

North Suburban Transit Opportunities Study



A report produced by the
Central Transportation Planning Staff
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North Suburban Transit Opportunities Study

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1. EXISTING CONDITIONS

Review of Existing Transit Routes

Existing transit service to the North Suburban subregion is primarily designed for traditional commuter trips to downtown Boston. MBTA Commuter Rail service provides daily service, approximately every half hour during weekday peak periods and less frequently at other times and on weekends. Express bus service operates on weekdays only via Interstate 93 from Burlington and Woburn, and other local bus services feed into MBTA subway lines.

There are, however, a number of other transit routes designed to provide circulator service within the North Suburban subregion. Aside from local service on regular MBTA bus routes, the Towns of Burlington and Lexington operate municipal bus services with assistance from the MBTA. These routes focus mainly on their respective town centers and the Burlington Mall. The Lowell Regional Transit Authority and the Massachusetts Port Authority (Massport) also operate regular transit service that enters the study area, which is defined as Wakefield, Stoneham, Reading, Woburn, Wilmington, Burlington, and a portion of Bedford.

Special reverse commuter-oriented services have also begun operating in the area over the past five years. In particular, the MBTA provides service to Woburn, Burlington, and Bedford employment areas from Downtown Boston and from Alewife Station on the Red Line. The Lowell Regional Transit Authority operates service from Lowell to the same employment areas in Burlington and Bedford. Private shuttles are also operated by area employers to provide connections from the Anderson Regional Transportation Center (RTC) in Woburn.

Additional details on these existing transit services are provided below.

Commuter Rail

The MBTA's Lowell and Haverhill commuter rail lines both operate through the study area. The Lowell line stops at Wilmington, Anderson RTC in Woburn, and also provides limited service to Mishawum station. The Haverhill line stops at North Wilmington, Reading, Wakefield, and Greenwood (which is also in Wakefield).

Estimated round trip weekday ridership at these stations in June 2002 was as follows:

TABLE 1
Weekday Commuter Rail Ridership

Station	Weekday Ridership
Wilmington	416
Anderson RTC	937
Mishawum	81
North Wilmington	220
Reading	663
Wakefield	649
Greenwood	208

MBTA Buses

MBTA bus routes operating in the study area are as follows:

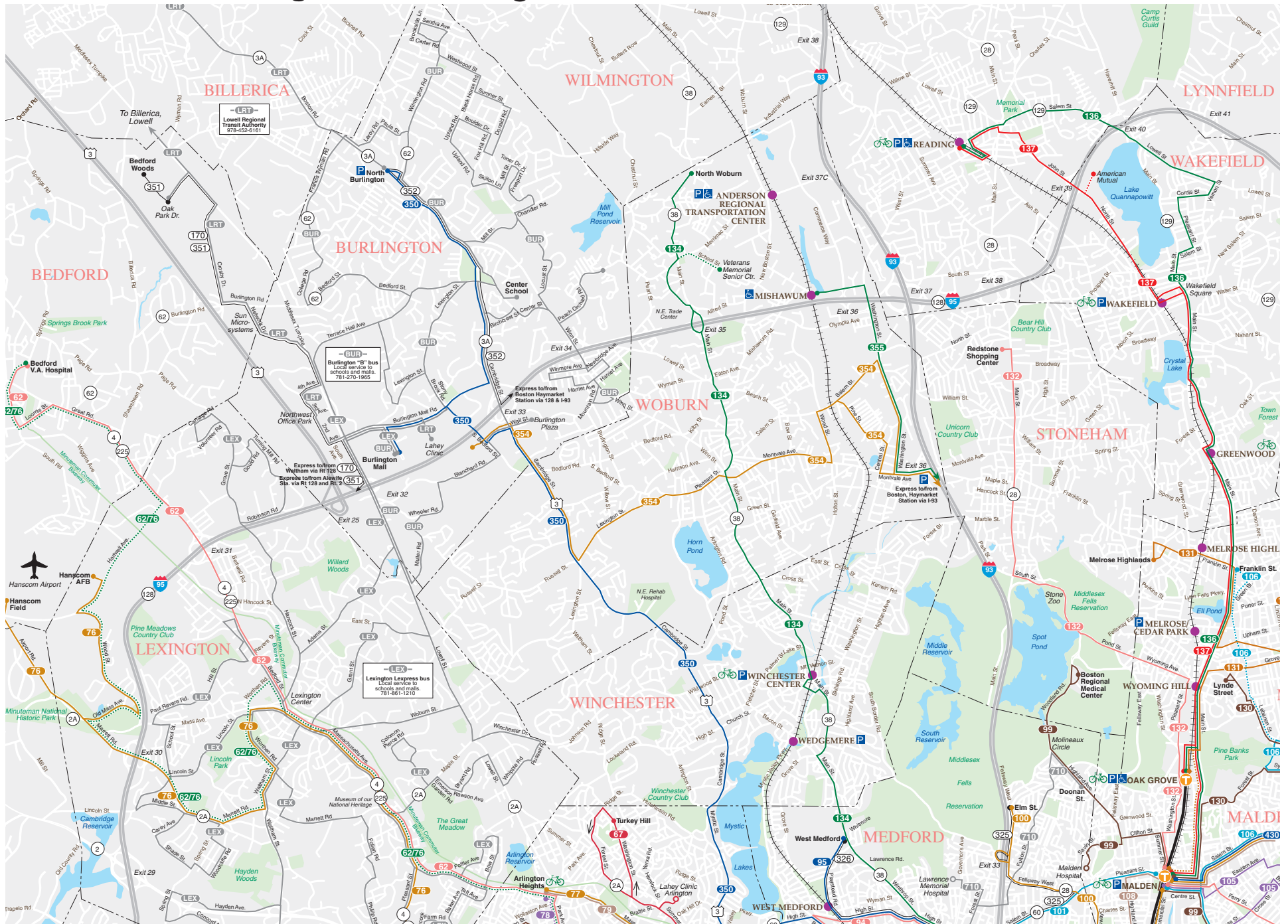
- 132 (Redstone Plaza, Stoneham – Malden)
- 134 (North Woburn – Wellington)
- 136 (Reading – Malden)
- 137 (Reading – Malden)
- 170 (Oak Park Drive – Dudley)
- 350 (North Burlington – Alewife)
- 351 (Bedford Woods – Alewife)
- 352 (Burlington – Boston)
- 354 (Woburn – Boston)
- 355 (Mishawum – Boston)

These routes are shown on the North Suburban section of the MBTA System Map, printed on the following page as Figure 1.

Route 132 operates 16 trips to Malden and 14 trips from Malden on weekdays, and 10 trips to Malden and 8 trips from Malden on Saturday. The route begins at Redstone Shopping Center and operates via Main Street and South Street in Stoneham. The route continues through Melrose to Malden station on the Orange Line. Total weekday ridership is 482 and Saturday ridership is 116.

Route 134 operates 15 round trips on weekdays and 13.5 round trips on Saturday. The route begins at the Wilmington/Woburn town line and proceeds via Main Street, Elm Street, and Main Street into Winchester. The route continues via Winchester and Medford to Wellington Station on the Orange Line. Four trips on weekdays make a diversion via School Street in Woburn to serve the Veteran's Memorial Senior Center. At Winchester Center, the route makes connections with the Lowell commuter rail line. Total weekday ridership is 1605 and Saturday ridership is 1044.

Figure 1: Existing North Suburban Transit Services



Together, Routes 136 and 137 operate 32 round-trips weekdays and 25 round trips Saturday between Reading Depot and Malden station. Both routes travel between Reading Depot and Reading Square via Woburn Street. Route 136 continues to Wakefield Square by operating via Salem Street, Lowell Street, Vernon Street, Cordis Street, Pleasant Street, Salem Street, and Main Street. Route 137 travels between Reading and Wakefield via John Street and North Avenue. Three trips also operate via Quannapowitt Parkway to serve Wakefield Medical. Both routes travel between Wakefield Square and Malden via Main Street in Wakefield and Melrose, and a stop is made at Oak Grove station on the Orange Line. Weekday ridership on Route 136 is 949 and Saturday ridership is 420. Weekday ridership on Route 137 is 966 and Saturday ridership is 379.

Route 170 provides limited express bus service from Dudley station in Roxbury, Back Bay Station in Boston, and Central Square Waltham to Oak Park Drive in Bedford. Two trips operate to Bedford in the weekday AM and one trip returns in the PM. Stops are made along Crosby Drive, at Sun Microsystems, and along Middlesex Turnpike, Fourth Avenue, Third Avenue, and Second Avenue. Total ridership on the route is 58.

Route 350 operates between Burlington (near the Billerica line) and Alewife station in Cambridge, primarily via Cambridge Street (Route 3A). The route includes a major diversion from Cambridge Street to serve Burlington Mall and Burlington Mall Road. There are 30 trips per weekday to Alewife and 28 trips from Alewife, 17 trips on Saturday to Alewife and 19 returning, and 13 trips on Sunday to Alewife with 14 returning. Most trips serve Mall Road except weekday trips operating toward Alewife between 6:36 AM and 8:26 AM and outbound trips departing Alewife between 4:40 PM and 6:20 PM. Weekday ridership on the route is 1537, Saturday ridership is 697, and Sunday ridership is 421.

Route 351 operates between the Bedford Woods development in Bedford and Alewife station on the Red Line. The route serves Oak Park Drive, Middlesex Turnpike, Crosby Drive, Sun Microsystems, Fourth Avenue, Third Avenue, and Second Avenue. The route then operates express via Route 128 and Route 2. There are 6 trips in the AM from Alewife to Bedford Woods and 7 return trips in the afternoon. Ridership is 238 per day.

Route 351 began operation in September 1998. It replaced MBTA Route 353 (Burlington Industrial Area – Boston). Route 353 had operated from Boston via Interstate 93 and local streets in Woburn. With this change in service, former patrons of Route 353 from Boston could continue to access locations formerly served by Route 353 in Burlington by transferring from the Red Line to Route 351. Passengers traveling between local stops in Woburn to locations north of Burlington Mall, however, did not have alternatives to replace Route 353. Ridership data at the time indicated only a small number of passengers were making local trips between locations in Woburn and Burlington.

Route 352 is an express bus operating between Burlington and Downtown Boston. Local stops are made in Burlington along Cambridge Street from

Chestnut Avenue to the entrance to Route 128. Buses operate express via Route 128 and Interstate 93 to Boston. There are 11 trips in the morning to Boston and 10 trips returning in the afternoon. There are 5 additional trips in the early evening which return to Burlington as an extension of Route 354. Ridership is 484 per day.

Route 354 operates between Woburn and Boston. The route begins at Van DeGraff Drive in Burlington and operates via Cambridge Street to Lexington Street and Woburn Square. The route then follows two alternative paths to Interstate 93. One variation operates principally via residential areas along Salem and Pine Streets. Another operates via Salem Street and Washington Street past West Cummings Park. There are 23 weekday round-trips between Woburn and Boston.

While the heaviest concentration of service on Route 354 is in the peak periods towards Boston in the morning and returning to Woburn in the evening, service is provided in both directions throughout the daytime hours. Reverse commute buses leaving Boston from 6:35 AM to 2:45 PM and leaving Woburn between 9:30 AM and 6:00 PM operate directly via Cummings Park. Passengers may also travel locally in Woburn and only need to pay the MBTA's local bus fare if they are not traveling to or from Boston. Ridership is 819 per day.

Route 355 operates between Downtown Boston and Mishawum station. There are two trips in the morning from Boston to Mishawum and 2 return trips in the afternoon. Ridership is 13 per day.

Other Public Bus Services

The Town of Burlington, in cooperation with the MBTA, contracts with a private bus company to operate the "B-Line" network, which consists of 6 bus routes operating within the town. Service is provided between 9:00 AM and 5:00 PM or 5:30 PM (depending on individual route). In September 2002, the span of service was expanded to include new trips operating in the morning between 6:30 AM and 9:30 AM. The network within Burlington focuses on the Center School, Lahey Clinic, and the Burlington Mall. Most residential areas within Burlington are situated within 1/2 mile of a B-Line Route.

The Town of Lexington's bus system (Lexpress) includes one route (Route 5), that serves the study area. This route provides service from Lexington to the Burlington Mall.

The Lowell Regional Transit Authority (LRTA) operates two routes that reach the Town of Burlington. Route 19 provides service from Lowell and Burlington to the Middlesex Turnpike area, Burlington Mall, and Lahey Clinic. The route operates every 60 minutes. LRTA reports that 207 passengers a day ride this route. Route BI also provides service via Billerica from Lowell to Chestnut Street in Burlington.

Massport provides Logan Express bus service from Anderson RTC to Logan Airport. Service operates throughout the day, 7 days a week, with no stops between Woburn and the airport.

Overview of Travel Patterns by Municipality

In this section, existing travel patterns will be described for each of the municipalities in the study area. In particular, the number of residents making traditional commutes into Boston and Cambridge are identified, along with the number of Boston residents who work in these communities. Some information from the 1990 Census is used in these descriptions since journey-to-work data is not yet available from the 2000 Census. This information is supplemented by information about the growth in population and employment over the intervening ten year period. As 2000 journey-to-work data becomes available, these figures should be revisited to determine whether any major shifts in origin-destination pairs have occurred.

Reading

In 2000, Reading had a population of 23,708. This was an increase of 5% from 1990. The 1990 Census found that 9.86% of the town population worked in Boston or Cambridge then.

Reading Depot is slightly south of the geographic center of town. The 1993 commuter rail survey found that Reading Depot was the most common boarding point for commuter rail trips originating in Reading with 601 boardings. The remaining boardings of Reading residents at other stations was quite small in comparison, with 17 boarding in Wakefield, 5 boarding at Mishawum, and 1 in Winchester.

Reading is also served by MBTA bus Routes 136 and 137. 102 passengers boarded these routes in Reading on a typical weekday in Spring 1999.

The 1990 Census found 271 Boston residents employed in Reading. The commuter rail survey found only three reverse-commuting trips from Boston to Reading via commuter rail. Total employment in Reading grew by 23% (1395 jobs) between 1990 and 2000.

Wakefield

In 2000, Wakefield had a population of 24, 804. This was a decrease of 0.1% from 1990. The 1990 Census found that 9.67% of the population of Wakefield worked in Boston or Cambridge then.

Wakefield station is located close to the geographic center of town. Greenwood station is located in the southern part of the community, close to Melrose. The 1993 commuter rail survey found 496 Wakefield residents boarding commuter rail at Wakefield station, 69 boarding at Greenwood, 29 at Melrose Highlands, 5 at Melrose Cedar Park, and 2 at Reading Depot.

Wakefield is also served by MBTA bus Routes 136 and 137. 550 passengers boarded these routes in Wakefield on a typical weekday in Spring 1999.

The 1990 census found 317 Boston residents employed in Wakefield in 1990. The 1993 commuter rail survey found only seven reverse-commuting trips from Boston to Wakefield via commuter rail. Total employment in Wakefield grew by 38% (4174 jobs) between 1990 and 2000.

Wilmington

In 2000, Wilmington had a population of 21,363. This was an increase of 21% from 1990. In percentage and absolute terms, this growth was much greater than the surrounding towns of Tewksbury and Billerica. The 1990 Census found that 1,548 residents of Wilmington (8.8% of the town population) worked in Boston or Cambridge then. This was slightly below average among towns with rail service at similar distances from Boston.

Wilmington Station is south of the geographic center of the town, but some residents would have to travel in the opposite direction from Boston to access it. The 1993 commuter rail passenger survey found that Wilmington Station was the most common boarding point for commuter rail trips originating in Wilmington, with 65%, (190 of 292) followed by North Wilmington (23%), Mishawum (8%) and Reading (4%).

The 1990 Census found 442 Boston residents employed in Wilmington in 1990. The survey found only three reverse-commuting trips from Boston to Wilmington via commuter rail. Total employment in Wilmington grew by 10% (1,965 jobs) between 1990 and 2000.

North Reading

In 2000, North Reading had a population of 13,837. This was an increase of 15.3% from 1990. The 1990 Census found that 957 North Reading residents (8.0% of the town population) were employed in Boston or Cambridge then. This was somewhat below average among towns at a similar distance from Boston, with or without rail service.

The 1993 commuter rail passenger survey found a total of 155 trips originating in North Reading. The station used most often for North Reading trips was Reading, with 102 (66%) followed by Mishawum with 22 (14%) and Wakefield with 21 (14%). Limited parking capacity at Wilmington was probably part of the reason for low use of that station for home-based North Reading trips.

The 1990 Census showed a total of 51 Boston residents employed in North Reading. Total employment in North Reading increased by 83% (2,872 jobs) between 1990 and 2000. The 1993 survey found an unusually large number of reverse-commuting trips from work locations in North Reading, with 27, including 12 going to homes in Boston. Most of the reverse-commuters used

employer-sponsored shuttle vans to Mishawum Station from an office and industrial park along Concord Street east of Interstate 93. This area is slightly closer to Wilmington Station than to Mishawum, but use of Interstate 93 and the shorter rail distance to Boston gave Mishawum a travel time advantage. Time via Anderson RTC would be even faster.

Woburn

In 2000, Woburn had a total population of 37,258. This was an increase of 3.7% from 1990. Woburn had slightly fewer residents than Billerica (38,981), but many more than Wilmington (21,363) or Winchester (20,810). The 1990 Census found that 3,227 residents of Woburn (9.0% of the town population) worked in Boston or Cambridge then. This was below average for cities and towns at similar distances from Boston with or without rail service. The low rate was partly a result of the large number of employment opportunities within Woburn itself and in other communities along Route 128 and Interstate 93.

Mishawum Station is north of the geographic center of Woburn, and Anderson RTC is even further north. The majority of trips from Woburn to Boston would have to include access trips in the opposite direction if made via either of those stations. Nevertheless, the survey found that of 354 commuter rail trips originating in Woburn, 281 (79%) were made via Mishawum. Winchester and Wedgemere together accounted for another 18%, with the remainder scattered. The total from Woburn included only 179 trips from home to work locations in Boston or Cambridge, equivalent to a 5.5% share of the 1990 work trips to those cities from Woburn. Of these, 121 were made via Mishawum.

Woburn is also served by express bus service on MBTA Route 354 that operates directly into downtown Boston. 431 passengers boarded this route in Woburn on a typical weekday in Spring 1999, and the 1995 bus passenger survey indicated that 81% of the riders were residents of the city.

The 1990 Census showed a total of 1,312 Boston residents employed in Woburn. Total employment in Woburn increased by 16% (5,604 jobs) between 1990 and 2000. Census data from 2000 will be available by Spring 2003 and these figures may be revisited then. The 1993 commuter rail survey found an unusually large number of reverse-commuting trips from work locations in Woburn, with 75, including 50 going to homes in Boston. All but one of the Boston trips were made via Mishawum, and all but four of the latter were walk-ins. A one-day CTPS count in December 2000 found a total of 59 passengers alighting from four outbound AM peak trains at Mishawum and walking out of the station. Their origins, destinations, and trip purposes were not determined. Reverse-commuters who used Mishawum before Anderson RTC opened are still able to do so, or they may choose to alight at the new station.

A March 2002 CTPS count at Anderson RTC found a total of 28 passengers alighting from the four outbound AM peak trains that stopped there. A complete breakdown of egress modes was not obtained, but no more than half walked away.

Burlington

In 2000, Burlington had a population of 22,876. This was a decrease of 1.8% from 1990. The 1990 Census found that 1,846 residents of Burlington (7.9% of the town population) worked in Boston or Cambridge. This was below average for the distance from Boston, but many of the communities with higher rates had direct rail service.

The 1993 commuter rail survey found a total of only 66 trips originating in Burlington for all purposes. The most common boarding location for these was Mishawum, with 49. The remainder were split about evenly between Wilmington, Winchester, and Wedgemere stations.

Burlington is also served by express bus service on MBTA Route 352 that operates directly into downtown Boston. 216 passengers boarded this route in Burlington on a typical weekday in Spring 1999, and the 1995 bus passenger survey indicated that 63% of the riders were residents of the town, and the rest originated in Billerica.

The 1990 Census showed a total of 1,185 Boston residents employed in Burlington in 1990. (This was one of the largest absolute totals among towns without direct rapid transit or commuter rail service.) None of the trips from Burlington in the 1993 commuter rail survey were from work to home, but it should be noted that substantial reverse commuting bus service is available between Burlington and Alewife on the Red Line. Total employment in Burlington grew 19% (6,247 jobs) between 1990 and 2000.

Stoneham

In 2000, Stoneham had a total population of 22,219. This was almost unchanged from 1990. The 1990 Census found that 2,799 residents of Stoneham worked in Boston or Cambridge then. This was 12.6% of the total 1990 population of the town. It was slightly above average for towns at similar distance from Boston, despite the lack of direct rail service. The 1993 survey found a total of 140 commuter rail trips originating in Stoneham. The most common boarding stations for these were Wakefield and Melrose Highlands, with 36% each. Both of these stations are in towns adjoining Stoneham. The other Stoneham trips were scattered among six stations, with 11% going to other stations on the Haverhill/ Reading Line and 16% to stations on the Lowell Line, including Mishawum with 2% (7).

Stoneham is also served by local bus service on MBTA Route 132, which operates directly to the Orange Line at Oak Grove Station. 174 passengers boarded this route in Stoneham on a typical weekday in Spring 2001.

The 1990 Census showed a total of 305 Boston residents employed in Stoneham. Total employment in Stoneham decreased by 1% (75 jobs) between

1990 and 2000. Of the commuter rail trips originating in Stoneham in the 1993 survey, only one went from work to home.

2. NORTH SUBURBAN EMPLOYMENT CHARACTERISTICS

An important component of this study was the location, collection and spatial analysis of information related to the employer sites as well as employee origins for businesses in the study area. Ideally, journey-to-work data from the Year 2000 Census would already be available, obviating the need for additional data collection. However, these data are not expected to be released until later this Fall. Pending their release, alternative procedures were employed to obtain current information on distribution of employers and origins of their employees.

The procedures undertaken to obtain both types of data (distribution of employer locations by business size, and detailed employee origin data [i.e., zip codes or towns of origin] for particular large employers) were as follows:

Employer location data

Data on total town-wide employment is obtained relatively easily from the Massachusetts Department of Employment and Training (DET), but comprehensive and up-to-date site-specific data on individual employers is not available from DET or any other public agency source. Neither do town planners and engineers typically have this kind of information, unless they have been directly involved in negotiations with particular large developers or companies seeking permits. Town assessors' records provide information about lot size and building square footage, which can be used to infer employment capacity for different business types. However, this is only a very approximate source of employment capacity, rather than actual employment. Such estimates typically require a large investment in research time to obtain, since few towns keep their assessors' data in digital formats which can be easily downloaded and given to requesters.

Several alternative sources of site-level employment data, usually compiled by private data development firms, were found to be available. These included the following:

- A. Dun & Bradstreet's published Regional Business Directory for Massachusetts. This set of volumes provides data on companies by town, and zip code within town, giving telephone numbers, address, SIC code, names of chief officers, and annual sales.
 - the volumes are updated every year (currently: Year 2002 edition), but all employers are not revisited every year.
 - because of this, the directory tends to miss new start-ups and recent closures, and to lag on reported employment
 - the directory is not comprehensive—it includes only a subset of businesses for each town. It does usually include the largest companies, and frequently lists multiple addresses for individual companies with multiple sites; and separate corporate identities for divisions or subsidiaries under the same overall corporate name.

--it is most useful as a backup reference because it, alone among sources, clearly attempts to differentiate site employment from total company employment.

- B. InfoData's ReferenceUSA. This source is available on-line by subscription through the Kirstein Business Branch or the Main (Copley Square) Branch of the Boston Public Library. One must visit one of these two Branch libraries to use this reference; however, the terms of the subscription allow limited downloading of employer data. The index is searchable geographically, by employer size category, and by business type. It appears to be the same database used by several internet search engines to locate and provide travel directions to businesses and individuals. This resource, unlike the Dun's resource above, appears to be quite comprehensive and fairly up-to-date, at least with regard to business locations, as of about the last 6-9 months.

There are also several drawbacks associated with the ReferenceUSA data:

First, employer sites are characterized by size category (e.g., '100 to 249 employees') rather than by providing a discrete number of employees per employer. The category definitions are listed below:

10,000+
5,000 – 9,999
1,000 – 4,999
500 – 999
250 – 499
100 – 249
50 – 99
20 – 49
10 – 19
5 – 9
0 – 4

We wished to be able to compare an estimated total employment for each town using these data with the town-wide employment totals provided by DET as a check on reasonableness. Also, the largest employment sites were of the greatest interest from a transportation perspective, and a more precise estimate of employment than was represented by the corresponding broad category was needed at each large site. In order to convert the categories to single-number employment estimates for each employer, an arbitrary single estimate was selected to represent each size class (e.g., "120" for the category "100 to 150"). This estimate was assigned to each employer within a category. For the largest employers (500 and above), an alternate source of employment size was consulted (usually Dun's Directory). This is described more fully below.

The estimates were totaled by town and compared with DET's town-wide employment totals. If the result was significantly different from the DET total, the estimated number for one or more categories would be changed, until the

overall total represented a reasonable approximation of the DET employment total. The totals were not expected to be exact in any case, since DET excludes certain categories of employment from its reporting (i.e., categories not subject to unemployment compensation laws¹)

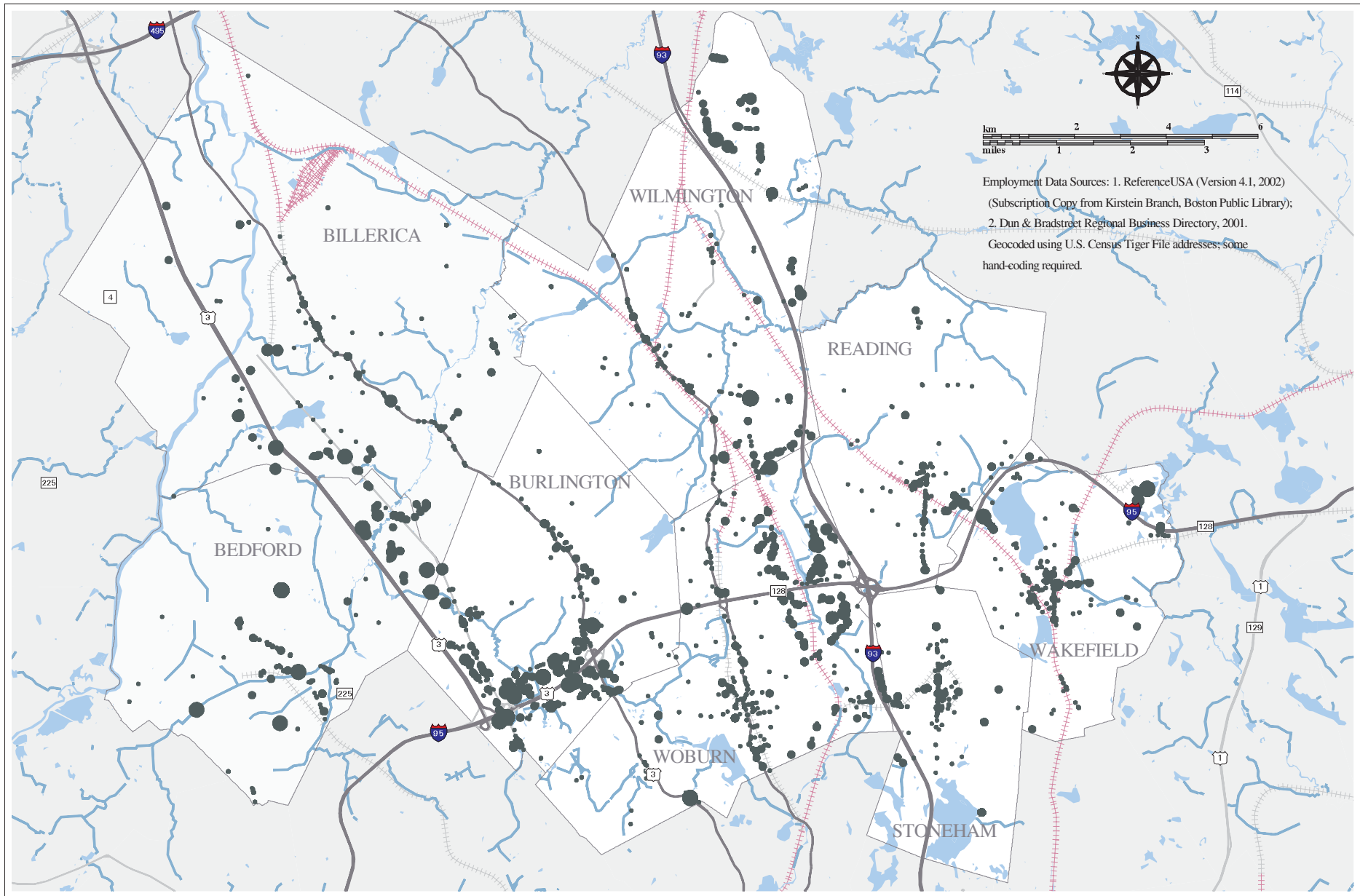
Secondly, it was clear for some of the largest companies that the size category given in ReferenceUSA must refer to more than one actual work site and not just the primary address listed. The largest companies are the ones more likely to have multiple work locations, and are also the sites of most interest in terms of ride-sharing or paratransit. To adjust for this, alternate estimates were sought for all employment sites listed in the upper size categories (i.e., “500 to 1000” or more) in Dun’s Directory. These were usually available, and were substituted for the ReferenceUSA estimates, before comparing the resulting totals to the DET town wide totals. Efforts were also made to contact particularly problematic companies, known to have multiple locations, by telephone. These yielded little useful information, because large companies were found to be reluctant to disclose these kinds of data to individuals making such “cold calls.”

After these adjustments were made, the resulting databases for each town were mapped using GIS-based address-matching techniques. Success rates for initial matching runs were on the order of 50-70 percent; the resulting “reject” files were modified to correct address errors or inconsistencies and rematched, usually resulting in the addition of another 8-12 percent. The “reject” files from the second matching attempts were then hand-matched based on Internet address searches and limited field checking.

Finally, estimated employment totals were aggregated by street address (e.g., “55 Middlesex Turnpike”). This was done so that total employment could be plotted by address or building, not just by individual company. The result was a set of maps representing the distribution of total employment across each town; the mapping by address allowed areas where multiple small companies are gathered together under one roof to stand out from areas characterized by a wider scattering of smaller firms. The individual town maps were distributed to town representatives at a meeting of the North Suburban Planning Council in May 2002. Subsequently, feedback was received from the Burlington Town Planner, allowing some employer estimates within that town to be modified or updated.

Figure 2 shows all the employment data for the individual towns aggregated into a single illustration and simplified to be readable in report format. Even at report scale, it is clear that the largest single area of employment concentration in the area is the Burlington Mall/New England Executive Park/Lahey Clinic area in Burlington. A second area of high employment, although less concentrated, is

¹ E.g., agricultural workers, domestic workers, the self-employed, some state and local employees and railroad employees covered by alternative unemployment rules, and some categories of non-profit employees. Even with these exclusions, the Bureau of Labor Statistics estimates that about 97.5 percent of employees on non-farm payrolls are covered in their tabulations.



CTPS

- More than 1000 employees
- 500-1000 employees
- 100-500 employees
- 10-100 employees

Figure 2
Study Area Towns: Buildings/Addresses
with Highest Employment

the Mishawum area of Woburn, particularly the Commerce Way businesses north of Mishawum Road and the Cummings Park area south of I-95. Beyond these areas, employment throughout the North Suburban area appears to consist of the following types of concentrations:

- small buildings of one or more small companies located adjacent to each other along arterial roadways (as Route 28 in Stoneham and Reading, and Route 38 in Woburn and Wilmington),
- small-site concentrations of local businesses typical of town centers (as in Wakefield and Stoneham)
- locations with one or several large to mid-size employment addresses which are relatively isolated (as in the VA Hospital in Bedford, Edgewater Place/Edgewater Drive in Reading, or Ballardvale Avenue in North Wilmington).

These data were used to calculate employment densities for the North Suburban area towns, at the level of 1990 Census block groups. The results are shown on Figure 3, both as density shadings and as the estimated total number of employees per area. Note that water bodies, conservation land, and similar uses were not extracted from the town areas before calculating densities; if this additional step were taken and land areas were limited to developed areas, densities would increase for some areas.

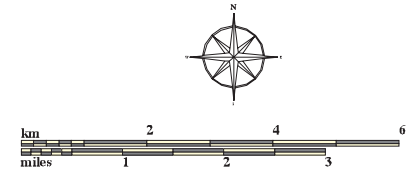
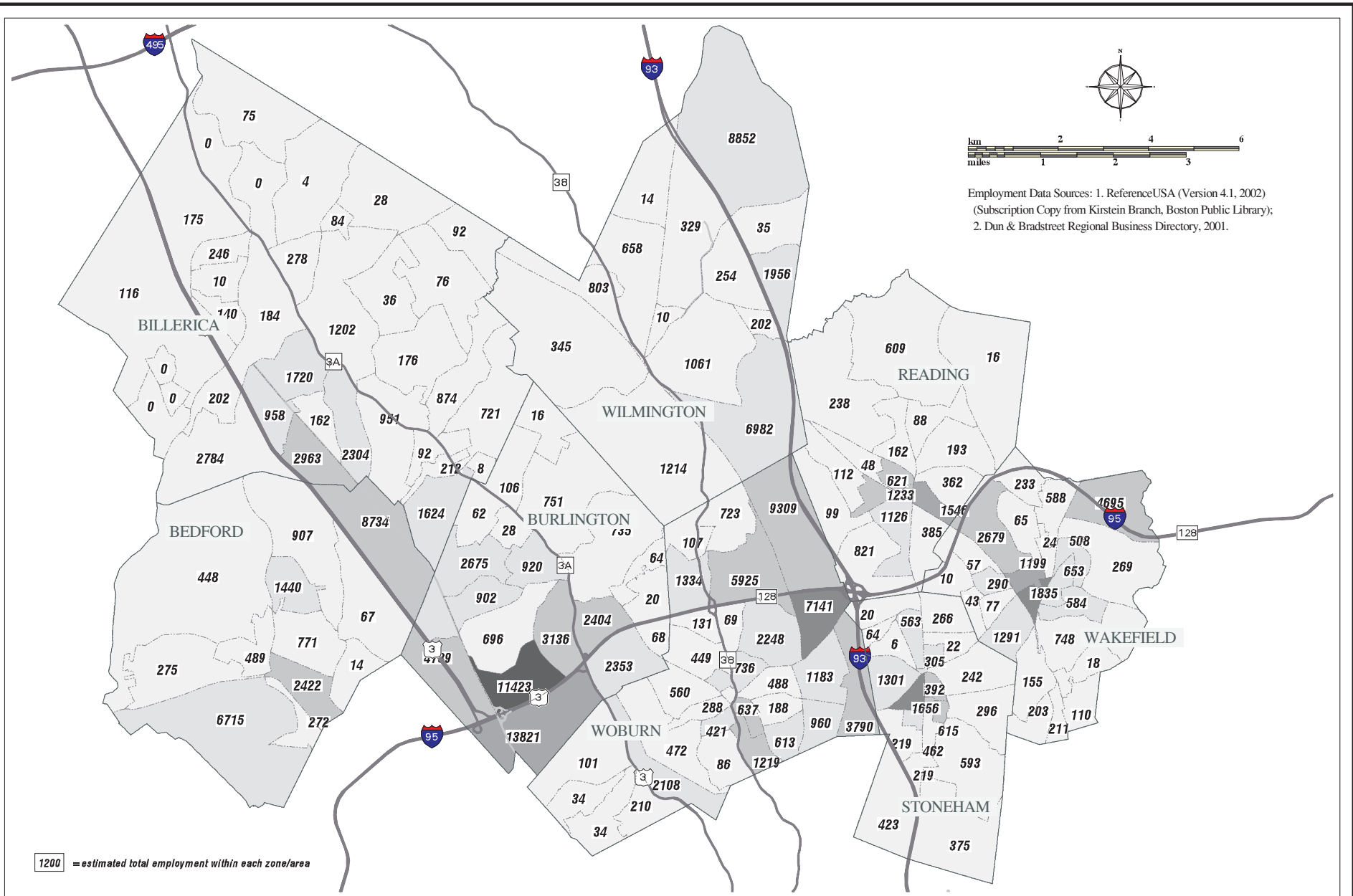
Data on Employee Origins

In addition to information on the distribution of employment sites throughout the North Suburban communities, it was desired to obtain data from the largest employers or employment destinations regarding the distribution of origins of their employees. This usually means zip code or town of origin data from companies' own files. Generally, employers are not willing to part with such information unless required to by law. The only such data obtained by us came from the files of the Massachusetts Department of Environmental Protection's Ride-Share Program, for two companies which had been required to file survey data with DEP in the year 2000—Sun Microsystems and Lahey Clinic, both now located in Burlington.² The data filed by both companies was mapped separately; the results of the mapping are illustrated in Figures 4 and 5. They represent totals of 1,052 and 1,966 “applicable”³ employees respectively. (NOTE: the estimated 2002 total employment at these two work sites, based on the methods outlined in the section above, are 1,836 and 3,533 respectively.)

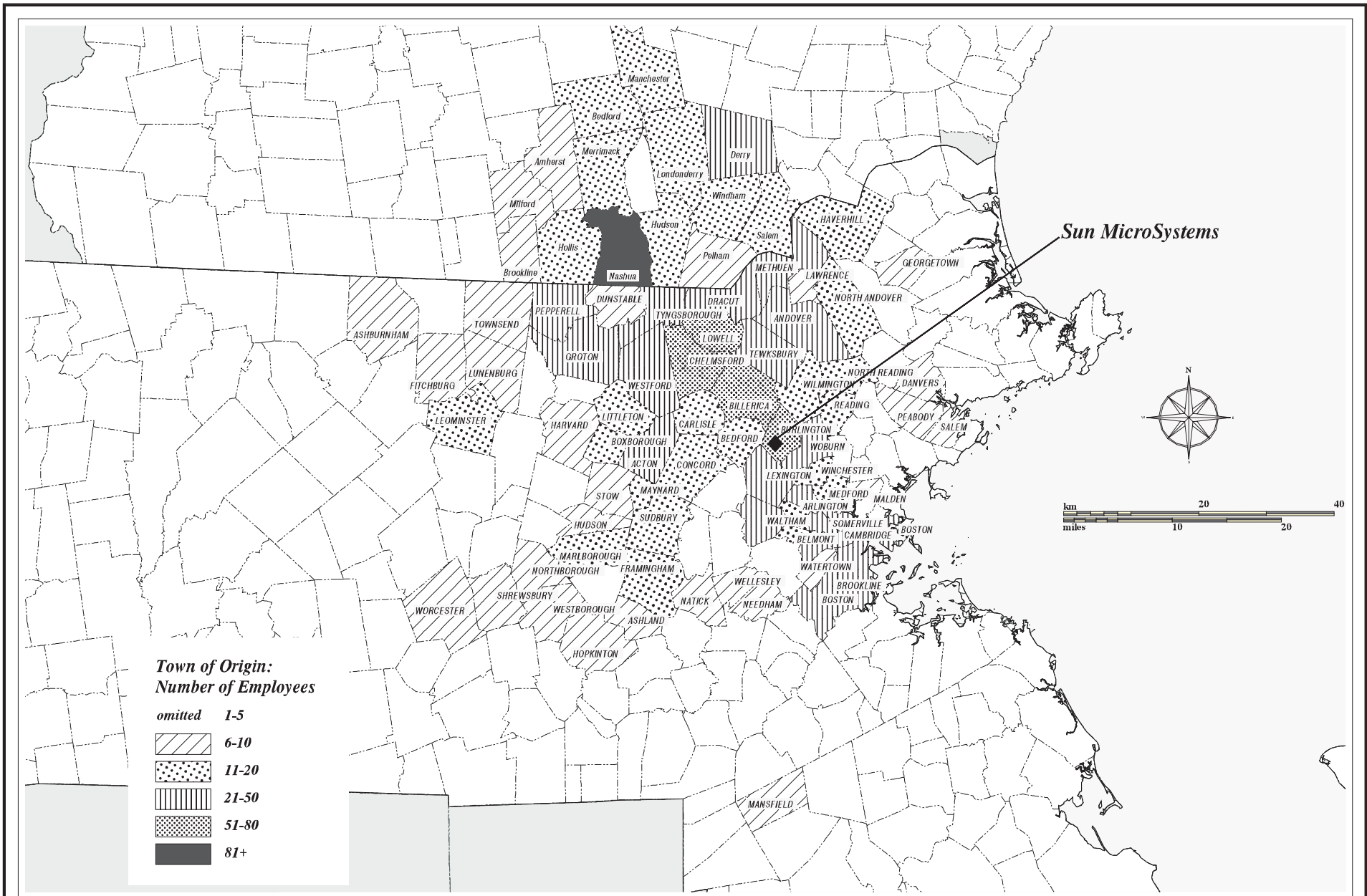
These totals, and the figures, include towns of origin for employees residing in New Hampshire or other states; and give an indication of the proportion of out-of-state residents commuting to these locations. For Sun Microsystems, the most noteworthy observation is the importance of Nashua, New Hampshire as the single largest employee residence location, followed by the Route 3 communities of Billerica, Chelmsford, Lowell, and Burlington itself. The Lahey Clinic similarly draws employees from Burlington itself and from the other

² At the time, Sun was in the process of consolidating several previous sites into its new headquarters location in Burlington.

³ I.e., according to DEP criteria

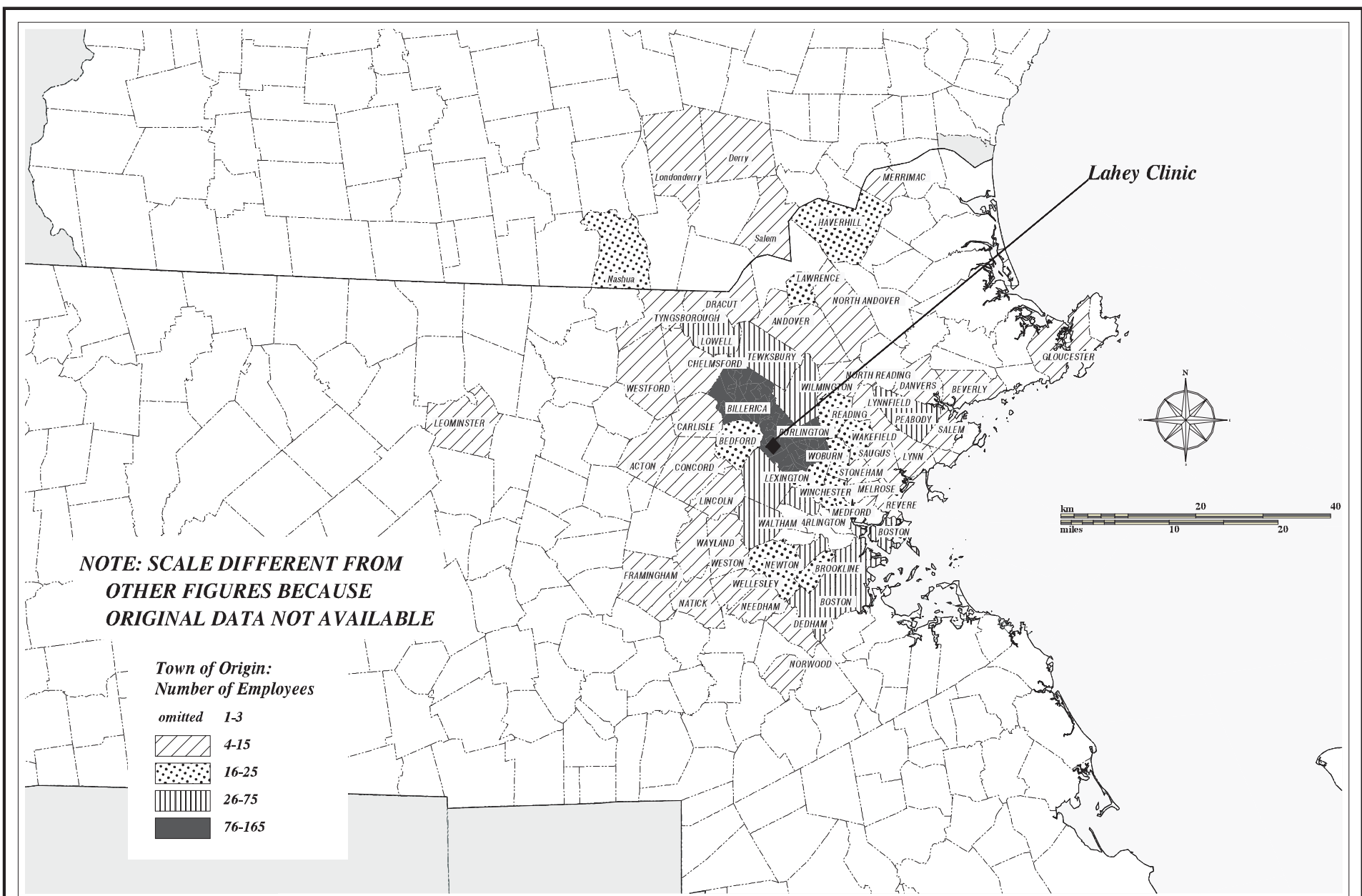


Employment Data Sources: 1. ReferenceUSA (Version 4.1, 2002) (Subscription Copy from Kirstein Branch, Boston Public Library); 2. Dun & Bradstreet Regional Business Directory, 2001.



CTPS

**Figure 4
Sun Microsystems Employee Origins
(as reported to Mass DEP, 2000)**



CTPS

**Figure 5
Lahey Clinic (Burlington) Employee Origins
(as reported to Mass DEP, 2001)**

Route 3 communities, although southern New Hampshire does not appear to be as important an origin as it is for Sun. Over time, however, it is likely that both the Route 3 communities and southern New Hampshire will continue to grow in importance as residence locations for both Sun and Lahey employees.

Ideally, zip code or town-of-origin data would have been available for other companies within the North Suburban area. Because such data were not available, an alternative method was used to obtain limited origin information for several employment areas of interest. License plate numbers were collected manually⁴ for vehicles at two locations in Woburn (Presidential Way north of Atlantic Avenue and Industrial Parkway west of Ryan Road), and at one location in Bedford (the entrance to Oak Park Drive at Middlesex Turnpike). These locations were selected because they represent relatively high concentrations of employment which can be isolated from other nearby activities; i.e., they have only one or two entrance/exit points.

The Woburn observation points at Presidential Way and at New Boston Street were the most important entrance points. However, it should be noted that vehicles can also enter or exit the Presidential Way area via Woburn Street or Industrial Way in Wilmington (see Figure 6). Consequently, the sample obtained at the Presidential Way location represents only a subset of the total, which may be assumed to under-represent contributions from nearby towns to the north and west, particularly Wilmington, Tewksbury and Billerica. Currently there is no direct connection between New Boston Street and Woburn Street. The New Boston Street sample may therefore be taken as more representative of all traffic entering that industrial area. It is likely that some local Woburn traffic enters the New Boston Street area from the only other possible entrance (Merrimac/ School Streets), but this is not an option likely to be particularly attractive to drivers from other towns. In Bedford, there is only one entrance/exit to the Oak Park Drive industrial area, viz., from Middlesex Turnpike.

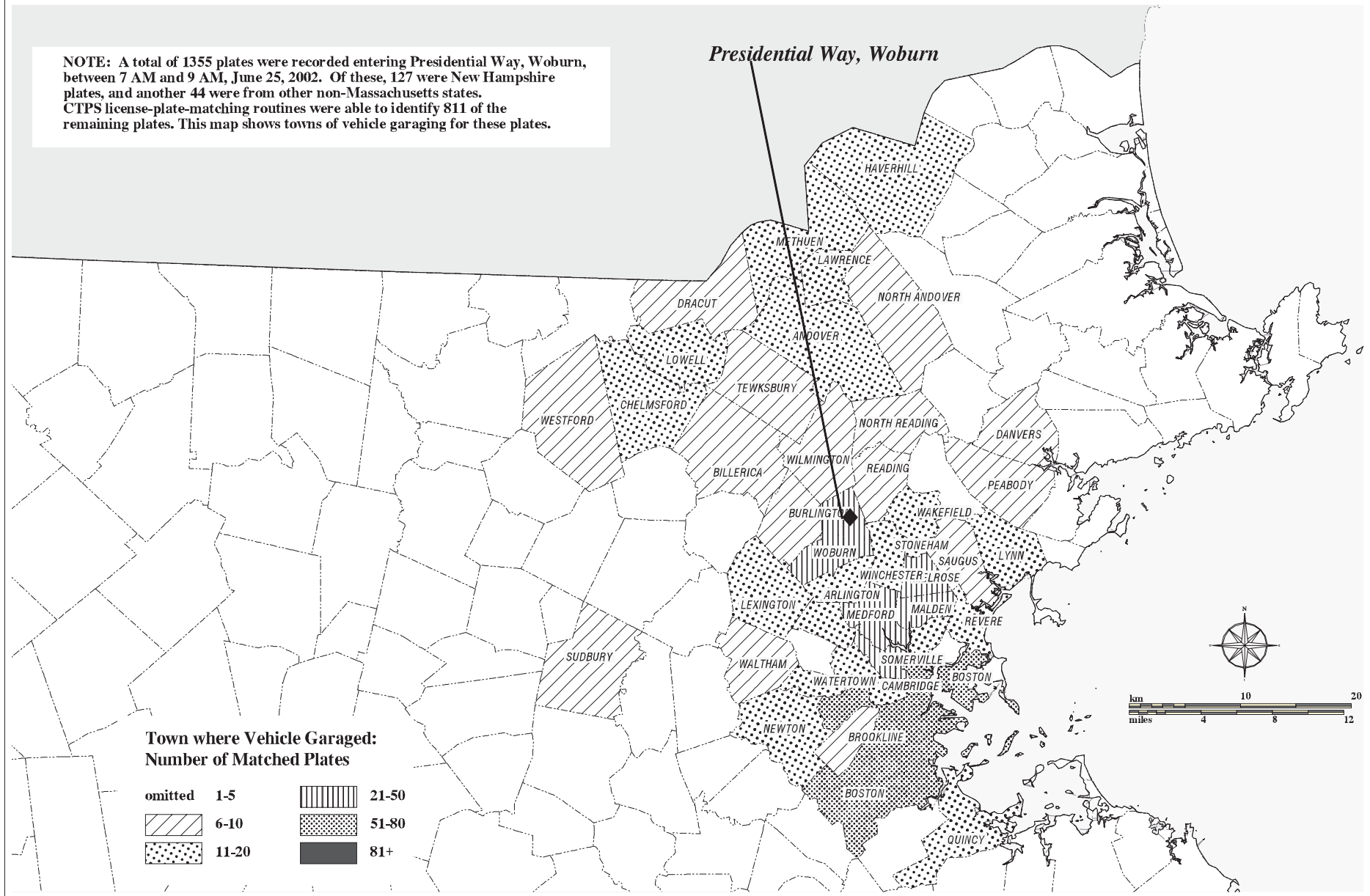
Volumes at the two Woburn locations were quite high, but it is estimated that about 70-80 percent of entering vehicles were recorded. Total plate counts were 1355 and 1258 at Presidential Way and New Boston Street respectively. Traffic volumes entering Oak Park Drive in Bedford were considerably lower: 542 plate numbers were recorded, and the percentage captured appears to have been around 90 percent. Table 2 presents summary statistics for the three data collection sites.

Figures 7 through 9 illustrate the distribution of Massachusetts origins for the matched license plates at each site. The most noteworthy characteristic of all three data sets is the wide area of distribution of origins for license plates. Plates were recorded from as far away as Harwich on Cape Cod, and Stockbridge in Western Massachusetts. Of course, many plates listed by the Registry as garaged in faraway towns may actually represent vehicles coming from much nearer starting points on the days when the surveys were conducted. For this reason, and because such isolated origins offer virtually no chance for ride-sharing






⁴ i.e., by recording them with a hand-held tape recorder.

NOTE: A total of 1355 plates were recorded entering Presidential Way, Woburn, between 7 AM and 9 AM, June 25, 2002. Of these, 127 were New Hampshire plates, and another 44 were from other non-Massachusetts states. CTPS license-plate-matching routines were able to identify 811 of the remaining plates. This map shows towns of vehicle garaging for these plates.

Presidential Way, Woburn



**Town where Vehicle Garaged:
Number of Matched Plates**

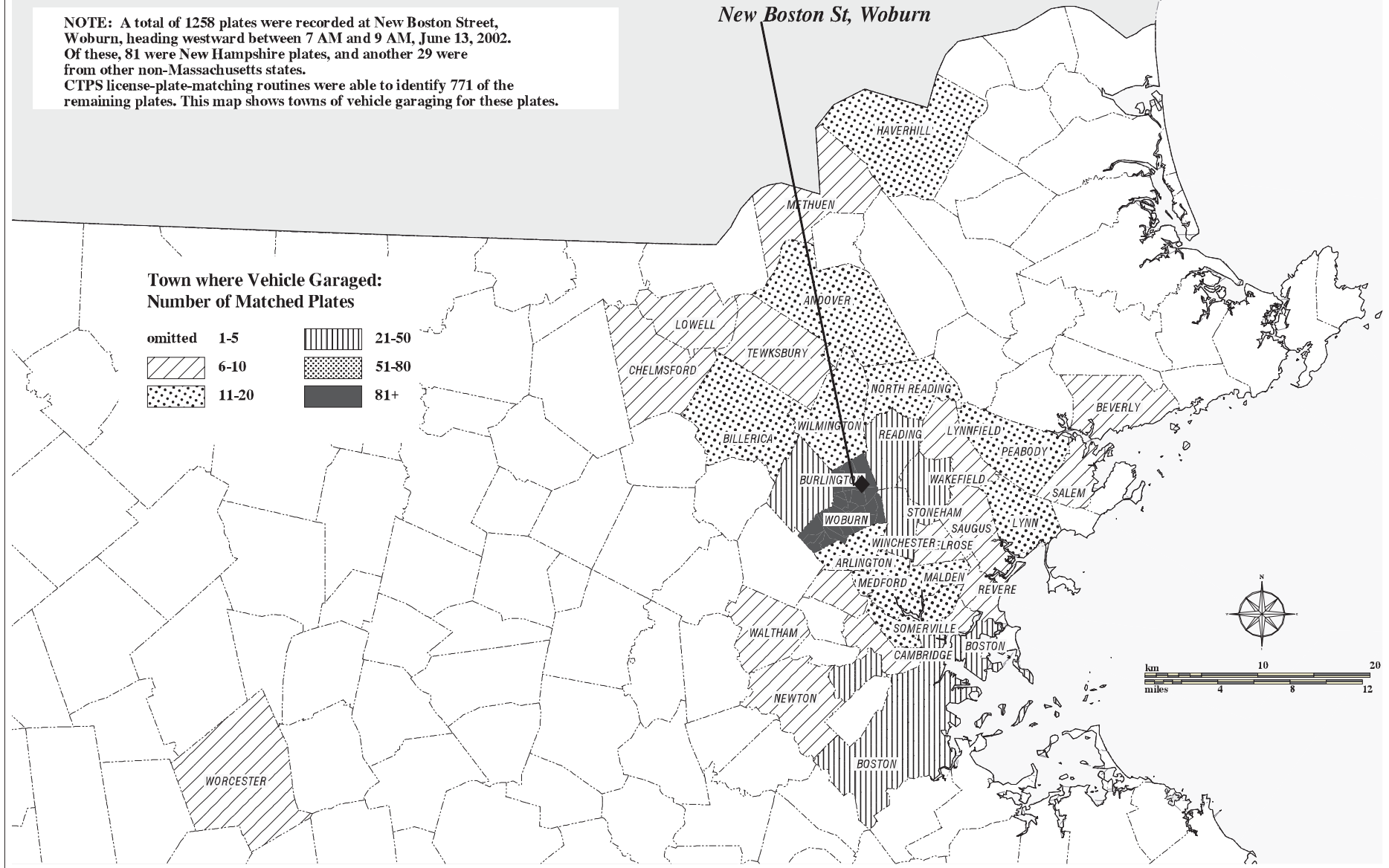
omitted	1-5		21-50
	6-10		51-80
	11-20		81+

CTPS

Figure 7
Mass. Origins from License Plate Survey:
Presidential Way, Woburn (June 2002)

NOTE: A total of 1258 plates were recorded at New Boston Street, Woburn, heading westward between 7 AM and 9 AM, June 13, 2002. Of these, 81 were New Hampshire plates, and another 29 were from other non-Massachusetts states. CTPS license-plate-matching routines were able to identify 771 of the remaining plates. This map shows towns of vehicle garaging for these plates.

New Boston St, Woburn

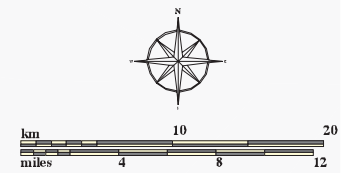
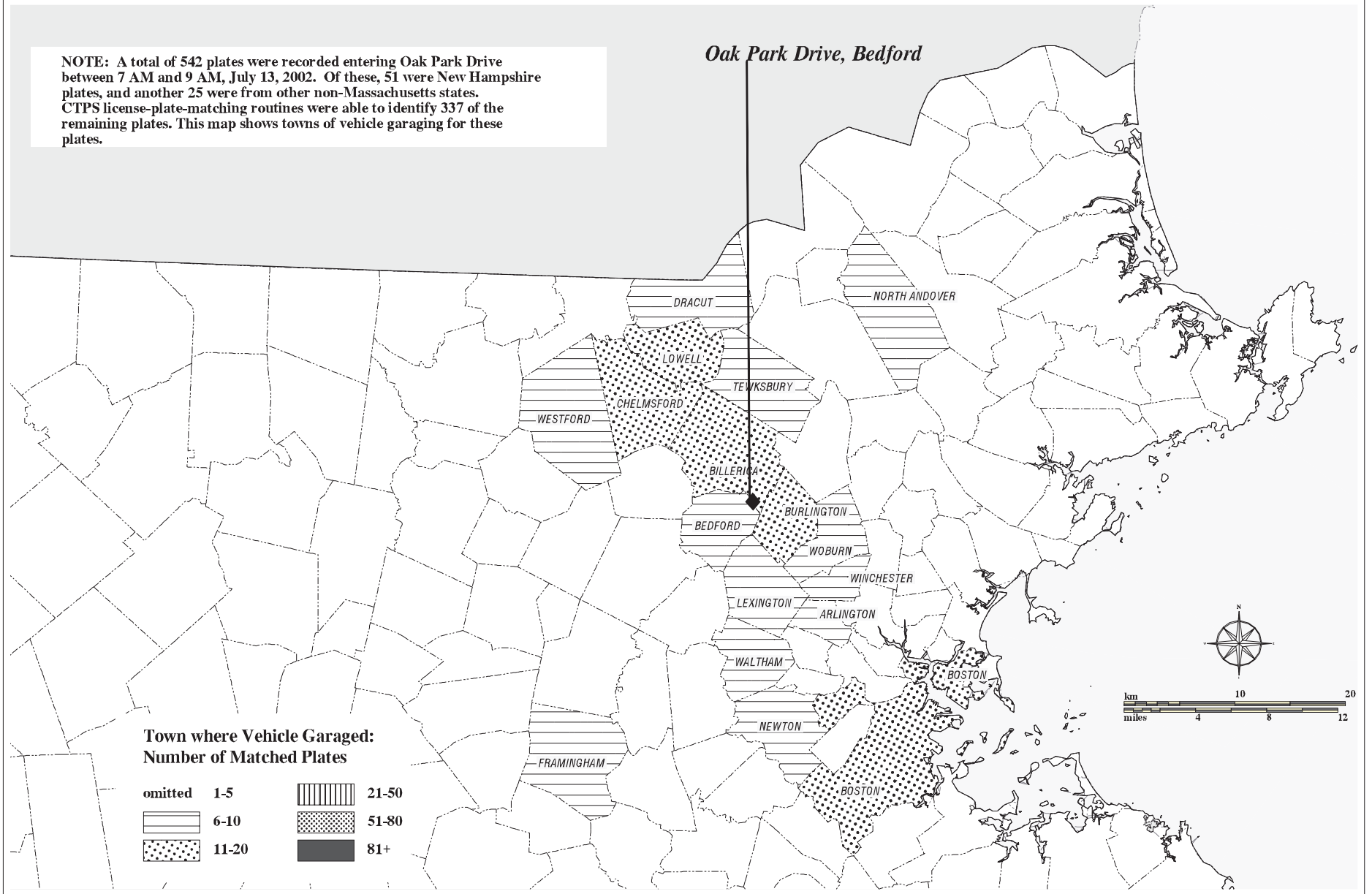


CTPS

**Figure 8
Mass. Origins from License Plate Survey:
New Boston St., Woburn (June 2002)**

NOTE: A total of 542 plates were recorded entering Oak Park Drive between 7 AM and 9 AM, July 13, 2002. Of these, 51 were New Hampshire plates, and another 25 were from other non-Massachusetts states. CTPS license-plate-matching routines were able to identify 337 of the remaining plates. This map shows towns of vehicle garaging for these plates.

Oak Park Drive, Bedford



CTPS

Figure 9
Oak Park Drive (Bedford) License Plates--Towns of Origin (July 2002)

beyond the individual household, Figures 5 through 7 exclude towns from which fewer than 5 plates were recorded.

TABLE 2
License Plate Data Collection—Summary of Sites

Location	Date	Number of Plates	Approx. % of Total Volume	Out-Of-State or Unmatched Plates	Plates Matched
New Boston St, Woburn	June 13	1258	70%	110	771
Presidential Way, Woburn	June 25	1355	75%	171	811
Oak Park Drive, Bedford	July 16	542	90%	76	337

For Presidential Way, the largest concentration of origins was from the City of Boston, with secondary concentrations (21-50 plates per town) from Melrose, Malden, Medford and Somerville, as well as Woburn itself—municipalities with relatively easy access to Interstate 93. On the New Boston Street side of Woburn, the largest concentration of origins was from Woburn itself, with secondary concentrations (21-50 plates per town) from Burlington, Reading, Wakefield, Stoneham, and the City of Boston.

At the Bedford location, no single town contributed more than 20 entering license plates. The sources of the highest numbers of entering plates were Burlington, Billerica, Chelmsford and Lowell, as well as the City of Boston.

Roughly 10 percent of the plates observed at Presidential Way and at Oak Park Drive, and approximately 8 percent of those seen at New Boston Street, were New Hampshire registrations. It would be informative to know which particular towns in New Hampshire generate the highest volume of demand at each location. At present, however, CTPS has no access to New Hampshire Registry data, so these origins cannot be determined.

3. ASSESSMENT OF DEMAND FOR NEW TRANSIT SERVICES

This chapter will review the demand potential for commuter rail feeder services and intersuburban local circulator routes. The primary focus of the assessment of feeder services is on reverse commuting opportunities to employment areas along Route 128, but there is also some discussion of traditional commuting to downtown Boston. Potential new services are examined on a station-by-station basis. In the subsection on intersuburban local circulator services, transit connections between adjoining towns are considered where license plate survey, employer zip code data, and Census data indicate a substantial number of work trips being made.

Feeder Service To/From Rail Stations⁵

At present, the only commuter rail station on the Haverhill/Reading line that is in the study area but is not served by connecting transit service is North Wilmington station. North Wilmington is in the same town as Wilmington Station on the Lowell Line, which also has no transit connections but is more centrally located. Just south of Wilmington is Woburn, where Anderson RTC is not served by any local transit services, but is served by Massport's Logan Express service to the airport. Potential demand for transit service to these three stations, as well as Wakefield and Reading stations is discussed below.

Wilmington/North Wilmington Stations

Wilmington Station is the only station on the Lowell Line in the town of Wilmington. North Wilmington Station, on the Haverhill/Reading Line, is also in Wilmington. Neither station has any transit service connections at present. Wilmington Station is more centrally located, and road layout there would allow for more possible bus connections.

The 1993 commuter rail survey found that 52% of the passengers boarding at Wilmington Station had trip origins in Wilmington. Most of the rest originated in Tewksbury (25%) or Billerica (19%). Other sources included Burlington and North Reading, with 2% each.

Tewksbury adjoins Wilmington to the northwest, and has no direct rail or other transit service to Boston. Billerica adjoins Wilmington to the west. North Billerica Station on the Lowell Line serves Billerica directly, but some Billerica residents find Wilmington Station more convenient. Burlington adjoins Wilmington to the southwest. It has no direct rail service, but has MBTA express bus service to downtown Boston and a local MBTA bus to the Alewife Red Line terminal.

⁵ Portions of this section are extracted from an earlier CTPS analysis of the potential for commuter rail feeder bus routes throughout the entire commuter rail service area. Information concerning stations located in the North suburban study area is included here.

Wilmington is bounded to the north by Andover and to the east by Reading and North Reading. Andover and Reading are served directly by the Haverhill/Reading commuter rail line. Reading is also served by two MBTA bus routes to the Oak Grove and Malden Orange Line stations. North Reading has no direct rail or bus service, but most commuter rail riders from there use stations other than Wilmington.

For most passengers with origins in Wilmington south of Wilmington Station and beyond convenient walking distance, a bus connection to Anderson RTC would be preferable to one to Wilmington Station. To the northeast, along the Route 62 corridor, most homes beyond walking distance from Wilmington Station are close to North Wilmington Station. The Route 38 and Route 129 corridors north of Wilmington Station are discussed in conjunction with Tewksbury and Billerica below.

The largest cluster of employment in Wilmington is along Industrial Way, just north of the border of Woburn. Reverse-commuting time to there would be less via a bus connection from Anderson RTC than via a bus from Wilmington Station.

Tewksbury – Wilmington

The most direct routing for a bus from Tewksbury to Wilmington station would follow state Route 38 for the entire way, but an alternate routing over parallel roads would bring it closer to more homes. The Lowell Regional Transit Authority (LRTA) currently operates a bus route from downtown Lowell to the Tewksbury/Wilmington town line. Within Tewksbury, it covers that same general area that a route from Wilmington station would. An extension of the LRTA route to provide a connection to Wilmington Station might be feasible, but increased bus frequency and coordination of bus and train schedules would also be needed.

The scattered locations of major employers in Tewksbury would make it difficult to design an efficient bus link to them from Wilmington Station. Further investigation would be needed to determine the level of interest of Tewksbury employers in establishment of reverse-commuting service. A bus route from Tewksbury to Wilmington Station would also serve one of the most densely developed residential sections of Wilmington. While many of the homes in that area are within one mile of the station, the residential area surrounding Silver Lake in Wilmington is well beyond a reasonable walking distance.

Billerica – Wilmington

The shortest bus route from Wilmington Station to Billerica would follow state Routes 38 and 129, but such a routing would bypass the section of Billerica most likely to originate traffic for the station. The shortest route to those neighborhoods would follow state Route 62 from the station through Burlington to Route 3A. Within Burlington and Billerica, such a routing would overlap

existing routes of the Burlington B Line bus system and the Lowell Regional Transit Authority. Some modification of those routes to provide a connection to Wilmington Station might be feasible.

In 2000, Billerica had a population of 38,981, and in 1990, 5.8% of the town's population worked in Boston or Cambridge. Of these, approximately 266 were found to use commuter rail in the 1993 commuter rail passenger survey, with 62% choosing to board trains at North Billerica station and 25% boarding trains at Wilmington station. Of the 11 work-to-home trips from Billerica in the 1993 survey, eight were made via Wilmington Station and three via North Billerica.

Conclusion

From most points in Burlington, commuter rail travel to Boston would be more convenient if accessed at Anderson RTC rather than at Wilmington. Therefore, a bus link from Burlington to Wilmington Station other than one incidental to a connection from Billerica would not be worthwhile. The MBTA already provides some reverse-commuting bus service from downtown Boston to Burlington.

Based on the findings above, if a single bus route from Wilmington Station were to be instituted, a route to Tewksbury would have the greatest demand potential both for commuters to Boston and for reverse commuters. A route to Billerica via North Burlington would have the second-best potential.

Anderson Regional Transportation Center

Feeder Routes Serving Woburn Residents

Anderson RTC is currently one of two stations on the Lowell Line in the city of Woburn. It was opened in April 2001, and no official surveys of passengers using it have been conducted yet. Before Anderson RTC opened, Woburn was served by Mishawum Station. That station now has only three outbound AM peak trains and three inbound PM peak trains, which stop there for the benefit of reverse commuters. The parking lot at Mishawum has been closed. The distribution of passenger origins at Anderson RTC would be expected to be similar to that formerly found at Mishawum, but the greater parking capacity at the new station should draw riders from a larger area.

The 1993 commuter rail survey found that 60% of the passengers boarding at Mishawum Station had trip origins in Woburn. Other origins were scattered among many towns. Of these, the only ones accounting individually for at least 5% of the boardings were Burlington (11%), Billerica (7%), North Reading (5%) and Wilmington (5%).

Burlington and Wilmington directly adjoin Woburn, but Billerica and North Reading do not. Other towns that directly adjoin Woburn are Reading and Stoneham to the east, Lexington to the west, and Winchester to the south. Reading is served directly by the Haverhill/Reading line. Winchester has two

stations on the Lowell line, and both are closer to Boston than Anderson RTC. Stoneham and Lexington have no direct rail service, but both have MBTA bus connections to rapid transit lines.

Anderson RTC is only one half mile south of the border of Woburn with Wilmington. A bus route running north from the station would serve no residential areas within Woburn, and would not reach many Wilmington homes until it was more than one half mile beyond the border. Such a route could serve reverse-commuting trips to sites along Industrial Way in Wilmington. Most of the homes in the part of Woburn north of Route 128 are within 1.5 miles of Anderson RTC, but are on the west side of the station, to which there is no direct access. In most cases, these areas are well served by existing MBTA local bus Route 134.

Trips originating south of Route 128 that are made via Anderson RTC would require significant travel in the opposite direction from Boston. The survey results showed that only a small percent of Woburn residents chose to use Mishawum station for travel to Boston. Access to Anderson RTC via a bus would be even more time-consuming than driving to Mishawum. Therefore, existing frequent express bus service to Boston on MBTA bus Route 354 and local bus service to Wellington Station on the Orange Line via Route 134 are best suited to serve the needs of traditional commuters living in Woburn and working in Boston or Cambridge.

Feeder Routes Serving Area Employees

The Lowell Line crosses Route 128 about one quarter mile west of Exit 36 in Woburn (Washington Street). Mishawum Station is located just north of the Route 128 crossing. The new Anderson RTC, about one mile north of Mishawum, opened on April 30, 2001. At the same time, service at Mishawum was reduced to three outbound AM peak and three inbound PM peak trains. The area around the old and new station sites is one of the most densely developed industrial areas on Route 128, and it has some of the heaviest reverse commuting in the commuter rail system. A December 2000 count found a total of 90 passengers alighting at Mishawum from the five outbound trains then arriving there between 6:00 and 9:30 AM. This was a slight decrease from the 92 alightings observed from trains in the same interval there in 1996. The 1993 survey showed 82 PM peak riders boarding inbound trains at Mishawum for work-to-home trips.

The 2000 count included observations of egress modes from Mishawum Station, but did not determine passenger origins or trip purposes. The most common egress mode was walking, used by 68 riders (74%). Some of these may stop using rail service if the revised schedule results in less convenient access to their destinations. A van sponsored by one employer was the second most common egress mode, with 12 riders (13%). Loads on individual van trips ranged from one to five. Exits by taxi were third with five riders (5%), at least some of whom had fare vouchers from an employer in Wilmington. Three riders were picked up in private autos, and two transferred to the Logan Express bus.

The 1993 commuter rail survey also showed 12 reverse commuters using connecting van service at Mishawum, so this segment has not grown in absolute terms and has declined slightly relative to other egress methods there.

In the 1990 Census, Woburn had the largest number of reverse commuters from Boston of any Route 128 community north of Boston, and the eighth-largest on Route 128 overall. Specifically, there were 262 reverse commuters from Boston Proper, and 1,050 from the rest of Boston. Between 1990 and 1999, total employment in Woburn increased by 10%, or 3,457 jobs. In both 1990 and 1999, Woburn ranked fourth in total employment among all Route 128 communities. In both total employment and employment of Boston residents, Woburn was far ahead of any community with direct commuter rail service on the north side lines further to the east.

Conclusion

Given the above finding that there are likely close to 1,500 Boston residents working in Woburn in 2000, and given the substantial existing commuter rail ridership on reverse commuting trips, there appears to be potential for a successful Anderson RTC feeder transit service oriented toward area employees. This conclusion is supported by the more detailed analysis of employee trip origins presented in Chapter 2 which also indicates that there may be some demand for such feeder service from the north. Finally, the Wilmington Station analysis earlier in this chapter suggests that Anderson RTC would be a better transfer point than Wilmington for buses to/from the southern edge of Wilmington, especially for employers along Presidential Way.

Wakefield Station

Reverse Commuting Connections Within Wakefield

The Haverhill/Reading Line crosses Route 128 near Exit 39 at John Street in Wakefield, but does not have a station there. The nearest stations are Wakefield, about one mile further inbound, and Reading, about one mile further outbound. MBTA bus Route 137 from Malden Station to Reading stops at both Wakefield station and Reading station, and follows John and North Streets between them. The scheduled running time between the two stations is about 11 minutes, with Route 128 being crossed at about the mid-point. Two outbound AM peak trips and one inbound PM peak trip make side diversions into an office park just inside Route 128, adding about two minutes to the running time.

Train and bus schedules are not intentionally coordinated, but allow for efficient transfers. The three outbound AM peak trains stopping at Wakefield have connecting times of 14, 6, and 4 minutes to outbound Route 137 buses. In no case would it be advantageous to transfer at Reading and double back. A Spring 1999 count found all-day totals of 12 passengers alighting from northbound buses at stops just south of Route 128 and another 10 on the north side. No more than three of these boarded at the stop at Wakefield Station. Returning

southbound, there were no boardings at the stop on the north side of Route 128 and only one on the south side.

MBTA bus Route 136 from Malden Station to Reading diverges from Route 137 at Wakefield Square and bypasses Wakefield Station by about one third of a mile. It does run directly to Reading Station. The scheduled running time between Wakefield Square and Reading Station is 14 minutes. Route 128 is crossed on Lowell Street at Exit 40, slightly closer to Reading Station than to Wakefield Square.

Schedules of Routes 136 and 137 are coordinated to provide alternating trips on the overlapping segments. Since Route 137 makes fair-to-good connections with outbound AM peak trains at Wakefield, Route 136 cannot also do so. Two of the three outbound trains have scheduled connections of two and four minutes with southbound Route 136 buses at Reading Station, however, so it is theoretically possible to travel from Boston to the Exit 40 area of Route 128 by doubling back from Reading Station. Reading and Wakefield are both in commuter rail fare Zone 2, and the bus fare to Route 128 from either station is the same, so there is no cost advantage from transferring at one station instead of the other. The train time from Boston to Reading is six minutes longer than that to Wakefield.

There is much less employment potential around Exit 40 than around Exit 39. A Spring 1999 count showed no passengers alighting from southbound buses at the stops nearest to Route 128 on either side. Northbound, there were eight alightings all day at the nearest stop south of Route 128 and five at the nearest stop north. But as noted above, northbound trips would not have made good connections with trains for reverse commuting.

The 1990 Census found 51 work trips to Wakefield from Boston Proper, and 266 from the rest of Boston. Of these, only 18 were reportedly made by commuter rail. Between 1990 and 1999, total employment in Wakefield increased by 30%, or 3,222 jobs.

Given that most of the dense employment development in Wakefield is located near Exits 39 and 40 on Route 128, along John or North Streets, or near Wakefield Square, existing feeder service provided by MBTA local bus Routes 136 and 137 is sufficient to serve reverse commuting needs. Furthermore, these routes provide direct service to the Orange Line at Oak Grove Station on trips that do not provide efficient connections with commuter rail. These connections serve reverse commuters to Wakefield, and Wakefield residents alike.

Connections to Reading and Stoneham

To the west of Exit 39 in Wakefield, the next exit is Exit 38 at Main Street (Route 28) on the border of Reading and Stoneham. Development in the area is mostly residential, but there is some low-density commercial development. At present there is no direct bus service to the Exit 38 area. MBTA bus Route 132 from Malden Station terminates at the Redstone Shopping Center in Stoneham,

about three quarters of a mile to the south. Buses on this route also stop at the Wyoming Hill commuter rail station, but do not make good connections with outbound AM peak trains. The scheduled bus running time from Malden Station to Redstone is 25 minutes.

There is insufficient slack in the schedule to allow for an extension of the bus route further north without adding an additional vehicle. If a vehicle was to be added to the line, the time from Malden Station to Exit 38 would be about 30 minutes. The bus running time from Wyoming Hill would be 13 minutes less. The commuter rail time from Malden Station to Wyoming Hill is only three minutes, but most Route 132 riders from Boston would transfer from the Orange Line rather than from Haverhill/Reading trains. (Spring 2000 counts showed no outbound alightings from commuter rail trains at Malden in the AM peak.) Commuter rail and Orange Line running times from North Station to Malden are about the same, but the Orange Line has the added advantage of higher frequency and direct service to more of the residential sections of Boston.

A bus from Wakefield Station could reach the Exit 38 employment area in about nine minutes. The train running time from Malden Station to Wakefield is 10 to 12 minutes, so excluding differences in waiting times for connections, travel between Malden and Exit 38 via Wakefield and a new bus route would be 9 to 11 minutes faster than taking an extended Route 132 from Malden. However, in-vehicle time via Wyoming Hill and an extended Route 132 would be about the same as that via Wakefield and a new bus route. In addition, Route 132 also connects with the Orange Line at Oak Grove. Transferring there instead of at Malden reduces net in-vehicle time by about six minutes, but this may be offset by a longer wait for the bus at Oak Grove.

Conclusion

In conclusion, while the ridership potential for new transit connections to points along Route 128 in Wakefield, Lynnfield, or Reading is limited, the market in the vicinity of Exit 38 might best be served by an extension of bus Route 132 and improved coordination with Orange Line service.

Reading Station

The greatest employment density in Reading is in the vicinity of Reading Square and Reading Depot. Additional employment areas can be found along Salem Street and John Street between Reading and Wakefield. MBTA bus Routes 136 and 137 provide service to this area from Reading Depot and Reading Square.

The largest area of employment in Reading without direct transit service is along Main Street between Reading Square and Exit 38 of Route 128. This has been identified as a possible corridor for new transit in the analysis of service between Reading and Stoneham in the following section.

There are employment areas located along or near Main Street between Reading Square and the North Reading/Reading town line. There is no transit service in this segment. MBTA bus service was discontinued in this segment in 1978 because of poor ridership. The low density of employment locations does not suggest a high demand for possible new transit.

Census data indicates that over 1000 Reading residents work in Woburn. The previously-mentioned license plate survey of vehicles entering New Boston Street in Woburn found that Reading ranked third after Woburn and Boston as the town of registration for vehicles observed. A transit service between Reading Depot and Anderson RTC via Woburn Street and West Street in Reading could serve the employment centers that are located near Anderson RTC with trip times of about 10 minutes. Such a service could also be incorporated into a larger route also serving employment areas in Woburn several miles away from Anderson RTC. Connections with the Haverhill commuter rail line at Reading would also improve access from communities in the Merrimack Valley region to employment opportunities in Woburn.

Intersuburban Circulator Services

This section assesses the potential for new or redirected local transit service between towns within the study area. In particular, these service concepts focus on markets other than feeder service to commuter rail stations and direct service to downtown Boston.

The most recent census data available with detailed journey-to-work information dates from 1990. Data from the 2000 census is not yet available. For this reason, the 1990 data was used only to provide a broad outline of town-to-town travel patterns within the area. When 2000 journey-to-work data becomes available in Spring 2003, these assessments may be reexamined to determine whether significant new travel patterns have developed.

Reading – Wakefield

Patterns identified in Census data suggest that the greatest potential for a town-to-town service serving employment areas in Reading would be from Wakefield. The same data also suggests that the greatest potential for a town-to-town service serving employment areas in Wakefield would be from Reading. However, MBTA bus routes 136 and 137 already provide service between Reading Depot and Wakefield as part of a longer route continuing through Melrose to Malden station on the Orange Line.

The most recent ridership data on these routes indicates that on a typical weekday, there are approximately 38 local round trips made on the segments within Reading and Wakefield. Close to two-thirds of these passengers used Route 136 and the rest used Route 137.

Since these routes provide regular service throughout the day on weekdays and Saturdays, and no crowding problems have been observed in Reading or

Wakefield, there does not appear to be the need for new routes or substantial changes to these existing routes.

Reading – Stoneham

There is no other local transit service to Reading beyond that provided by Route 136 and 137 bus service. Presently, any passengers wishing to make a journey from Stoneham to Reading via bus must transfer from MBTA Route 132 to MBTA Routes 136/137 at Oak Grove Station. This trip takes at least 60 minutes, even when good connections are available between the routes.

MBTA bus Route 132 operating between Malden and Stoneham terminates at Redstone Plaza just south of the Reading/Stoneham border. It is a distance of less than two miles to Reading Depot. There is, however, insufficient slack in the present Route 132 schedule to extend service to Stoneham without an erosion of existing service frequencies. The MBTA would have to allocate additional resources to extend the route. If an additional vehicle was to be added to the route for the duration of the present Route 132 service day (5:30 AM-7:30 PM), the annual increase in expenses to the MBTA is estimated at \$240,000. Expanding the service by one vehicle and extending the route to Reading Depot only during the rush-hour would cost approximately \$125,000 annually.

A separate non-MBTA service operating only between Stoneham and Reading Square would probably draw fewer new riders than an extension of the already existing MBTA route, but would most likely have lower operating costs. Annual costs for a rush-hour only mini-bus service between Stoneham and Reading operated by a contractor would be \$70,000 to \$80,000.

Stoneham – Wakefield

If a new service from Stoneham to Reading Depot was to be implemented, it would allow for transfers to MBTA bus Routes 136 and 137, which connect Reading and Wakefield. Presently, any passengers wishing to make this journey via bus must transfer from MBTA Route 132 to MBTA Routes 136/137 at Oak Grove Station. This trip takes 50 minutes, even when good connections are available between the routes. If it were possible to make this journey via Reading Depot, the journey time could most likely be reduced by 50%.

Reading – Woburn

Anderson RTC and the commercial area surrounding it is within 2 miles of Reading Square. A transit service linking Anderson RTC to surrounding employment areas could also be designed to provide service to Reading Square operating via West Street and Woburn Street. This would require a greater allocation of resources than a service operating only within Woburn would require.

If connections were to be provided to MBTA Route 354 at Cummings Park, this would allow potential passengers to travel from Reading Square to Woburn

Square and West Woburn with one transfer. At Reading Depot, connections could be made with the Haverhill commuter rail line and with MBTA bus Routes 136 and 137 to Wakefield and Melrose. Any new transit service between Reading and Stoneham would offer additional transfer opportunities.

Burlington – Billerica

Patterns identified in Census data suggest that the greatest potential for a town-to-town service to employment areas in Burlington would be from Billerica. However, the Lowell Regional Transit Authority (LRTA) has already initiated service from Lowell and Billerica to employment areas along Middlesex Turnpike, the Burlington Mall, and the Lahey Clinic. LRTA also operates a service from Billerica that connects with MBTA route 350 in Burlington, providing connections to locations along Cambridge Street not directly served by the Lahey Clinic route.

There does not appear to be a need for any additional service between Burlington and Billerica beyond that already provided by LRTA.

Burlington – Woburn

MBTA bus Route 350 from Burlington to Alewife Station also serves Cambridge Street in Woburn, and is available for access to the Lahey Clinic and Burlington Mall. Route 350 also provides access to these locations from Arlington and Cambridge.

Route 350 does not, however provide service from the central part of Burlington to the Lahey Clinic in the morning peak before 8:39 AM or from Lahey Clinic to Burlington Center between 5:01 PM and 6:52 PM. During these hours, Route 350 operates direct via Cambridge Street in order to provide a faster, direct service for Burlington commuters bound for Arlington, Cambridge, and the Red Line at Alewife.

MBTA bus Route 354 (Woburn-Boston) provides access from Woburn Square as far as Van DeGraff Drive in Burlington. Woburn residents from areas east of Cambridge Street wishing access to Burlington Mall or Lahey Clinic must transfer to Route 350. If they wish to travel to locations along Middlesex Turnpike or to locations in Bedford, they must transfer twice – from MBTA Route 354 to MBTA Route 350 to LRTA Route 19. Direct access had been provided for this market until 1998 by Route 353, but ridership data collected then does not suggest there is strong enough demand to restore a one-seat ride. However, extending LRTA Route 19 from Lahey Clinic to Van DeGraff Drive would provide a single transfer service at little added operating cost to the LRTA or the MBTA.

Burlington – Lexington

Lexpress Route 5 provides service from Lexington to the Burlington Mall. The earliest arrival time is 7:45 AM and the last departure time is 5:45 PM. Operating

earlier and later peak period trips could improve access to employment at the mall and improve connections to LRTA Route 19. The annual increase in costs would be approximately \$10,000.

Stoneham – Woburn

Rerouting reverse peak service on MBTA bus Route 354 to leave Interstate 93 in Medford and operate via Main Street and Montvale Avenue in Stoneham could provide morning outbound service and afternoon inbound service between Stoneham and Cummings Park, Woburn Square, Cambridge Street in Woburn, and Van DeGraff Drive in Burlington. Implementing new connections between Route 354 and LRTA Route 19, as suggested in the discussion of Burlington–Woburn circulator services above, would further increase the possible destinations available with one transfer to include the Lahey Clinic, Burlington Mall, and various locations in Burlington and Bedford served by LRTA Route 19.

There would be little to no added cost for the MBTA to reroute "reverse-commute" trips on Route 354. However, there would be some increase in travel times for existing riders traveling between Boston and Woburn. This added travel time could make the service unattractive for some present riders, which should be considered fully before a service change is implemented.

Bedford – Woburn

The section of Bedford west of the Middlesex Turnpike along Crosby Drive and Oak Park Drive presently receives bus service from MBTA Route 351, MBTA Route 170, and LRTA Route 19. MBTA Route 351 operates from Alewife Station on the Red Line, and MBTA Route 170 operates from Dudley Station in Roxbury, Back Bay Station in Boston, and Central Square, Waltham. LRTA Route 19 operates between Lowell, Billerica, and Burlington. MBTA Route 351 was also recently extended to serve Bedford Woods.

Improving connections between LRTA Route 19 and MBTA Route 354 would provide a one-transfer ride between Woburn and locations in Bedford served by the LRTA. Initiating earlier and later service on Lexpress bus #5 could also improve connections between locations in Lexington and locations served by LRTA #19.

4. DESCRIPTIONS OF POTENTIAL SERVICE IMPROVEMENTS

This section summarizes the new transit service concepts that appear to hold the most potential for increasing the transit mode share for home-to-work trips in the North Suburban subregion. Overall, it appears that these new services would primarily be targeted to persons who work in one of the study area's municipalities. In some cases, these employees also live in the subregion and would be able to make their entire trips via public transportation. Similarly, many Boston residents using these services could leave their cars at home for their daily commute. Commuter rail park & ride customers from northern suburbs in the Merrimack Valley and Northern Middlesex regions may also find these services useful in trips to North Suburban employers.

Each of these new or improved transit service concepts are shown on Figure 10, and are assigned a number which corresponds to those printed in the subsection titles.

Proposed New Services

Anderson RTC Shuttle #1 (#1 on map)

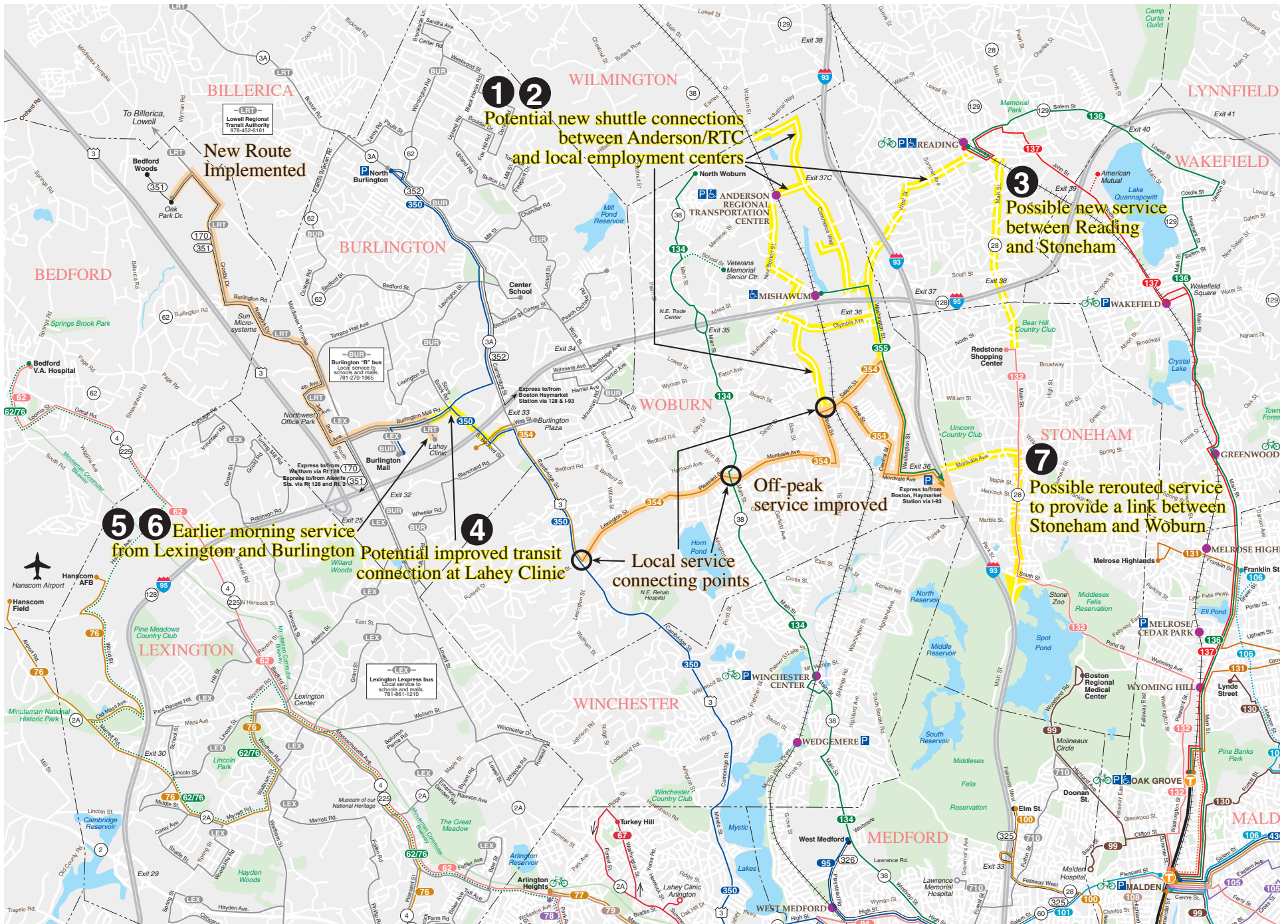
In the 1990 Census, Woburn had the largest number of reverse commuters from Boston of any Route 128 community north of Boston, and the eighth largest on Route 128 overall. Improving the connections between Anderson RTC and nearby employment centers could make commuter rail a more attractive alternative for commuters from both the Boston and Lowell areas to Woburn.

A feasible loop route starting at Anderson RTC could operate via Atlantic Avenue, Commerce Way, Mishawum Road, Washington Street, Cedar Street, Salem Street, Wildwood Avenue, Olympia Avenue, Mishawum Road, Industrial Parkway, and New Boston Street. It would turn around at Gill Street, then proceed via New Boston Street, Industrial Parkway, Mishawum Road, Commerce Way, to Atlantic Avenue. The route could be adjusted depending on the exact needs of specific employers.

This service would connect multiple job locations located within three miles of Anderson RTC with the commuter rail station. One vehicle should be sufficient to provide a schedule that would meet most trains arriving at the station. Based on present train schedules, a route utilizing one vehicle would be required to make a round-trip in 40 minutes in the morning and 30 minutes or less in the afternoon in order to meet most trains.

This service would require 7 vehicle hours per day, and it is estimated that the costs per hour to operate a mini-bus shuttle are \$48.00 per hour. Thus, the daily cost for a one-bus route would be \$336.00. Annual costs would be approximately \$85,000. The following table includes present peak period train arrival times at Anderson/RTC and identifies potential arrival/departure times for a connecting shuttle.

Figure 10: Potential New and Modified Transit Services



**TABLE 3
Anderson RTC Weekday Morning Train Arrivals**

Train Arrival	Train Origin	Mins. to Next Arrival	Potential Shuttle Departure Time
0555	Lowell	15	
0610	Boston	30	0615
0640	Lowell	18	
0658	Boston	14	0705
0712	Lowell	27	
0739	Boston	5	
0744	Lowell	8	
0752	Boston	20	0755
0812	Lowell	18	
0830	Boston	15	0835
0845	Lowell	43	
0927	Lowell	8	
0935	Boston		

**TABLE 4
Anderson RTC Weekday Afternoon Train Arrivals**

Train Arrival	Train Destination	Mins. to Next Arrival	Potential Shuttle Arrival Time
1530	Boston	5	1525
1535	Lowell	60	
1635	Boston	3	1625
1638	Lowell	29	
1707	Boston	1	1655
1708	Lowell	22	
1730	Boston	8	1725
1738	Lowell	27	
1805	Boston	8	1800
1813	Lowell	26	
1839	Boston		

Anderson RTC Shuttle #2 (#2 on map)

This proposal suggests the operation of a shuttle from Reading Depot and Anderson RTC to job locations along Commerce Way, Mishawum Road, Washington Street, Cummings Park, and New Boston Street.

This route would be similar to shuttle #1 except it would require 2 vehicles and operate an additional segment serving Reading Depot, operating via Atlantic Avenue, Commerce Way, Mishawum Road, West Street, and Woburn Street.

A service to Reading Depot would connect with the Haverhill commuter rail line, which serves Haverhill, Lawrence, Andover, and North Wilmington from the north and Wakefield, Melrose, Malden, and Boston from the south. Connections could also be made to MBTA bus Routes 136 and 137 which serve Reading, Wakefield, Melrose, and Malden. This would provide a wider range of options than a service only operating from Anderson RTC to surrounding employers.

Annual costs would be approximately \$170,000 (double that of shuttle #1).

Stoneham-Reading (#3 on map)

This proposal would provide service from the Stoneham terminal of MBTA bus Route 132 (Redstone Plaza) to Reading Square via Main Street.

This service would provide access to commercial areas along Main Street in Reading and improve connections between Stoneham and Reading and between Stoneham and Wakefield (via transfers to MBTA Routes 136/137).

Because there is insufficient slack in the existing MBTA Route 132 service to extend it without causing a deterioration of service frequency, the MBTA would need to add an additional vehicle to the route to accommodate an extension. Extending the route all day would increase annual costs to the MBTA by approximately \$240,000. Extending the route only during rush hours would cost the MBTA approximately \$125,000 annually.

Having a contractor operate service between Stoneham and Reading as an independent route would cost \$70,000-\$80,000 annually. However, this service would likely draw fewer riders than a service operated as an extension of the already existing MBTA route because of the additional transfer required.

Proposed Changes to Existing Transit Services

Montvale (Woburn) – Oak Park, Burlington (#4 on map)

This proposal would provide a connection between MBTA bus Route 354 (Woburn-Boston) and Lowell Regional Transit Authority Route 19 (Lahey Clinic-Lowell). This new connection would simplify trips made from Montvale and Woburn Square to Lahey Clinic, Burlington Mall, the employment areas in Burlington and Bedford, and Lowell. Combined with proposal #7, it would also provide a one-transfer service to customers in Stoneham Center.

The connection between the two routes could be made at either Van de Graff Drive or the Lahey Clinic. However, since there is sufficient slack in the LRTA's schedule for their route to be extended without requiring additional resources beyond a minor increase in fuel costs, it would be preferable for the routes to meet at Van de Graff Drive.

Expanded Service Hours Between Burlington and Lahey Clinic (#5 on map)

This proposal suggests operating earlier AM peak service on Burlington B-Line buses to serve Lahey Clinic. Earlier operation of B-Bus service would improve access to daytime work shifts at Lahey Clinic.

Burlington has recently initiated this service.

Expanded Service Hours Between Lexington and Burlington (#6 on map)

This proposal suggests operating earlier and later service on Lexpress Route 5. Earlier and later operation of Lexpress Route 5 would improve connections to LRTA Route 19 and provide improved access to employment in Burlington and Bedford. In particular, early shifts at the Lahey Clinic would be more accessible, as would employment opportunities at area retailers and restaurants that open at 8:00 AM or before.

The annual increase in costs required to expand service hours would be approximately \$10,000.

Stoneham – Woburn (#7 on map)

This proposal suggests the operation of reverse peak direction service on MBTA Route 354 via Stoneham Square to provide Stoneham residents with access to jobs in Woburn.

Reverse peak trips on MBTA Route 354 could leave Interstate 93 at Roosevelt Circle instead of Montvale Avenue and make stops on Main Street in Stoneham. This would provide access from Stoneham to employment opportunities at Cummings Park in Woburn and Wayside Drive in Burlington.

There would be little to no added cost for the MBTA to reroute "reverse-commute" trips on Route 354. However, there would be some increase in travel times for existing riders traveling between Boston and Woburn. The added travel time could make the service unattractive for some present riders, which should be considered fully before a service change is implemented.