to double by 2040, with the number of residents under the age of 35 is expected to decrease between by 2040.<sup>6</sup>

*Lower-income and Cost Burdened Households* – According to 2012-2016 ACS data, the estimated median household income for North Reading is \$119,933, with around one to six percent of the population below the poverty line.<sup>7</sup> **Figure 1.7** shows the distribution

of median household income in North Reading by Census block groups.

To better understand income and poverty, MAPC also looked at the number of cost burdened households. The Census considers a household to be “cost burdened” when more than 30 percent of the household income is used to pay for housing expenses. According to 2012-2016 ACS data, approximately 25 percent of the households in North Reading are considered cost burdened (with a margin of error of 4.4 percentage points).

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<sup>5</sup> Massachusetts Vehicle Census, May 2014.

<sup>6</sup> MAPC population age groups with projections by municipality, 1990-2040, modified May 2017.

<sup>7</sup> The 2012-2016 ACS data show 3.17 percent of the population in poverty, with a margin of error of 1.5 percent. Much of the ACS data on race, income, and poverty for North Reading have large margins of error at the Census block group level, and should be observed with caution.



Figure 1.6. North Reading Vehicles per Household (Block Group)

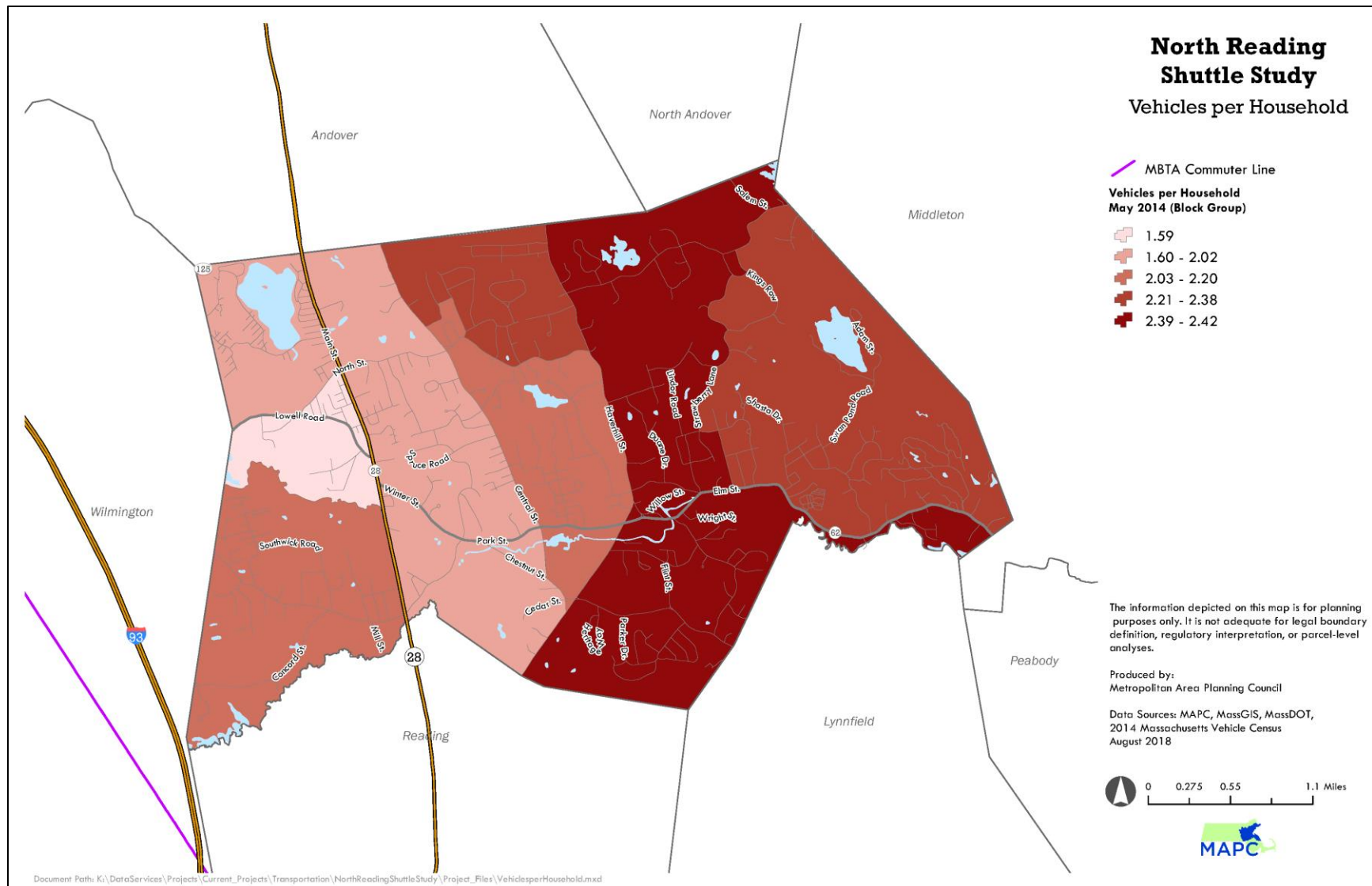
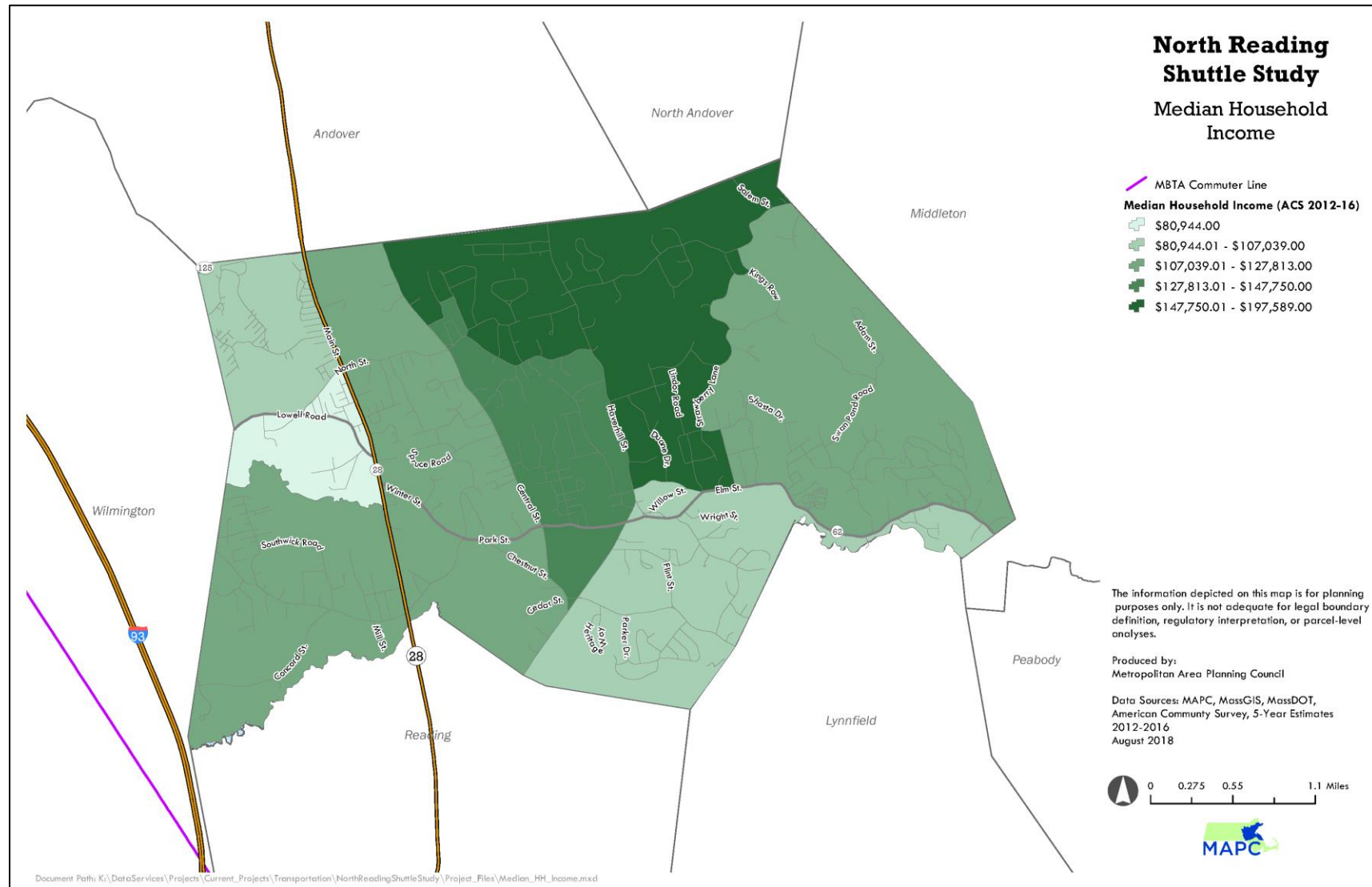


Figure 1.7. North Reading Median Household Income (Block Group)



## **1.6 Recent Town Surveys and Other Planning Efforts**

MAPC completed the North Suburban Mobility Study in 2017, which identified the Concord Road area as a candidate for future “first/last mile” employment connections with commuter rail. North Reading in 2017 also completed a study on senior transportation needs, which included a town-wide survey of adults that generated over 300 responses. The survey found that over 12 percent of respondents did not drive, and that over 36 percent said that they found the lack of public transportation a difficulty when making travel choices.

In a town-wide survey completed in 2018 as part of the Master Plan Update, regional transit connections was the top answer for how best to connect North Reading, and respondents also wanted more walkable environments along key corridors such as the historic Town Center and Main Street/Route 28.

## **1.7 Existing Conditions Key Findings**

- North Reading is mostly lower density, but has some multifamily housing clusters and concentrations of employment along corridors including Main Street and Concord Street. While over 90 percent of North Reading workers drive to work, Boston is the largest employment draw, which shows that there may be an untapped demand for using transit.
- There are very few reverse commuters into North Reading from Boston, but Lawrence is the largest draw for out-of-town workers commuting. In theory, some workers from Lawrence could take the train to Reading or North Wilmington to connect to a shuttle to North Reading. Amazon Robotics on Concord Street funds shuttles for their employees to connect to MBTA Red and Orange lines to help with their reverse commuters.
- While the Town is experiencing only modest growth, the number of older residents is projected to more than double in the next 30 years. This growth in the seniors who cannot or should not drive is one reason why the Town introduced an on-demand senior medical transportation services through the MVRTA. The needs for

this population for transit services for all trip types will continue to grow.

- The percent of households in North Reading below the poverty line is relatively low, but over one-fifth of the Town’s households are cost burdened, meaning they spend over 30 percent of their income on housing expenses. For these households, finding affordable transportation options is particularly important.
- Recent town-wide surveys have demonstrated that residents want better connections to regional transit, along with better bicycle and pedestrian infrastructure.

The next chapter will look at the data in this chapter and other data and conduct a suitability analysis to determine which areas might be best candidates for transit services.

## 2. Suitability Analysis

This chapter describes the suitability analyses conducted to determine the areas of North Reading that might be best candidates for shuttle transit services. The analyses were completed for three different components:

- Census block group areas of North Reading more suitable for transit services
- Potential sites for park and ride facilities within the Town of Reading
- Rail stations in nearby communities – Woburn, Wilmington, Reading, and Malden – where a potential shuttle can connect

### 2.1 Suitability Analysis of Transit Services

To identify areas where a new transit shuttle service might be implemented, MAPC conducted a suitability analysis for the Town of North Reading. This process was similar to the analysis conducted by MAPC in the 2017 North Suburban Mobility Study. Through the suitability analysis process, MAPC identified areas where combined demographic characteristics and the built environment within the North Reading as the best candidates for local public transportation improvements.

MAPC conducted this analysis at the census block group level for two scenarios—Boston-centered commutes, and commutes to workplaces in Lawrence or Lowell. Each of the criteria listed for the scenarios were assembled into a single feature class, where each measure is rescaled to a score from 0 to 100 and finally combined to create an overall score for each scenario. Details on the data used and the analysis results can be found in Appendix A.

#### 2.1.1 Boston-Centered Commutes

This analysis determined which census block groups were most suitable for access to a shuttle service by more heavily weighting those block groups with higher percentages of working-age residents who are employed in Boston and live in close proximity to commuter rail stations. In this way, shuttle service within suitable block groups would complement existing transit infrastructure by connecting areas with high potential and existing ridership along a route with the ability to provide service frequency aligned with commuter rail schedules during peak morning and evening times. As such, those block groups with a high population density, or the number of residents per acre, were deemed more suitable locations for shuttle stops, as were areas with lower percentages of vehicle ownership per household. Finally, the analysis accounted for block groups with high proportions of residents with disabilities and potential environmental justice populations: those who identify as a race other than non-Hispanic white, limited English speaking households, or cost-burdened household. Connecting these block groups with marginalized communities to transit advances equitable outcomes, and thus received a higher score during analysis.<sup>8</sup>

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<sup>8</sup> North Reading does not have any Environmental Justice Communities as defined by the Massachusetts Executive Office of Energy and Environmental Affairs. As noted, however, the analysis accounted for block groups with a

higher proportion of residents that could be identified as EJ communities. The Massachusetts EOEAA defines an EJ community as one where a Census block group has an annual median household income that is equal to or less than

An itemized breakdown of scoring criteria, weighting, and data sources is as follows:

1. Population Density - Number of residents per acre. A higher density resulted in a higher rating. (Source: Census 2010 and 2010-2017)
2. Employment Density - Number of employees per acre. A higher density resulted in a higher rating. (Source: LEHD 2014)
3. Vehicles per Household - A lower number of vehicles per household resulted in a higher rating. (Source: Mass Vehicle Census, 2014 quarter 4)
4. Commuters traveling to Boston – Percent of working-age residents of each Census block group who work in Boston. A higher percentage of commuters resulted in a higher rating. Weighted at 10. (Source: Central Transportation Planning Package 2006-2010)
5. Residents with Disabilities - Census tracts which have a high percentage of disabled residents received a higher rating. (Source: Census 2010)
6. Proximity to MBTA Service- Census block groups which have close proximity to commuter rail stations received a higher rating; distance from Census block group centroid to nearest Commuter Rail station using street networks. Weighted at 10 (Source: MAPC analysis)
7. Environmental Justice: Minority population, limited English speaking households, low income households -- Census block groups with high proportions of residents who identify as a race other than non-Hispanic White, limited English speaking

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65 percent of the statewide median (\$62,072 in 2010); or where 25 percent or more of the residents identify as a race other than white; or where 25 percent or more of households have no one over the age of 14

households, or low income households receive a higher score. (Source: MassGIS/MAPC)

- a. Percent population that identifies as a race or ethnicity other than non-Hispanic White (Source: Census 2010)
- b. Percent of Households considered Limited English speaking households (previously known as linguistic isolation, ACS 5 year estimates 2012-2016)
- c. Cost-Burdened Households - A higher percentage of households that are burdened by housing costs resulted in a higher rating. (Source: ACS 5-year estimates 2012-2016)

#### 2.1.2 Lawrence or Lowell Centered Commutes

Similar criteria were used to determine the locational suitability for shuttle stops connecting those residents that work in Lawrence or Lowell with transit. As with the aforementioned analysis, those Census block groups with high proportions of residents commuting to Lawrence or Lowell were weighted more highly than other criteria, except for proximity to commuter rail stations.

An itemized breakdown of scoring criteria, weighting, and data sources can be found below.

1. Population Density - Number of residents per acre. A higher density resulted in a higher rating. (Source: Census 2010 and 2010-2017)
2. Employment Density - Number of employees per acre. A higher density resulted in a higher rating. (Source: LEHD 2014)

who speaks English only or very well. For more information on EJ communities, see <https://www.mass.gov/info-details/environmental-justice-communities-in-massachusetts>.

3. Vehicles per Household - A higher percentage of households having less than one vehicle resulted in a higher rating. (Source: Mass Vehicle Census, 2014 quarter 4)
4. Journey to Work Data for Lawrence and Lowell Commuting – Percent of workers in each block group who do not work at home who commuted to or from Lawrence or Lowell. A higher number of workers commuting to or from Lawrence or Lowell results in a higher rating. (Source: ACS 2006-2010 Journey to Work Data)
5. Residents with Disabilities - Census tracts which have a high percentage of disabled residents received a higher rating. (Source: Census 2010)
6. Proximity to MBTA Service - Census block groups which have close proximity to commuter rail stations received a higher rating; distance from Census block group centroid to nearest Commuter Rail station using street networks. Weighted at 10 (Source: MAPC analysis)
7. Environmental Justice: Minority population, limited English speaking households, low income households -- Census block groups with high proportions of residents who identify as a race other than non-Hispanic White, limited English speaking households, or low income households receive a higher score. (Source: MassGIS/MAPC)
  - a. Percent population that identifies as a race or ethnicity other than non-Hispanic White (Source: Census 2010)
  - b. Percent of Households considered Limited English speaking households (previously known as linguistic isolation, ACS 5 year estimates 2012-2016)
  - c. Cost-Burdened Households - A higher percentage of households that are burdened by housing costs resulted in a higher rating. (Source: ACS 5-year estimates 2012-2016)

### 2.1.3 Transit Services Suitability Analysis Results

The analyses are nearly identical in their findings, with Census block groups along Main Street and south of Park Street having overall higher scores, as seen in **Figures 2.1 and 2.2**.

Census block groups on the western edge of North Reading demonstrated higher suitability for shuttle stop locations connecting to the MBTA commuter rail for both Boston and Lawrence/Lowell centered commute scenarios. These areas score highly because they are closest to the Haverhill and Lowell commuter rail lines and, therefore, most suitable to host a shuttle stop along a route that would be able to provide service that could work with the commuter rail schedule at peak morning and evening times. Block groups within this area also have the highest percentage of residents commuting to Boston or Lawrence/Lowell for work.

More details on the results of the transit suitability analysis can be found in Appendix A.

Figure 2.1. Boston-Centered Commute Transit Suitability Scoring

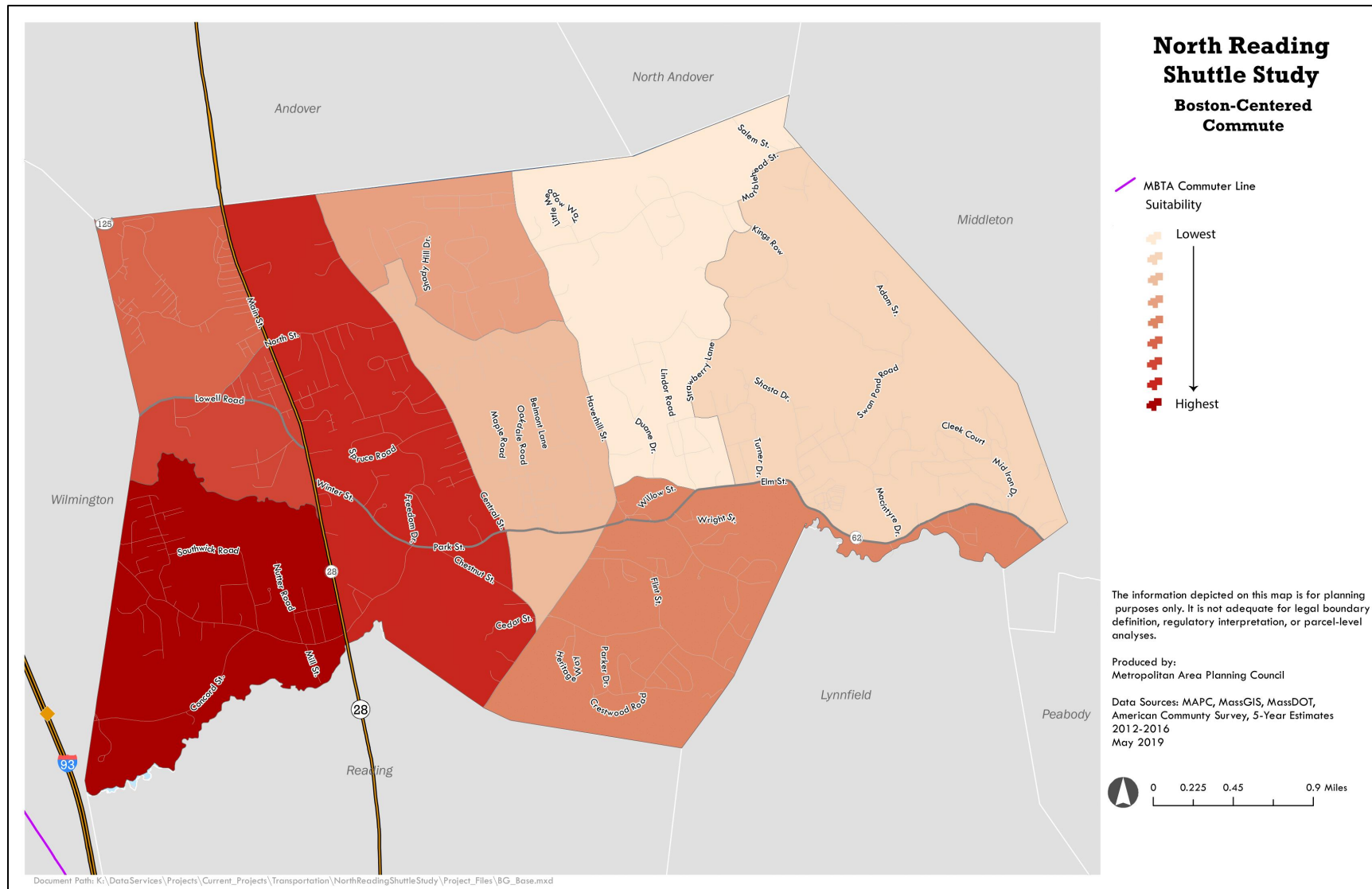
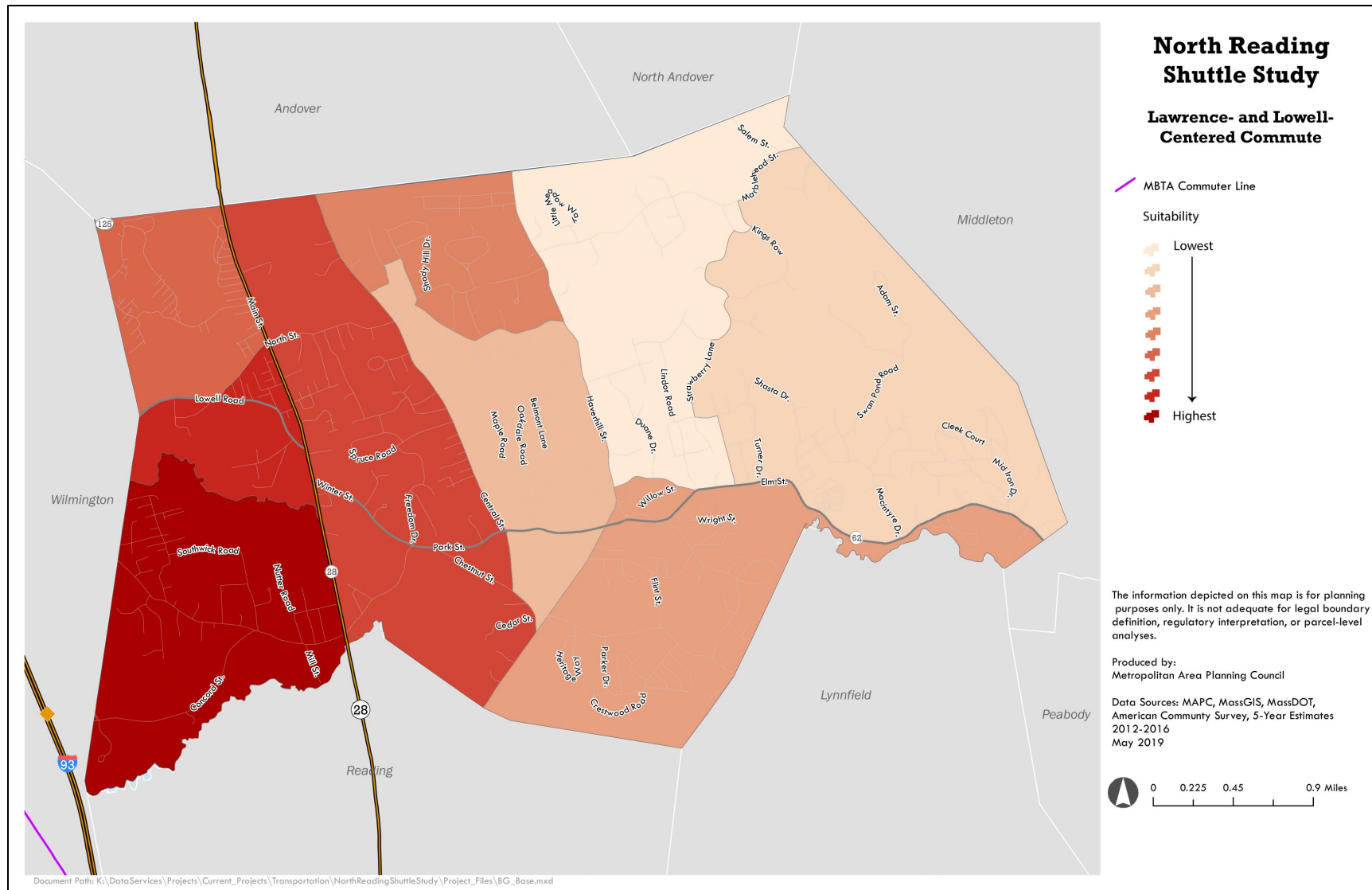




Figure 2.2. Lawrence and Lowell Commute Transit Suitability Scoring



## 2.2 Suitability Analysis of Potential Park and Ride Sites

In addition to evaluating the transit suitability, MAPC conducted a suitability analysis for locations for potential park and ride lots where residents could drive and take the shuttle to connect to commuter rail. The suitability analysis for park and ride sites considered the following factors:

- Size
- Ease of access for vehicles and pedestrians
- Location (is the site located within Census block group identified as more suitable for transit shuttle service)
- Ownership (public versus private)
- Potential upgrades needed

MAPC and the Town first identified a number of potential sites, looking at tax parcel data for vacant and underused parcels that might support a park and ride lot. Then, MAPC and the Town eliminated sites that were not accessible by a collector or arterial street, as well as sites that have wetlands or were thought to be too small or otherwise limited. Finally, sites that were outside of areas most suitable for transit services (as shown in 2.1 above) were eliminated.

Residents were also asked where they would like to see a shuttle stop in the Town-wide online survey. Respondents noted several potential sites along Main Street that were also identified by Town staff and MAPC for a park and ride site. Several survey respondents identified the Ipswich River Park at 15 Central Street as a potential stop, likely because of the surface parking lot at the park. This site was added to the list of potential park and ride sites, although it was in an area identified as less suitable for transit. Additionally, the parking lot fills to capacity during certain times of the year and Town events. More details on the survey can be found in Chapter 3.

The sites evaluated for a potential park and ride stops are listed in **Table 2.1**. A map of these sites is shown in **Figure 2.3**.

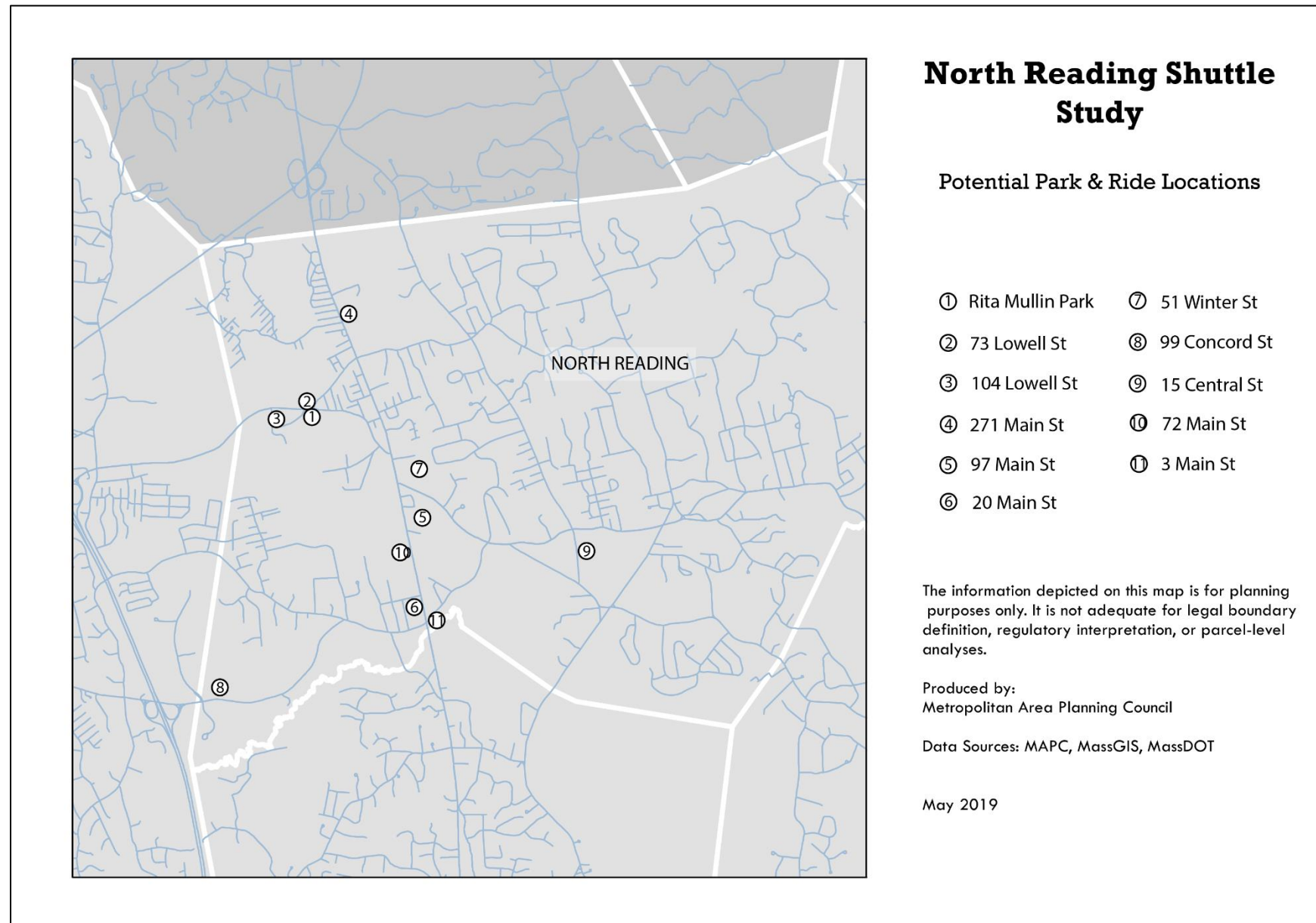


72 Main Street (Walmart) in North Reading

Table 2.1. Park and Ride Site Suitability Analysis

Location	Address	Town Parcel ID	Ownership	Notes
1. Rita Mullin Field Parking Lot	96 Lowell Road	213/014.0-0000-0142.0	Town	Would require paving and other upgrades.
2. Vacant lot near senior living	104 Lowell Road	213/014.0-0000-0148.0	Town	Would require paving and other upgrades.
3. Vacant lot NW corner of North Street and Lowell Road	73 Lowell Road	213/014.0-0000-0011.0	Commonwealth of Massachusetts	Would require paving and other upgrades; most of the site is within FEMA flood zone.
4. Stop and Shop Shopping Center	271 Main Street	213/013.0-0000-0014.0	Private	Parking is limited even without all stores being occupied.
5. Ocean State Job Lot	97 Main Street	213/024.0-0000-0036.0	Private	Parking site would be on vacant outparcel near fuel center. Lot set back and not as visible from street as other locations.
6. North Reading Plaza parking lot (Walmart)	72 Main Street	213/023.0-0000-0029.0	Private	Appears to have parking availability; portion of lot covered in FEMA flood zone.
7. Shopping Center at 20 Main Street	20 Main Street	213/022.0-0000-0080.0	Private	Parking area not as large as other sites. Site currently being redeveloped, and circulation is difficult if the shuttle is required to enter/exit the parking lot.
8. St. Theresa's Catholic Church	51 Winter Street	213/024.0-0000-0014.0	Private	Just east of Main Street on Route 62. Parking may be limited.
9. International Family Church Parking Lot	99 Concord Street	213/002.0-0000-0011.0	Private	Closer to employment center and I-93, but further from residential areas. FEMA Flood zone covers portion of site.
10. Ipswich River Park	15 Central Street	213/041.0-0000-0029.0	Town	Compared to other sites, further from major routes such as Park Street, parking lot set back from street. Within an area identified as less suitable for transit. Lot is filled to capacity during certain events.
11. Lobster Claw Restaurant	3 Main Street	213/022.0-0000-0107.0	Private	Appears to have parking availability; portion of lot covered in FEMA flood zone.

Figure 2.3. Potential Park and Ride Locations



The two Town-owned sites along Lowell Road – Rita Mullen park and the lot near the senior center – are both good candidates for a park and ride since the Town owns the sites. However, both would require significant investments by the Town to build new parking lots. Residents could use a paved parking lot at Rita Mullen for recreational activities in the evenings and weekends, and thus the lot could serve a dual purpose.

The parking lot at Ipswich River Park (recommended by respondents in the Town survey) would be functional from the first day of service, and would require little to no improvements outside of signage. The site, however, is further away from a likely shuttle routes along Park Street or Main Street, is set back from Central Street, and is in an area identified as less suitable for transit service. The location would require add additional travel time for a shuttle to access the parking lot before heading to Park Street and Main Street. The parking lot also frequently fills to capacity on days when events are held in the park, a common occurrence in the summer. Therefore, this site is less favored, but should be considered if the Town is unable to secure another park and ride site along Main Street or Park Street.

Of the privately owned sites, the shopping site at 72 Main Street appears to have the most promise for a park and ride stop. The lot is adjacent to Main Street, which will allow for easy access for a shuttle, and serves much of the areas identified in the study as most suitable for transit services. There appears to be adequate and even excess parking for the businesses. A portion of the lot is within the one percent annual flood hazard zone, but other portions of the lot area outside of the flood zone.

The shopping center at 20 Main Street should be considered as an alternative. This site has less parking available than at 72 Main Street, but is visible and is within the area identified as most suitable for transit. Finally, the vacant outparcel at 97 Main Street is also a viable option, but less favorable due to the lack of visibility from Main Street. This site would require construction of a parking area in addition to a land lease.

## 2.3 Suitability Analysis of Rail Stations

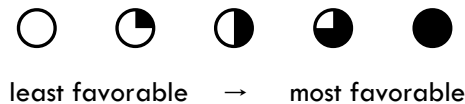
The third area for evaluation was to analyze the rail stations nearby to determine which station might be the best connection for a shuttle. The suitability analysis for the rail stations considered the following:

- Train frequency and hours of train service
- Other transit connections
- Distance from North Reading
- Ease of access for shuttle vehicle
- Amenities

### 2.3.1 Stations Analyzed

The study evaluated five sites. Four are commuter rail stations in municipalities adjacent to or near North Reading: Wilmington, Woburn, and Reading. The station analysis also included the Oak Grove Orange Line rapid transit station in Malden.

To help envision the station analysis, the following symbolic rating system was used to show the overall favorability of each station within each criterion, with an overall rating.



**Table 2.2** shows the results of this analysis.

Table 2.2. Rail Station Suitability Analysis

Evaluation Criteria and Data Used	Findings				
	Wilmington	North Wilmington	Anderson/Woburn	Reading	Oak Grove
<b>Train service</b>  Number of trains on weekdays  Hours of weekday service  MBTA fare zone	26 to Boston/26 to Lowell 8 morning peak period trains to Boston 8 afternoon/evening peak period trains from Boston Service 5:51 AM to 12:42 AM Zone 3 (\$7.50 one-way)	8 to Boston/ 13 to Haverhill; Trains to Boston only before 7 AM and after 9:30 AM Service 5:36 AM to 12:40 AM Zone 3 (\$7.50 one-way)	26 to Boston/26 to Lowell 9 morning peak period trains to Boston 8 afternoon/evening peak period trains from Boston Service 5:56 AM to 12:39 AM Zone 2 (\$6.75 one-way)	16 to Boston/ 21 to Haverhill 6 morning peak period trains to Boston 7 afternoon/evening peak period trains from Boston Service 5:43 AM to 12:42 AM Zone 2 (\$6.75 one-way)	Trains average every 6 to 10 minutes, depending on time of day Approximately 25 morning and 25 afternoon/evening peak period trains to/from Boston Service 5:15 AM to 12:30 AM Zone 1 (\$2.25 one-way)
<b>Other transit connections</b>	Lowell RTA Route 12	None	Logan Express bus	MBTA Routes 136/137	MBTA Routes 136/137
<b>Distance</b> measured from intersection of Route 62 and Route 28 in N. Reading	5.1 to 5.3 miles, depending on route	3.2 to 4.1 miles, depending on route	6.2 to 7.3 miles, depending on route	4.2 to 6.3 miles, depending on route	13.3 to 14.2 miles, depending on route

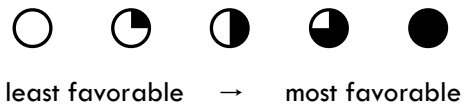
























Table 2.2. Rail Station Suitability Analysis (continued)

Evaluation Criteria and Data Used	Findings				
	Wilmington	North Wilmington	Anderson/Woburn	Reading	Oak Grove
<b>Ease of access for shuttle vehicle</b>  Ease or difficulty of shuttle to drop off/pick up passengers at station, and make turn for return trip	Shuttle can access station via Main Street  Drop off/pick up likely at delineated curbside loop within station parking lot  Some peak period traffic congestion anticipated  	Shuttle can access station via Route 62  Drop off/pick up likely at curbside  No ability to turn vehicle in station lot, but may be feasible to turn in nearby retail parking lot  Minor peak period traffic congestion anticipated  	Shuttle can access station via I-93 or other streets  Delineated drop off/pick up zone and vehicle loop at station for shuttle turn around  Peak period traffic congestion expected along Atlantic Avenue, I-93  	Shuttle can access station and drop off/pick up could be on High Street or Lincoln Street, with shuttle turn around within parking lot or via street network loop  Peak period congestion expected within downtown Reading  May be hindered from accessing station when crossing gates are down  	Shuttle can access station via Washington Street, with turnaround via small lot  Heavy traffic congestion anticipated along entire route in peak periods  
<b>Other amenities</b> Waiting amenities at station, retail and other destinations within walking distance; Walk Score* <a href="http://www.walkscore.com">*www.walkscore.com</a> (0 = "car-dependent" to 100 = "Walker's Paradise")	Shelters at platform Some retail and restaurants within walking distance of station Walk Score 42  	Small shelter at platform Limited retail and restaurants within walking distance of station Walk Score 44  	Interior waiting room with concessions and ticketing Restaurants and retail along Commerce Way, 0.6 mile to over one mile walk Walk Score 23  	Shelters at platform Downtown Reading retail establishments within walking distance of station Walk Score 83  	Shelters at platforms Primarily residential Walk Score 65  
<b>Overall Rating</b>					






  
least favorable → most favorable



### *2.3.2 Rail Station Suitability Analysis Results*

Of the five rail stations, North Wilmington is closest to North Reading. However, the station has only half the number of commuter rail trains when compared to Wilmington, Anderson/Woburn, or Reading, and has no trains to Boston operating between 7:00 AM and 9:30 AM. North Wilmington is also in MBTA Fare Zone 3, requiring North Reading residents to pay a slightly higher fare compared to Woburn and Reading, which are in Fare Zone 2. For these reasons, the North Wilmington station was deemed to be the least favorable option.

The Oak Grove station on the MBTA Orange Line option was included in this study because most transportation management association (TMA) and employer shuttles in the Boston region connect to rapid transit stations. When possible, a connection to rapid transit is preferred over commuter rail since Orange Line trains operate more frequently and have a lower fare when compared to commuter rail. While connecting to Oak Grove would provide the most frequent rail service versus commuter rail, the trip from North Reading to Oak Grove is over twice as far when compared to other options. In peak periods, a one-way shuttle trip from North Reading to Oak Grove could take 45 minutes to an hour, while a one-way trip to Wilmington, Anderson/Woburn, or Reading would be under 30 minutes. Given these long travel times, Oak Grove was rated less favorable than other stations.

Three commuter rail stations – Wilmington, Anderson/Woburn, and Reading – all had similar ratings, with trade-offs for each station. Wilmington and Anderson/Woburn have more rail service than Reading. Anderson/Woburn has a climate controlled waiting area, while the Reading station has the most walkable area with connections to MBTA bus services. Wilmington would require riders to pay Zone 3 fares versus Zone 2 fares at Anderson/Woburn or Reading.

One additional criterion to be considered is the results of the public survey conducted as part of this study. Survey respondents in North Reading preferred connecting to the Reading commuter rail station by 14 percentage points higher than the runner up of Oak Grove. More information on the Town survey can be found in chapter 3.

Given the similar overall ratings for the three commuter rail stations, all three are included in the evaluation of shuttle route and service recommendations in chapter 4. The final selection of the station served will depend on other factors, such as the routing of the shuttle within North Reading, whether there is business support to fund the service for employees who are reverse commuters, and whether the municipalities of Wilmington, Woburn, or Reading wish to help fund a shuttle that could serve other destinations in their communities.

### 3. Town Survey

As part of this study, MAPC and The Town of Reading surveyed Town residents and workers to gain a better understanding of their commuting patterns and interest in using a shuttle service.

#### 3.1 Survey Development and Deployment

MAPC and the Town staff developed the questions on where residents commute to work, what mode they use (drive alone, take transit, etc.), whether they might use a shuttle, and where a shuttle should operate and stop. MAPC developed the survey via Survey123 on ArcGIS, a web-based surveying suite that allows residents not only to respond to questions but also enter data directly onto an interactive map. MAPC then created a mail insert with the unique survey web link, which the Town printed and included in Town's February/ March 2019 property tax bill. The Town mailed the insert to 5,679 addresses. North Reading also posted the survey link address on the Town's website. The survey was open between early March and early May 2019.

#### 3.2 Survey Results

##### 3.2.1 Survey Demographics

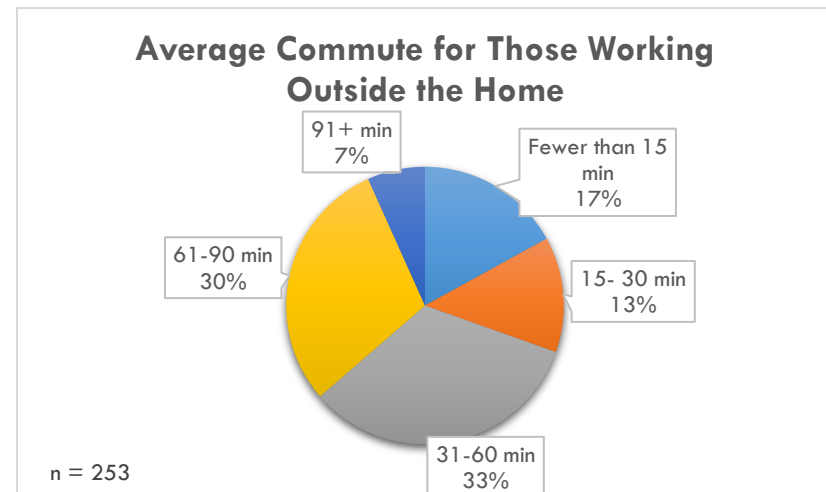
MAPC received 270 responses, which represent approximately 4.7 percent of households and 1.7 percent of the Town's population. The gender breakdown of respondents was 59 percent female and 39 percent male. Over 90 percent of the respondents were between the ages of 18 and 64 years old and over 95 percent live in North Reading. The average household size was just over 3.7 persons, with an average of 2.4 vehicles per household.

Of the survey respondents, 10 percent work in North Reading, and approximately 23 percent work in Boston. These figures are somewhat similar to the 2015 ACS data for North Reading workers of 8.6 percent working in North Reading and 18.8 percent working in Boston, as shown in Table 1.1 in chapter 1.

##### 3.2.2 Commute Mode and Length of Commute

Figure 3.1 shows that, of those who indicated that they work outside the home, there was a nearly even split between those who stated their commute was between 31 and 60 minutes (33 percent) and those with 61 to 90 minute commutes (30 percent).

Figure 3.1. Survey Responses, Average Commuting Time



The average commute reported in the survey was 54 minutes. Over 67 percent of those who work outside the home stated that they drive alone, and 27 percent stated that they take transit. The average commute for drivers (regardless of workplace) was 47 minutes. Those who drive into Boston reported an average daily commute of 76

minutes, while transit riders into Boston reported an average commute of 82 minutes.

All of the above average commute times are greater than the mean journey to work time for North Reading residents of 34 minutes as reported by the Census. Furthermore, the percent of respondents who take transit to work at 27 percent is much greater than the five percent transit mode share reported in the Census.<sup>9</sup> These longer reported commutes could be due to some confusion in the survey, since some may have included round-trip estimates, not one-way. The difference in the share of transit users in this survey compared to Census data is likely because those who take transit and have long commutes were more interested in the survey topic of a potential new shuttle service, and thus made the effort to complete the survey.

### *3.2.3 Current Transit Users*

Of those who responded that they take transit to work, 71 percent commute into Boston. Of those who reported using transit, 84 percent stated they also had a vehicle available and the 86 percent stated that they drove themselves to the station; 10 percent reported being dropped off at the station. If transit were not available, a vast majority (77 percent) stated that they would drive to work instead, followed by 13 percent stating that they would not make the trip. Only three percent stated that they would try to carpool or vanpool.

### *3.2.4 Non-Transit Users*

The survey asked those who do not use public transportation a series of questions on why they do not use transit. As seen in **Figure 3.2**, over 50 percent agreed or strongly agreed that they cannot reach transit, and that the lack of parking at existing transit stations is a hindrance. Nearly 60 percent agreed or strongly agreed that transit is not available when they want to travel, and over 60 percent agreed or strongly agreed that current transit does not reach their destination. Just above 50 percent agreed or strongly agreed that

transit takes too long. Fewer than 40 percent of respondents agreed that taking transit is too confusing, that transit is too expensive, and that they need a car during the day.

A shuttle connecting from North Reading to a rail transit station could reduce some barriers for non-transit riders noted in the survey. For example, a shuttle would extend the geographic reach of transit, and would provide an alternative to the parking problems at nearby stations such as Reading. A shuttle would have less effect on those who think transit takes too long, or who believe they cannot reach their destination with transit.

### *3.2.5 Responses to Suggested Transit Services*

When asked about potential transit service enhancements and their impacts, over 75 percent agreed or strongly agreed that a new shuttle connecting North Reading to a rail station would make them want to use transit more often. Nearly the same percentage agreed/strongly agreed that more parking at rail stations would make them want to ride transit more often. Lower fares were also viewed favorably by survey respondents. These findings are shown in **Figure 3.3**.

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<sup>9</sup> 2011-2016 American Community Survey data. See Chapter 1.

Figure 3.2. Survey Responses, Reasons for Not Using Transit

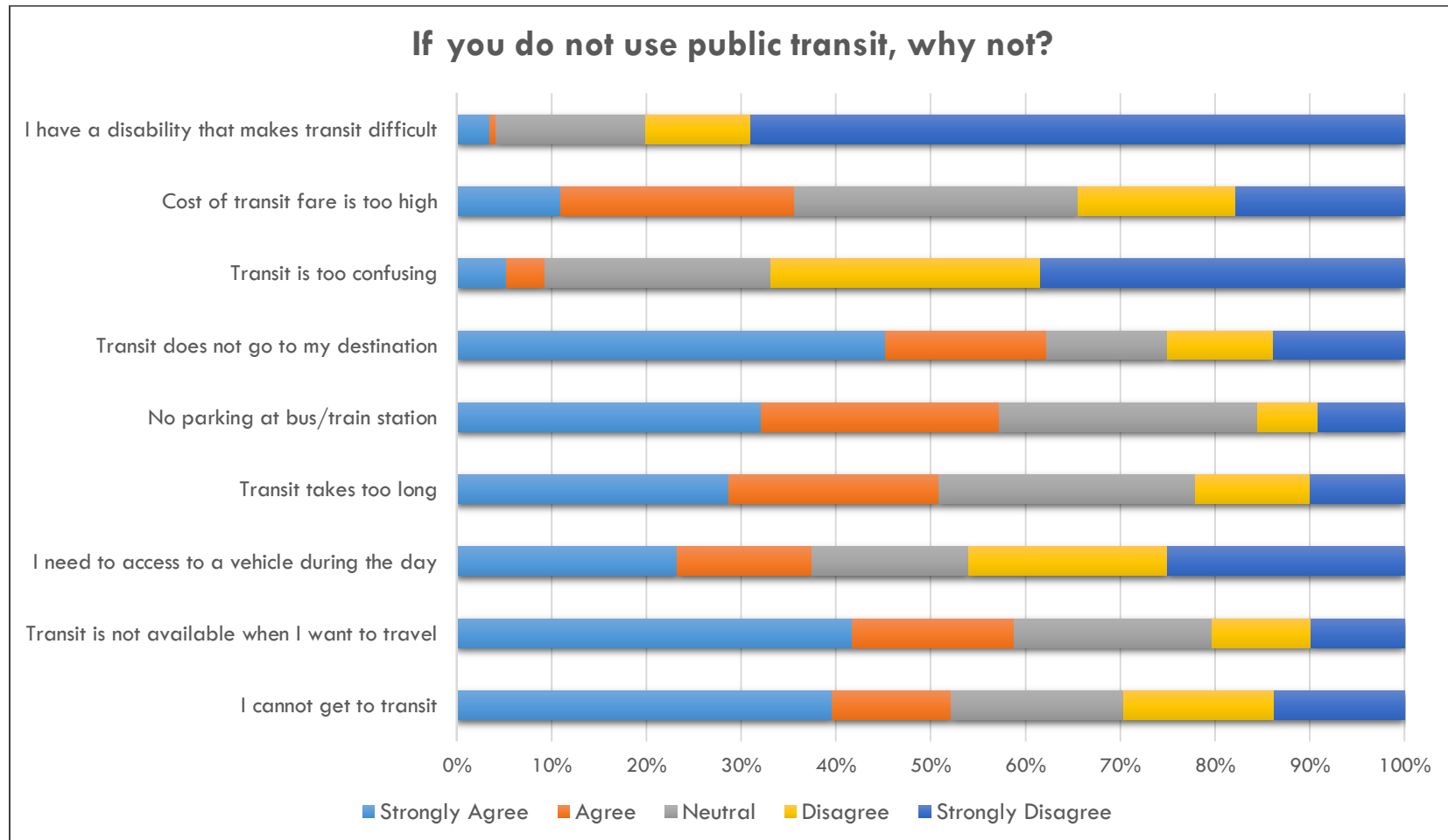
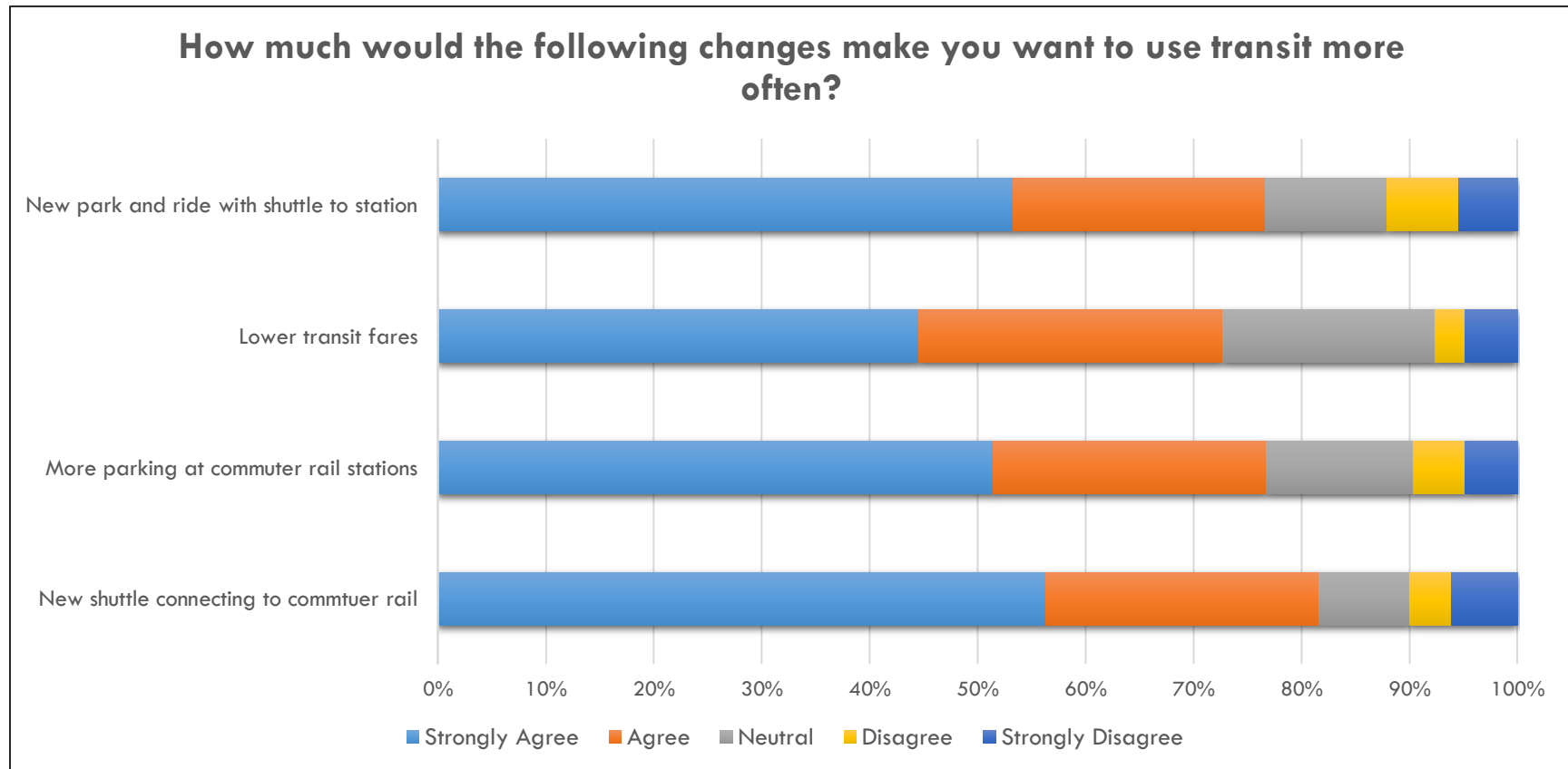


Figure 3.3. Survey Responses, Opinion on Possible Transit Service Changes



When asked specifically if they would use a shuttle connecting to Wilmington, Woburn or Reading, respondents were almost evenly split between “might use it regularly” at 35 percent and “Definitely would use it regularly” at 36 percent. Those who stated that they “definitely would not use” a shuttle was seven percent, as seen in **Figure 3.4**.

When asked which station they would prefer to connect with a shuttle, 41 percent chose Reading, followed by Oak Grove at 28 percent, and Anderson/Woburn at 17 percent, as seen in **Figure 3.5**. Interestingly, when cross-tabulating the survey respondents who currently use transit to get to work, the split was nearly equal among Oak Grove station (34 percent), Anderson/Woburn (30 percent), and Reading (29 percent).

Figure 3.4. Survey Responses, Shuttle to Rail Option

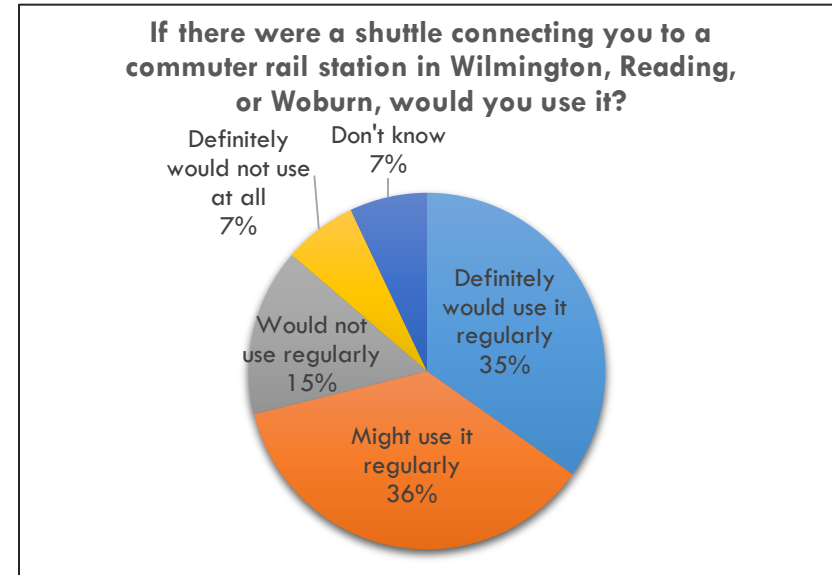
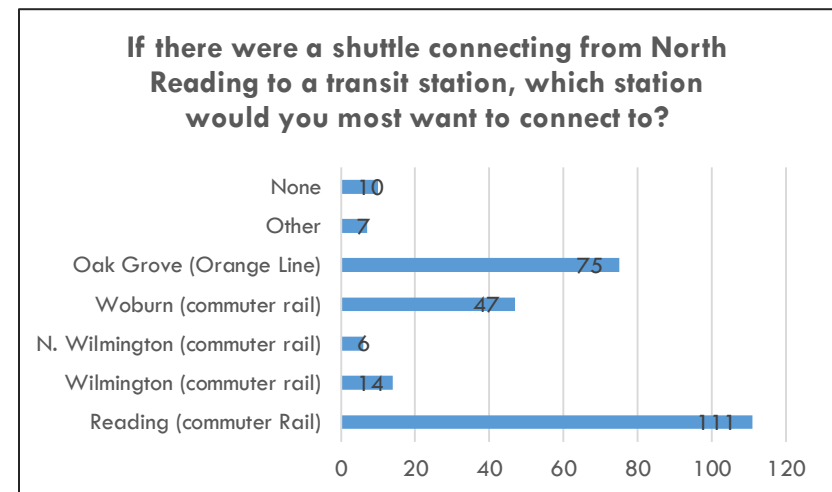


Figure 3.5. Survey Responses, Shuttle Station Connection Options



The survey also asked how long of a shuttle ride would respondents be willing to have in order to connect to a rail station. Not surprisingly, a vast majority would prefer to have a shuttle ride under 20 minutes. Only 31 percent were willing to have a shuttle ride longer than 20 minutes, as seen in **Table 3.1**.

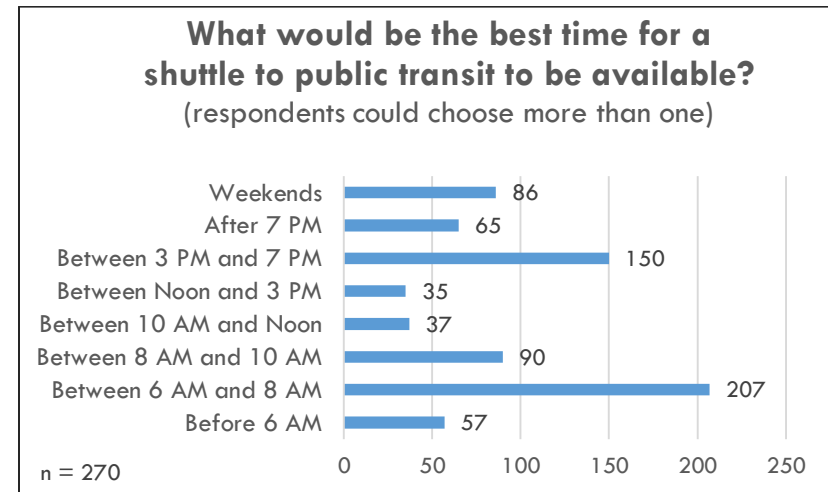
*Table 3.1. Survey Responses, Shuttle Travel Time*

Potential Shuttle Travel Time	Responses
15 minutes or less	31%
Between 15 to 20 minutes	34%
Between 20 and 25 minutes	16%
Between 25 and 30 minutes	12%
More than 30 minutes	3%
Would not use shuttle	4%
Total (270 responses)	100%

*Question from survey: How long of a shuttle ride connecting North Reading to a transit station would you be willing to take, in order to take advantage of a shuttle?*

The survey asked respondents of possible times when they would want to see a shuttle service. Respondents were permitted to choose more than one time slot, since most travelers would need a shuttle twice a day. **Figure 3.6** shows that mid-day services (between 10 AM and 3 PM) were the least desired option. The most popular time frame was between 6 AM and 8 AM, followed by between 3 PM and 7 PM. These most popular time slots generally align with the peak travel periods.

*Figure 3.6. Survey Responses, Potential Shuttle Service Hours*

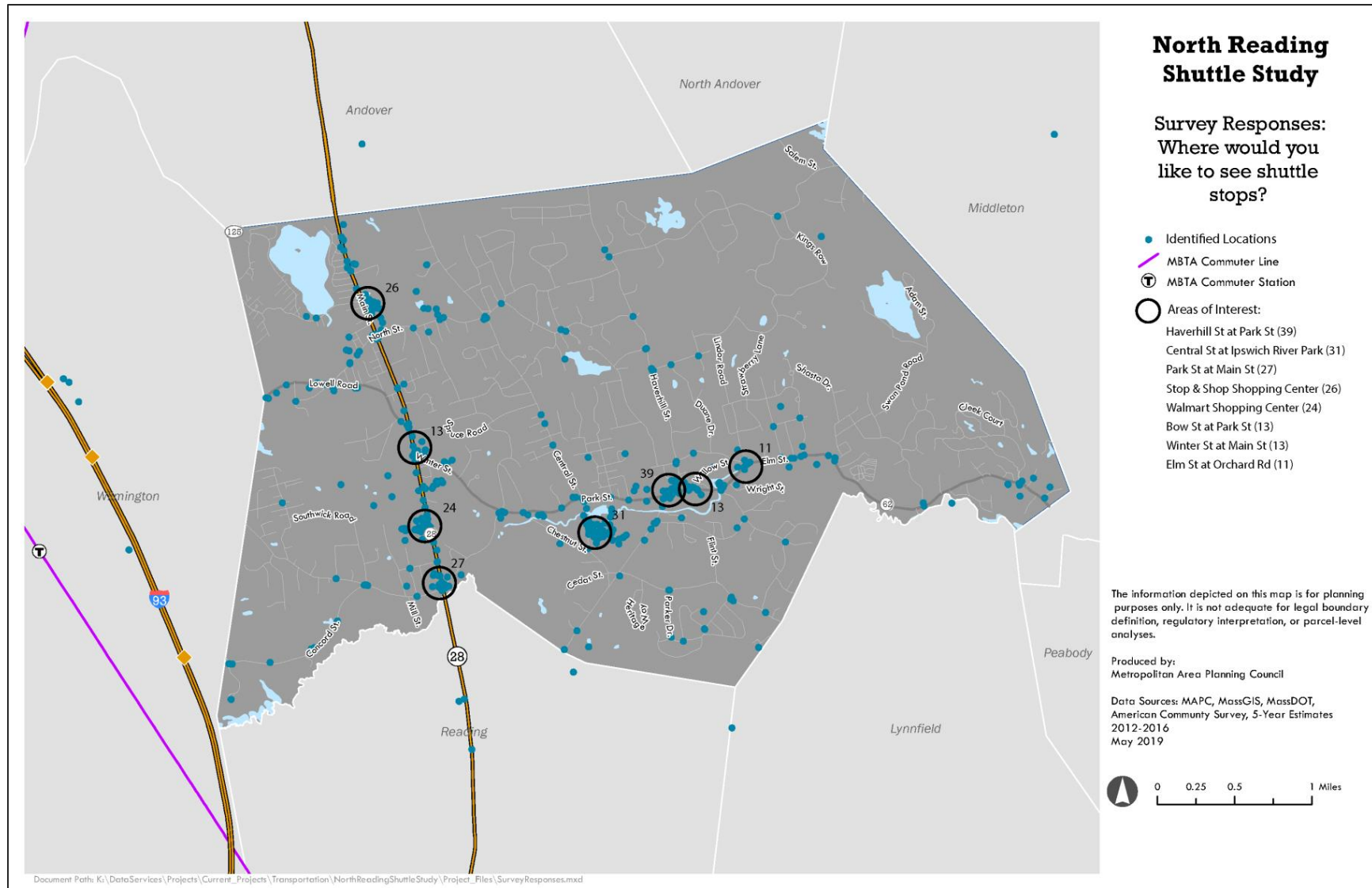


### 3.2.6 Survey of Potential Transit Stops

The survey also allowed people to mark on a map up to three specific sites where they would like to see a shuttle stop. Nearly all of the identified shuttle stops were on or near Route 62/Park Street and Route 28/Main Street, with definitive clusters near Ipswich River Park, historic downtown North Reading near the schools and Town Common, and at or near shopping centers along Main Street. Many of the top locations mirrored sites selected by MAPC and the Town staff for consideration of a possible park and ride stop (see chapter 2). **Figure 3.7** shows the sites identified by the survey respondents.



Figure 3.7. Survey Responses, Possible Shuttle Stops



## **4. Findings and Recommendations**

### **4.1 Overall Findings**

The survey conducted for this study shows a considerable level of interest for a shuttle connecting North Reading to the Reading commuter rail station, with some interest in connections to other Oak Grove or Anderson/Woburn. Respondents also noted concerns about the lack of transit services in North Reading. Many survey respondents noted commutes of an hour or more, which are longer than the median commutes for the Boston region and for North Reading as seen in the Census data. These long commutes to Boston were noted by both drivers and transit users in the survey. Likely because of the existing long commutes, most of those surveyed were interested in a shuttle, but would prefer a shuttle ride no longer than 20 minutes. Given the distance needed to connect to Reading, Anderson/Woburn, or even Wilmington stations, achieving scheduled service connecting North Reading in 20 minutes or less may be a challenge.

The suitability analysis shows that a potential shuttle service in North Reading should be concentrated in the more densely populated areas along Park Street/Route 62 and Main Street/Route 28. These were also the corridors that had the greatest concentration of requested stops noted in the Town-wide survey. Along these routes, the most promising locations for a park and ride site are shopping centers along Main Street, such as the North Reading Plaza (Walmart) or at 20 Main Street. Given that the actual demand for a shuttle is unknown, the Town should consider a pilot that uses an existing parking before conducting a large capital outlay to construct a new parking lot on town controlled land. This early phase will require an agreement with the property owners of the shopping center; similar agreements have been arranged by municipalities or transit agencies across the Commonwealth. The agreement will likely require leasing between 15 and 30 parking spaces.

Determining the potential demand for a shuttle service is extremely difficult, given the lack of data. Census data shows that only around five percent of the approximately 8,400 workers in North Reading currently use transit to get to work; this equals to approximately 400 commuters. Around 70 percent of the survey respondents for this study who use transit commute into Boston. Moreover, the survey for this study indicated that 90 percent of transit commuters drive and park at a nearby station – likely Anderson/Woburn, Wilmington, or Oak Grove. (Given the limited parking options in Reading, likely very few of these respondents drive there.)

Reviewing limited data reported by TMAs, similar shuttles operated by the Middlesex 3 TMA and CrossTown Connect TMA have 6 to 12 riders per shuttle trip connecting with a rapid transit or commuter rail station. A shuttle operating in North Reading would likely have similar ridership. MAPC also reviewed ridership data for transit services provided by four other municipalities in greater Boston: Bedford, Beverly, Burlington, and Lexington. Using data from the National Transit Database and the Census, MAPC determined that a shuttle operating in North Reading has the potential for providing between 20 and 40 passenger trips per weekday, or approximately 10 to 20 persons per weekday, assuming each person makes a round trip. More details on estimating the demand for a shuttle can be found in Appendix C.

If the Town wishes to undertake a pilot and create a new shuttle service, MAPC has outlined two options – a fixed route service and a microtransit (on demand) transit service. Both are described below.

## 4.2 Fixed Route Shuttle to Rail Options

All of the schedules shown were developed by MAPC and assume a single vehicle traveling back and forth between North Reading and the station. The final schedule for any shuttle would be determined by the shuttle operator and would depend on the number and location of stops in North Reading.

**Shuttle Between North Reading and Reading:** A connection to Reading was the most popular option noted by survey respondents. A potential routing could start near the Post Office on Park Street, proceed west along Park Street to Main Street, head south on Main Street and stop at a park and ride site along Main Street before heading south into Reading and terminating at the rail station. The one-way distance travelled is approximately six miles, and would take around 20 to 25 minutes; a round trip would be 45 to 50 minutes to allow for time for loading and unloading passengers.

Looking at the Reading train schedule, there appears to be at least two morning southbound and two or three afternoon northbound trains that could be met by a shuttle in the 6 AM to 9 AM and 4 PM to 7 PM timeframes, respectively. Each shuttle could also meet at least one train for “reverse commuters” traveling in the non-peak direction.

The following tables show the possible schedules for a shuttle connecting North Reading to Reading station.

*Potential N. Reading – Reading Shuttle Schedule Alternative 1*

Morning Shuttle Schedule			
Depart North Reading	Arrive Reading Station	SB Train Meet (peak direction)	NB Train Meet
5:50 AM	6:10 AM	6:18 AM	--
6:45 AM	7:05 AM	--	7:15 AM
7:35 AM	7:55 AM	8:00 AM	8:06 AM
8:45 AM	9:15 AM	9:41 AM	
Afternoon Shuttle Schedule			
NB Train Meet (peak direction)	SB Train Meet	Depart Reading Station	Arrive North Reading
4:24 PM	--	4:30 PM	4:55 PM
5:22 PM	4:50 PM	5:30 PM	6:00 PM
6:39 PM	--	6:45 PM	7:10 PM

*Potential N. Reading – Reading Shuttle Schedule, Alternative 2*

Morning Shuttle Schedule			
Depart North Reading	Arrive Reading Station	SB Train Meet (peak direction)	NB Train Meet
6:20 AM	6:45 AM	6:48 AM	--
7:10 AM	7:35 AM	--	7:42 AM
8:00 AM	8:25 AM	8:30 AM	--
9:00 AM	9:25 AM	9:41 AM	--
Afternoon Shuttle Schedule			
NB Train Meet (peak direction)	SB Train Meet	Depart Reading Station	Arrive North Reading
4:24 PM	--	4:30 PM	4:55 PM
5:22 PM	4:50 PM	5:25 PM	6:00 PM
6:39 PM	--	6:45 PM	7:10 PM

**Shuttle Between North Reading and Anderson/Woburn:** For this option, the average shuttle travel time is assumed to be 30 minutes with a round trip of 60 to 65 minutes to allow for passenger loading and unloading. The stops in North Reading would be similar to those in the Reading option, but would proceed west to Anderson/Woburn after serving stops along Main Street. The following tables show the possible schedule for a shuttle connecting North Reading and Anderson/Woburn station.

*Potential N. Reading – Anderson/Woburn Shuttle Schedule*

Morning Shuttle Schedule			
Depart North Reading	Arrive Anderson/Woburn Station	SB Train Meet (peak direction)	NB Train Meet
5:55 AM	6:25 AM	6:31 AM	6:34 AM
7:15 AM	7:55 AM	8:01 AM	--
8:30 AM	9:00 AM	9:06 AM	--
Afternoon Shuttle Schedule			
NB Train Meet (peak direction)	SB Train Meet	Leave Anderson/Woburn Station	Arrive North Reading
4:40 PM	4:21 PM	4:45 PM	5:15 PM
5:54 PM	5:30 PM	6:00 PM	6:30 PM
7:20 PM	7:13 PM	7:25 PM	7:50 PM

**Shuttle Between North Reading and Wilmington:** A shuttle to Wilmington would likely be similar to Anderson/Woburn in both travel time and scheduled train connections. Wilmington is within fare zone 3, and thus is slightly more expensive than a trip to Boston from Anderson/Woburn or Reading (both are fare zone 2). As such, Wilmington would likely be least preferable (in the online survey, a connection with Wilmington was preferred by only five percent of respondents).

**Figure 4.1** shows the potential routes of shuttles connecting to Reading, Anderson/Woburn, and Wilmington.

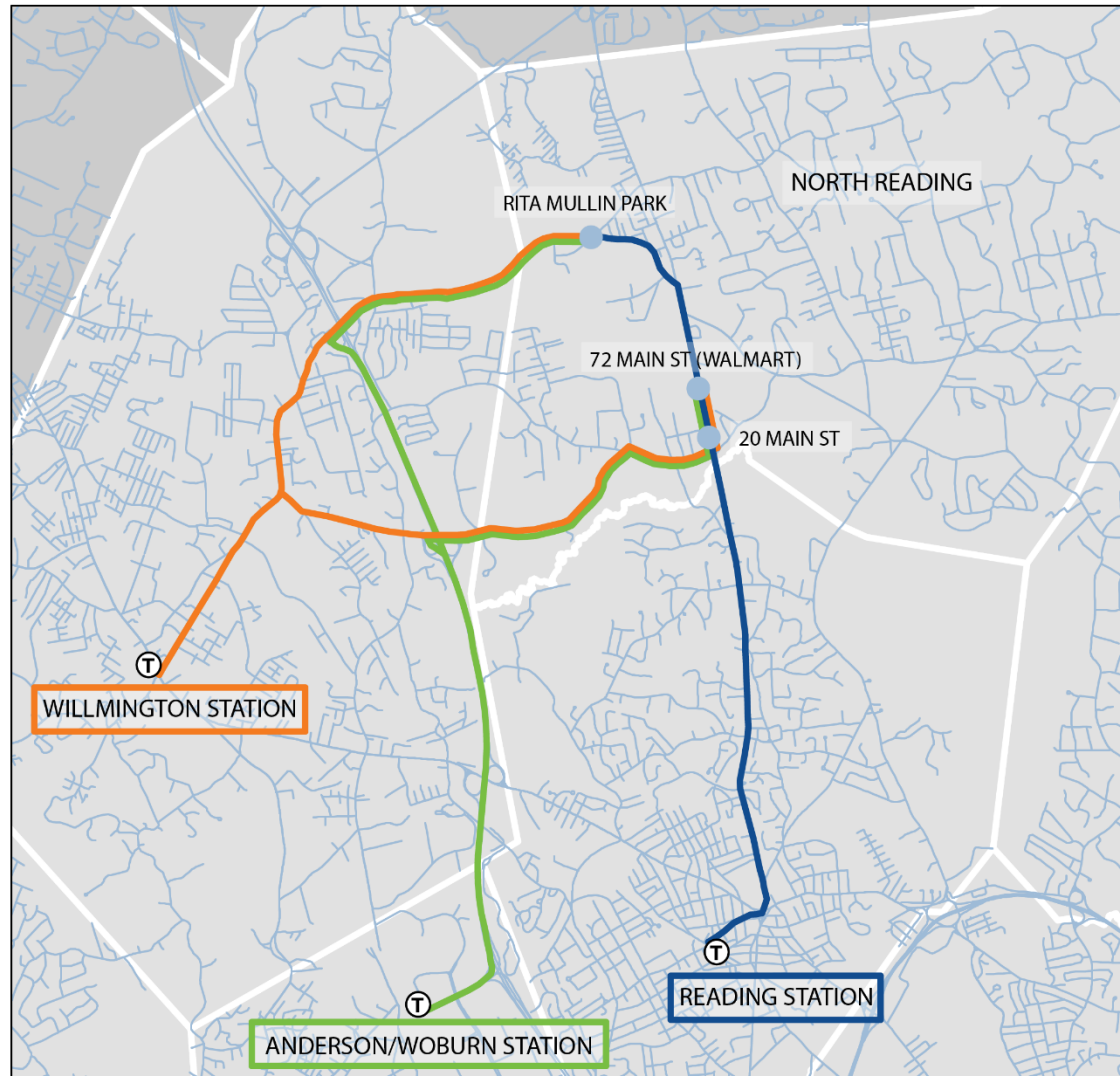
As noted previously, some survey respondents expressed interest in connecting with Oak Grove station and the MBTA Orange Line. The

Oak Grove station in Malden is more than twice the distance from North Reading (15 miles) as other options, and thus would likely require a 40 to 45 minute one-way trip schedule. With an 80 to 90 minute round trip, the schedule would only allow for two round trips each in the morning and afternoon periods.



*Anderson/Woburn station*

Figure 4.1. Fixed-Route Shuttle Options



## North Reading Shuttle Study

### Fixed Route Shuttle Options

#### Potential Park and Ride Stops

- Rita Mullin Park
- 72 Main St
- 20 Main St

#### Commuter Rail Stations

#### Potential Station Routes

- Wilmington
- Anderson/Woburn
- Reading

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

Produced by:  
Metropolitan Area Planning Council

Data Sources: MAPC, MassGIS, MassDOT

May 2019

**Shuttle Costs:** Under any scenario, the shuttle would operate a morning shift and afternoon shift for a total of eight to nine hours of daily operation. This total includes the travel time for the operator to drive between North Reading and the vehicle storage site. Similar privately contracted shuttles have cost around \$166,400 annually, assuming eight hours per weekday, five days per week, 52 weeks a year, at \$80 per hour. MVRTA estimated the shuttle annual operating cost at \$177,450. That cost is based upon 8.75 hours per day, at \$78 per hour, equaling \$682.50 per day or \$3,412.50 per week.

MAPC also reviewed the operating costs of municipally operated transit services in greater Boston listed in the National Transit Database reports for Bedford, Beverly, Burlington, and Lexington, as well as data from a recent regional transit study for Bedford, Burlington, and Lexington. These systems report bus operating costs of around \$50 to \$70 per revenue hour. The lower costs are typically because the municipalities hire their own drivers, and garage and maintain their own vehicles, thereby sharing some costs with other municipal departments. More information on shuttle operating costs can be found in Appendix C.

For the park and ride lot, the Town could either construct a dedicated parking area on Town-owned land or could lease spaces from a private entity such as a hotel, church, or shopping center.

Surface parking construction costs are on average \$20,000 per space, with annual operating and maintenance costs at \$500 to \$800 per space.<sup>10</sup> Assuming the need for around 20 parking spaces, constructing a new lot would cost the Town \$400,000 plus design fees. Annual operating and maintenance costs would be \$10,000 to \$16,000.

Leasing spaces at a retail or other establishment typically cost \$50 per space per month; assuming leasing 20 spaces, the annual leasing costs would be \$12,000.

### 4.3 Microtransit Shuttle Option

An alternative that the Town may wish to consider is a microtransit shuttle that operates within the Town limits and that also provides trips to Anderson/Woburn, Wilmington, or Reading station.

**Microtransit** is defined as public transportation services that serve passengers using dynamically generated routes derived from advanced software, and which may expect passengers to make their way to and from common pick-up or drop-off points. Unlike more traditional dial-a-ride transit, microtransit does not require the typical 24- to 48-hour advance scheduling. The transit operates similar to ride-hailing technology like Uber and Lyft, with dynamic trip routing and vehicles that are hailed by the user with a smartphone app. Unlike Uber and Lyft, microtransit vehicles are not individual private contractors but instead public transportation, with professionally trained drivers who usually operate wheelchair accessible vehicles. Moreover, as a public transit operation, ridership and other trip data are in the public domain.

Microtransit vendors can provide a range of services. Some microtransit vendors provide the dynamic scheduling software to route the vehicles and to develop the mobile app, with the transit agency or municipality using its own drivers and vehicles. Other microtransit vendors can provide a turnkey service – consulting, scheduling software, hardware, drivers, and vehicles.

**Possible microtransit operation in North Reading:** A microtransit operation in North Reading would not have a fixed route. Instead, residents could hail the vehicle using a mobile app, or via the web, or

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<sup>10</sup> Transportation Cost and Benefit Analysis Techniques, Estimates and Implications, Second Edition. Victoria Transportation Institute, October 2016. <http://www.vtpi.org/tca/>



even by calling a phone number. Once the trip is booked in the system, the driver receives a notification on the in-vehicle tablet where to pick up the passenger and their destination. If others request a trip while the vehicle is in route, the scheduling and routing software calculates in real-time an optimized routing for all of the pickups and drop offs scheduled for the riders on the vehicle.

A microtransit service could provide service to and from a commuter rail station in a nearby town, if riders requested such a trip. (The microtransit vendor creates “geofencing” that permits trips to originate or end in specific locations such as a train station as well as within a municipal boundary.) Riders who request a connection with a commuter rail train would need to have priority over other trips, given the time-sensitive nature of the connection. The key in developing the microtransit operation with a vendor would be to ensure that these rail connection trips are more time-sensitive, and thus have priority over other trip requests. Microtransit vendors work with the sponsoring municipality or agency to determine which trip types, geographic areas, or time of day services would have priority.

Another feature of microtransit is the option of the Town to set which trips are door-to-door, and which trips are “corner to corner”, where the rider is instructed to meet the vehicle at a nearby landmark. With microtransit, riders can be instructed to walk to a designated pick up/drop off point can help speed up the service for other passengers waiting for or in the vehicle. Those who require direct service to the door or driveway, such as a person with a disability, can be registered ahead of time and noted in the route scheduling when the trip is booked.

The advantage of the microtransit over a fixed-route service is that the transit vehicle can be hailed by anyone within the Town limits. Moreover, the vehicle could provide trips to other destinations in North Reading, such as medical or shopping trips, when there is no demand for trips to and from the commuter rail. Given the low-density development in North Reading, the microtransit’s ability to have a greater geographic reach might be an advantage.

**Existing microtransit services:** Currently the only microtransit service operating in Massachusetts is a night transit service operated by Via for Harvard University students and faculty. The City of Newton is now developing a microtransit service for their senior transportation, and GATRA is evaluating a microtransit pilot in the Foxboro area as a first and last mile connection with commuter rail.

There are several microtransit operations across the US. Sacramento Transit is currently operating microtransit services in two areas that are examples of a service that might operate in North Reading. Riders can connect with both commuter rail and light rail stations within the microtransit service zone. In addition to using the mobile app, riders can hail the vehicle on their computer or by calling the transit agency. While Sacramento is more densely populated than North Reading, the Sacramento service provides a possible model for have on-demand transit that serves as a connection to rail transit as well as other trip needs. More details can be found at <https://smartride.sacrt.com/>.

**Microtransit costs:** It should be noted that the vehicle revenue hour operating costs for microtransit are usually the same as with fixed-route transit, because the primary costs – vehicle operators/drivers, fuel, maintenance – are the same whether the vehicle is operating on-demand or on a fixed-route. The advantages with microtransit are the geographic coverage of the service, the ability to serve needs other than work trips, and increasing the number of shared rides, which can lower the per-trip costs.

#### 4.4 Direct Shuttle to Downtown Boston Option

In June 2019 the Town of North Reading and MAPC discussed the study recommendations with the MVRTA. During that conversation, MVRTA raised the option of a direct shuttle linking North Reading with downtown Boston. MVRTA currently operates a similar shuttle that runs between North Andover and Boston. That North Andover service operates Monday through Friday, with one bus to Boston in the morning and two buses from Boston in the afternoon. MVRTA

developed a draft schedule of a direct shuttle operating Monday through Friday from North Reading to downtown Boston, with one inbound morning trip to Boston and one outbound afternoon trip back to North Reading. The proposed service would operate seven hours per day, which includes the time for the bus to “deadhead” to and from the MVRTA bus facility. At \$78 per hour, the Town’s cost for this bus service would be nearly \$142,000 per year.

The advantage of a direct shuttle would be a one seat ride from North Reading to downtown Boston. The disadvantages would be only one departure time, with less certainty on arrival times since the bus would be in congested traffic on I-93 and downtown Boston.

## 4.4 Next Steps

### 4.4.1 Determine Type of Transit Service

If it wishes to implement a shuttle, the Town should contact the Merrimack Valley RTA to see if they are willing to contract for any of these options (shuttle to commuter rail, microtransit, or direct bus to downtown Boston). The Town already has a contract with MVRTA to provide senior on-demand transportation for medical trips to sites outside of the Town limits, and may be able to contract with the RTA for a new fixed route or microtransit service.

If selecting a microtransit option, MAPC suggests conducting a request for proposals for a vendor to develop and implement the service, if MVRTA does not already have a microtransit option with their current dispatching software. As part of the RFP process, the Town should develop a scope of work that clearly defines if the vendor will provide a full turnkey service with drivers and vehicles, or just dispatching and scheduling of existing MVRTA vehicles or vehicles operated by a third party. Moreover, this scope should include guidelines on the geographic coverage anticipated for the microtransit, including the locations and service times for any connections with rail stations outside of North Reading.

### 4.4.2 Possible Sources for Funding and Technical Assistance

There are several existing and emerging programs that the Town can apply for technical assistance and implementation assistance. Here are funding sources that the Town may want to consider if looking to develop and implement the pilot:

#### Technical Assistance

- The Central Transportation Planning Staff (CTPS), who are the staff of the Boston Metropolitan Planning Organization, provide technical assistance to municipalities on concerns such as traffic operations and parking, both that may be needed if the Town wishes to create a new park and ride lot, as well as technical assistance on new transit operations. <https://www.ctps.org/ctta> or [https://www.ctps.org/regional\\_transit](https://www.ctps.org/regional_transit)
- MAPC provides technical assistance on evaluating job access and first/last mile transportation through the Technical Assistance Program. <https://www.mapc.org/about-mapc/funding-opportunities>
- MassDOT provides technical assistance via the Community Transit Grant Program (<https://www.mass.gov/mobility-management-and-transportation-coordination>). The funds are from the Federal Transit Administration (FTA) 5310 program, which is primarily provides transportation for seniors and persons with disabilities. This program can provide both technical assistance as well as funding for project implementation.
- The Community Compact program provides funding for planning, particularly for projects that create municipal collaboration. <https://www.mass.gov/orgs/community-compact-cabinet>

#### Implementation Assistance

The Efficiency and Regionalization Grant (ERG) is a competitive grant providing financial support to implement regionalization and other efficiency initiatives. For example, the municipalities of Danvers and Beverly in 2018 received a grant to implement a shuttle that connects

from the Beverly depot to employment centers in these two municipalities. <https://www.mass.gov/efficiency-regionalization-grant-program>

Two new funding programs are being developed that are aimed at community and employment transportation, which may be applicable to a pilot shuttle.

- The Boston MPO is creating a new Community Transportation Program funded at \$2 million annually starting in federal fiscal year 2021. The program will use Congestion Mitigation and Air Quality (CMAQ) federal funds. Eligible projects include transit infrastructure as well as wayfinding and education. Transit operations are also eligible, but only for one to three years and the project must have a clear financial plan for sustainability beyond the grant funds. Sandy Johnston at CTPS is heading this new grant program ([sjohnston@ctps.org](mailto:sjohnston@ctps.org)).
- MassDOT has eliminated the MassRIDES program and is creating a new Workforce Transit Grant Program that will fund workforce transportation projects. The program uses CMAQ funds. The program is still under development but will be a competitive grant with \$1.5 million available annually across the Commonwealth. More information on this program will be provided later in 2019 by MassDOT.

## **Appendix A: Suitability Analysis Data**

MAPC conducted the analysis to determine which areas within North Reading would be the best candidates for local public transportation improvements. The analysis was completed for the nine Census block group areas for North Reading; the Census block group level was the most detailed level of Census data available. In addition to data from the US Census, the analysis used data from the Massachusetts Vehicle Census, and the Central Transportation Planning Staff.

North Reading does not have any Environmental Justice (EJ) Communities as defined by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). The Massachusetts EOEEA defines an EJ community as one where a Census block group has an annual median household income that is equal to or less than 65 percent of the statewide median (\$62,072 in 2010); or where 25 percent or more of the residents identify as a race other than white; or where 25 percent or more of households have no one over the age of 14 who speaks English only or very well. Even though the Town does not have any EJ Communities as defined by EOEEA, for the suitability analysis, MAPC evaluated data to determine areas with block groups with a higher proportion of residents that could be identified as environmental justice communities.

The analysis was divided into Boston-centered commute and a Lawrence/Lowell-centered commute analysis to determine if areas might be more suited to serve those commuting to/from Boston and those commuting to/from Lawrence and Lowell.

### *Boston-Centered Commutes*

To emphasize the connection between those North Reading residents who work in Boston and commute using public transit, this analysis determined which census block groups were most suitable for access to a shuttle service by more heavily weighting those block groups with higher percentages of working-age residents who are employed in Boston and live in close proximity to commuter rail stations. In this way, shuttle service within suitable block groups would complement

existing transit infrastructure by connecting areas with high potential and existing ridership along a route with the ability to provide service frequency aligned with commuter rail schedules during peak morning and evening times. As such, those block groups with a high population density, or the number of residents per acre, were deemed more suitable locations for shuttle stops, as were areas with lower percentages of vehicle ownership per household. Finally, the analysis accounted for block groups with high proportions of residents with disabilities and potential environmental justice (EJ) populations: those who identify as a race other than non-Hispanic white, limited English speaking households, or cost-burdened household.

An itemized breakdown of scoring criteria, weighting, and data sources is as follows:

1. Population Density - Number of residents per acre. A higher density resulted in a higher rating. (Source: Census 2010 and 2010-2017)
2. Employment Density - Number of employees per acre. A higher density resulted in a higher rating. (Source: LEHD 2014)
3. Vehicles per Household - A lower number of vehicles per household resulted in a higher rating. (Source: Mass Vehicle Census, 2014 quarter 4)
4. Commuters traveling to Boston – Percent of working-age residents of each Census block group who work in Boston. A higher percentage of commuters resulted in a higher rating. Weighted at 10. (Source: Central Transportation Planning Package 2006-2010)
5. Residents with Disabilities - Census tracts which have a high percentage of disabled residents received a higher rating. (Source: Census 2010)

6. Proximity to MBTA Service- Census block groups which have close proximity to commuter rail stations received a higher rating; distance from Census block group centroid to nearest Commuter Rail station using street networks. Weighted at 10 (Source: MAPC analysis)
7. Environmental Justice: Minority population, limited English speaking households, low income households -- Census block groups with high proportions of residents who identify as a race other than non-Hispanic White, limited English speaking households, or low income households receive a higher score. (Source: MassGIS/MAPC)
  - a. Percent population that identifies as a race or ethnicity other than non-Hispanic White (Source: Census 2010)
  - b. Percent of Households considered Limited English speaking households (previously known as linguistic isolation, ACS 5 year estimates 2012-2016)
  - c. Cost-Burdened Households - A higher percentage of households that are burdened by housing costs resulted in a higher rating. (Source: ACS 5-year estimates 2012-2016)

*Lawrence or Lowell Centered Commutes*

Similar criteria were used to determine the locational suitability for shuttle stops connecting those residents that work in Lawrence or Lowell with transit. As with the aforementioned analysis, those census block groups with high proportions of residents commuting to Lawrence or Lowell were weighted more highly than other criteria, except for proximity to commuter rail stations. Additionally, this analysis accounted for employment density, with a higher number of employees per acre resulting in a higher rating, and coverage for residents with disabilities.

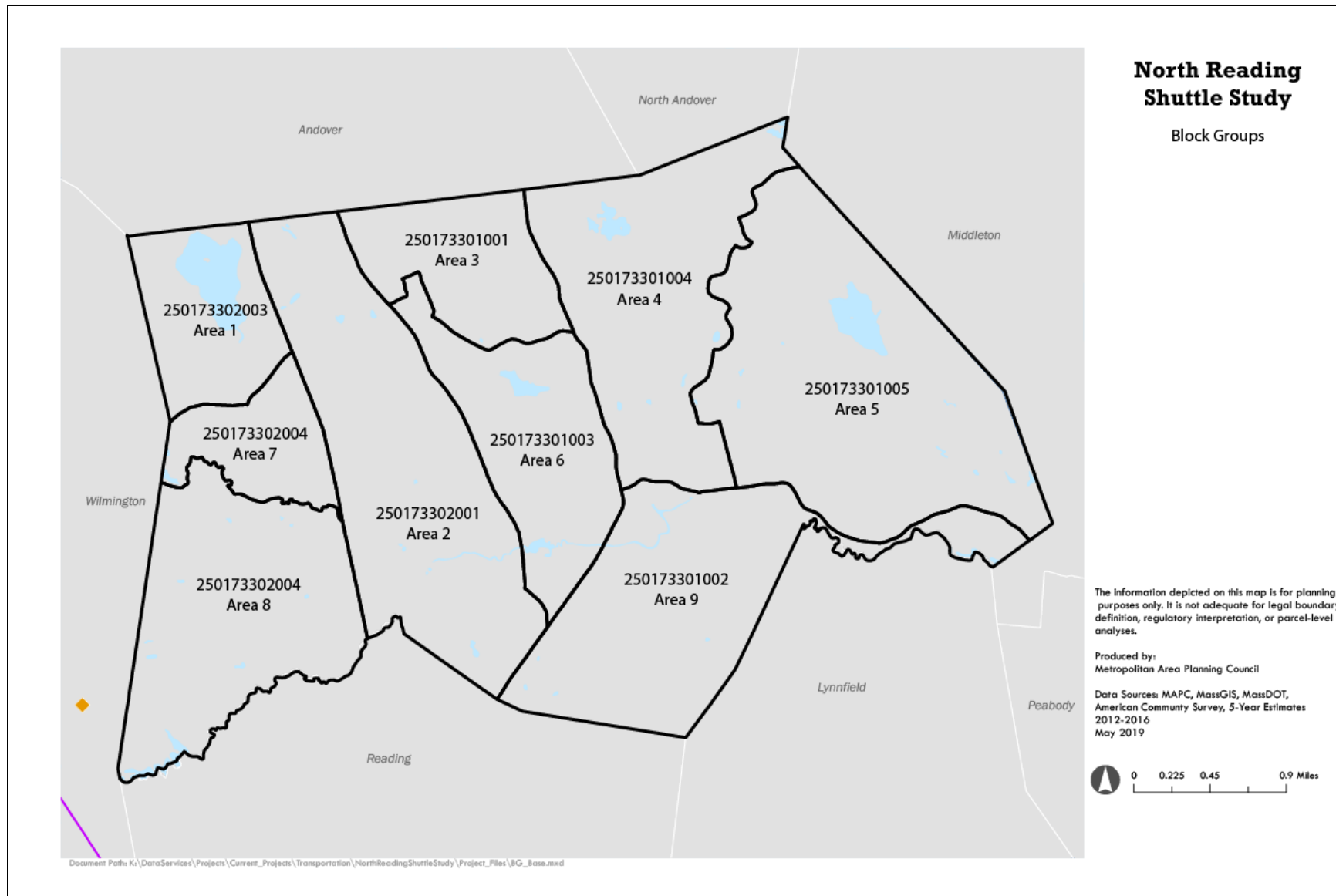
An itemized breakdown of scoring criteria, weighting, and data sources can be found below.

1. Population Density - Number of residents per acre. A higher density resulted in a higher rating. (Source: Census 2010 and 2010-2017)
2. Employment Density - Number of employees per acre. A higher density resulted in a higher rating. (Source: LEHD 2014)
3. Vehicles per Household - A higher percentage of households having less than one vehicle resulted in a higher rating. (Source: Mass Vehicle Census, 2014 quarter 4)
4. Journey to Work Data for Lawrence and Lowell Commuting – Percent of workers in each block group who do not work at home who commuted to or from Lawrence or Lowell. A higher number of workers commuting to or from Lawrence or Lowell results in a higher rating. (Source: ACS 2006-2010 Journey to Work Data)
5. Residents with Disabilities - Census tracts which have a high percentage of disabled residents received a higher rating. (Source: Census 2010)
6. Proximity to MBTA Service- Census block groups which have close proximity to commuter rail stations received a higher rating; distance from Census block group centroid to nearest Commuter Rail station using street networks. Weighted at 10 (Source: MAPC analysis)
7. Environmental Justice: Minority population, limited English speaking households, low income households -- Census block groups with high proportions of residents who identify as a race other than non-Hispanic White, limited English speaking households, or low income households receive a higher score. (Source: MassGIS/MAPC)
  - a. Percent population that identifies as a race or ethnicity other than non-Hispanic White (Source: Census 2010)

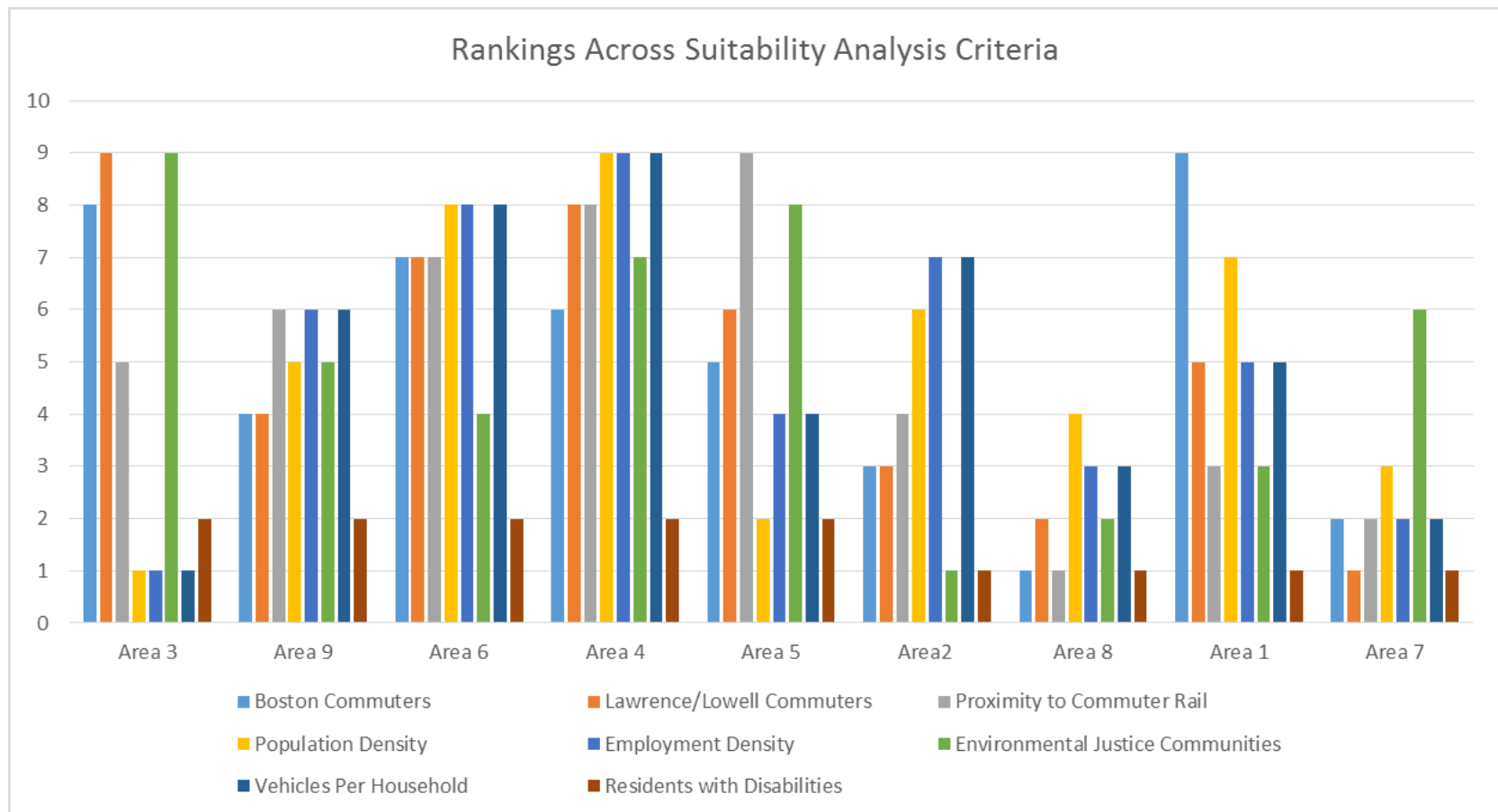
- b. Percent of Households considered Limited English speaking households (previously known as linguistic isolation, ACS 5 year estimates 2012-2016)
- c. Cost-Burdened Households - A higher percentage of households that are burdened by housing costs resulted in a higher rating. (Source: ACS 5-year estimates 2012-2016)

The map on the following page shows the block groups in North Reading used for the suitability analysis, which corresponds to the scoring for each area shown in the following tables and graphs.





	Area 3	Area 9	Area 6	Area 4	Area 5	Area2	Area 8	Area 1	Area 7
Boston Commuters	8	4	7	6	5	3	1	9	2
Lawrence/Lowell Commuters	9	4	7	8	6	3	2	5	1
Proximity to Commuter Rail	5	6	7	8	9	4	1	3	2
Population Density	1	5	8	9	2	6	4	7	3
Employment Density	1	6	8	9	4	7	3	5	2
Environmental Justice Communities	9	5	4	7	8	1	2	3	6
Vehicles Per Household	1	6	8	9	4	7	3	5	2
Residents with Disabilities	2	2	2	2	2	1	1	1	1
	250173301001	250173301002	250173301003	250173301004	250173301005	250173302001	250173302002	250173302003	250173302004
Average Ranking By Block Group (Unweighted)	4.5	4.75	6.375	7.25	5	4	2.125	4.75	2.375



## **Appendix B: Town Survey**

As part of this study, MAPC and The Town of Reading surveyed Town residents and workers to gain a better understanding of their commuting patterns and interest in using a shuttle service.

MAPC and the Town staff developed the questions on where residents commute to work, what mode they use (drive alone, take transit, etc.), whether they might use a shuttle, and where a shuttle should operate and stop. MAPC developed the survey via Survey123 on ArcGIS, a web-based surveying suite that allows residents not only to respond to questions but also enter data directly onto an interactive map. MAPC then created a mail insert with the unique web link for the survey, which the Town printed and included in Town's February/ March 2019 property tax bill. The survey was mailed to 5,679 household in the Town. The Town also posted the survey link address on the Town's website. The survey was open online between early March and early May 2019.

MAPC received 270 responses, which represent approximately 4.7 percent of households and 1.7 percent of the Town's population. The gender breakdown of respondents was approximately 59 percent female and 39 percent male. Over 90 percent of the respondents were between the ages of 18 and 64 years old and over 95 percent live in North Reading. The average household size was just over 3.7 persons, with an average of 2.4 vehicles per household.

The following is a summary of the survey responses. Not everyone responded to every question. Moreover, the survey skipped some questions depending on the responses to previous questions.

### **Question 1. Where is your home? (Enter cross streets and zip code only. This survey is anonymous.)**

*270 responses*

Of the 270 responses, 256 respondents entered an address with the Town of North Reading zip code of 01864. Fourteen respondents either did not enter cross streets, or did not enter a zip code.

### **Question 2. If you currently work, where do you work? (Enter cross streets and zip code only. This survey is anonymous.)**

*270 responses*

Ten percent of the survey respondents work in North Reading, and approximately 23 percent work in Boston. Four percent indicated they were retired or do not work. The remaining 63 percent indicated they work in locations other than Boston and North Reading.

### **Question 3. If you currently work, how do you get to work most often?**

*250 responses*

<b>Mode of Travel to Work</b>	<b>Number of Responses</b>
Bus	3
Train	48
Carpool/Vanpool	7
Drive Alone	171
Work from home	4
Other	17

"Other" includes responses such as retired, don't work, and more than one travel mode to work

**Question 4. If you currently work outside the home, what is the average time of your commute?**

253 responses

Respondents were requested to enter a specific number of minutes for their commute. The table below categorizes the responses.

Commute Travel Time	Number of Responses
1 to 15 minutes	43
16 to 30 minutes	34
31 to 60 minutes	84
61 to 90 minutes	75
over 90 minutes	17

**Question 5. Do you use public transit to get to work?**

270 responses

70 responded “yes”, and 200 responded “no”.

The 70 who responded yes to this question were asked the following additional follow-up questions.

**Question 5a. Is a car available for your trip to work?**

70 responses

Response	Number of Responses
Yes	59
No	3
Sometimes	8

**Question 5b. How do you most often get to your public transit stop or station?**

70 responses

Response	Number of Responses
Drive	60
Get dropped off	10

**Question 5c. How would you get to work if there were no public transit?**

70 responses

Response	Number of Responses
Carpool/Vanpool	2
Drive	54
Taxi, Uber, Lyft	4
Would not make the trip	9
Other	1

The “other” response noted that the person would not be able to make the trip due to parking costs and long travel time

**Question 6. If you do not use public transit, why not?***Between 171 and 188 responses*

The survey asked respondents to select how much they agree or disagree to a series of statements on why they do not use transit. Not all respondents to this questions indicated their preference to each statement.

	I cannot get to transit	Transit is not available when I want to travel	I need to access to a vehicle during the day	Transit takes too long	No parking at bus/train station	Transit does not go to my destination	Transit is too confusing	Cost of transit fare is too high	I have a disability that makes transit difficult
Strongly Agree	72	76	41	52	60	85	9	19	6
Agree	23	31	25	40	47	32	7	43	1
Neutral	33	38	29	49	51	24	41	52	27
Disagree	29	19	37	22	12	21	49	29	19
Strongly Disagree	25	18	44	18	17	26	66	31	118
Total Responses	182	182	176	181	187	188	172	174	171

**Question 7. How much would the following changes make you want to use transit more often?***Between 249 and 261 responses*

The survey asked respondents to select how much they agree or disagree to a series of statements on what might make them want to use transit more often. Not all respondents to this questions indicated their preference to each statement.

	A new shuttle connecting to commuter rail	More parking at commuter rail stations	Lower transit fares	New park and ride locations with a shuttle to a rail station
Strongly Agree	147	128	111	137
Agree	66	63	70	60
Neutral	22	34	49	29
Disagree	10	12	7	17
Strongly Disagree	16	12	12	14
Total Responses	261	249	249	257

**Question 8. If there were a shuttle connecting you to a commuter rail station in Wilmington, Reading or Woburn, would you use it?**

270 responses

Response	Number of Responses
Definitely would use it regularly	94
Might use it regularly	98
Would not use regularly	41
Definitely would not use at all	18
Don't know	19

**Question 9. If there were a shuttle to commuter rail stations, where would you like the pickup points to be along the route to the train station? Please use the maps below to indicate your first, second, and third choices. (Public stops, not private homes.)**

The responses to this question are shown in the map following Question 13d.

**Question 10. If there were a shuttle connecting from North Reading to a transit station, which station would you most want to connect to?**

270 responses

Response	Number of Responses
Reading (commuter rail)	111
Wilmington (commuter rail)	14
N. Wilmington (commuter rail)	6
Woburn (commuter rail)	47
Oak Grove (Orange Line)	75
Other	7
None	10

Other responses included Ballardvale, Alewife, Andover, Wakefield

**Question 11. How long of a shuttle ride connecting North Reading to a transit station would you be willing to take, in order to take advantage of a shuttle?**

270 responses

Response	Number of Responses
15 minutes or less	83
Between 15 to 20 minutes	91
Between 20 and 25 minutes	42
Between 25 and 30 minutes	33
More than 30 minutes	9
Would not use shuttle	12

**Question 12. What would be the best time for a shuttle to public transit to be available?**

270 responses

Respondents were permitted to select multiple responses.

Response	Number of Responses
Before 6 AM	57
Between 6 AM and 8 AM	207
Between 8 AM and 10 AM	90
Between 10 AM and Noon	37
Between Noon and 3 PM	35
Between 3 PM and 7 PM	150
After 7 PM	65
Weekends	86

**Question 13a. What is your gender?**

210 responses

Response	Number of Responses
Female	124
Male	82
Other	4

**Question 13b. What is your age?**

245 responses

Response	Number of Responses
Under 18	None
18-64	221
Over 65	24

**Question 13c. How many people are in your household (including yourself)?**

244 responses

Response	Number of Responses
One	13
Two	63
Three	48
Four	71
Five	35
Six	8
Seven	3
Eight or more	3

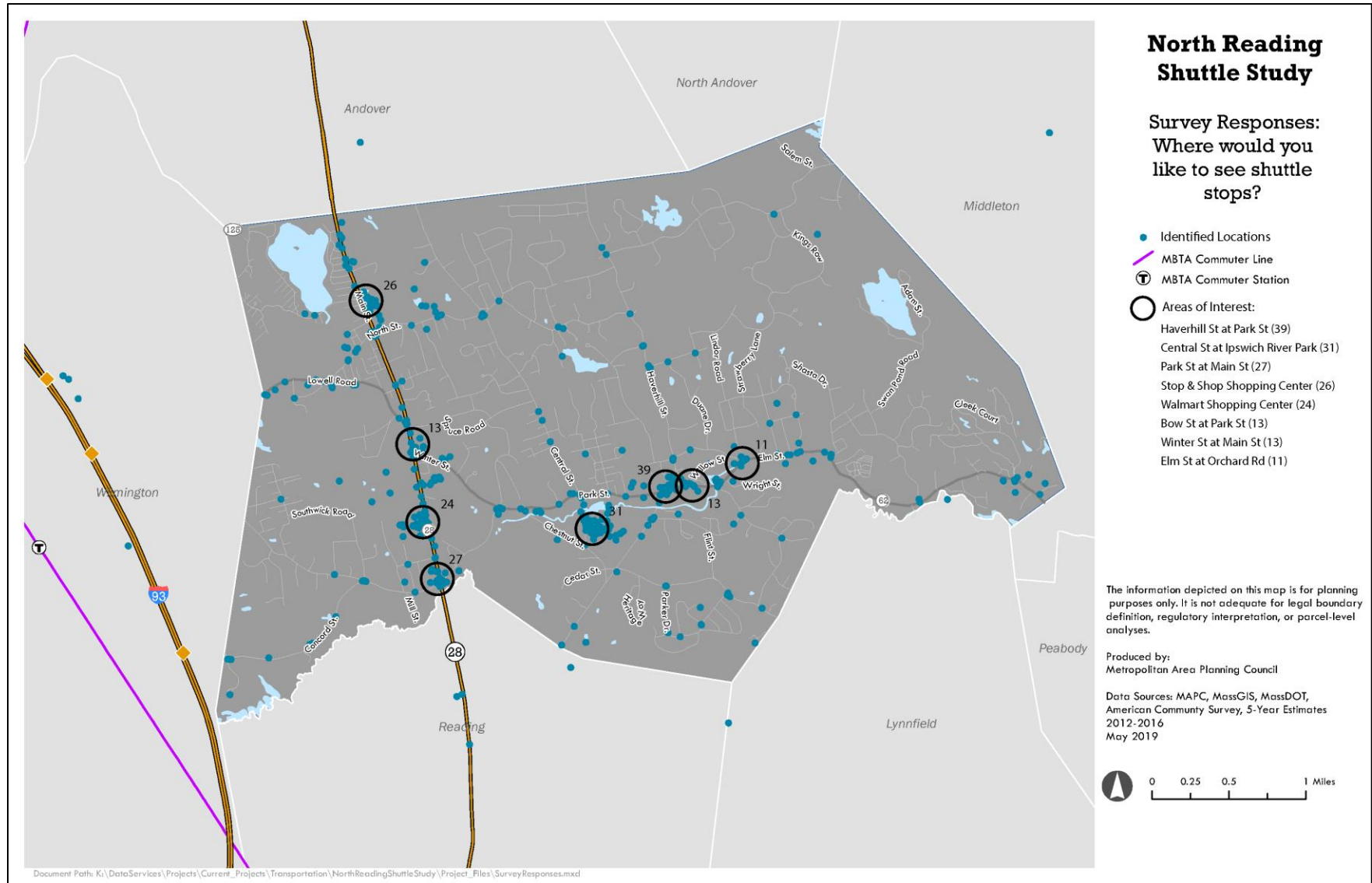
**Question 13d. How many vehicles are in your household?**

244 responses

Response	Number of Responses
One	25
Two	138
Three	47
Four	27
Five	7



Map of responses to Question 10



## **Appendix C: Transit Use and Costs of Similar Systems**

### **Estimating Transit Need and Demand**

To estimate the potential ridership of a shuttle system, MAPC used the *Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation* workbook, published in 2013 by the Transportation Research Board. The workbook is useful for estimating the annual demand and ridership for both rural and small urban transit services. The workbook includes an Excel spreadsheet where users can enter Census and other data to estimate transit demand. A copy of the workbook and the accompanying Excel file can be downloaded at <https://www.nap.edu/catalog/22618/methods-for-forecasting-demand-and-quantifying-need-for-rural-passenger-transportation>.

The workbook and the Excel file was used by MAPC to estimate overall transit need for North Reading as well as transit demand. To calculate the transit needs and possible transit ridership, the user inputs Census data of the municipality, and the workbook includes macros and formulas to develop estimates. The workbook contains detailed descriptions of the formulas used, including data sources.

MAPC used the workbook to estimate the overall transit need in North Reading. This overall transit need is helpful if the Town decided to offer an in-town microtransit service, and/or a shuttle that connected to a commuter rail station in an adjacent municipality.

To estimate transit need for North Reading, the workbook uses as inputs the number of persons in households in the Town with income below the poverty level, plus the number of households without access to a vehicle. The workbook also includes a “mobility gap” factor for each state, computed by determining the difference in the average number of trips per household between a household with one vehicle versus zero vehicles available. That formula uses data for Massachusetts from the 2009 National Household Travel Survey.

The workbook estimated that North Reading has approximately 600 persons who need some sort of public transportation service. For those 600 persons, the mobility gap for North Reading is estimated at approximately 80 daily one-way passenger trips.

The workbook notes that, “the estimates of need made using the mobility gap method are typically far greater than the number of trips actually observed on rural passenger transportation systems and are likely greater than the demand that would be generated for any practical level of service. Much of the remaining trip-based mobility gap is likely filled by friends and relatives driving residents of non-car-owning households. Therefore, agencies choosing to use the mobility gap may wish to establish a target or goal for the proportion of the gap to be satisfied by publicly provided services. In the testing of these suggested methodologies with a number of rural transit agencies, it was found that, at best, only about 20% of the mobility gap trip-based need was met.” (p. 17).

If we apply the 20 percent figure described in the workbook to the 80 daily one-way passenger transit trips, a local transit system in North Reading could meet approximately 16 daily one-way transit trips.

MAPC also used the workbook to estimate transit demand in North Reading. The workbook includes two methods: a “general public” method using Census data, and a “peer” method using data from municipal transit systems in the state. The workbook notes that the peer system is usually a more accurate predictor. MAPC completed both methods for this study since data were available for both methods.

The general public rural non-program<sup>11</sup> method uses as inputs from Town Census data including the number of persons 60 years and older, those age 18 to 64 with a mobility limitation, and those living in households with no vehicle available. Using this method, the workbook estimated the transit demand for the Town at 10,400 annual one-way passenger trips. Assuming a transit system operating 250 days a year, this equals to around 42 one-way transit trips per weekday.

For the peer transit system method of estimating transit demand, MAPC used data from four municipal transit systems in the greater Boston area: Bedford, Burlington, Lexington, and Beverly. MAPC obtained the peer transit system data for these municipalities from their 2017 agency profiles listed in the National Transit Database.

The peer transit system method also requires assumptions on the annual vehicle miles and annual vehicle hours for a new transit service in North Reading. MAPC assumed that a the service would be a single vehicle operate weekdays, or 250 days per year, for eight hours per day, traveling 50 miles per day. Under these assumptions, the North Reading transit service would have 12,500 annual vehicle miles, with 2,000 annual vehicle hours.

Based upon these inputs, the workbook estimated that a single vehicle transit service operating weekdays in North Reading would have between 5,000 and 9,441 annual one-way transit trips. Assuming a transit system operating 250 days a year, this equals to between 20 38 one-way transit trips per weekday.

Copies of the workbook inputs and outputs for the transit need, general public rural non-program demand, and peer transit data are shown the following pages. The Town could use these data as well as updated Census data and updated peer transit system data to evaluate other transit service options.

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<sup>11</sup> The workbook defines non-program as general public transportation not related to a social service such as Council on Aging.

### Service Area Characteristics Input Table

SERVICE AREA CHARACTERISTICS INPUT TABLE -- Fill In All Unshaded Boxes									
Service Area:	North Reading								
Analysis Description:	For Satellite Shuttle Study								
Additional Description:									

Transit Need Inputs		
Number of persons residing in households with income below the poverty level:		526
Number of households residing in households owning no vehicles:	Households	Persons
1-Person households:	33	33
2-Person households:	0	0
3-Person households:	0	0
4-or-more-Person households:	13	52
Mobility Gap:		
Enter State (from drop-down list):	MA	
General Public Rural Non-Program		
Population Age 60+	3,469	B01001
Population Age 18 - 64 with a Mobility Limitation	512	S1810
Persons Living in Households with No Vehicle Available	85	B08201
General Public Rural Passenger Transportation		
Need:	153,360	
Annual Vehicle-miles of Service:	Annual Revenue-Miles	
Small City Fixed Route Inputs		
Population of City:	1,000	
College and University Enrollment (Total):	Students	
Annual Revenue-Hours of Service:	Annual Revenue-Hours	
Demand - Commuter by Transit to an Urban Center		
Workers Commuting from Rural County to Urban Center	Miles	
Distance from Rural County to Urban Center	Check Box for Yes	
Is the Urban Center a State Capital?	<input checked="" type="checkbox"/>	

Program Demand Inputs						
Program Name	Program Type	Number of Program Participants:	Number of Events per Week:	Percentage of Participants who attend on an AVERAGE day:	Percentage of Participants who are Transit Dependent or Likely to Use Transit:	Number of Weeks Program is Offered (Annually):

The preferred source of demographic data is the American Community Survey, available at:  
<http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>  
 At that website enter the referenced **Table Number** in the appropriate box. Some table numbers may not be available for communities under



### Rural Transit Need/Demand Estimation Output Table

[illegible]

Peer Data Worksheet

Peer Data Worksheet										
Input Data from Peer Transit Systems or Existing Transit Service										
Name of Peer System	Bedford	Burlington	Lexington	Beverly						
Population of Area	14,329	27,000	51,875	39,502						
Size of Area Served (Square Miles)	14	25	25	25						
Annual Vehicle-Miles of Service Provided	12,581	71,250	139,719	39,777						
Annual Vehicle-Hours of Service Provided	2,000	4,750	8,765	3,111						
Service Type (Fixed Route, Route-Deviation, Demand-Response)	Route-Deviation	Fixed Route	Fixed Route	Fixed Route						
Number of One-Way Trips Served per Year	5,200	15,862	63,169	13,914						
Degree of Coordination with Other Carriers (Low, Medium, High)	Low	Low	Medium	Low						

Results of Peer Data Comparison		Annual Vehicle-miles		Annual vehicles-hours
Input Data for My System:		Population	15,735	12,500
Observed Trip Rates		Demand Estimate Based On:		
Peer Values		Population	Annual Vehicle-miles	Annual vehicles-hours
Trips per Capita				
Maximum	1.2	18,882		
Average	0.6	9,441		
Median	0.5	7,868		
Minimum	0.4	6,294		
Trips per Vehicle-Mile				
Maximum	0.5		6,250	
Average	0.4		5,000	
Median	0.4		5,000	
Minimum	0.2		2,500	
Trips per Vehicle-Hour				
Maximum	7.2			14,400
Average	4.4			8,800
Median	3.9			7,800
Minimum	2.6			5,200
Values expected for my system				
Maximum		18,882	6,250	14,400.0
Average		9,441	5,000	8,800.0
Median		7,868	5,000	7,800.0
Minimum		6,294	2,500	5,200.0



### Estimating Transit Operating Costs

A shuttle that operates to a commuter rail station would operate two split shifts for a total of eight to nine hours of daily operation. An example operating plan would be 4.75 hours in the morning (5:00 AM to 9:45 AM) and four hours in the afternoon/evening (3:40 PM to 7:40 PM). This schedule includes the travel time for the operator to drive between North Reading and the shuttle storage site outside of North Reading. Similar privately contracted shuttles have cost around \$166,400 annually, assuming eight hours per weekday, five days per week, 52 weeks a year, at \$80 per hour. MVRTA estimated the shuttle annual operating cost at \$177,450. That cost is based upon 8.75 hours per day, at \$78 per hour, equaling \$682.50 per day or \$3,412.50 per week.

MAPC also reviewed the operating costs of municipally operated transit services in greater Boston listed in the National Transit Database<sup>12</sup> reports for Bedford, Beverly, Burlington, and Lexington, as well as data from a recent regional transit study for Bedford, Burlington, and Lexington. These systems report bus operating costs of around \$50 to \$70 per revenue hour. Assuming an average rate of \$60 per revenue hour, the annual operating cost for a shuttle operating weekdays for 8.75 hours per day would be \$136,500. The lower costs are typically because the municipalities hire their own drivers, and garage and maintain their own vehicles, thereby sharing some costs with other municipal departments.

### Estimating Park and Ride Lot Costs

For the park and ride lot, the Town could either construct a dedicated parking area on Town-owned land or could lease spaces from a private entity such as a hotel, church, or shopping center.

The following construction, operating and maintenance costs are derived from *Transportation Cost and Benefit Analysis Techniques, Estimates and Implications, Second Edition* October 2016, published by

the Victoria Transportation Institute. The report can be accessed at <http://www.vtpi.org/tca/>

Surface parking construction costs are on average \$20,000 per space, with annual operating and maintenance costs at \$500 to \$800 per space. Assuming the need for around 20 parking spaces, constructing a new lot would cost the Town \$400,000 plus design fees. These construction estimates do not include land acquisition costs. Annual operating and maintenance costs would be \$10,000 to \$16,000.

Leasing spaces at a shopping center or other establishment typically cost \$50 per space per month; assuming leasing 20 spaces, the annual leasing costs would be \$12,000.

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<sup>12</sup> <https://www.transit.dot.gov/ntd/transit-agency-profiles>





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