Innovations Deserving
Exploratory Analysis Programs

Transit IDEA Program

NEU BUS STOP SPACING ANALYSIS: A TOOL FOR EVALUATING AND OPTIMIZING BUS STOP LOCATION DECISIONS

Final Report for
Transit IDEA Project 31

Prepared by:
Peter G. Furth and Maaza C. Mekuria;
Northeastern University, Boston, MA

December 2005

TRANSPORTATION RESEARCH BOARD
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Innovations Deserving Exploratory Analysis (IDEA) Programs Managed by the Transportation Research Board

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EXECUTIVE SUMMARY

Spacing guidelines for bus stops reflect an inherent tradeoff – if stops are more closely spaced, passengers will have to walk less to reach a stop, but operating speed will suffer, increasing operating cost and passenger riding time. Interest in improving the speed and efficiency of bus systems, particularly bus rapid transit systems, has increased interest in changing stop spacing. The transit industry is in need of tools to help evaluate the impact of removing, consolidating, and adding stops.

The three main impacts of a change in stop spacing are to walking time, riding time, and operating cost. These impacts can be formulated mathematically as functions of the stop spacing and local parameters including passenger boarding and alighting rates, factors that affect ambient traffic speed, and characteristics of the local street network. Simplified models of bus routes and their surrounding areas show that the tradeoffs involved do not lead to simple, generalizable stop spacing guidelines such as "optimal stop spacing is X meters." Rather, optimal stop spacing depends on demand intensity for people walking to the stop, the demand of passengers riding through the stop, the running time impact of stopping, which can vary from location to location, and various speeds and unit costs.

While a general mathematical theory of stop spacing is well known, its application for transit planning has not been possible because realistic local factors play such an influence on walking distance. The most complex of those realistic local factors are

- the street network used for walk access – instead of being a fine rectilinear grid, it can contain streets that curve, that are diagonal, and that are interrupted
- non-uniform land use patterns that result in concentration of demand along certain street segments versus others.

The original plan of this project was to try to generalize and apply, as a prototype, one of the simplified models found in the literature, using an approximate way to deal with land use patterns.

However, we found that with an appropriate GIS (Geographic Information Systems) platform, a far superior method was possible, using parcel-level data available from a city assessor's office for land use data, and widely available street map data for the access network. Therefore, our approach changed from using GIS to provide input to a simplified model to building model in a GIS platform that skips the approximations, and directly calculates walking distance from parcels along the street network.

Consequently, the product of this project is not merely a generalization of an approximate method; it is a prototype development of an entirely new, GIS-based tool for evaluating stop spacing.

Products

There are three related products of this research. The first is a prototype software package for evaluating stop spacing impacts. The investigators are making the source code available to the general public (see "Product Dissemination" below). This

software is built on a GIS platform, and requires ArcView version 3 or above, along with the ArcView extension Network Analyst.

The second is documentation of the program, which includes a formal, scientific description of the methodology used. This documentation is available on request ((see "Product Dissemination" below).

The third product is a pair of case studies, contained in this report, describing the GIS model's successful application to a bus route in the Albany, NY area to a light rail line in Boston. Both case studies were done in cooperation with local transit agency planners, whose input helped guide product development. These case studies include sample outputs and screenshots that show the software's capability, and demonstrate the feasibility of a stop spacing analysis based on the actual street network and actual land use patterns.

At both case study sites, the transit agency was contemplating changes in stop spacing. On Boston's Green Line, for example, the agency had named four stops as candidates for elimination based on crude screening criteria. Our model was able to determine the likely impacts for each candidate stop. It showed that for some stops, the increase in walking time was more than compensated for in savings to riding time and running time; for others, the particulars of the demand distribution and walk access network made the overall impacts of eliminating the stop negative.

This project also proved the feasibility of the method in terms of the necessary data inputs. It showed that the model could be applied using readily available base map files and GIS databases from either the municipal assessor's office or the regional planning office.

Dissemination of Results

The product was demonstrated at the conference entitled "GIS in Transit" in Tampa in November, 2005, hosted by National Center for Transit Research at the University of South Florida.

A paper was also prepared for publication in the Journal of Public Transportation.

A full package of software including executable files, source files, and sample data files and output files is available for download on request. The software is distributed without charge, on the condition that it may only be disseminated under the same condition (i.e., without charge).

Program and methodological documentation are also available for download on request. Requests for software and documentation should be sent to *<Peter Furth> pfurth@coe.neu.edu*

Plans for Implementation

Northeastern University plans to further develop the software into a more user-friendly product on a more recent ArcView platform. It is expected that as transit agencies, consultants, and software developers for the transit industry become aware of the method demonstrated in this project, they will apply it through software on their chosen platforms.

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also available for download by request:

- This report (with full color figures)
- "NEU Stop Spacing Analysis: GIS-Based Software for Analyzing Bus Stop Spacing / Model and Software Documentation" (documentation of both the program and the method used)
- Program source code (written in Avenue)
- Program executable files (formatted as an ArcView extension)
- Sample input files for the case studies
- Sample output files for the case studies

Case Study 1

Green Line "B" - Commonwealth Avenue, Boston, MA

Sample data files that would allow one to repeat these case studies, along with output files, are included in the electronic documentation, available on request for download from <Peter Furth> pfurth@coe.neu.edu. Names of output files in the electronic documentation, formatted as spreadsheets, are given in Appendix B for the Boston case study, and Appendix A for the Albany case study.

1 Location

The Case Study for the Boston area is based on the MBTA Green Line light rail service and includes the western 2.7 miles of the route between Packard's Corner and the Boston College terminus.

Figure B-1 shows the study area, street network and the location of stops along the route. The project area was selected because the MBTA was considering removing some stops along this stretch of the service area as part of a larger program to improve operational speed. At present there are 15 stops over this 2.7 mile long section, for an average of about 6 stops per mile. The smallest stop spacing is 0.11 miles, and the greatest is 0.26 miles. This route has a several curves, and its service area has an irregular street pattern (see Figures B-1 and B-2), both of which complicate the determination of shed lines between stops' service areas.

2 Data Collection

Land use data was acquired from the City of Boston Assessor's Department. For each parcel, it includes its boundaries as a polygon, a land use code (LUC), and many other attributes. In this study, the attribute used to determine a parcel's relative transit demand was living floor area for residential land uses, and gross floor area for non-residential land uses. While the route lies entirely within the City of Boston, part of its service area lies in neighboring communities. For this case study, the parts of the route's service area lying outside the City of Boston were ignored.

Land use coefficients applied to each parcel's relevant floor area were generated using available trip generation data from the various published and unpublished sources (Furth, Mekuria, and San Clemente, "Modeling Transit Demand at the Parcel Level," submitted for publication to Transportation Research Record, target publication date is 2006).

The stop locations, running times, and on / off counts were obtained from the metropolitan planning agency Central Planning Transportation Staff (CTPS). Street data was obtained from the Mass. Highway Department's GIS section.

Other inputs to the stop table were generated by the analysts, including default arrival and departure delays of 6 and 7 seconds, respectively. The arrival and departure delays are stop specific, therefore it is possible to account for different aspect of the stop location characteristics. Stops that are located in level terrain may not need as much time as those in steeper grades. Directional indicator, whether

a stop is for inbound or outbound direction is required for each stop location (defaults to Inbound as True). Although it is not necessary for the operation of the program, the program analysis is for a single direction, therefore it is convenient to maintain a stop table by direction. Historic boardings and alightings are also required for each historic stop in the stop set. These were used to assign demand distribution to the respective parcels in the historic stop set service area. Once the parcels receive the portion of demand as an attribute, it is possible to perform alternative analysis of either adding or removing a stop.

Important parameters used for the analysis are shown on table B-1 and B-2.

Table B-1 – Global Parameters

cost walk ($/hr)	cost ride ($/hr)	unit on time (secs)	unit off tm (secs)	max walk dist (m)	pro-pensity ratio	file stem	no of periods	walk speed (m/s)	filepath
12	6	2.00	1.00	1600	0.33	Green B	3.00	1.22	D:\NEU\bustops \Boston\ Analysis\Eval

Table B-2 Period Parameters

period	start time	headway (min)	period length (hrs)	operating cost ($/hr)
1. AM	6:30	5	2.50	624
2. Mid	9:00	8	5.50	624
3. PM	15:30	5	3.00	624

Figure B-1 Project Location

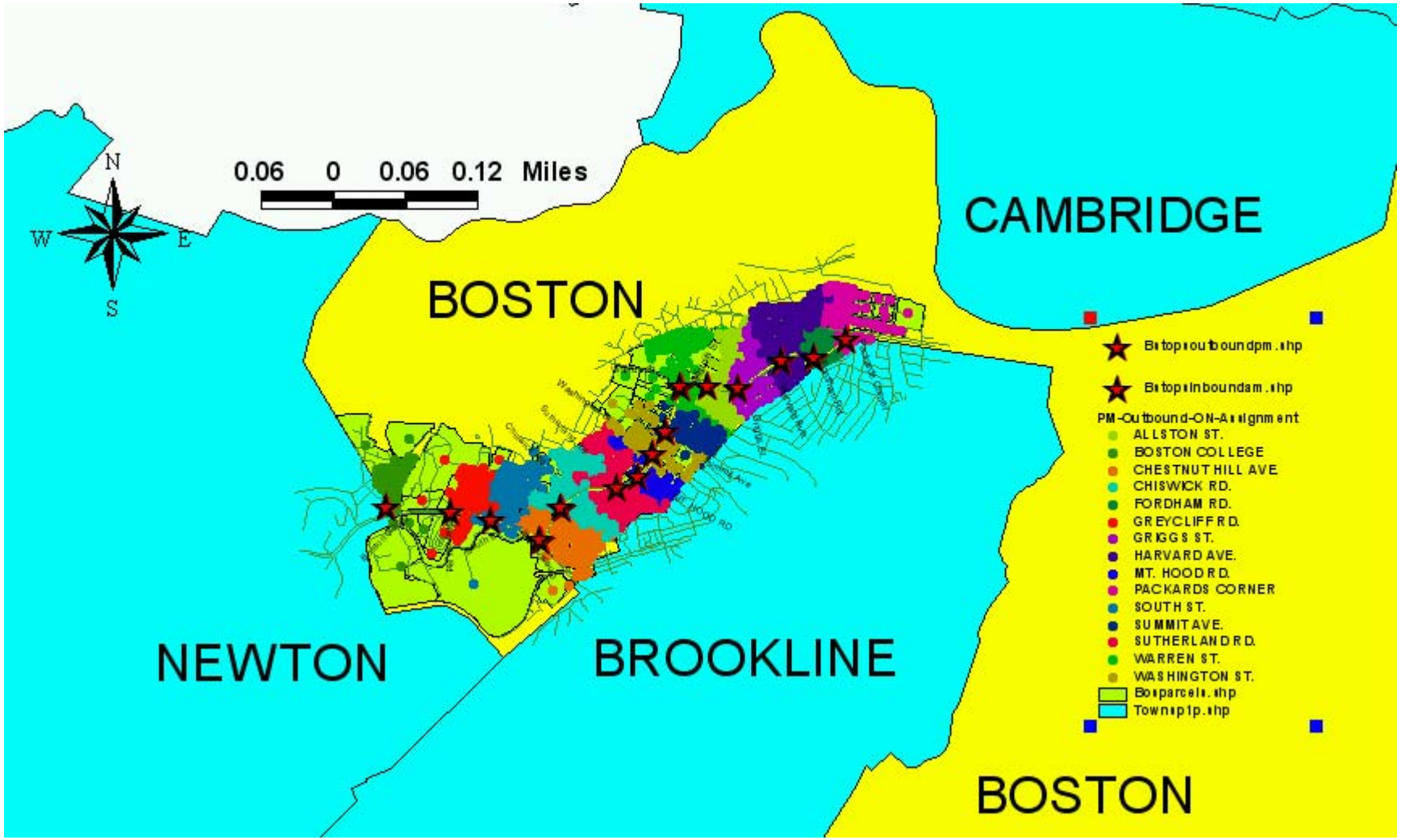
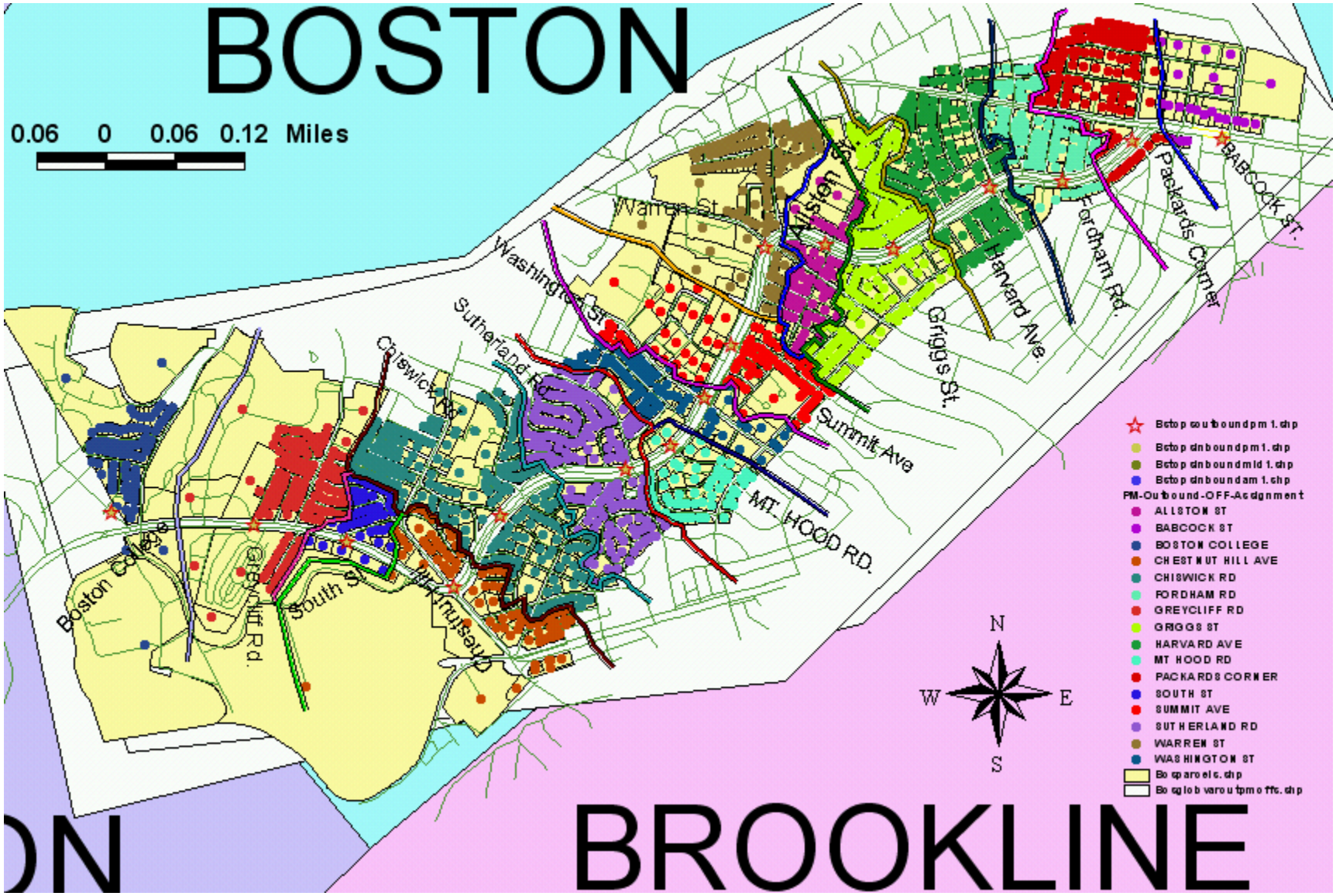


Figure B-2 Service Area Parcels, Centroids and Historic Stops



3 Analyzing the Historic Stop Set

Before the historic analysis could begin, further manipulation was required to convert the polygon assessor parcels to centroid points. This step is essential for the ESRI Network Analyst's "Closest Facility" routine to compute shortest paths between parcels and stops. A GIS analyst can perform this step easily. A polygon to point conversion utility is also provided with this application. Then, for each period / direction studied, the historic scenario was analyzed.

3.1 Walking Paths, Parcel-to-Stop Assignments, and Stop Service Areas

A first intermediate outcome of the historic analysis is that every parcel is assigned to a historic stop, choosing for each parcel the stop that minimizes a weighted sum of walking time to the stop plus riding time to the end of the line in the direction being analyzed. The assignment of parcels to stops effectively determines each stop's service area, and the shed lines between the various stops' service areas.

Figures B-3 and B-4 highlight some of the features of the assignment of parcels to stops. First, Figure B-3(a) shows the assignment in part of the route near the Mt. Hood Rd. stop for boardings in the outbound direction (westbound, toward Boston College). It shows optimal walking path trees (alternating black-green or alternating black-yellow lines) from parcels to its assigned stop. The parcels are color coded by assigned stop; for example, parcels assigned to Mt. Hood Rd. are highlighted yellow, and those assigned to Sunderland are cyan color.

Because service areas are based on passengers minimizing their generalized travel time, one should expect service area shed lines to shift according to the directional of travel, and depending on whether people are getting on or off. People from parcels that are roughly midway between two stops will prefer walking to a downstream stop when boarding, but will prefer walking from an upstream stop when alighting. Notice how in Figure B-3(a), there are some red parcels that are obviously a little closer to Mt. Hood Rd. than to Sutherland Rd., yet are assigned to Sutherland Rd., because Sutherland Rd. is the downstream of the two stops (for the direction illustrated, outbound).

To better illustrate this phenomenon, Figure B-3(b) shows optimal walking paths for *alightings* outbound. The color coding of parcels in this figure is still based on boardings – *i.e.*, it is taken unchanged from Figure B-3(a). Notice how in Figure B-3(b), many parcels are assigned for alightings to the same stop they were assigned for boardings; for example, most of the blue coded parcels south of the transit line are still on optimal walking paths leading to Mt. Hood Rd. However, most of the blue coded parcels north of the light rail line, and even some of the red coded parcels north of the light rail line, are on optimal walking paths that leading to Washington St., indicating that for alightings, unlike for boardings, those parcels are assigned to Washington St.

Figure B-4(a) shows the assignment of parcels to stops over the entire corridor for outbound *alightings*, with the respective alighting shed lines, Figure B-4(b) shows the assignment of parcels over the same corridor, and the resulting shed lines, for boardings outbound. Figure B-4(c) shows the assignment for *boardings* outbound, with shed lines for *alightings* (copied from Figure B-4(a)) superimposed. Again, the phenomenon of stops being assigned to one stop for boardings and a different stop for alightings is evident. Relative to shed lines for boardings, shed lines for alightings show a marked shift downstream (to the left).

Another interesting phenomenon that is clearly seen in Figure B-4(b) is that stop service areas do not border only those of adjacent stops, but they sometimes border the service areas of stops that are two

stops away. For example, Washington St.'s service area for boardings touches not only the service area of its two adjacent stops, Mt. Hood Rd. and Summit Ave., but also those of Warren St. and Sutherland Rd. This is an illustration of the "curve effect," because this phenomenon would not happen if the transit line were a straight line and the streets in its service area were all continuous and either parallel or perpendicular to the transit line. Another illustration of the same event is seen in Figure B-4(a) (shows the alighting shed line borders) where Chiswick Rd shed line meets Greycliff Rd shed line. There are two other stops (Chestnut St and South St) in-between these stops. Yet the curve effect is so strong that the min travel time paths almost come together. The same phenomena is repeated again in Figure B-4(a) between stops at Summit Ave and Griggs Street south of the trolley route. This effect is pointed out only because analytical models used until now to study stop spacing have made just those assumptions, and therefore assume that shed lines for stop service areas will simply be a series of parallel lines perpendicular to the transit line. This example shows that the real situation can be more complex.

3.2 Assigning Demand to Each Parcel

The most important outcome of the historical stop analysis is that a certain amount of demand (boardings and alightings, also called ons and offs) is assigned to each parcel. That assignment is stored as a permanent attribute of the parcel for use in analysis of alternative scenarios.

Demand is assigned to stops by allocating historic demand at each stop (an input) over the parcels in its service area. Ons and offs are allocated separately (since each have different service areas). Figures B-5(a) and (b) show demand for alightings and boardings, respectively, by parcel for the outbound PM peak. Larger circles represent parcels with greater demand. Notice that demand is not at all uniform around a particular stop; following the method's estimation procedure, a parcel's demand varies with its floor area, land use code, proximity to the nearest stop, and the observed demand at its assigned historic stop. Parcels with high demand are those with larger floor area – e.g., apartment buildings rather than single family homes. Also notice that parcels farther from the transit line tend to have less demand, a result of the gravity model-type propensity function used.

It is also interesting to compare PM peak *boarding* demand (Figure B-5(b)) with alighting demand (Figure B-5(a)). The two figures have different scales for circle size, because in the PM peak there are so many more alightings than boardings in this part of the route. What is worth noting is how some parcels are assigned considerably more boardings (relatively speaking) than alightings, and vice versa. This phenomenon is due to differences in land use coefficients used for boardings vs. alightings. In the PM peak, office buildings are given are much higher coefficient for generating boarding trips than for generating alighting trips, and so parcels with office buildings are assigned relatively more boardings and less alightings in the PM peak. Residential parcels, on the other hand, get a larger share of alightings demand than they do of the boardings demand. (The opposite should be true in the AM peak.)

3.3 Determining Undelayed Running Times

Another outcome of the historic stop analysis is that undelayed running times are estimated for every segment by subtracting from the historic running time profile the dwell time and expected arrival and departure delays at historic stops. These undelayed segment running times are stored permanently for use in analyzing alternatives.

Figure B-3(a) –Stop Assignment and Optimal Walking Path for Alightings (Mt. Hood Road Highlighted) (Inbound, AM)

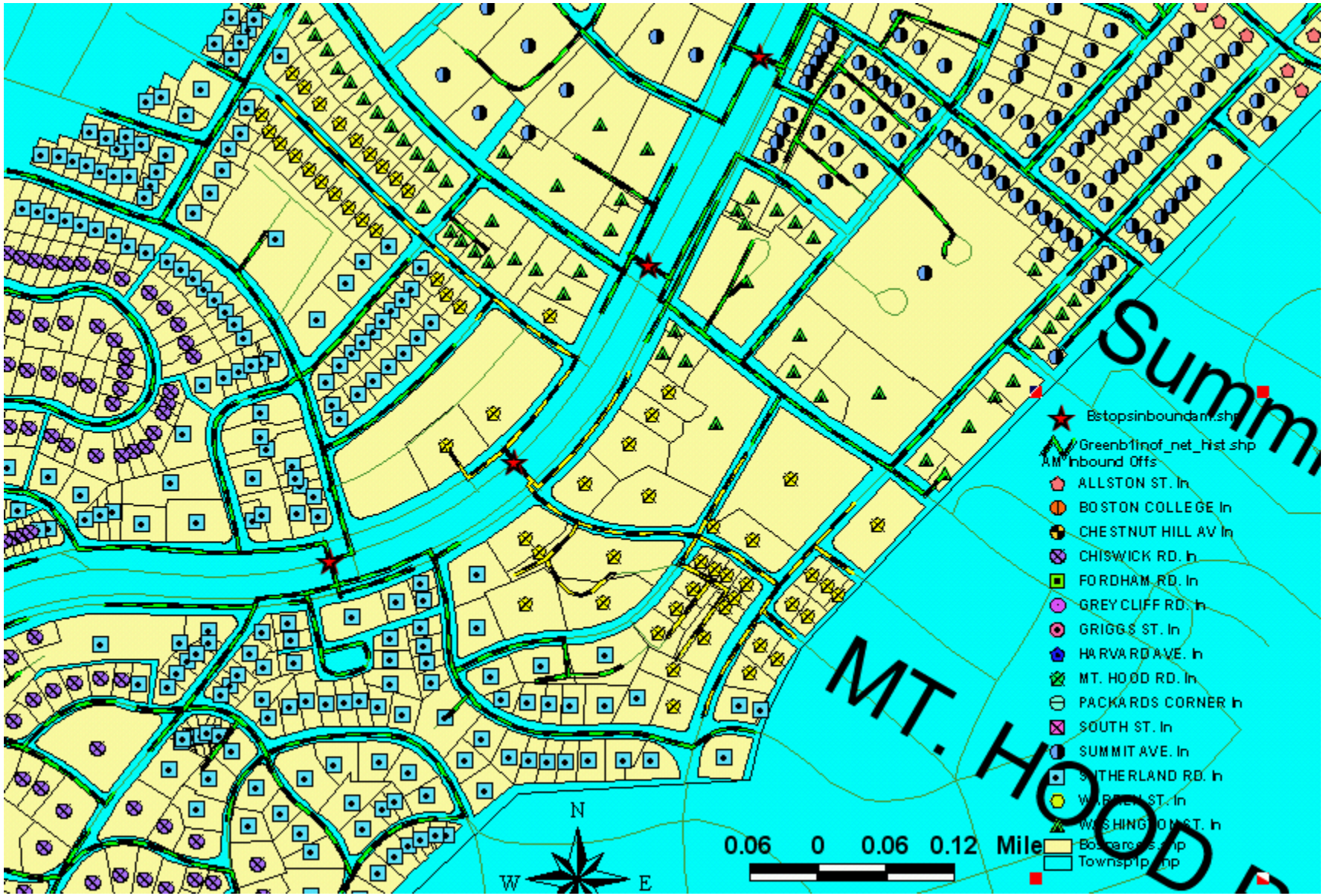


Figure B-3(b) – Optimal Walking Paths for Boardings, (Mt. Hood Road Highlighted) (Inbound, AM)

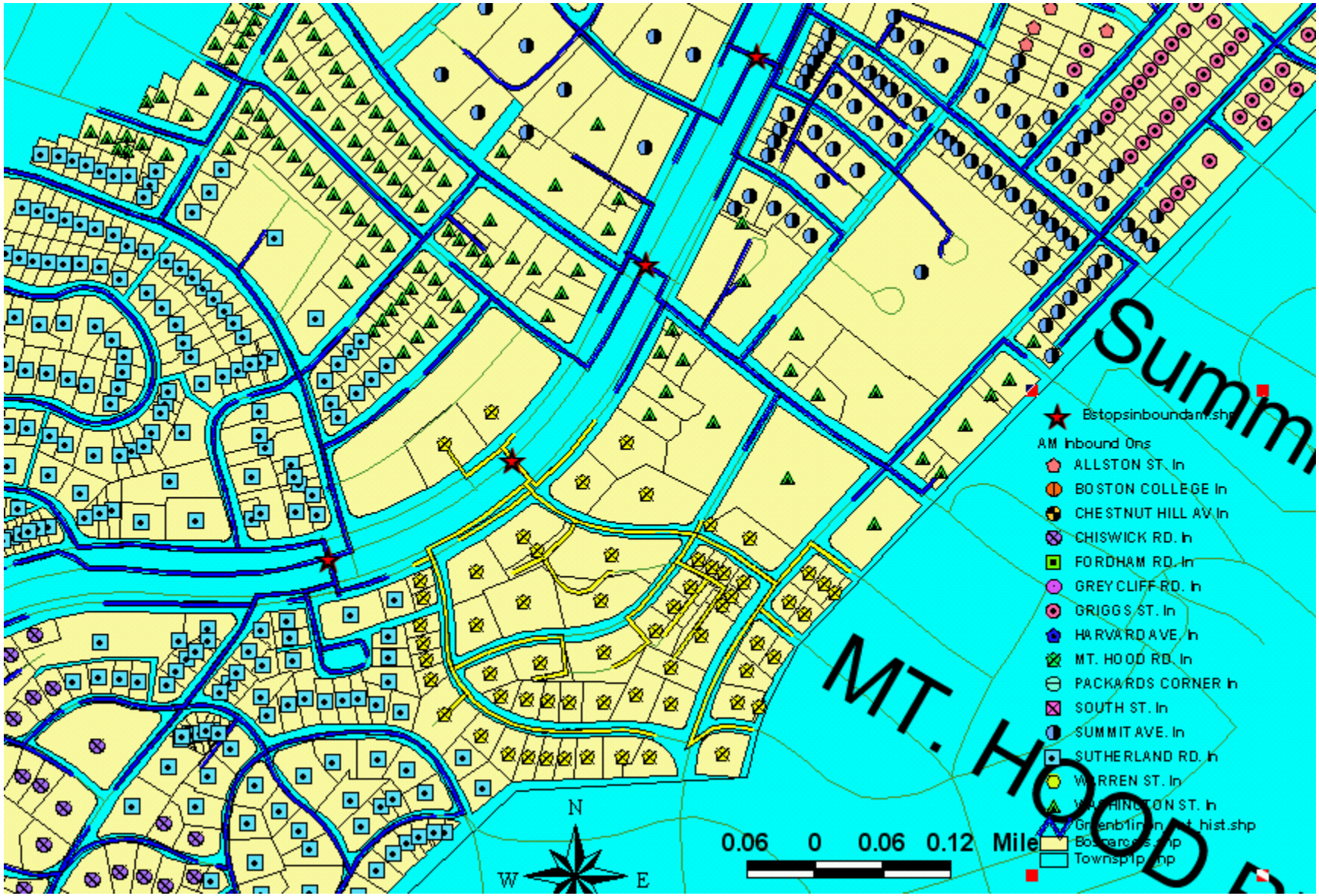


Figure B-4(a) – Stop Assignments and Shed Lines for Alightings (Outbound, PM)

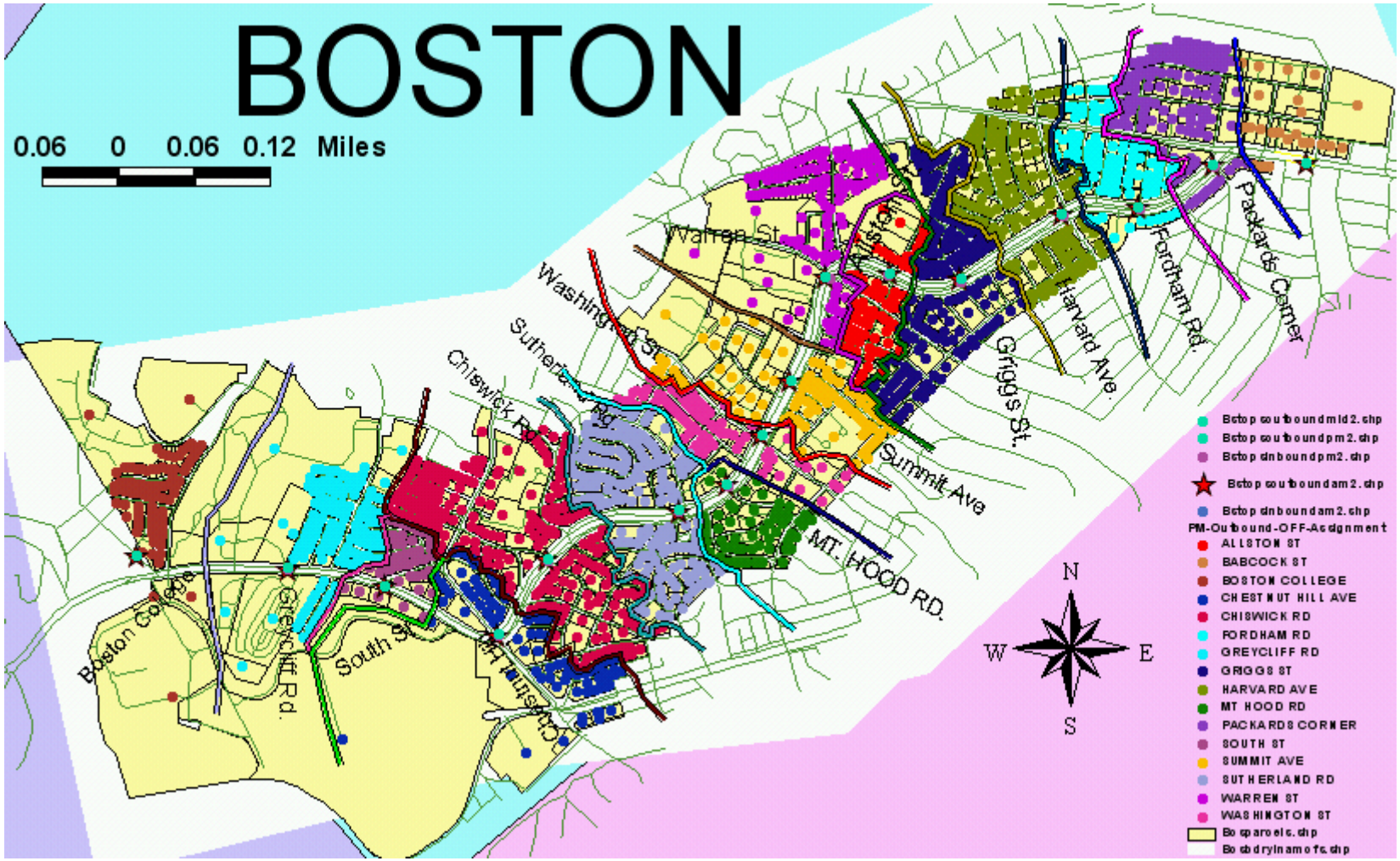


Figure B-4(b) – Stop Assignment for Alightings, with Shed Lines for Boardings (Outbound PM)

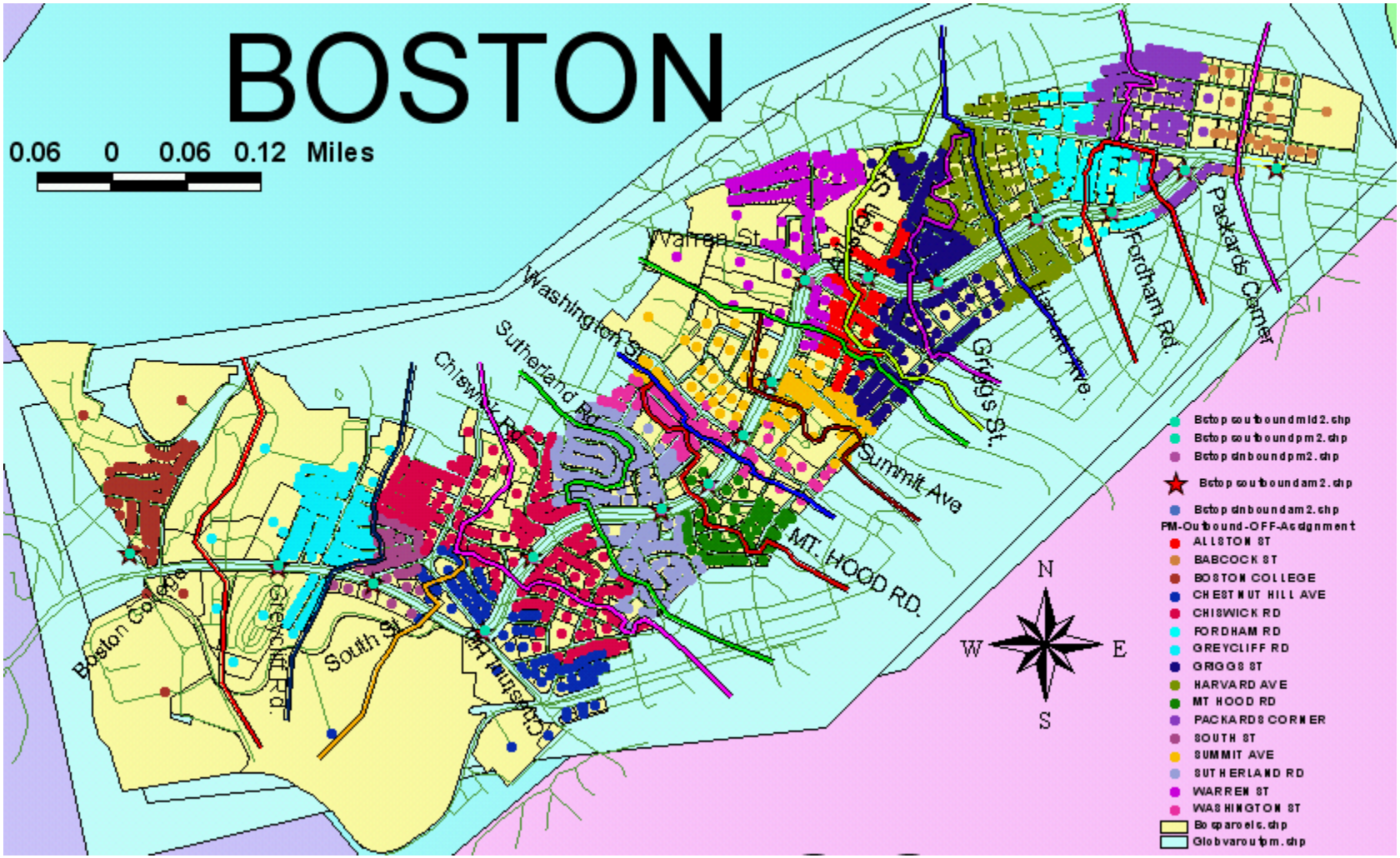


Figure B-5(a) – Outbound PM Alighting Contribution of Parcels

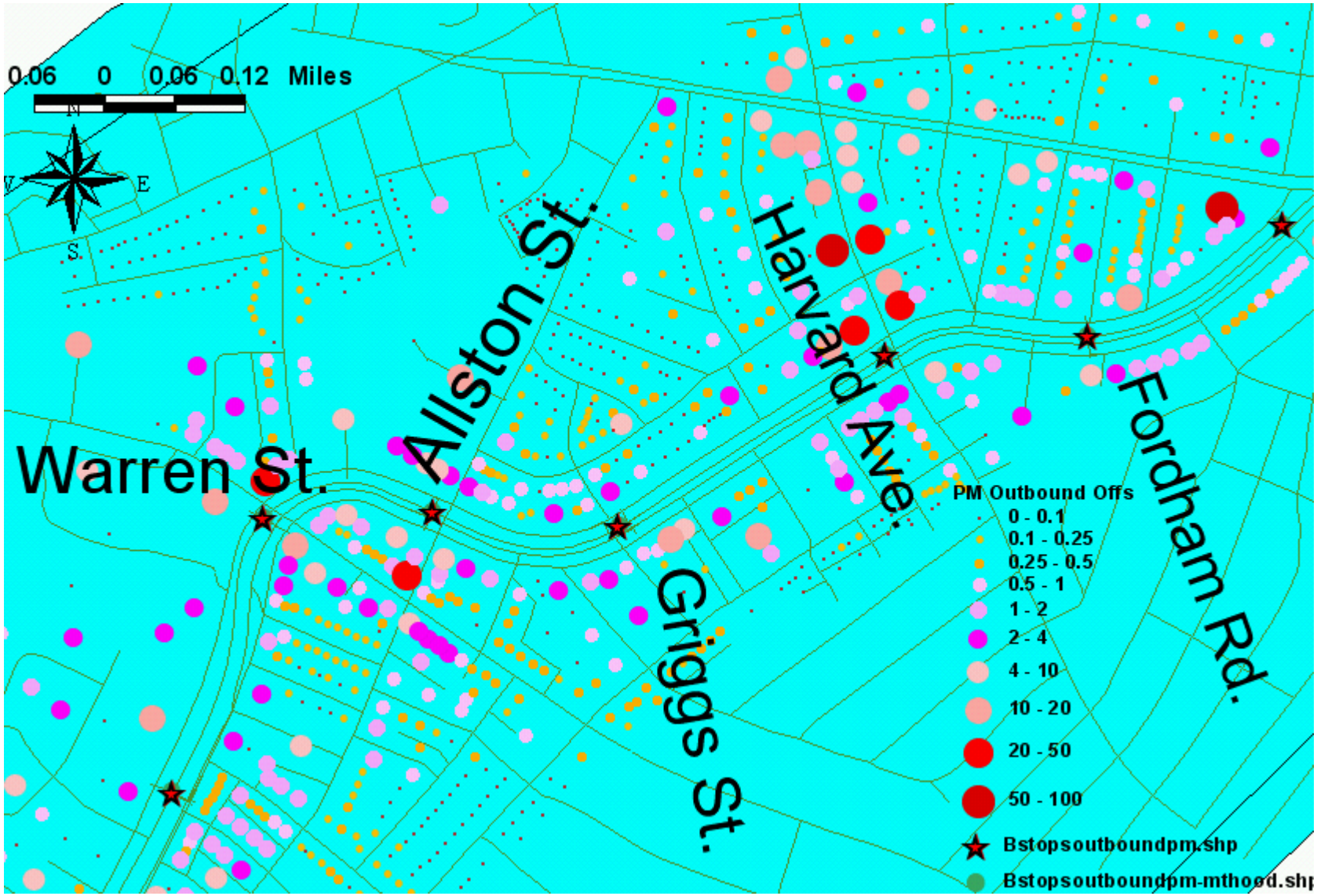
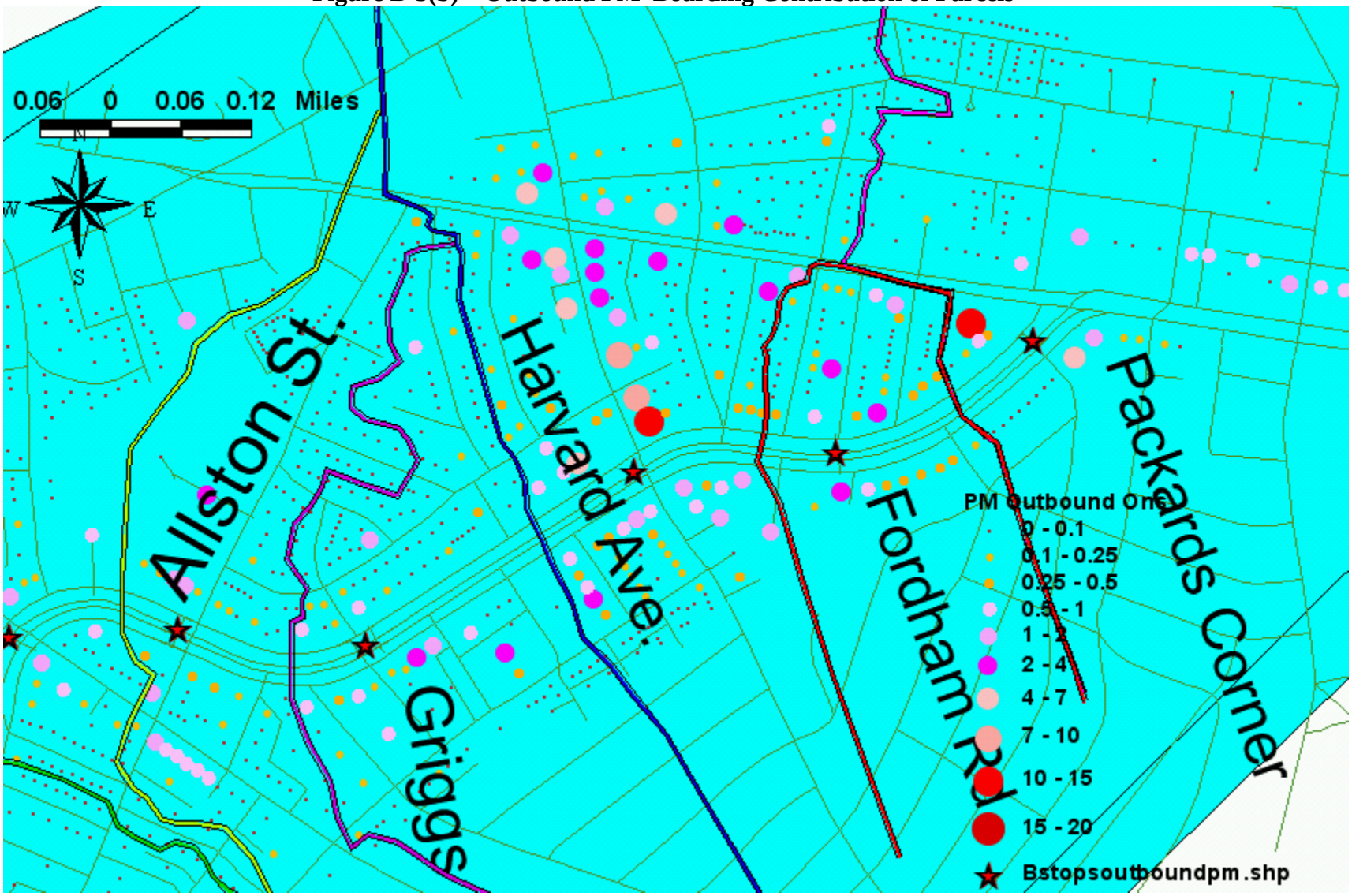


Figure B-5(b) – Outbound PM Boarding Contribution of Parcels



4 Eliminating a Stop

One alternative analyzed was elimination of a single stop, Mt. Hood Road. Lying 580 ft from the Sutherland Rd. stop on its west and 655 ft from the Washington St. stop on its east, and having lower demand than most of the stops, it is one of the three stops eliminated as part of the MBTA's pilot program. Results are presented here for the outbound direction, PM peak.

4.1 Walk Time Impact

Parcels formerly assigned to Mt. Hood Rd. were reassigned to another stop, based on minimizing combined walking and riding time (as in the historic analysis). Figures B-6(a) and (b) show, for outbound alighting and boarding passengers, respectively, the new optimal walking paths for parcels that historically had been assigned to Mt. Hood Rd. One can clearly see there how some of these parcels have been reassigned to the upstream stop (Washington St.) and some to the downstream stop (Sutherland Rd.).

In the political context of changing stop locations, it is helpful to see how much each parcel is affected by a stop elimination, so that strongly affected parcels can be identified. Figure B-7(a) shows walking times under the base case for outbound alighting passengers, with parcels color coded according to their walk time. While the general tendency of walk time to increase with airline distance from a stop is clear, one can also see local aberrations due to the irregular street network – some parcels that, as the crow flies, are quite close to a stop, have a long walk time because of the roundabout walking path they have to take. Of the parcels served by Mt. Hood Rd., only two have walk times greater than 6 minutes.

The impact of the stop elimination on each parcel is shown in Figure B-7(b), in which parcels are color coded according to their *change* in walking time. For this stop, no parcel's walking time (at least for alighting passengers) is increased by more than 2 minutes.

4.2 Overall Impact

What about the overall impact of the stop elimination? Table B-3 shows base case (historic stops) walking, riding, and running time for PM peak outbound service for each stop and its associated segment, which extends from a point halfway from the previous stop to the point halfway to the next stop, thereby including all the delay incurred at the stop, plus undelayed running time. One can see that average walk time is 2.7 minutes, average ride time 9.6 minutes, and running time for the entire segment is 27.5 minutes.

In that table, total cost is a weighted sum of walking, riding, and running time. Walking and riding time are weighted by unit costs ($12/hr and $6/hr, respectively) taken from the global parameter table (Table B-1). Running time is converted to operating cost by multiplying it by unit operating cost ($624/hr) and dividing it by the headway (6 minutes), found in the period table (Table B-2). The high unit operating cost reflects two-car operations, with an operator in each car (the operator in the trailing car is necessary for fare collection).

Results were likewise calculated for the alternative with Mt. Hood Rd. removed. Impacts, shown in Table B-4, are differences (Alternative minus Base Case). As expected, the only differences occur at stops in the vicinity of the eliminated stop.

Figure B-6(a) Alighting Passenger Paths for Parcels Previously Using Mt. Hood Rd. (PM Outbound)

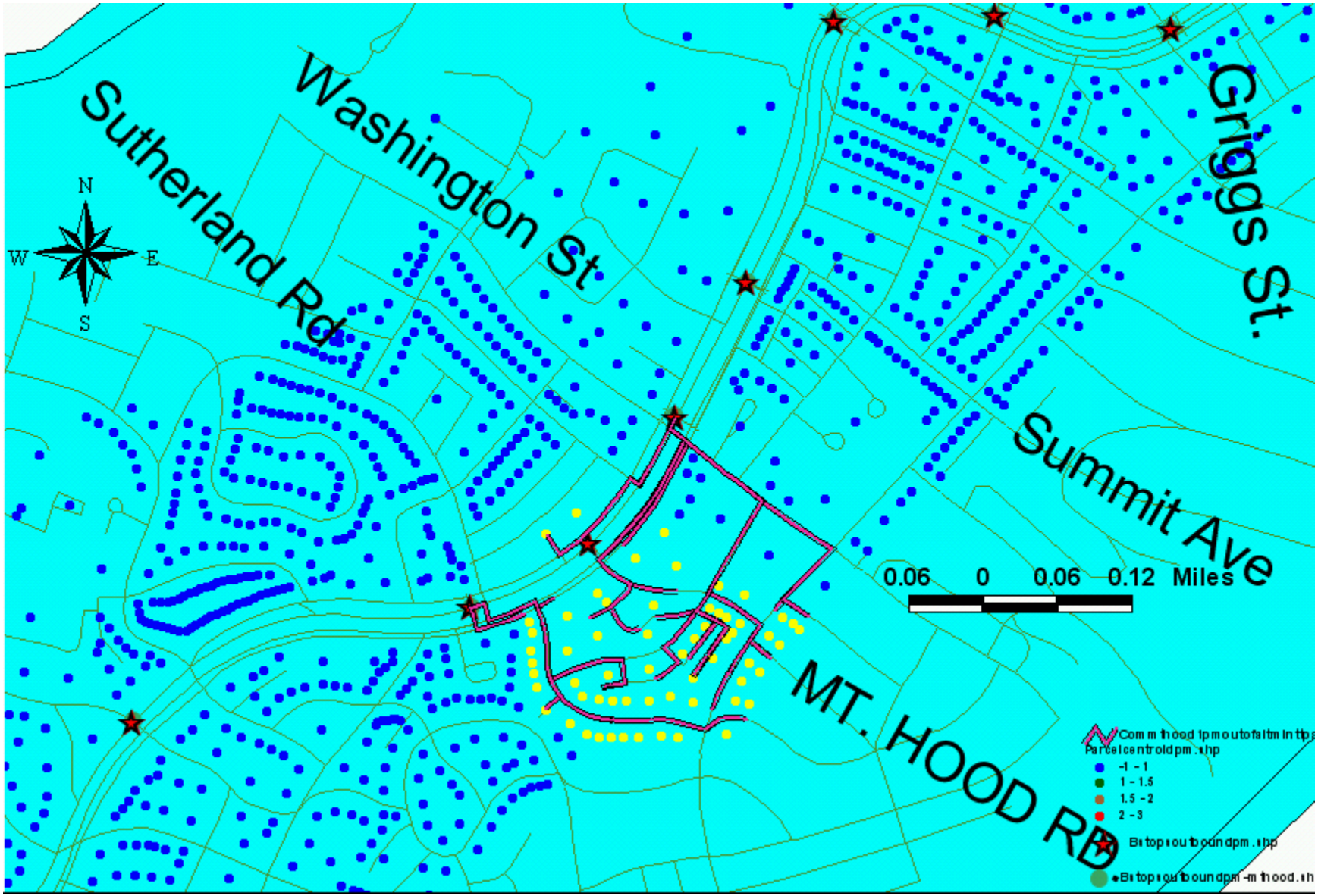


Figure B-6(b) Boarding Passenger Paths for Parcels Previously Using Mt. Hood Rd. (PM Outbound)

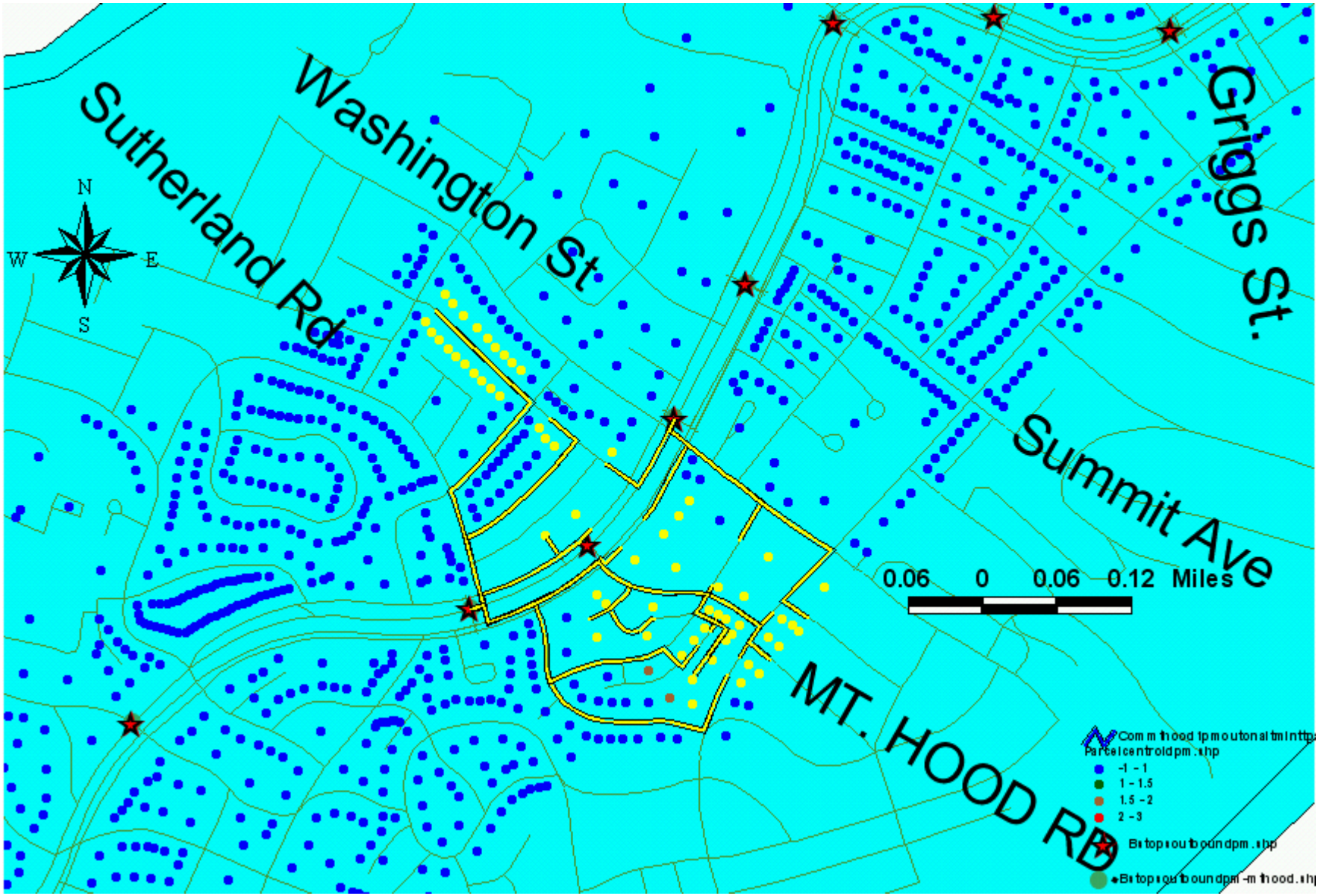


Figure B-7(a) – Walk Time by Parcel with Historic Stops (Outbound PM Alightings)

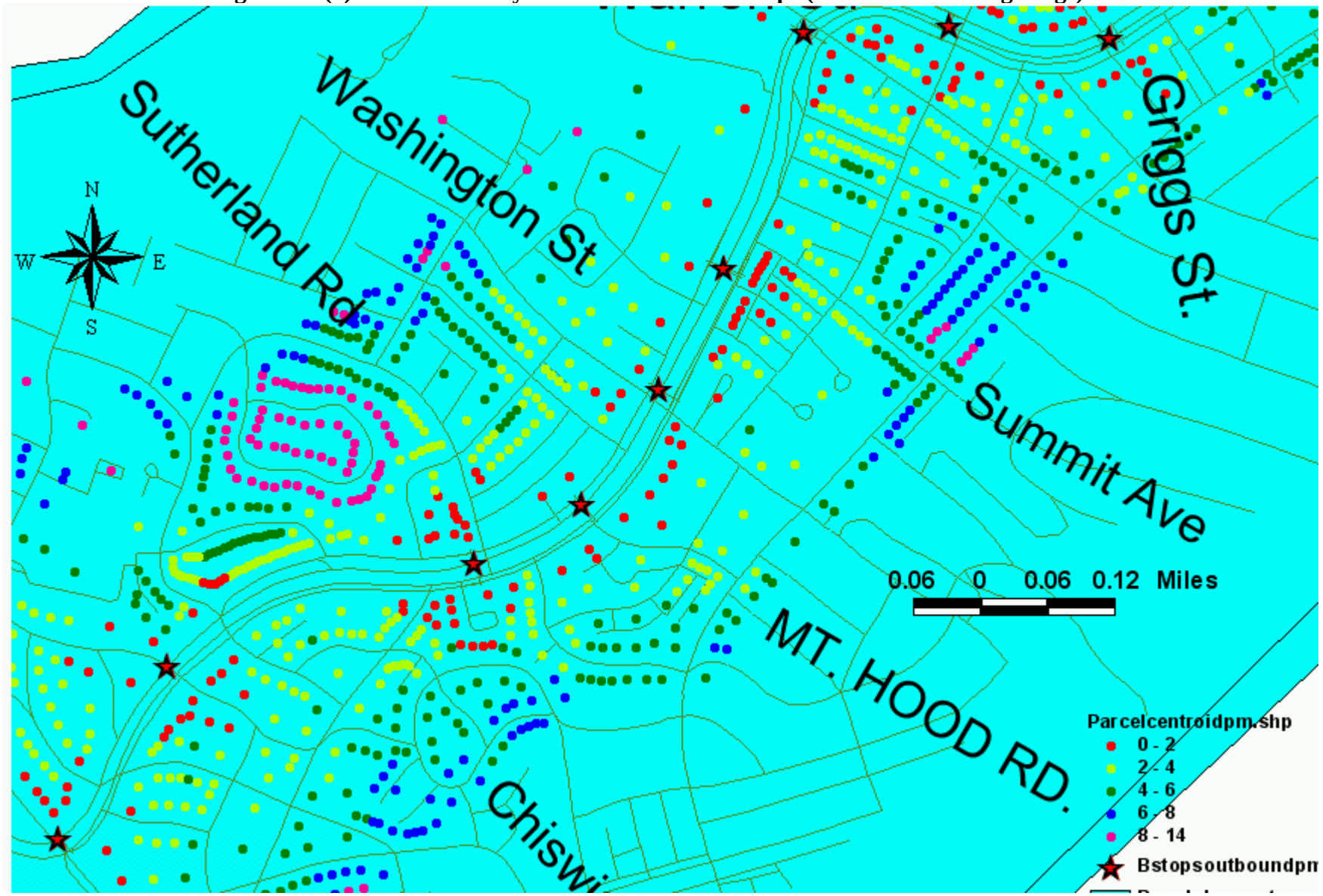
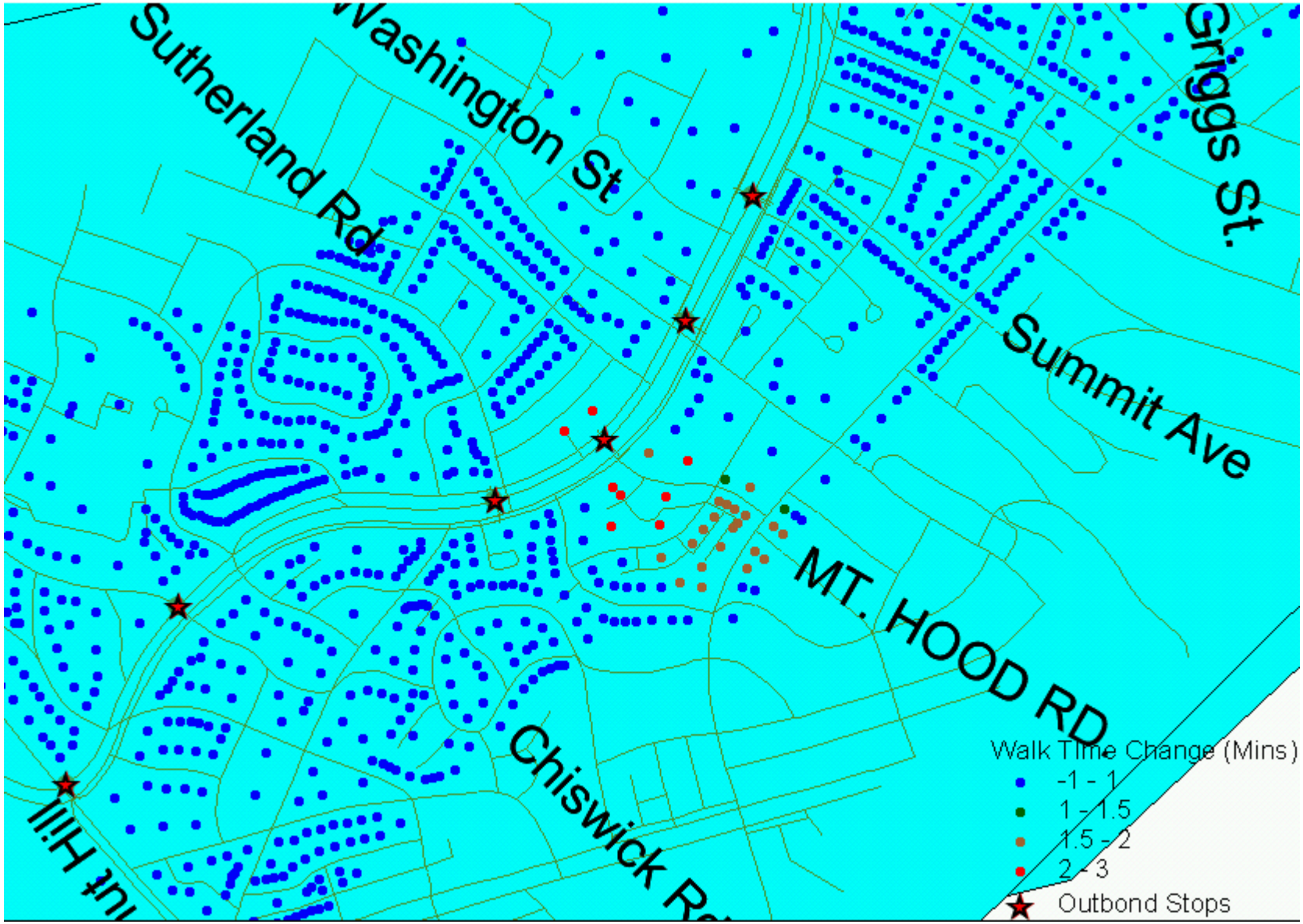


Figure B-7(b) – Change in Walk Time by Parcel with Removal of Mt Hood Rd stop (Outbound PM Alightings)



Result Tables

The results are given in tables for the historic and alternative scenarios in Tables B-3 through B-4. Table B-3 shows the impact of keeping all the historic stops as they are. This is the first step in the analysis procedure. Table B-4 shows the impact of removing Mt. Hood from the set of available stops. The evaluation program will determine the impacts to walking cost, ride cost and operating cost for this alternative. We observe a decrease in the cost of serving the same demand from $5,892.07 to $5,857.00 a savings of $35.07 per hour.

Table B-3 – Historic Stop Set Base Impact Result for Outbound Direction PM Period

stop	Stop Description	ons pax/hr	offs pax/hr	dep vol pax/hr	unde-layed run time (min)	walk time on pax-min/hr	walk tm off pax-min/hr	ride time pax-min/hr	seg-ment run time (min)	total cost $/hr	total cost $/pd
2	PACKARDS CORNER	25	170	1028	1.0	42	350	1746	1.6	453	1359
3	FORDHAM RD	15	74	969	2.1	25	231	1955	2.0	493	1479
4	HARVARD AVE	145	282	832	4.0	410	716	2631	3.1	870	2609
5	GRIGGS ST	22	102	751	6.1	63	308	1820	2.3	542	1627
6	ALLSTON ST	18	123	646	7.6	41	245	1453	2.1	465	1394
7	WARREN ST	24	116	554	9.4	95	325	1066	1.7	409	1227
8	SUMMIT AVE	3	100	457	10.2	7	323	1115	2.3	467	1400
9	WASHINGTON ST	36	144	349	13.1	99	293	1052	2.5	497	1490
10	MT HOOD RD	4	39	314	14.1	9	79	452	1.4	234	701
11	SUTHERLAND RD	16	71	259	15.2	39	172	402	1.4	257	772
12	CHISWICK RD	2	76	185	16.0	6	236	366	1.7	302	906
13	CHESTNUT HILL AVE	20	63	142	17.8	53	200	332	2.0	338	1013
14	SOUTH ST	4	29	117	19.3	13	42	160	1.2	175	524
15	GREYCLIFF RD	0	4	113	19.5	0	13	106	0.9	130	389
16	BOSTON COLLEGE	0	113	0	21.0	0	514	107	1.2	262	785
	Summary Data	333	1505			901	4048	14763	27.5	5892	17676

Table B-4 – Difference between Base case and Removing Mt. Hood Stop Results for Outbound Direction PM Period

stop	Stop Description	ons pax/hr	offs pax/hr	dep vol pax/hr	unde-layed run time (min)	walk time on pax-min/hr	walk tm off pax-min/hr	ride time pax-min/hr	seg-ment run time (min)	total cost $/hr	Annual Cost $/Year
2	PACKARDS CORNER	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
3	FORDHAM RD	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
4	HARVARD AVE	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
5	GRIGGS ST	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
6	ALLSTON ST	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
7	WARREN ST	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
8	SUMMIT AVE	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
9	WASHINGTON ST	1	31	-29	0.0	4.1	113.5	166.0	0.6	114	85811
10	MT HOOD RD	-4	-39	6	0.0	-8.6	-78.7	-452.5	-1.4	-234	-176715
11	SUTHERLAND RD	3	9	0	0.0	9.7	29.8	160.1	0.5	85	64389
12	CHISWICK RD	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
13	CHESTNUT HILL AVE	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
14	SOUTH ST	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
15	GREYCLIFF RD	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
16	BOSTON COLLEGE	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0
	Summary Data	0	0			5.2	64.6	-126.4	-0.3	-35	-26515
	Average	0	0	0	0.0	0.0	0.0	0.0	0.0	0	0

Table B-4 shows the difference between the alternative (eliminating Mt. Hood Rd.) and the historic results. As can be seen in Table B-4, the results differ only with in the shed line boundaries (see Figure B-3(c)) and the impact does not extend beyond the next two adjacent stops (Washington and Sutherland). Most of the alightings are assigned to the Washington St (See Fig. B-6(b)) stop, while most of the boardings are assigned to Sutherland Rd (See Fig. B-6(a)). A savings of $35/hour is realized by implementing this alternative.

Table B-5 shows the Annualized difference between the Six – Pair scenarios (With and with out Mt. Hood Rd.), i.e. three Inbound (AM, Mid-Day, PM) and three Outbound (AM, Mid-Day, PM) scenarios, result as a summary.

STOP	STOPDESC	Total Ons Pers/Hr	Total OFFS Pers/Hr	Total On Walk Time Pers-Min/Hr	Total Off Walk Time Pers-Min/Hr	Total RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/Hr	Run Time Savings After Removing Mt. Hood (Veh-Min/Hr)	TCOST $/Hr	Cost Savings After Removing Mt. Hood ($/Hr)	TCOST $/Year	Savings After Removing Mt. Hood $/Year
1	GreenB-inbound-AM-Hist-Summ	1440	116	3838	336	11381	22.3		$4,749		$2,991,804	
2	GreenB-inbound-AM-MtHood-Summ	1440	116	3879	342	11290	22.0	0.23	$4,721	$28	$2,974,081	$17,723
3	GreenB-inbound-Mid-Hist-Summ	855	128	2372	348	6602	22.2		$2,936		$4,808,697	
4	GreenB-inbound-Mid-MtHood-Summ	855	128	2400	352	6541	22.0	0.23	$2,918	$18	$4,779,543	$29,154
5	GreenB-inbound-PM-Hist-Summ	688	199	2169	530	5306	22.3		$3,858		$2,916,381	
6	GreenB-inbound-PM-MtHood-Summ	688	199	2188	540	5252	22.1	0.24	$3,829	$28	$2,894,976	$21,405
7	GreenB-outbound-AM-Hist-Summ	237	433	631	1472	4372	27.3		$4,270		$2,689,820	
8	GreenB-outbound-AM-MtHood-Summ	237	433	639	1481	4346	27.2	0.13	$4,254	$15	$2,680,128	$9,692
9	GreenB-outbound-Mid-Hist-Summ	239	652	639	1837	6094	27.5		$3,248		$5,320,257	
10	GreenB-outbound-Mid-MtHood-Summ	239	652	641	1855	6050	27.3	0.20	$3,232	$16	$5,293,746	$26,510
11	GreenB-outbound-PM-Hist-Summ	333	1505	901	4048	14763	27.5		$5,892		$4,454,405	
12	GreenB-outbound-PM-MtHood-Summ	333	1505	906	4113	14637	27.2	0.29	$5,857	$35	$4,427,889	$26,515
	Total							1.33		$141		$131,000

Case Study 2

Bus Route 55, Albany-Schenectady, New York

5 Location

The Case Study for the Albany area is based on the Route 55 bus service between the cities of Albany and Schenectady, NY. The object of the study is to reduce the route's run time by consolidating stops. The Capital District Transit Authority (CDTA), Albany, New York is introducing a bus rapid transit along the same route and would like to determine which stops to eliminate for a local bus service route. In order to determine which stops to keep and which one to eliminate, it is important to estimate the contributions of each stop on a route to the walking, riding and operating costs associated with that stop. The impact of stop elimination on the over all service to the customer is quantified by using geographic network data analysis tools. The total number of stops along the route are 58 in the westbound direction and 60 in the eastbound direction. Due to lack of land use data along part of the route, the analysis below utilizes only 42 (including one external stop) out of 58 stops in the Westbound (Outbound) direction and 45 (including one external stop) out of 60 in the Eastbound (Inbound) direction mostly in the section of the route around Schenectady. The land-use data around Albany was not readily available therefore the analysis concentrated on the Schenectady portion of the route (From MARJORIE RD & CENTRAL AVE to WASHINGTON AVE & STATE ST stops). Figure A-1 shows the over all area of study with stops (Start symbol), parcels (Colored dots), streets (blue lines). Figure A-2 shows the area with adequate land use data selected for the analysis.

6 Data Collection

Land use, stop locations and demand data was obtained from the Capital District Transit Authority (CDTA), Albany, New York. Most of the geographic data (Streets, stops and property/parcel) was obtained in MapInfo format from CDTA. An intermediate file (MIF) was created using MapInfo's universal translator. This data was then converted ArcView shape file data using ESRI/ArcView geographic data translator. The selected extent of street data is approximately a mile wide on each side of the route. Stops that were eligible for use were 42 (including one external stop) out of 58 stops in the westbound direction and 45 (including one external stop) out of 60 in the eastbound direction. These stops were selected based on the available land use data around them. Unlike the Boston property data, the Albany-Schenectady property data is already in a point format, hence there was no need to convert polygons to points. Also condominium (all properties that share a parcel area are superimposed on each other as individual units, while in Boston the condominium units were aggregated to form a super parcel in order to avoid duplication. Hence in a sense the Boston data might have much more individual parcels than Albany-Schenectady if the condominium were treated as individual parcels. The residential land used data begins to fail around the Marjorie Road & Central Ave stop (at the entry into the City of Albany while traveling eastbound). It was observed early during data collection, that there was geographic datum discrepancy between the property data and the street/stop data. Further research and communication with the data sources was not able to shed much light into the reason for the discrepancy. This analysis was not able to rectify the discrepancy since it was not known why and where

the discrepancy occurred. Some attempts were made to do data transformation but did not yield useful result. Therefore the data was used as is. The walking distances may not be accurate for the particular stop in the route. But because the major interest of the analysis is in the difference of the impact between two alternatives, it was possible decided to use the data as is. It is possible that that the data sets may be from different geographic referencing systems (datum).

The demand data included period counts of boardings and alightings by stop for weekdays and weekend. Also there were variant routes that operate during the different periods of the day. The day was divided into five periods: Early AM, AM Peak, Midday, PM Peak and Evening. Out of these four (AM Peak (5:30 AM – 8:30 Am), Midday (8:30 AM-2:30 PM), PM Peak (2:30 PM-5:30 PM) and Evening (5:30 PM –10:00 PM)) were used for the purpose of the this analysis. Data from each period was converted to hourly volumes by dividing the period ons and offs by the period length.

Parameter files such as global constants and period constants are used in the process of producing the results. The input file parameter tables (constants) that were used in the Schenectady - New York study are shown below. Headway values were average for the periods based on the spreadsheets data provided by the CDTA.

Global Constants

cost walk ($/hr)	cost ride ($/hr)	unit on time (secs)	unit off tm (secs)	max walk dist (ft)	pro-pensity ratio	file stem	no of periods	walk speed (ft/s)	filepath
10	5	2.0	2.0	3500	0.333	RT55	4	4	D:\NEU\bustops \Albany\ Dprog\AM

Constants for Eastbound

period	start time	headway (min)	period length (hrs)	operating cost ($/hr)
P1	5:30	3.00	16.36	80.00
P2	8:30	6.00	17.50	80.00
P3	14:30	3.00	14.55	80.00
P4	17:30	4.50	34.00	80.00

7 Analysis Procedure

As mentioned above the parcel data received was in point form hence no further manipulation was required. The stop data included both directions hence some manipulation was required to separate the eastbound from the westbound, as well as ordering the stops in the respective direction and adding run time information to all the stops. ESRI's Network Analyst has facility that computes distances along a linear path and that was utilized to append cumulative distances at each stop. Cumulative time was provided by the consultant and added to the stop data, whenever a stop is missing an interpolation using the cumulative distance was used. Running times varied by time of day and therefore period run-time

estimates were compiled and added to each period stop table (four periods, AM, Midday, PM, and evening, were used for the purpose of this study).

7.1 Alternatives selection:

For the purpose of this study, a historic case and two alternatives were analyzed. Tables A-0A and A-0B display the alternative set arrangement for the Westbound (outbound) and Eastbound (Inbound) directions. The columns showing the inclusion logical parameter indicates whether a stops is included in a scenario. Alternative B utilizes a non-historic stop (Stanford Street) being included in the stop set. It is possible to see that including Stanford Street is advantageous in reducing the walk time significantly. The distance between Balltown and Linda lane (The next stop) is very big (over 1/3 mile). Even though it has not been verified whether a westbound stop at Stanford St is possible, for this analysis this stop has been added to show the capability of the system. Since minimizing walking impact is one of the criterions used, in alternative "B" Stanford St is used to reduce the walking times for passengers. Alternative "B" also demonstrates the capability of the analysis tool to experiment adding stops that are new and estimate demands for these stops. It is also possible to generate demand to a completely new route (once determination is made as to the production and attractions strengths of all land use data attributes in the vicinity of proposed route.)

Table A-0A - Westbound Stop Set

		Westbound PM		Included in Alternative		
STOP #	Westbound Stop Names	ONS Pers/Hr	OFFS Pers/Hr	Historic	A	B
11330	MAYWOOD & CENTRAL AVE	0.00	0.00	TRUE	TRUE	TRUE
2281	MARJORIE RD & CENTRAL AVE	0.00	1.00	TRUE	TRUE	TRUE
10260	LISHAKILL ST & CENTRAL	0.67	1.67	TRUE	TRUE	TRUE
2282	2115 CENTRAL AVE	0.33	0.33	TRUE	TRUE	TRUE
2960	SALVATION ARMY STORE & CENTRAL AVE	0.00	0.00	TRUE	TRUE	TRUE
2959	SUNSET MOBILE HOME PARK & CENTRAL	0.67	0.33	TRUE	TRUE	TRUE
2285	2197 CENTRAL AVE	0.00	0.67	TRUE	TRUE	TRUE
2254	FULLERTON AVE & CENTRAL AVE	0.67	0.00	TRUE	TRUE	TRUE
2423	FAGAN AVE & CENTRAL AVE	0.67	0.33	TRUE	TRUE	TRUE
2286	CENTRAL AVE & CENTRAL AVE	1.00	0.33	TRUE	TRUE	TRUE
2422	BALLTOWN RD & CENTRAL AVE	0.00	0.00	TRUE	FALSE	FALSE
2422	STANFORD AVE & CENTRAL AVE	4.05	1.34	FALSE	FALSE	TRUE
2420	LINDA LANE & STATE ST	0.95	1.00	TRUE	TRUE	TRUE
2419	SHIRLEY DR & STATE ST	1.67	2.33	TRUE	TRUE	TRUE
1591	CHISWELL ST & STATE ST	0.67	0.33	TRUE	TRUE	TRUE
2287	MARSHALL AVE & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
1592	EASTHOLM RD & STATE ST	0.67	0.67	TRUE	TRUE	TRUE
2499	CORLAER AVE & STATE ST	2.33	1.67	TRUE	TRUE	TRUE
2288	NASSAU AVE & STATE ST	0.00	0.67	TRUE	TRUE	TRUE
2446	FENWICK ST & STATE ST	0.67	1.33	TRUE	TRUE	TRUE
2497	LAUREL AVE & STATE ST	5.33	3.33	TRUE	FALSE	TRUE
2289	VASSAR ST & STATE ST	0.67	0.67	TRUE	TRUE	TRUE
2447	FEHR AVE & STATE ST	1.67	1.67	TRUE	TRUE	TRUE
1736	WESTERN PARKWAY & STATE ST	3.33	3.67	TRUE	FALSE	TRUE
2416	JAMES ST & STATE ST	0.00	0.00	TRUE	TRUE	FALSE

2290	ROBINSON ST & STATE ST	2.00	1.99	TRUE	TRUE	TRUE
2342	ELM ST & STATE ST	0.67	3.33	TRUE	FALSE	TRUE
1721	FURMAN ST & STATE ST	0.33	2.33	TRUE	TRUE	TRUE
		Westbound PM		**Included in Alternative**		
STOP #	**Westbound Stop Names**	**ONS Pers/Hr**	**OFFS Pers/Hr**	**Historic**	**A**	**B**
3965	MCCLELLAN ST & STATE ST	5.33	7.67	TRUE	FALSE	TRUE
2961	BRANDYWINE AVE & STATE ST	0.33	6.04	TRUE	TRUE	TRUE
2995	WALDORF PLACE & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
2452	SWAN ST & STATE ST	0.67	6.62	TRUE	FALSE	TRUE
3200	STEUBEN ST & STATE ST	0.67	8.03	TRUE	TRUE	TRUE
3964	CATHERINE ST & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
2650	MYNDERSE ST & STATE ST	0.66	14.20	TRUE	TRUE	TRUE
1586	CLOSE ST & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
3692	NOTT TERR & STATE ST	0.00	15.11	TRUE	TRUE	TRUE
10230	CLINTON & STATE ST	0.67	13.49	TRUE	FALSE	TRUE
3744	BROADWAY & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
3743	ERIE BLVD & STATE ST	0.00	8.79	TRUE	FALSE	TRUE
11624	FERRY ST & STATE ST	0.00	0.00	TRUE	TRUE	FALSE
1594	S CHURCH ST & STATE ST	0.00	5.06	TRUE	TRUE	TRUE

Table A-0B - Eastbound Stop Set

		Eastbound AM		**Included in Alternative**		
STOP #	**Eastbound Stop Names**	**ONS Pers/Hr**	**OFFS Pers/Hr**	**Historic**	**A**	**B**
2421	WASHINGTON AVE & STATE ST	8.00	0.00	TRUE	TRUE	TRUE
3746	S FERRY ST & STATE ST	2.67	0.00	TRUE	TRUE	TRUE
2754	ERIE BLVD & STATE ST	3.00	0.00	TRUE	TRUE	TRUE
3744	BROADWAY & STATE ST	7.00	0.00	TRUE	TRUE	TRUE
10247	LAFAYETTE & STATE ST	1.67	0.00	TRUE	TRUE	TRUE
2755	VEEDER/NOTT TERR & STATE ST	17.33	0.00	TRUE	TRUE	TRUE
2260	CLOSE ST & STATE ST	0.00	0.67	TRUE	TRUE	TRUE
2393	HULETT ST & STATE ST	16.33	0.00	TRUE	TRUE	TRUE
2392	MARTIN ST & STATE ST	1.00	0.33	TRUE	TRUE	TRUE
2656	STEUBEN ST & STATE ST	4.00	0.33	TRUE	TRUE	TRUE
2968	SWAN ST & STATE ST	3.67	0.67	TRUE	TRUE	TRUE
2389	WALDORF PLACE & STATE ST	1.67	0.33	TRUE	TRUE	TRUE
10273	BRANDYWINE & STATE ST	0.00	0.00	TRUE	TRUE	TRUE
2261	MCCLELLAN ST & STATE ST	9.00	0.67	TRUE	TRUE	TRUE
11328	KELTON AVE & STATE ST	3.33	0.33	TRUE	TRUE	TRUE
2387	ELM ST & STATE ST	6.00	2.33	TRUE	TRUE	TRUE
2263	ROBINSON ST & STATE ST	1.67	0.67	TRUE	TRUE	FALSE
2264	CHARLES ST & STATE ST	6.00	0.33	TRUE	TRUE	TRUE
2265	HENRY ST & STATE ST	0.00	0.67	TRUE	TRUE	FALSE
2267	ELBERT ST & STATE ST	2.33	1.67	TRUE	TRUE	TRUE
2386	HARVARD ST & STATE ST	1.00	0.67	TRUE	FALSE	FALSE
2262	YALE ST & STATE ST	1.33	0.00	TRUE	TRUE	TRUE
2384	DARTMOUTH ST & STATE ST	0.00	0.00	TRUE	FALSE	FALSE

2383	MYRTLE AVE & STATE ST	0.00	0.33	TRUE	FALSE	TRUE
2382	LAWNWOOD ST & STATE ST	3.33	1.00	TRUE	TRUE	TRUE
2366	JACKSON AVE & STATE ST	2.00	2.00	TRUE	TRUE	FALSE
		Eastbound AM		**Included in Alternative**		
STOP #	**Eastbound Stop Names**	**ONS Pers/Hr**	**OFFS Pers/Hr**	**Historic**	**A**	**B**
2269	ROOSEVELT AVE & STATE ST	0.67	0.67	TRUE	TRUE	TRUE
2270	WILSON ST & STATE ST	1.00	1.00	TRUE	FALSE	FALSE
2967	VANZANDT ST & STATE ST	1.33	2.33	TRUE	TRUE	TRUE
2966	SANFORD ST & STATE ST	0.33	0.00	TRUE	FALSE	FALSE
2271	GEBHARDT ST & STATE ST	0.00	0.67	TRUE	FALSE	FALSE
11326	AUTOPORT ON STATE ST	0.33	0.00	TRUE	TRUE	TRUE
2381	LORRAINE & STATE ST	0.33	0.00	TRUE	TRUE	TRUE
2379	GIFFORD RD & STATE ST	1.67	1.00	TRUE	TRUE	TRUE
2378	LINDA LANE & STATE ST	0.33	0.33	TRUE	TRUE	TRUE
2657	BALLTOWN RD & STATE ST	2.33	3.67	TRUE	TRUE	TRUE
11327	STATE ST & FAIRFAX	0.67	0.33	TRUE	TRUE	TRUE
10264	FAGAN & CENTRAL AVE	0.33	0.67	TRUE	TRUE	TRUE
2697	WILBER AVE & CENTRAL AVE	0.67	1.00	TRUE	TRUE	TRUE
11318	CANTON ST & CENTRAL AVE	0.00	0.00	TRUE	TRUE	TRUE
11319	EVERGREEN CEMETARY/SUNSET TRAI	2.00	0.00	TRUE	TRUE	TRUE
11320	2128 CENTRAL AVE	0.00	0.33	TRUE	TRUE	TRUE
11321	LISHA'S KILL REFORMED CHURCH C	1.00	0.00	TRUE	TRUE	TRUE
2964	LISHAKILL RD & CENTRAL AVE	0.33	0.00	TRUE	TRUE	TRUE
11322	MARJORIE RD & CENTRAL AVE	0.33	0.33	TRUE	TRUE	TRUE

7.2 Walking Paths, Parcel-to-Stop Assignments and Stop Service Areas

The first table shows that the historic scenario where all the stops are those that are currently in service. The figures included in this document show an aspect of the analysis that is possible to perform during the course of an alternative analysis.

Figure A-3 and A-4 show shortest path trees (in solid red color) to historic stops (Eastbound direction and PM Period shown in highlighted yellow stars) used to determine the historic assignment of parcels to stops. Once this assignment is determined using the generalized minimum travel time, then the demand is reflected to the adjacent properties and stored as permanent attribute.

7.3 Demand Assignment

Figure A-5 and A-6 show such reflected demand distribution (Shown in Purple Round Dots) from the historic stops (Westbound PM Period shown in Blue Stars) to the adjacent properties. The demand is distributed based on factors such as land use types, number of persons dwelling (residential) or number of employees working (commercial) at the property, time of day such as AM when more boardings come from residential and more alightings to commercial properties, and proximity to the stop. This is in keeping with the assumption that demand decreases with the increase of distance from the servicing facility (gravity model). The available demand is distributed to all the parcels assigned to a stop according to the above attributes to all the properties are assigned to that particular stops relative to their attributes. As can be viewed from the figure the parcels closest to the stops have generally larger

contribution of demand than those farther away and commercial properties will have more boardings, while residential properties have more alightings. Figure A-5 shows a particular business property near Stanford Street Stop (bottom center of Figure A-5) which has 2.8.boardings and the same property has 0.8 alightings for the same period and direction. A residential property would show the opposite property.

Shed lines are shown on Figures A-7 through A-9. Figure A8 shows that there is a marked curve effect due to the irregular street network even though the route is straight. Also the accessibility of stops via the street network (presence of access streets to the respective stops) affects the stop facility assignment hence the shed lines. Another phenomena that is apparent is that stops that are not adjacent share a common shed line boundary, therefore some alighting passengers in the south west corner of Robinson / Elm /Furman opt to Board at McClellan St. to save travel time, even though they may have to walk more (See shed line on Figure A8). Robinson has common boundary with McClellan even though there are two other stops (Elm and Furman) between them. McClellan has boundary with four stops (Robinson, Elm and Furman in the south and Brandywine in the North). Figure A-9 also shows a similar curve effect except it is milder than the above. Eastholm Street has boundaries with Marshall and Chiswell streets. The shed lines show the slight difference between the boarding and alighting edges. This is due to the effect of direction on travel time (Figure A-9 shows this effect). The assumption is that more boarding people walk in the direction of their travel, if their origin is about half way between two stops, as long as it will save them time. And more passengers will alight earlier and walk to their destination for the same reason. Walk time differences in the various alternatives studied are caused due to the elimination of stops. In the generalized walking time computation, walk time is weighted more to reflect that people would rather ride a bus than walk. Therefore the stop assignment does favor riding rather than walking.

7.4 Walk time Impact

The impact of eliminating a stop causes a change in the walk time differences are shown on Figures A-10 and A-11. Figure A-10 shows the comparison between Alternate A and the historic scenarios. As can be observed from the figure, the increase in walk time is less than three minutes per parcel per stop removed (Yellow highlights the parcels with changed walk times). Once the total walk-time to and from a stop is computed it is multiplied by the unit walking cost in order to calculate the impact at that stop. Figure A-11 shows the difference in minutes of walking times between Alternate B and the historic scenario. There is a slight increase in walk time (Blue (0.5-1 min), Red (1.75-2.5 min) and Dark Red (2.5-3.5 minutes) colored properties) due to the elimination of more stops than Alternate A. Figure A-12 shows the area around the newly added Stanford St stop. Here we see both an increase of walk time in one area and a decrease in another. The increase in walk time is for those parcels (Blue color properties (0.5-1 min)) closer to Balltown which is removed in Alternative B, while those closer to Stanford St. have their walk time reduced by up to three minutes (Yellow colored properties).

7.5 Ride Time Difference

Ride time differences are also due to primarily elimination of stops. The arrival and departure delays associated with stopping contribute towards the difference in ride times between the alternatives. When a stop such as Harvard St in the Eastbound direction is removed those passengers boarding or alighting at that stop are transferred to the adjacent stops and the dwell time there varies accordingly. Delays experienced by passengers already on board the vehicle, and those trying to alight at that stop varies accordingly. At each stop the arrival and departure delays will slightly change depending on how many Boardings and alightings are occurring. The probability of stopping (Probability of stopping = 1 – exp(-

$^{(Ons+Offs)*headway)}$) will slightly vary from stop to stop according to the demand changes. The delay due to stopping will be the sum of arrival and departure delays multiplied by the probability of stopping and the additional variable dwell time (which is equal to the sum of the unit boarding time multiplied by the number of boardings and the unit alighting time by the number of alightings at that stop). Hence for the Eastbound AM period, the total on+offs at the Harvard stop = 1.67 + 0.33 = 2.0 pax/hr. Using the headway parameter, Probability of stopping = 0.36526, Acceleration delay = 7 secs and Deceleration delay = 6 sec. Savings realized = 0.36526*(6+7) = 4.7 secs. While the variable dwell time = 1.67 * 2 + 0.33 * 2 = 4.0 secs. Ride impact is computed by considering all the delays associated with stopping and multiplying with the unit cost of riding.

7.6 Running Time differences

Run time differences are calculated by first computing the un-delayed travel time between stops at the historic level. Once the base un-delayed run time is stored during the historic analysis, then alternative arrangement of stops could be compare to the historic cumulative ride time to determine if in-fact it is beneficial. A stop elimination will almost always reduce the run time (special case of no reduction when that stop has zero demand). The expected arrival and departure delays play an important role in determining the impact on run time calculations. When a stop is not part of the historic set an estimate of ride time required for the analysis to give meaningful results. When an estimate of ride time between stops is not adequate to cover the delay between stops then a warning message is displayed as well as a text report written to indicate which segments cumulative ride time has the deficiency. Run time is computed using segments of the route between successive stops. The analysis breaks down segments before and after a stop in to half the segment before and half the segment after a stop in-order to compute the impact of run time at a stop. When a stop such as Harvard St in the Eastbound direction is removed a savings of time equivalent to the sum of arrival and departure delays multiplied by the probability of stopping is realized. (Probability of stopping = 1 – exp($^{(-(Ons+Offs)*headway)}$). Hence for the Eastbound AM period, the total on+offs at the Harvard stop = 1.67 + 0.33 = 2.0 pax/hr. Using the headway parameter, Probability of stopping = 0.36526, Acceleration delay = 7 secs and Deceleration delay = 6 sec. Savings realized = 0.36526*(6+7) = 4.7 secs. Overall run time does not get affected by movement of passengers from one stop to the next, since no passengers are assumed to change modes, i.e. the demand is never lost. Therefore variable dwell time get subtracted out when comparing alternatives and does not affect the total savings over total travel time. Once the change in runtime is determined its impact is calculated by multiplying it with the unit cost of operating the vehicle. In Albany the operating cost is $80/hr. The reduction (savings) in run time of Alternative A for Outbound PM period is 51.6 Vehicle-Minutes per hour. The cost in $ per hour is calculated by using the headway for the period (h=15 minutes, i.e. 4 buses per hour) is 51.6/60*4*80 = $218/hr.

7.7 Albany and Boston Comparison

The Albany study has three times the number of stops and more than twice as many parcels as Boston's. As a consequence, program runs for Albany took considerably longer (about 8 minutes) than did runs for Boston (about 3 minutes).

8 Result Tables

The results are given in tables for the historic and alternative scenarios. The Summary table A-1A and A-1B show summary data produced at the end of the analysis. Table A-1A emphasizes the results based different cost factors for the walking and riding impacts ($10/hr walking and $5/hr for riding). As can be seen from the results for the time saving (in pers-Min/Hr) for walk and ride impacts Alternative A has

a deficit of **$2,110.41/year** while Alternative B has a savings of **$8,968.78/year**. The cost factor between walking and riding time is 2 (i.e. Walking Cost is twice more than Riding cost cost) hence the walking time impact is exaggerated.

If the same cost factors for both riding and walking (i.e. $5/hr as in Table A-1B) are applied the total **savings** for **Alternative A** will be equal to **$8,830.90/year** while **Alternative B** has a **savings** of **$16,860.69/year**. There is shift in Alternative A from a deficit to a savings when the cost factors for walking and riding are equal.

The summary table A-2 shows the results for the comparison of the different scenarios for each period and direction. The historic scenario where all the existing stops are included is compared with the two alternatives (Alternative A was suggested by the Consultant, while Alternative B was one which was done by Northeastern University). All the three scenarios have the same ons and offs even though the number of stops are different. Alternative A has six (6) less stops in the eastbound direction and has nine (9) less stops in the westbound direction than the historic scenario while alternative "B" has nine (8) less stops in the eastbound and has eight (8) less stops in the westbound direction (including addition of Stanford St to the Alternative). The three impact estimators, i.e. walking time, riding time and operating time are compared for each alternative by period and by direction and then an overall summary is produced. Due to the relatively low demand values in the route, the total savings are smaller than Boston case study.

Details of each alternative by direction for AM and PM peaks are re-produced and shown in Tables A-3 through A-8. The rest of the results are provided as an excel spreadsheet and are available with the project submittal.

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Table A-1A Summary of Daily Time Savings (Cost of Walking = $10/Hr, Cost of Riding = $5/Hr)

Impact	Runtime Per Cycle (min)	Total (On+Off) Walk Time Pers-Min/Hr	Operating Cost per Cycle ($)	Walk Cost Per Year ($)	Riding Cost Per Year ($)	Operating Cost Per Year ($)	Total Cost ($/Year)
Daily Total Historic Values	50.1	2228	$190	$396,400	$829,456	$860,796	$2,086,653
Daily Total Alternate A Values	49.5	2357	$188	$418,283	$819,821	$850,659	$2,088,763
Daily Total Alternate B Values	49.4	2325	$188	$412,184	$816,724	$848,775	$2,077,684
Change (Historic - Alternate A) Pers-Min/Hr	-0.6	129	-$2	$21,883	-$9,636	-$10,137	$2,110
Change (Historic - Alternate B) Pers-Min/Hr	-0.7	97	-$3	$15,784	-$12,732	-$12,021	-$8,969

Table A-1B Summary of Daily Time Savings (Cost of Walking = $5/Hr, Cost of Riding = $5/Hr)

Impact	Runtime Per Cycle (min)	Total (On+Off) Walk Time Pers-Min/Hr	Operating Cost per Cycle ($)	Walk Cost Per Year ($)	Riding Cost Per Year ($)	Operating Cost Per Year ($)	Total Cost ($/Year)
Daily Total Historic Values	50.1	2228	$190	$198,200	$829,456	$860,796	$1,888,453
Daily Total Alternate A Values	49.5	2357	$188	$209,141	$819,821	$850,659	$1,879,622
Daily Total Alternate B Values	49.4	2325	$188	$206,092	$816,724	$848,775	$1,871,592
Change (Historic - Alternate A) Pers-Min/Hr	-0.6	129	-$2	$10,941	-$9,636	-$10,137	-$8,831
Change (Historic - Alternate B) Pers-Min/Hr	-0.7	97	-$3	$7,892	-$12,732	-$12,021	-$16,861

Table A-2 Albany Route 55 Grand Summary for Scenario Results

Alternative STOP Result Set	Total Ons Pers/ Hr	Total OFFS Pers/ Hr	Total On Walk Time Pers-Min/Hr	Total Off Walk Time Pers-Min/Hr	Total RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/Hr	Run Time Savings After Removing (Veh-Min/Hr)	TCOST $/Hr	Cost Savings After Removing Stops ($/Hr)	TCOST $/Year	Savings After Removing Stops $/Year
Outbound EV Historic Result	19	72	55	178	974	23.2		$174.2		$197,576	
Outbound EV ALT A Result	19	72	58	197	947	22.5	0.7	$174.0	$0.2	$197,336	$239
Outbound EV ALT B Result	19	72	49	188	954	22.6	0.6	$171.9	$2.3	$194,917	$2,659
Outbound PM Historic Result	37	119	68	206	1680	26.4		$326.1		$246,519	
Outbound PM ALT A Result	37	119	75	241	1649	25.8	0.6	$327.4	-$1.3	$247,492	-$973
Outbound PM ALT B Result	37	119	63	230	1650	25.8	0.5	$323.8	$2.3	$244,760	$1,759
Outbound MID Historic Result	42	83	117	219	1126	26.1		$259.5		$392,435	
Outbound MID ALT A Result	42	83	126	239	1103	25.6	0.6	$260.5	-$0.9	$393,810	-$1,376
Outbound MID ALT B Result	42	83	111	231	1108	25.7	0.5	$257.2	$2.4	$388,831	$3,604
Outbound AM Historic Result	37	66	103	187	855	25.2		$231.5		$174,986	
Outbound AM ALT A Result	37	66	115	198	842	24.9	0.3	$232.7	-$1.2	$175,886	-$900
Outbound AM ALT B Result	37	66	107	192	845	25.0	0.3	$231.0	$0.4	$174,669	$318
Inbound EV Historic Result	41	17	105	40	475	22.3		$116.1		$131,662	
InBound EV ALT A Result	41	17	105	41	474	22.2	0.0	$116.1	$0.0	$131,637	$25
InBound EV ALT B Result	41	17	106	44	472	22.2	0.1	$116.4	-$0.3	$132,051	-$388
InBound PM Historic Result	126	81	234	108	1565	25.9		$329.6		$249,147	
InBound PM ALT A Result	126	81	235	110	1560	25.8	0.1	$329.1	$0.5	$248,805	$343
InBound PM ALT B Result	126	81	237	124	1540	25.5	0.3	$328.9	$0.7	$248,633	$514
InBound MID Historic Result	108	49	281	112	1489	26.3		$309.7		$468,329	
InBound MID ALT A Result	108	49	283	115	1485	26.2	0.1	$309.7	$0.1	$468,254	$76

InBound MID ALT B Result	108	49	287	125	1468	26.0	0.3	$309.7	$0.0	$468,314	$15
InBound AM Historic Result	116	25	180	36	1663	25.1		$297.3		$224,736	
InBound AM ALT A Result	116	25	182	39	1656	25.0	0.1	$297.1	$0.2	$224,587	$149
InBound AM ALT B Result	116	25	187	44	1639	24.9	0.3	$296.5	$0.8	$224,169	$567
Daily Total Historic Values	526	513	1142	1086	9827	200.4		$2,044.0		$2,085,391	
Daily Total Alternate A Values	526	513	1177	1180	9715	197.9	2.4	$2,046.5	-$2.5	$2,087,807	-$2,417
Daily Total Alternate B Values	526	513	1147	1178	9675	197.6	2.8	$2,035.4	$8.6	$2,076,344	$9,047

Figure A-1 - Case Study 2: Route 55 – Schenectady -Albany , NY (Stops selected shown in yellow)

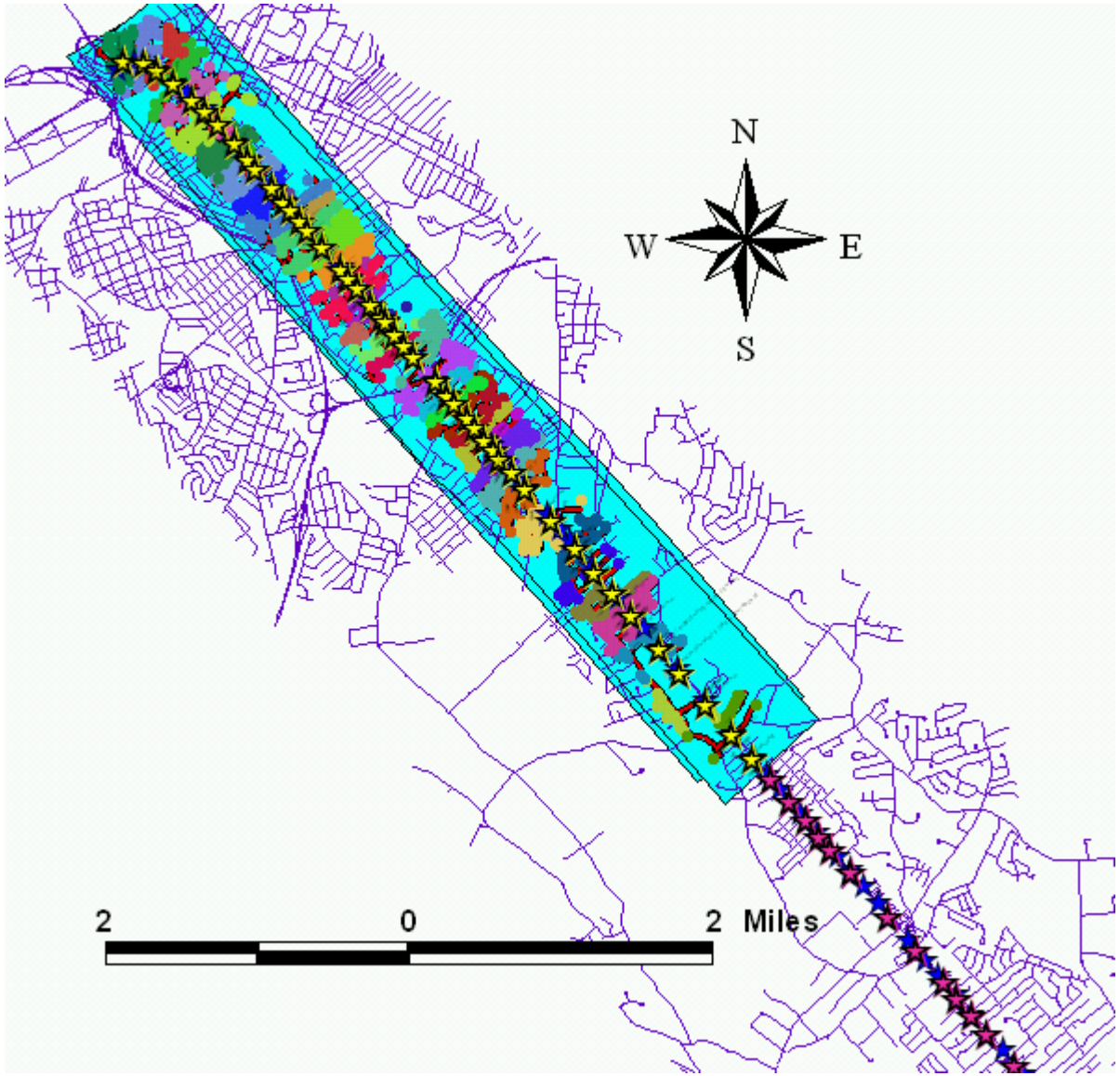

Figure A-2 - Case Study 2: Route 55 – Schenectady -Albany , NY - Showing area of analysis

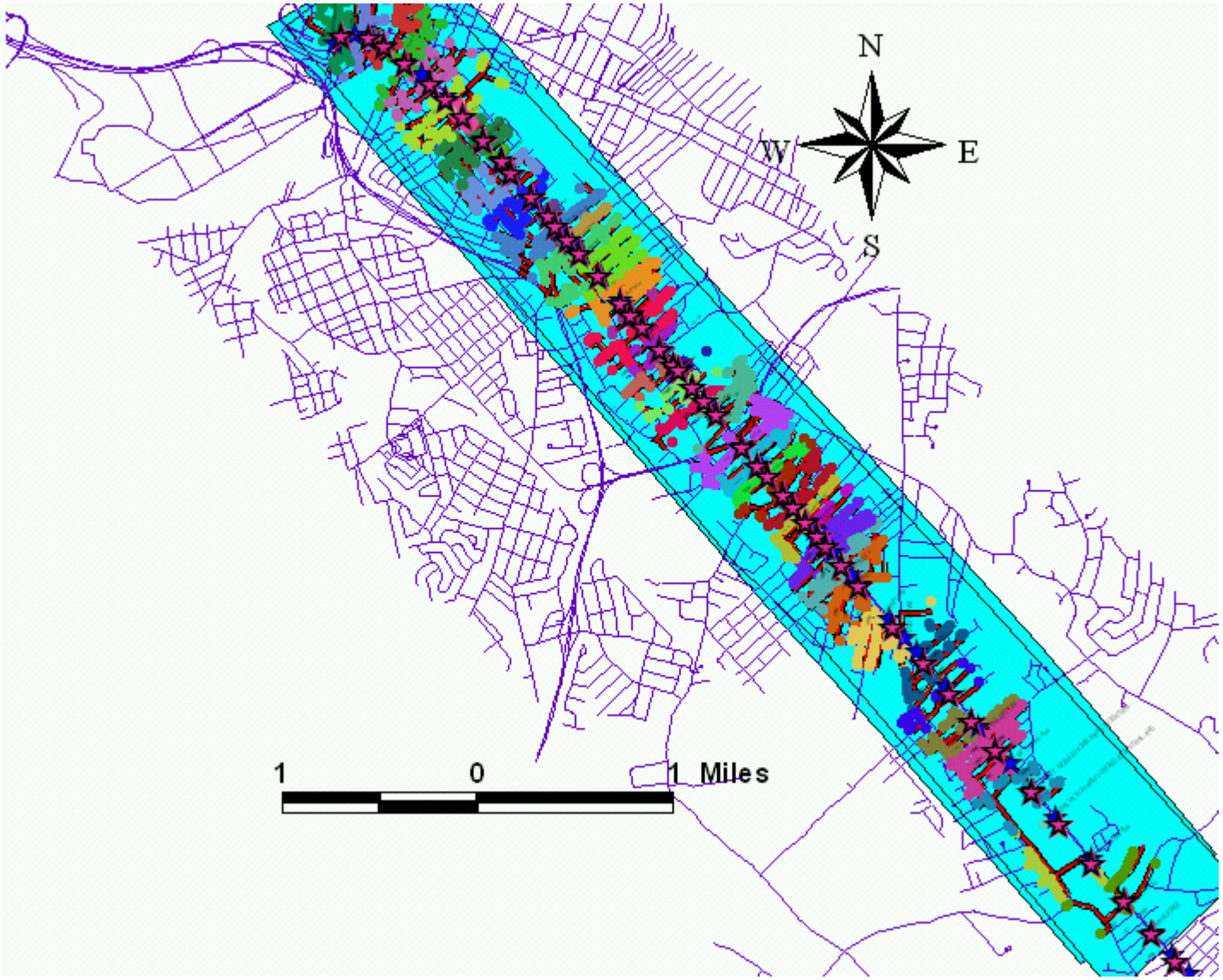

Figure A-3 - Case Study 2: Route 55 – Schenectady -Albany , NY – Shortest Time historic stop assignment (Eastbound PM period Alightings) Red overlay showing shortest path trees

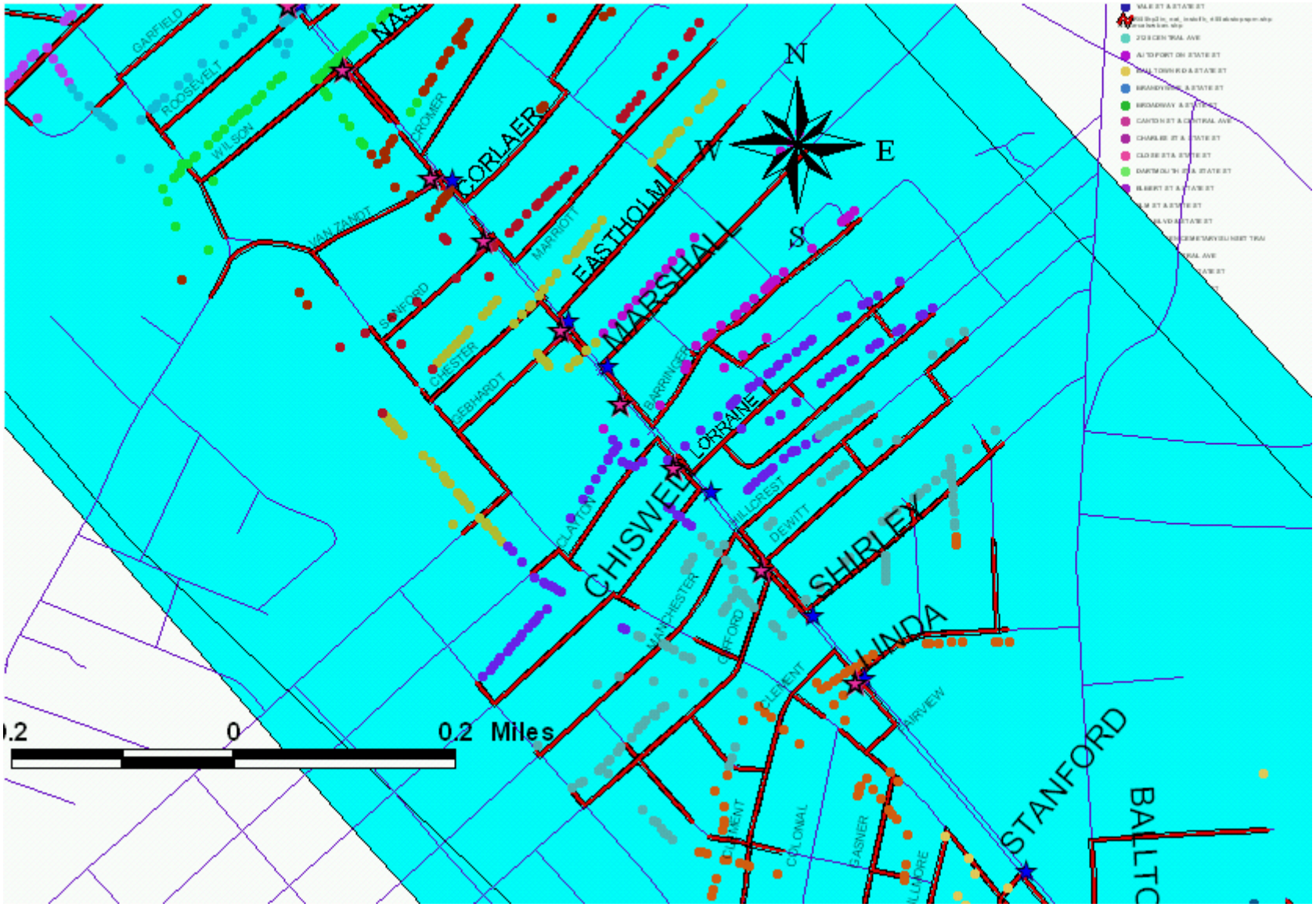

Figure A-4 - Case Study 2: Route 55 – Schenectady -Albany , NY – Shortest Time historic stop assignment (Eastbound PM period Boarding) Red overlay showing shortest path trees

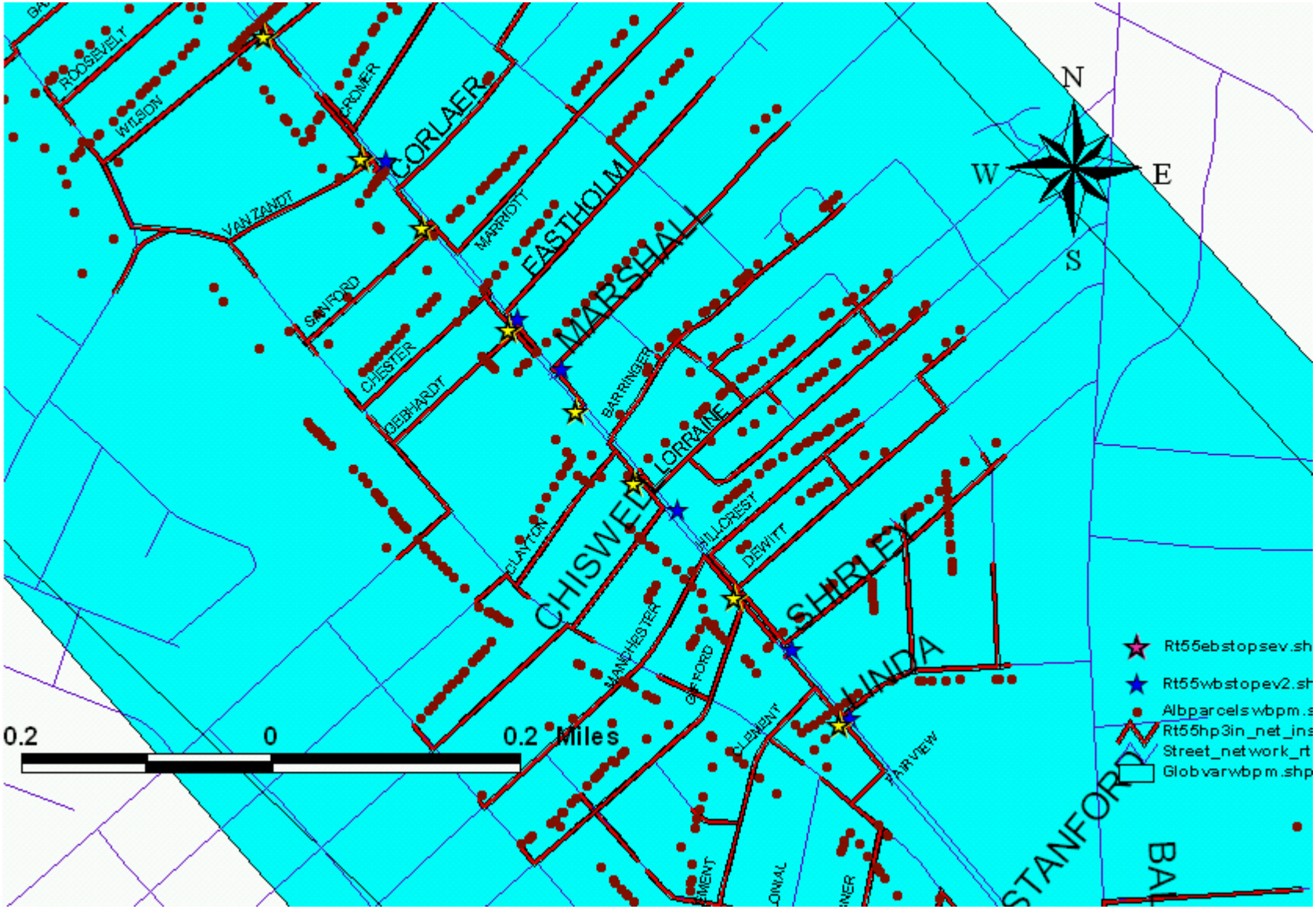

Figure A-5 Case Study 2 – Route 55 Schenectady -Albany , NY – Boarding Demand Distribution (Westbound PM period)

Figure A-6 Case Study 2 – Route 55 Schenectady -Albany , NY – Alighting Demand Distribution (Westbound PM period)

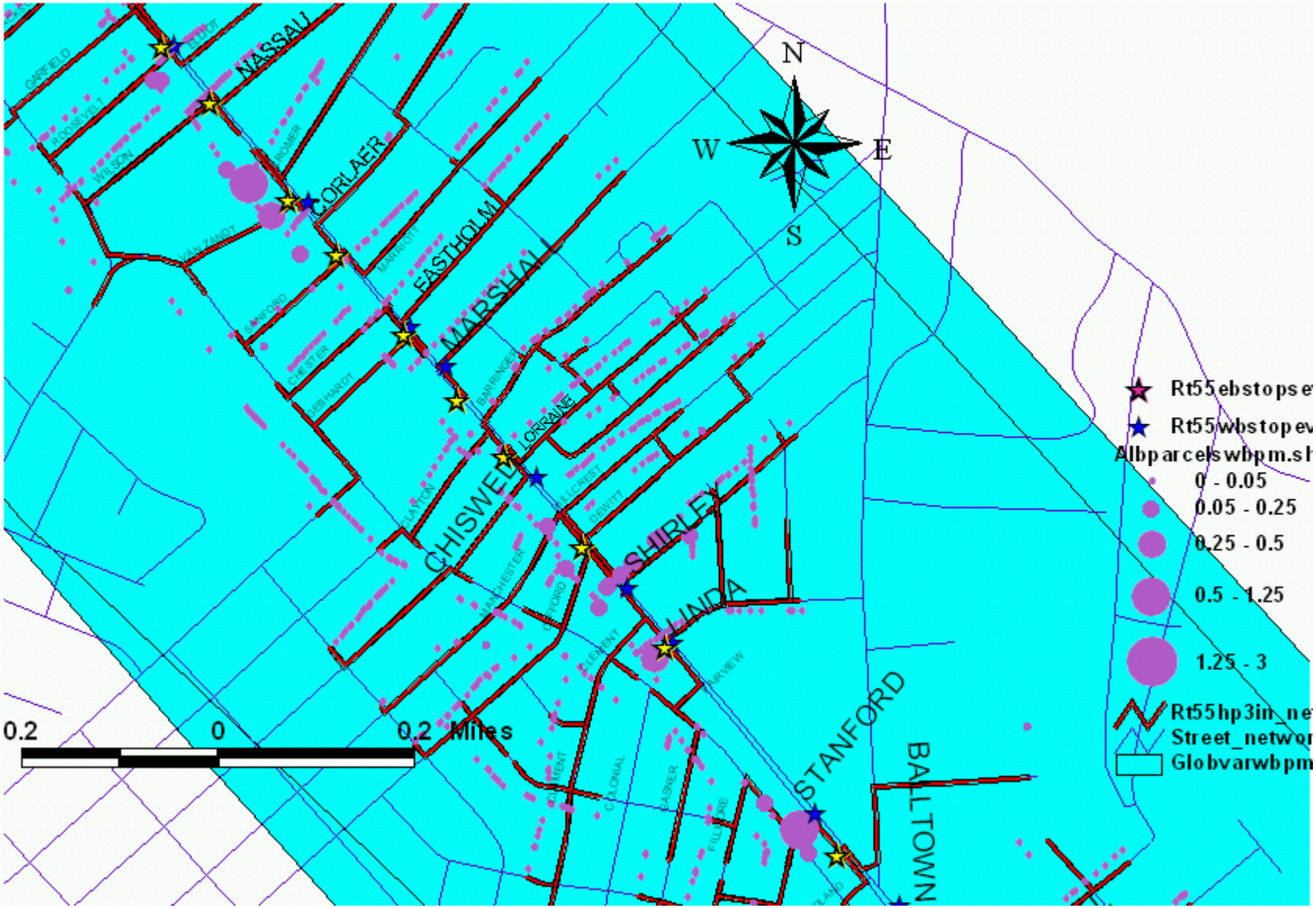

Figure A-7 -Case Study 2- Albany Rt. 55 Historic Stop Assignment (including shed lines) for Evening Alightings

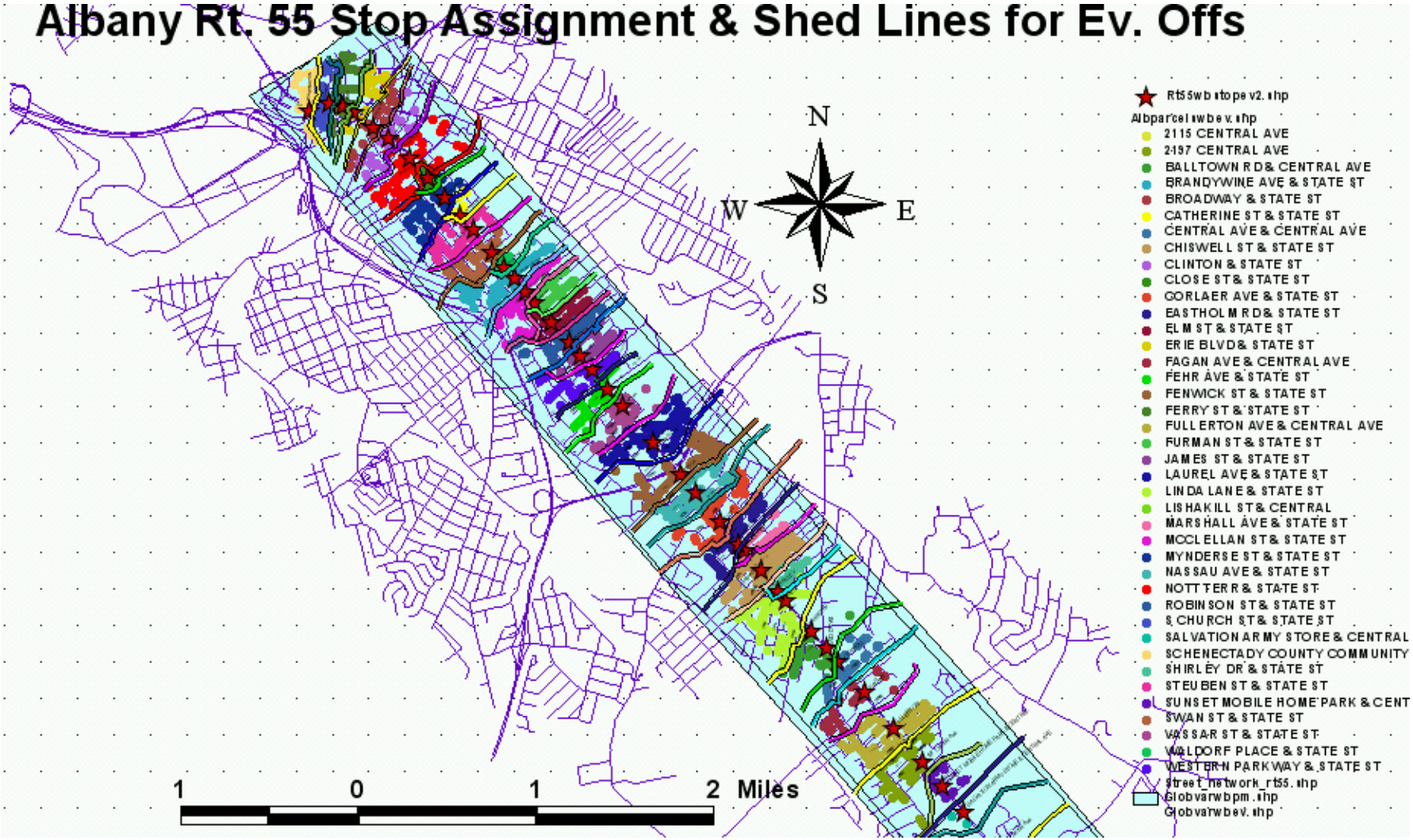

Figure A-8 -Case Study 2- Albany Rt. 55 Historic Stop Assignment with Shed Lines for Westbound (outbound) PM Boardings showing areas with curve effect.

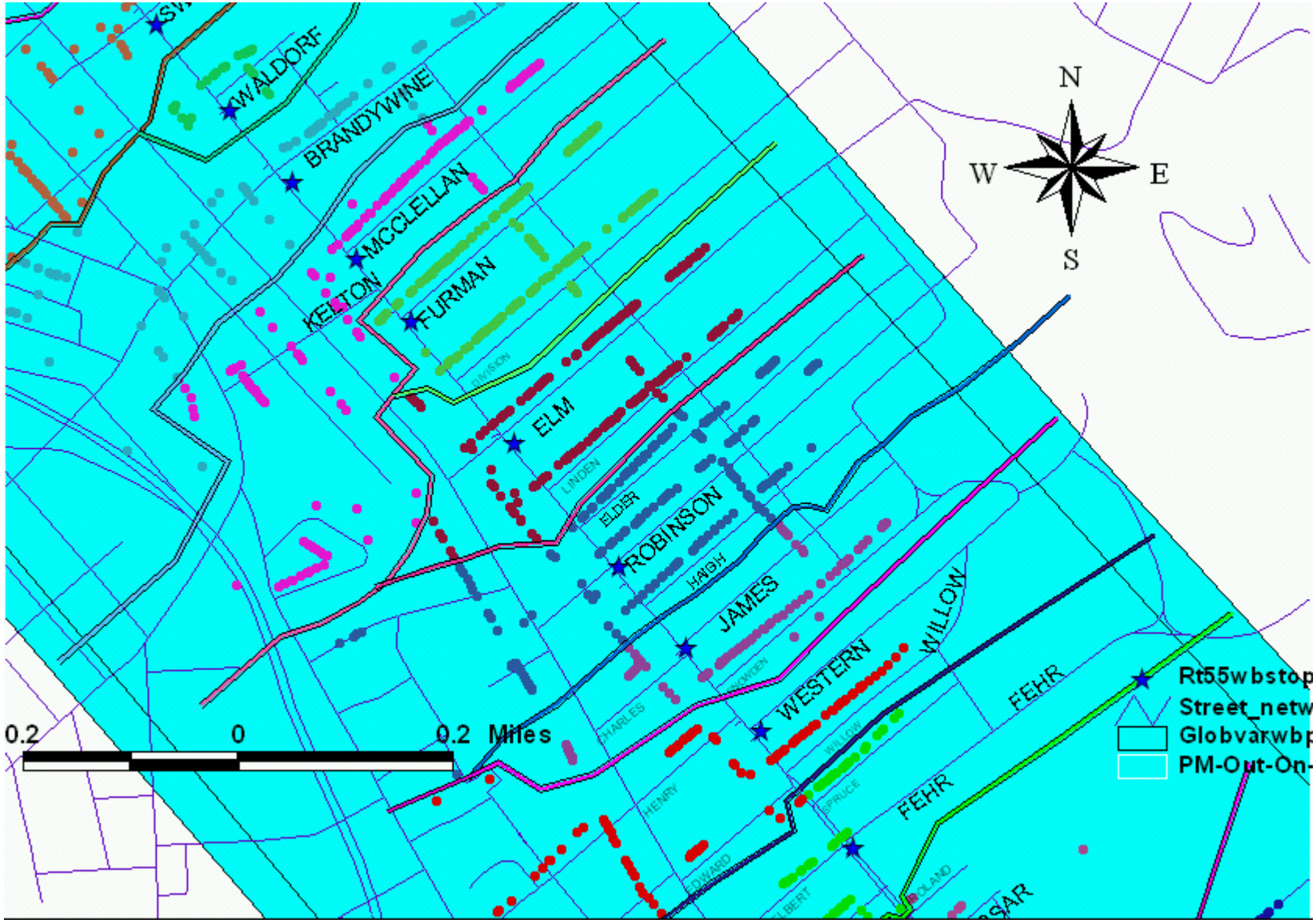

Figure A-9 -Case Study 2- Albany Rt. 55 Historic Stop Assignment for Evening Boardings with Shed lines for Alightings

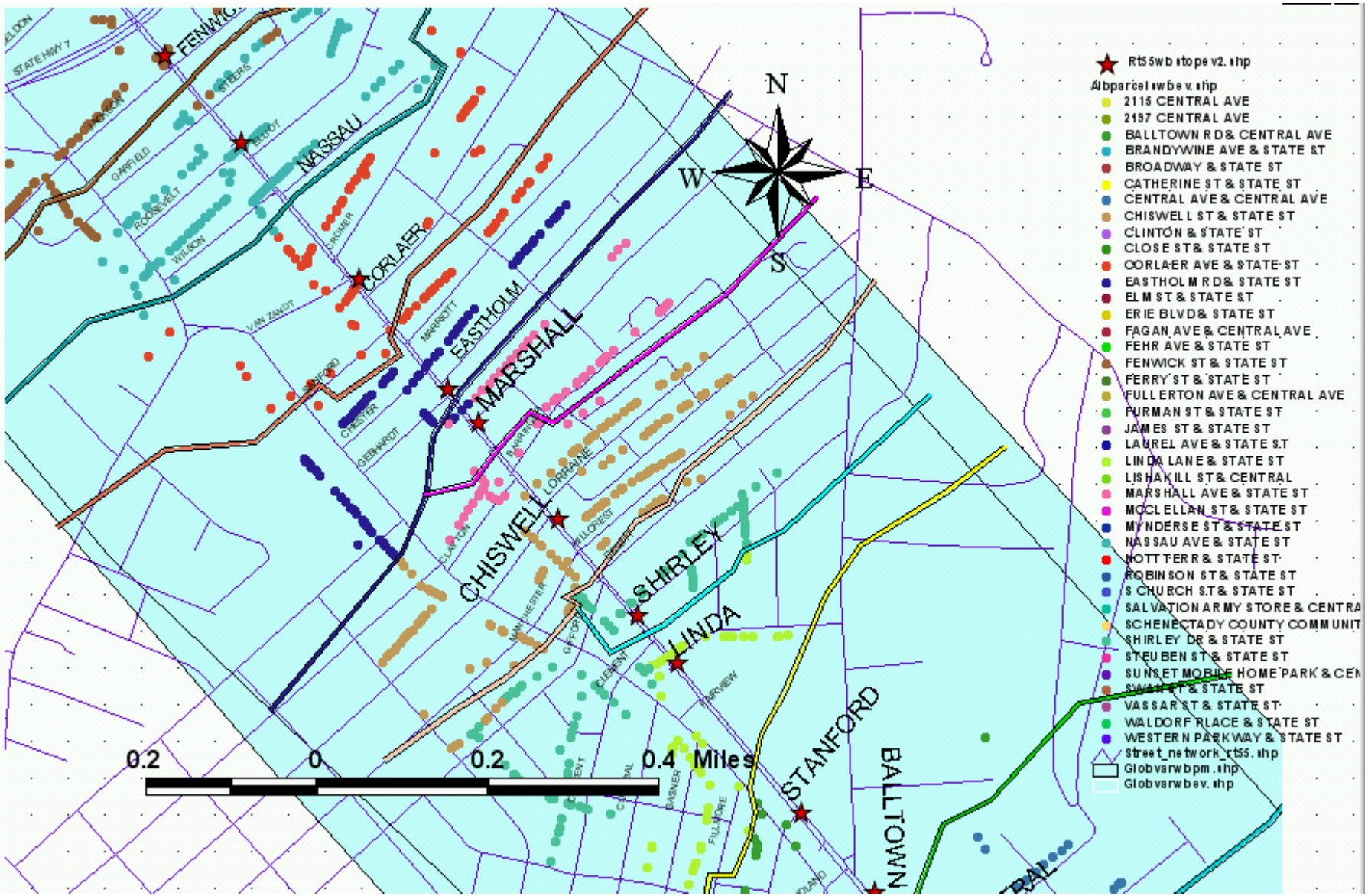

Figure A-10 -Case Study 2- Albany Rt. 55 Walk Time Difference for Ev. Offs (Mins) Between Alternate A and Historic

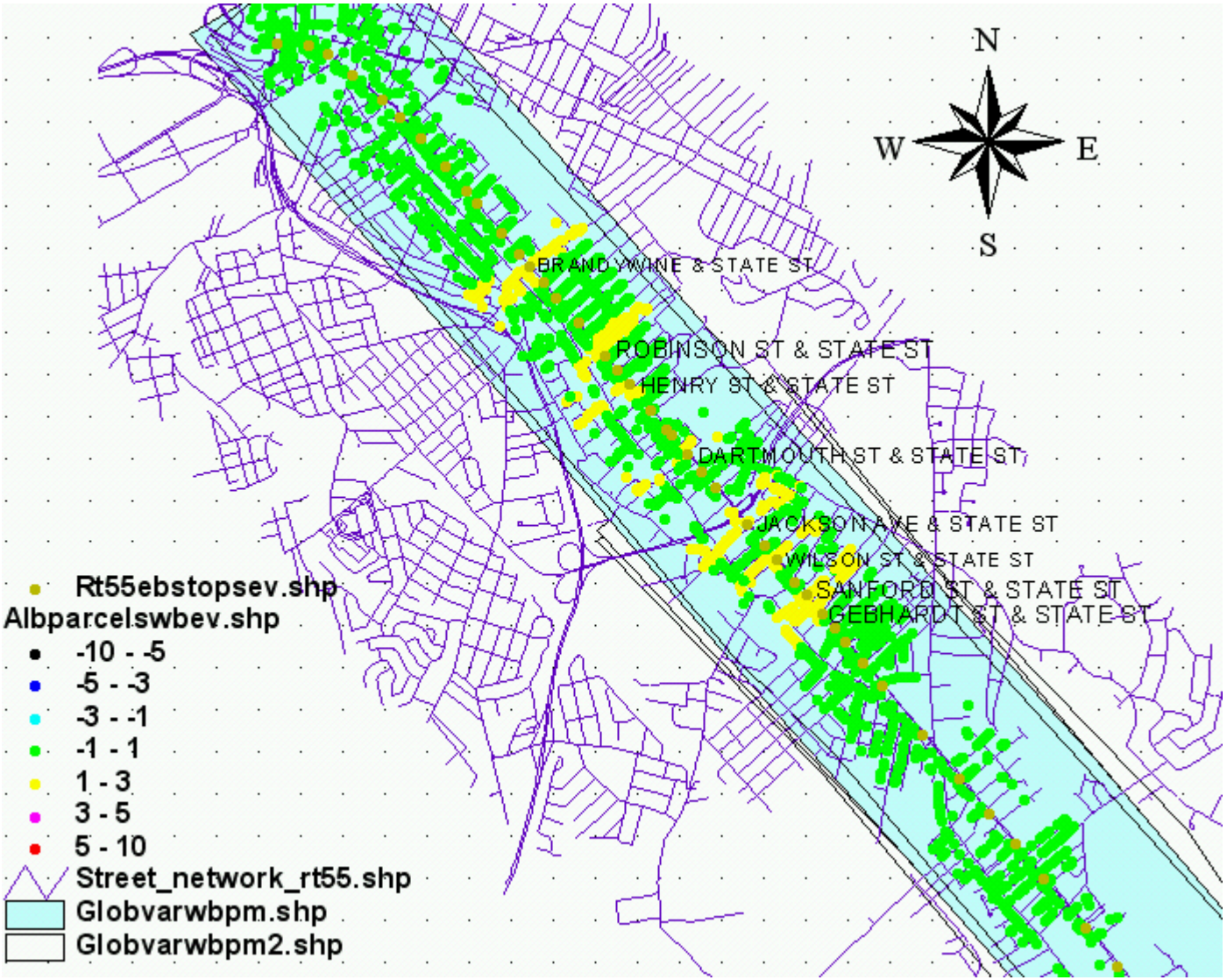

Figure A-11 -Case Study 2- Albany Rt. 55 Walk Time Difference for PM.Westbound (Outbound) Boardings (Mins) Between Alternate B and Historic

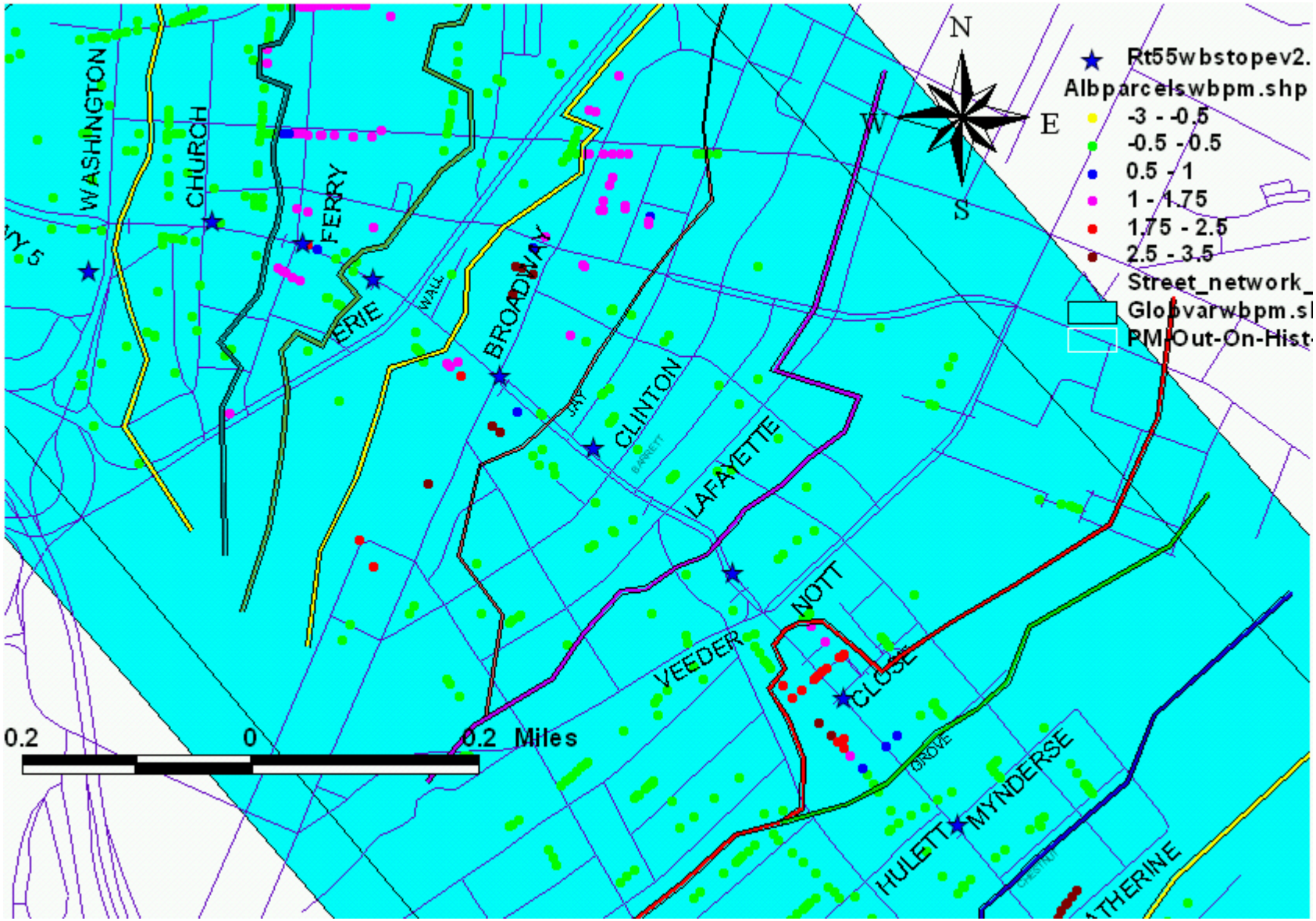

Figure A-12 -Case Study 2- Albany Rt. 55 Walk Time Difference for PM.Westbound (Outbound) Boardings (Mins) Between Alternate B and Historic

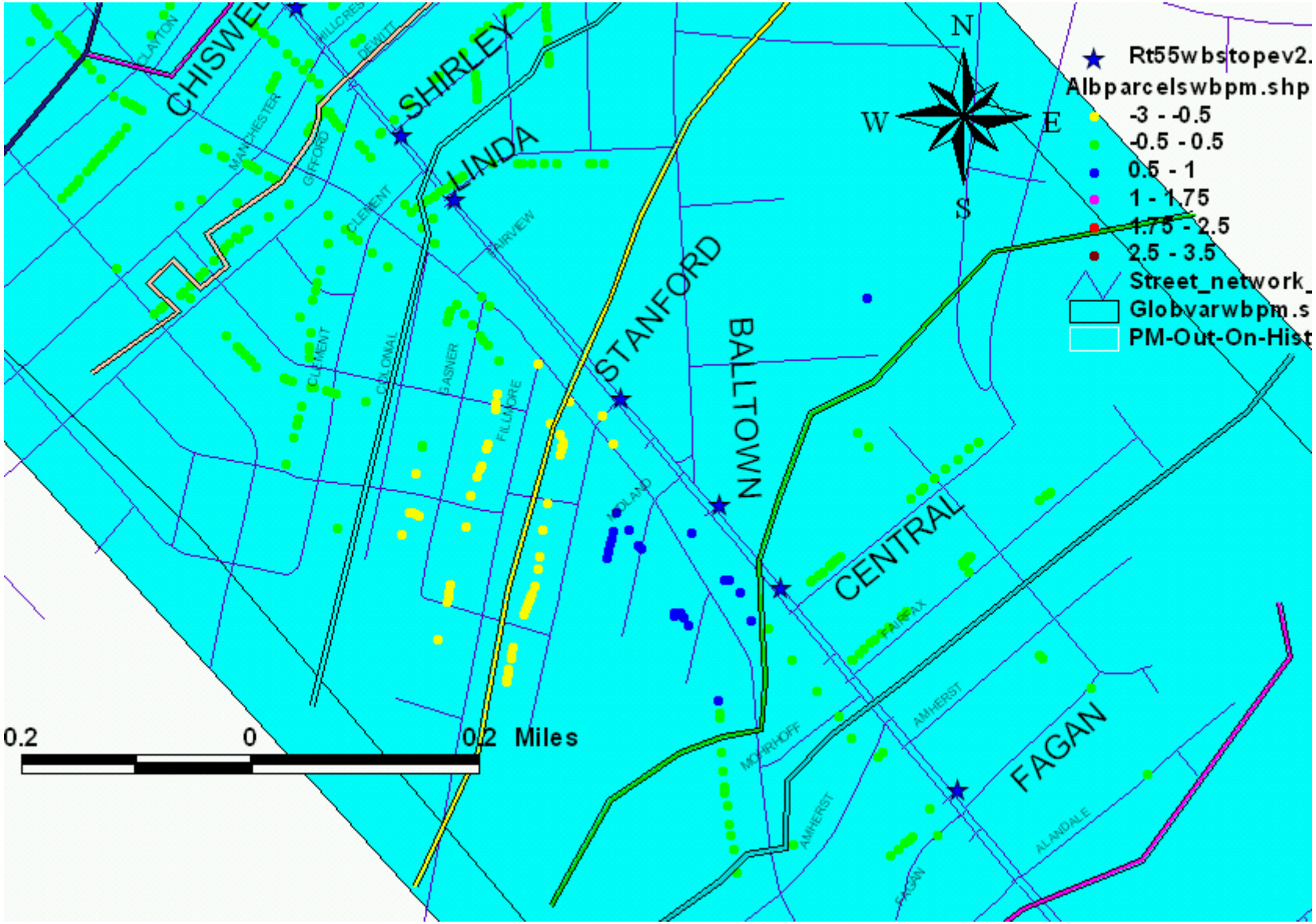

Table A-3 Albany Route 55 Eastbound AM Historic Result Set

HISTORIC

STOP	STOPDESC	INCLUDE	ONS Pers/ Hr	OFFS Pers/ Hr	DEP VOL Pers/ Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/ Hr	Off Walk Time Pers-Min/ Hr	Total Walk Time Pers-Min/ Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/ Hr	TCOST $/Hr
2421	WASHINGTON AVE & STATE ST	TRUE	8.0	0.0	8.0	0.0	20.4	0.0	20.4	3.1	0.5	$5.9
3746	S FERRY ST & STATE ST	TRUE	2.7	0.0	10.7	0.5	3.7	0.0	3.7	8.8	0.9	$5.7
2754	ERIE BLVD & STATE ST	TRUE	3.0	0.0	13.7	1.5	2.9	0.0	2.9	11.2	0.9	$6.0
3744	BROADWAY & STATE ST	TRUE	7.0	0.0	20.7	2.1	11.7	0.0	11.7	14.9	0.9	$7.4
10247	LAFAYETTE & STATE ST	TRUE	1.7	0.0	22.3	2.8	4.5	0.0	4.5	15.1	0.7	$5.4
2755	VEEDER/NOTT TERR & STATE ST	TRUE	17.3	0.0	39.7	3.3	37.8	0.0	37.8	33.7	1.1	$14.4
2260	CLOSE ST & STATE ST	TRUE	0.0	0.7	39.0	4.2	0.0	0.7	0.7	33.0	0.8	$7.0
2393	HULETT ST & STATE ST	TRUE	16.3	0.0	55.3	4.9	21.1	0.0	21.1	40.7	0.9	$11.4
2392	MARTIN ST & STATE ST	TRUE	1.0	0.3	56.0	5.3	1.2	0.4	1.6	40.5	0.7	$7.2
2656	STEUBEN ST & STATE ST	TRUE	4.0	0.3	59.7	6.2	5.9	0.5	6.4	54.9	1.0	$10.3
2968	SWAN ST & STATE ST	TRUE	3.7	0.7	62.7	6.8	4.0	0.8	4.7	37.9	0.6	$7.0
2389	WALDORF PLACE & STATE ST	TRUE	1.7	0.3	64.0	7.1	0.9	0.2	1.2	29.2	0.5	$4.9
10273	BRANDYWINE & STATE ST	TRUE	0.0	0.0	64.0	7.5	0.0	0.0	0.0	30.9	0.5	$4.9
2261	MCCLELLAN ST & STATE ST	TRUE	9.0	0.7	72.3	8.0	8.9	0.7	9.6	50.4	0.8	$9.4
11328	KELTON AVE & STATE ST	TRUE	3.3	0.3	75.3	8.4	5.5	0.5	6.0	43.1	0.6	$7.4
2387	ELM ST & STATE ST	TRUE	6.0	2.3	79.0	8.9	9.0	3.5	12.5	43.3	0.6	$8.5
2263	ROBINSON ST & STATE ST	TRUE	1.7	0.7	80.0	9.0	2.2	0.9	3.1	19.0	0.2	$3.3
2264	CHARLES ST & STATE ST	TRUE	6.0	0.3	85.7	9.1	8.3	0.6	8.9	42.6	0.5	$7.5
2265	HENRY ST & STATE ST	TRUE	0.0	0.7	85.0	9.6	0.0	0.9	0.9	34.7	0.4	$5.0
2267	ELBERT ST & STATE ST	TRUE	2.3	1.7	85.7	9.8	3.1	2.2	5.3	28.5	0.3	$4.9
2386	HARVARD ST & STATE ST	TRUE	1.0	0.7	86.0	9.9	1.4	0.8	2.2	21.4	0.3	$3.4

2262	YALE ST & STATE ST	TRUE	1.3	0.0	87.3	10.1	1.6	0.0	1.7	32.1	0.4	$4.8
2384	DARTMOUTH ST & STATE ST	TRUE	0.0	0.0	87.3	10.4	0.0	0.0	0.0	28.9	0.3	$4.0
2383	MYRTLE AVE & STATE ST	TRUE	0.0	0.3	87.0	10.8	0.0	0.3	0.3	46.8	0.5	$6.6
2382	LAWNWOOD ST & STATE ST	TRUE	3.3	1.0	89.3	11.5	2.4	0.7	3.0	59.0	0.7	$8.7
2366	JACKSON AVE & STATE ST	TRUE	2.0	2.0	89.3	11.7	4.7	4.6	9.3	34.2	0.4	$6.3
2269	ROOSEVELT AVE & STATE ST	TRUE	0.7	0.7	89.3	11.9	0.8	0.8	1.6	30.7	0.3	$4.5
2270	WILSON ST & STATE ST	TRUE	1.0	1.0	89.3	12.3	1.2	1.2	2.4	32.3	0.4	$4.9
2967	VANZANDT ST & STATE ST	TRUE	1.3	2.3	88.3	12.4	1.3	2.3	3.7	34.7	0.4	$5.4
2966	SANFORD ST & STATE ST	TRUE	0.3	0.0	88.7	12.7	0.5	0.0	0.5	28.1	0.3	$4.0
2271	GEBHARDT ST & STATE ST	TRUE	0.0	0.7	88.0	13.0	0.0	1.0	1.0	27.3	0.3	$3.9
11326	AUTOPORT ON STATE ST	TRUE	0.3	0.0	88.3	13.2	0.4	0.0	0.4	32.4	0.4	$4.6
2381	LORRAINE & STATE ST	TRUE	0.3	0.0	88.7	13.7	0.5	0.0	0.5	38.3	0.4	$5.4
2379	GIFFORD RD & STATE ST	TRUE	1.7	1.0	89.3	14.1	2.3	1.4	3.8	72.8	0.8	$10.7
2378	LINDA LANE & STATE ST	TRUE	0.3	0.3	89.3	15.0	0.2	0.3	0.5	79.7	0.9	$11.1
2657	BALLTOWN RD & STATE ST	TRUE	2.3	3.7	88.0	15.8	4.2	6.5	10.7	69.9	0.8	$11.5
11327	STATE ST & FAIRFAX	TRUE	0.7	0.3	88.3	16.1	0.5	0.3	0.8	38.4	0.4	$5.5
10264	FAGAN & CENTRAL AVE	TRUE	0.3	0.7	88.0	16.5	0.5	1.0	1.6	38.3	0.4	$5.6
2697	WILBER AVE & CENTRAL AVE	TRUE	0.7	1.0	87.7	16.9	1.3	2.0	3.3	45.0	0.5	$6.8
11318	CANTON ST & CENTRAL AVE	TRUE	0.0	0.0	87.7	17.3	0.0	0.0	0.0	48.1	0.6	$6.7
11319	EVERGREEN CEMETARY/SUNSET TRAI	TRUE	2.0	0.0	89.7	18.0	2.3	0.0	2.3	63.1	0.7	$9.1
11320	2128 CENTRAL AVE	TRUE	0.0	0.3	89.3	18.5	0.0	0.4	0.4	52.1	0.6	$7.3
11321	LISHA'S KILL REFORMED CHURCH C	TRUE	1.0	0.0	90.3	19.1	1.6	0.0	1.7	52.5	0.6	$7.5
2964	LISHAKILL RD & CENTRAL AVE	TRUE	0.3	0.0	90.7	19.6	0.4	0.0	0.4	42.1	0.5	$5.9
11322	MARJORIE RD & CENTRAL AVE	TRUE	0.3	0.3	90.7	20.0	0.4	0.4	0.0	0.0	0.0	$0.0
Total			116.0	25.3	0.0	0.0	179.7	35.8	214.8	1663.3	25.1	$297.3

Table A-4 Albany Route 55 Eastbound AM Alternative Result Set

Alternate A - MINUS Harvard, Dartmouth St, Myrtle Av, Wilson Av, Sanford St, and Gebhardt St Stops												
STOP	STOPDESC	INCLUDE	ONS Pers/ Hr	OFFS Pers/ Hr	DEP VOL Pers/ Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/ Hr	Off Walk Time Pers-Min/ Hr	Total Walk Time Pers-Min/ Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/ Hr	TCOST $/Hr
2421	WASHINGTON AVE & STATE ST	TRUE	8.0	0.0	8.0	0.0	20.4	0.0	20.4	3.1	0.5	$5.9
3746	S FERRY ST & STATE ST	TRUE	2.7	0.0	10.7	0.5	3.7	0.0	3.7	8.8	0.9	$5.7
2754	ERIE BLVD & STATE ST	TRUE	3.0	0.0	13.7	1.5	2.9	0.0	2.9	11.2	0.9	$6.0
3744	BROADWAY & STATE ST	TRUE	7.0	0.0	20.7	2.1	11.7	0.0	11.7	14.9	0.9	$7.4
10247	LAFAYETTE & STATE ST	TRUE	1.7	0.0	22.3	2.8	4.5	0.0	4.5	15.1	0.7	$5.4
2755	VEEDER/NOTT TERR & STATE ST	TRUE	17.3	0.0	39.7	3.3	37.8	0.0	37.8	33.7	1.1	$14.4
2260	CLOSE ST & STATE ST	TRUE	0.0	0.7	39.0	4.2	0.0	0.7	0.7	33.0	0.8	$7.0
2393	HULETT ST & STATE ST	TRUE	16.3	0.0	55.3	4.9	21.1	0.0	21.1	40.7	0.9	$11.4
2392	MARTIN ST & STATE ST	TRUE	1.0	0.3	56.0	5.3	1.2	0.4	1.6	40.5	0.7	$7.2
2656	STEUBEN ST & STATE ST	TRUE	4.0	0.3	59.7	6.2	5.9	0.5	6.4	54.9	1.0	$10.3
2968	SWAN ST & STATE ST	TRUE	3.7	0.7	62.7	6.8	4.0	0.8	4.7	37.9	0.6	$7.0
2389	WALDORF PLACE & STATE ST	TRUE	1.7	0.3	64.0	7.1	0.9	0.2	1.2	29.2	0.5	$4.9
10273	BRANDYWINE & STATE ST	TRUE	0.0	0.0	64.0	7.5	0.0	0.0	0.0	30.9	0.5	$4.9
2261	MCCLELLAN ST & STATE ST	TRUE	9.0	0.7	72.3	8.0	8.9	0.7	9.6	50.4	0.8	$9.4
11328	KELTON AVE & STATE ST	TRUE	3.3	0.3	75.3	8.4	5.5	0.5	6.0	43.1	0.6	$7.4
2387	ELM ST & STATE ST	TRUE	6.0	2.3	79.0	8.9	9.0	3.5	12.5	43.3	0.6	$8.5
2263	ROBINSON ST & STATE ST	TRUE	1.7	0.7	80.0	9.0	2.2	0.9	3.1	19.0	0.2	$3.3
2264	CHARLES ST & STATE ST	TRUE	6.0	0.3	85.7	9.1	8.3	0.6	8.9	42.6	0.5	$7.5
2265	HENRY ST & STATE ST	TRUE	0.0	0.7	85.0	9.6	0.0	0.9	0.9	34.7	0.4	$5.0
2267	ELBERT ST & STATE ST	TRUE	2.5	1.8	85.8	9.8	3.6	2.5	6.1	40.0	0.5	$6.6
2386	HARVARD ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0

2262	YALE ST & STATE ST	TRUE	2.1	0.5	87.3	10.1	3.0	0.7	3.8	84.5	1.0	$12.4
2384	DARTMOUTH ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2383	MYRTLE AVE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2382	LAWNWOOD ST & STATE ST	TRUE	3.3	1.3	89.3	11.5	2.4	1.6	4.0	88.8	1.0	$13.0
2366	JACKSON AVE & STATE ST	TRUE	2.0	2.0	89.3	11.7	4.7	4.6	9.3	34.2	0.4	$6.3
2269	ROOSEVELT AVE & STATE ST	TRUE	1.5	1.4	89.4	11.9	2.9	2.6	5.5	41.7	0.5	$6.7
2270	WILSON ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2967	VANZANDT ST & STATE ST	TRUE	1.9	2.7	88.6	12.4	2.6	3.1	5.6	77.9	0.9	$11.7
2966	SANFORD ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2271	GEBHARDT ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
11326	AUTOPORT ON STATE ST	TRUE	0.3	0.6	88.3	13.2	0.4	1.6	2.0	61.7	0.7	$8.9
2381	LORRAINE & STATE ST	TRUE	0.3	0.0	88.7	13.7	0.5	0.1	0.6	38.4	0.4	$5.4
2379	GIFFORD RD & STATE ST	TRUE	1.7	1.0	89.3	14.1	2.3	1.4	3.8	72.8	0.8	$10.7
2378	LINDA LANE & STATE ST	TRUE	0.3	0.3	89.3	15.0	0.2	0.3	0.5	79.7	0.9	$11.1
2657	BALLTOWN RD & STATE ST	TRUE	2.3	3.7	88.0	15.8	4.2	6.5	10.7	69.9	0.8	$11.5
11327	STATE ST & FAIRFAX	TRUE	0.7	0.3	88.3	16.1	0.5	0.3	0.8	38.4	0.4	$5.5
10264	FAGAN & CENTRAL AVE	TRUE	0.3	0.7	88.0	16.5	0.5	1.0	1.6	38.3	0.4	$5.6
2697	WILBER AVE & CENTRAL AVE	TRUE	0.7	1.0	87.7	16.9	1.3	2.0	3.3	45.0	0.5	$6.8
11318	CANTON ST & CENTRAL AVE	TRUE	0.0	0.0	87.7	17.3	0.0	0.0	0.0	48.1	0.6	$6.7
11319	EVERGREEN CEMETARY/SUNSET TRAI	TRUE	2.0	0.0	89.7	18.0	2.3	0.0	2.3	63.1	0.7	$9.1
11320	2128 CENTRAL AVE	TRUE	0.0	0.3	89.3	18.5	0.0	0.4	0.4	52.1	0.6	$7.3
11321	LISHA'S KILL REFORMED CHURCH C	TRUE	1.0	0.0	90.3	19.1	1.6	0.0	1.7	52.5	0.6	$7.5
2964	LISHAKILL RD & CENTRAL AVE	TRUE	0.3	0.0	90.7	19.6	0.4	0.0	0.4	42.1	0.5	$5.9
11322	MARJORIE RD & CENTRAL AVE	TRUE	0.3	0.3	90.7	20.0	0.4	0.4	0.0	0.0	0.0	$0.0
Total			116.0	25.3	0.0	0.0	181.8	38.8	219.9	1655.8	25.0	$297.1

Table A-5 Albany Route 55 Eastbound AM Alternative B Result Set

Alternate B MINUS Brandywine, Robinson St, Henry St, Harvard St, Dartmouth St, Jackson Av, Wilson St, Sanford St, Gebhardt St, and Lorraine St

STOP	STOPDESC	INCLUDE	ONS Pers/ Hr	OFFS Pers/ Hr	DEP VOL Pers/ Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/ Hr	Off Walk Time Pers-Min/ Hr	Total Walk Time Pers-Min/ Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/ Hr	TCOST $/Hr
2421	WASHINGTON AVE & STATE ST	TRUE	8.0	0.0	8.0	0.0	20.4	0.0	20.4	3.1	0.5	$5.9
3746	S FERRY ST & STATE ST	TRUE	2.7	0.0	10.7	0.5	3.7	0.0	3.7	8.8	0.9	$5.7
2754	ERIE BLVD & STATE ST	TRUE	3.0	0.0	13.7	1.5	2.9	0.0	2.9	11.2	0.9	$6.0
3744	BROADWAY & STATE ST	TRUE	7.0	0.0	20.7	2.1	11.7	0.0	11.7	14.9	0.9	$7.4
10247	LAFAYETTE & STATE ST	TRUE	1.7	0.0	22.3	2.8	4.5	0.0	4.5	15.1	0.7	$5.4
2755	VEEDER/NOTT TERR & STATE ST	TRUE	17.3	0.0	39.7	3.3	37.8	0.0	37.8	33.7	1.1	$14.4
2260	CLOSE ST & STATE ST	TRUE	0.0	0.7	39.0	4.2	0.0	0.7	0.7	33.0	0.8	$7.0
2393	HULETT ST & STATE ST	TRUE	16.3	0.0	55.3	4.9	19.9	0.0	19.9	40.7	0.9	$11.2
2392	MARTIN ST & STATE ST	TRUE	1.0	0.3	56.0	5.3	1.2	0.4	1.6	40.5	0.7	$7.2
2656	STEUBEN ST & STATE ST	TRUE	4.0	0.3	59.7	6.2	5.9	0.5	6.4	54.9	1.0	$10.3
2968	SWAN ST & STATE ST	TRUE	3.7	0.7	62.7	6.8	4.0	0.8	4.7	37.9	0.6	$7.0
2389	WALDORF PLACE & STATE ST	TRUE	1.7	0.3	64.0	7.1	1.2	0.3	1.5	29.2	0.5	$4.9
10273	BRANDYWINE & STATE ST	TRUE	0.0	0.0	64.0	7.5	0.0	0.0	0.0	30.9	0.5	$4.9
2261	MCCLELLAN ST & STATE ST	TRUE	9.0	0.7	72.3	8.0	8.9	0.7	9.6	50.4	0.8	$9.4
11328	KELTON AVE & STATE ST	TRUE	3.3	0.3	75.3	8.4	5.5	0.5	6.0	43.1	0.6	$7.4
2387	ELM ST & STATE ST	TRUE	6.3	2.5	79.2	8.9	10.2	4.0	14.2	46.4	0.6	$9.2
2263	ROBINSON ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2264	CHARLES ST & STATE ST	TRUE	7.4	1.2	85.4	9.1	11.9	2.9	14.8	62.4	0.8	$11.3
2265	HENRY ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2267	ELBERT ST & STATE ST	TRUE	2.5	2.2	85.8	9.8	3.6	3.4	7.0	61.3	0.7	$9.8
2386	HARVARD ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0

2262	YALE ST & STATE ST	TRUE	2.1	0.5	87.3	10.1	3.0	0.7	3.8	53.9	0.6	$8.2
2384	DARTMOUTH ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2383	MYRTLE AVE & STATE ST	TRUE	0.0	0.3	87.0	10.8	0.0	0.3	0.3	61.3	0.7	$8.6
2382	LAWNWOOD ST & STATE ST	TRUE	4.9	2.7	89.2	11.5	8.3	7.4	15.7	71.1	0.8	$12.5
2366	JACKSON AVE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2269	ROOSEVELT AVE & STATE ST	TRUE	1.9	1.7	89.4	11.9	5.4	4.2	9.6	55.6	0.6	$9.3
2270	WILSON ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2967	VANZANDT ST & STATE ST	TRUE	1.9	2.7	88.6	12.4	2.6	3.1	5.6	77.9	0.9	$11.7
2966	SANFORD ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
2271	GEBHARDT ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0.0
11326	AUTOPORT ON STATE ST	TRUE	0.3	0.6	88.3	13.2	0.4	1.6	2.0	61.7	0.7	$8.9
2381	LORRAINE & STATE ST	TRUE	0.3	0.0	88.7	13.7	0.5	0.1	0.6	38.4	0.4	$5.4
2379	GIFFORD RD & STATE ST	TRUE	1.7	1.0	89.3	14.1	2.3	1.4	3.8	72.8	0.8	$10.7
2378	LINDA LANE & STATE ST	TRUE	0.3	0.3	89.3	15.0	0.2	0.3	0.5	79.7	0.9	$11.1
2657	BALLTOWN RD & STATE ST	TRUE	2.3	3.7	88.0	15.8	4.2	6.5	10.6	69.9	0.8	$11.5
11327	STATE ST & FAIRFAX	TRUE	0.7	0.3	88.3	16.1	0.6	0.3	0.9	38.4	0.4	$5.5
10264	FAGAN & CENTRAL AVE	TRUE	0.3	0.7	88.0	16.5	0.5	1.0	1.6	38.3	0.4	$5.6
2697	WILBER AVE & CENTRAL AVE	TRUE	0.7	1.0	87.7	16.9	1.3	2.0	3.3	45.0	0.5	$6.8
11318	CANTON ST & CENTRAL AVE	TRUE	0.0	0.0	87.7	17.3	0.0	0.0	0.0	48.1	0.6	$6.7
11319	EVERGREEN CEMETARY/SUNSET TRAI	TRUE	2.0	0.0	89.7	18.0	2.3	0.0	2.3	63.1	0.7	$9.1
11320	2128 CENTRAL AVE	TRUE	0.0	0.3	89.3	18.5	0.0	0.4	0.4	52.1	0.6	$7.3
11321	LISHA'S KILL REFORMED CHURCH C	TRUE	1.0	0.0	90.3	19.1	1.6	0.0	1.7	52.5	0.6	$7.5
2964	LISHAKILL RD & CENTRAL AVE	TRUE	0.3	0.0	90.7	19.6	0.4	0.0	0.4	42.1	0.5	$5.9
11322	MARJORIE RD & CENTRAL AVE	TRUE	0.3	0.3	90.7	20.0	0.4	0.4	0.0	0.0	0.0	$0.0
Total			116.0	25.3	0.0	0.0	187.3	43.8	230.5	1639.0	24.9	$296.5

Table A-6 Albany Route 55 Westbound PM Historic Result Set

HISTORIC SCENARIO												
STOP	STOPDESC	INCLUDE	ONS Pers/Hr	OFFS Pers/Hr	DEP VOL Pers/Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/Hr	Off Walk Time Pers-Min/Hr	Total Walk Time Pers-Min/Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/Hr	TCOST $/Hr
2281	MARJORIE RD & CENTRAL AVE	TRUE	0.0	1.0	81.0	46.0	0.0	1.2	0.0	0.0	0.00	$0.0
10260	LISHAKILL ST & CENTRAL	TRUE	0.7	1.7	80.0	46.5	1.0	2.4	3.4	53.1	0.66	$8.5
2282	2115 CENTRAL AVE	TRUE	0.3	0.3	80.0	47.1	0.8	0.8	1.5	50.0	0.62	$7.8
2960	SALVATION ARMY STORE & CENTRAL AVE	TRUE	0.0	0.0	80.0	47.6	0.0	0.0	0.0	33.8	0.42	$5.1
2959	SUNSET MOBILE HOME PARK & CENTRAL	TRUE	0.7	0.3	80.3	47.9	0.8	0.4	1.2	41.4	0.51	$6.4
2285	2197 CENTRAL AVE	TRUE	0.0	0.7	79.7	48.5	0.0	1.7	1.7	51.3	0.64	$8.0
2254	FULLERTON AVE & CENTRAL AVE	TRUE	0.7	0.0	80.3	49.2	1.7	0.0	1.7	48.2	0.60	$7.5
2423	FAGAN AVE & CENTRAL AVE	TRUE	0.7	0.3	80.7	49.7	1.1	0.6	1.7	33.0	0.41	$5.2
2286	CENTRAL AVE & CENTRAL AVE	TRUE	1.0	0.3	81.3	49.9	1.1	0.4	1.5	41.5	0.51	$6.4
2422	BALLTOWN RD & CENTRAL AVE	TRUE	4.0	1.3	84.0	50.5	14.0	4.8	18.8	99.5	1.20	$17.8
2422	STANFORD AVE & CENTRAL AVE	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2420	LINDA LANE & STATE ST	TRUE	1.0	1.0	84.0	51.8	1.0	1.0	2.0	72.0	0.86	$10.9
2419	SHIRLEY DR & STATE ST	TRUE	1.7	2.3	83.3	52.1	3.0	3.9	6.8	33.7	0.40	$6.1
1591	CHISWELL ST & STATE ST	TRUE	0.7	0.3	83.7	52.3	1.0	0.5	1.5	41.5	0.50	$6.4
2287	MARSHALL AVE & STATE ST	TRUE	0.0	0.0	83.7	52.9	0.0	0.0	0.0	35.5	0.42	$5.2
1592	EASTHOLM RD & STATE ST	TRUE	0.7	0.7	83.7	53.2	1.2	1.7	2.9	32.2	0.38	$5.2
2499	CORLAER AVE & STATE ST	TRUE	2.3	1.7	84.3	53.6	3.3	2.1	5.4	41.1	0.49	$6.9
2288	NASSAU AVE & STATE ST	TRUE	0.0	0.7	83.7	53.8	0.0	0.9	0.9	34.5	0.41	$5.2
2446	FENWICK ST & STATE ST	TRUE	0.7	1.3	83.0	54.3	1.5	2.9	4.3	50.8	0.61	$8.2
2497	LAUREL AVE & STATE ST	TRUE	5.3	3.3	85.0	54.8	8.3	5.2	13.5	67.4	0.80	$12.2
2289	VASSAR ST & STATE ST	TRUE	0.7	0.7	85.0	55.4	1.2	1.2	2.4	61.4	0.72	$9.4
2447	FEHR AVE & STATE ST	TRUE	1.7	1.7	85.0	56.1	2.5	2.4	5.0	61.4	0.72	$9.8
1736	WESTERN PARKWAY & STATE ST	TRUE	2.7	2.3	85.3	56.5	3.3	2.8	6.1	53.0	0.62	$8.8
2416	JAMES ST & STATE ST	TRUE	1.7	1.7	85.3	57.0	3.0	3.2	6.2	63.9	0.75	$10.3
2290	ROBINSON ST & STATE ST	TRUE	1.0	1.7	84.7	57.7	1.3	2.0	3.3	70.5	0.83	$10.8
2342	ELM ST & STATE ST	TRUE	0.7	3.3	82.0	58.4	0.9	4.5	5.4	52.6	0.63	$8.6
1721	FURMAN ST & STATE ST	TRUE	0.3	2.3	80.0	58.6	0.4	4.3	4.7	32.4	0.40	$5.6
3965	MCCLELLAN ST & STATE ST	TRUE	5.3	7.7	77.7	58.9	10.6	10.1	20.7	44.2	0.57	$10.1
2961	BRANDYWINE AVE & STATE ST	TRUE	0.3	5.0	73.0	59.1	0.6	9.3	9.9	32.4	0.43	$6.6
2995	WALDORF PLACE & STATE ST	TRUE	0.3	1.3	72.0	59.3	0.3	1.2	1.5	30.0	0.41	$4.9

2452	SWAN ST & STATE ST	TRUE	0.3	6.3	66.0	59.8	0.4	8.3	8.7	40.4	0.58	$7.9
3200	STEUBEN ST & STATE ST	TRUE	0.7	7.3	59.3	60.0	1.1	12.1	13.3	44.8	0.73	$9.8
3964	CATHERINE ST & STATE ST	TRUE	0.3	3.3	56.3	60.7	0.3	3.1	3.4	41.6	0.71	$7.8
2650	MYNDERSE ST & STATE ST	TRUE	0.3	7.7	49.0	61.1	0.4	10.1	10.6	35.4	0.67	$8.3
1586	CLOSE ST & STATE ST	TRUE	0.0	4.7	44.3	61.6	0.0	5.0	5.0	24.8	0.52	$5.7
3692	NOTT TERR & STATE ST	TRUE	0.0	14.3	30.0	61.8	0.0	39.3	39.3	49.9	1.52	$18.8
10230	CLINTON & STATE ST	TRUE	0.7	12.0	18.7	63.9	1.7	28.2	29.9	45.8	1.72	$18.0
3744	BROADWAY & STATE ST	TRUE	0.0	4.7	14.0	64.6	0.0	6.5	6.5	13.7	0.82	$6.6
3743	ERIE BLVD & STATE ST	TRUE	0.0	2.7	11.3	65.2	0.0	2.3	2.3	8.5	0.66	$4.6
11624	FERRY ST & STATE ST	TRUE	0.0	3.0	8.3	65.7	0.0	2.3	2.3	7.5	0.77	$5.1
1594	S CHURCH ST & STATE ST	TRUE	0.0	5.0	3.3	66.5	0.0	7.9	7.9	5.0	0.74	$5.7
11293	SCHENECTADY COUNTY COMMUNITY COLL	TRUE	0.0	3.3	0.0	66.8	0.0	9.3	9.3	0.9	0.40	$3.8
Total			37.3	119.3			67.6	205.9	272.3	1680.4	26.36	$326.1

Table A-7 Albany Route 55 Westbound PM Alternative A Result Set

Alternative A stops After removing Linda Lane, Vassar St, James St, Furman St, Brandywine Av, Stueben St, Broadway and Ferry St Stops

STOP	STOPDESC	INCLUDE	ONS Pers/Hr	OFFS Pers/Hr	DEPVOL Pers/Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/Hr	Off Walk Time Pers-Min/Hr	Total Walk Time Pers-Min/Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/Hr	TCOST $/Hr
2281	MARJORIE RD & CENTRAL AVE	TRUE	0.0	1.0	81.0	46.0	0.0	1.2	0.0	0.0	0.00	$0.0
10260	LISHAKILL ST & CENTRAL	TRUE	0.7	1.7	80.0	46.5	1.0	2.4	3.4	53.1	0.66	$8.5
2282	2115 CENTRAL AVE	TRUE	0.3	0.3	80.0	47.1	0.8	0.8	1.5	50.0	0.62	$7.8
2960	SALVATION ARMY STORE & CENTRAL AVE	TRUE	0.0	0.0	80.0	47.6	0.0	0.0	0.0	33.8	0.42	$5.1
2959	SUNSET MOBILE HOME PARK & CENTRAL	TRUE	0.7	0.3	80.3	47.9	0.8	0.4	1.2	41.4	0.51	$6.4
2285	2197 CENTRAL AVE	TRUE	0.0	0.7	79.7	48.5	0.0	1.7	1.7	51.3	0.64	$8.0
2254	FULLERTON AVE & CENTRAL AVE	TRUE	0.7	0.0	80.3	49.2	1.7	0.0	1.7	48.2	0.60	$7.5
2423	FAGAN AVE & CENTRAL AVE	TRUE	0.7	0.3	80.7	49.7	1.1	0.6	1.7	33.0	0.41	$5.2
2286	CENTRAL AVE & CENTRAL AVE	TRUE	1.0	0.3	81.3	49.9	1.1	0.4	1.5	41.5	0.51	$6.4
2422	BALLTOWN RD & CENTRAL AVE	TRUE	4.0	1.3	84.0	50.5	14.2	4.8	19.0	108.5	1.30	$19.2
2422	STANFORD AVE & CENTRAL AVE	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2420	LINDA LANE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2419	SHIRLEY DR & STATE ST	TRUE	2.6	3.3	83.3	52.1	5.0	6.0	11.0	92.0	1.10	$15.4
1591	CHISWELL ST & STATE ST	TRUE	0.7	0.3	83.7	52.3	1.0	0.5	1.5	41.5	0.50	$6.4
2287	MARSHALL AVE & STATE ST	TRUE	0.0	0.0	83.7	52.9	0.0	0.0	0.0	35.5	0.42	$5.2
1592	EASTHOLM RD & STATE ST	TRUE	0.7	0.7	83.7	53.2	1.2	1.7	2.9	32.2	0.38	$5.2
2499	CORLAER AVE & STATE ST	TRUE	2.3	1.7	84.3	53.6	3.3	2.1	5.4	41.1	0.49	$6.9
2288	NASSAU AVE & STATE ST	TRUE	0.0	0.7	83.7	53.8	0.0	0.9	0.9	34.5	0.41	$5.2
2446	FENWICK ST & STATE ST	TRUE	0.7	1.3	83.0	54.3	1.5	2.9	4.3	50.8	0.61	$8.2
2497	LAUREL AVE & STATE ST	TRUE	5.3	3.6	84.7	54.8	8.3	6.9	15.2	98.3	1.17	$17.0
2289	VASSAR ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0

2447	FEHR AVE & STATE ST	TRUE	2.3	2.0	85.0	56.1	5.3	3.7	9.0	88.2	1.04	$14.4
1736	WESTERN PARKWAY & STATE ST	TRUE	3.3	3.7	84.7	56.5	5.2	7.2	12.5	88.5	1.04	$15.0
2416	JAMES ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2290	ROBINSON ST & STATE ST	TRUE	2.0	2.0	84.7	57.7	4.8	2.6	7.4	92.0	1.09	$14.7
2342	ELM ST & STATE ST	TRUE	0.7	4.1	81.3	58.4	1.0	6.6	7.6	65.0	0.78	$10.8
1721	FURMAN ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
3965	MCCLELLAN ST & STATE ST	TRUE	5.6	9.3	77.7	58.9	11.3	13.9	25.3	65.6	0.83	$14.1
2961	BRANDYWINE AVE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2995	WALDORF PLACE & STATE ST	TRUE	0.7	6.3	72.1	59.3	1.3	15.6	16.9	50.7	0.68	$10.6
2452	SWAN ST & STATE ST	TRUE	0.4	6.8	65.6	59.8	0.5	10.6	11.1	63.1	0.93	$12.1
3200	STEUBEN ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
3964	CATHERINE ST & STATE ST	TRUE	1.0	10.2	56.4	60.7	2.4	24.9	27.2	61.0	0.98	$14.9
2650	MYNDERSE ST & STATE ST	TRUE	0.3	7.7	49.0	61.1	0.5	10.3	10.7	35.4	0.67	$8.3
1586	CLOSE ST & STATE ST	TRUE	0.0	4.7	44.3	61.6	0.0	5.0	5.0	24.8	0.52	$5.7
3692	NOTT TERR & STATE ST	TRUE	0.0	14.3	30.0	61.8	0.0	39.3	39.3	49.9	1.52	$18.8
10230	CLINTON & STATE ST	TRUE	0.7	13.5	17.2	63.9	1.7	34.7	36.4	50.2	2.02	$21.0
3744	BROADWAY & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
3743	ERIE BLVD & STATE ST	TRUE	0.0	8.8	8.4	65.2	0.0	16.0	16.0	19.6	1.53	$12.5
11624	FERRY ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
1594	S CHURCH ST & STATE ST	TRUE	0.0	5.1	3.3	66.5	0.0	8.1	8.1	7.1	0.99	$7.2
11293	SCHENECTADY COUNTY COMMUNITY COLL	TRUE	0.0	3.3	0.0	66.8	0.0	9.3	9.3	0.9	0.40	$3.8
Total			37.3	119.3	0.0	0.0	74.7	241.1	314.6	1648.5	25.77	$327.4

Table A-8 Albany Route 55 Westbound PM

Alternative B Result Set Alternative B Balltown Rd (Replaced by Stanford Av), Marshall St, James St, Waldorf St, Catherine St, Broadway and Ferry St Stops

STOP	STOPDESC	INCLUDE	ONS Pers/Hr	OFFS Pers/Hr	DEPVOL Pers/Hr	Undelayed Ridetime(Min)	On Walk Time Pers-Min/Hr	Off Walk Time Pers-Min/Hr	Total Walk Time Pers-Min/Hr	RIDECOST Pers-Min/Hr	Segment Run Time Veh-Min/Hr	TCOST $/Hr
2281	MARJORIE RD & CENTRAL AVE	TRUE	0.0	1.0	81.0	46.0	0.0	1.2	0.0	0.0	0.00	$0.0
10260	LISHAKILL ST & CENTRAL	TRUE	0.7	1.7	80.0	46.5	1.0	2.4	3.4	53.1	0.66	$8.5
2282	2115 CENTRAL AVE	TRUE	0.3	0.3	80.0	47.1	0.8	0.8	1.5	50.0	0.62	$7.8
2960	SALVATION ARMY STORE & CENTRAL AVE	TRUE	0.0	0.0	80.0	47.6	0.0	0.0	0.0	33.8	0.42	$5.1
2959	SUNSET MOBILE HOME PARK & CENTRAL	TRUE	0.7	0.3	80.3	47.9	0.8	0.4	1.2	41.4	0.51	$6.4
2285	2197 CENTRAL AVE	TRUE	0.0	0.7	79.7	48.5	0.0	1.7	1.7	51.3	0.64	$8.0
2254	FULLERTON AVE & CENTRAL AVE	TRUE	0.7	0.0	80.3	49.2	1.7	0.0	1.7	48.2	0.60	$7.5
2423	FAGAN AVE & CENTRAL AVE	TRUE	0.7	0.3	80.7	49.7	1.1	0.6	1.7	33.0	0.41	$5.2
2286	CENTRAL AVE & CENTRAL AVE	TRUE	1.0	0.3	81.3	49.9	1.1	0.4	1.5	64.9	0.80	$9.9
2422	BALLTOWN RD & CENTRAL AVE	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2422	STANFORD AVE & CENTRAL AVE	TRUE	4.0	1.3	84.0	51.1	5.9	2.0	7.9	98.8	1.20	$15.9
2420	LINDA LANE & STATE ST	TRUE	1.0	1.0	84.0	51.8	0.7	1.0	1.7	47.6	0.57	$7.3
2419	SHIRLEY DR & STATE ST	TRUE	1.7	2.3	83.3	52.1	3.0	3.9	6.8	33.7	0.40	$6.1
1591	CHISWELL ST & STATE ST	TRUE	0.7	0.3	83.7	52.3	1.0	0.5	1.5	50.7	0.61	$7.7
2287	MARSHALL AVE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
1592	EASTHOLM RD & STATE ST	TRUE	0.7	0.7	83.7	53.2	1.2	1.7	2.9	58.5	0.70	$9.1
2499	CORLAER AVE & STATE ST	TRUE	2.3	1.7	84.3	53.6	3.3	2.1	5.4	41.1	0.49	$6.9
2288	NASSAU AVE & STATE ST	TRUE	0.0	0.7	83.7	53.8	0.0	0.9	0.9	34.5	0.41	$5.2
2446	FENWICK ST & STATE ST	TRUE	0.7	1.3	83.0	54.3	1.5	2.9	4.3	50.8	0.61	$8.2
2497	LAUREL AVE & STATE ST	TRUE	5.3	3.3	85.0	54.8	8.3	5.2	13.5	67.4	0.80	$12.2
2289	VASSAR ST & STATE ST	TRUE	0.7	0.7	85.0	55.4	1.2	1.2	2.4	61.4	0.72	$9.4

2447	FEHR AVE & STATE ST	TRUE	1.7	1.7	85.0	56.1	2.5	2.4	5.0	61.4	0.72	$9.8
1736	WESTERN PARKWAY & STATE ST	TRUE	3.3	3.7	84.7	56.5	5.2	7.2	12.5	88.5	1.04	$15.0
2416	JAMES ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2290	ROBINSON ST & STATE ST	TRUE	2.0	2.0	84.7	57.7	4.8	2.6	7.4	92.0	1.09	$14.7
2342	ELM ST & STATE ST	TRUE	0.7	3.3	82.0	58.4	0.9	4.5	5.4	52.6	0.63	$8.6
1721	FURMAN ST & STATE ST	TRUE	0.3	2.3	80.0	58.6	0.4	4.3	4.7	32.4	0.40	$5.6
3965	MCCLELLAN ST & STATE ST	TRUE	5.3	7.7	77.7	58.9	10.6	10.1	20.7	44.2	0.57	$10.1
2961	BRANDYWINE AVE & STATE ST	TRUE	0.3	6.0	72.0	59.1	0.6	12.3	12.9	49.3	0.67	$9.8
2995	WALDORF PLACE & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2452	SWAN ST & STATE ST	TRUE	0.7	6.6	66.0	59.8	1.2	8.8	10.0	48.9	0.70	$9.5
3200	STEUBEN ST & STATE ST	TRUE	0.7	8.0	58.6	60.0	1.1	14.2	15.3	57.7	0.95	$12.4
3964	CATHERINE ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
2650	MYNDERSE ST & STATE ST	TRUE	0.7	14.2	45.1	61.1	1.2	24.9	26.2	64.9	1.23	$16.3
1586	CLOSE ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
3692	NOTT TERR & STATE ST	TRUE	0.0	15.1	30.0	61.8	0.0	41.4	41.4	59.5	1.73	$21.1
10230	CLINTON & STATE ST	TRUE	0.7	13.5	17.2	63.9	1.7	34.7	36.4	50.2	2.02	$21.0
3744	BROADWAY & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
3743	ERIE BLVD & STATE ST	TRUE	0.0	8.8	8.4	65.2	0.0	16.0	16.0	19.6	1.53	$12.5
11624	FERRY ST & STATE ST	FALSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	$0.0
1594	S CHURCH ST & STATE ST	TRUE	0.0	5.1	3.3	66.5	0.0	8.1	8.1	7.1	0.99	$7.2
11293	SCHENECTADY COUNTY COMMUNITY COLL	TRUE	0.0	3.3	0.0	66.8	0.0	9.3	9.3	0.9	0.40	$3.8
Total			37.3	119.3	0.0	0.0	62.7	229.7	291.2	1649.5	25.84	$323.8

Appendix –A- Albany Case Study List of Sample Spreadsheet Names of "Albany Sample Results" File

No.	Sheet	Description
1	Albany-Rt55-Grand-Summary	Summary of Cost Savings of adopting alternatives for all scenarios
2	Outbound EV ALT B Result	Alternative B Scenario for Outbound Evening Period
3	Outbound EV ALT A Result	Alternative A Scenario for Outbound Evening Period
4	Outbound EV Historic Result	Historic Result Summary for Outbound Evening Period
5	Outbound PM ALT B Result	Alternative B Scenario for Outbound PM Period
6	Outbound PM ALT A Result	Alternative A Scenario for Outbound PM Period
7	Outbound PM Historic Result	Historic Result Summary for Outbound PM Period
8	Outbound MID ALT B Result	Alternative B Scenario for Outbound Mid-Day Period
9	Outbound MID ALT A Result	Alternative A Scenario for Outbound Mid-Day Period
10	Outbound MID Historic Result	Historic Result Summary for Outbound Mid-Day Period
11	Outbound AM ALT B Result	Alternative B Scenario for Outbound AM Period
12	Outbound AM ALT A Result	Alternative A Scenario for Outbound AM Period
13	Outbound AM Historic Result	Historic Result Summary for Outbound AM Period
14	Inbound EV ALT B Result	Alternative B Scenario for Inbound Evening Period
15	Inbound EV ALT A Result	Alternative A Scenario for Inbound Evening Period
16	Inbound EV Historic Result	Historic Result Summary for Inbound Evening Period
17	Inbound PM ALT B Result	Alternative B Scenario for Inbound PM Period
18	Inbound PM ALT A Result	Alternative A Scenario for Inbound PM Period
19	Inbound PM Historic Result	Historic Result Summary for Inbound PM Period
20	Inbound MID ALT B Result	Alternative B Scenario for Inbound Mid-Day Period
21	Inbound MID ALT A Result	Alternative A Scenario for Inbound Mid-Day Period
22	Inbound MID Historic Result	Historic Result Summary for Inbound Mid-Day Period
23	Inbound AM ALT B Result	Alternative B Scenario for Inbound AM Period
24	Inbound AM ALT A Result	Alternative A Scenario for Inbound AM Period
25	Inbound AM Historic Result	Historic Result Summary for Inbound AM Period
	Rest of spreadsheets are output files	Naming convention of the files is shown below
26-49	rt55hp4inrt55ebstopsev	Appendage-(rt55) - Alternative (h-Historic,a-Alternative A,b-Alternative-B),Period-(p4,p3,p2,p1),-Direction-(in,out), - name of stop file used

Appendix – B - Boston Case Study List of Sample Spreadsheet Names for "Boston Sample Results" File

No.	Sheet	Description
1	Greenb-inbound-PM-MtHood-Hist	Difference between Alternative and Historic Scenarios for PM Inbound
2	GreenB-inbound-PM-Hist-Summ	Historic Result Summary for PM Inbound
3	GreenB-inbound-PM-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for PM Inbound
4	Greenb-inbound-PM-Hist	Detail Result Sheet for Historic Set of Stops PM Inbound
5	Greenb-inbound-PM-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for PM Inbound
6	Greenb-inbound-Mid-MtHood-Hist	Difference between Alternative and Historic Scenarios for Mid Inbound
7	GreenB-inbound-Mid-Hist-Summ	Historic Result Summary for Mid Inbound
8	GreenB-inbound-Mid-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for Mid Inbound
9	Greenb-inbound-Mid-Hist	Detail Result Sheet for Historic Set of Stops Mid Inbound
10	Greenb-inbound-Mid-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for Mid Inbound
11	Greenb-inbound-AM-MtHood-Hist	Difference between Alternative and Historic Scenarios for AM Inbound
12	GreenB-inbound-AM-Hist-Summ	Historic Result Summary for AM Inbound
13	GreenB-inbound-AM-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for AM Inbound
14	Greenb-inbound-AM-Hist	Detail Result Sheet for Historic Set of Stops AM Inbound
15	Greenb-inbound-AM-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for AM Inbound
16	Greenb-outbound-PM-MtHood-Hist	Difference between Alternative and Historic Scenarios for PM outbound
17	GreenB-outbound-PM-Hist-Summ	Historic Result Summary for PM outbound
18	GreenB-outbound-PM-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for PM outbound
19	Greenb-outbound-PM-Hist	Detail Result Sheet for Historic Set of Stops PM outbound
20	Greenb-outbound-PM-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for PM outbound
21	Greenb-outbound-Mid-MtHood-Hist	Difference between Alternative and Historic Scenarios for Mid outbound
22	GreenB-outbound-Mid-Hist-Summ	Historic Result Summary for Mid outbound
23	GreenB-outbound-Mid-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for Mid outbound
24	Greenb-outbound-Mid-Hist	Detail Result Sheet for Historic Set of Stops Mid outbound

25	Greenb-outbound-Mid-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for Mid outbound
26	Greenb-outbound-AM-MtHood-Hist	Difference between Alternative and Historic Scenarios for AM outbound
27	GreenB-outbound-AM-Hist-Summ	Historic Result Summary for AM outbound
28	GreenB-outbound-AM-MtHood-Summ	Alternative with out Mt. Hood Rd. Result Summary for AM outbound
29	Greenb-outbound-AM-Hist	Detail Result Sheet for Historic Set of Stops AM outbound
30	Greenb-outbound-AM-MtHood	Detail Result Sheet After Mt. Hood is Eliminated for AM outbound
31	GreenB-Grand-Summary	Summary of Cost Savings of adopting alternatives for all scenarios