Assembly Square
Transportation Plan

Final Report

Assembly Square
Somerville, Massachusetts

Submitted to:
City of Somerville
Office of Housing and
Community Development

May 13, 2003

ENGINEERS • SCIENTISTS • PLANNERS

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May 13, 2003

Stephen M. Post, Director
Office of Housing and Community Development
City Hall
93 Highland Avenue, Third Floor
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Re: Assembly Square Transportation Plan

Final Report

Assembly Square
Somerville, Massachusetts

Dear Mr. Post:

Rizzo Associates, Inc. is pleased to submit this draft Final Report. It includes a comprehensive discussion of existing conditions, the alternatives that were analyzed, the results of the alternatives analysis, and the findings and recommendations of the Assembly Square Transportation Plan. We hope that this document proves informative and useful, and we hope to have a chance to work with you in the future on some of the plan's recommendations.

If you have any questions, please contact me at 508-903-2425 (rbryant@rizzo.com) or Ned Codd at 508-903-2094 (ncodd@rizzo.com). Thank you again for the opportunity to work on this exciting project.

Very truly yours,

Joseph Berg

for Richard S. Bryant, P.E.
Vice President

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Executive Summary

Assembly Square, on the banks of the Mystic River in Somerville, Massachusetts, is the subject of great development and planning interest. The City of Somerville and its residents have responded to this interest by developing a vision for re-creating Assembly Square as a lively, mixed use "urban village." To achieve this vision, Assembly Square's transportation connections must be improved in all transportation modes: public transportation, pedestrian and bicycle, and motor vehicle.

The Assembly Square Transportation Plan proposes a transportation improvement program that enhances Assembly Square's connectivity in all transportation modes, and creates a transportation network that will support the future land use vision and serve the needs of the district's visitors. The Assembly Square Transportation Plan provides the following:

- Identification of the transportation challenges facing Assembly Square
- An evaluation of potential improvements in public transportation, pedestrian and bicycle access, and motor vehicle access
- Recommendations for a multi-modal transportation improvement plan that is designed to help Assembly Square achieve the vision of a vibrant urban village.

Existing Conditions

Assembly Square is surrounded by major transportation corridors, including regional roadways (Interstate 93, Route 28, and Mystic Avenue) and public transportation lines (the Orange Line and Commuter Rail). These corridors offer opportunities for good regional connections in these modes, but the transportation infrastructure itself (i.e. highways, viaducts, and rail lines) creates physical barriers that block access, both for regional connections and local Somerville neighborhood connections. Figure ES-1 shows Assembly Square and the existing transportation system that serves the district.

Public Transportation

Assembly Square is immediately adjacent to public transportation infrastructure. The Orange Line and Commuter Rail tracks border Assembly Square on its eastern edge. However, access to the Orange Line

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Assembly Square

Figure ES-1

from the existing stations at Sullivan Square and Wellington Station is difficult, and bus service to Assembly Square is infrequent. The dense, urban-scale district that is envisioned for Assembly Square is well-suited to transit-oriented development. Enhanced transit service to Assembly Square could capture a significant share of the new district's new trips.

Pedestrian and Bicycle

Pedestrian and bicycle access to Assembly Square is currently blocked by the physical barriers of wide roadways, viaducts, high-speed ramps, and rail tracks. Once inside Assembly Square, pedestrians and bicyclists are faced with large blocks and uninviting streets. Proposed mixed-use development promises to create new streets and divide up the large blocks, at the same time that it attracts pedestrians and bicycles, and enlivens these streets. In addition, the adjacent residential neighborhoods, the Mystic River park spaces, and connections to the public transit system could generate significant pedestrian and bicycle utilization of Assembly Square.

Motor Vehicle

Assembly Square has access to the adjacent major regional roadways, and most of the surrounding intersections operate acceptably under existing conditions. However, vehicular access to Assembly Square, both regional and local, is largely blocked by the infrastructure barriers. Assembly Square traffic is concentrated at the few gateway intersections, and on the few existing internal streets. The limited comprehensive internal street network produces large blocks and a lack of direct connections, resulting in difficult and confusing circulation throughout the district.

Alternatives Analysis

The Assembly Square Transportation Plan has assessed a broad range of potential improvement alternatives that take advantage of Assembly Square's access opportunities and address the district's existing and future constraints by creating:

- A new Orange Line station within Assembly Square, Urban Ring rail and bus service, and improved bus connections, potentially including shuttle buses.

- Improved and new pedestrian and bicycle connections to and from Assembly Square, especially in the center of the district, to enhance access and connectivity along the Mystic Riverfront park spaces, and a pedestrian-oriented and bicycle-oriented streetscape within Assembly Square

- Improved regional vehicular access at the edges of the district including a reconfigured highway interchange and new gateways and improvements to the internal street network that include more streets and smaller blocks.

The proposed alternatives have been evaluated with a variety of analytical tools. The potential benefits of the improvement alternatives were assessed using a regional travel demand model. The travel demand model tested a total of seven scenarios, with different combinations of land use and transportation alternatives. The results of the model provided information on travel demand in all modes: public transportation, pedestrian, bicycle, and motor vehicle, including both major regional flows and traffic volumes at a local intersection level.

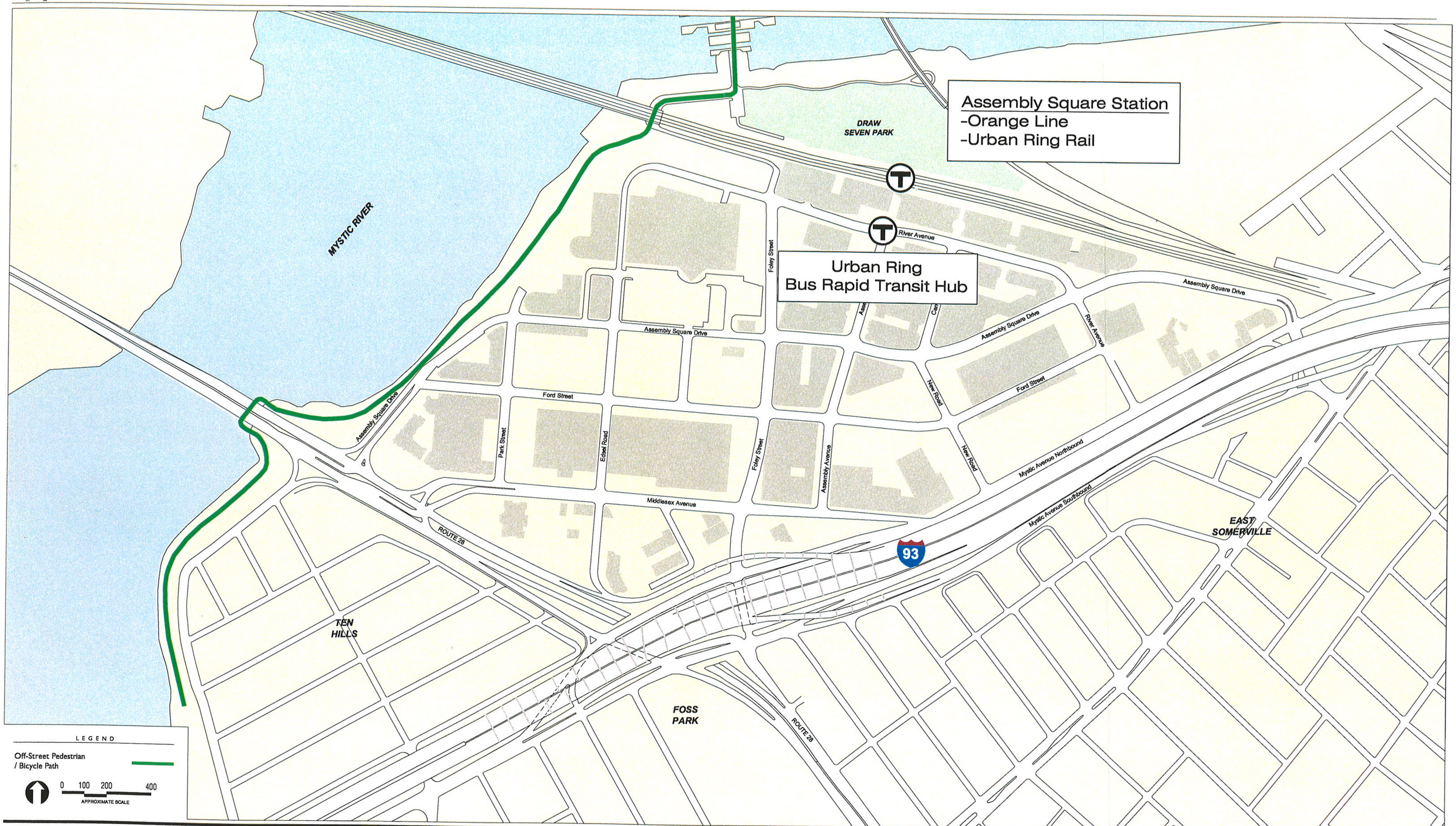
The transportation improvement alternatives were further analyzed to provide a more complete view of their benefits and impacts. The projected public transportation ridership was reviewed to assess transit line capacity constraints and feasible ridership. The proposed highway interchange alternatives were evaluated not only for traffic demand, but also for structural and physical feasibility, as well as cost. The projected intersection traffic volumes, and pedestrian crossing requirements, were evaluated using traffic capacity analysis software, enabling conceptual design of intersections, lane assignment, and assessment of any expected traffic congestion.

Recommendations

Based on the alternatives analysis, a comprehensive multi-modal transportation improvement plan was developed. The elements of this plan are shown in Figure ES-2 and summarized in Table ES-1.

Costs were estimated for interchange construction and internal street network improvements. The estimated cost to reconstruct the I-93 / Route 28 / Mystic Avenue interchange is $53.9 million and $7.6 million to improve the local streets in Assembly Square. The Assembly Square Orange Line Feasibility Study will provide cost estimates for transit improvements.

The implementation of these recommendations can best be achieved through a combined public and private funding strategy. Public funding and state agency participation will be essential for the large scale infrastructure improvements. Smaller-scale improvements, such as new



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Assembly Sqaure Transportation Plan Recommendations

Figure ES-2

roadway construction and traffic signals, can be implemented to some degree through public – private partnerships between the City of Somerville and developers in Assembly Square. This developer participation should be pursued in the context of a comprehensive development impact review and policy framework.

Table ES-1 Summary of Recommendations

Mode	Improvement
Public Transportation	Orange Line station at Assembly Square Urban Ring rail service to Assembly Square Urban Ring bus rapid transit (BRT) service to Assembly Square Local bus service Commuter rail connections at Sullivan Square
Pedestrian and Bicycle	External Gateway Improvements ▪ Route 28 bridge pedestrian / bicycle underpass ▪ Route 28 / Middlesex Avenue ▪ Foley Street Extension ▪ Assembly Square Drive / Mystic Avenue / Lombardi Street ▪ Assembly Square rail station ▪ Amelia Earhart Dam Internal Street Network Improvements ▪ Robust street network with small blocks and direct connections ▪ Wide, continuous sidewalks with street trees ▪ Crosswalks at all intersection approaches ▪ Bicycle accommodation on all internal streets (bicycle lane or wide outside lane)
Motor Vehicle	External Gateway Improvements ▪ New district gateways at ○ Foley Street Extension / Mystic Avenue Northbound ○ I-93 Northbound Off-Ramp / Middlesex Avenue / Edsel Road ○ River Avenue / Mystic Avenue Northbound ▪ Reconfigured highway interchange with the following elements: ○ Foley Street Extension: Connects Route 28 Northbound to Assembly Square and Connects Assembly Square to I-93 Southbound On-Ramp ○ Rebuilt I-93 Northbound Off-Ramp to Route 28 Northbound, Split to Middlesex Avenue (connections to Assembly Square, Route 28 southbound, Mystic Avenue northbound) ○ Route 28 Southbound Underpass ○ Elimination of Redundant Route 28 Southbound to I-93 Southbound Ramp ○ Retention of Two-Way Segment of Mystic Avenue North of Foley Street Extension Internal Street Network Improvements ▪ Robust street grid ▪ New gateways for Assembly Square ▪ Street hierarchy

- Small, urban-scaled blocks
- Direct connections into and out of Assembly Square

2.0 Existing Conditions

A central characteristic of Assembly Square's existing transportation system is its reliance on only a few gateways for access into and out of the district. Assembly Square currently has a significant obstacle on each side. The MBTA rail lines are to the east. Route 28 (designated as McGrath Highway to the south of Assembly Square and as the Fellsway adjacent to and north of Assembly Square) is a wide, high-speed regional roadway; it is located on the west side of Assembly Square. Interstate 93, an expressway, and Mystic Avenue, a major arterial, border Assembly Square to the southwest. The Mystic River lies to the north.

As a result of these barriers, connections into and out of Assembly Square must be made at the points where the barriers are breached. Assembly Square has two primary gateways, which provide the principal access for all modes. These two gateways are at Mystic Avenue / Lombardi Street / Assembly Square Drive and at Route 28 / Middlesex Avenue. These gateways are located at the far southern corner and far northern corner, respectively, of Assembly Square. Although there are other minor gateways, such as Mystic Avenue Northbound / New Road and Mystic Avenue Northbound / Middlesex Avenue, the two main gateways provide the best access to and from multiple directions. As a result, most connections must pass through the two main gateways. Figure 2-1 shows Assembly Square's gateways, as well as the obstacles to reaching the central part of the district.

At the southwestern corner of Assembly Square, adjacent to the center of the district, I-93 and Mystic Avenue cross Route 28. The resulting complex of overpasses, underpasses, ramps, and signalized intersections creates another barrier in this location. In spite of the proximity of Assembly Square's center to this interchange, the only vehicular access to Assembly Square in this location is via Mystic Avenue northbound to Middlesex Avenue.

This southwestern corner of Assembly Square is also closest to the greatest concentration of neighborhood activities: Foss Park, the Broadway commercial district, and the residential neighborhoods of Winter Hill and East Somerville. Nevertheless, local connections in all modes are difficult at this location. Local vehicular connections via Route 28 northbound must utilize the northern or southern gateway. Although there is a crossing at the northern end of Kensington Avenue for pedestrians and bicycles, it requires unprotected crossings of high-speed ramps and roadways and an unappealing passage beneath the I-93 viaduct and ramps.

These barriers and Assembly Square's resulting dependence on two principal gateways at opposite corners of the district have negative ramifications:

- Local travelers to and from Assembly Square must often go out of their way to reach a gateway
- Local access from Winter Hill and East Somerville is circuitous and difficult, especially by foot or bicycle
- Traffic is concentrated at a few access points, which increases congestion at those points
- The center of Assembly Square is distant from both major gateways
- Visitors to Assembly Square tend to enter and exit in an oblique manner, which undermines their understanding of Assembly Square as a cohesive district

The following is a detailed description of existing conditions in each major transportation mode: public transportation, pedestrian / bicycle, and motor vehicle.

2.1 Public Transportation

Although Assembly Square is bounded on its eastern edge by rail transit lines, the direct public transportation service to Assembly Square is limited. The existing public transportation service in the area consists primarily of walking connections from the Sullivan Square Orange Line station, although it is a difficult walk. Some Massachusetts Bay Transportation Authority (MBTA) bus routes provide direct service to Assembly Square, but these connections are fairly infrequent, especially during off-peak periods. In addition, Assembly Square's current development pattern, with large-footprint retail uses standing alone amid large parking lots, cannot be considered "transit-oriented."

2.1.1 Existing Public Transportation Connections

The public transportation services available to Assembly Square include the Orange Line subway and three MBTA bus routes. Figure 2-2 shows Assembly Square's existing public transportation connections, which include:

- Sullivan Square (with service via the Orange Line and 11 MBTA bus routes) is approximately ¼-mile from the southern corner of Assembly Square

- Wellington Station (Orange Line) is approximately ½-mile from the northwestern corner of Assembly Square
- MBTA bus routes 90, 92, and 95 run through or adjacent to Assembly Square, providing connections to Sullivan Square (all), Wellington Station (90), Davis Square (90), Charlestown (92), downtown Boston (92), Medford Center (95), and West Medford (95)

Public transit service characteristics are shown below in Table 2-1.

Table 2-1 Public Transportation Frequency

Service	Weekday Peak Service[1]	Weekday Off-Peak Service[1]	Night Service[1]	Weekend Service[1]
Orange Line Subway	12	7.5	4.6	4.6
Bus Route #90	1.7	1.7	1	Saturday: 1 Sunday: 0
Bus Route #92	4.6	2	1	Saturday: 2 Sunday: 0
Bus Route #95	4	2	1	Saturday: 2 Sunday: 1

1. Number of trips per hour

2.1.2 Public Transportation Constraints

Public transportation riders who wish to reach Assembly Square face significant obstacles, in terms of distance, physical barriers, difficult road crossings, and difficult way-finding. Figure 2-3 illustrates the difficulties of the existing public transportation connections to Assembly Square.

- No Orange Line station between Sullivan Square and Wellington Station
- Difficult-to-find pedestrian connection from Sullivan Square. This connection is circuitous and blocked by high-speed roads and highway viaduct
- A 5-minute walk from Sullivan Square just reaches the edge of Assembly Square, while a 10-minute walk does not even reach the middle of the district

- Circuitous pedestrian connection from Wellington Station, and a 10-minute walk that barely reaches the northwest corner of the district
- MBTA buses through Assembly Square operate at low frequencies, especially relative to the Orange Line, as shown in Table 2-1

2.2 Pedestrian and Bicycle

Assembly Square is well-situated for bicycle and pedestrian access. It is close to several dense residential neighborhoods, and has parklands and trails along the Mystic River. Even in its current state, it has destinations that are attractive to pedestrians and bicyclists, including the movie theatre, restaurant and retail stores. However, Assembly Square's physical barriers are especially daunting for pedestrians and bicyclists.

- Viaduct and ramp structures present insurmountable barriers in some locations.
- There are crosswalks at the intersection of Mystic Avenue / Route 28, but this intersection is complex and requires multiple crossings, some of them unprotected crossings of high-speed traffic.
- The major gateways into and out of Assembly Square have better pedestrian and bicycle accommodation, but the circuitous routes via these gateways can present infeasible detours for pedestrians.

In addition, the Assembly Square internal street network is not pedestrian friendly. There are sidewalks on most major streets, but these sidewalks typically lie between wide streets with high-speed traffic and large parking lots. Pedestrians and bicyclists are attracted to the parklands along the Mystic River, although these are also difficult to reach.

In spite of these disadvantages, Assembly Square still attracts some pedestrians and bicyclists. These pedestrians and bicyclists demonstrate the potential for Assembly Square to attract many more in the future when access is improved.

2.2.1 Pedestrian and Bicycle Opportunities

Assembly Square's location along the Mystic River, near dense residential neighborhoods, could make it attractive and convenient for pedestrian and bicycle usage. Figure 2-4 illustrates the advantages that Assembly Square enjoys with respect to pedestrian and bicycle access.

- Assembly Square is adjacent to the dense residential neighborhoods of Ten Hills, Winter Hill, and East Somerville; residents of these neighborhoods would be more likely to visit the commercial uses and park spaces in Assembly Square if pedestrian and bicycle access were improved

- Assembly Square is directly adjacent to parklands along the Mystic River and at Draw Seven Park
- Assembly Square is a fairly compact district, approximately ¾-mile long from the southern corner at Lombardi Street to the northern corner at the Wellington Bridge

2.2.2 Pedestrian and Bicycle Constraints

Pedestrians and bicyclists traveling to and from Assembly Square are blocked by the high-speed traffic and structural barriers that surround the district. As Figure 2-5 shows, it is difficult for pedestrians and bicyclists to reach Assembly Square from adjacent neighborhoods because access via the main gateways is circuitous.

For the most part, the existing pedestrian and bicycle connections are difficult, circuitous, and/or uninviting, as shown in Figures 2-6 and 2-7.

Mystic River Path

The riverfront bicycle / pedestrian path ends abruptly at Route 28, with no crosswalk and no protected crossing across Route 28. The nearest protected crossing is approximately 500 feet away, at Middlesex Avenue / Route 28.

Route 28 / Assembly Square Drive

There is no crosswalk and no protected crossing of Route 28 at Route 28 / Assembly Square Drive.

Route 28 / Middlesex Avenue

At this major gateway to Assembly Square, a crosswalk and protected crossing is provided. This is the principal connection between Assembly Square and the adjacent Ten Hills residential neighborhood.

Mystic Avenue / Route 28

This complex intersection is very difficult to cross for pedestrians and bicycles. Crosswalks and pedestrian push-buttons are provided at several crossing points. However, the crossing from the southwest corner of the intersection (at Foss Park) to Assembly Square requires unprotected crossings of high speed traffic. An alternate crossing point in the vicinity of Kensington Street also requires unprotected crossings of high-speed traffic. Both require passing beneath the I-93 viaduct, which is uninviting.

Mystic Avenue Northbound / Assembly Square Drive / Lombardi Street

The pedestrian and bicycle crossing at this major gateway to Assembly Square provides protected crossings. However, the passage beneath the I-93 viaduct is not inviting for pedestrians and bicyclists. This intersection is located approximately 2,500 feet from the nearest adjacent crossing between East Somerville and Assembly Square at Kensington Street. As a result, reaching one of these entry points could require a diversion of up to 1,250 feet (from the vicinity of Michigan Avenue).

Existing Internal Streets

Conditions within Assembly Square are unfriendly to pedestrians and bicycles, with wide streets, high-speed traffic, and wide parking lots. The intersection of Middlesex Avenue / Foley Street is the only internal intersection equipped with a traffic signal, although it is currently operating in "flash" mode. This signal is not equipped with pedestrian push buttons, nor does it have pedestrian signal heads. Many of the intersections lack crosswalks, or the crosswalks are not highly visible.

2.3 Motor Vehicles

Motor vehicle access will continue to be a principal mode for access to and from Assembly Square. However, to achieve the goals of the Assembly Square Transportation Plan, Assembly Square should become better integrated into the surrounding roadway system, and better able to take advantage of the roadway infrastructure that surrounds it. Assembly Square's internal street network should also be more extensive, more direct, and more understandable. The following is a summary of Assembly Square's existing roadway network and its relationship to the surrounding regional roadway system. This information was used as a basis to formulate strategies that addressed the objectives of the plan.

2.3.1 Existing Roadway Network

Assembly Square has the potential for excellent regional roadway access. It is bounded on two sides by major regional roadways, with high capacities and high traffic volumes. However, these regional roadways are currently oriented for through-traffic, and not for access to Assembly Square. Figure 2-8 shows Assembly Square and the existing roadway system.

Interstate 93

On the southwestern edge of Assembly Square, Interstate 93 carries approximately 130,000 vehicles per day on an eight-lane elevated expressway. To the south, I-93 provides connections to downtown Boston and the South Shore. To the north, I-93 provides connections to the northern suburbs, I-95 / Route 128, I-495, and New Hampshire.

Interstate 93 provides access to and from the Route 28 / Assembly Square area via full complement of highway ramps: northbound off-ramp, northbound on-ramp, southbound off-ramp, southbound on-ramp. Both sets of ramps, northbound and southbound, have an overlapping "scissor" layout: the off-ramp exits in advance, and passes over the on-ramp. This enables I-93 to dedicate a lane to each off-ramp, and add that lane back to the mainline at each on-ramp. This is appropriate and beneficial to highway traffic operations, given the high traffic demand on each of the Assembly Square interchange ramps.

Mystic Avenue

Mystic Avenue is a major arterial that runs directly adjacent to I-93 and carries approximately 40,000 vehicles per day. In the vicinity of Assembly Square, Mystic Avenue serves largely as a frontage road for I-93, with northbound travel lanes to the east of I-93 and southbound travel lanes to the west. This segment of Mystic Avenue northbound currently serves heavy regional traffic volumes, especially in the evening peak period.

The completion of the Central Artery / Tunnel (CA/T) project should relieve congestion and improve access to I-93 northbound via the downtown on-ramp. This could reduce demand for the Mystic Avenue northbound connection to I-93 from its current level of approximately 2,200 vehicles during the evening peak hour. Since the I-93 northbound on-ramp at City Square in Charlestown was closed as part of the CA/T project, the I-93 northbound on-ramp near Assembly Square has become the first on-ramp north of downtown Boston and therefore has heavy demand in the evening peak period. There are no plans for a new I-93 northbound on-ramp between downtown Boston and Assembly Square, so this ramp will continue to be the first northbound on-ramp outside downtown Boston.

Route 28

Assembly Square is bounded on the west side by Route 28, a four-lane limited access highway which carries approximately 50,000 vehicles per day in the vicinity of Assembly Square. Route 28 (McGrath Highway) runs south through East Somerville to East Cambridge near Lechmere, and to downtown Boston at Leverett Circle. To the north, Route 28 becomes the Fellsway, passing through Medford, the Middlesex Fells Reservation, Stoneham, and Reading.

Motor vehicle access to and from Assembly Square is a challenge for local Somerville residents due to the location of the limited-access regional highways that interrupt the local street network and block access to Assembly Square. Route 28 northbound offers the principal connection to Assembly Square for most Somerville neighborhoods, but access to Assembly Square via Route 28 northbound requires entry at the far northern end of the district at Middlesex Avenue or Assembly Square Drive. This also requires a weaving maneuver across I-93 northbound off-ramp traffic.

Internal Street Network

Once inside Assembly Square, the internal street network is currently limited. Large blocks are separated by just a few wide, high-speed roadways. As a result, all internal Assembly Square traffic is concentrated on these roadways.

The principal existing streets in the Assembly Square district are Assembly Square Drive, Middlesex Avenue, Foley Street, and New Road. Middlesex Avenue and New Road are minor arterial roadways, with two lanes in each direction and no parking. Assembly Square Drive from Mystic Avenue northbound to Foley Street is a minor arterial street with two lanes in each direction and no parking, although illegal parking in the outside lane is common.

The extension of Assembly Square Drive between Foley Street and Route 28 is a private way, owned by the Assembly Square Mall. Foley Street is a collector roadway, with two lanes in each direction between Middlesex Avenue and Assembly Square Drive, and one lane in each direction beyond Assembly Square Drive. Minor local streets within Assembly Square include the extensions of McGrath Highway and Kensington Street, as well as Cummings Street and North Union Street. Garfield Avenue off of Middlesex Avenue is a public roadway, but it is not currently accessible.

Currently, Assembly Square's land uses generate more trips during the Saturday midday peak period than during the commuter peak periods, especially the morning peak period. These traffic patterns are consistent with the current preponderance of retail uses in the district, uses which are not major trip generators during commuter peak periods, especially the morning peak period. However, traffic volumes within Assembly Square are still at their highest during commuter peak periods, due to the through-traffic that uses Assembly Square roadways to make regional connections. This is especially true of traffic seeking to make the connection from Mystic Avenue Northbound to Route 28 northbound; since there is no direct connection, traffic uses Middlesex Avenue and Assembly Square Drive.

2.3.2 Existing Traffic Volumes

Traffic volumes were counted at the study area intersections and ramp locations shown in Figure 2-9. The traffic counts captured the specific turning movement volumes at a total of 12 existing intersections (eight signalized intersections and four unsignalized intersections), and the traffic volumes at six highway ramp connections. Although the intersection of Middlesex Avenue / Foley Street has a traffic signal, it currently operates in "flash" mode, which is functionally comparable to unsignalized control. It is assumed that this intersection will function as a signalized intersection in the future.

The weekday AM peak hour counts were taken in February 2002 from 7:00 to 9:00 AM. The weekday PM peak hour turning movement counts were conducted in September and October 2000 between 4:00 and 6:00 PM by VHB, Inc. for the traffic impact analysis for the proposed IKEA Mixed-Use Development. These volumes from September and October 2000 have been increased by a growth factor to reflect current conditions.

The peak hour volumes represent the highest volumes of traffic at each individual intersection recorded during one consecutive hour during these peak periods. At most of the study area intersections, this was 7:30 – 8:30 AM or 7:45 – 8:45 AM, and 4:45 – 5:45 PM or 5:00 – 6:00 PM. By taking the "worst case" volume at each individual intersection, the resulting volume network represents the most conservative analysis.

These existing peak hour turning movements at intersections in and around Assembly Square are shown in Figures 2-10 (AM Peak Hour) and 2-11 (PM Peak Hour). The traffic volume data are included in Appendix A.

2.3.3 Existing Traffic Operations

Existing traffic volumes and roadway configurations were used to evaluate the existing traffic operations at the study area intersections during the weekday morning and evening commuter peak periods. Although the Saturday midday peak period is currently an important consideration for Assembly Square traffic, the dramatic increase in office and research and development (R&D) uses in the district desired over the next 20 years, as indicated in the *Assembly Square Planning Study*, will have a much higher impact on weekday peak periods. New retail uses proposed for the district will have some impact on Saturday peak periods, and these impacts will be examined in the context of specific development proposals. However, these increases in Saturday traffic will be largely offset by the elimination of retail uses that will be replaced with other uses during that time.

As a result of the new mix of uses, especially the high concentration of office / R&D development, the overall traffic demand for the Assembly Square full-build condition (per the *Assembly Square Planning Study*) will be highest during the weekday commuter peak hours. These are also the periods that have the highest level of ambient traffic on surrounding roadways. Therefore, weekday morning and evening commuter peak hours are the design conditions for the transportation plan.

Level of Service Criteria

The quality of traffic operations at a given location is generally described in terms of level of service. Level of service (LOS) is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. LOS is an aggregate indicator of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions. LOS A represents free-flow or uncongested conditions with little or no delay to motorists, while LOS F represents a forced-flow condition with long delays and traffic demands exceeding roadway capacity.

Roadway operating levels of service are calculated following procedures defined in the *2000 Highway Capacity Manual (HCM)*, published by the Transportation Research Board. For signalized and unsignalized intersections, the operating level of service is based on travel delays. Delays can be measured in the field but generally are calculated as a function of traffic volume; peaking characteristic of traffic flow; percentage of heavy vehicles in the traffic stream; type of traffic control; number of travel lanes and lane use; intersection approach grades; pedestrian activity; and signal timing, phasing, and progression where applicable. The specific criteria applied per the *2000 Highway Capacity Manual* are summarized in Table 2-2.

Table 2-2 Intersection Level of Service Criteria

Level of Service	Average Delay per Vehicle (Seconds) Signalized Intersections	Unsignalized Intersections
A	≤ 10	≤ 10.0
B	> 10.0 and ≤ 20.0	> 10.0 and ≤ 15.0
C	> 20.0 and ≤ 35.0	> 15.0 and ≤ 25.0
D	> 35.0 and ≤ 55.0	> 25.0 and ≤ 35.0
E	> 55.0 and ≤ 80.0	> 35.0 and ≤ 50.0
F	>80.0	>50.0

Source: Transportation Research Board, Highway Capacity Manual, Special Report 209, Third Edition, National Research Council, Washington, DC, 2000.

While levels of service for both signalized and unsignalized intersections are based on delay, care should be used when comparing results for the two different intersection types. The calculated average delay per vehicle for signalized intersections applies to all vehicles entering the intersection and under control of the traffic signal. For unsignalized intersections, it is assumed that through movements on the major street have the right of way, and are not delayed by side street traffic. Consequently, the total delay values in Table 2-2 for unsignalized intersections apply only to the minor street intersection approaches or to left turns from the major street into the minor street which must yield to oncoming traffic. The results of the traffic operations analysis are included in Appendix B.

Signalized Intersections – Gateways and Surrounding Intersections

The gateway intersections and peripheral intersections around Assembly Square are signalized intersections. Under existing conditions, these intersections generally function well. All of these signalized intersections operate at LOS D or better during the morning and evening peak hours, with the exception of Broadway / Lombardi Street, which operates at LOS E during the evening peak hour.

The Broadway / Lombardi Street intersection operates at LOS E during the evening peak hour mainly due to high volumes of I-93 southbound off-ramp traffic. It is likely that this traffic is made up principally of commuters returning to the East Somerville area from the north.

The level of service, delay, and volume-to-capacity ratios for the study area's signalized intersections are summarized in Table 2-3.

Table 2-3 Signalized Intersection Level of Service and Delay

Location	Peak Hour	2002 Existing Conditions LOS[1]	Delay[2]	V/C[3]
Route 28 at Assembly Square Drive	AM	A	3.4	0.72
	PM	A	4.7	0.74
Route 28 at Middlesex Avenue	AM	D	40.1	0.80
	PM	B	12.2	0.49
Route 28 at Mystic Avenue NB	AM	D	35.2	0.58
	PM	B	17.7	0.34
Route 28 at Mystic Avenue SB	AM	D	38.0	1.01
	PM	B	10.1	0.63
Route 28 NB at Mystic Avenue SB	AM	C	24.9	0.38
	PM	C	26.1	0.45
Broadway at Lombardi Street	AM	B	17.6	0.69
	PM	E	62.3	0.97
Mystic Avenue NB at Lombardi Street	AM	B	13.8	0.43
	PM	D	38.4	0.98
Mystic Avenue NB at New Road	AM	A	4.6	0.34
	PM	A	8.8	0.80

1 Level-of-service
2 Average delay in seconds per vehicle
3 Volume-to-capacity ratio

Unsignalized Intersections

All of Assembly Square's internal intersections currently function as unsignalized intersections. The intersection of Middlesex Avenue / Foley Street is outfitted with traffic signal equipment, but operates under flashing yellow (Middlesex Avenue) – flashing red (Foley Street westbound) control, which is functionally analogous to unsignalized operation. It is expected that the traffic signal equipment at this intersection will be upgraded, and that this intersection will function as a signalized intersection in the future.

At these unsignalized intersections, the major street traffic has priority over minor street traffic, which is Stop-controlled by a stop sign or by a flashing red light. The delay and level of service designation for unsignalized intersections applies only to the minor street stop-controlled approaches. All of the unsignalized intersections in the study area currently operate at LOS D or better. Most of them operate at LOS A or B, except for the Mystic Avenue Southbound approach to Lombardi Street, which operates at LOS D during the evening peak hour, and the New Road eastbound approach to Assembly Square Drive, which operates at LOS C during the evening peak hour.

These levels of service at the unsignalized intersections in the study area are indicative of the relatively low levels of existing traffic volumes, especially on the stop-controlled minor street approaches. With more development in Assembly Square, especially development that generates weekday peak hour traffic, more traffic will be present at these internal intersections.

The level of service, delay, and volume-to-capacity ratios for the study area's unsignalized intersections are summarized in Table 2-4.

Table 2-4 Unsignalized Intersection Level of Service and Delay

Location	Peak Hour	2002 Existing Conditions LOS[1]	Delay[2]	V/C[3]
Middlesex Avenue at Assembly Square Mall Drive	AM	A	8.9	0.01
	PM	B	10.2	0.12
Lombardi Street at Mystic Avenue SB	AM	B	14.3	0.44
	PM	D	27.9	0.69
Assembly Square Drive at New Road (EB)	AM	A	9.9	0.04
	PM	C	17.9	0.24
Assembly Square Drive at Foley Street				
Assembly Square Drive (NB)	AM	A	8.2	0.16
	PM	B	10.3	0.42
Assembly Square Drive (SB)	AM	A	8.9	0.32
	PM	B	10.2	0.37
Foley Street (WB)	AM	A	8.4	0.10
	PM	A	9.6	0.10
Foley Street (EB)	AM	A	8.5	0.27
	PM	B	10.0	0.35
Middlesex Avenue at Foley Street (WB)	AM	B	10.5	0.05
	PM	B	14.0	0.27

1 Level-of-service
2 Average delay in seconds per vehicle
3 Volume-to-capacity ratio

2.3.4 Vehicular Access Opportunities

The major roadways directly adjacent to Assembly Square offer the potential for good regional vehicular connections. The principal connections into and out of Assembly Square are shown in Figures 2-12 – 2-17.

Because of Assembly Square's system of gateways, with major connections at only the far northern and southern corners of the district, the vehicular access to and from Assembly Square can be divided among the various sectors of Assembly Square: Figures 2-12 and 2-13 show access to and from the northern end of Assembly Square, Figures 2-14 and 2-15 show access to and from the southern end, and Figures 2-16 and 2-17 show access to and from the center of the district.

The varying ease and directness of each of the connections to and from these areas of Assembly Square are shown in Figures 2-12 – 2-17 by different colored arrows: green for a "direct" connection, yellow for a "moderate" connection, and red for an "indirect" connection. These distinctions are essentially qualitative and relative, and are based on the distance traveled, the number of intersections traversed, and the degree of current congestion. The distinctions are not meant to be quantitatively rigorous, but rather to show the existing connections to and from Assembly Square, and demonstrate in general terms the effects of Assembly Square's current system of gateways on access into and out of the district.

The following are some of the advantages that Assembly Square currently enjoys with respect to motor vehicle access:

- The roadway infrastructure immediately adjacent to Assembly Square provides good regional roadway connections

- Assembly Square's pattern of major gateways (at the northern and southern corners of the district) make vehicular access to and from the northern and southern ends of Assembly Square generally good, although some connections are somewhat circuitous, as shown in Figures 2-12, 2-13, 2-14, and 2-15

- There is a great deal of capacity on the regional roadways adjacent to Assembly Square

- Most of the intersections in the study area perform acceptably during weekday peak periods in existing conditions, as demonstrated in Tables 2-3 and 2-4 above. It is not anticipated that this circumstance will continue in the future, when development in both Assembly Square and surrounding areas may cause future operational problems at these intersections, an issue that will be addressed in the future conditions and the proposed improvements.

2.3.5 Vehicular Access Constraints

In spite of the roadway infrastructure and capacity, there are obstacles to realizing Assembly Square's potential for good vehicular access. These obstacles include circuitous connections via Assembly Square's limited gateways, vehicular connections that are not intuitive, and a lack of visual cohesiveness to Assembly Square and to its connections to surrounding roadways and neighborhoods.

Dividing Assembly Square into three sectors and considering access to the different sectors is still informative. Even in existing conditions, with light traffic and minimal delays, the lack of a cohesive, intuitive street network or good signage makes travel within Assembly Square confusing.

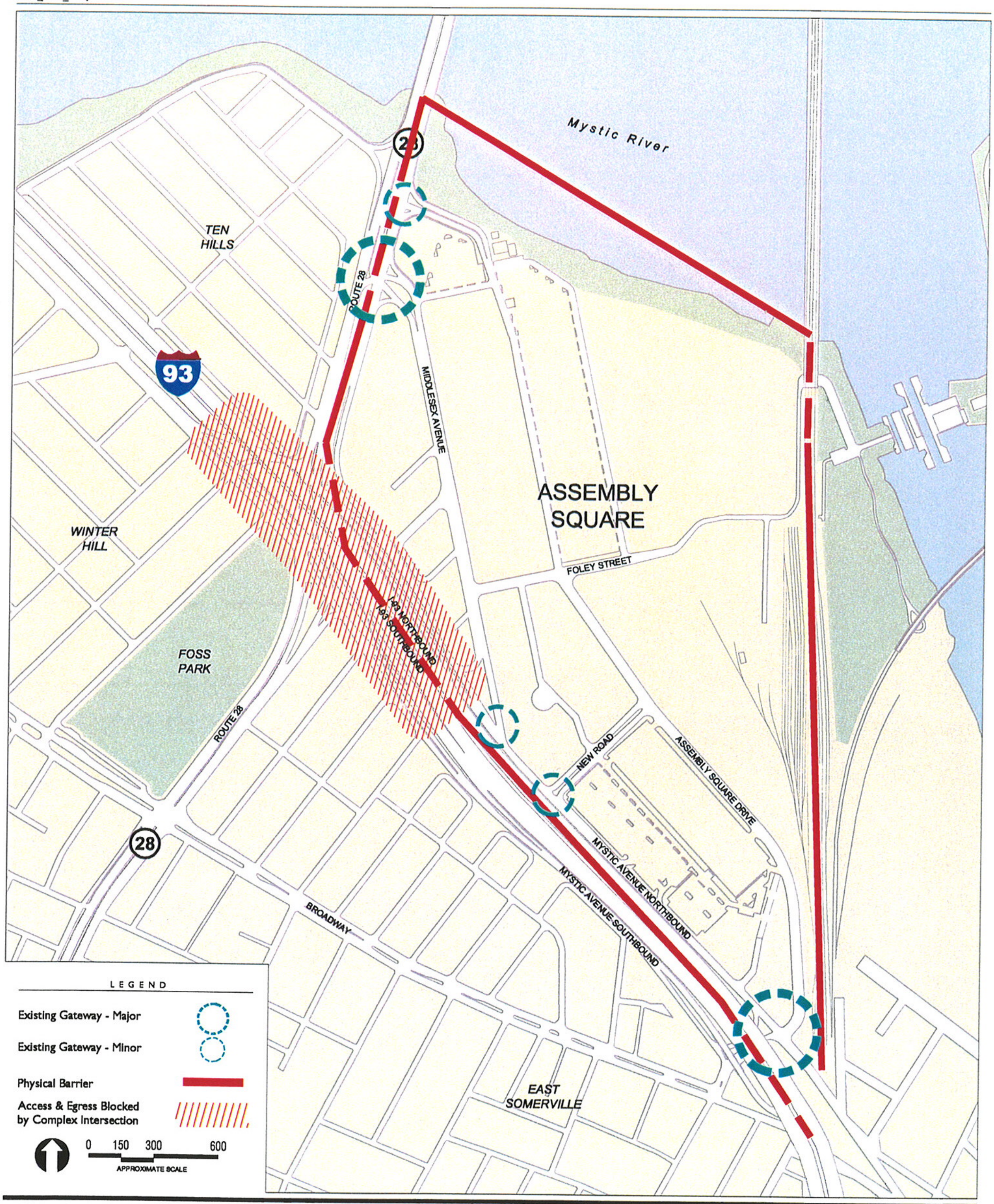
In the future, internal traffic and delays will increase, making internal travel even more challenging.

- Assembly Square has a limited number of gateways that make regional and local vehicular connections circuitous, especially to the central portion of Assembly Square, as shown in Figures 2-16 and 2-17
- The I-93 Ramps / Route 28 / Mystic Avenue interchange is confusing, with short weaving sections, high accident rates, and redundant connections
  - The I-93 northbound off-ramp traffic bound for Route 28 northbound and Route 28 northbound mainline attempting to turn right on Middlesex Avenue have a short weaving section of only about 250 feet, as shown in Figure 2-18
  - The Route 28 southbound – Mystic Avenue southbound – I-93 southbound on-ramp 600-foot weaving section provides redundant connections between Route 28 southbound, Mystic Avenue southbound, and I-93 southbound, as shown in Figure 2-19
- The I-93 Ramps / Route 28 / Mystic Avenue interchange offers poor connections from Mystic Avenue to Route 28 northbound, resulting in the potential for cut-through traffic on Assembly Square streets and on Winter Hill neighborhood streets, as shown in Figure 2-20
- Much of the peak hour traffic on Assembly Square roadways is regional through-traffic, that make connections between Mystic Avenue and Route 28
- As shown in Figure 2-21, Assembly Square's existing internal street network is minimal, with large blocks and relatively few streets, including several private streets and access roads

3.0 Transportation Improvement Alternatives Analysis

For the Assembly Square district to overcome its existing challenges and take best advantage of its opportunity to become a vibrant "urban village," the transportation system in and around Assembly Square requires improvements. The Assembly Square Transportation Plan recommends a set of transportation system improvements that will:

- Address existing transportation needs and issues in Assembly Square, as described above in the existing conditions analysis, and



Assembly Square Transportation Plan
Somerville, Massachusetts

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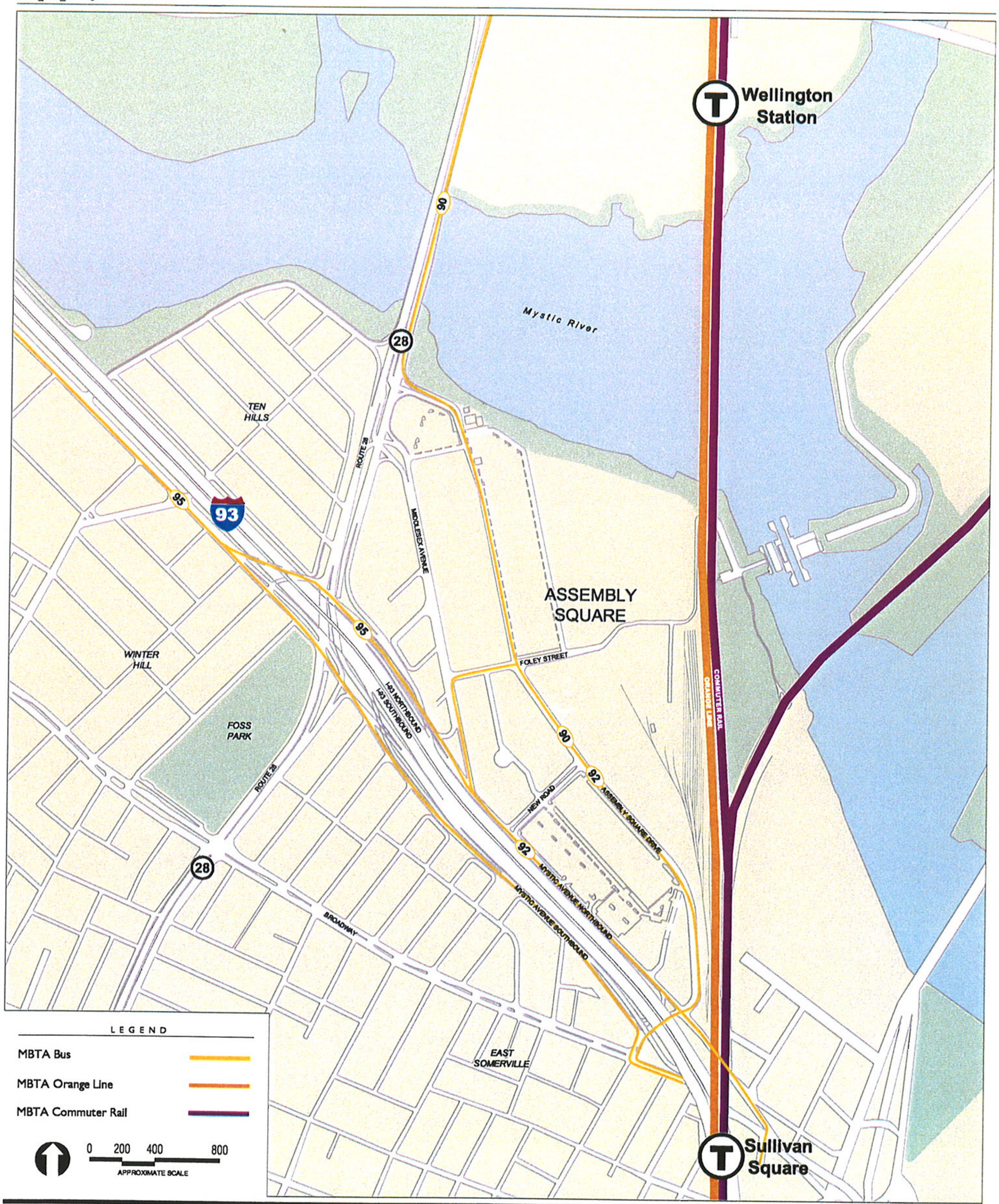
Assembly Square's Gateways and Obstacles

Figure 2-1



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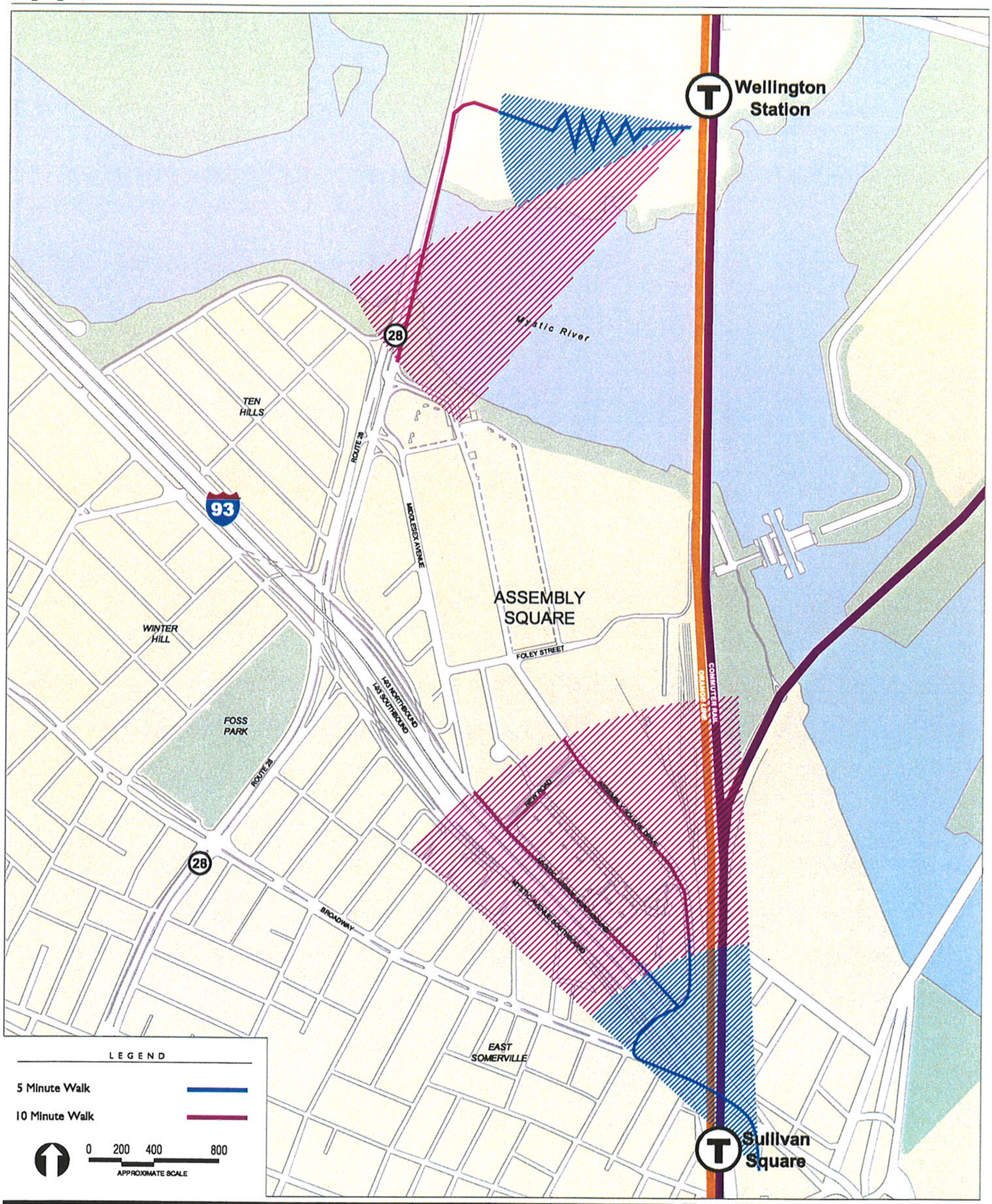
Existing Public Transportation

Figure 2-2



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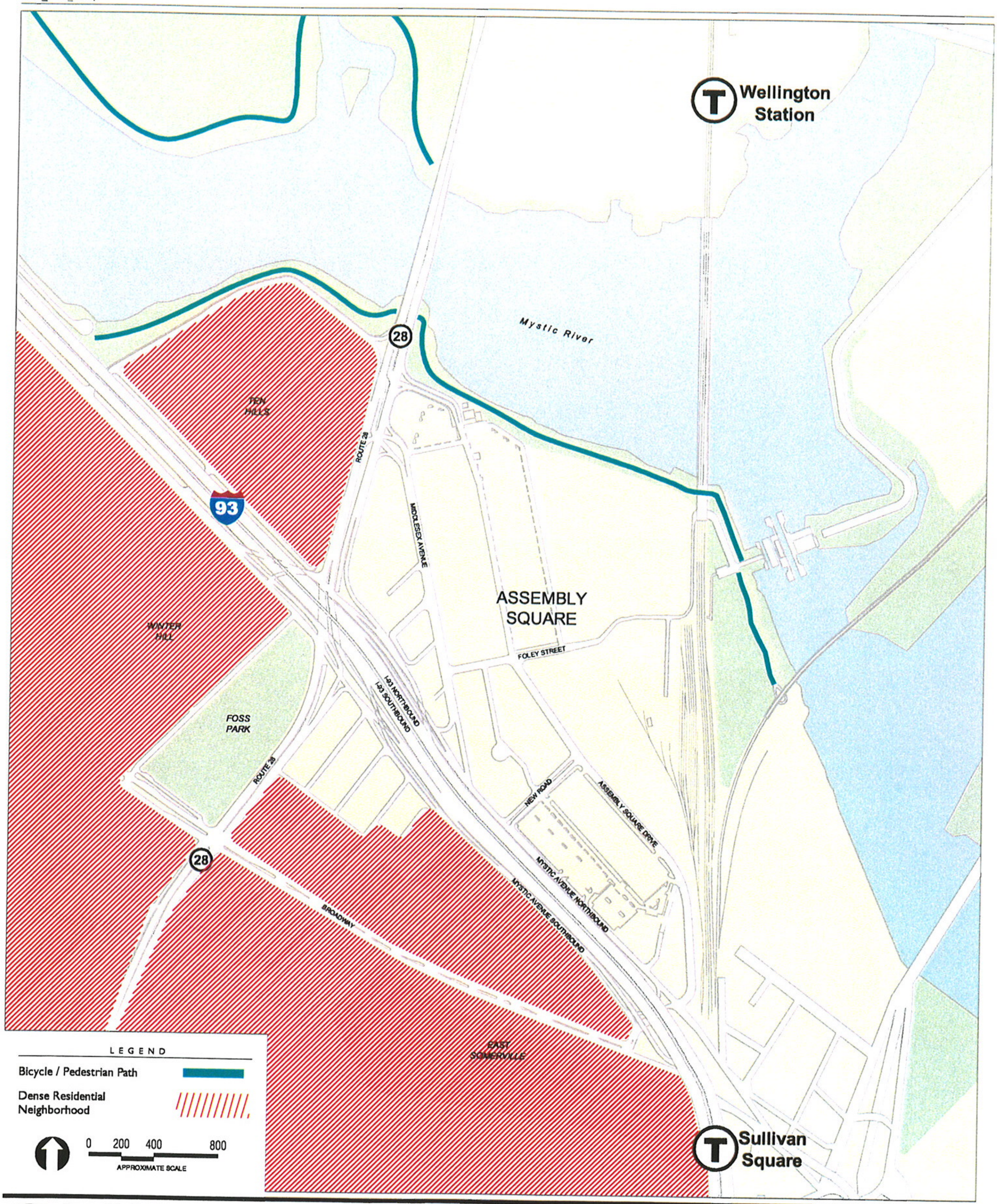
Existing Rapid Transit Connections

Figure 2-3

8640_2-04_PedOp



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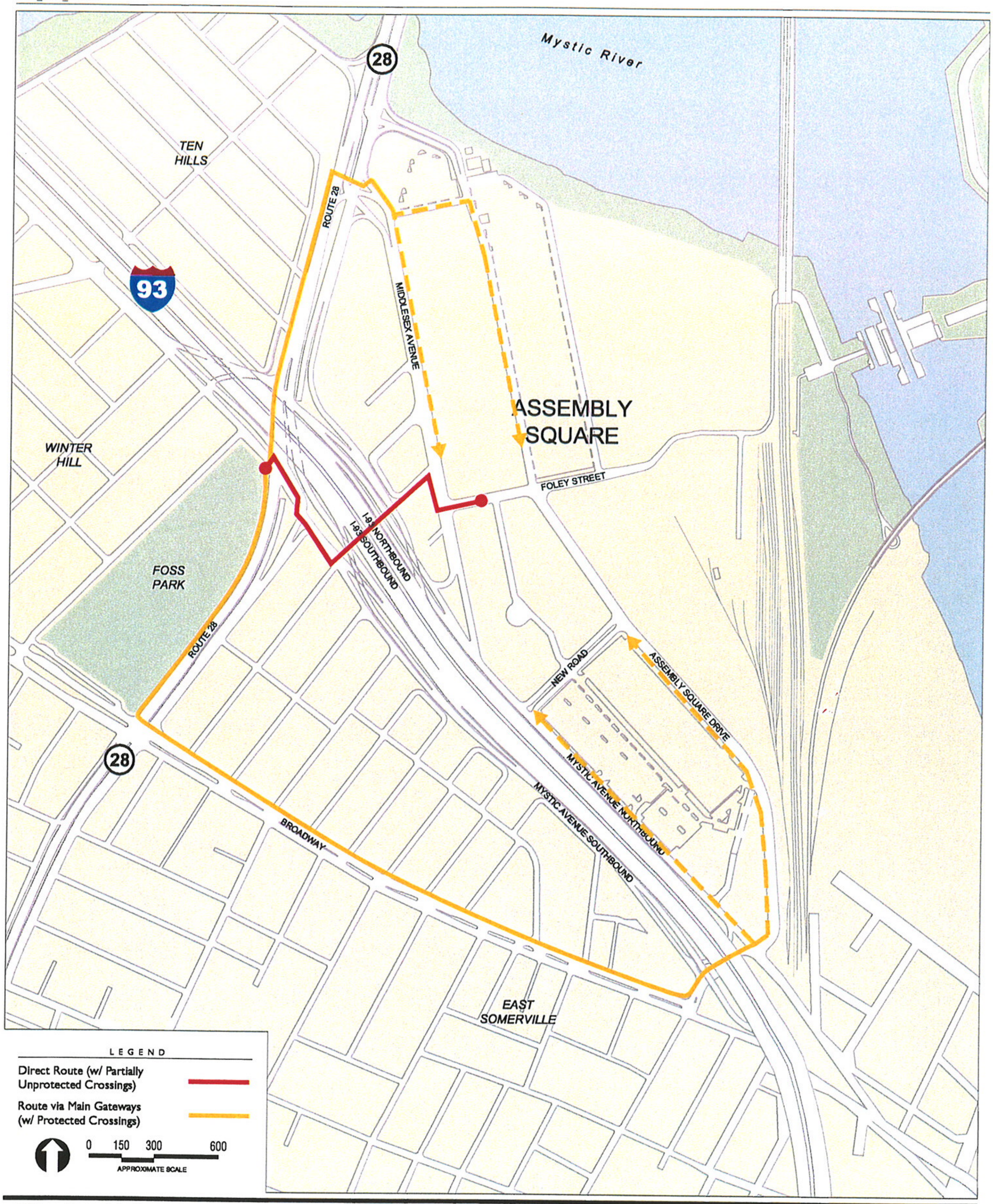
Existing Advantages for Pedestrian & Bicycle Access to Assembly Square

Figure 2-4



Assembly Square Transportation Plan
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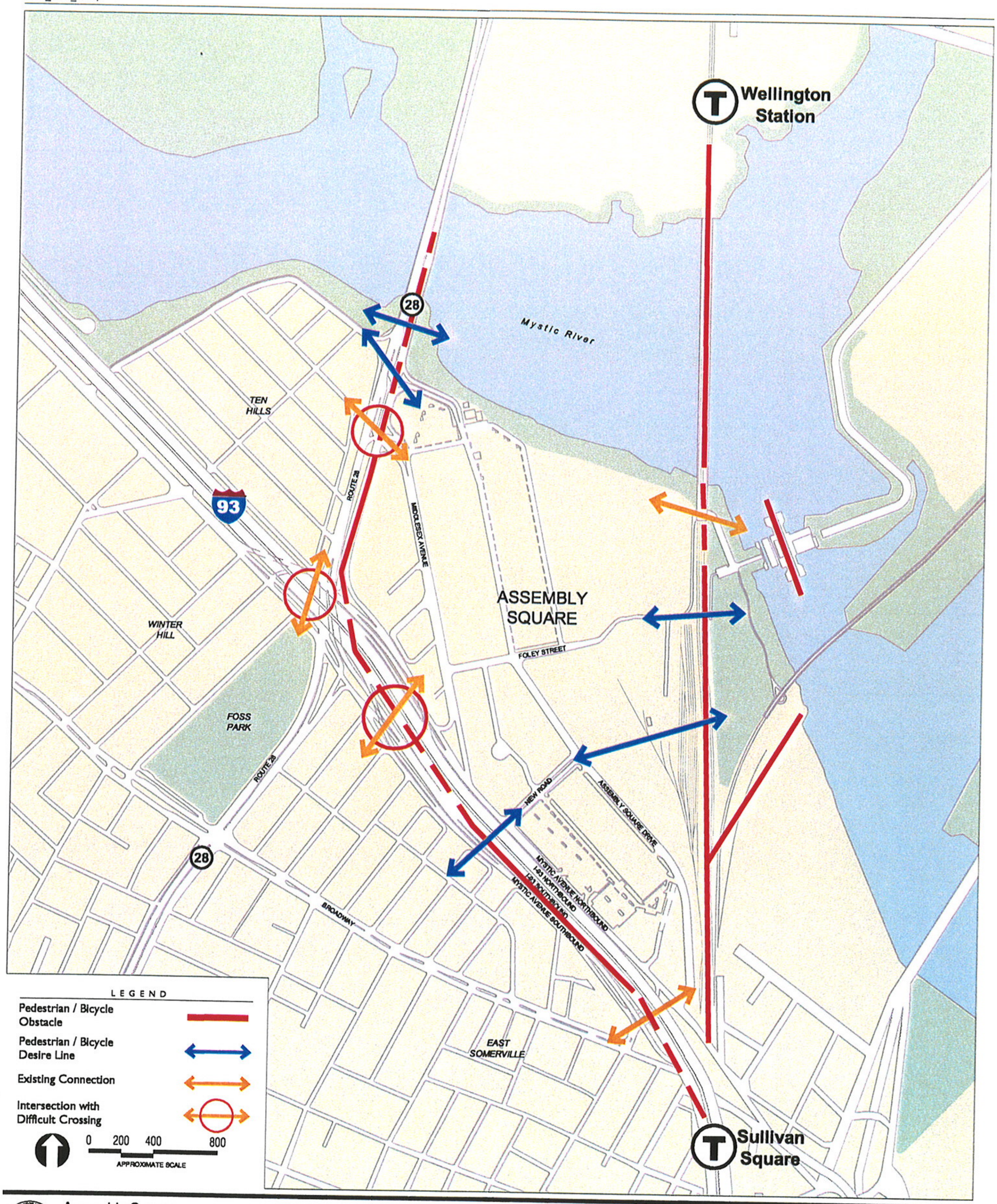
Pedestrian Connections from Foss Park to Assembly Square

Figure 2-5



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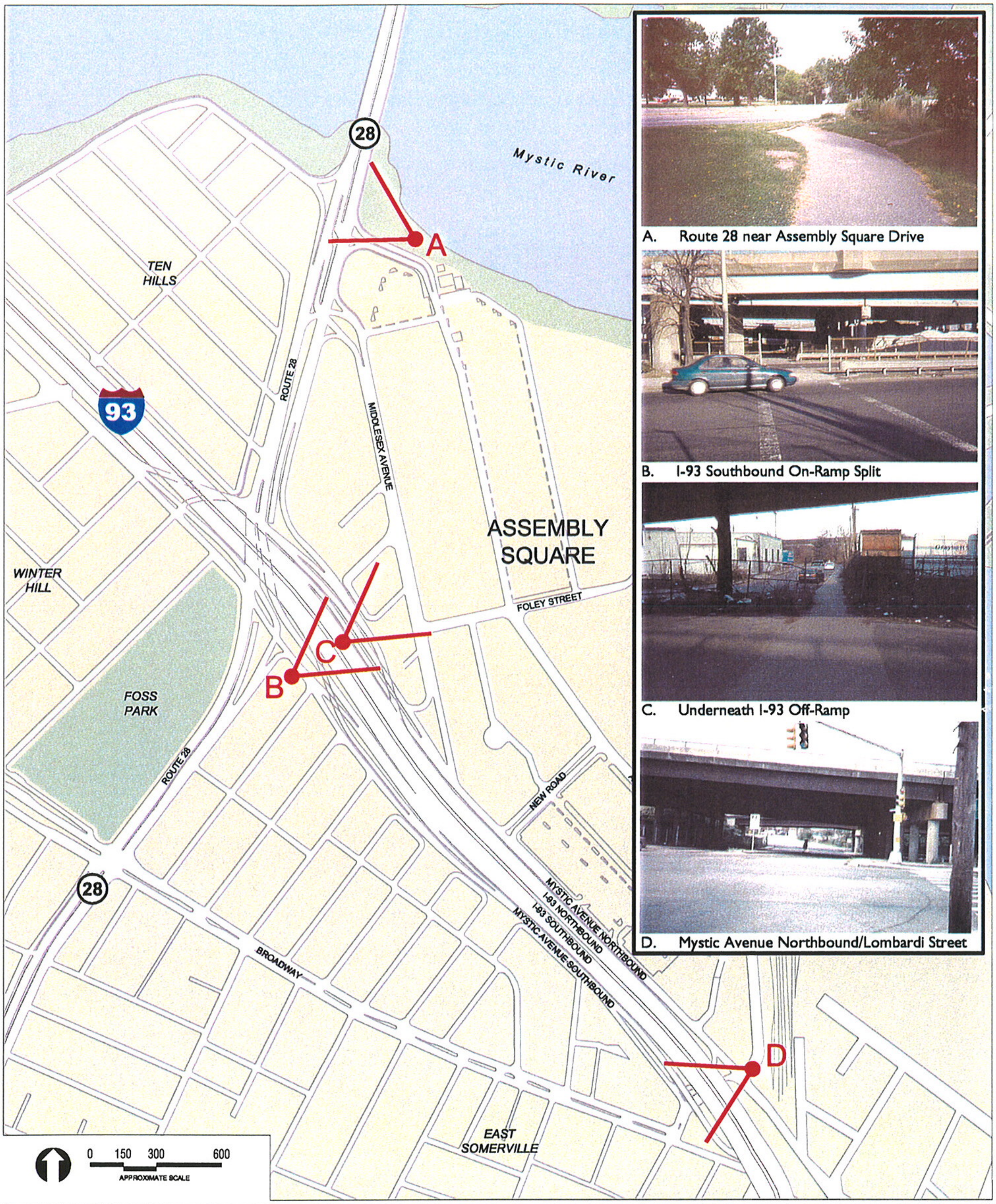
Pedestrian and Bicycle Obstacles

Figure 2-6



A. Route 28 near Assembly Square Drive

B. I-93 Southbound On-Ramp Split

C. Underneath I-93 Off-Ramp

D. Mystic Avenue Northbound/Lombardi Street

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Photos of Existing Pedestrian Obstacles

Figure 2-7

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Somerville, Massachusetts

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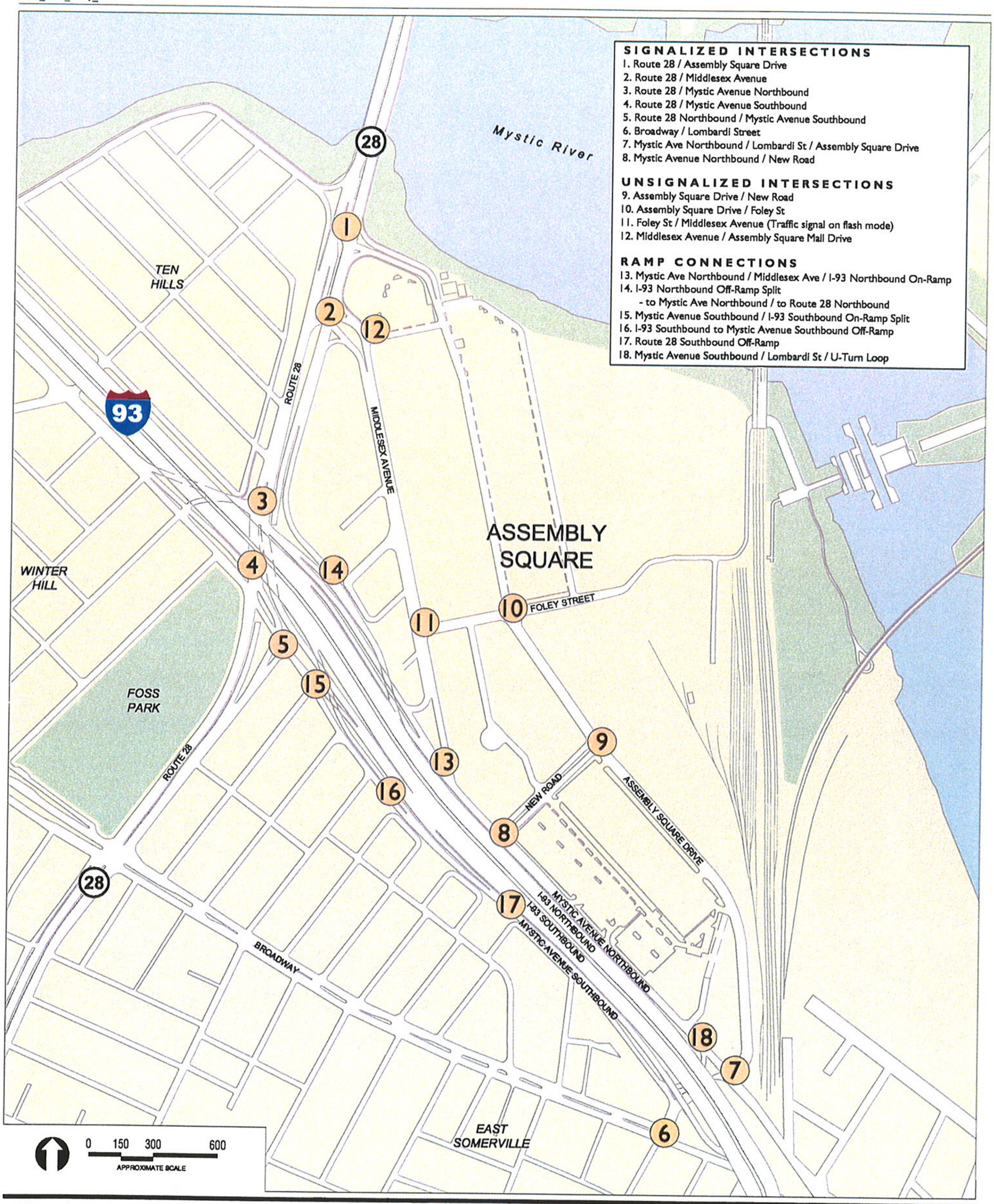
Study Area Roadways

Figure 2-8



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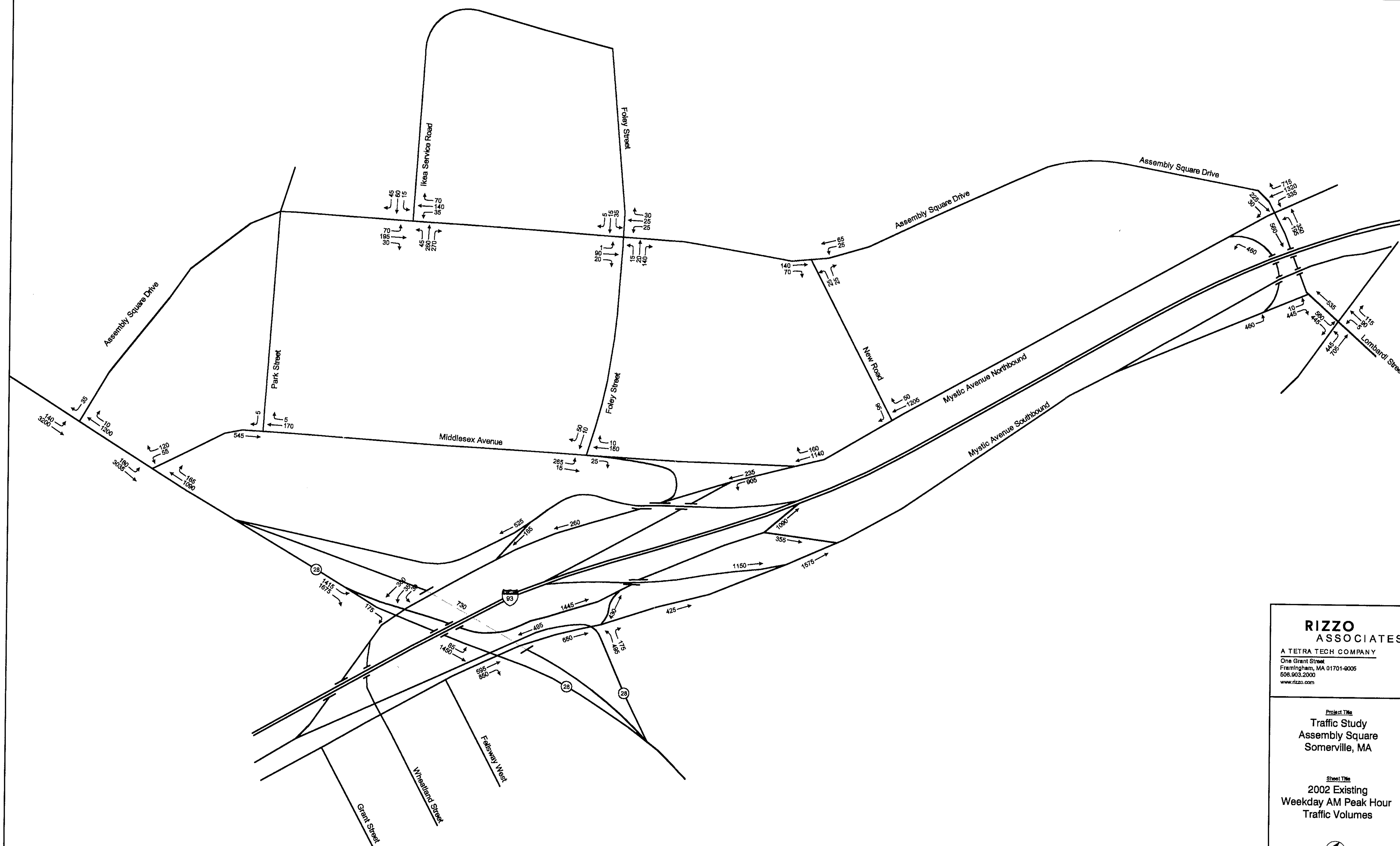
Study Area Intersections Figure 2-9



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Project Title
Traffic Study
Assembly Square
Somerville, MA

Sheet Title
2002 Existing
Weekday AM Peak Hour
Traffic Volumes

Not to Scale

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Sheet No.
Date: 5/01/03
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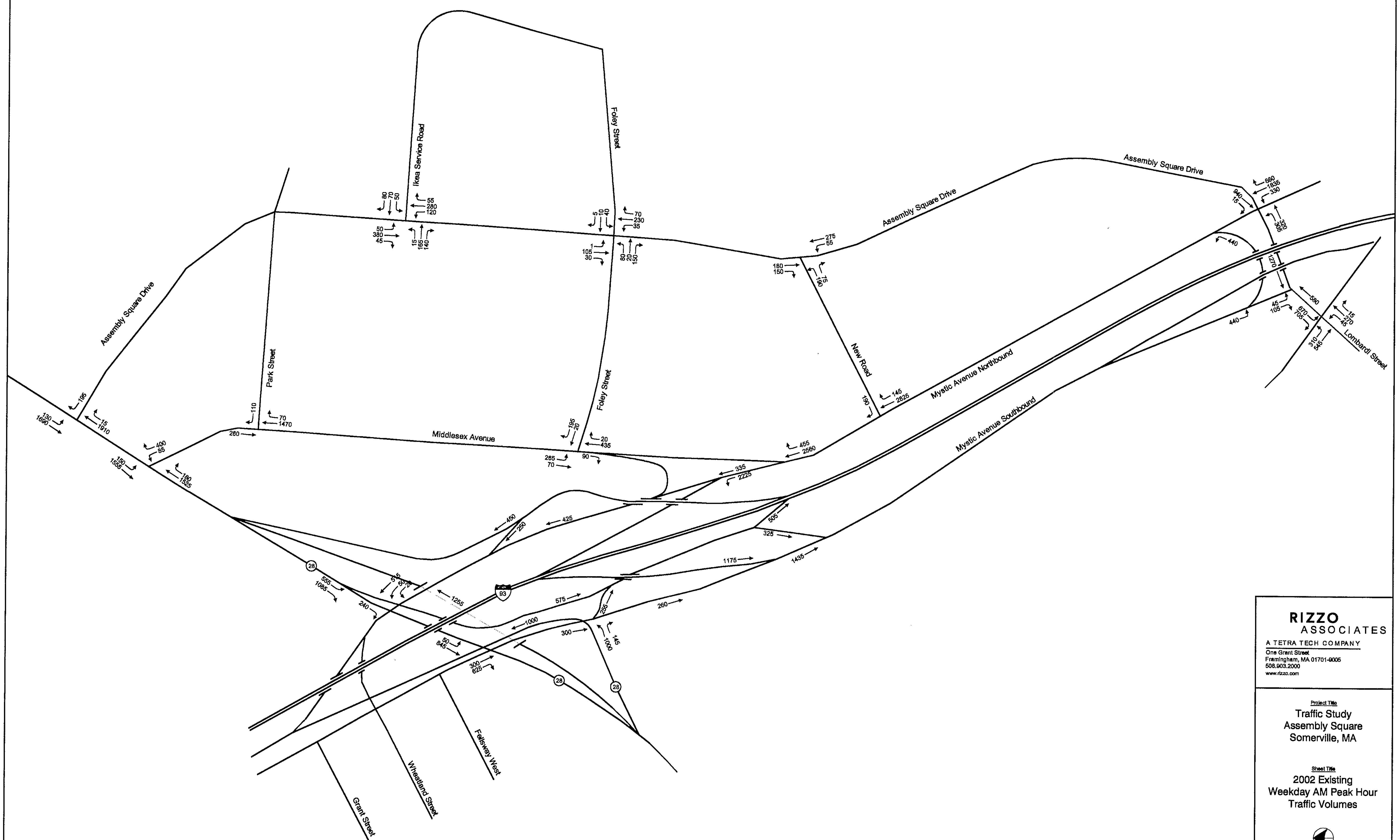

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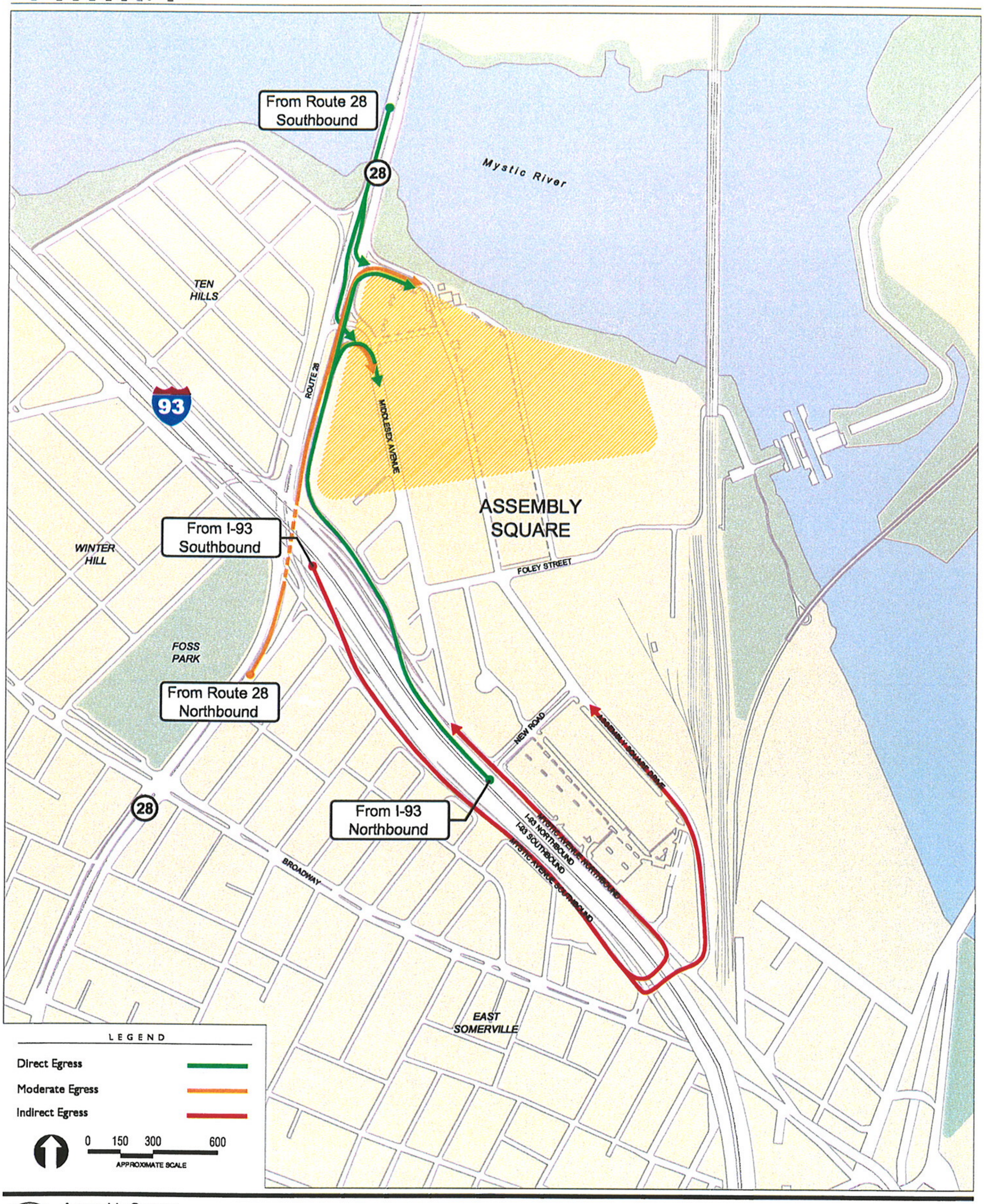

Assembly Square
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Access to Northern End
to Assembly Square

Figure 2-12

Assembly Square Transportation Plan
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Egress from Northern End of Assembly Square

Figure 2-13

Assembly Square
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Access to Southbound End of Assembly Square

Figure 2-14

Assembly Square
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Egress from Southern End
of Assembly Square

Figure 2-15

Assembly Square Transportation Plan
Somerville, Massachusetts

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Access to Center of Assembly Square

Figure 2-16

Assembly Square
Transportation Plan
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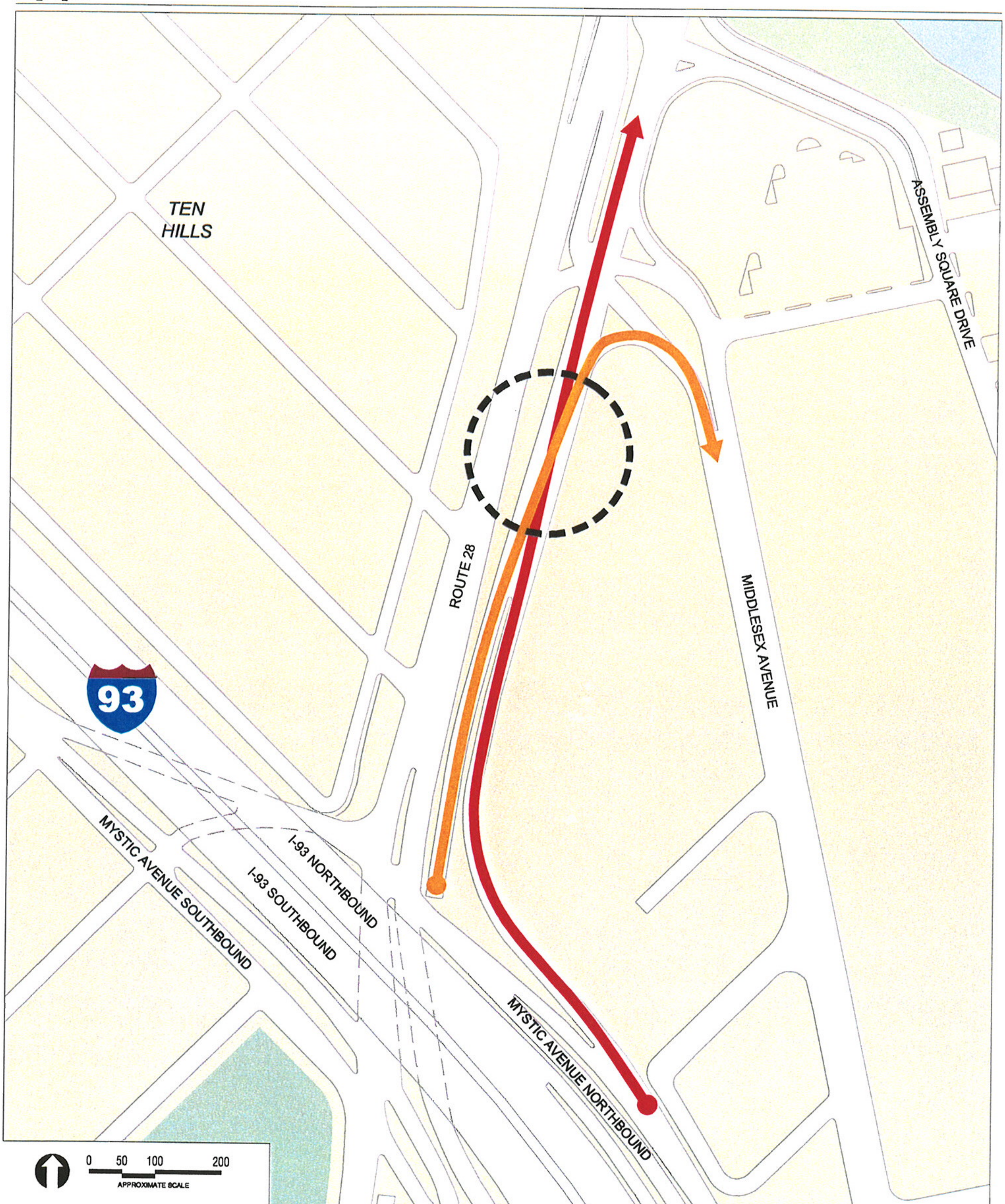
Egress from Center
of Assembly Square

Figure 2-17



Assembly Square Transportation Plan
Somerville, Massachusetts

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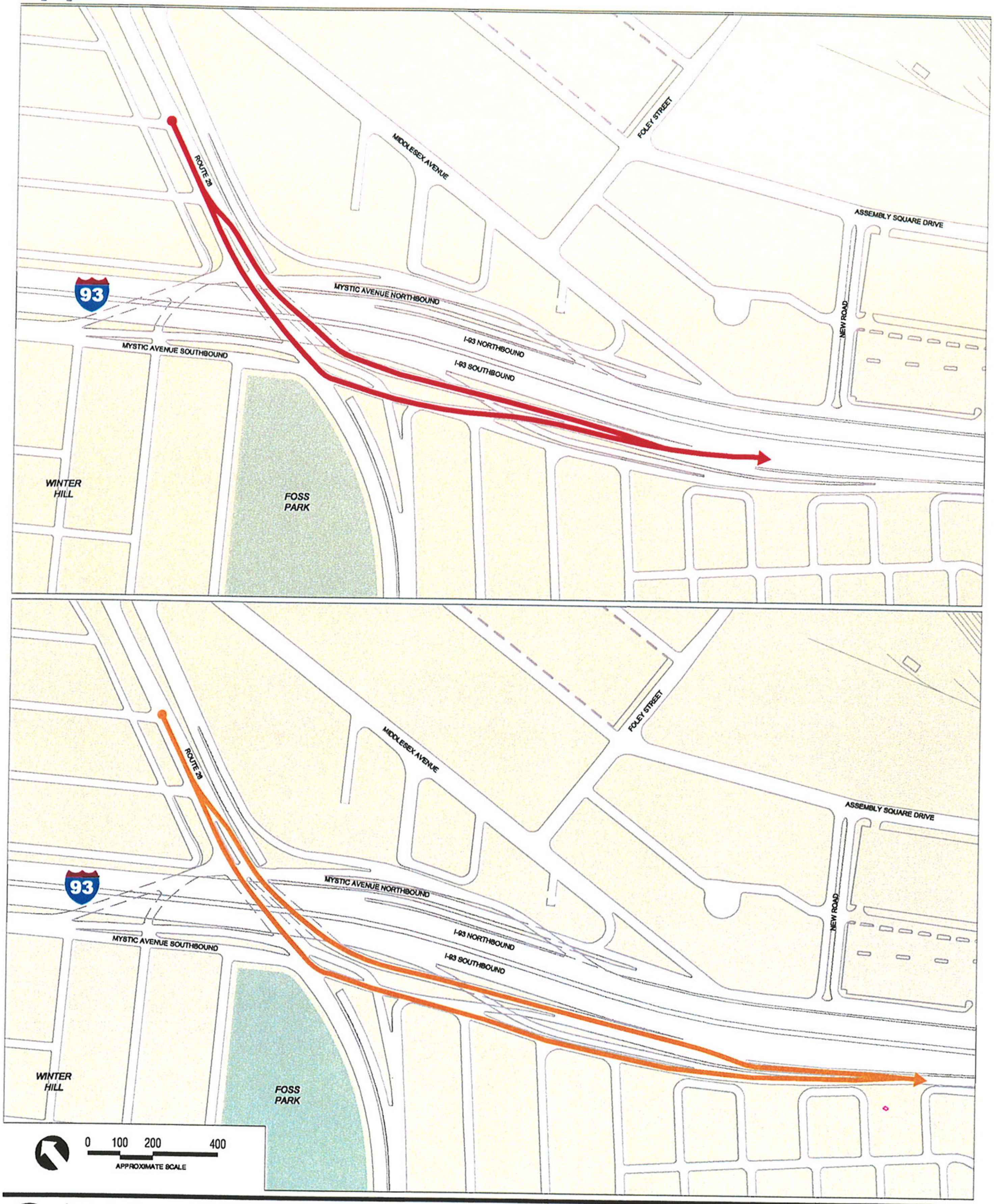
I-93 Off-Ramp / Route 28 NB Weave

Figure 2-18

8640_2-19_redundant



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Redundant Connections Figure 2-19

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Somerville, Massachusetts

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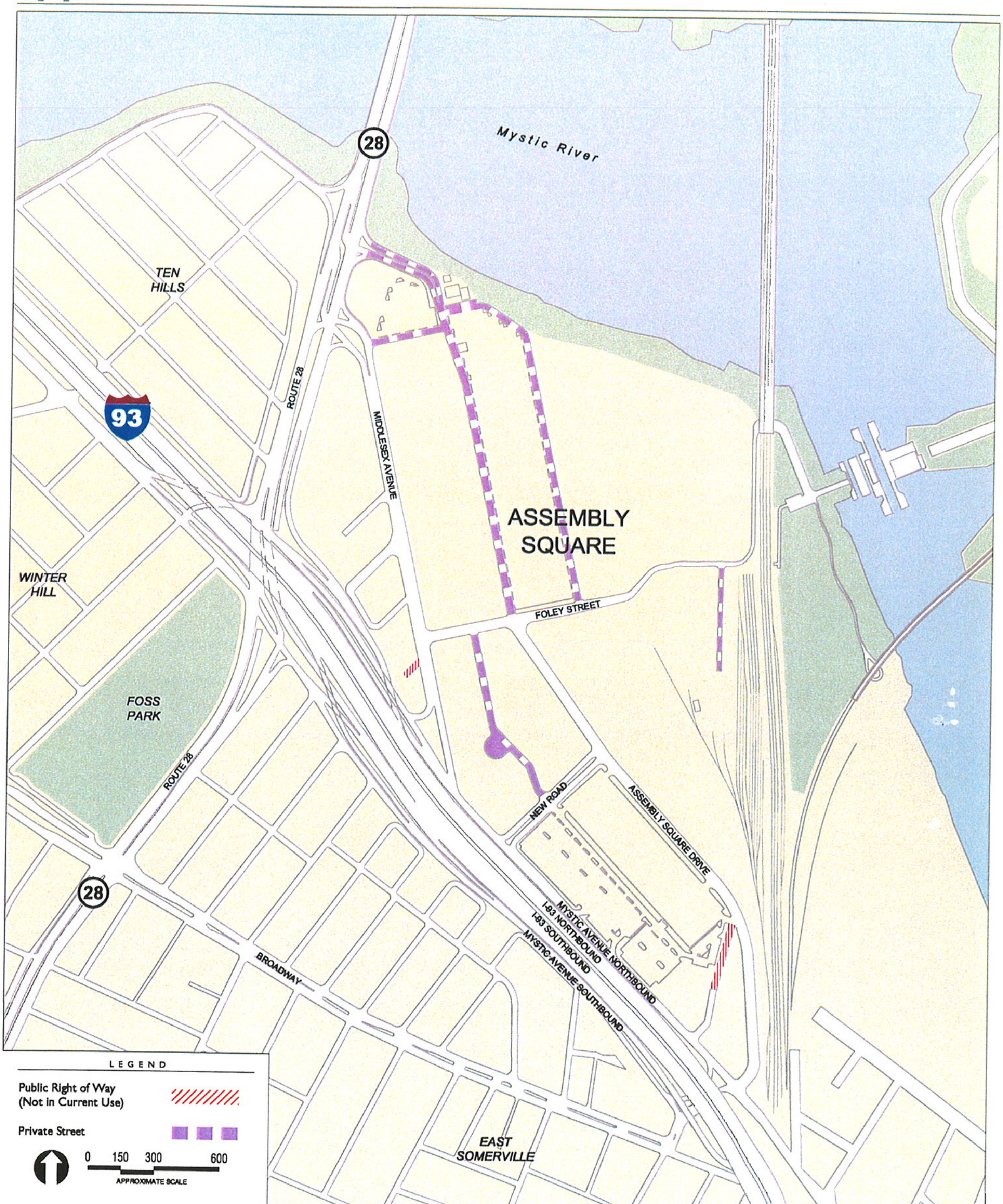
Connections to Route 28 Northbound

Figure 2-20



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Existing Street Network Figure 2-21

1.0 Introduction

Assembly Square is widely seen as Somerville's last major development frontier. A 145-acre site, it is currently home mainly to large retail stores and their parking lots, as well as some industrial uses, a movie theatre, a hotel, a courthouse, an office building, and vacant land. The Mystic River waterfront parks and the Winter Hill Yacht Club offer recreational opportunities directly adjacent to Assembly Square.

Assembly Square currently has many vacant or under-utilized parcels, and has great potential to support new development. Somerville has worked hard to establish a vision for Assembly Square with a series of planning efforts. The latest of these, *The Assembly Square Planning Study*, completed by the Cecil Group in October 2000, articulates a compelling vision for Assembly Square. It recommends that Somerville and potential developers work together to make Assembly Square a growing "urban village" along the waterfront in Somerville, with a mix of community-oriented land uses that will bring economic opportunity and vitality to this area.

Transportation access is an important element of Assembly Square's success. The purpose of the Assembly Square Transportation Plan is to assess the district's transportation access in all modes, and to evaluate and recommend transportation improvements that will facilitate appropriate development and enhance the district as a valuable resource for Somerville.

1.1 Study Area

The Assembly Square Transportation Plan focuses on the area within and immediately surrounding the Assembly Square district. Assembly Square is surrounded by major regional transportation facilities, including Interstate 93, Route 28, Mystic Avenue, the Orange Line subway, the Commuter Rail, and the nearby MBTA bus maintenance yard. Figure 1-1 shows the Assembly Square district in its regional context.

The study area includes Assembly Square's internal streets and intersections, the gateway intersections at the edges of Assembly Square, and the adjacent highways and ramps surrounding Assembly Square. The study area also encompasses the pedestrian and bicycle connections to nearby neighborhoods and park spaces. It also includes the public transportation connections at adjacent transit hubs, primarily Sullivan Square and Wellington Station, and takes into account general public transportation system connectivity. Figure 1-2 shows the transportation plan study area, including the intersections that are included in the motor vehicle, pedestrian, and bicycle analysis, as well as the elements of the public transportation system.

1.2 Goals and Objectives

The Assembly Square Transportation Plan is designed to articulate a multi-modal transportation vision for achieving a livable urban village, and to create an ambitious, feasible, technically sound implementation plan for enabling this vision. To this end, the transportation plan's principal goals are:

- Enhance Assembly Square's connections to the surrounding neighborhoods and the regional transportation system
- Identify transportation improvements, in all modes, that will enable Assembly Square to become a vibrant urban village, with
    - Adequate function and capacity to support the desired development
    - Enhanced non-motorized access and broader modal choice
    - Place-making qualities that enhance Assembly Square's livability, cohesiveness and urban character

In order to achieve these goals, the transportation plan will pursue the following objectives. These objectives will guide the transportation plan's analysis of existing conditions, identification of potential improvement alternatives, and evaluation of the benefits and impacts of those alternatives. Table 1-1 presents the key objectives in each major transportation mode.

1.3 Opportunities and Constraints

Assembly Square offers Somerville great opportunities for community-oriented development. Assembly Square lies on the Mystic River waterfront, and is directly adjacent to the dense residential neighborhoods of Ten Hills, East Somerville, and Winter Hill. In addition, Assembly Square is only two miles from downtown Boston, and it is surrounded by a great deal of regional transportation infrastructure, including Interstate 93, state Routes 28, 38, and 99, the Orange Line, and commuter rail lines. These conditions offer potential development excellent transportation access in all modes: public transit, pedestrian, bicycle, and motor vehicle.

Table 1-1 Key Objectives of Transportation Plan

Mode	Objectives
Public Transportation	Create improved connections to existing public transportation infrastructure adjacent to Assembly Square, in particular the Orange Line Accommodate and encourage future Urban Ring transit service Facilitate improved bus service, both public and private (MBTA bus, shuttle bus)
Pedestrian and Bicycle	<u>External Gateway Connections</u> ▪ Improve existing pedestrian and bicycle connections between Assembly Square and surrounding neighborhoods ▪ Create new connections where major pedestrian and bicycle desire lines are unsatisfied ▪ Enhance connections to the regional recreational network of the Mystic River waterfront, including the Mystic River Reservation and Draw 7 Park <u>Internal Street Network Improvements</u> ▪ Make Assembly Square's internal street grid pedestrian-oriented and bicycle-oriented
Motor Vehicle	<u>External Gateway Connections</u> ▪ Improve vehicular access between Assembly Square and the surrounding neighborhoods, and between Assembly Square and the regional roadway system ▪ Propose improvements to the existing I-93 Ramps / Route 28 / Mystic Avenue interchange in order to: o Improve safety o Improve connections into and out of Assembly Square o Preserve and/or improve regional connections <u>Internal Street Network Improvements</u> ▪ Create a robust and cohesive internal street network with an urban scale ▪ Create small blocks with multiple paths to destinations ▪ Ensure adequate traffic operations for the anticipated amount and pattern of development

However, Assembly Square also faces major access challenges. The tremendous infrastructure resources are largely untapped by Assembly Square. Ironically, the proximity of this infrastructure is a principal cause of Assembly Square's poor accessibility. The viaducts, ramps, embankments, high speed roadways, and rail lines were not designed to facilitate access for Assembly Square. Instead, they present significant barriers, especially to pedestrians and bicyclists.

Although two rapid transit rail lines, the Orange Line and commuter rail, pass through Assembly Square, they provide no service to it. In addition, they block access along the eastern edge of the district. Sullivan Square station provides Orange Line and bus service quite close to the southeast corner of Assembly Square. However, the pedestrian obstacles and the distance from the heart of Assembly Square, let alone the northwest corner, make Sullivan Square station a poor resource for Assembly Square at present.

Major roadways directly adjacent to Assembly Square or nearby include Interstate 93, state highways (Routes 28, 38 and 99), and Rutherford Avenue, but circuitous ramp connections and a lack of visual connection hamper vehicular access to Assembly Square, especially for local traffic. Even drivers who are able to navigate to and from their destination within Assembly Square generally do not have a good understanding of the district as a whole.

Under existing conditions, motor vehicle travel dominates the transportation system in and around Assembly Square. The existing land use within the district is primarily retail and entertainment. These stores, their parking lots, and their access patterns are automobile-oriented. There is some pedestrian and bicycle activity associated with the Mystic River parks and nearby public transportation terminals, but these connections are difficult for pedestrians and bicyclists.

The infrastructure that forms barriers around Assembly Square has the potential to be turned into a major asset if it can be used correctly. In order to do this, the highways and public transportation system must be better connected to Assembly Square, rather than just passing it by and creating obstacles around it. Improvements such as a new Orange Line station and changes to the Route 28 / Mystic Avenue / I-93 interchange can unlock the potential of the existing billions of dollars in public investment for Assembly Square's use. The Assembly Square Transportation Plan explores these and other potential transportation system improvements in order to enable Assembly Square to develop in a community-friendly manner.

1.4 Report Organization

The Assembly Square Transportation Plan is organized into five chapters that correspond generally to the major tasks undertaken in the transportation planning process.

1. **Introduction.** The introduction establishes the purpose and need for the study, the transportation plan's goals and objectives, the study area, and the key assumptions underlying the study.

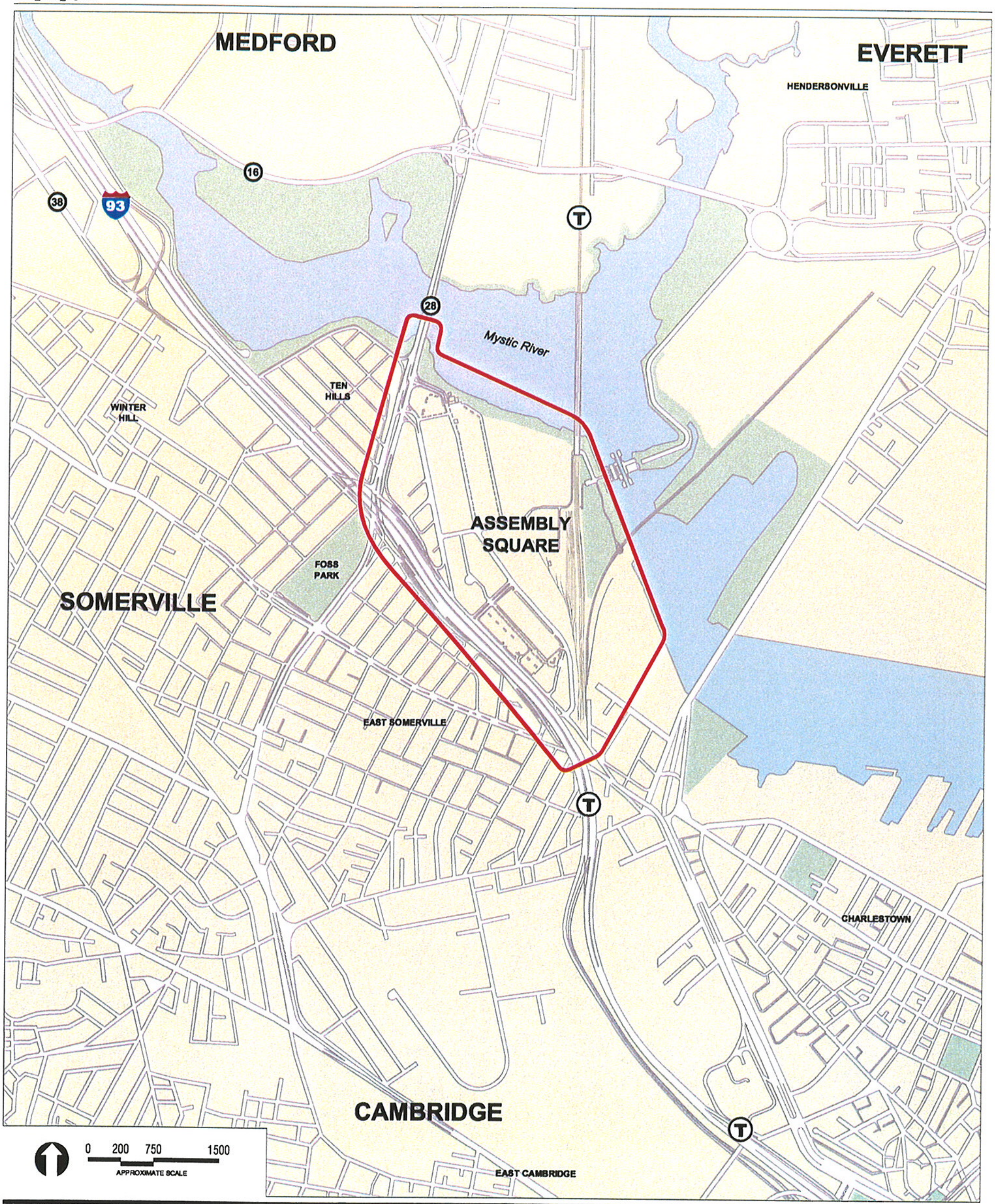
2. **Existing Conditions.** This section describes current conditions in Assembly Square, the existing transportation system in its

various modes (public transportation, pedestrian and bicycle, and motor vehicle), and each mode's key opportunities and constraints relative to improving the Assembly Square transportation system.

3. **Transportation Improvement Alternatives Analysis.** This section defines the future travel demand at Assembly Square, proposes a set of transportation improvement alternatives, and describes the travel demand modeling process used to assess the efficacy of the proposed transportation improvement alternatives.

4. **Alternatives Analysis Results.** This section describes the travel demand of Assembly Square, the manner in which the travel demand is distributed over the various modes, and the advantages and disadvantages of the various alternatives relative to the transportation plan's goals and objectives. This section also includes preliminary designation of the preferred alternatives in all modes.

5. **Transportation Plan Recommendations.** This section summarizes the preferred alternatives in all modes, estimates the costs of implementing these preferred alternatives, and proposes guidelines for implementing the preferred alternatives.



Assembly Square Transportation Plan
Somerville, Massachusetts

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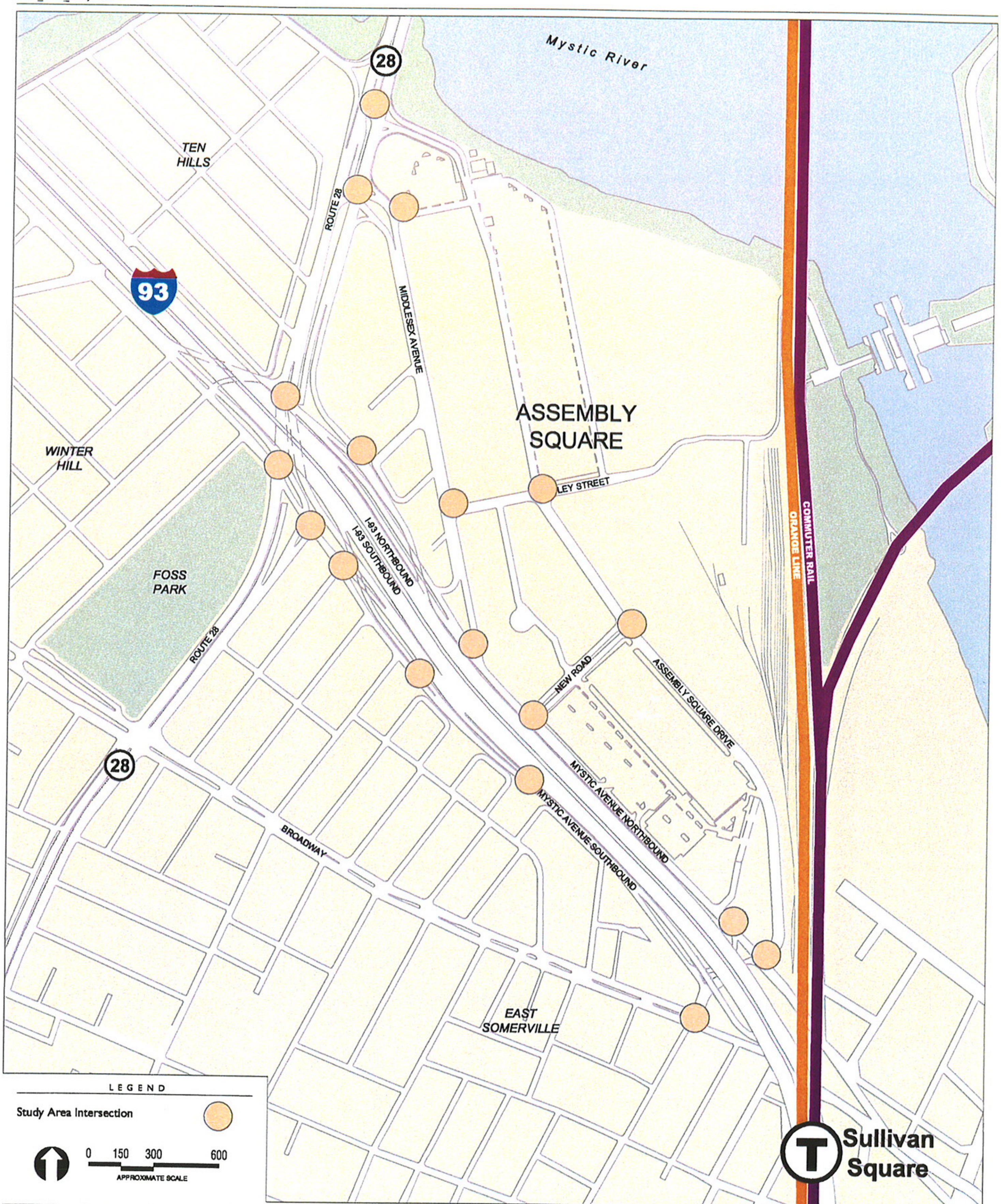
Assembly Square, Somerville
Regional Context

Figure 1-1

8640_1-02_StudyArea



Assembly Square Transportation Plan
Somerville, Massachusetts

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Assembly Square Transportation Plan Study Area

Figure 1-2

- Accommodate the changes in use and the significant increases in travel demand that are envisioned for the future of Assembly Square.

A thorough assessment of existing and future transportation conditions was undertaken for Assembly Square. The Assembly Square alternatives analysis entails evaluating scenarios that combine travel demand projections with potential transportation system improvement alternatives. The alternatives analysis determined the appropriate level of travel demand and proposed transportation improvement alternatives that best satisfy the travel demand.

This section of the report discusses the alternatives analysis component of the transportation plan. It includes:

- A discussion of the travel demand modeling process

- A definition of the future land use assumptions and other regional conditions that determine the travel demand

- A description of the transportation improvement alternatives in the various modes of transportation (public transportation, pedestrian / bicycle, and motor vehicle

- A summary of the model scenarios (the specific combinations of land use assumptions and transportation improvement alternatives) that the transportation plan has tested in order to identify the transportation improvements that best satisfy the travel demand and address the study's goals

3.1 Travel Demand Model Process

Assessing the future conditions of the transportation system is a complex task. There are many factors that will influence travel behavior, and these factors will interact in ways that are difficult to predict. This is especially true for an area like Assembly Square: it is a large area, it is accessible via many different modes and routes, and in the future it is expected to undergo major changes in land use and transportation infrastructure.

Assembly Square is also centrally located in a complex transportation system. Consequently, congestion and travel pattern shifts elsewhere in the transportation system, might impact the accessibility of Assembly Square. Assembly Square's central location also means that a considerable amount of regional traffic is passing through or near Assembly Square and this regional traffic might be impacted by land use changes at Assembly Square. Conversely, this regional traffic might also impact the accessibility of Assembly Square.

The complex relationships between the various components of the transportation system are far too difficult to track using manual or hand held calculator techniques. Therefore, it is common practice for projects of this nature to use computer based travel demand forecasting models to assist with the analysis. A travel demand model is a computer simulation of the transportation system. This simulation process is known as an aggregate simulation process, as opposed to a disaggregate or micro-simulation. An aggregate simulation process examines how population groups react to changes in the transportation system. For example, the entire population of the Ten Hills area would be simulated as a population group. In a micro-simulation process, the itinerary of each member of the population is independently simulated.

The benefits of the aggregate method are that it requires less data, it is easier to implement, and it can be used in a large geographic area. The micro simulation technique provides analyst with the ability to examine intersection queue lengths and individual transit vehicle boardings. However, implementation costs weigh in favor of aggregate planning techniques for large-scale projects such as Assembly Square.

For the Assembly Square project, the TransCAD ® software package developed by Caliper Corporation of Newton, Massachusetts was used. TransCAD ® was selected because it is the software selected by the Massachusetts Highway Department for the state-wide travel demand forecasting model, and this software is also used by most of the Commonwealth's regional planning agencies.

The first step in the construction of a travel demand forecasting model is to identify the area that will be included in detail within the simulation process. The area selected for this analysis includes all the communities inside and adjacent to the Route 128 corridor. Within the detailed model area, there are a number of data items needed to construct the model. For the Assembly Square analysis, the key data items and their sources are listed below.

- **Highway Network.** MassHighway's road inventory database was used as the basis for the model's highway network. This database was downloaded from the web-based MassGIS system. Along with road attributes (such as posted speed and number of travel lanes), the road inventory files are in a geographic information system (GIS) environment, which enables the development of a spatially correct digital map directly from the road inventory files.

- **Traffic Analysis Zones.** As discussed earlier, an aggregate level model was used. These types of models represent population in groupings. Each grouping is referred to as a Traffic Analysis Zone (TAZ). The most common method of establishing population groupings is to use U.S. Census geography. The U.S. Census Bureau has established a detailed geographic structure to geographically identify population location and density. In the Census system, blocks are combined into block groups, which are combined into Census Tracts. Census Tracts are combined into Counties and Counties into States. Most aggregate demand forecasting models start with population groupings consistent with one of these geographies. For the Assembly Square project, 2000 Census block groups were used initially and then modified as needed to enhance the model's accuracy. Census geography is readily downloaded from the web.

- **Demographic Data (population, households, household size, and auto availability).** One of the benefits of using Census geography for TAZs is that population, households, and household size data is readily available for each geography level. The data used in the Assembly Square model is Summary File 1 for Census Block Groups. This data is also readily downloaded from the web. Auto availability will be available from the Census but was not available when the Assembly Square model was being constructed. Consequently, town level vehicle registration data from the Massachusetts Registry of Motor Vehicles (MassRMV) was used to allocate to Census block groups.

- **Employment Data.** This was one of the more difficult pieces of information to collect. The 2000 Census will eventually release some employment data but that information is not yet available. The employment data used to setup the Assembly Square model reflects a compilation of data from 3 sources: MassHighway's state-wide travel demand forecasting model, employment data from private sources such as Info USA, and Commonwealth of Massachusetts data sources such as the ES-202 community employment summaries.

- **Transit Routes and Stops.** This information was readily downloaded from the MBTA's web page. The entire MBTA system inside Route 128 was not replicated in the Assembly Square model. Only commuter rail routes into North Station, subway, and bus routes that pass through Somerville were included in the model.

The Assembly Square model was built for a base year of 2002. Consequently all the employment and demographic data collected above was normalized to this common year. The model was designed to simulate three time periods: the AM peak hour, the PM peak hour, and daily. The travel modes in the model are as follows:

- Automobile
- Walk
- Bike
- Drive to Bus or Rail
- Walk to Bus or Rail
- Bike to Bus or Rail

In addition to the 2002 base year, the model was designed to develop forecasts for 2007 and 2025. The forecasting process requires predicting population, employment and auto availability for these years. The process also requires the identification of the transportation likely to exist in each of these years. Regional community level population and employment projections from published sources were used along with specific land use projections for the Assembly Square area as noted below. The future year transportation system only considered major transportation projects such as the completion of the Central Artery/Third Harbor Tunnel, and completion of the Urban Ring as noted below.

The travel demand modeling analysis includes a total of seven scenarios, each of which has a different combination of land use and transportation infrastructure. The seven scenarios include existing conditions, one short-term future (2007) scenario and five different long-term future (2025) scenarios.

The existing conditions scenario includes the existing transportation system. The 2007 short-term future scenario includes minor changes to the transportation system, such as improved bus service to Assembly Square and minor internal roadway improvements, as well as changes to the transportation system that are planned or nearing completion, such as the Central Artery / Tunnel Project.

The 2025 long-term future condition, which corresponds to the "full-build" of the Assembly Square district, is the condition for which significant transportation improvements should be implemented. The level of proposed development in Assembly Square will require such improvements by 2025, and the 22-year planning horizon provides adequate time for completion of major improvement projects.

The 2025 condition is therefore the focus of much of the planning and analysis; as a result, it is allotted five modeling scenarios. These five 2025 future full-build modeling scenarios will each include the same land use assumptions, but each will include a different set of transportation improvement alternatives. This will enable a meaningful "apples-to-apples" comparison of the merits of the different transportation improvement alternatives. Table 3-1 includes shows the general approach to formulating the modeling scenarios.

Table 3-1 Model Scenarios

Scenario	Land Use	Regional Transportation System	Assembly Square Street Network
1	Existing	Existing	Existing
2	2007 – Phase 1	Base (no Assembly Square improvements)	Base (minor development-related improvements)
3	2025 – Phase 2	Base (no Assembly Square improvements)	Base (development-related improvements)
4	2025 – Phase 2	Regional Improvements Alternative A	Base (development-related improvements)
5	2025 – Phase 2	Regional Improvements Alternative B	Base (development-related improvements)
6	2025 – Phase 2	Preferred Regional Improvements Alternative 1	Roadway Plan 1
7	2025 – Phase 2	Preferred Regional Improvements Alternative 2	Roadway Plan 2

The modeling scenarios have been analyzed in two stages. The first stage includes Scenarios 1 – 5. In Scenarios 1 and 2, the existing and short-term transportation conditions have been analyzed for the purpose of calibrating the model and identifying potential short-term problems and opportunities. In Scenarios 3, 4 and 5, the impact of major regional transportation system improvements have been analyzed for the full-build condition. Such improvements include new public transportation services (e.g. an Orange Line station at Assembly Square) and changes to the regional highway system (e.g. changes to the I-93 Ramps / Route 28 / Mystic Avenue interchange).

Based on this regional analysis, preferred regional improvements have been selected, and included in Scenarios 6 and 7. These two final scenarios have been used to test different roadway plans, for both regional connections and the Assembly Square internal street network.

The scenarios are designed to yield useful information about the future land use vision for Assembly Square and the various transportation improvement alternatives that have been proposed through the course of the Assembly Square Transportation Plan. The following sections describe the inputs to the regional travel demand model in more detail: the future land development projections that determine the level of travel demand, and the transportation improvement alternatives that determine how well the transportation system satisfies the travel demand.

3.2 Future Travel Demand

The future travel demand in the Assembly Square study area is determined by the development and land use in Assembly Square, major new developments near Assembly Square, and general travel trends in the Boston metropolitan region.

3.2.1 Development in Assembly Square

Assembly Square is well-positioned to benefit from regional development demands. The district is only about two miles from downtown Boston, and has the potential for excellent access. Assembly Square's appeal to developers is apparent from the current proposals, including the proposals for the mixed-use Yard 21 development and the IKEA Mixed-Use Development.

The current proposals are reflected in the Phase I land use projections. Although some of these proposals include destination retail development, they do so in the context of larger, mixed-use, urban-style developments. Phase I includes some new retail uses, but also significant amounts of office / research & development and housing. Phase II includes mostly dense office / R & D development, along with some housing and accessory uses, such as small retail uses.

The 2000 *Assembly Square Planning Study* includes a land use and development strategy in two principle phases, covering about 20 years of development:

- Phase I
    - Public Initiative – Yard 21 and adjacent parcels

    - Private Initiative – Assembly Square Mall, Mystic River waterfront, parcels north of Foley Street
- Phase II – dense development adjacent to Mystic Avenue, dense infill on some Phase I (Private Initiative) parcels

The *Assembly Square Planning Study* Phase II full-build district plan is shown in Figure 3-1.

The Assembly Square Transportation Plan assessed the transportation demands and conditions for existing conditions and for two future land use conditions that correspond roughly to these two phases described in the *Assembly Square Planning Study.* These future scenarios include a short-term development condition with a five year planning horizon (Phase 1 – 2007) and a long-term development condition with a 20+ year planning horizon (Phase 2 – 2025). The year 2025 is the long-term planning horizon year that is currently being used by many of the Commonwealth of Massachusetts' transportation agencies. Therefore, 2025 was selected as the long-term planning horizon for the sake of consistency with other regional planning efforts.

The transportation improvements alternatives were tested for these scenarios as appropriate. Short-term improvements were evaluated for Phase 1, and long-term improvements were evaluated for Phase 2. The *Assembly Square Planning Study* land use projections have been updated based upon development proposals and development plans that have been filed since the planning study was published. In developing the scenarios, the long-term urban planning vision articulated in the 2000 *Assembly Square Planning Study* has been carefully followed. However, the development of scenarios has also been integrated as much as possible with the actual development proposals for Assembly Square.

Future Land Use Assumptions

The Assembly Square Transportation Plan's future development scenarios therefore include the appropriate land uses, locations, and square footages that correspond to the proposals for the mixed-use IKEA Mixed-Use Development, the Assembly Square Mall redevelopment, and the Sturtevant Partnership proposals for Yard 21 and adjacent parcels. In order to do this, the development proposals were carefully reviewed, and tabulated by land use. The total square footages for each land use in the development proposals were then compared to the total square footage by land use from the planning study. Table 3-2 summarizes the land use assumptions.

Table 3-2 Land Use Assumptions (square feet)

	Assembly Square Transportation Plan			Assembly Square Planning Study – Phase 2 Full-Build
	Existing	Phase 1 -- 2007	Phase 2 – 2025	
Residential	-	1,604,300	1,774,800	908,000
Office / R&D	240,000	1,803,800	4,468,000	4,468,000
Retail	668,284	1,077,616	1,142,616	1,000,000
Hotel	86,000	86,000	180,000	180,000
Industrial	80,000	42,000	12,000	12,000
Institutional	32,000	32,000	32,000	32,000
Total	**1,106,284**	**4,645,716**	**7,609,416**	**6,600,000**

Taken all together, these development plans and proposals correspond quite well to the 2000 *Assembly Square Planning Study* vision. However, as Table 3-2 shows, there are a few discrepancies between the development proposals and the planning study's full-build land use recommendations, resulting in a difference of approximately one million square feet in total square footage of development in Assembly Square (6.6 million square feet of development in the *Assembly Square Planning Study* versus 7.6 million square feet of development in the Assembly Square Transportation Plan).

- **Residential.** The planning study includes a recommendation for 900 residential units. The extant development plans and proposals include a total of 1,360 residential units. This difference in residential development is responsible for virtually all of the discrepancy between the *Assembly Square Planning Study's* proposed land use program and the land use assumptions for the Assembly Square Transportation Plan 2025 full-build condition. Of the total difference in development area between the two plans, this difference in residential square footage accounts for 866,800 square feet, or 86%. This difference is due to both an increase of about 50% in the number of residential units, and an assumption of a somewhat larger average residential unit (1,300 square feet in the transportation plan versus about 1,000 square feet in the planning study). It was decided to assume the higher level of residential development, since there are proposals for this development, and because residential development is desirable from the perspective of creating a lively, vibrant Assembly Square. In addition, residential development is relatively benign from a transportation perspective, since residential trips tend to be more spread out over time.

- **Office / Research & Development.** The office / research & development assumptions of the transportation plan are consistent with those of the planning study. Using the current development proposals as a starting point, there was a significant shortfall in the total amount of proposed office / R&D space, relative to the planning study's vision. In order to make the transportation plan's office / R&D program consistent with the planning study vision, approximately 2.2 million square feet of office / research and development space was added to the Phase 2 – 2025 development scenario. It was assumed that this space was added in a variety of locations that are currently under-utilized, and for which there are no current development proposals. These parcels principally include large parking lots for existing retail stores.

- **Retail.** The transportation plan's assumptions for total retail space slightly exceed the planning study's proposal of 1,000,000 square feet. The transportation plan's assumptions for retail space are based on retention of existing retail square footage that is expected to remain in the long-term, along with retail space included in current development proposals. Although this total slightly exceeds the planning study's proposal, it was decided to evaluate the higher level of retail development since this tends to make the transportation plan's analysis slightly more conservative.

- **Hotel, Industrial and Institutional.** The transportation plan's assumptions for these land uses are consistent with those of the *Assembly Square Planning Study.*

Parking

These land use assumptions are accompanied by assumptions for the parking supply at Assembly Square. The parking supply assumptions are principally based on parking proposals included in current development proposals. For infill office / R&D space that was added for consistency with the *Assembly Square Planning Study*, parking was added at a ratio that is consistent with the current development proposals. It was also assumed that existing parking supplies will remain, although the configuration of the parking supply may change (e.g. surface parking may be replaced by structured parking as density and land value in Assembly Square increase). The following is a summary of parking supply assumptions for the 2025 full-build condition.

Table 3-3 Parking Supply Assumptions for 2025 Full-Build Conditions

Land Use	Square Footage	Parking Supply	Parking Ratio (spaces per 1,000 sq ft)
Residential	1,774,800	1,415	1.04 (spaces per unit)
Office / R&D	4,468,000	6,721	1.50
Retail	1,142,616	3,782	3.31
Hotel	180,000	206	1.14
Industrial	12,000	35	2.92
Institutional	32,000	165	5.16
Total	**7,609,416**	**12,323**	**1.62**

These future development scenarios provide the basis for estimating the future transportation demand at Assembly Square. The likely traffic volumes associated with the development at Assembly Square can be calculated using the analytical tools in the travel demand forecasting model.

3.2.2 Other Future Land Development

In addition to the new development proposed and anticipated, there are a number of other significant developments in the region around Assembly Square that were taken into account in assessing future travel demand. These future developments include

- Super Stop & Shop, Somerville
- Gateway Center, Everett
- TeleCom City, Everett, Malden, Medford
- North Point Development, Cambridge, Somerville, Charlestown
- Twin City Plaza expansion, Somerville, Cambridge

In addition, community level population and employment forecasts were incorporated into the demand forecasting model. These community level increases are translated into background traffic growth by the demand forecasting process. Table 3-4 is a list of communities included in the model along with the estimated 2002 and future year populations used in the model to account for background traffic growth.

Table 3-4 Regional Modeling Area Community Assumptions

Community	2002 Population	2007 Population	2025 Population
Arlington	42,528	42,912	44,372
Belmont	24,285	24,515	25,360
Boston	590,468	595,802	616,083
Brookline	57,305	57,831	59,806
Burlington	22,962	23,180	23,979
Cambridge	101,700	102,627	106,129
Chelsea	35,213	35,547	36,773
Everett	38,181	38,543	39,872
Lexington	30,470	30,759	31,820
Malden	56,554	57,091	59,060
Medford	56,080	56,584	58,508
Melrose	27,237	27,495	28,443
Newton	84,147	84,946	87,876
Revere	47,462	47,912	49,564
Saugus	26,177	26,425	27,336
Somerville	77,973	78,612	81,213
Stoneham	22,303	22,514	23,290
Wakefield	24,898	25,134	26,001
Waltham	59,451	60,015	62,085
Watertown	33111	33,425	34,578
Winchester	20,889	21,087	21,814
Winthrop	18,372	18,546	19,185
Woburn	37,399	37,754	39,056

3.3 Future No-Build Transportation System

The term "Future No-Build Transportation System" does not imply that there is not change to the transportation system. It simply refers to a "No-Build" condition for improvements to the Assembly Square area. Consequently, major transportation system improvements elsewhere in the network are taken into consideration and coded into the travel demand forecasting model to establish a future No-Build" condition for the Assembly Square area.

The only major regional transportation project considered in the Assembly Square travel demand forecasting model is the completion of the CA/T project which is reflected in the 2007 and 2025 future no-build travel demand forecasting model.

However, the demolition of the Sullivan Square overpass is not reflected in the base 2002 model since the traffic counts used in the calibration of the travel demand forecasting model were taken prior to the close of the overpass. The Sullivan Square overpass is deleted from all future year networks.

In the future no-build condition, it is assumed that the Assembly Square internal street network has had some improvements. The future "base" street network that was assumed for the future no-build condition includes new streets that have been proposed as part of the current development proposals for the Yard 21 development and the IKEA Mixed-Use Development. The future no-build base street network is shown in Figure 3-2.

However, these base roadway improvements mostly include new internal streets adjacent to the proposed development parcels. They do not create new connections into and out of Assembly Square, and therefore they do not address the issue of traffic and access bottlenecks at Assembly Square's existing limited gateways. Such connections and access improvements are discussed in the section on motor vehicle alternatives.

3.4 Public Transportation Improvement Alternatives

Although Assembly Square currently has limited public transportation service, it has the long-term potential for dramatically enhanced public transit access. A new subway stop on the Orange Line and rail transit via the proposed Urban Ring are the two central proposals for the implementation of rapid transit service to Assembly Square in the long-term. In the shorter term, public transportation service at Assembly Square can be enhanced through improved bus service and promotion of this service.

3.4.1 Orange Line Station in Assembly Square

The City of Somerville, community stakeholders and potential Assembly Square developers are pursuing the construction of a station stop on the existing Orange Line as it passes through Assembly Square. This stop would be located approximately midway between Sullivan Square station and Wellington Station.

- Long-term proposal linked to developments at Assembly Square
- 5-minute headways during peak periods
- 5-minute walk to much of Assembly Square, as shown in Figure 3-3

3.4.2 Urban Ring Service

The Urban Ring is a proposed circumferential transit system that offers Assembly Square significantly improved public transit connections and capacity. The Urban Ring is a phased system of public transportation improvements that is designed to supplement the Boston area's radial rapid transit system with circumferential transit services. These improvements are needed to alleviate congestion in the core downtown transfer stations, provide transit connections to dense new development areas outside the downtown core, and reduce transit travel times. In July 2001, the Massachusetts Bay Transportation Authority (MBTA) completed a Major Investment Study (MIS) report on the project and filed an Environmental Notification Form (ENF), the first step in the environmental review process for implementing the project.

The Urban Ring circumferential transit system will offer a blend of different transit modes, and it will be implemented in three phases over the course of the next 15 to 20 years. The Urban Ring transit services will pass through a corridor that lies approximately 1 ½ - 2 ½ miles from the center of downtown Boston. This corridor includes Assembly Square; the proposed elements of the Urban Ring in the Assembly Square study area are shown in Figure 3-4, and are described in detail below.

Phase 1: Improved Bus Service (2001 – 2005)

Additional conventional bus routes will be implemented in the Urban Ring corridor. These routes will supplement the "cross-town" bus routes that have already been implemented (the CT1, CT2, and CT3). These new routes will provide early connections between the radial transit lines and destinations in the Urban Ring corridor. The Phase 1 CT buses will be 40-foot, low-floor compressed natural gas (CNG) buses.

As currently described in the MIS and ENF, the new CT5 bus route along Assembly Square Drive will operate with 10-minute headways during peak periods. The CT5 service could be diverted to new Main Street when it is built. The CT5 bus route will provide connections to Sullivan Square, Wellington Station, Everett, Chelsea, Wood Island Station on the Blue Line, Airport Station on the Blue Line, and the Logan Airport Terminals.

Phase 2: Bus Rapid Transit (BRT) Service (2006 – 2010)

Several of the new conventional CT routes will be converted to BRT service. Urban Ring BRT service will offer 60-foot articulated buses, less-frequent stops, enhanced bus stations, on-bus and at-station information systems, and dedicated right-of-way (rather than operation in general traffic) on some portions of the routes.

As currently described in the MIS and ENF, the BRT1 route will replace the CT5, and will provide service along Assembly Square Drive / Main Street. It will operate with 10-minute headways during peak periods, and will provide connections to the south and west (Sullivan Square, New Lechmere, Cambridgeside, Second Street, and Kendall Square / MIT), and to the north and east (Wellington Station, Broadway in Everett, Second Street in Everett, Chelsea HS, Mystic Mall, Downtown Chelsea, Airport Blue Line Station, and the Logan Airport Terminals.

In addition to the BRT1, the BRT3 route will pass by Assembly Square on Route 28. However, the BRT3's nearest station stops will be at Wellington Station and at the intersection of Route 28 / Broadway, so the BRT3 will not provide convenient service for Assembly Square.

Phase 3: Rail Service (2010 – 2015)

Rail service will be implemented in the western half of the Urban Ring corridor (from the vicinity of Dudley Square / Ruggles Station to the vicinity of Assembly Square / Wellington Station). Three different alternatives with somewhat different alignments are being reviewed. These include two light rail alternatives and one heavy rail alternative. In the heavy rail alternative, the Urban Ring rail service would be a branch of the Orange Line.

As currently described in the MIS and ENF, the Phase 3 Urban Ring would service Assembly Square as described below for the different transit modes under consideration.

- **Phase 3 – Alternatives A1 and B: Light Rail Service.** In both of these alternatives, Assembly Square is the final stop on the Urban Ring light rail transit service. The current MBTA proposal situates the Urban Ring station closer to the southern corner of Assembly Square in order to allow the trains to cross over the Orange Line and Commuter Rail tracks and enter Charlestown Yards. However, the Urban Ring rail platforms should be integrated as much as possible into the proposed Orange Line station, and should be as close as possible to a new Orange Line station at Assembly Square. This would improve the geographic coverage and accessibility of the Urban Ring rail to Assembly Square, facilitate convenient transfers between the Orange Line and the Urban Ring, and provide a better, more concentrated transit hub in Assembly Square.

The Urban Ring light rail service would provide connections from Assembly Square to Sullivan Square and New Lechmere Station; southwest of New Lechmere Station, the Assembly Square branch of the Urban Ring Light Rail (LRT Route #1) would interline with LRT Route #2 from the Green Line extension. Beyond New Lechmere Station, the Urban Ring Light Rail Alternative A1 would make the following connections: Kendall Square, MIT / Mass Avenue, Kenmore Square / Yawkey Station, Boylston Street / Park Drive, Longwood Avenue / Louis Pasteur, Ruggles Station, and Dudley Square. Alternative B would make similar stops, except it would make some additional intermediate stops and it would pass to the west of Kenmore Square. The light rail service would operate with 5-minute headways during peak periods in both alternatives.

- **Phase 3 – Alternative A2: Heavy Rail Service.** In the heavy rail alternative, the Urban Ring rail service would be a branch of the Orange Line. The Urban Ring rail service would follow the Orange Line alignment to Wellington Station, where it would diverge to form a separate heavy rail line. The Urban Ring heavy rail would run adjacent to the Orange Line to the Assembly Square station, and Sullivan Square. Beyond Sullivan Square, it would diverge from the Orange Line and provide connections to the same stops as the Light Rail Alternative A1. The Urban Ring rail service would operate at 4-minute headways during peak periods.

- **Phase 3 – Continuing Bus Rapid Transit Service.** The eastern half of the Urban Ring would continue to rely upon BRT service. This BRT service would overlap the rail service at both the northern and southern termini of the rail service. In order to provide this overlap at the northern terminus of the rail service, the BRT1 and BRT3 service retained in all three alternatives. Both of these routes would continue to provide 10-minute headways during peak periods, and would make the same connections as described above under Phase 2.

3.4.3 Enhanced Bus Service

Other possible enhancements were considered to improve service to Assembly Square as part of a short-term alternative. These included consolidation and coordination of existing MBTA bus routes serving Assembly Square (Routes 90, 92 and 95) as described below.

- Coordinate bus schedules to even out headways serving the Sullivan Square – Assembly Square connection

- Consolidate bus stops in Assembly Square (on Assembly Square Drive) and at Sullivan Square to improve chances of catching the connecting bus

3.4.4 Assembly Square Shuttle Bus Service

The potential also exists to supplement existing and planned short-term MBTA services with shuttle buses. These services would supplement to MBTA bus service, especially during off-peak periods. A potential route would operate in a continuous loop along Assembly Square Drive with connections to Sullivan Square, and possibly to Broadway at Route 28. The potential exists to implement these services in the near-term as part of mitigation for developers at Assembly Square

3.5 Pedestrian and Bicycle Improvement Alternatives

The approach to improve pedestrian and bicycle conditions in Assembly Square seeks to improve:

- External access into and out of Assembly Square at the district's gateways, and

- Accessibility and accommodation within Assembly Square.

The recommended improvements for Assembly Square should enhance the pedestrian and bicycle connections between Assembly Square and the surrounding neighborhoods, as well as to the regional bicycle and pedestrian network. They should also ensure that pedestrians and bicycles have safe, convenient and attractive accommodation throughout the district.

In the sense that improvements are required for both the external gateways and the internal network, Assembly Square's pedestrian and bicycle system is similar to its motor vehicle system. In fact, because Assembly Square will be developed as an "urban village," most of the pedestrian and bicycle improvements should be incorporated into the multi-modal design of the roadway system. There are exceptions to this principle, particularly along the Mystic Riverfront, where pedestrians and bicycles should have dedicated facilities through the parkland, and may warrant dedicated connections at either end of the riverfront park.

This section discusses some of the key gateway connections for pedestrians and bicycles, and describes the internal street network principles and objectives as they are related to pedestrian and bicycle access. The roadway alternatives section below will include further discussion of district gateways and internal street network planning. The pedestrian and bicycle improvements alternatives are shown in Figure 3-5.

3.5.1 External Gateways

The pedestrian and bicycle experience at the Assembly Square gateways should be improved. The locations of these improvements correspond to the existing district gateways.

Mystic Avenue / Route 28

In existing conditions, the principal pedestrian and bicycle connections to and from Assembly Square are at the northern gateway (Route 28 / Middlesex Avenue) and the southern gateway (Mystic Avenue / Lombardi Street). As with motor vehicle connections, there is a need for pedestrian and bicycle connections to and from the center of the district, near the I-93 Ramps / Route 28 / Mystic Avenue interchange. There are currently pedestrian crossings in this area, notably the connection from Kensington Avenue to Old McGrath Highway, but this connection involves unprotected crossings of high-speed ramps and passing beneath the I-93 viaduct without an adjacent roadway for security. Therefore, there is a need for a pedestrian and bicycle connection from the East Somerville and Winter Hill neighborhoods, beneath the I-93 viaduct, to Assembly Square.

- Long-term alternative, due to dependence upon roadway improvements at the interchange
- Signal-protected pedestrian and bicycle crossings (as opposed to existing crossing of high-speed ramps)
- Shorter, direct connection to center of Assembly Square

Mystic River Path

Assembly Square should incorporate an extension of the Mystic River Reservation's path system. There is currently park space along the Mystic River edge of Assembly Square, with a path. However, the connection to the Mystic River path in the Ten Hills neighborhood requires a significant diversion to the Route 28 / Middlesex Avenue intersection. A more direct connection is required.

- Short-term improvement
- Potential undercarriage beneath Wellington Bridge (Route 28)

Middlesex Avenue / Route 28

There is currently a signal-protected crossing at Route 28 / Middlesex Avenue. However, Route 28 must be crossed in stages, and the pedestrian / bicycle refuge zones in the medians are under-sized. In addition, the crossing is not fully signal-protected; the Route 28 northbound right-turn and the Middlesex Avenue northbound right-turn are not signal-controlled.

- Traffic signal improvements to provide fully-protected crossings
- Design enhancements to improve pedestrian and bicycle accommodation

Mystic Avenue / Lombardi Street / Assembly Square Drive

Pedestrians and bicycles are currently accommodated at Assembly Square's southern gateway, but the intersection's geometry is tight, and the passage beneath the I-93 viaduct is dark and uninviting.

- Geometric improvements to provide greater room for pedestrians and bicycles
- Lighting, urban design of passage beneath I-93 viaduct

Regional Bicycle Connection through Assembly Square

Investigate potential for bicycle route through Assembly Square to connect the proposed Somerville Community Path and the Bike-to-Sea Path.

- Long-term

- Related to Yard 21 development, right-of-way requirements for Orange Line station, Urban Ring station
- Possible pedestrian and bicycle connection across Amelia Earhart Dam

3.5.2 Internal Streetscape

Assembly Square's few existing internal streets are currently unfriendly to pedestrians and bicycles. New development proposed for the area will restructure the internal roadway network and extend it. Streetscape improvements are needed on existing roads to enhance the pedestrian and bicycle access in a way that conforms to the new roadway designs. Design standards will ensure that streets throughout the district, but particularly the district's major streets, will reflect the importance of pedestrians and bicycles through their design: wider sidewalks, on-street bicycle facilities, open spaces, street trees, plantings and furnishings. Such design standards will also help to facilitate transit ridership and a high quality street environment in general.

Somerville's recently completed Unifying Design Guidelines for Assembly Square establish the appropriate design standards. The Assembly Square Transportation Plan is consistent with the Unifying Design Guidelines for Assembly Square. The following are the transportation plan's key principles for planning Assembly Square's internal street network.

- Robust street grid
- New gateways for Assembly Square
- Street hierarchy
- Small, urban-scaled blocks
- Direct connections into and out of Assembly Square

In keeping with the integration of pedestrian and bicycle design with motor vehicle design, these principles are the same for both pedestrian / bicycle accommodation and motor vehicle access. These principles, and their application to pedestrian / bicycle accommodation and motor vehicle accessibility, are discussed below in Section 3.6.2: Internal Street Network Improvement Alternatives.

3.6 Motor Vehicle Improvement Alternatives

As with the pedestrian and bicycle alternatives, the motor vehicle improvements must address the regional connections at Assembly Square's gateways and the internal street network.

3.6.1 Regional Roadway Improvement Alternatives

Improving Assembly Square's vehicular gateways is essential to ensuring convenient access to all areas of the district, and to improving the cohesiveness of Assembly Square. A major issue that affects all of Assembly Square's regional connections is the interchange of Mystic Avenue / Route 28 / I-93 Ramps, shown in Figure 3-6. This interchange is confusing for drivers, has a high rate of motor vehicle accidents, blocks access to the center of Assembly Square, and concentrates traffic at the existing gateways, especially the congested major gateways at Assembly Square Drive / Mystic Avenue Northbound and at Middlesex Avenue / Route 28.

1994 Massachusetts Highway Department Interchange Redesign Concept Plan

The Massachusetts Highway Department (MassHighway) has recognized the issues at the interchange, and in 1994 undertook a study of this location. In this study, Vollmer Associates developed a conceptual design for rebuilding the interchange, as shown in Figure 3-7. MassHighway began final design work for the reconstruction, but this design work was subsequently suspended.

A follow-up study of the redesign by the Central Transportation Planning Staff (CTPS) indicated that the improvement was beneficial but not critical, based on then-current traffic operations and future land use projections. However, safety and access concerns, and not just traffic operations, are paramount at this location. In addition, the vision for the future of Assembly Square has changed. Development in Assembly Square, as well as in surrounding areas, is significantly different from what was anticipated in the CTPS study. The existing interchange presents safety issues, and is not responsive to future access priorities for Assembly Square.

The following are the key elements of the 1994 MassHighway conceptual design, as shown in Figure 3-8:

- New connector road beneath I-93 viaduct to create a connection from Route 28 northbound to Mystic Avenue northbound and to Middlesex Avenue
- Reconstructed I-93 northbound off-ramp
- Elimination of I-93 northbound off-ramp to Mystic Avenue Northbound connection
- New Route 28 southbound underpass (new tunnel bored for Route 28 northbound, Route 28 southbound uses existing underpass)
- Elimination of the Route 28 northbound / I-93 northbound off-ramp weave (Route 28 northbound traffic can connect to Middlesex Avenue via the new connector road underneath I-93 – right turns from Route 28 northbound to Middlesex Avenue are prohibited)
- Elimination of the complex and redundant ramp weave: Route 28 southbound / I-93 southbound on-ramp / Mystic Avenue southbound

However, the 1994 MassHighway conceptual design raises the following issues, as shown in Figures 3-9 through 3-14:

- **Indirect Connection to Assembly Square.** The proposed connection from Route 28 northbound to Assembly Square ends at a T-intersection with Middlesex, essentially "running into" the back of Assembly Square Mall. The failure of this roadway connection to align with a major street into Assembly Square would significantly reduce the effectiveness of this connection as an entrance to Assembly Square.
- **Potential for High-Speed Weave Remains.** The proposed design may not thoroughly resolve the Route 28 northbound / I-93 northbound off-ramp weave. The right turn onto Middlesex Avenue is still permitted for I-93 northbound off-ramp traffic. Although Route 28 northbound traffic can make the connection into Assembly Square via the new connector road, some traffic might still try to weave across the I-93 northbound off-ramp through-traffic to Route 28 northbound and turn right onto Middlesex Avenue. This potential demand is exacerbated by the fact that the proposed design eliminates the intersection of Route 28 / Assembly Square Drive, thereby making Middlesex Avenue the last opportunity for Route 28 northbound traffic to enter Assembly Square before crossing the Mystic River.

- **Regional Connection from I-93 Northbound to Mystic Avenue, Route 28 Southbound Worsened.** The I-93 northbound off-ramp split to Mystic Avenue northbound is eliminated. This makes several connections from I-93 northbound more difficult. In order to reach Mystic Avenue northbound or Route 28 southbound, I-93 northbound traffic must turn right onto Middlesex Avenue southbound, traverse the length of Middlesex Avenue, then turn right onto Mystic Avenue northbound. Route 28 southbound traffic must then make the U-turn at Wheatland Street.

- **Regional Connection from Assembly Square to I-93 Southbound Worsened.** The proposed design worsens the connection from Assembly Square to I-93 southbound. Under existing conditions, drivers can exit Assembly Square via Middlesex Avenue to Route 28 southbound, and take the ramp connection to I-93 southbound. By eliminating this connection, the proposed design would require Assembly Square drivers to pass through an additional two signalized intersections to reach the I-93 southbound on-ramp.

- **Gateway at Route 28 / Assembly Square Drive Eliminated.** The proposed design eliminates the intersection of Route 28 / Assembly Square Drive. This concentrates all the traffic entering and exiting Assembly Square at the northern end of the district into a single intersection, Route 28 / Middlesex Avenue.

- **Sewer Pumping Station Eliminated.** The new roadway connection from Route 28 northbound to Mystic Avenue Northbound requires the relocation of the Somerville sewer pumping station beneath the I-93 viaduct. Relocating this facility would be difficult and expensive, with an estimated cost in 1994 of approximately $4 – 5 million.

Interchange Redesign Goals and Objectives

The Assembly Square Transportation Plan has undertaken a thorough analysis of the Mystic Avenue / Route 28 / I-93 Ramps interchange. This analysis takes into account the key existing issues at the interchange, the advantages of the 1994 MassHighway conceptual design, and the issues that are not addressed optimally in the 1994 MassHighway conceptual design. Table 3-5 presents the key goals and objectives that were defined to inform the analysis and design process for the interchange redesign.

Table 3-5 Key Goals and Objectives for Interchange Redesign

Goal	Objectives
Improve Safety	Provide safe pedestrian connection in the vicinity of the existing Kensington Street

(Figure 3-15)	pedestrian connection (which currently entails unprotected crossings of high-speed highway ramps) Eliminate sub-standard weaving sections Route 28 northbound underpass right turns into Assembly Square / I-93 northbound off-ramp traffic to Route 28 northbound Route 28 southbound traffic to Mystic Avenue southbound / Mystic Avenue southbound traffic to I-93 southbound Improve confusing, high-accident intersection at Route 28 southbound / Mystic Avenue northbound
Improve Connections Into and Out of Assembly Square (Figure 3-16)	Create a major multi-modal gateway in the center of Assembly Square, connected to Foley Street (the central east-west corridor in Assembly Square) Create other new gateways where possible to open Assembly Square to vehicular access, to pedestrian and bicycle access, and to connections to Somerville's neighborhoods
Preserve and/or Improve Regional Connections (Figure 3-17)	Ensure that all current regional traffic moves (i.e. connections from highway to highway, and between highways and surrounding neighborhoods) are preserved in as similar a form as feasible while maximizing total safety and mobility for all moves Improve the congested Route 28 southbound connection

The analysis of the interchange improvements has included an evaluation of several combinations of interchange components, based on the degree to which they satisfy the goals and objectives above, as well as on traffic safety characteristics and physical feasibility. In order to identify the potential interchange improvement alternatives, it is necessary to understand the different components of the interchange, and the constraints that limit the configuration of the interchange.

The Mystic Avenue / Route 28 / I-93 ramps interchange is clearly a complex roadway system. There are many different components: I-93 on viaduct above the surface intersections, the I-93 ramps, Route 28 including the northbound underpass and the southbound surface roadway, Mystic Avenue split into northbound and southbound roadways, and the many connections between these roads. An interchange reconstruction will involve many of these components. Given the vertical and horizontal constraints of these components, there are certain combinations of changes that are consistent with one another, and certain combinations that are not consistent.

The Assembly Square Transportation Plan reviewed a number of interchange concepts, and assessed them in terms of how well they satisfied the above goals and objectives, as well as in terms of physical feasibility and cost.

The new interchange concepts reviewed shared several common features. These features are all elements of the 1994 MassHighway conceptual design that were deemed advantageous. These common features are:

- Route 28 southbound tunnel is included
- Route 28 southbound direct connection to I-93 southbound on-ramp is eliminated (redundant connection that can be satisfied via Route 28 southbound to Mystic Avenue southbound to I-93 southbound on-ramp)
- The connection from the I-93 southbound on-ramp to Mystic Avenue southbound is also eliminated (this connection is also redundant, and creates the unsafe weave)
- Route 28 to Assembly Square "Connector Road" beneath the I-93 viaduct is included (in one of two different configurations)

Aside from these elements, the different interchange design concepts included different combinations of features. From the perspective of the physical and structural feasibility analysis, there are four critical modules that interact and impose significant constraints on each other and on the overall interchange redesign. Table 3-6 describes the four key modules, and the principal alternatives that have been considered for each of these modules.

Table 3-6 Interchange Design Concept Modules

Module	Alternatives
Route 28 to Assembly Square Connector Road (Figure 3-18)	▪ Align with Old McGrath Highway ▪ Align with Foley Street
I-93 Northbound Off-Ramp (Figure 3-19)	▪ Use existing ramp ▪ Reconstruct ramp and continue to provide existing connections (to Route 28 northbound, Mystic Avenue northbound) ▪ Reconstruct ramp and connect to Route 28 northbound; eliminate split to Mystic Avenue northbound ▪ Reconstruct ramp and connect to Middlesex Avenue; eliminate split to Mystic Avenue northbound ▪ Reconstruct ramp and connect to Mystic Avenue northbound at New Road
Connection from Assembly Square to I-93 Southbound (Figure 3-20)	▪ Via new "Connector Road" underneath I-93 viaduct ▪ U-turn ramp connection beneath I-93 northbound on-ramp
I-93 Northbound On-Ramp (Figure 3-21)	▪ Use existing ramp ▪ Reconstruct ramp to accommodate other changes (Connector Road, U-turn ramp) ○ Move ramp to the north to accommodate the Connector Road aligned with Foley Street ○ Raise the vertical clearance to enable a U-turn ramp to pass beneath it ○ Widen the ramp to enable a U-turn ramp to split off to the left

The following is a discussion of the physical and structural characteristics of each of the modules, and the interactions between the modules.

Route 28 to Assembly Square Connector Road

This surface connection from Route 28 northbound beneath I-93 is a central component of the proposed interchange reconstruction. It would create a significant new vehicular, pedestrian and bicycle connection from Somerville to Assembly Square. The following are the principal alternatives.

- **Align the Connector Road with Old McGrath Highway.** This is essentially the 1994 proposal. As the Connector Road passes beneath the I-93 viaduct, it passes between two column bays. The Connector Road connects with the remaining segment of Old McGrath Highway on the Assembly Square side of I-93. This intersects with Middlesex Avenue at an acute angle, directly across from the back wall of the Assembly Square Mall. The presence of the mall blocks the Connector Road from continuing directly into Assembly Square, which would have traffic and urban design benefits.

- **Align the Connector Road with Foley Street.** This proposed alternative is designed to improve access into the heart of Assembly Square. This connection passes beneath the I-93 viaduct, and would either need to go between column bays, or would require eliminating an existing column bay, underpinning the structure, and spanning the eliminated columns. It would also require a roadway connection through private property between Mystic Avenue and Middlesex Avenue. However, it would enable a direct traffic, pedestrian, and bicycle connection to Foley Street, which should be the main east-west roadway in Assembly Square.

I-93 Northbound Off-Ramp

The I-93 northbound off-ramp is an important connection for Assembly Square, Somerville, Route 28 northbound, and Mystic Avenue. Any interchange reconstruction would entail reconstruction of the I-93 northbound off-ramp, since the existing ramp does not provide adequate vertical clearance for any of the proposed alignments.

- **Existing Ramp.** The existing ramp does not provide adequate vertical clearance for either Connector Road alignment.

- **Reconstruct Ramp and Continue to Provide Existing Connections (to Route 28 Northbound and Mystic Avenue Northbound).** This option not feasible in combination with either Connector Road alignment. The I-93 northbound off-ramp would have to pass over the Connector Road, then make the vertical drop to Mystic Avenue at grade before the intersection with Route 28 southbound. Even with the new Route 28 southbound underpass, there would need to be a Route 28 southbound surface roadway to enable connections from Route 28 southbound to Mystic Avenue southbound and I-93 southbound. After passing over a new Connector Road, there would only be 400 – 600 feet (depending on the location of the Connector Road) to make the vertical drop to the Route 28 intersection with Mystic Avenue northbound. This does not provide adequate distance to make this vertical drop, allow proper transition curves, and enable traffic from Mystic Avenue to merge with off-ramp traffic to Mystic Avenue. Therefore, the interchange redesign must provide a reasonable substitute for the connection from the I-93 northbound off-ramp to Mystic Avenue northbound.

- **Reconstruct Ramp and Connect to Route 28 Northbound: Eliminate Split to Mystic Avenue Northbound.** Because this option eliminates the ramp split to Mystic Avenue northbound, it also eliminates the issues of the steep vertical drop after passing over the Connector Road. Therefore, this option is consistent with either Connector Road alignment.

- **Reconstruct Ramp and Connect to Middlesex Avenue; Eliminate Split to Mystic Avenue Northbound.** This option also eliminates the ramp split to Mystic Avenue northbound, and is consistent with either Connector Road alignment. Assuming that the off-ramp comes to an at-grade intersection at Foley Street, and that this is the first at-grade intersection for the ramp, there is adequate distance for the off-ramp's vertical drop. However, an off-ramp to Middlesex Avenue raises a number of other issues, such as accommodating the ramp structure in the Middlesex Avenue alignment, providing appropriate surface connections that might be blocked by the new ramp (such as the Mystic Avenue northbound to Route 28 northbound connection), horizontal and vertical sight distance on the approach from the I-93 northbound mainline to the ramp, and traffic operations issues to ensure that this proposed off-ramp (which is shorter than the existing ramp or the other ramp alternatives) does not back up onto the I-93 northbound mainline.

- **Reconstruct Ramp and Connect to Mystic Avenue Northbound at or near New Road.** This proposal for the northbound off-ramp would take one of two different forms: it would either replace the I-93 northbound off-ramp in the vicinity of Route 28, or a new ramp would be built in addition to another northbound off-ramp in the vicinity of Route 28. If this were a replacement ramp, and the I-93 northbound off-ramp at Route 28 were eliminated, the traffic volumes from the I-93 northbound off-ramp would overlap with the traffic approaching the I-93 northbound on-ramp, and cause excessive congestion.

  If the ramp were in addition to an I-93 northbound off-ramp at Route 28, this would result in two off-ramps very close together on the I-93 northbound mainline, which could cause conflicts, since there is no room for an additional deceleration lane on the I-93 viaduct in this area; an additional ramp in the vicinity of New Road would not offer any construction economies, because the off-ramp near Route 28 would still need to be rebuilt to provide vertical clearance for the Route 28 northbound to Assembly Square "Connector Road."

In addition to these issues, a new I-93 northbound off-ramp in the vicinity of New Road would have the following challenges:

- **Physical Feasibility.** Between the viaduct sections at Lombardi Street and Route 28, I-93 is built on retained fill. The retained fill section has a lower elevation than the viaduct sections, and the highway surface is only about 10 – 15 feet above the surface of Mystic Avenue northbound in the vicinity of New Road. Assuming the intention is for the ramp to fly over Mystic Avenue northbound and come to ground on the eastern side of Mystic Avenue northbound, the substructure required beneath a ramp viaduct would not leave Mystic Avenue northbound with adequate clearance beneath the ramp.

- **Alternate Ramp Configurations**

  1) The off-ramp could diverge from I-93 further south, closer to Lombardi Street, where the clearance between I-93 and Mystic Avenue is greater. This may still require some adjustments to grades, since Lombardi Street is at a significantly lower grade to pass beneath I-93 than Mystic Avenue northbound.

  2) Alternatively, an off-ramp to Mystic Avenue northbound could be accommodated on the western side of Mystic Avenue northbound, between Mystic Avenue and the I-93 retaining wall. However, this would require displacing Mystic Avenue to the east.

- **Operational Issues.** Any off-ramp to Mystic Avenue northbound would add significant traffic volumes to Mystic Avenue northbound just in advance of the I-93 northbound on-ramp, which draws very heavy volumes. In effect, the off-ramp traffic would overlap with the on-ramp traffic, creating congestion and introducing significant weaving conflicts between off-ramp traffic and Mystic Avenue northbound traffic. These issues could be addressed by signalizing the off-ramp and Mystic Avenue, but this would introduce additional delay and the potential for queuing back onto the I-93 mainline.

- **Property Issues.** Any ramp in this area would require either placing the ramp on private property or displacing Mystic Avenue onto private property (the approximate location of the Home Depot / Circuit City parking lot). This would also increase the amount of highway and roadway infrastructure adjacent to Assembly Square, rather than reducing it.

Connection from Assembly Square to I-93 Southbound

This improvement is designed to satisfy some of the demand for access from Assembly Square to I-93 southbound. Currently, traffic bound from Assembly Square to I-93 southbound has two options:

- Exit Assembly Square via Middlesex Avenue to Route 28 southbound then turn left onto the I-93 southbound on-ramp.

- Exit onto Mystic Avenue Northbound (via Assembly Square Drive, New Road, or Middlesex Avenue), then pass through the signalized intersection with Route 28 southbound, make the U-Turn onto Mystic Avenue Southbound, and pass through another signalized intersection with Route 28 southbound.

The first route is relatively direct for drivers departing from the northern end of the district. However, the second route is circuitous, and requires passing through at least two additional signalized intersections. A new connection should provide a more direct route from the southern end of Assembly Square to I-93 southbound.

The following are the basic options for the U-turn ramp:

- **Via the new "Connector Road" beneath the I-93 viaduct.** This assumes that the Connector Road provides two-way traffic for a portion of its length (at least as far as the I-93 southbound on-ramp). Making this Connector Road two-way would complicate traffic signalization design along its length, and may make other movements more difficult to accommodate.

- **U-turn ramp connection beneath I-93 viaduct.** The proposed U-turn would pass beneath the I-93 viaduct, and connect Mystic Avenue northbound with the I-93 southbound on-ramp. It would pass to the south of any proposed Connector Road, and would therefore avoid the traffic signals that would be required where the Connector Road intersects Mystic Avenue northbound and Mystic Avenue southbound. Construction of the Mystic Avenue northbound to I-93 southbound U-turn connection would require the elimination of the Route 28 southbound to I-93 southbound on-ramp direct connection that is currently in place. Eliminating this connection is desirable in any case, since this is necessary in order to eliminate the dangerous weave on the I-93 southbound on-ramp. The U-turn connection to the I-93 southbound on-ramp may require changes to the I-93 northbound on-ramp due to vertical and horizontal constraints. These are discussed below in the description of the I-93 northbound on-ramp.

I-93 Northbound On-Ramp

The I-93 northbound on-ramp off of Mystic Avenue northbound is an important component of the highway system. This is the first northbound on-ramp to I-93 after downtown Boston, and therefore it attracts significant traffic demand. The existing ramp does not have any conflicts with any of the I-93 off-ramp options. However, there are vertical clearance issues for the proposed alternative Connector Road that aligns with Foley Street. There are also potential issues related to the proposed U-turn ramp connecting Mystic Avenue northbound with the I-93 southbound on-ramp. To address the various issues related to the other interchange modules, the following four alternative ramp configurations have been identified.

- **Use Existing On-Ramp.** The existing on-ramp provides adequate vertical clearance for the proposed Connector Road aligned with Old McGrath Highway. It is also consistent with any of the I-93 northbound off-ramp proposals (except the existing off-ramp). However, the existing northbound on-ramp would not accommodate a U-turn ramp connecting Mystic Avenue Northbound to the I-93 southbound on-ramp.

- **Reconstruct on-ramp to the north to accommodate the Connector Road aligned with Foley Street.** The existing on-ramp does not provide adequate vertical clearance for the proposed Connector Road aligning with Foley Street. The on-ramp cannot be reconstructed to the south, to provide adequate headroom for this Connector Road, because then the on-ramp would not have adequate headroom under the I-93 northbound off-ramp. The alternative is to reconstruct the on-ramp to the north, so that the on-ramp approach is at-grade where the Connector Road meets Mystic Avenue Northbound, and the on-ramp begins its ascent north of that point. This alternative has two major challenges:

    - Reconstructing the on-ramp's connection to the I-93 mainline would be difficult and costly. The structural connections between the ramp and the highway viaduct, combined with the presence of the surface roadways beneath these connections, would pose significant difficulties. It might be possible to address these difficulties by providing new structural supports when the existing Route 28 southbound – I-93 southbound on-ramp connection is closed.

    - Having the Connector Road meet the ramp approach at grade would enable Route 28 northbound traffic to access I-93 northbound directly at this point, rather than traveling northbound on Mystic Avenue to enter at Exit 30, as it must do currently. This could increase demand for the on-ramp to the degree that it would overwhelm the ramp capacity.

- **Raise the ramp's the vertical clearance to enable a U-turn ramp to pass beneath it.** In order to accommodate a U-turn ramp connection from Mystic Avenue Northbound to the I-93 southbound on-ramp beneath the I-93 northbound on-ramp, the northbound on-ramp would have to be rebuilt to raise its elevation.

- **Widen the ramp to enable a U-turn ramp to split off to the left.** The I-93 northbound on-ramp could be reconstructed to accommodate a U-Turn ramp connection from Mystic Avenue northbound to the I-93 southbound on-ramp. This would entail widening the existing ramp to accommodate two approach lanes. The left lane could then continue at or near grade to split off to the left onto the U-turn ramp leading to the I-93 southbound on-ramp. The right lane (including the widening) would rejoin the existing I-93 on-ramp alignment. The widening would require the displacement of Mystic Avenue Northbound toward Assembly Square; this could be accommodated, since the I-93 northbound off-ramp would need to be rebuilt in any case.

Based on the issues and constraints identified above, there is a limited set of combinations of these module options that are physically feasible.

Interchange Alternatives

Taking all of the issues into account, seven interchange alternatives were developed and analyzed. These included two preliminary alternatives developed for the purpose of the regional travel demand modeling; three intermediate alternatives that incorporated the findings of the regional modeling; and two final alternatives that included the most promising elements of the previous alternatives. All of these alternatives include the common elements noted above: a Route 28 southbound tunnel, a roadway connection from Route 28 northbound into Assembly Square in the vicinity of Foley Street / Old McGrath Highway, the elimination of the direct connection from Route 28 southbound to the I-93 southbound on-ramp, and the elimination of the connection from the I-93 southbound on-ramp to Mystic Avenue southbound.

Table 3-7 Interchange Alternatives

Alternative	Elements
Preliminary	
Alternative A	▪ Route 28 to Assembly Square Connector Road: aligned with Old McGrath Highway ▪ I-93 Northbound Off-Ramp: to Middlesex Avenue ▪ Connection from Assembly Square to I-93 Southbound: via Mystic Avenue northbound to Mystic Avenue southbound ▪ I-93 Northbound On-Ramp: existing on-ramp
Alternative B	▪ Route 28 to Assembly Square Connector Road: aligned with Foley Street ▪ I-93 Northbound Off-Ramp: to Route 28 northbound, with split to Mystic Avenue northbound ▪ Connection from Assembly Square to I-93 Southbound: U-turn connection from Mystic Avenue northbound ▪ I-93 Northbound On-Ramp: ramp rebuilt to the north to accommodate the Foley Street Connector Road
Intermediate	
Alternative C	▪ Route 28 to Assembly Square Connector Road: aligned with Old McGrath Highway ▪ I-93 Northbound Off-Ramp: to Route 28 northbound, eliminate split to Mystic Avenue northbound ▪ Connection from Assembly Square to I-93 Southbound: U-turn connection, ramp split from I-93 northbound on-ramp ▪ I-93 Northbound On-Ramp: ramp widened to enable U-turn ramp to split off to the left
Alternative D	▪ Route 28 to Assembly Square Connector Road: aligned with Old McGrath Highway ▪ I-93 Northbound Off-Ramp: to Middlesex Avenue ▪ Connection from Assembly Square to I-93 Southbound: U-turn connection from Mystic Avenue northbound beneath I-93 northbound on-ramp ▪ I-93 Northbound On-Ramp: ramp rebuilt to raise the vertical clearance over the U-turn connection
Alternative E	▪ Route 28 to Assembly Square Connector Road: aligned with Foley Street ▪ I-93 Northbound Off-Ramp: to Route 28 northbound, with split to Mystic Avenue northbound ▪ Connection from Assembly Square to I-93 Southbound: U-turn connection from Mystic Avenue northbound ▪ I-93 Northbound On-Ramp: ramp rebuilt to north to accommodate the Foley Street Connector Road
Final	
Alternative 1	▪ Route 28 to Assembly Square Connector Road: aligned with Foley Street (a.k.a. Foley Street Extension) in new alignment between column bays of the I-93 viaduct ▪ I-93 Northbound Off-Ramp: to Route 28 northbound, with split to Middlesex Avenue ▪ Connection from Assembly Square to I-93 Southbound: via two-way Foley Street Extension ▪ I-93 Northbound On-Ramp: existing ramp (accommodates Foley Street Extension in new alignment)
Alternative 2	▪ Route 28 to Assembly Square Connector Road: aligned with Foley Street (a.k.a. Foley Street Extension) in new alignment between column bays of the I-93 viaduct ▪ I-93 Northbound Off-Ramp: directly to Middlesex Avenue ▪ Connection from Assembly Square to I-93 Southbound: U-turn connection from Mystic Avenue northbound beneath I-93 northbound on-ramp ▪ I-93 Northbound On-Ramp: ramp rebuilt to raise the vertical clearance over the U-turn connection

Two Preliminary Regional Modeling Alternatives, Alternative A and Alternative B, were included in the preliminary regional travel demand modeling (in Scenarios 4 and 5, respectively). These alternatives were designed to include the major contrasting interchange elements, and identify the key regional effects of these different elements. The following is a description of these alternatives and the different components that they include.

- **Alternative A**. This alternative is based on the 1994 MassHighway preferred alternative, with a few differences, and is shown in Figure 3-22:

- **Alternative B.** This alternative is designed to review elements that contrast with those in Alternative A in order to assess the impacts of the different elements on regional traffic flows; it is shown in Figure 3-23:

The two preliminary interchange alternatives were evaluated using the regional multi-modal travel demand model. The model demonstrated the impacts of the different preliminary alternatives on regional traffic flows. The intermediate alternatives analysis also included a close examination of physical and structural feasibility, and mutual compatibility of the various interchange elements. Based on these regional traffic results and the feasibility review, the following intermediate alternatives were developed and reviewed:

- **Alternative C.** This alternative is shown in Figure 3-24:

- **Alternative D.** Alternative D is shown in Figure 3-25:

- **Alternative E.** Alternative E is shown in Figure 3-26:

The results of the regional travel demand modeling and the physical and structural feasibility analysis from Alternatives A – E were reviewed. Advantages and disadvantages of these alternatives were identified, and a few new elements were added to optimize the advantages and minimize the disadvantages. Appropriate and consistent elements were then combined into two feasible and representative final alternatives for assessing the overall roadway plans in travel demand model Scenarios 6 and 7.

- **Alternative 1.** Alternative 1 is shown in Figure 3-27:

- **Alternative 2.** Alternative 2 is shown in Figure 3-28:

The results of the interchange alternatives analysis, including advantages, disadvantages, and selection criteria will be discussed further in Chapter 4.

3.6.2 Internal Street Network Improvement Alternatives

The internal street network will be essential not only for facilitating convenient vehicular access into, out of, and within Assembly Square, but also for creating the desired character for Assembly Square. The following are the key principles for planning the Assembly Square street network, and achieving the desired urban character within the district.

The internal street network planning is also designed to incorporate the findings and recommendations of the *Assembly Square Planning Study* and the *Unifying Design Guidelines for the Public Realm*. Two alternatives for the full-build internal street network are shown in Figures 3-29 and 3-30. These alternatives correspond to interchange final Alternative 1 and Alternative 2, and they are incorporated into travel demand model Scenarios 6 and 7.

Robust Street Grid

Assembly Square currently has relatively few streets. These streets carry the relatively low traffic volumes that are either entering or exiting Assembly Square's limited land uses, or using Assembly Square's streets as cut-through routes, typically between Mystic Avenue and Route 28. In the future build condition, Assembly Square should have a robust street grid, with many streets. This will help to distribute traffic and improve traffic operations, provide more public spaces, provide more view corridors, and enable direct connections and multiple paths for pedestrians and bicycles, as well as automobiles. To the degree possible, the street grid should be regular, with orthogonal blocks, and streets should be continuous, from one side of the district to the other. These guidelines will help to make the district understandable and easy to navigate, improve traffic operations, and create view corridors. In Assembly Square, there are opportunities for views to the water and downtown Boston, in addition to views interconnecting important places within the district.

New Gateways for Assembly Square

Creating new external gateways is related to creating a robust street grid. The creation of new streets should also extend, to the degree possible, to creating new gateways at the edges of Assembly Square. New gateways for Assembly Square will distribute the traffic, create new opportunities for pedestrian and bicycle access, and make the district more understandable.

Street Hierarchy

The Assembly Square street network should have an appropriate hierarchy of streets. This hierarchy should include a range of street designs and functions, from major to minor: it should include arterial streets, collector streets, and local streets. The arterial streets will carry the principal traffic flows, and should be connected to the district gateways. The collector streets will distribute the traffic through the district, and carry somewhat lower traffic volumes. Local streets, service roads, and alleys will carry low traffic volumes, and will be principally for the purpose of local access, not through-movement. The hierarchy of any given street and its related public spaces should be reflected in its design, according to the standards outlined in Assembly Square's *Unifying Design Guidelines for the Public Realm.* All of Assembly Square's streets should accommodate pedestrians and bicyclists.

Small Urban-Scaled Blocks

Small, urban-scaled blocks are integral to creating a robust street grid and a pedestrian-oriented character within a district. The more streets, the more finely-grained the division of the district into blocks. Smaller blocks allow for shorter connections among destinations and a choice of paths for pedestrians and bicyclists that is more inviting than the Assembly Square's existing large blocks. Pedestrian crossings should be a priority in intersection design, minimizing crossing distances by keeping the number of traffic lanes to a minimum and integrating curb extensions where possible.

Direct Connections into and out of Assembly Square

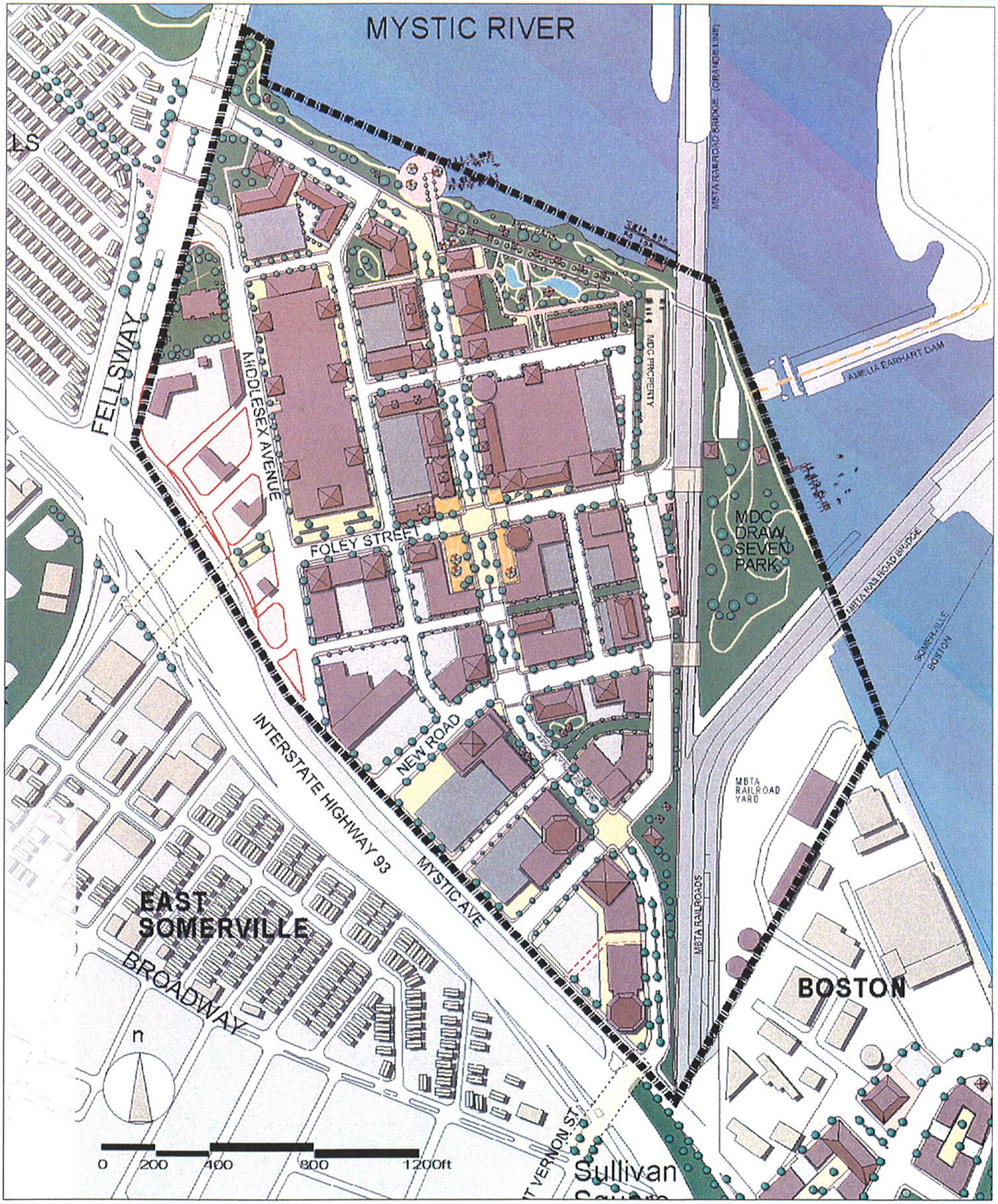
The roadway connections into and out of Assembly Square should be as direct as possible, and should be integrated as seamlessly as possible into the surrounding roadway network. This improves both traffic operations and the navigability of the district. Parking facilities should be carefully located within the district in predictable locations for searching motorists. To the degree possible, parking facilities and parking access points should be located closer to the periphery of the district, rather than further in. This would tend to shorten vehicle trips between the district gateways and the parking access points, reducing vehicular circulation and enhancing pedestrian and bicycle accommodation. Parking access should also be located on minor streets and alleys, rather than on major streets, in order to create fewer conflict points for pedestrians and through-traffic.

3.7 Travel Demand Modeling Scenarios

These improvement alternatives were combined into multi-modal scenarios in order to facilitate analysis using the regional travel demand model. The specific improvement alternatives and their characteristics have been described above. Table 3-8 identifies the manner in which the improvement alternatives were combined into scenarios for use with the travel demand model.

Table 3-8 Transportation Plan Scenarios

Scenario	Land Use	Public Transportation	Roadway	Pedestrian / Bicycle
Scenario 1: Existing Conditions (Figure 3-31)	2002 – Existing	• Orange Line at Sullivan Sq, Wellington • Bus routes 90, 92, 95	Existing	Existing
Scenario 2: Short-Term (Figure 3-32)	2007 – Phase 1	• Consolidate bus routes 90, 92, 95, increase frequency • Urban Ring BRT1	• No-Build regional network • Internal street improvements from development	• Pedestrian / bicycle undercarriage beneath Fellsway Bridge (Rt. 28) • Signal, signage improvements at existing gateways
Scenarios 3: Full-Build Baseline (Figure 3-33)	2025 – Phase 2	Base Transit Network • Same as Phase 1	Base Roadway Network • No-Build regional network • Internal street improvements from development	• Base Pedestrian / Bicycle Network • Internal street improvements from development
Scenario 4: Full-Build Regional Improvements Alternative A (Figure 3-34)	2025 – Phase 2	• Orange Line at Assembly Square • Urban Ring Heavy Rail • Commuter Rail service at Sullivan Square	• Rt. 28 SB underpass • Rt. 28 NB Connector Rd to Old McGrath • Rt. 28 SB to I-93 SB ramp eliminated (connection via Mystic Ave retained) • New I-93 NB off-ramp to Middlesex Ave	• Improvements at new Connector Road • Connection through Orange Line station to Draw 7 Park • Rt. 28 Bridge undercarriage • Street enhancements
Scenario 5 Full-Build Regional Improvements Alternative B (Figure 3-35)	2025 – Phase 2	• Orange Line at Assembly Square • Urban Ring Light Rail • Commuter Rail service at Sullivan Square	• Rt. 28 SB underpass • Rt. 28 NB Connector Rd to Old McGrath • Rt. 28 SB to I-93 SB ramp eliminated • New I-93 NB off-ramp to Rt. 28 • U-turn from Mystic Ave NB to I-93 SB	• Same as Scenario 4
Scenario 6 Final Alternative 1 (Figure 3-36)	2025 – Phase 2	Preferred Regional Transit Improvements • Orange Line at Assembly Square • Urban Ring Rail • Commuter Rail service at Sullivan Square	• Rt. 28 southbound underpass • Foley St Ext. Rt. 28 NB to Foley St • Rt. 28 SB to I-93 SB ramp eliminated • New I-93 NB off-ramp to Rt. 28, w/ split to Middlesex Ave • Connection from Assembly Sq to I-93 SB on-ramp via 2-way Foley St Ext • Robust internal street network	• Same as Scenario 4
Scenario 7 Final Alternative 2 (Figure 3-37)	2025 – Phase 2	Preferred Regional Transit Improvements	• Rt. 28 southbound underpass • Foley St Ext. Rt. 28 NB to Foley St • Rt. 28 SB to I-93 SB ramp eliminated • New I-93 NB off-ramp to Middlesex Ave • Connection from Assembly Sq to I-93 SB on-ramp via U-turn under I-93 • Robust internal street network	• Same as Scenario 4



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

SOURCE: Cecil Group

Assembly Square
Planning Study
Full-Build District Plan

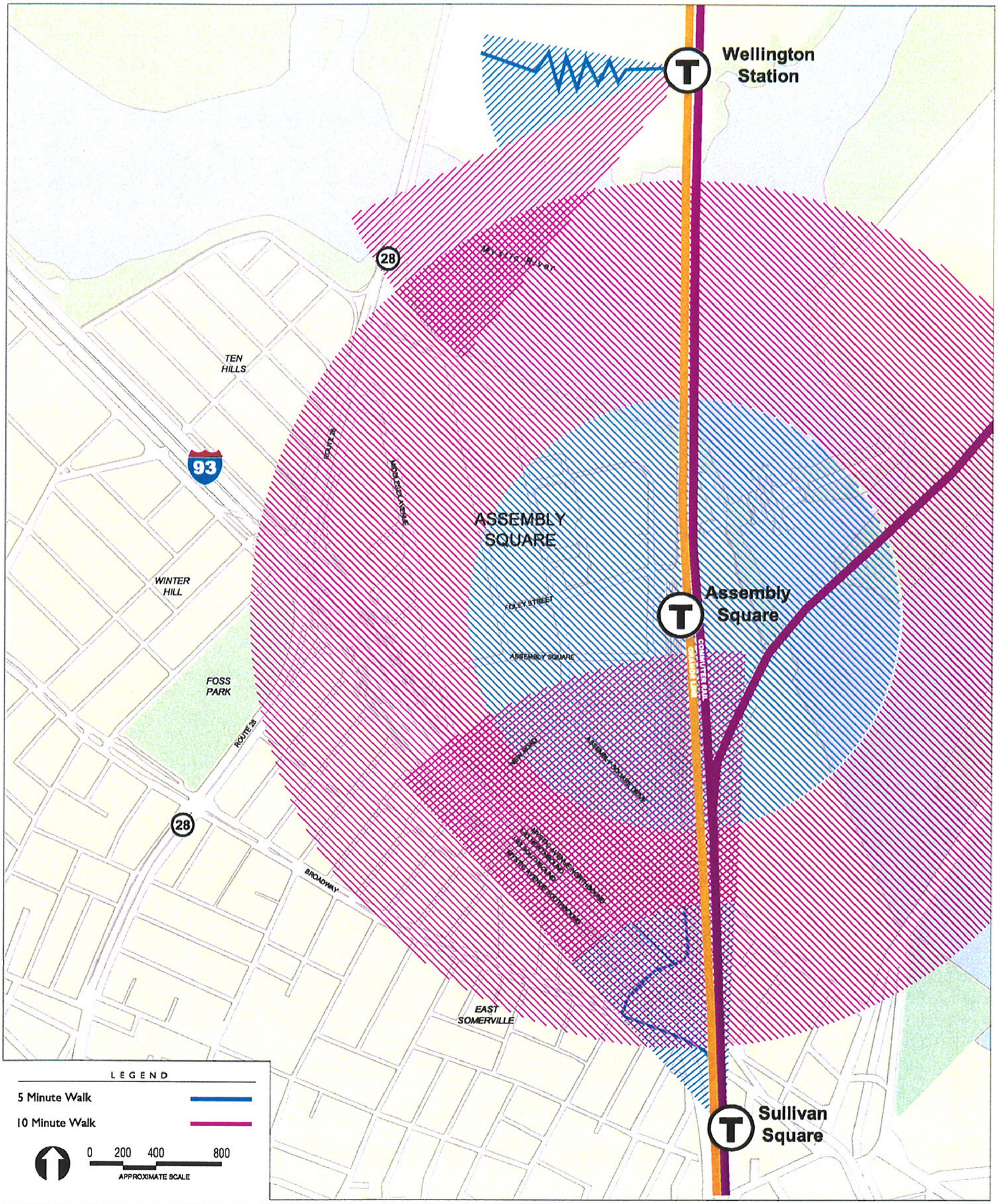
Figure 3-1

Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Future No-Build Base Internal Street Network

Figure 3-2

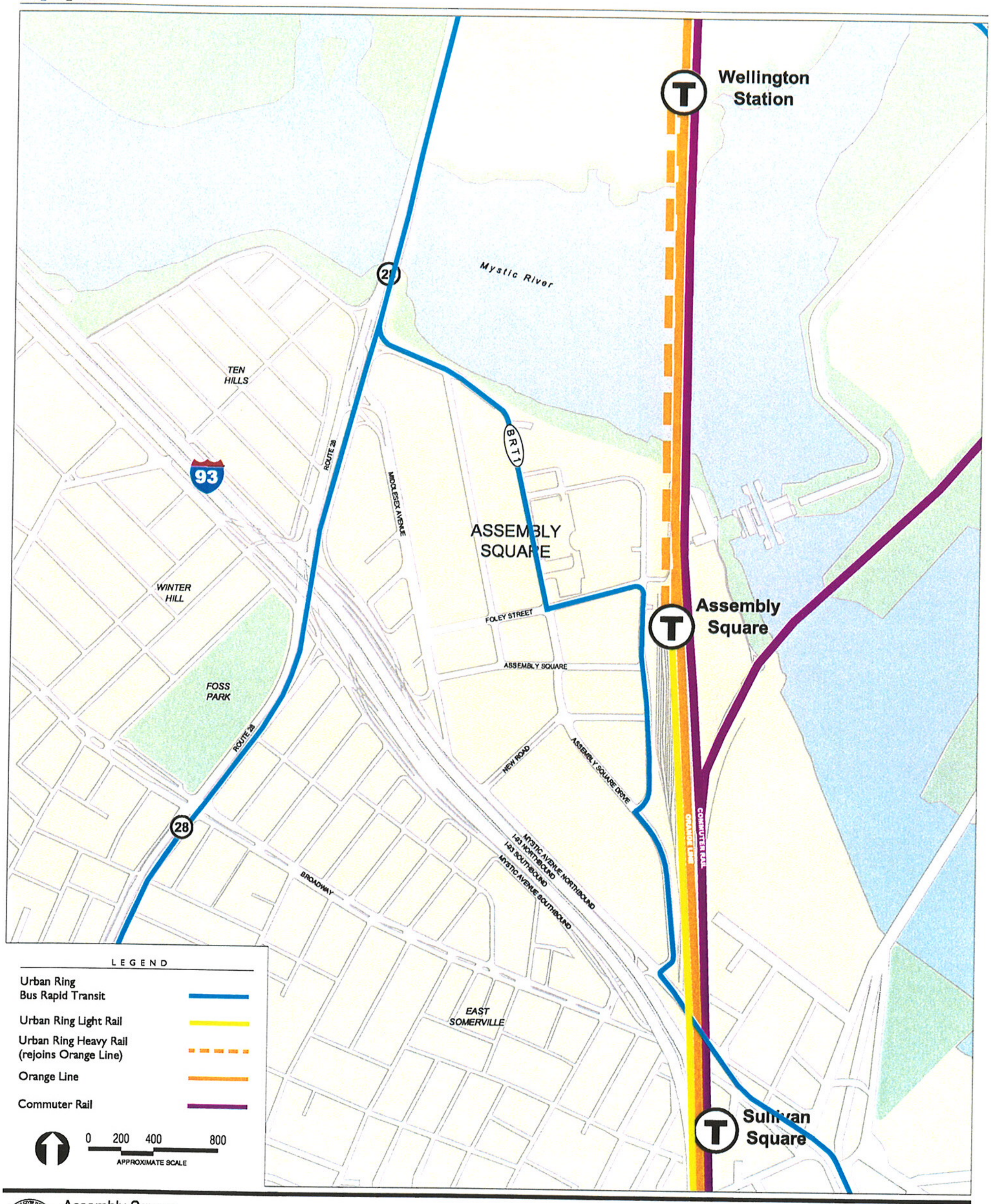


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

New Orange Line Station at Assembly Square

Figure 3-3



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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Long Term Public Transportation Improvements

Figure 3-4

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Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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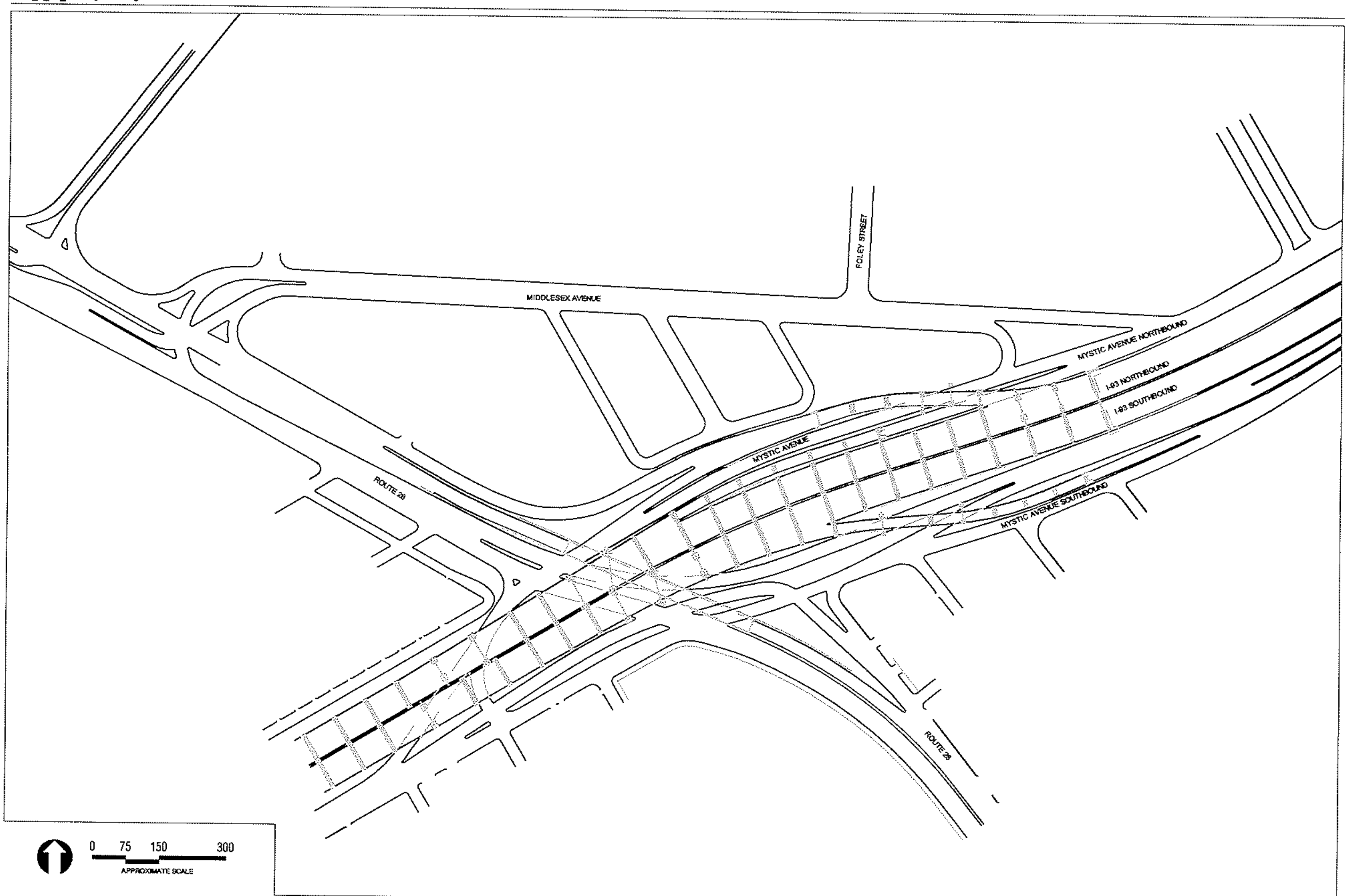
Pedestrian & Bicycle Improvements

Figure 3-5



Assembly Square Transportation Plan
Somerville, Massachusetts

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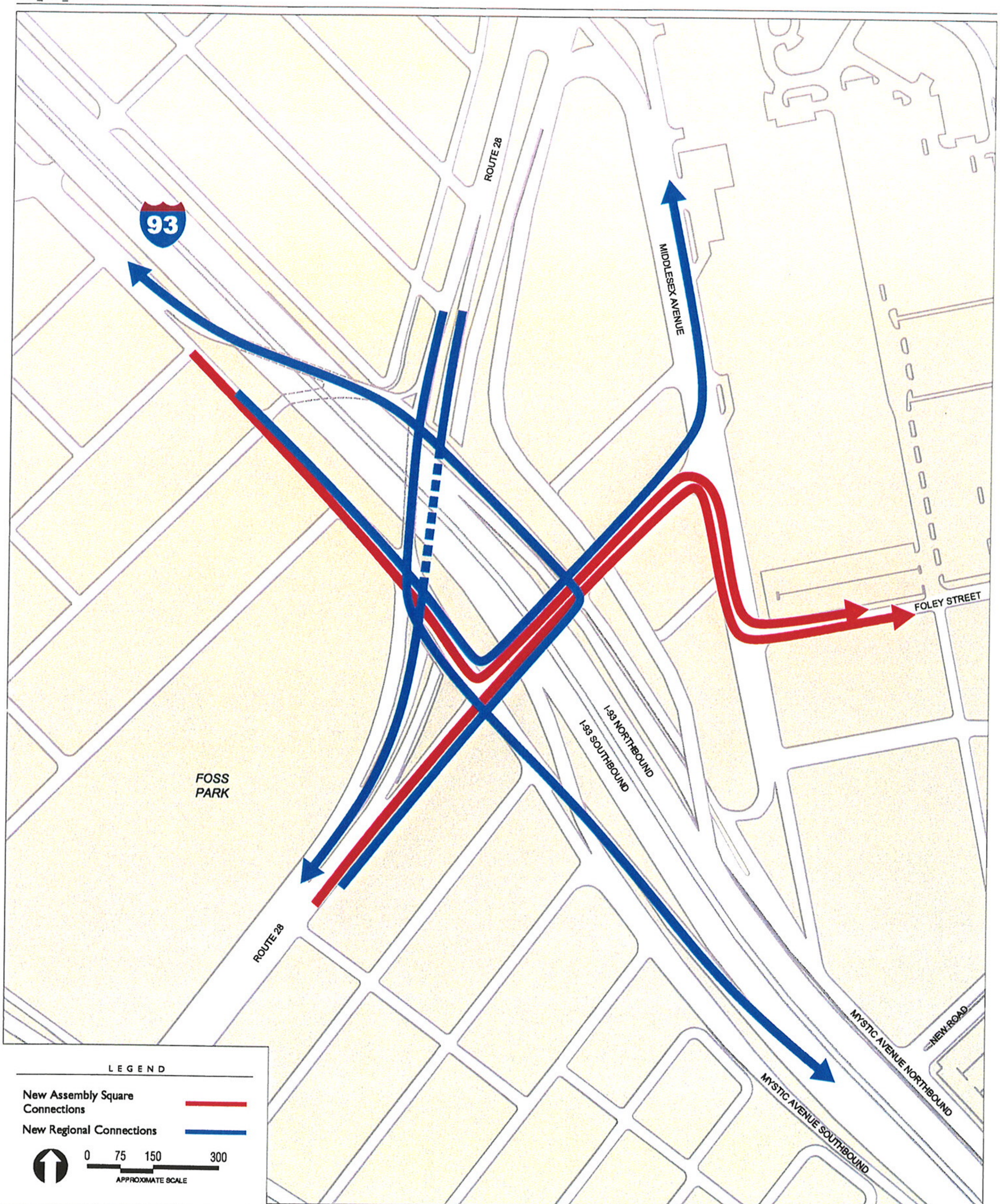
Interchange -- Existing Conditions

Figure 3-6



Assembly Square Transportation Plan
Somerville, Massachusetts

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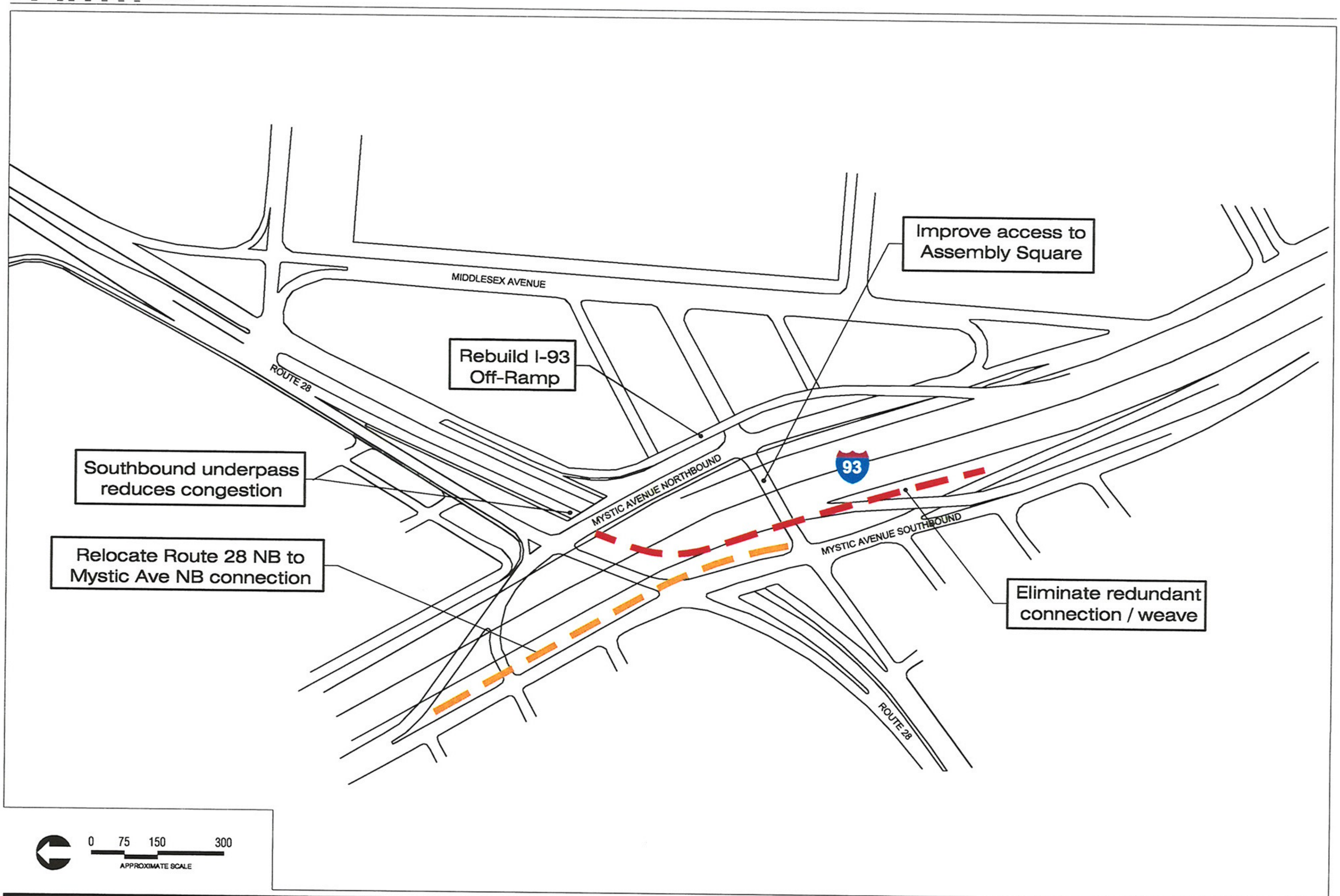
Masshighway
1994 Interchange
Improvement Proposal

Figure 3-7

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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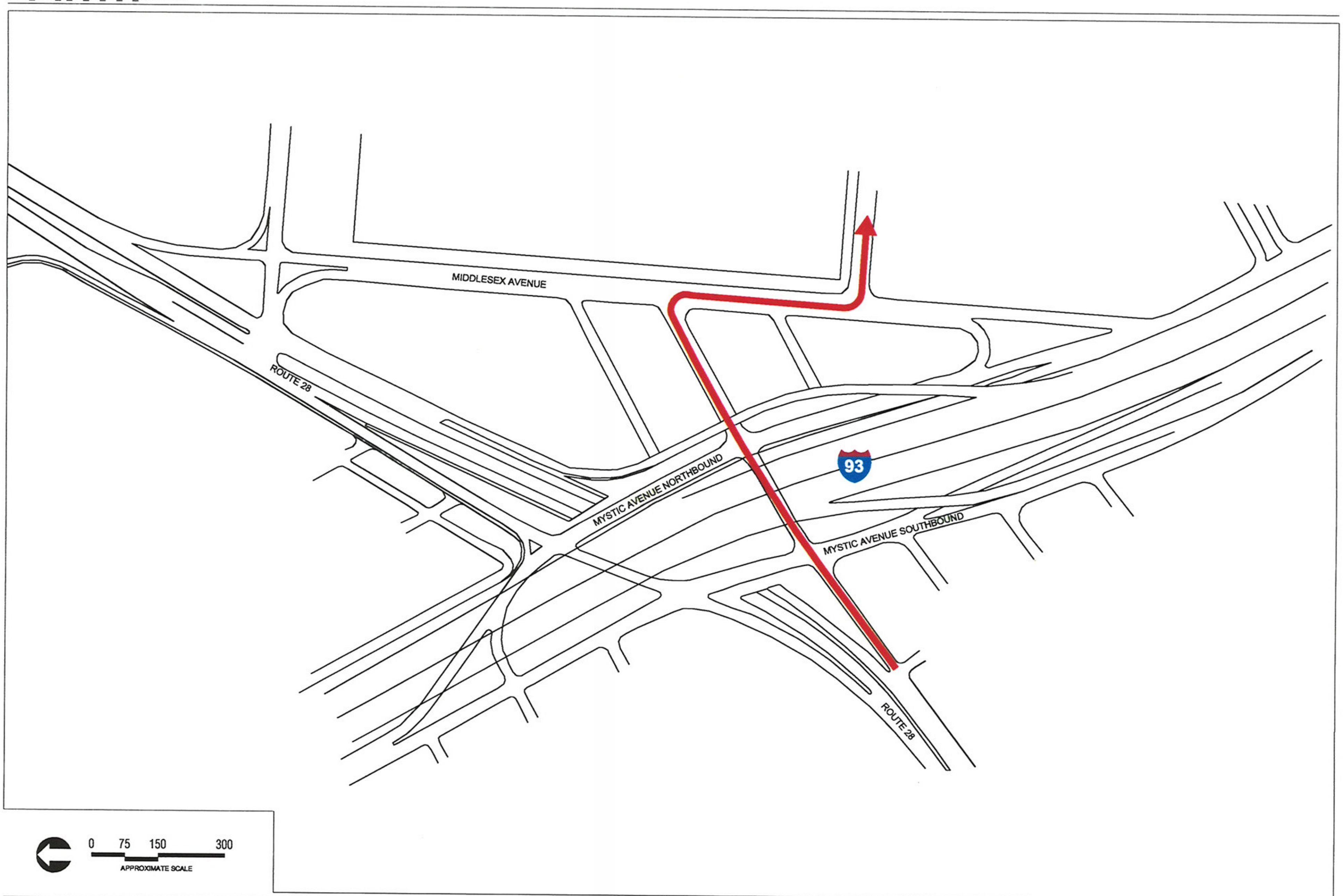
MassHighway 1994 Feasibility Study - Preferred Plan

Figure 3-8

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

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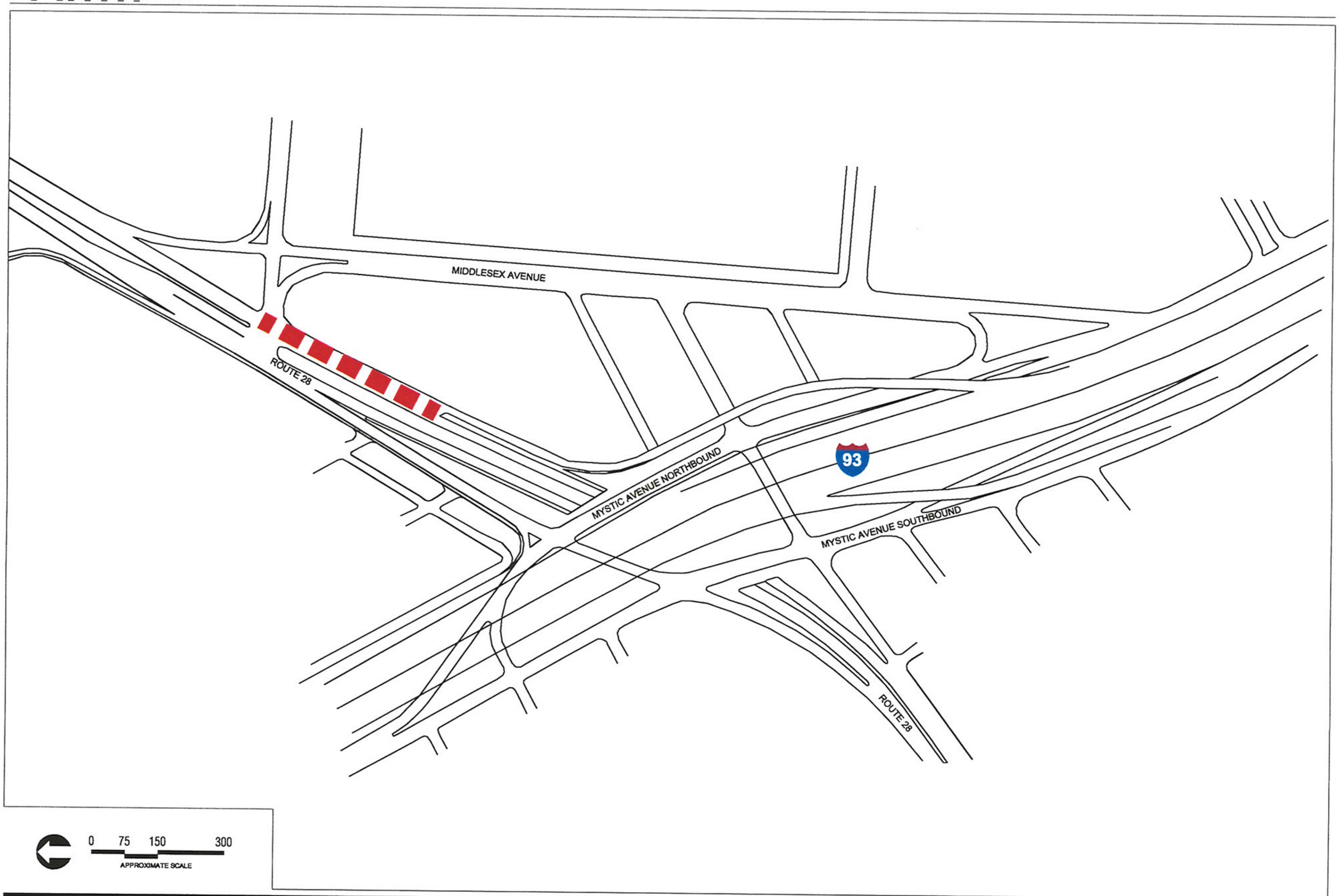
1994 Interchange Plan Indirect Connection to Assembly Square

Figure 3-9

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

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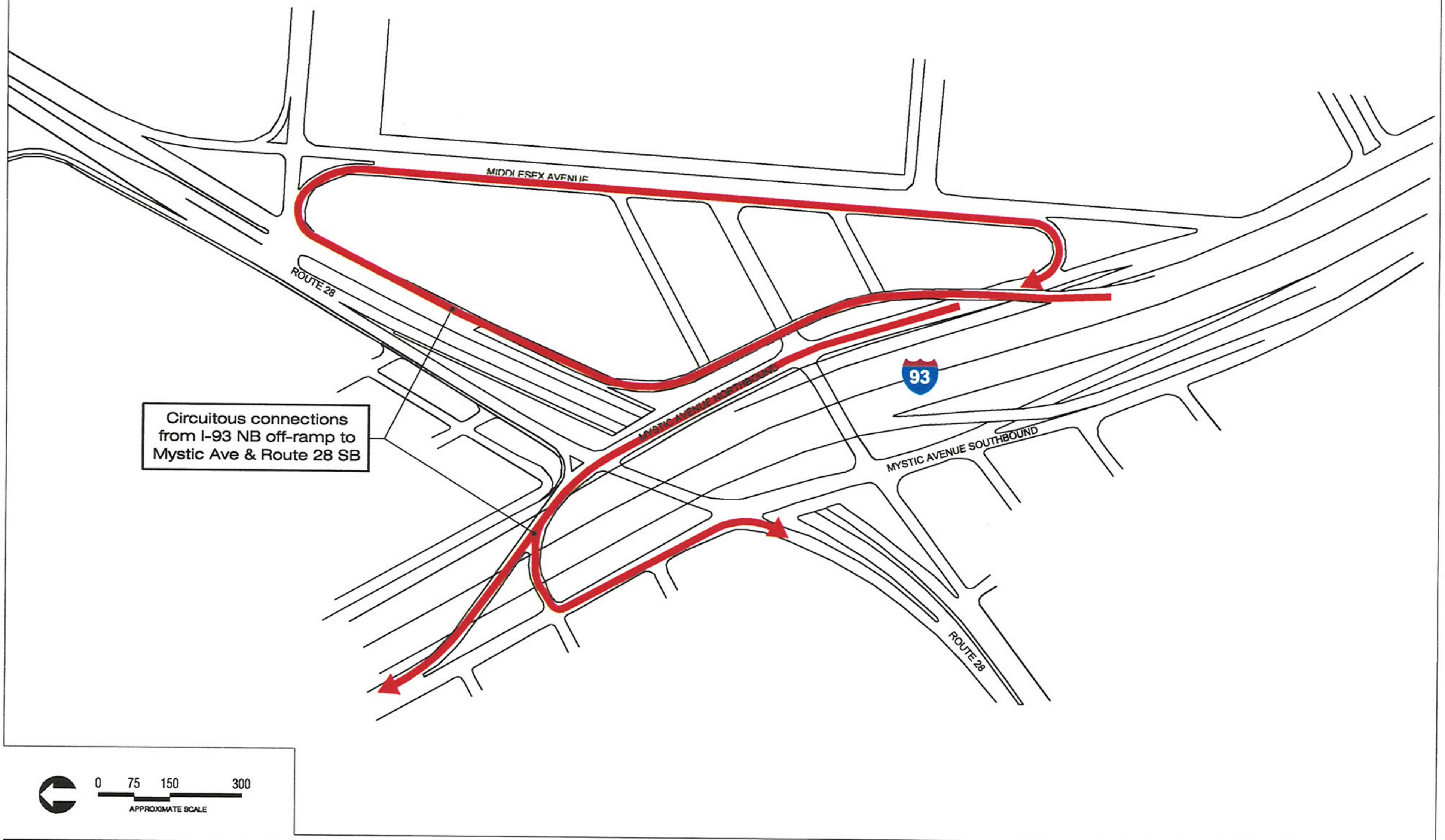
1994 Interchange Plan
Potential for High-Speed Weave Remains

Figure 3-10

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

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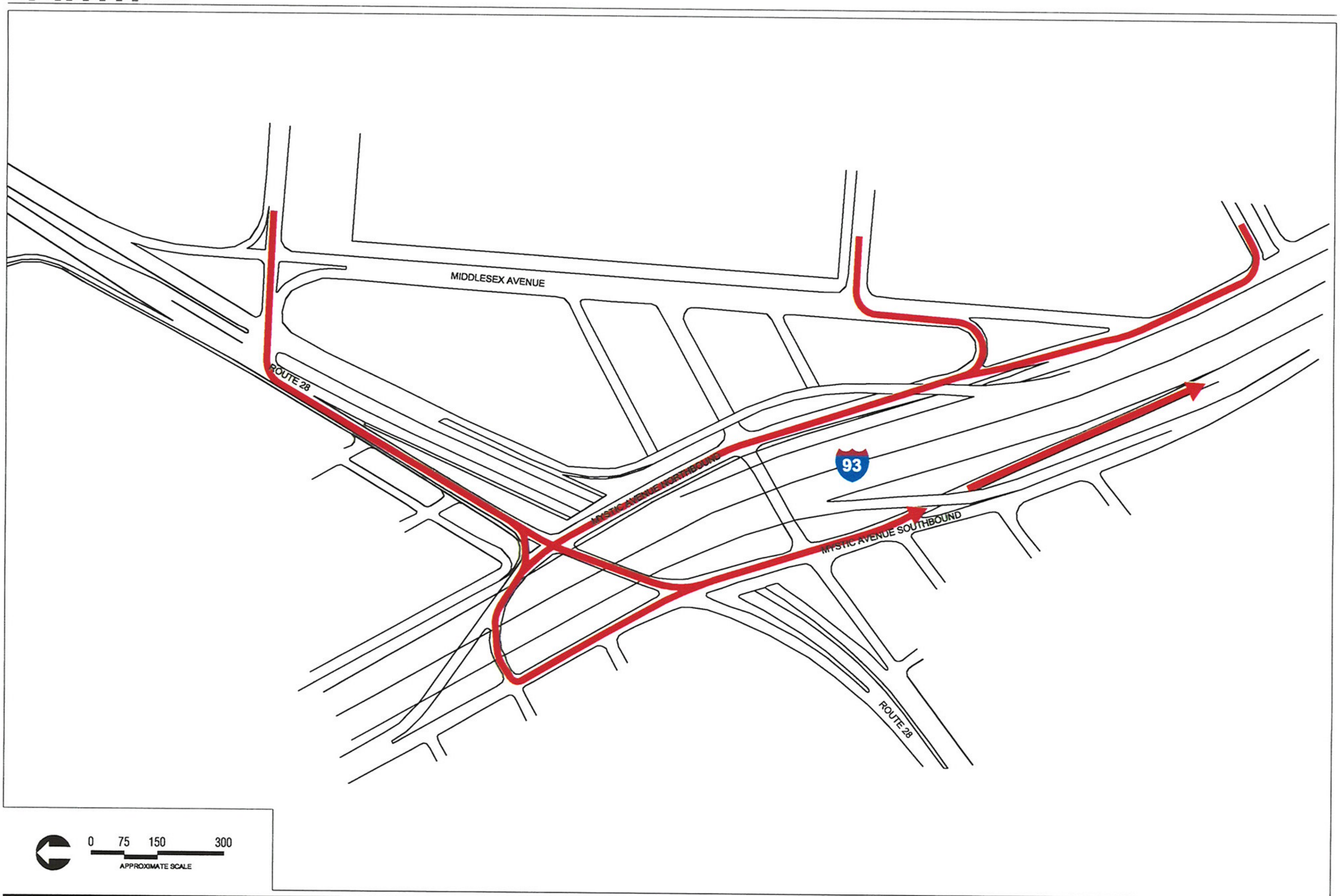
1994 Interchange Plan

Regional Connection from I 93 NB to Mystic Ave, Route 28 SB Worsened

Figure 3-11

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

1994 Interchange Plan

Regional Connection from Assembly Square to I-93 SB Worsened

Figure 3-12

8640_3-08_9_10_11_12_13_14MHD1994

Assembly Square Transportation Plan
Somerville, Massachusetts

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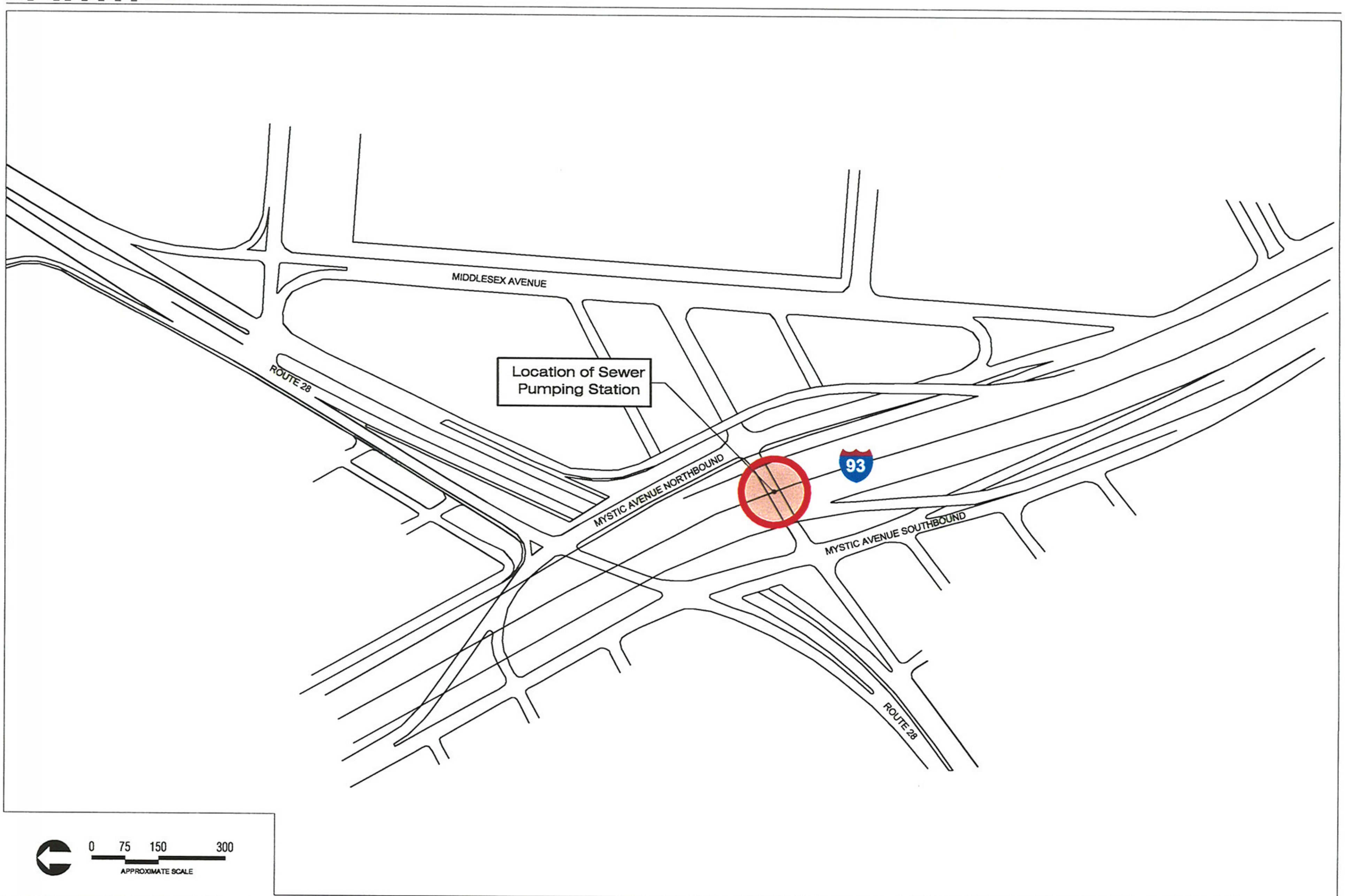
MassHighway 1994
Preffered Plan
Outstanding Issues

Figure 3-13

8640_3-08_9_10_11_12_13_14MHD1994



Assembly Square Transportation Plan
Somerville, Massachusetts

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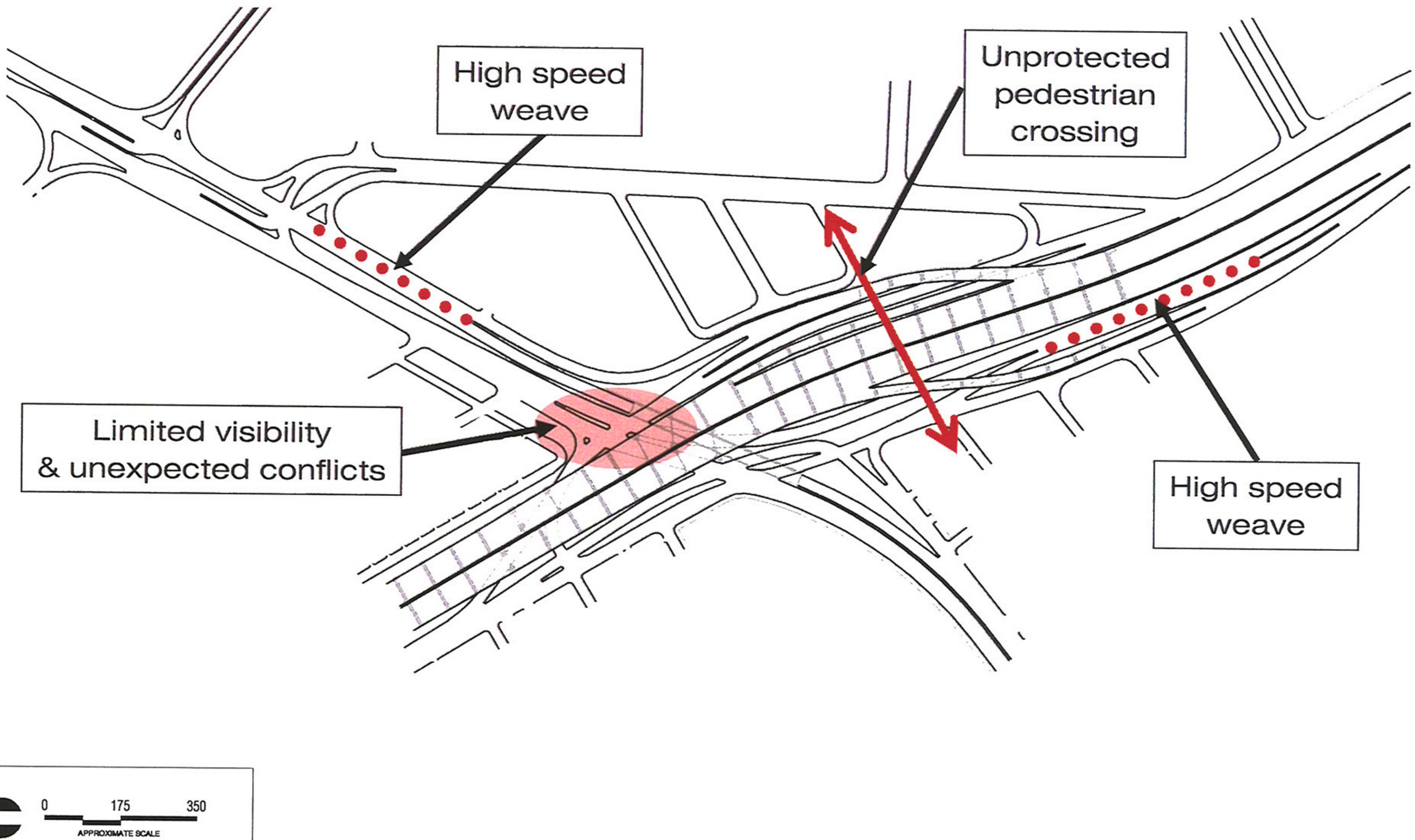
A TETRA TECH COMPANY

1994 Interchange Plan
Sewer Pumping
Station Eliminated

Figure 3-14

8640_3-15_16_17IntOb



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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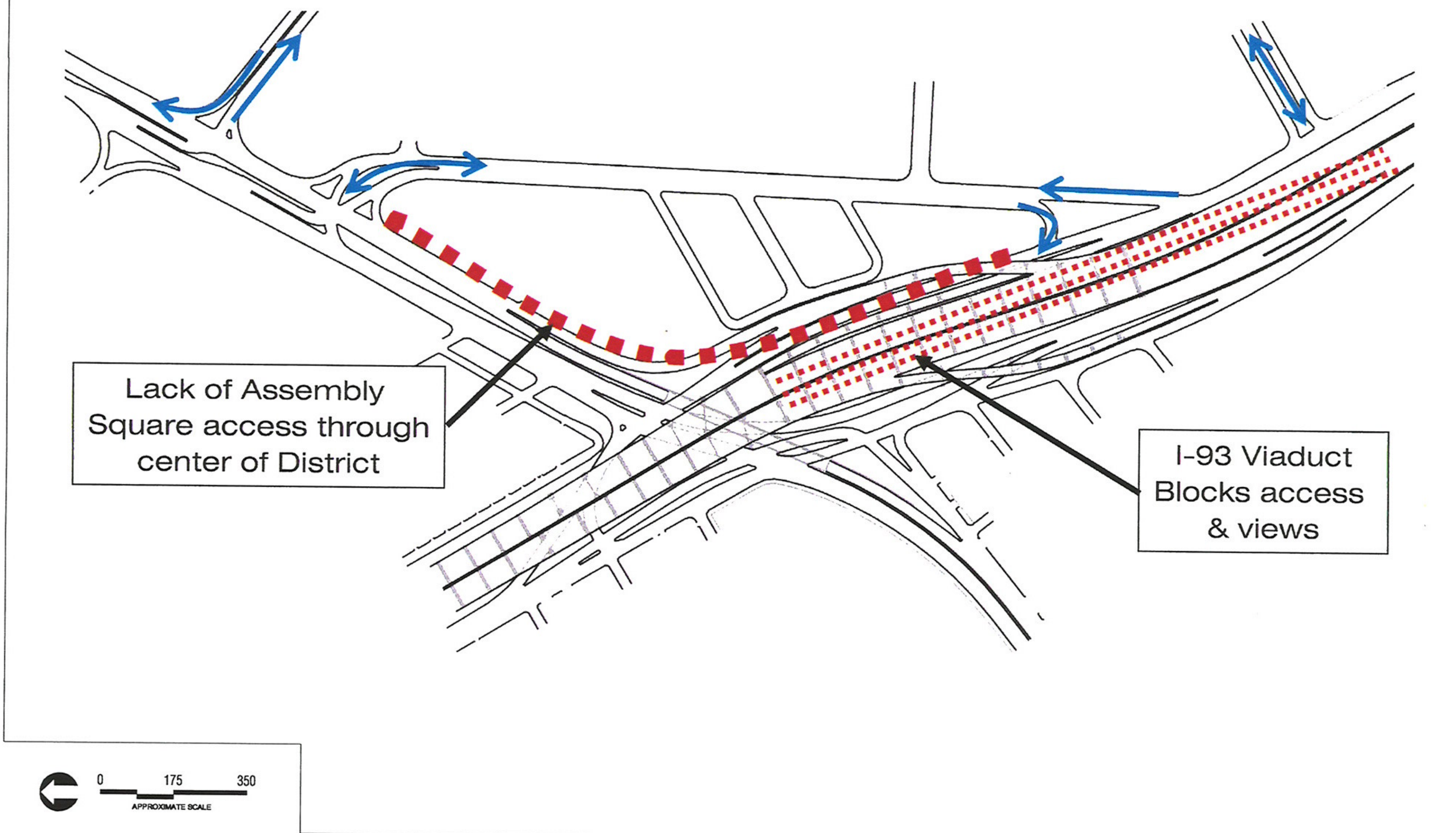
Interchange Objectives
Improve Safety

Figure 3-15

8640_3-15_16_17IntOb



Assembly Square Transportation Plan
Somerville, Massachusetts

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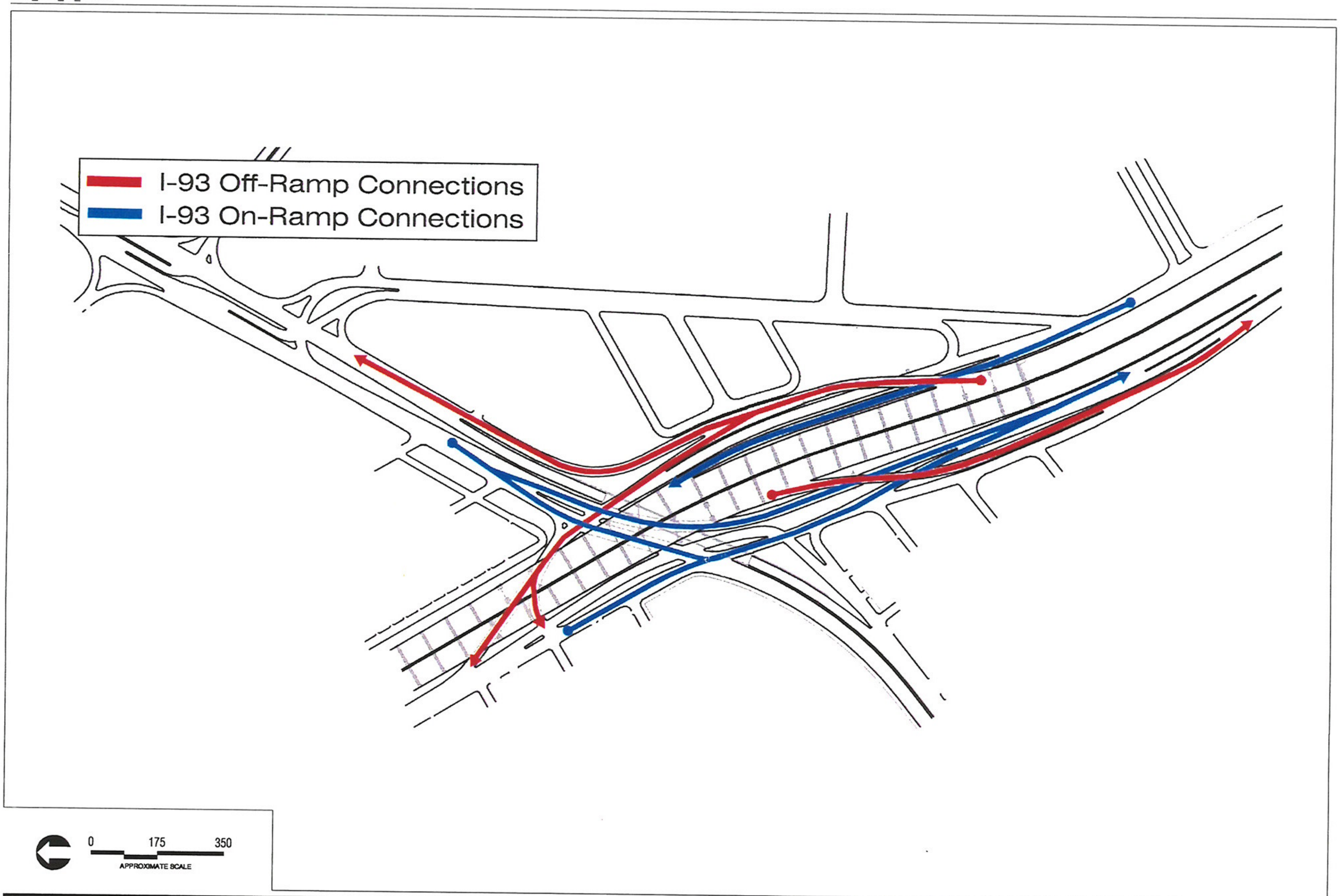
A TETRA TECH COMPANY

Interchange Objectives
Improve Connections to & from Assembly Square Figure 3-16

8640_3-15_16_17IntOb



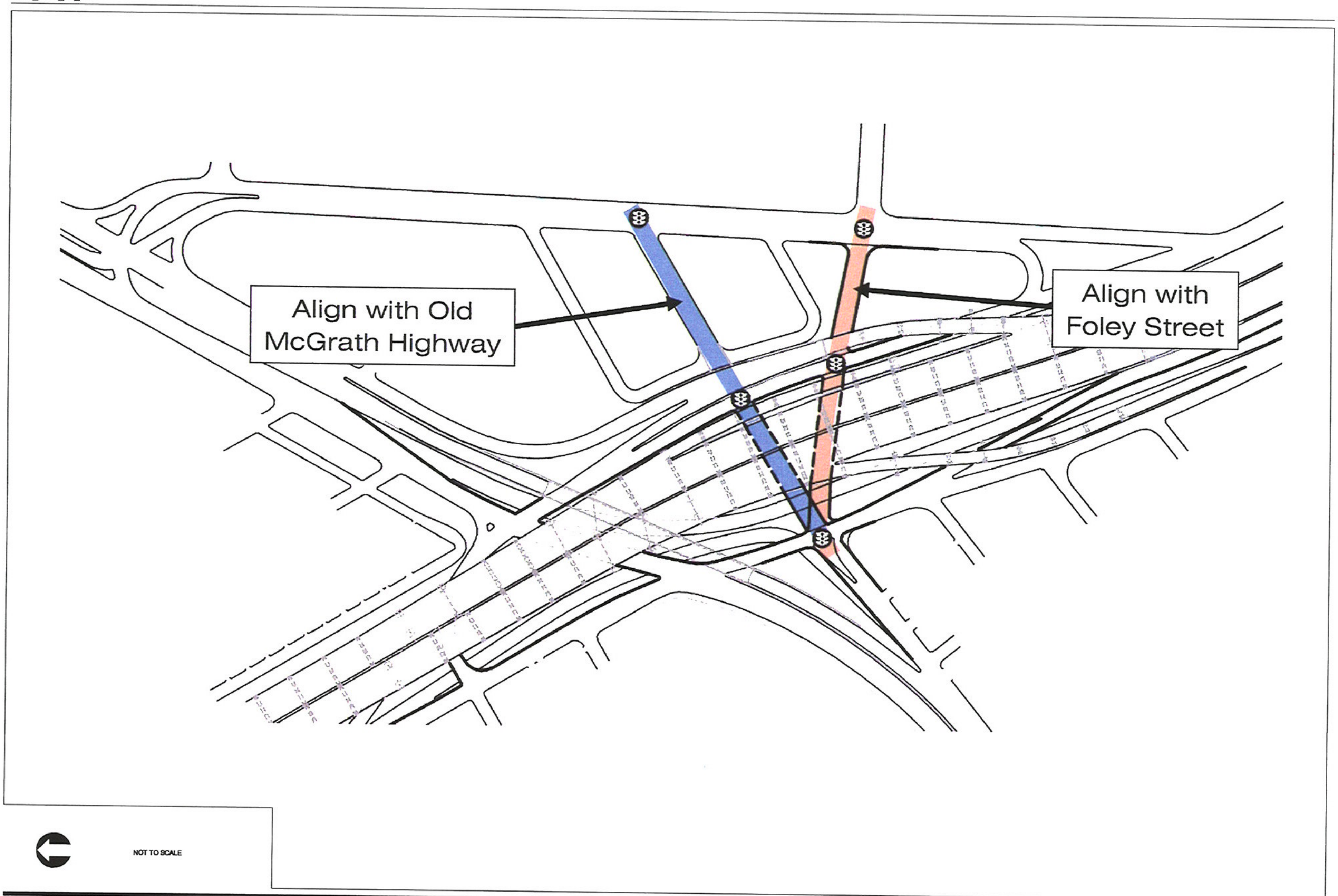
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Objectives Satisfy Required Regional Connections

Figure 3-17

8640_3-18_19_20



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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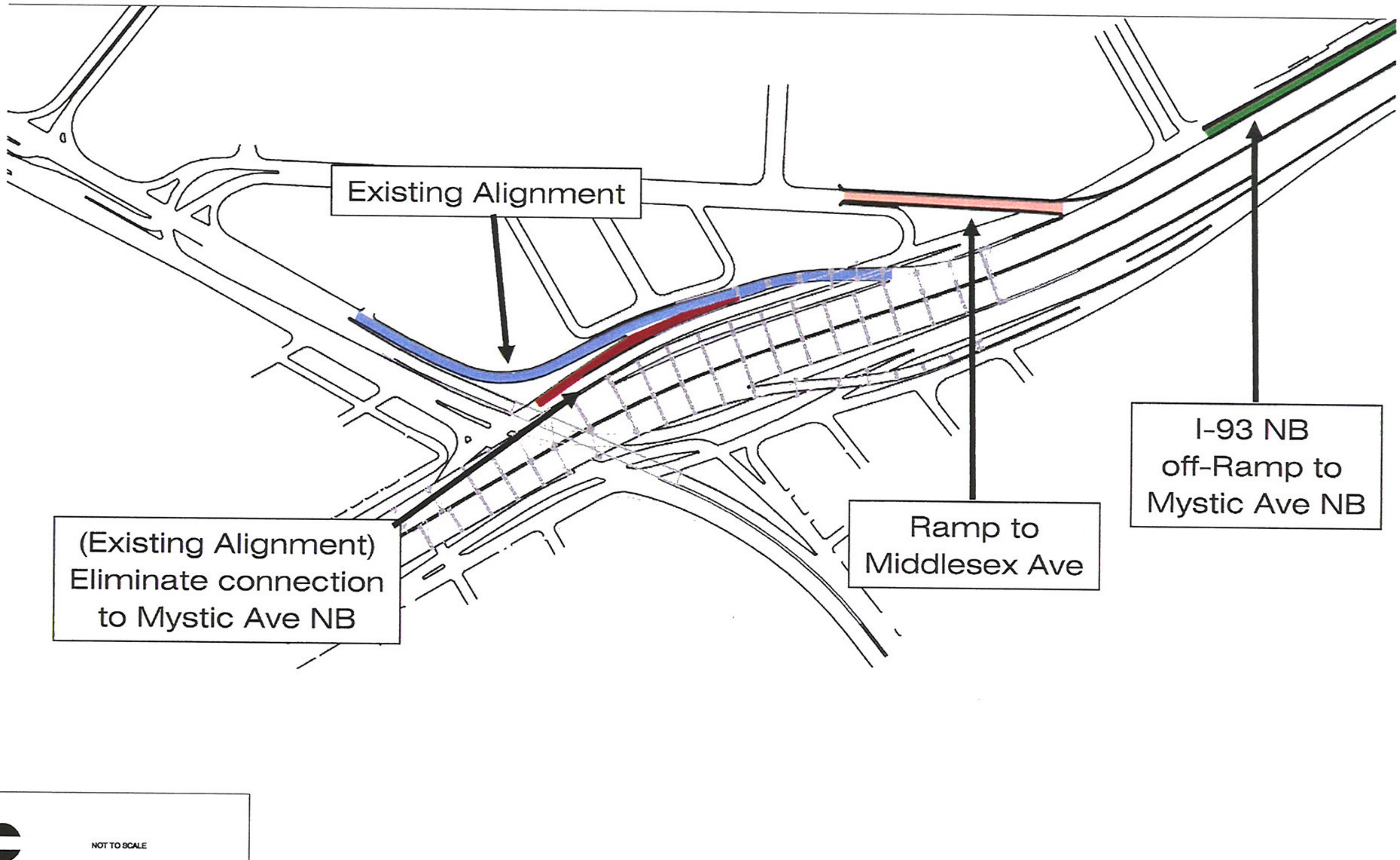
Route 28 Northbound to Assembly Square Connector Road

Figure 3-18

8640_3-18_19_20



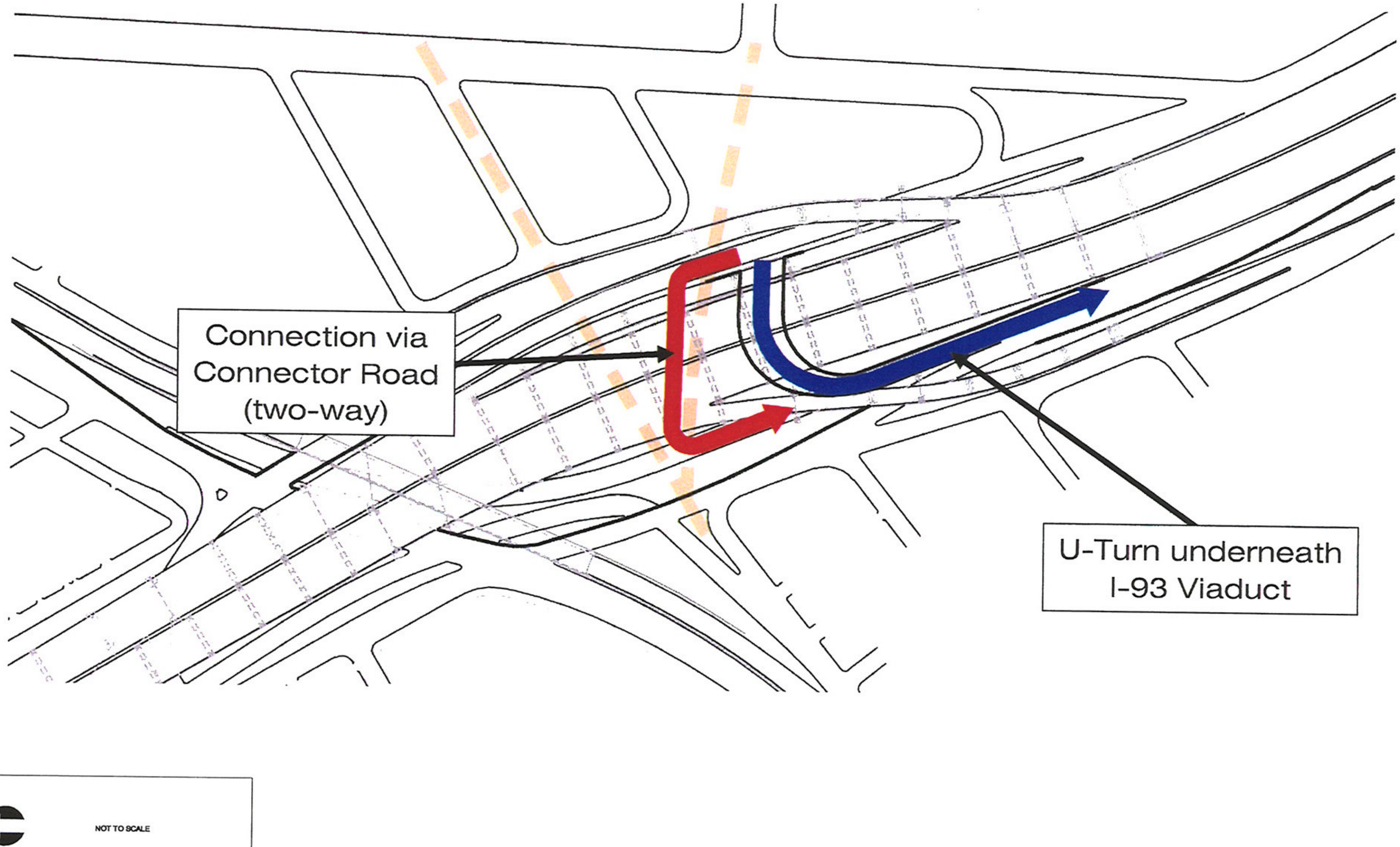
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

I-93 Northbound Off-Ramp

Figure 3-19

8640_3-18_19_20



Assembly Square Transportation Plan
Somerville, Massachusetts

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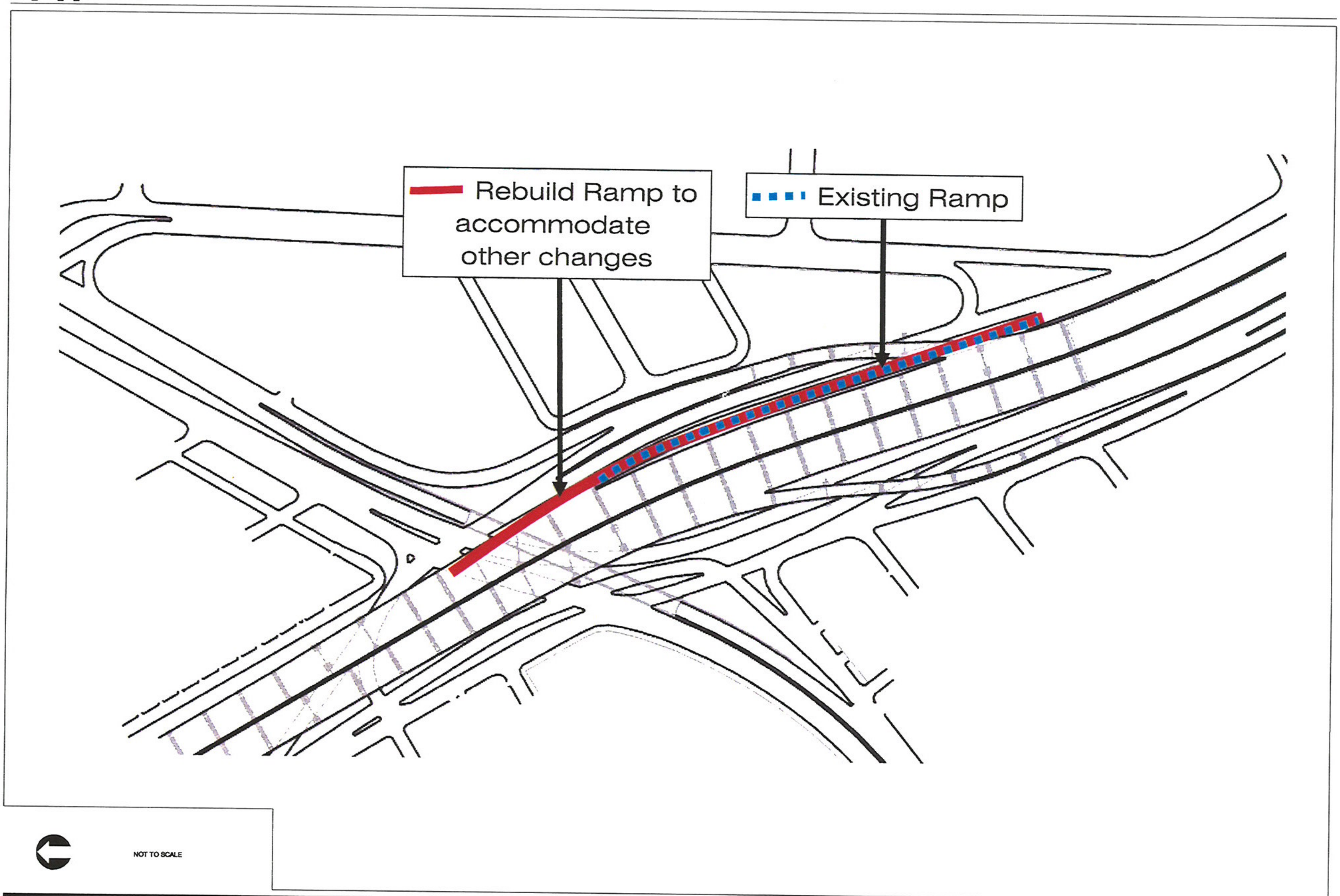
A TETRA TECH COMPANY

Mystic Avenue
Northbound to I-93
Southbound Connection Figure 3-20

8640_3-18_19_20

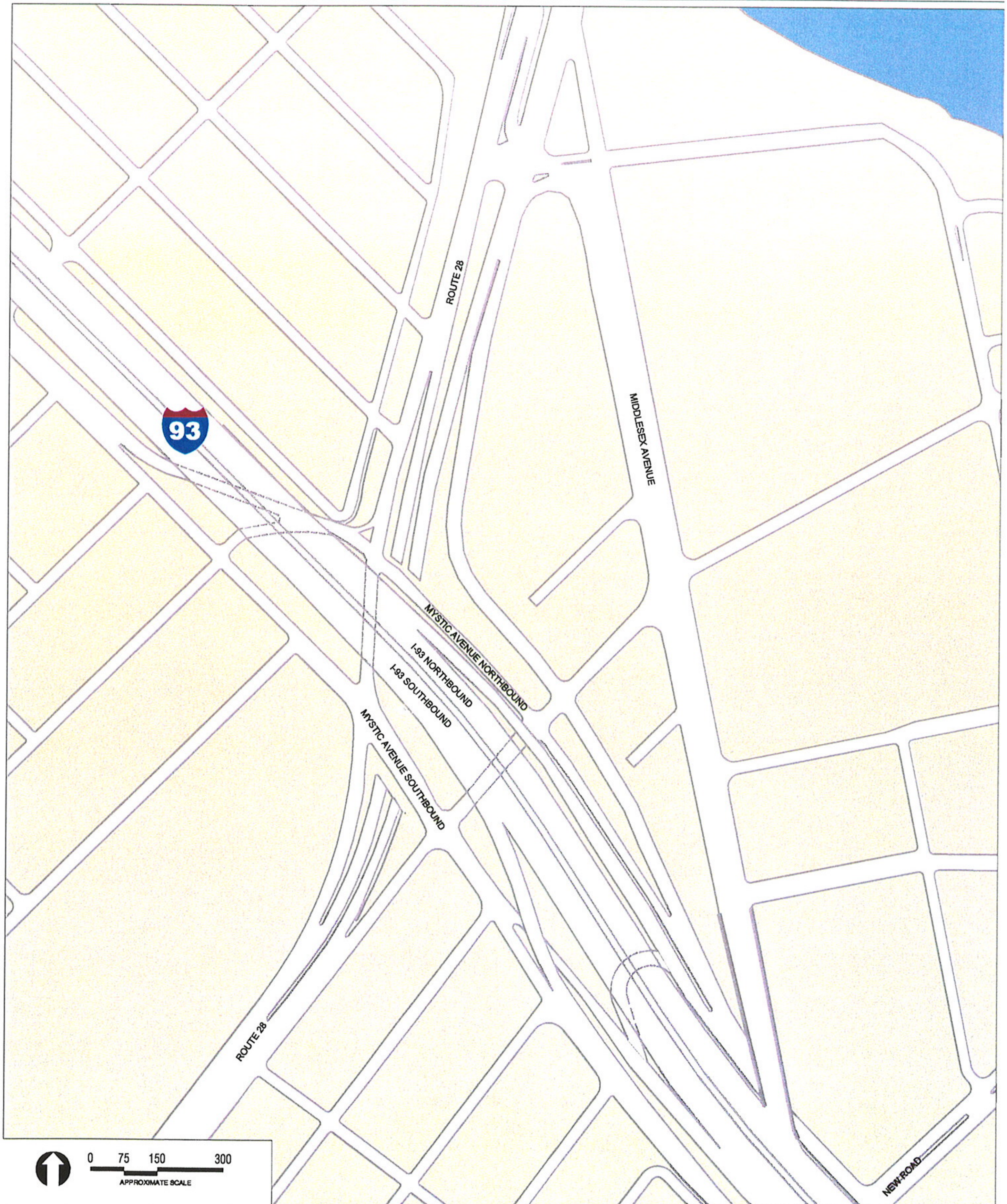


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

I-93 Northbound On-Ramp

Figure 3-21



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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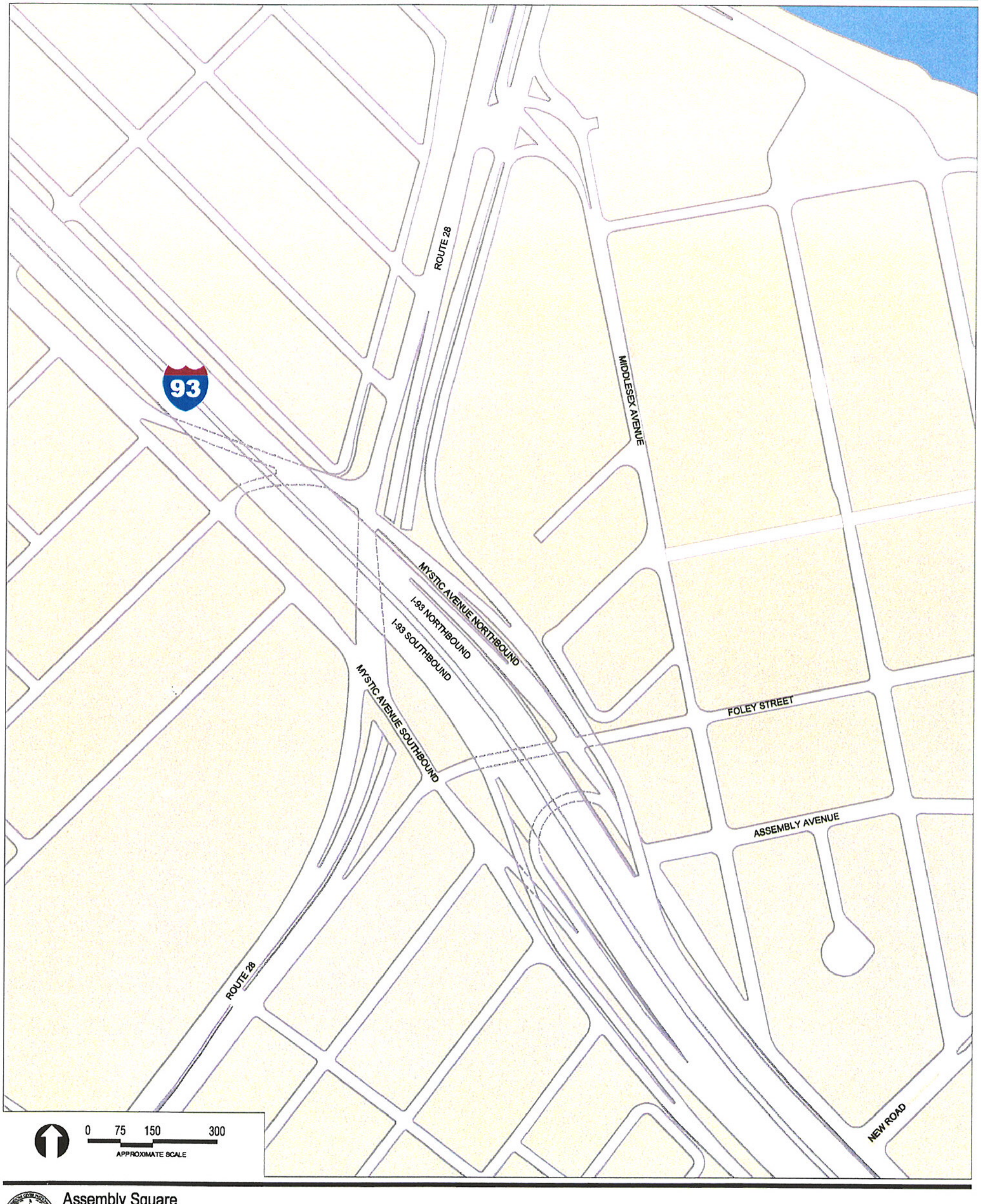
Preliminary Interchange Alternative A

Figure 3-22



Assembly Square Transportation Plan
Somerville, Massachusetts

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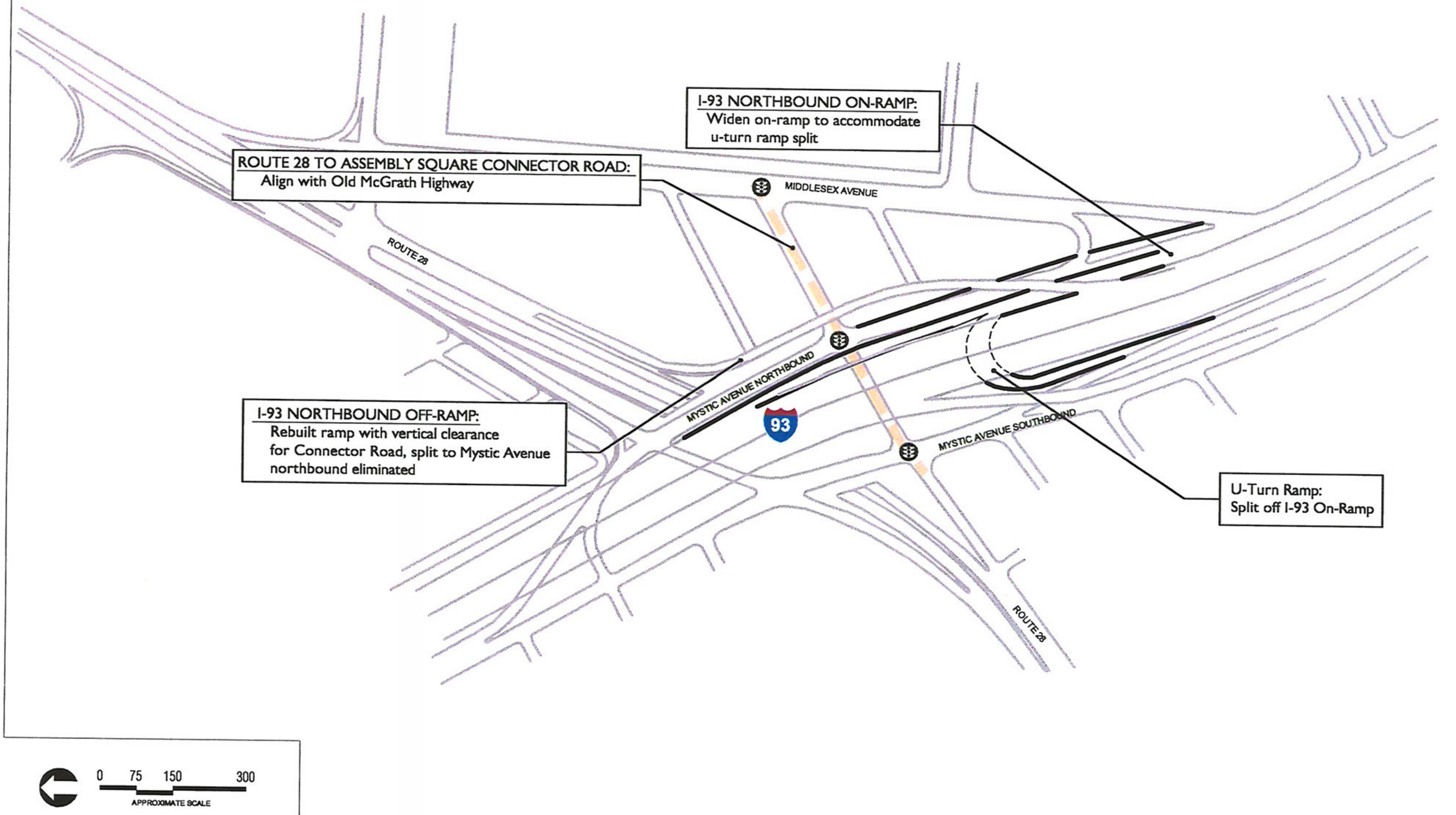
Preliminary Interchange Alternative B

Figure 3-23

8640_3-24_IntC



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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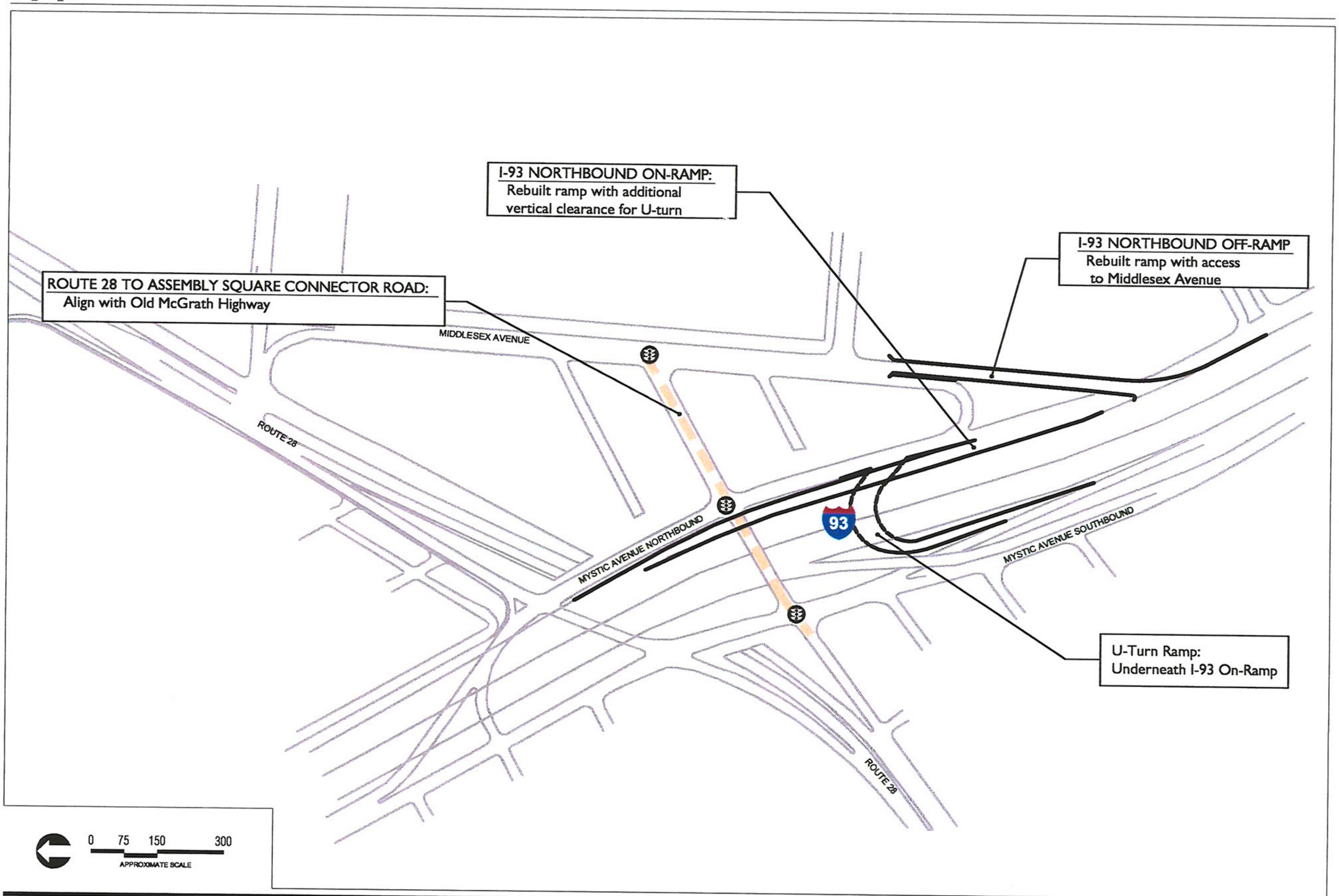
Interchange Alternative C

Figure 3-24

8640_3-25_IntD



Assembly Square Transportation Plan
Somerville, Massachusetts

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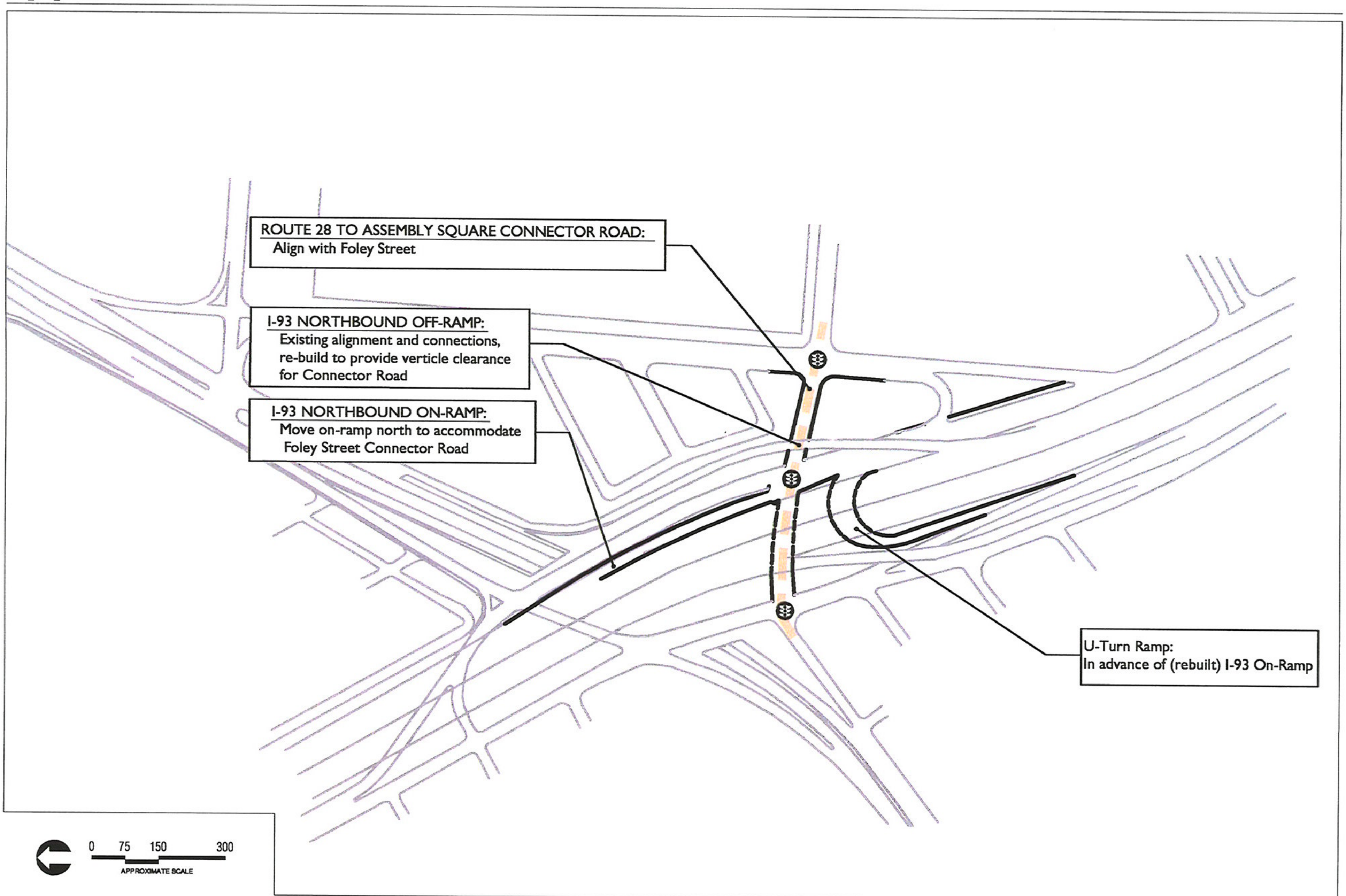
Interchange Alternative D

Figure 3-25



Assembly Square Transportation Plan
Somerville, Massachusetts

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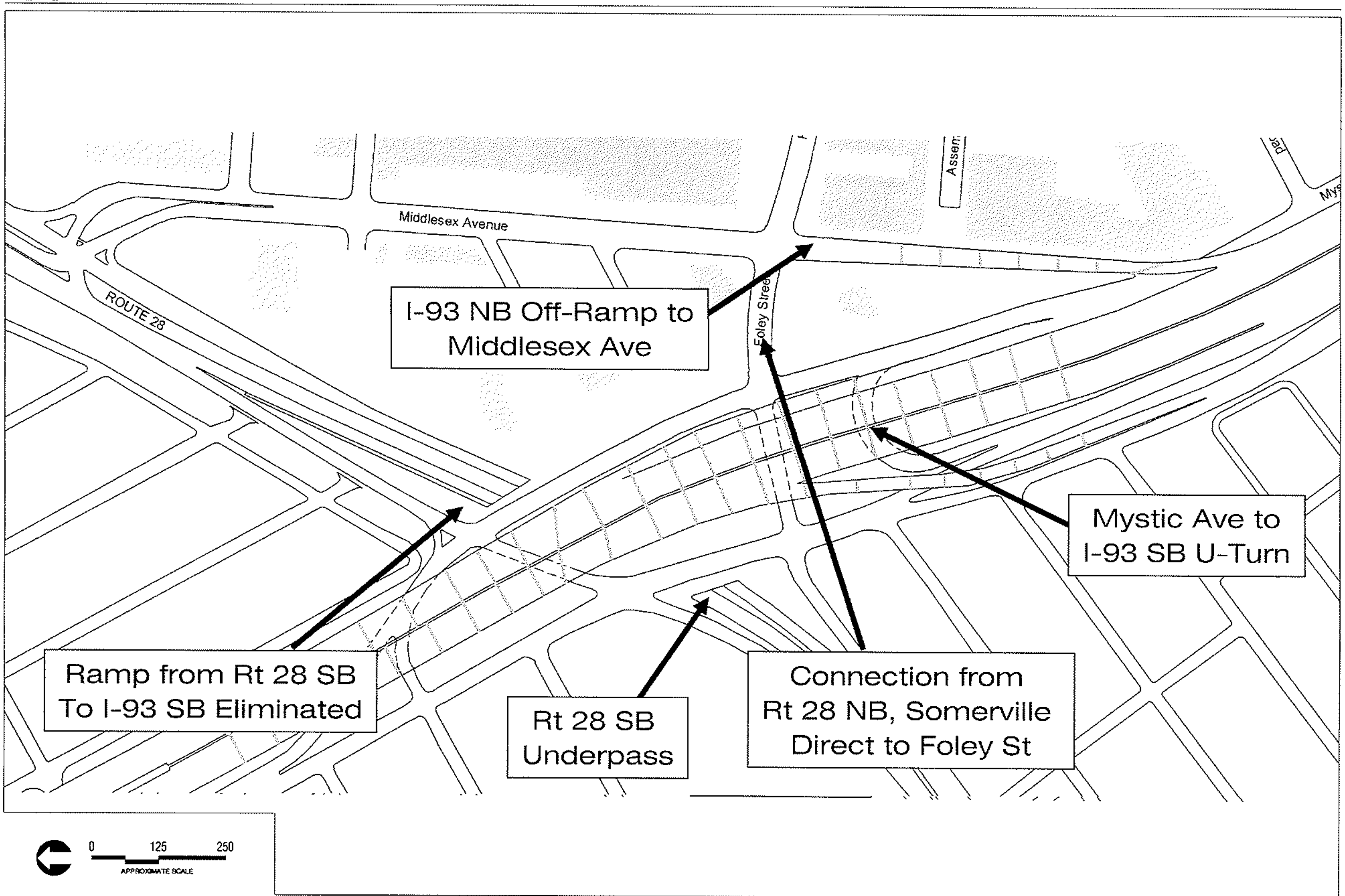
Interchange Alternative E

Figure 3-26

8640_3-27_28Alt1Alt2



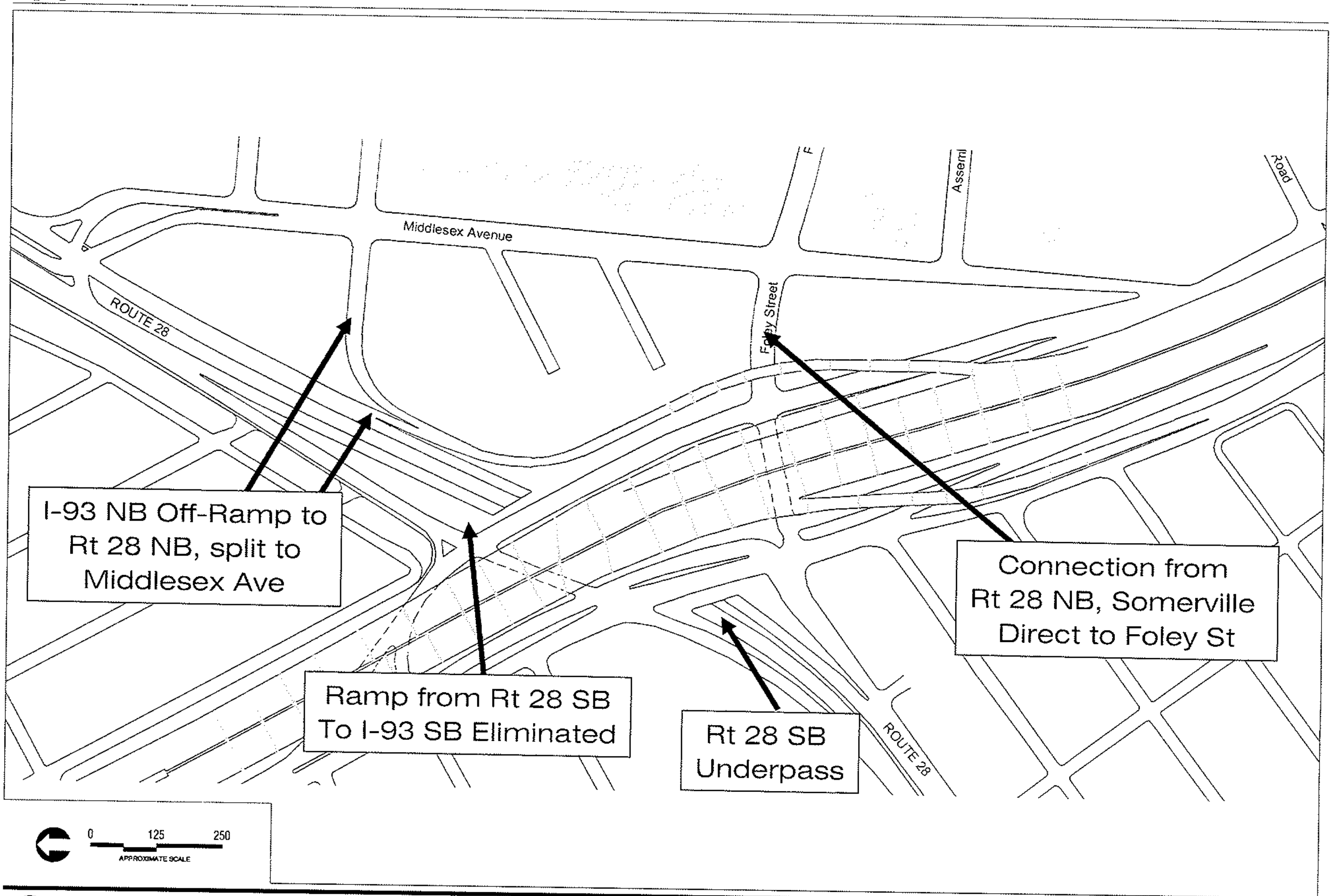
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Final Interchange
Alternative 1

Figure 3-27

8640_3-27_28Alt1Alt2



Assembly Square Transportation Plan
Somerville, Massachusetts

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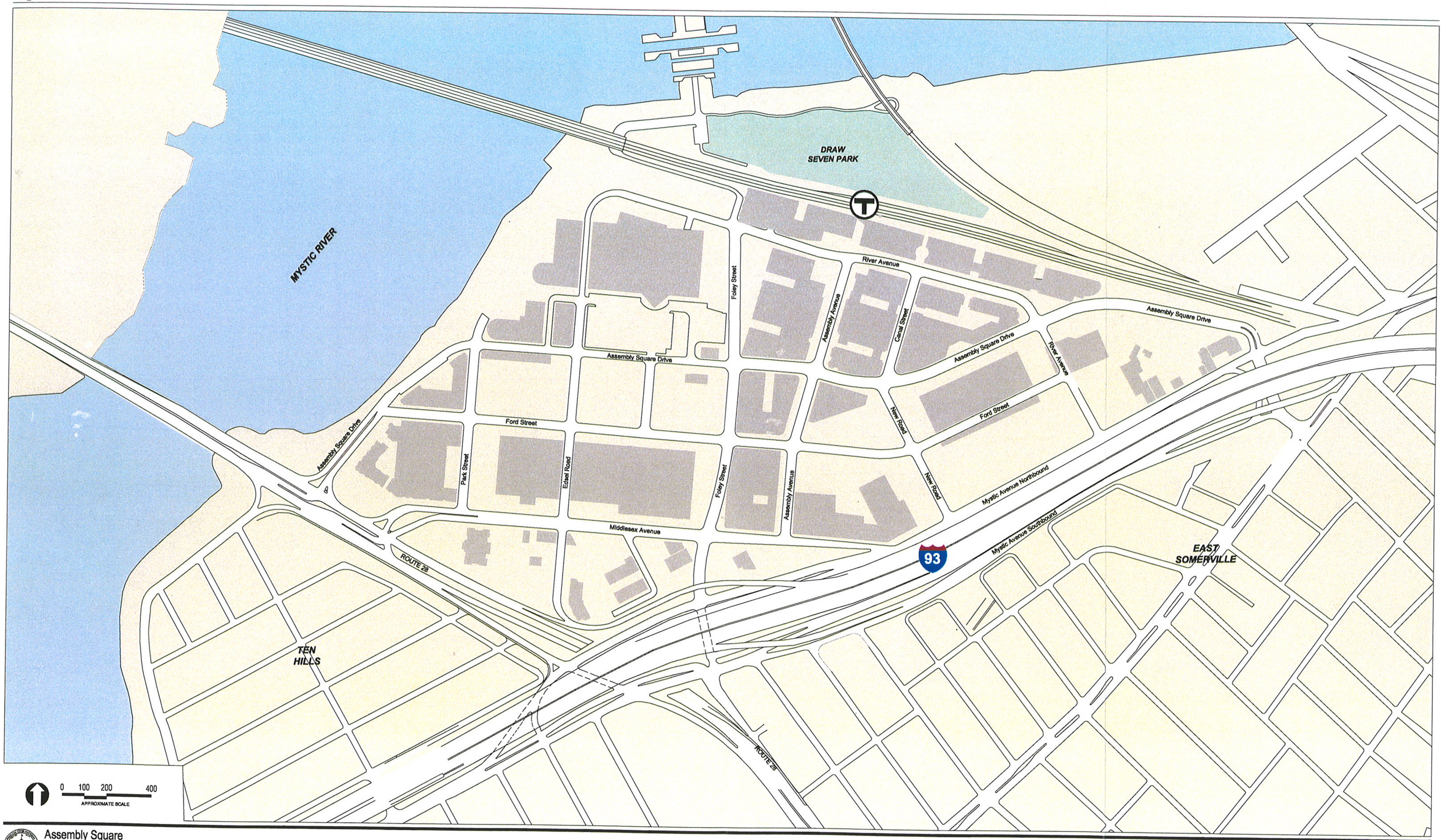
A TETRA TECH COMPANY

Final Interchange
Alternative 2

Figure 3-28

8640_03-29Alt1



Assembly Square Transportation Plan
Somerville, Massachusetts

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Roadway Plan
Alternative 1

Figure 3-29

8640_03-30Alt2

Assembly Square Transportation Plan
Somerville, Massachusetts

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Roadway Plan
Alternative 2

Figure 3-30

Assembly Square Transportation Plan
Somerville, Massachusetts

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Scenario 1
Existing Conditions

Figure 3-31

8640_3-32_Scen2

Assembly Square Transportation Plan
Somerville, Massachusetts

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Scenario 2 -- 2007

Figure 3-32

8640_3-33_Scen3

Assembly Square Transportation Plan
Somerville, Massachusetts

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Scenario 3
2025 Baseline

Figure 3-33

Assembly Square Transportation Plan
Somerville, Massachusetts

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Scenario 4
2025 Regional Improvements
Alternative A

Figure 3-34

Assembly Square Transportation Plan
Somerville, Massachusetts

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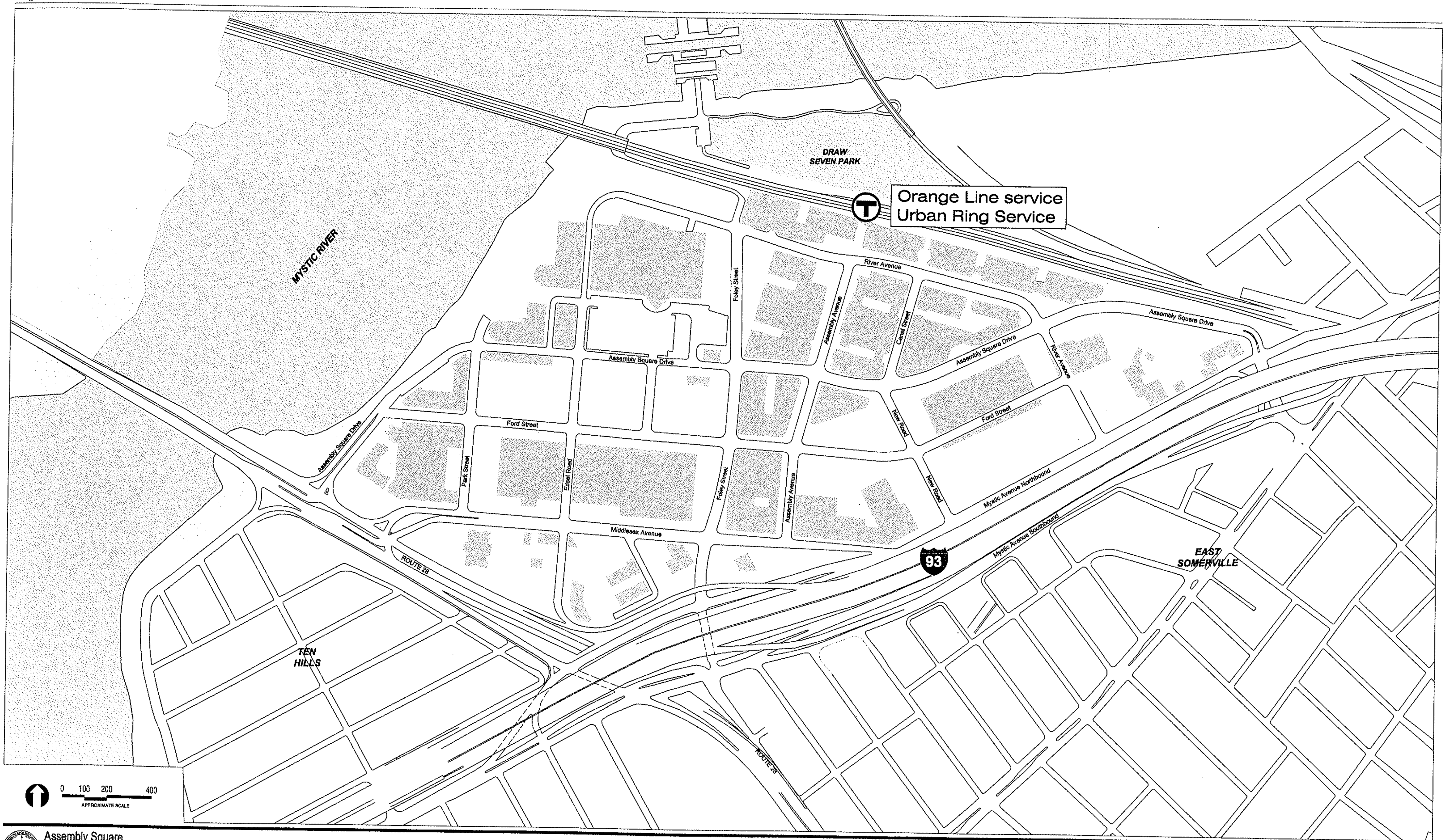
Scenario 4
2025 Regional Improvements
Alternative B

Figure 3-35

8640_03-36Scen6

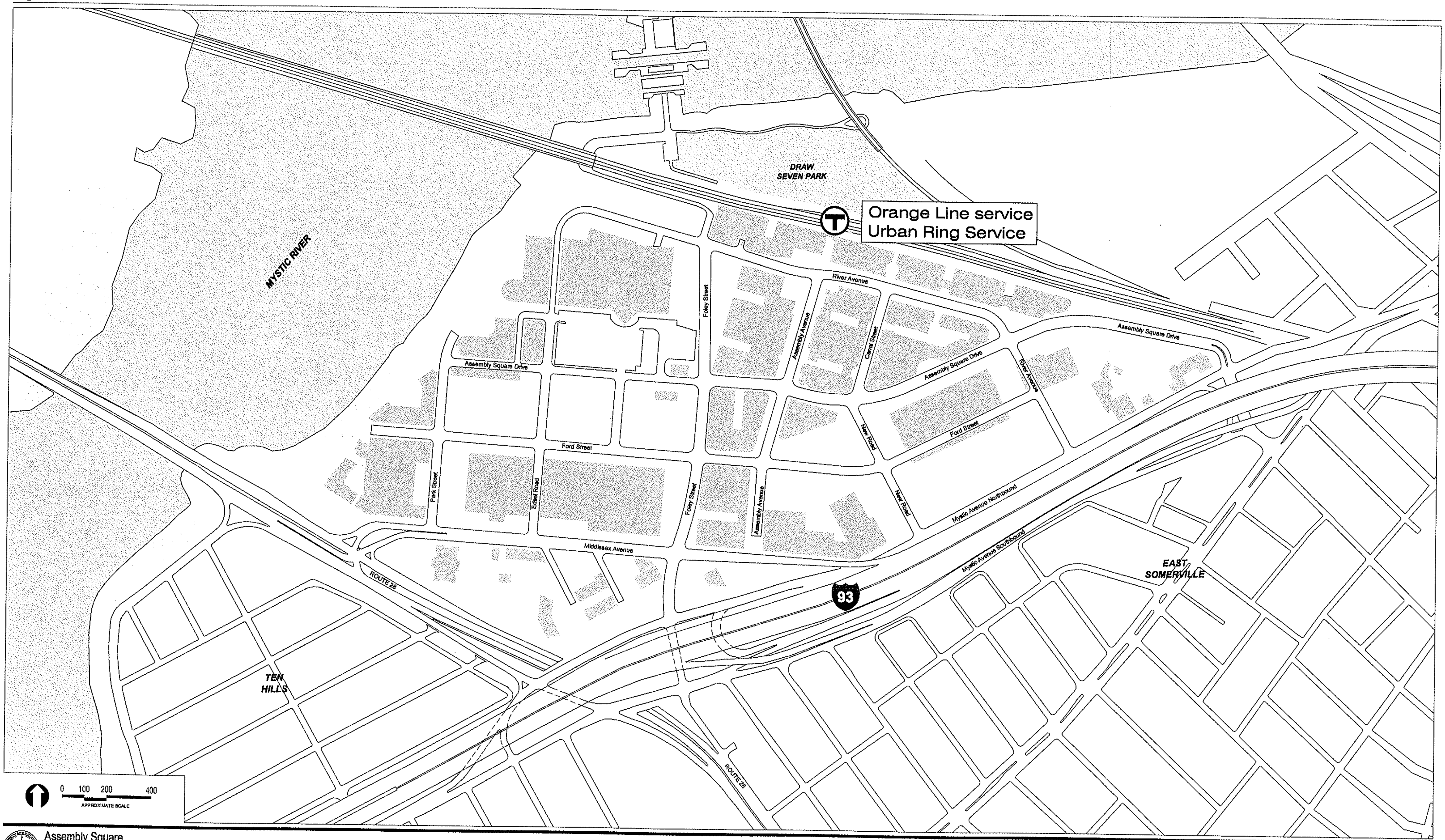


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Scenario 6
Final Plan
Alternative 1

Figure 3-36



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Scenario 7
Final Plan
Alternative 2

Figure 3-37

4.0 Alternatives Analysis Findings

The alternatives analysis yielded a considerable amount of information. This included data from the travel demand modeling of the seven land use – transportation improvement scenarios, assessment of the interchange reconstruction alternatives, and evaluation of the proposed internal street network from a traffic and urban design perspective. The following chapter summarizes the results and conclusions of the alternatives. It includes a discussion of the overall travel demand by transportation mode for the various scenarios,

4.1 Travel Demand and Mode Split

The travel demand forecasting model has the ability to determine the likely travel mode for Assembly Square travelers. This capability is referred to as a mode split model. A mode split model works principally from travel times. Basically, it is possible to walk or bike between any 2 points in the transportation system (excluding such roads as the interstate system for example). The mode split model works by first identifying travel routes for the walk, bicycle, and auto modes. Then the model looks at combined modes such as walk, bike or drive to transit. Some of these travel modes are then imposed caps. Such as for walking, any walking trip over 2.5 miles is usually disqualified by the model. Any transit trip where access time to transit, or the egress time from transit to a final destination is over 30 minutes is also disqualified. Transit trips with more than 3 transfers are also disqualified.

In the next step, the model assigns time equivalencies to each mode. The drive mode for example, has operating costs, parking costs, and a point to point travel time. The operating and parking costs are converted to time (based on area wages) and thus the auto mode has a certain overall time associated with it. Similarly, transit has an actual transit travel time as well as a fare that is converted to time and combined with the actual travel time to get an overall transit travel time. The mode split model will then examine each potential travel mode available to travel between origin and destination points. Based on a comparison of the overall travel times associated with each mode, and based on some mode bias considerations, the model will identify the most likely travel mode to use.

Based on the assumed land uses and the transportation network described above for the seven scenarios, the regional travel demand model projected the number of trips to and from Assembly Square that are expected during a typical weekday 24-hour period, as well as during the morning commuter peak hour and the afternoon commuter peak hour. After carefully reviewing the model output and making adjustments to the model to ensure appropriate results, the model produced the following travel demand projections in each travel mode.

Note that the travel demand by automobile is expressed in two ways: both by person-trips and by vehicle-trips. A person-trip is the basic unit of measure of travel demand, and corresponds to a single person making a trip by any given mode. For the purposes of assessing traffic volumes, it is important to understand not just how many people are traveling by automobile (person-trips), but also how many automobiles are on the roadway network (vehicle-trips). The number of vehicle-trips is a function of the number of people in each automobile, a factor known as vehicle occupancy rate (VOR), which varies by different land uses. In order to provide information for both overall trip demand and traffic volumes, Tables 4-1, 4-2 and 4-3 provide information on automobile travel in terms of both person-trips and vehicle-trips.

Table 4-1 Daily Person Trips by Mode for Each Scenario

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**650**	2%	**1,700**	2%	**34,900**	**26%**	**41,650**	**31%**	**42,750**	**32%**
Orange Line							26,330		27,050	
Urban Ring Rail							13,560		13,940	
Urban Ring BRT			560		32,330		560		560	
Bus	650		1,140		2,570		1,200		1,200	
Automobile	**32,650**	**95%**	**87,250**	**96%**	**93,550**	**71%**	**87,100**	**66%**	**85,900**	**65%**
Vehicle-Trips	20,950		56,700		61,450		56,925		56,390	
Walk/ Bike/ Other	**1,200**	**3%**	**1,650**	**2%**	**3,550**	**3%**	**3,950**	**3%**	**3,850**	**3%**
Total Person Trips	**34,500**		**90,600**		**132,000**		**132,700**		**132,500**	

Note: Scenarios 6 and 7 have identical land use to Scenarios 3, 4 and 5, and Scenarios 6 and 7 have a regional transportation system that will produce the same results as Scenarios 4 and 5.

Table 4-2 AM Peak Hour Person Trips by Mode for Each Scenario

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**20**	**1%**	**65**	**1%**	**1,875**	**19%**	**2,270**	**22%**	**2,420**	**24%**
Orange Line							1,420		1,540	
Urban Ring Rail							755		780	
Urban Ring BRT			20		1,745		30		30	
Bus	20		45		130		65		70	
Automobile	**1,875**	**97%**	**5,360**	**97%**	**7,760**	**79%**	**7,700**	**76%**	**7,600**	**75%**
Vehicle-Trips	1,205		3,480		5,095		5,040		4,985	
Walk/ Bike/ Other	**40**	**2%**	**75**	**1%**	**165**	**2%**	**180**	**2%**	**180**	**2%**
Total Person Trips	**1,935**		**5,500**		**9,800**		**10,150**		**10,200**	

Note: Scenarios 6 and 7 have identical land use to Scenarios 3, 4 and 5, and Scenarios 6 and 7 have a regional transportation system that will produce the same results as Scenarios 4 and 5.

Table 4-3 PM Peak Hour Person Trips by Mode for Each Scenario

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**70**	**2%**	**150**	**2%**	**3,630**	**24%**	**4,335**	**27%**	**4,550**	**28%**
Orange Line							2,740		2,865	
Urban Ring Rail							1,410		1,500	
Urban Ring BRT			50		3,360		60		60	
Bus	70		100		270		125		125	
Automobile	**3,030**	**95%**	**8,065**	**97%**	**11,430**	**74%**	**11,440**	**71%**	**11,330**	**70%**
Vehicle-Trips	1,950		5,240		7,510		7,475		7,440	
Walk/ Bike/ Other	**100**	**3%**	**135**	**2%**	**290**	**2%**	**325**	**2%**	**320**	**2%**
Total Person Trips	**3,200**		**8,350**		**15,350**		**16,100**		**16,200**	

Note: Scenarios 6 and 7 have identical land use to Scenarios 3, 4 and 5, and Scenarios 6 and 7 have a regional transportation system that will produce the same results as Scenarios 4 and 5.

The travel demand model results for total trips by mode are shown above for Scenarios 1 – 5. These are the scenarios that are designed to evaluate major changes in Assembly Square's regional travel demand levels, and regional travel demand mode choice:

- **Overall Travel Demand.** Scenarios 1 – 5 reflect major differences in overall travel demand, resulting from differences in land use in Assembly Square. Scenario 1 reflects existing land use conditions with a total of about 1.1 million square feet, Scenario 2 reflects the short-term development build-out with a total of about 4.6 million square feet, and Scenarios 3, 4 and 5 reflect the long-term full build-out of the district with a total of about 7.6 million square feet. These different levels of development result in major differences in total trips.

- **Regional Transportation System.** Scenarios 1 – 5 also reflect major differences in the regional transportation system. These differences are particularly critical in Scenarios 3, 4 and 5. Scenarios 3, 4 and 5 include the same land use program, and essentially the same overall travel demand. The differences in the model results among Scenarios 3, 4 and 5 are caused by the differences in the regional transportation network: Scenario 3 reflects a no-build "base case" for the regional transportation system, with no major Assembly Square-related improvements, while Scenarios 4 and 5 includes two different transportation improvement programs for Assembly Square. These three scenarios therefore allow a meaningful "apples-to-apples" comparison of the effects of the transportation system on Assembly Square access via the different travel modes.

Tables 4-1, 4-2 and 4-3 do not include the results from Scenarios 6 and 7. This is because the overall travel demand and trip totals by mode for Scenarios 6 and 7 do not change relative to Scenarios 4 / 5. The results of Scenarios 1 – 5 are used to identify Assembly Square's overall travel demand, and to assess the impacts of different *regional* transportation improvements. Based on the results of Scenarios 1 – 5, advantageous regional transportation improvements are identified and incorporated into Scenarios 6 and 7. Scenarios 6 and 7 have identical land use to Scenarios 3, 4 and 5, and Scenarios 6 and 7 have a regional transportation system that will produce the same results as Scenarios 4 and 5, respectively.

The results from Scenarios 3, 4 and 5 show that the regional transportation improvements proposed in Scenarios 4 and 5 have a significant impact on the mode split, or the relative distribution of trips among the various modes. The improvements in Scenarios 4 and 5 are even more significant when the transit system capacity constraints are taken into account, as described below in Section 4.2.

However, Tables 4-1, 4-2 and 4-3 show that Scenarios 4 and 5 have trip totals and mode splits that are almost identical. This means that even though the specific regional improvements proposed in Scenarios 4 and 5 vary significantly, the effectiveness of these different alternatives at satisfying travel demand is comparable. Since Scenarios 6 and 7 will include regional transportation system improvements that are selected from among the alternatives included in Scenarios 4 and 5, then the travel demand and mode splits for Scenarios 6 and 7 should be essentially the same as Scenarios 4 and 5.

The following sections summarize the results of the alternatives analysis, specific to each of the travel modes: public transportation, pedestrian and bicycle, and motor vehicle.

4.2 Public Transportation

The regional travel demand modeling results in Tables 4-1, 4-2 and 4-3 demonstrate the public transit ridership projections and impacts of an Orange Line station, an Urban Ring rail station, Urban Ring bus rapid transit (BRT) service, and continued Massachusetts Bay Transportation Authority (MBTA) bus service.

The regional modeling assessed both heavy rail and light rail Urban Ring alternatives, but the model results for the two different rail technologies were virtually the same owing to the comparable connections and service characteristics that they provide. Therefore, given the general and regional nature of the transportation plan's modeling, the model results indicate no significant difference between heavy rail and light rail for the Urban Ring rail service. Therefore, the transportation plan's assessment of the Urban Ring rail service will consider that service in a generic manner, and will not distinguish between light rail and heavy rail.

In the regional travel demand model, public transportation ridership is dependent upon parking constraints at Assembly Square. In early model runs without parking constraints, public transit ridership was lower than what is shown in Tables 4-1, 4-2 and 4-3, and automobile mode share was higher. Subsequent model runs with constrained parking resulted in higher transit ridership and mode share.

However, the travel demand model results in Tables 4-1, 4-2 and 4-3 reflect a public transit system whose capacity was unconstrained. It is important to ensure that the transit mode share is not higher than feasible, and that the traffic and parking assumptions are not too low. Therefore, the model results for transit capacity and feasible ridership have been reviewed, and the extra "unmet" transit demand has been diverted back to the motor vehicle mode.

In order to develop an appropriate estimate of transit ridership and mode share, the model results for public transit ridership in the future "build" scenarios (Scenarios 4 and 5) were compared to the transit line capacity in order to ensure that adequate capacity is available. The projected transit ridership at Assembly Square was then compared to ridership at other transit stations in the MBTA system to assess whether the projected ridership is realistic, as well as possible from a capacity perspective. Finally, the transit ridership projections were revised based on these comparisons and the extra "unmet" transit demand was added to the motor vehicle mode.

4.2.1 Transit Capacity

In assessing projected transit demand versus transit capacity, the critical measure should be the peak hour of demand. Since the PM peak hour transit demand is projected to be approximately twice the AM peak hour transit demand, the transit demand versus capacity analysis has been based on the PM peak hour demand, which represents the "worst-case" in terms of Assembly Square transit demand.

In order to execute this more detailed assessment of public transit ridership at Assembly Square, some consistent patterns in the public transit ridership projections were employed. In each of the 2025 future scenarios, the PM peak hour transit ridership is approximately 10% of the daily transit ridership, both in terms of overall transit ridership and in terms of the individual transit modes. The PM peak hour transit ridership is also approximately twice the projected AM peak hour transit ridership, again for total transit ridership as well as for the individual transit modes. We assume that these patterns are representative of the Assembly Square travel demand behavior. In re-evaluating the transit ridership projections, these basic proportions will be maintained.

Bus

Scenario 3, the 2025 future base case, has projected transit ridership that is appears overstated. The 90, 92, and 95 MBTA bus routes currently serve Assembly Square. Between these three routes, under existing conditions, approximately 20 buses per hour serve Assembly Square (10 buses per hour inbound, 10 buses per hour outbound). With a 60 passengers per bus maximum capacity, these buses provide a total capacity of 1,200 passengers per hour. In Scenario 3, the projected bus ridership boarding or deboarding at Assembly Square during the PM peak hour is 271 passengers, or approximately 23% of the total capacity. This appears to be a feasible projection, so the bus ridership projections for Scenario 3 are acceptable. The bus ridership projections for Scenarios 4 and 5, which include an Orange Line station at Assembly Square and Urban Ring rail service, are actually lower than the Scenario 3 bus ridership projections (lower by about half). Therefore, the bus ridership projections for Scenarios 4 and 5 are acceptable as well.

Urban Ring Bus Rapid Transit

The Scenario 3 Urban Ring Bus Rapid Transit (BRT) projections appear to be excessive at 32,330 daily riders, 1,745 AM peak hour riders and 3,362 PM peak hour riders. With a 100 passengers per vehicle (for 60-foot articulated buses) maximum capacity and 10 minute peak hour headways in each direction, the Urban Ring BRT1 route through Assembly Square would provide a peak hour capacity of 1,200 passengers. Assuming that there is high turnover at Assembly Square (many boarding passengers replacing deboarding passengers), a densely developed Assembly Square could arguably capture as many as 600 passengers during a peak hour. Since the PM peak hour is consistently the highest, worst-case travel period, it is assumed that this peak demand is during the PM peak hour. Assuming consistent proportions of peak hour and daily ridership, this would result in 6,000 daily Urban Ring BRT riders served at Assembly Square, 300 AM peak hour riders, and 600 PM peak hour riders.

Although this 600 Assembly Square-related passengers could account for 50% of the 1,200 peak hour passenger capacity, this would only be the case if all the passengers were traveling in the peak direction, through the same point. In addition, all 600 passengers would have to board OR deboard. A more likely situation would result in some of these 600 passengers boarding, some deboarding, some traveling in the peak direction, and some traveling in the opposite-to-peak direction. The model's Scenario 3 BRT ridership projections in excess of these levels can be assumed to be "unmet transit demand." Scenarios 4 and 5 have projected Urban Ring BRT ridership levels significantly lower than the assumed maximum, and if anything may be somewhat low. Therefore, it is assumed that the Urban Ring BRT ridership projections for Scenarios 4 and 5 are achievable. BRT ridership in Scenarios 4 and 5 will most likely be higher than that included in the model results; however, no basis for increasing the BRT ridership is available, so the BRT ridership numbers were left at their lower, conservative level.

Scenarios 4 and 5 both include an Orange Line station at Assembly Square and Urban Ring rail service to Assembly Square. Scenario 4 assumes Urban Ring heavy rail service, and Scenario 5 assumes Urban Ring light rail service, though both alternatives provide comparable connections and service characteristics. The model projections for ridership on each transit mode are virtually the same for Scenarios 4 and 5, so the distinctions between these two scenarios are not significant with respect to transit.

Orange Line

The Assembly Square Orange Line ridership projections for Scenarios 4 and 5 are consistent with the Orange Line capacity. Based on the MBTA's 1997 ridership counts, the Orange Line north of downtown experiences its peak load in the vicinity of Haymarket Station, and the peak passenger load is southbound in the AM peak hour and northbound in the PM peak hour. Table 4-4 shows the peak load counts, the Orange Line capacity, and projections for future Orange Line capacity and peak load demand. The increase in Orange Line capacity is based upon the increased service frequency that will be possible with the completion of the ongoing Orange Line Re-Signaling Project, which would allow 3-4 minute peak hour headways, instead of the current 5 minute headways. It is assumed that base ridership would grow by 1% per year over the 28 years between 1997 and 2025.

Table 4-4 Orange Line Capacity and Demand

	Baseline – 1997	Future No-Build – 2025	Future Build – 2025
Cars per train	6	6	6
Capacity (passengers / car)	130	130	130
Headway (minutes)	5	3.5	3.5
Frequency (trains / hour)	12	17	17
Capacity (passengers / hour)	9,360	13,371	13,371
Assembly Square Boardings / Deboardings			
AM peak hour	--	--	1,600
PM peak hour	--	--	2,800
Peak Hour Demand at Peak Load Point			
AM (southbound, North Station to Haymarket)	8,663	11,446	13,046
PM (northbound, State Street to Haymarket)	7,532	9,952	12,752

Peak Hour V/C Ratio at Peak Load Point			
AM peak hour	0.93	0.86	0.98
PM peak hour	0.80	0.74	0.95

The model predicts that there would be approximately 1,600 Orange Line boardings and deboardings at Assembly Square during the AM peak hour, and approximately 2,800 during the PM peak hour. To provide an extremely conservative analysis, it was assumed that *all* of the Assembly Square related Orange Line riders would travel in the peak demand direction, through the peak load point. In fact, some of these riders would be traveling in the opposite-to-peak direction, some would be boarding after the peak load point, some would be deboarding prior to the peak load point, and some would be traveling along the segment of the Orange Line north of Assembly Square, where the ridership does not approach the peak load level experienced in the downtown section.

Table 4-4 demonstrates that even with this very conservative assumption, the Orange Line could support all of the Assembly Square-related riders. Therefore, Orange Line capacity does not indicate that the model's projections for Orange Line ridership at Assembly Square should be reduced.

Urban Ring Rail

A similar evaluation should also be performed for the model's Urban Ring projections. Although there are naturally no existing Urban Ring ridership counts, the projected demand for Assembly Square-related riders can be compared to the Urban Ring rail line capacity. The potential demand associated with the projected Assembly Square-related Urban Ring rail ridership is shown in Table 4-5.

Table 4-5 Urban Ring Rail Capacity and Demand

	Future Build – Light Rail - 2025	Future Build – Heavy Rail - 2025
Cars per train	2	6
Capacity (passengers / car)	120	130
Headway (minutes)	5.0	4.0
Frequency (trains / hour)	12	15
Capacity (passengers / hour)	2,880	11,700
Assembly Square Boardings / Deboardings		

AM peak hour	800	800
PM peak hour	1,500	1,500
Peak Hour Demand by Assembly Square Riders		
AM peak hour	0.28	0.07
PM peak hour	0.52	0.13

The model predicts that Assembly Square would generate approximately 800 AM peak hour Urban Ring rail riders and 1,500 PM peak hour riders. The two Urban Ring rail alternatives, heavy rail and light rail, would each have different line capacities, although they would provide similar connections and service characteristics. The Urban Ring light rail alternative operating at 5-minute headways would provide lower rider capacity than the Urban Ring heavy rail alternative operating at 4-minute headways, although the Urban Ring light rail alternative serving Assembly Square would be only one of two branch lines.

The analysis in Table 4-5 is extremely conservative, because like the Orange Line assessment of demand to capacity, it assumes all Assembly Square-related riders are traveling in the same direction past the same point. In fact, the Assembly Square-related ridership would consist of boarding and deboarding riders traveling in different directions. Even so, the Assembly Square demand for the Urban Ring heavy rail is only 7% of capacity in the AM peak hour, and only 13% of capacity in the PM peak hour. The Assembly Square demand for the Urban Ring light rail is 28% of capacity in the AM peak hour and 52% in the PM peak hour. Although this represents a very high proportion of the light rail capacity, Assembly Square is located at the terminus of the Urban Ring light rail line, all of the Urban Ring light rail capacity would conceivably be available for Assembly Square riders. Therefore, the Assembly Square demand for the Urban Ring rail service, both heavy rail and light rail, is feasible from a capacity perspective.

This transit system capacity analysis has demonstrated that the model's transit projections for Scenarios 4 and 5 are possible, from the perspective of a strict accounting of transit line capacity in each major transit mode. The projections for Scenario 3 are best characterized as "unmet transit demand." However, the transit line capacity analysis is more suited for showing what is theoretically possible, not the transit ridership levels that are likely at Assembly Square.

4.2.2 Comparative Transit Station Boardings

In order to evaluate the feasibility and reasonability of the model's projections of public transit ridership, it is desirable to assess not only the potential maximum limit represented by the transit line capacity, but also the likely ridership levels at Assembly Square. One method of assessing the likely transit ridership at Assembly Square is by identifying actual boarding counts at other transit stations with comparable service situations.

The following are some of the salient features that are expected to characterize Assembly Square in the 2025 Build condition.

- Dense development patterns, with a total of approximately 7 million square feet of land use
- Principally office / research & development land uses, with significant components of residential, retail and entertainment
- Location outside Boston's downtown central business district, but still within the metropolitan core, in an area that has very dense population, development patterns, and infrastructure
- Rapid transit connections via two rail lines (the Orange Line and the Urban Ring) that provide distinct connections

Table 4-6 provides a summary of the total daily boardings at selected MBTA rapid transit stations. This listing includes all the Red Line, Orange Line, and Green Line stations to the north of downtown Boston. It is important to note that the MBTA data is based on 1995 counts of rapid transit station entries, and it is for boardings only. The Assembly Square modeling results are for total transit trips / operations, i.e. at a given station like Assembly Square, the model provides total boardings *and* deboardings. Assuming that as a general rule, every boarding at a given MBTA station is paired with a deboarding for the return trip, the MBTA data should be doubled to enable a direct comparison with the model results.

Table 4-6 MBTA Rapid Transit Station Boardings

	Boardings (passengers per day)
Red Line	
Kendall Square	11,219
Central Square	11,735
Harvard Square	20,210
Porter Square	7,355

Davis Square	10,695
Alewife Station	9,409
Orange Line	
Community College	3,648
Sullivan Square	8,667
Wellington Station	7,010
Malden Station	10,335
Oak Grove Station	4,791
Green Line	
Science Park	1,358
Lechmere	5,363

Although the proposal at Assembly Square is for an Orange Line station, it could be argued that the Red Line stations to the north of Boston offer better comparative situations for an Assembly Square Orange Line station than the Orange Line stations north of Boston. The Orange Line stations north of Boston are relatively remote from surrounding land uses, and are not surrounded by the type of development (like work-related office / R&D) that would attract significant transit ridership.

The Red Line stations north of Boston, however, are surrounded by fairly dense development. At most of these stations, the land uses tend to be a mix of residential and commercial. Kendall Square, in particular, may present a useful comparative case for Assembly Square. The Kendall Square station is located at Kendall Square in East Cambridge, which shares several characteristics with the anticipated Assembly Square future condition. These characteristics include a concentration of office / research & development destinations, some adjacent residential areas, and a location near downtown Boston.

The Kendall Square / East Cambridge area is also served by a second rapid transit line, another feature that makes it comparable to the proposed future condition at Assembly Square. Lechmere Station is located at the northern terminus of the Green Line, which provides transit connections for the Kendall Square / East Cambridge area that are different from those provided by the Red Line. Although Lechmere Station is approximately ¾-mile away from Kendall Square station on the Red Line, the two stations serve a similar market area. This is especially true for Lechmere Station, since most of its trips are generated from the commercial and residential neighborhood to its southwest, in the direction of Kendall Square. To the northeast of Lechmere Station is industrial land, rail yards, and the I-93 viaduct, none of which generate significant transit demand.

It is therefore assumed that the Kendall Square / East Cambridge area can serve as a comparable transit service area for a full-build Assembly Square, at least for the sake of identifying the maximum transit ridership that the Orange Line and the Urban Ring rail are likely to achieve at Assembly Square. Daily boardings at the Kendall Square Red Line station are 11,219, and daily boardings at the Lechmere Green Line station are 5,383. Rounding these boardings down to the nearest thousand, it is assumed that total daily transit ridership at Assembly Square could be 22,000 (= 2 x 11,000) via the Orange Line and 10,000 (= 2 x 5,000) via the Urban Ring rail.

Assuming consistent ridership patterns in the AM and PM peak hours, the AM peak hour ridership could be 1,100 on the Orange Line and 500 on the Urban Ring, and the PM peak hour ridership could be 2,200 on the Orange Line and 1,000 on the Urban Ring. Tables 4-7, 4-8 and 4-9 summarize the daily, AM peak hour, and PM peak hour travel demand, by mode, for each scenario, corrected to account for transit capacity limitations and likely station ridership based on comparable transit station demand.

Table 4-7 Daily Trips by Mode for Each Scenario, Adjusted

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**650**	**2%**	**1,700**	**2%**	**8,570**	**6%**	**33,760**	**25%**	**33,760**	**25%**
Orange Line							22,000		22,000	
Urban Ring Rail							10,000		10,000	
Urban Ring BRT			560		6,000		560		560	
Bus	650		1,140		2,570		1,200		1,200	
Automobile	**32,650**	**95%**	**87,250**	**96%**	**93,550**	**71%**	**87,100**	**66%**	**85,900**	**65%**
Vehicle-Trips	20,950		56,700		61,450		56,926		56,390	
Walk/ Bike/ Other	**1,200**	**3%**	**1,650**	**2%**	**3,560**	**3%**	**3,950**	**3%**	**3,850**	**3%**
Unmet Transit Demand					**26,330**	**20%**	**7,890**	**6%**	**8,990**	**7%**
Total Person Trips	**34,526**		**90,600**		**132,000**		**132,700**		**132,500**	

The trips displaced from the transit modes are assumed to be diverted back to the motor vehicle mode. These trips are assumed to have an average vehicle occupancy rate (VOR) of approximately 1.5, which is consistent with the overall average VOR for Assembly Square in the future full-build condition.

Table 4-8 AM Peak Hour Person Trips by Mode for Each Scenario, Adjusted

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**20**	**1%**	**65**	**1%**	**425**	**4%**	**1,695**	**17%**	**1,700**	**17%**
Orange Line							1,100		1,100	
Urban Ring Rail							500		500	
Urban Ring BRT			20		300		30		30	
Bus	20		45		125		65		70	
Automobile	**1,875**	**97%**	**5,360**	**97%**	**7,760**	**79%**	**7,700**	**76%**	**7,600**	**75%**
Vehicle-Trips	1,205		3,480		5,095		5,040		4,985	
Walk/ Bike/ Other	**40**	**2%**	**75**	**1%**	**165**	**2%**	**180**	**2%**	**180**	**2%**
Unmet Demand					**1,450**	**15%**	**575**	**6%**	**720**	**7%**
Total Person Trips	**1,935**		**5,500**		**9,800**		**10,150**		**10,200**	

Table 4-9 PM Peak Hour Trips by Mode for Each Scenario, Adjusted

Mode	Scenario 1: 2002 Existing		Scenario 2: 2007 Short Term		Scenario 3: 2025 Long Term Base Case / No-Build		Scenario 4: 2025 Long Term Regional Improvements Alternative A		Scenario 5: 2025 Long Term Regional Improvements Alternative B	
	# Trips	%	# Trips	%	# Trips	%	# Trips	%	# Trips	%
Public Transit	**70**	**2%**	**150**	**2%**	**870**	**6%**	**3,385**	**21%**	**3,385**	**21%**
Orange Line							2,200		2,200	
Urban Ring Rail							1,000		1,000	
Urban Ring BRT			50		600		60		60	
Bus	70		100		270		125		125	
Automobile	**3,030**	**95%**	**8,065**	**97%**	**11,430**	**74%**	**11,440**	**71%**	**11,330**	**70%**
Vehicle-Trips	1,950		5,240		7,510		7,475		7,440	
Walk/ Bike/ Other	**100**	**3%**	**135**	**2%**	**290**	**2%**	**325**	**2%**	**320**	**2%**
Unmet Demand					**2,760**	**18%**	**950**	**6%**	**1,165**	**7%**

Total Person Trips	**3,200**	**8,350**	**15,350**	**16,100**	**16,200**

The preferred public transportation alternative includes both an Orange Line station and Urban Ring rail station at Assembly Square. As the analysis above shows, the differences in the model results between Scenario 4 (Orange Line station and Urban Ring heavy rail) and Scenario 5 (Orange Line station and Urban Ring light rail) are negligible with respect to public transit ridership. Therefore, Table 4-10 summarizes the future full-build travel demand by mode for the preferred regional improvement, adjusted to reflect public transit capacity and achievable station boarding projections.

Table 4-10 Travel by Mode, Future Build Preferred Regional Improvements (2025 Long-Term)

	Daily Trips		AM Peak Hour Trips		PM Peak Hour Trips	
	# Trips	%	# Trips	%	# Trips	%
Public Transit	**33,760**	**25%**	**1,700**	**17%**	**3,385**	**21%**
Orange Line	22,000		1,100		2,200	
Urban Ring Rail	10,000		500		1,000	
Urban Ring BRT	560		30		60	
Bus	1,200		70		125	
Automobile	**94,890**	**72%**	**8,320**	**82%**	**12,495**	**77%**
Vehicle-Trips	62,390		5,475		8,215	
Walk/ Bike/ Other	**3,850**	**3%**	**180**	**2%**	**320**	**2%**
Total Person Trips	**132,500**		**10,200**		**16,200**	

4.3 Pedestrian and Bicycle

The Assembly Square Transportation Plan is intended to recommend important pedestrian and bicycle improvements. As described above in Section 3.5, these improvements will entail better external gateway connections at Assembly Square's boundaries, connections to and through Assembly Square's green spaces, and better pedestrian and bicycle accommodation on Assembly Square's internal street system.

The transportation plan recommends that pedestrian and bicycle conditions and access be enhanced to the degree possible given the constraints of the transportation system, the geography, and the recommended improvements in other modes. Therefore, the transportation plan's alternatives analysis does not present sharp distinctions between alternatives for pedestrians and bicycles. Each alternative is designed to accommodate pedestrians and bicycles to the greatest degree possible. From a pedestrian and bicycle access perspective, the improvement alternatives are all fairly similar.

The quantitative model results bear out the similarity between the alternatives. The model results show a 3% daily pedestrian / bicycle mode share, and a 2% pedestrian / bicycle mode share during peak hours. Because it is regional in scope and emphasis, the travel demand model should not be expected to be highly accurate or sensitive to pedestrian and bicycle travel. More important than the model results is identifying the important external connections and developing an internal street plan that is the most conducive and inviting for pedestrians and bicycles. These measures are discussed in Section 5.2.

4.4 Motor Vehicle

The regional modeling analysis in Scenarios 1 – 5 was used to develop two final roadway plan alternatives for testing in Scenarios 6 and 7. These final roadway plan alternatives combine the regional highway interchange changes with internal street network improvements to create two cohesive overall roadway plans. These plans were then tested with the regional travel demand model, and the resulting traffic volumes provided by the travel demand model were analyzed to evaluate the traffic operations at the study area intersections. The following is a summary of the analysis of the final roadway plans, from the perspective of regional connections and internal street network improvements.

4.4.1 Regional Connections

As described in section 3.6, the analysis of the interchange improvements has included an evaluation of a total of seven combinations of interchange components. The preliminary evaluation of the first five interchange options, designated as Interchange Alternatives A – E, was based on the degree to which they satisfy the study's goals and objectives, as well as on traffic safety characteristics and physical feasibility.

This preliminary evaluation, described in detail in section 3.6, produced two final alternatives for the interchange redesign. These two final alternatives include the most promising and advantageous elements of the interchange redesign. The following is a description of the two alternatives, their benefits with respect to the study goals and objectives, and their disadvantages.

The two final alternatives have been designated as Alternative 1 and Alternative 2. The two alternatives share many similarities; their defining differences are the configuration of the I-93 northbound off-ramp, and the connection from Assembly Square to the I-93 southbound on-ramp. Due to these differences, they have also been given names based on the characteristics of the I-93 northbound off-ramp included in each alternative.

Final Alternative 1: I-93 Off-Ramp to Route 28 Northbound

Alternative 1 is shown in Figure 4-1. Table 4-11 presents the principal features of Alternative 1, which are discussed below.

Table 4-11 Principal Features of Alternative 1

Features	Comment
Route 28 Northbound to Assembly Square Connector Road (a.k.a. Foley Street Extension)	Aligned with Foley Street Passes between I-93 viaduct columns, does not require relocation of sewage pumping station
Rebuilt I-93 Northbound Off-Ramp	Must be rebuilt to provide vertical clearance over Foley Street Extension I-93 northbound off-ramp splits to provide connections to • Route 28 northbound (no right turn onto Middlesex Avenue) • Middlesex Avenue o Assembly Square o Route 28 southbound (via Middlesex Avenue northbound) o Mystic Avenue / Ten Hills (via Middlesex Avenue southbound to Foley Street Extension or via Middlesex Avenue northbound to Route 28 southbound)
Route 28 Southbound Underpass	Reduces congestion at Mystic Avenue intersections
Elimination of Redundant Route 28 Southbound to I-93 Southbound Ramp	Reduces conflicts and confusion at intersection of Route 28 southbound / Mystic Avenue northbound Facilitates elimination of weave between I-93 southbound on-ramp traffic and Route 28 southbound to Mystic Avenue southbound traffic
Connection from Assembly Square to I-93 Southbound On-Ramp Via Foley Street Extension	Foley Street Extension is two-way, providing access to the I-93 southbound on-ramp
Retention of Two-Way Segment of Mystic Avenue North of Foley	Necessary to satisfy traffic demand from Route 28 northbound to Mystic Avenue northbound

The following are the key characteristics and advantages of Alternative 1, as they relate to the interchange redesign goals and objectives:

Improve Safety (Figure 4-2)

- **Elimination of the Route 28 Northbound / I-93 Off-Ramp Weave.** The Route 28 northbound right turn onto Middlesex Avenue would be prohibited. This movement is not necessary because Route 28 northbound traffic can make substitute connections via Foley Street Extension or via Assembly Square Drive; I-93 northbound off-ramp traffic can make a substitute connection via the ramp split to Middlesex Avenue.

- **Elimination of the Route 28 Southbound Ramp Connection to the I-93 Southbound On-Ramp.** Route 28 southbound traffic can still access the I-93 southbound on-ramp by turning left onto Mystic Avenue southbound. Eliminating this ramp facilitates two important safety benefits:

    - **Elimination of the I-93 Southbound On-Ramp Weave.** In the existing condition, the I-93 southbound on-ramp has an exit onto Mystic Avenue southbound. This provides a redundant connection from Route 28 southbound to Mystic Avenue southbound, and results in a sub-standard weave of Route 28 southbound-to-Mystic Avenue southbound with Mystic Avenue southbound-to-I-93 southbound traffic. The exit from this ramp onto Mystic Avenue southbound should be eliminated.

    - **Simplification of the Route 28 Southbound / Mystic Avenue Northbound Intersection.** In the existing condition, this intersection has two parallel approaches from Route 28 southbound. This results in a confusing intersection layout. In the proposed plan, one of these approaches, the direct connection from Route 28 southbound to the I-93 southbound on-ramp, would be eliminated. This would simplify the intersection, making it smaller, less confusing, and much easier for pedestrians to traverse.

Improve Connections Into and Out of Assembly Square

Figure 4-3 shows the major vehicular connections into Assembly Square, and Figure 4-4 shows the major connections exiting Assembly Square.

- **Direct Roadway Connection to and from Center of Assembly Square District.** The proposed plan includes a roadway connection, Foley Street Extension, that provides direct connections to and from Foley Street, the principal east-west roadway in the center of the Assembly Square district. Foley Street Extension would provide a new eastbound connection from Somerville, via Route 28 northbound, into Assembly Square via Foley Street. Foley Street Extension would also provide a new westbound connection out of Assembly Square to Mystic Avenue northbound and to the I-93 southbound on-ramp. Foley Street Extension should include an ample multi-use path along the southern side of the road to provide pedestrian and bicycle connections between East Somerville / Winter Hill and Assembly Square. Foley Street Extension would significantly open up the center of the Assembly Square district for all modes, and provide visitors with a better understanding of Assembly Square's geography and its relationship to its surroundings.

- **Direct Access from the I-93 Off-Ramp into Assembly Square.** In the proposed plan, the I-93 northbound off-ramp splits: the left ramp provides a connection to Route 28 northbound, while the right ramp provides connections to a signalized intersection at Middlesex Avenue. This intersection provides access to the Assembly Square district via Edsel Road, or via Middlesex Avenue to Foley Street.

Preserve and/or Improve Regional Connections (Figure 4-5)

- **I-93 Northbound Off-Ramp Connections.** In existing conditions, the I-93 northbound off-ramp splits to provide access to Route 28 northbound and directly down to Mystic Avenue northbound. The ramp split to Mystic Avenue northbound provides good access from I-93 northbound via Mystic Avenue northbound to Route 28 southbound and to the Ten Hills, Winter Hill, and East Cambridge neighborhoods. However, the existing split to Mystic Avenue northbound also creates weaving conflicts between the off-ramp traffic and the Mystic Avenue northbound through-traffic. These conflicts may contribute to the high accident rate at the intersection of Mystic Avenue northbound / Route 28 southbound. In the proposed plan, the I-93 northbound off-ramp would have to be reconstructed in order to provide adequate vertical clearance over Foley Street Extension. With the reconstructed ramp providing clearance over Foley Street Extension, there would not be adequate distance to provide a ramp split to Mystic Avenue northbound before the intersection at Route 28 southbound; in addition, restoring this ramp split would re-create the existing weave. However, the proposed I-93 northbound off-ramp split to the signalized intersection at Middlesex Avenue / Edsel Road provides the existing regional connections, although they are slightly more circuitous:

- **To Route 28 Southbound.** I-93 northbound off-ramp traffic can access Route 28 southbound via Middlesex Avenue northbound to Route 28. This connection also provides access to most of the Somerville neighborhoods, including Winter Hill and East Somerville.

- **To Mystic Avenue Northbound, Ten Hills.** I-93 off-ramp traffic can access Mystic Avenue northbound and Ten Hills via Middlesex Avenue southbound to Foley Street Extension.

- **I-93 Southbound On-Ramp Connections.** There are some changes to the I-93 southbound on-ramp access. As described above, the direct Route 28 southbound connection to the ramp would be closed. This connection would instead be made via Mystic Avenue southbound. Foley Street Extension would also provide from Assembly Square and from Mystic Avenue northbound to the I-93 southbound on-ramp.

Principal Disadvantages of Alternative 1

- **Longer I-93 Northbound Off-Ramp Connection to Mystic Avenue Northbound, Ten Hills (Figure 4-6).** This connection is made more circuitous by the reconstruction of the I-93 northbound off-ramp. Instead of a ramp directly down to Mystic Avenue northbound, vehicles would have to traverse the I-93 northbound off-ramp to Middlesex Avenue southbound, turn right onto Foley Street Extension, and right again onto Mystic Avenue northbound. This would require passing through three additional traffic signals, which would add approximately one and a half minutes of travel time during a typical afternoon peak hour. Alternatively, drivers bound from I-93 northbound to Mystic Avenue could also turn left from the I-93 off-ramp onto Middlesex Avenue northbound, then turn left onto Route 28 southbound and right onto Mystic Avenue northbound. This would require passing through only two additional traffic signals, but one would be at the congested intersection of Route 28 / Middlesex Avenue. This route would add approximately three minutes of travel time, mostly due to delay at this intersection. Based on travel demand model projections, there is demand of approximately 100 – 120 vehicles per peak hour for the connection from I-93 northbound to Mystic Avenue northbound, or about 5 – 6 % of the total off-ramp demand.

- **Southbound Mystic Avenue Traffic Must Use Lombardi Street or the Adjacent U-Turn to Enter Assembly Square (Figure 4-7).**

Foley Street Extension accommodates two-way traffic to provide access to I-93 southbound. As a result, the intersection of Route 28 Northbound / Mystic Avenue Southbound / Foley Street Extension cannot accommodate left turns due to traffic signal operations limitations. Left turns from Mystic Avenue southbound into Assembly Square could be accommodated on Foley Street Extension by eliminating the connection to the I-93 southbound on-ramp. However, the connection to the I-93 southbound on-ramp was considered a higher priority, since demand for this movement is significantly heavier than demand for the Mystic Avenue southbound connection into Assembly Square, and re-routing the I-93 southbound on-ramp traffic would worsen congestion at more intersections. Mystic Avenue southbound is not a major connection for Assembly Square, since regional traffic from the north may stay on I-93 and exit at Assembly Square. The U-turn adjacent to Lombardi Street provides good access to Assembly Square for Mystic Avenue southbound and I-93 southbound traffic.

- **Retention of Two-Way Segment of Mystic Avenue Between the Route 28 Northbound Off-Ramp and the Mystic Avenue Northbound Merge (Figure 4-8).** In existing conditions, Route 28 northbound traffic bound for Mystic Avenue northbound must take a left turn onto an unconventional two-way segment of Mystic Avenue on the western side of the I-93 viaduct. This configuration must be retained in the proposed plan, because the traffic demand for this movement is too heavy to be accommodated on the other side of the I-93 viaduct, at the intersection of Foley Street Extension / Mystic Avenue northbound.

- **Westbound Traffic on Foley Street Extension (West of Mystic Avenue Northbound) Must Turn Onto the I-93 Southbound On-Ramp (Figure 4-9).** All westbound traffic on the segment of Foley Street Extension west of Mystic Avenue northbound would have to turn left onto the I-93 southbound on-ramp. The traffic signal at the intersection of Foley Street Extension / Mystic Avenue southbound cannot accommodate left turns from Foley Street Extension onto Mystic Avenue southbound. Vehicles attempting to make this connection would need to turn right onto Mystic Avenue northbound and make the turn onto Mystic Avenue southbound at Wheatland Street.

Final Alternative 2: I-93 Off-Ramp to Middlesex Avenue

Alternative 2 is shown in Figure 4-10. Table 4-12 presents the principal feature of Alternative 2, which are discussed below.

Table 4-12 Principal Features of Alternative 2

Features	Comment
Route 28 Northbound to Assembly Square Connector Road (a.k.a. Foley Street Extension)	Aligned with Foley Street Passes between I-93 viaduct columns, does not require relocation of sewage pumping station
Rebuilt I-93 Northbound Off-Ramp	Must be rebuilt because existing off-ramp does not provide adequate vertical clearance over Foley Street Extension I-93 northbound connects directly to Middlesex Avenue at Foley Street
Route 28 Southbound Underpass	Reduces congestion at Mystic Avenue intersections
Elimination of Redundant Route 28 Southbound to I-93 Southbound Ramp	Reduces conflicts and confusion at intersection of Route 28 southbound / Mystic Avenue northbound Facilitates elimination of weave between I-93 southbound on-ramp traffic and Route 28 southbound to Mystic Avenue southbound traffic
Connection from Assembly Square to I-93 Southbound On-Ramp Via U-Turn Ramp Beneath the I-93 Viaduct	Foley Street Extension is two-way, providing access to the I-93 southbound on-ramp
Elimination of Two-Way Segment of Mystic Avenue North of Foley Street Extension	Access from Route 28 northbound to Mystic Avenue northbound is made via Foley Street Extension

The following are the key characteristics and advantages of Alternative 2, as they relate to the interchange redesign goals and objectives:

Improve Safety (Figure 4-11)

- **Elimination of the Route 28 Northbound / I-93 Off-Ramp Weave.** Access from I-93 northbound to Route 28 northbound is via Middlesex Avenue. There is no merge onto Route 28 northbound from the I-93 northbound off-ramp, so there is no weave.

- **Elimination of the Route 28 Southbound Ramp Connection to the I-93 Southbound On-Ramp.** Route 28 southbound traffic can still access the I-93 southbound on-ramp by turning left onto Mystic Avenue southbound. Eliminating this ramp facilitates two important safety benefits (same as in Alternative 1):

- Elimination of the I-93 southbound on-ramp weave.
- Simplification of the Route 28 southbound / Mystic Avenue northbound intersection.

Improve Connections Into and Out of Assembly Square

Figure 4-12 shows the major vehicular connections into Assembly Square, and Figure 4-13 shows the major connections exiting Assembly Square.

- **Direct Roadway Connection to and from Center of Assembly Square District.** The proposed plan includes a roadway connection, Foley Street Extension, that provides direct connections to and from Foley Street, the principal east-west roadway in the center of the Assembly Square district. Foley Street Extension would provide a new eastbound connection from Somerville, via Route 28 northbound, into Assembly Square via Foley Street. Foley Street Extension would also provide a new westbound connection out of Assembly Square to Mystic Avenue northbound and to the I-93 southbound on-ramp. Foley Street Extension should include an ample multi-use path along the southern side of the road to provide pedestrian and bicycle connections between East Somerville / Winter Hill and Assembly Square. Foley Street Extension would significantly open up the center of the Assembly Square district for all modes, and provide visitors with a better understanding of Assembly Square's geography and its relationship to its surroundings.
- **Direct Access from the I-93 Off-Ramp into Assembly Square.** In the proposed plan, the I-93 northbound off-ramp connects directly to Middlesex Avenue at Foley Street. This would provide direct access to Assembly Square via Foley Street and via Middlesex Avenue.

Preserve and/or Improve Regional Connections (Figure 4-14)

- **I-93 Northbound Off-Ramp Connections.** In the proposed plan, the I-93 northbound off-ramp would have to be reconstructed because the existing off-ramp does not provide adequate vertical clearance over Foley Street Extension. In Alternative 2, the I-93 off-ramp would come to grade and interface with the surface street system at a signalized intersection at Middlesex Avenue / Foley Street / Foley Street Extension. This off-ramp configuration provides the following regional connections:
  - **To Route 28 northbound.** Traffic from I-93 northbound would reach Route 28 northbound via Middlesex Avenue.

- **To Route 28 southbound.** The most direct connection from the I-93 northbound off-ramp to Route 28 southbound would most likely be via Foley Street Extension, Mystic Avenue northbound, and Mystic Avenue southbound to Route 28 southbound. Alternatively, this connection could be made via Middlesex Avenue northbound to Route 28 southbound.

- **To Mystic Avenue northbound, Ten Hills.** The I-93 off-ramp traffic would be able to access Mystic Avenue northbound and Ten Hills via a left turn onto Foley Street Extension and a right turn onto Mystic Avenue northbound.

- **I-93 Southbound On-Ramp Connections.** Due to the high volumes of traffic and the large number of traffic movements that must be accommodated at the intersection of Foley Street / I-93 Northbound Off-Ramp / Middlesex Avenue, the significant traffic volumes demanding access from Assembly Square to I-93 southbound cannot be accommodated via Foley Street to Foley Street Extension. Therefore, the Alternative 2 plan would accommodate this traffic via New Road to Mystic Avenue northbound to a U-turn ramp beneath the I-93 viaduct connecting to the I-93 southbound on-ramp.

Principal Disadvantages of Alternative 2

- **I-93 Northbound Off-Ramp Would Experience Queuing Back Onto I-93 Mainline, Sub-Standard Sight Distance (Figure 4-15).** The intersection of Foley Street / Foley Street Extension / I-93 Northbound Off-Ramp / Middlesex Avenue would experience LOS F during both the morning and afternoon peak hours. This would result in significant congestion, delay, and queuing at all approaches to the intersection. The most severe problems related to this congestion would be on the I-93 northbound off-ramp approach, where the congestion is expected to cause queuing back onto the I-93 mainline. As that queue back onto the mainline was building, vehicles on I-93 seeking to use the off-ramp would have sub-standard sight distance (both horizontal and vertical), so that these vehicles might not be able to stop safely before reaching the back of the off-ramp queue. These issues represent a fatal flaw with the Middlesex Avenue off-ramp.

- **Several Major Traffic Movements Concentrated at Two Intersections Results in Significant Congestion (Figure 4-16).** Several major regional traffic movements and Assembly Square access and egress traffic movements are concentrated at two intersections: Foley Street / Foley Street Extension / I-93 Northbound Off-Ramp /

Middlesex Avenue and Mystic Avenue Northbound / New Road. These traffic movements include:

- **Foley Street / Foley Street Extension / I-93 Northbound Off-Ramp / Middlesex Avenue**
  - All I-93 northbound off-ramp traffic
    - To Assembly Square
    - To Route 28 northbound (via Middlesex Avenue)
    - To Mystic Avenue northbound (via Foley Street Extension)
  - Mystic Avenue northbound to Route 28 northbound traffic. The I-93 northbound off-ramp would close the southern end of Middlesex Avenue, forcing traffic from Mystic Avenue northbound to turn right onto Foley Street Extension and left onto Middlesex Avenue to reach Route 28 northbound.
  - Somerville / Route 28 northbound traffic entering Assembly Square via Foley Street Extension to Foley Street
- **Mystic Avenue Northbound / New Road**
  - Traffic bound for the I-93 northbound on-ramp
  - Traffic bound for the I-93 southbound on-ramp

This concentration of traffic causes these two major gateway intersections to experience LOS F during both the morning and afternoon peak hours. This results in significant congestion, delay, and such problems as the queuing and sight distance problems on the I-93 northbound off-ramp described above.

- **Middlesex Avenue Becomes an Extension of the I-93 Northbound Off-Ramp (Figure 4-17).** The ramp configuration in Alternative 2 makes the Middlesex Avenue corridor into a significant barrier, cutting the western edge of Assembly Square off from the rest of the district. The I-93 off-ramp itself creates a barrier from I-93 to Foley Street; north of Foley Street, Middlesex Avenue must accommodate all of the traffic from I-93 to Route 28 northbound, in addition to all of the traffic from Mystic Avenue northbound to Route 28 northbound.

4.4.2 Internal Street Network

The highway interchange planning has been combined with internal street network planning to create two overall roadway plans for Assembly Square, corresponding to the two highway interchange alternatives described above.

Alternative 1 (Figure 4-18)

Roadway Plan Alternative 1, shown in Figure 4-18, includes highway interchange Alternative 1 (I-93 northbound off-ramp to Route 28 northbound), along with a new internal street network within Assembly Square. Assembly Square's internal street network will be an important component of the district's character, and can help contribute to Assembly Square's success from the perspective of traffic operations, pedestrian and bicycle access, and urban design. The following is a discussion of the way the key street planning principles influenced the proposed internal street network:

- **Robust Street Grid.** Figure 4-18 shows the proposed street network for Assembly Square; this street network includes a significant expansion in the number of streets. Although the Assembly Square district itself is somewhat irregularly shaped, the proposed internal street network creates mostly orthogonal blocks and intersections. It should also be noted that Figure 4-18 reflects the primary street network, made up of the district's arterial streets and collector streets. A more finely-grained network of minor access roads and alleys is appropriate for an urban street system like Assembly Square's, and these should be incorporated into development plans in a manner that is appropriate to the proposed project. The Assembly Square *Unifying Design Guidelines for the Public Realm* discusses optional standards that allow such minor streets to be design primarily for pedestrian use, with occasional vehicular use for loading.

- **New Gateways for Assembly Square.** As Figure 4-19 shows, Alternative 1 retains Assembly Square's five existing gateways, and creates three major new gateways: at River Avenue, at Foley Street Extension, and at the I-93 Off-Ramp / Edsel Road. This creates new access opportunities for motor vehicles, pedestrians, and bicycles. It distributes the traffic, and makes it less reliant on a few congested gateway intersections. It also opens up Assembly Square to the adjacent roadways and neighborhoods, making the district more inviting and understandable for cars, bicycles and pedestrians.

- **Street Hierarchy.** The proposed street network has a hierarchy of streets. The district's major, arterial streets include the connections to the district's principal gateways: Assembly Square Drive, Foley Street, and Middlesex Avenue. The design of these roadways should reflect their role as entry roadways for all modes. Assembly Square Drive and Foley Street in particular were identified in the Assembly Square *Unifying Design Guidelines for the Public Realm* as opportunities for special treatments. Assembly Square Drive (Main Street in the *Guidelines*) is recognized as the central spine of the district and connecting the adjacent Broadway neighborhood to the waterfront, and special streetscape standards were identified in the Guideline to respond to that role. Similar, Foley Street was identified as a primary connection both from adjacent neighborhoods and within the district to the proposed transit station, and subject to a stronger pedestrian orientation through wider sidewalks. Most of the other streets in the proposed street network function as collector streets.

- **Small, Urban-Scaled Blocks.** Smaller blocks contribute to an urban, pedestrian-scaled character in the district. The proposed street network shown in Figure 4-18 includes blocks that are mostly in the range of about 300' by 500' – 600', with a few blocks that are larger or smaller. By contrast, the typical block size in the Back Bay is about 250' by 550'. As noted above, the blocks shown in Figure 4-18 should also incorporate alleys, pedestrian ways and access drives, as do the blocks in the Back Bay.

- **Direct Connections Into and Out of Assembly Square.** The roadway connections into and out of Assembly Square should be as direct as possible. This improves both traffic operations and the navigability of the district. Some of the major new connections in and out of Assembly Square include:

    - Route 28 northbound to Foley Street Extension to Foley Street
    - Foley Street to Foley Street Extension to I-93 southbound on-ramp
    - I-93 northbound off-ramp to Edsel Road to IKEA Service Road to River Avenue
    - River Avenue through-connection from Mystic Avenue northbound to the Yard 21 development

In addition to these planning principles for establishing the street network, the Assembly Square Transportation Plan has also adhered to the following guidelines in order ensure consistency, economy and feasibility in creating a new internal street network:

- **Consistency with Other Planning Efforts.** The Assembly Square Transportation Plan roadway network is designed to respect previous planning efforts. In particular, the Assembly Square Transportation Plan adhered to principles and proposals from the 2000 *Assembly Square Planning Study*, the final roadway plan for which is shown in Figure 4-20. The Assembly Square Transportation Plan reflects the basic street layout and district organization of the Planning Study's proposal, including the key concepts of Assembly Square Drive and Foley Street as the principal roadways in the district. The transportation plan builds upon the Planning Study's proposal, to incorporate a reconfigured interchange into the Assembly Square roadway plan. The Assembly Square Transportation Plan also reflects the principles and recommendations of the 2002 *Unifying Design Guidelines for the Public Realm.*

- **Use of Existing Roadways and Rights of Way.** Unless there is a compelling need for change from a safety, traffic, or urban design standpoint, the Assembly Square internal street network should respect existing roadways and rights of way. This will simplify the process of creating the new internal street network, and reduce the cost. However, the other principles should not be sacrificed for the sake of adhering to existing roadway alignments. The utilization of existing roadways and rights of way is evident in the layout of the major streets in Assembly Square: major roadways include Assembly Square Drive, Middlesex Avenue, Foley Street, New Road, and "Ford Street," which is in the alignment of the existing access roadway along the eastern edge of the Assembly Square Mall.

- **Recognition of Future Development Proposals.** Where appropriate, the Assembly Square internal street network should respect the plans and proposals for future developments. However, creating an optimal street network should take precedence over tentative, long-range development plans. The internal street network should seamlessly integrate public roadways with development parcelization, from the perspective of both direct traffic connections and consistent roadway and streetscape design standards (per the *Unifying Design Guidelines for the Public Realm*). The street network shown in Figure 4-18 reflects the IKEA Mixed-Use Development proposal and the proposal for the Yard 21 parcels.

    - IKEA Mixed-Use Development. In the case of the IKEA Mixed-Use Development, which has already been through considerable public review, the development plan and site layout has been respected. However, the I-93 northbound off-ramp connection to Assembly Square is directly aligned with the IKEA Service Road via Edsel Road. This would enable traffic from I-93 northbound traveling to the Yard 21 development area to travel via Edsel Road to IKEA Service Road to River Avenue. This affords the opportunity to integrate the IKEA site into the Assembly Square roadway system.

- Yard 21. In the case of the Yard 21 Development proposal, the basic configuration of the parcels has been respected, but roadways have been changed to improve circulation and connectivity in all modes. These changes include
  - Making Assembly Square Drive the through-street at River Avenue
  - Improving Assembly Square Drive's alignment
  - Extending River Avenue out to Mystic Avenue northbound
  - Making River Avenue (between Mystic Avenue and Assembly Square Drive) and New Road a one-way pair, with River Avenue one-way into Assembly Square and New Road one-way exiting Assembly Square
  - Aligning Foley Street with the roadway connection to Draw Seven Park

Alternative 2 (Figure 4-21)

Roadway Plan Alternative 2, shown in Figure 4-21, includes highway interchange Final Alternative 2 (I-93 northbound off-ramp to Middlesex Avenue) along with an appropriate internal street network within Assembly Square. The same principles were used for laying out the Alternative 2 internal street network as described above for Alternative 1, so the Alternative 2 internal street network is similar to that of Alternative 1. However, Alternative 2 does differ from Alternative 1 in that the I-93 northbound off-ramp to Middlesex Avenue results in significant changes to Assembly Square's gateways, which has impacts on the internal streets. In addition, the northern end of Assembly Square Drive is eliminated in Alternative 2 in order to provide more park land along the edge of the Mystic River. The following is a discussion of these differences, and some of the effects of the differences.

- **Assembly Square Gateways.** Like Alternative 1, Alternative 2 creates new roadway gateways for Assembly Square. These new gateways, shown in Figure 4-22, are comparable to the gateways created by Alternative 1:

- Foley Street Extension. The Foley Street Extension connecting Route 28 northbound to Foley Street creates a new gateway into Assembly Square at Mystic Avenue northbound.

- I-93 Northbound Off-Ramp. The I-93 northbound off-ramp provides a new, direct gateway into Assembly Square via Middlesex Avenue and Foley Street.

- River Avenue. River Avenue, which forms a one-way pair with New Road, provides new access into Assembly Square, especially the Yard 21 area.

However, Alternative 2 does not open up Assembly Square to new access as successfully as Alternative 1. Two of the new gateways, the Foley Street Extension gateway and the I-93 northbound gateway, essentially "overlap." All of the Assembly Square traffic entering via the Foley Street Extension gateway must pass through the I-93 northbound off-ramp gateway intersection at Middlesex Avenue. Therefore, these two gateways must share the traffic capacity of a single gateway, causing this gateway intersection at Middlesex Avenue / I-93 Northbound Off-Ramp / Foley Street / Foley Street Extension to experience LOS F and significant congestion.

Alternative 2 also eliminates two existing gateways:

- Middlesex Avenue at Mystic Avenue northbound is replaced by the I-93 northbound off-ramp connection. As a result, traffic from Mystic Avenue northbound to Middlesex Avenue and Route 28 northbound must all pass through the other two gateway intersections: Foley Street Extension / Mystic Avenue Northbound and Middlesex Avenue / I-93 Northbound Off-Ramp / Foley Street / Foley Street Extension. This further congests these two intersections, particularly the latter.

- Assembly Square Drive at Route 28. Eliminating the northern end of Assembly Square Drive eliminates one of two gateways on Route 28 at the northern end of Assembly Square. This concentrates more traffic at the remaining gateway at Middlesex Avenue / Route 28, an already congested location.

- **Elimination of the Northern End of Assembly Square Drive, Between Park Street and Route 28.** It was proposed that the northern end of Assembly Square Drive, adjacent to the Mystic River Park, be eliminated in order to provide more park space along the Mystic River. This proposal was incorporated into Alternative because it is more consistent with an I-93 northbound off-ramp to

Middlesex Avenue. Since the I-93 northbound off-ramp to Middlesex Avenue eliminates the ramp merge onto Route 28 northbound, and therefore any danger of a weaving problem on Route 28 northbound, then right turns from Route 28 northbound onto Middlesex Avenue need not be prohibited. This makes eliminating the Assembly Square Drive access more feasible, because northbound right turns can be accommodated at Middlesex Avenue. However, the elimination of the northern end of Assembly Square Drive is problematic for these reasons:

- Elimination of a Gateway for Assembly Square. As discussed above, this concentrates traffic at the other gateways, in this case at Route 28 / Middlesex Avenue, which has high levels of congestion even with the Assembly Square Drive gateway present.

- Privatization of the Mystic River Park Land. Although eliminating this segment of Assembly Square Drive would enable an increase in the amount of park space along the Mystic River, it would also inhibit public access to this park land. By placing private development between the riverfront park space and the nearest publicly-accessible roadway, it threatens to "privatize" this park space.

Assembly Square Future Build Traffic Volumes and Traffic Operations

With the final roadway plan alternatives proposed, the regional travel demand model was used to assign traffic volumes to the roadway network. The model provided turning movement volumes at all study area intersections for both morning and afternoon peak hour periods.

These traffic volumes were then thoroughly reviewed. The major regional traffic flows and the entering and exiting traffic at Assembly Square gateways is consistent with existing traffic patterns, future network and land use changes, and the trip generation calculations for future development at Assembly Square.

However, because of limitations of regional travel demand models, some of the turning movement volumes at intersections within Assembly Square required some adjustment. These turning movement volumes were adjusted to reflect the proposed internal street network and hierarchy, and the anticipated distribution of parking supply within the Assembly Square district.

Alternative 1

The resulting traffic network volumes for Alternative 1 are shown in Figures 4-23 and 4-24; these show the morning and afternoon peak hour volumes, respectively. These two figures show the way that traffic is distributed between the various Assembly Square gateways, as well as upon the internal street network. Some of the key points that the traffic volume networks for Alternative 1 show are:

- Traffic is heaviest at Assembly Square's gateways, along the district's western and southwestern edges. Further into the district, traffic volumes dissipate as vehicles distribute themselves to and from their parking destinations. Toward the eastern edge of the district, on River Avenue, traffic volumes are significantly lower, since there is very little through-traffic at this edge of the site; the traffic is almost exclusively traffic with River Avenue origins and destinations. In general, Assembly Square's streets will carry mostly Assembly Square traffic; since two of its four sides are blocked to through-traffic by the Mystic River and by the railroad tracks, Assembly Square's streets generally do not offer good through-connections.

- Internal Assembly Square traffic is heaviest on the roadways that provide connections to and from Assembly Square's principal gateways. These roadways include Assembly Square Drive, Foley Street, Middlesex Avenue, Edsel Road, and New Road. As a result, these are also the roadways for which most of the new traffic signals within Assembly Square are proposed. Generally, new traffic signals have been proposed for locations where unsignalized operations experience LOS F, and where it is anticipated that traffic signal warrants would be met. Note that the only traffic signal warrants that can be reviewed based on model data are peak hour signal warrants. Some of the new Assembly Square intersections meet peak hour signal warrants, but peak hour signal warrants tend to have very high thresholds, and are designed for locations that experience very concentrated traffic peaks (e.g. major employment centers where many workers enter and exit during short time periods).

- Foley Street Extension and Foley Street attract significant volumes of traffic entering and exiting Assembly Square. This demonstrates the importance of this new connection in providing access into and out of Assembly Square.

- Foley Street and Assembly Square Drive carry heavy traffic volumes. These volumes are appropriate to the roles of these streets as the Assembly Square district's major arterials.

- Middlesex Avenue also carries heavy traffic volumes. This is largely a consequence of Middlesex Avenue's role as a principal connection to Route 28 northbound, for both Assembly Square traffic and through traffic from Mystic Avenue northbound and the I-93 northbound off-ramp.

- Mystic Avenue continues to carry heavy traffic volumes as it does in existing conditions, especially in advance of the I-93 northbound on-ramp. This is a result of the fact that the I-93 northbound on-ramp at Assembly Square is the first on-ramp connection to I-93 north of downtown, and will continue to be for the foreseeable future.

- New Road carries heavy traffic outbound volumes, including a large contingent of traffic bound for the I-93 northbound on-ramp.

The traffic operations at the study area intersections were analyzed using the Synchro traffic capacity analysis software. Based on traffic volumes, intersection design and layout, and traffic control (i.e. stop control versus traffic signal, traffic signal timing allocation), Synchro provides an evaluation of the quality of traffic operations based on the Highway Capacity Manual (HCM) level-of-service (LOS) assessment criteria. Figures 4-25 and 4-26 show the traffic operations, by LOS, at each study area intersection. For signalized intersections, the LOS is given for the intersection as a whole. For unsignalized intersections, the LOS is given for each stop-controlled approach at the intersection (since congestion and delay at unsignalized intersections is typically experienced principally by the stop-controlled minor street approaches).

As Figures 4-25 and 4-26 show, most of the study area intersections in Alternative 1 perform with a level-of-service of D or better, a quality of operation that is generally considered "acceptable." The exceptions to this include the following intersections:

- Route 28 / Middlesex Avenue. This intersection operates with LOS E during the morning peak hour and LOS F during the afternoon peak hour. This is due largely to heavy through-traffic on Route 28, and to the fact that Middlesex Avenue at Route 28 is a major regional connection for I-93 connections to Route 28, as well as a major gateway for Assembly Square. All of these overlapping demands create significant congestion.

- Mystic Avenue Northbound / Assembly Square Drive / Lombardi Street. This intersection operates with LOS F during the afternoon peak hour. This is principally the result of the heavy demand for the I-93 northbound on-ramp off of Mystic Avenue northbound adjacent to Assembly Square (the first connection to I-93 northbound north of downtown Boston). Because northbound (outbound) traffic is significantly lower during the morning peak hour, this intersection operates much better, at LOS B, during the morning peak hour.

- Broadway / Lombardi Street / Mount Vernon Street. This intersection operates at LOS E during the morning peak hour. This is due to the heavy morning southbound traffic on Broadway bound for Rutherford Avenue and downtown Boston.

Alternative 2

Figure 4-27 shows the afternoon peak hour volumes for Alternative 2. The Alternative 2 afternoon peak hour traffic volumes were analyzed to determine their traffic operations performance, as shown in Figure 18. The afternoon peak hour was assessed first because it represents a worst case scenario from a traffic volume perspective, since Assembly Square traffic volumes are approximately 50% higher during the afternoon peak hour than during the morning peak hour.

As Figure 4-28 shows, there are several major intersections that experience LOS F. These include:

- Mystic Avenue Northbound / Assembly Square Drive / Lombardi Street
- Mystic Avenue Northbound / New Road
- Middlesex Avenue / I-93 Northbound Off-Ramp / Foley Street / Foley Street Extension
- Middlesex Avenue / Edsel Road
- Middlesex Avenue / Route 28

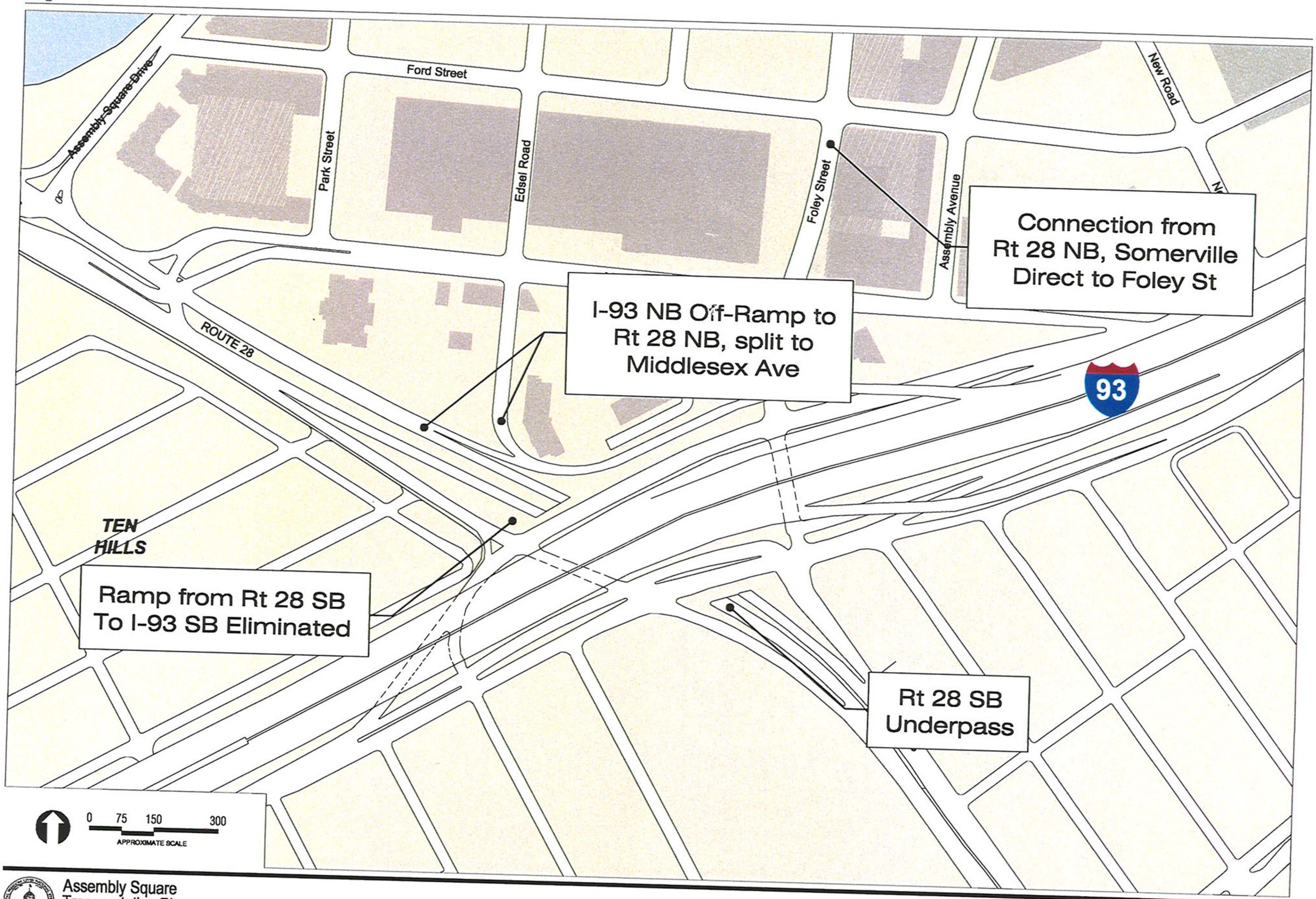
The fact that most of the major Assembly Square gateway intersections experience LOS F reflects the congestion that results from reducing the number of gateways and concentrating the traffic at the remaining gateways. In general, this concentration of traffic and the resulting congestion is problematic, because it hampers access to Assembly Square.

In addition to the general congestion level, the congestion at the intersection of Middlesex Avenue / I-93 Northbound Off-Ramp / Foley Street / Foley Street Extension creates safety problems. The congestion at this intersection is expected to result in queuing back onto the I-93 northbound main-line, and sub-standard sight distance from the highway to the back of the queue as the queue builds. These safety problems represent a fatal flaw with Alternative 2, which is therefore rejected.

Preferred Alternative – Alternative 1

Alternative 1, by contrast, has safe traffic access and acceptable traffic operations (with the exception of two intersections that carry heavy through-traffic) for the level of development proposed by the Assembly Square Planning Study. In addition, it satisfies the planning and urban design goals established by the Assembly Square Planning Study, the Unifying Design Guidelines for the Public Realm, and the Assembly Square Transportation Plan. Therefore, Alternative 1 is designated as the Preferred Alternative.

8640_04-01



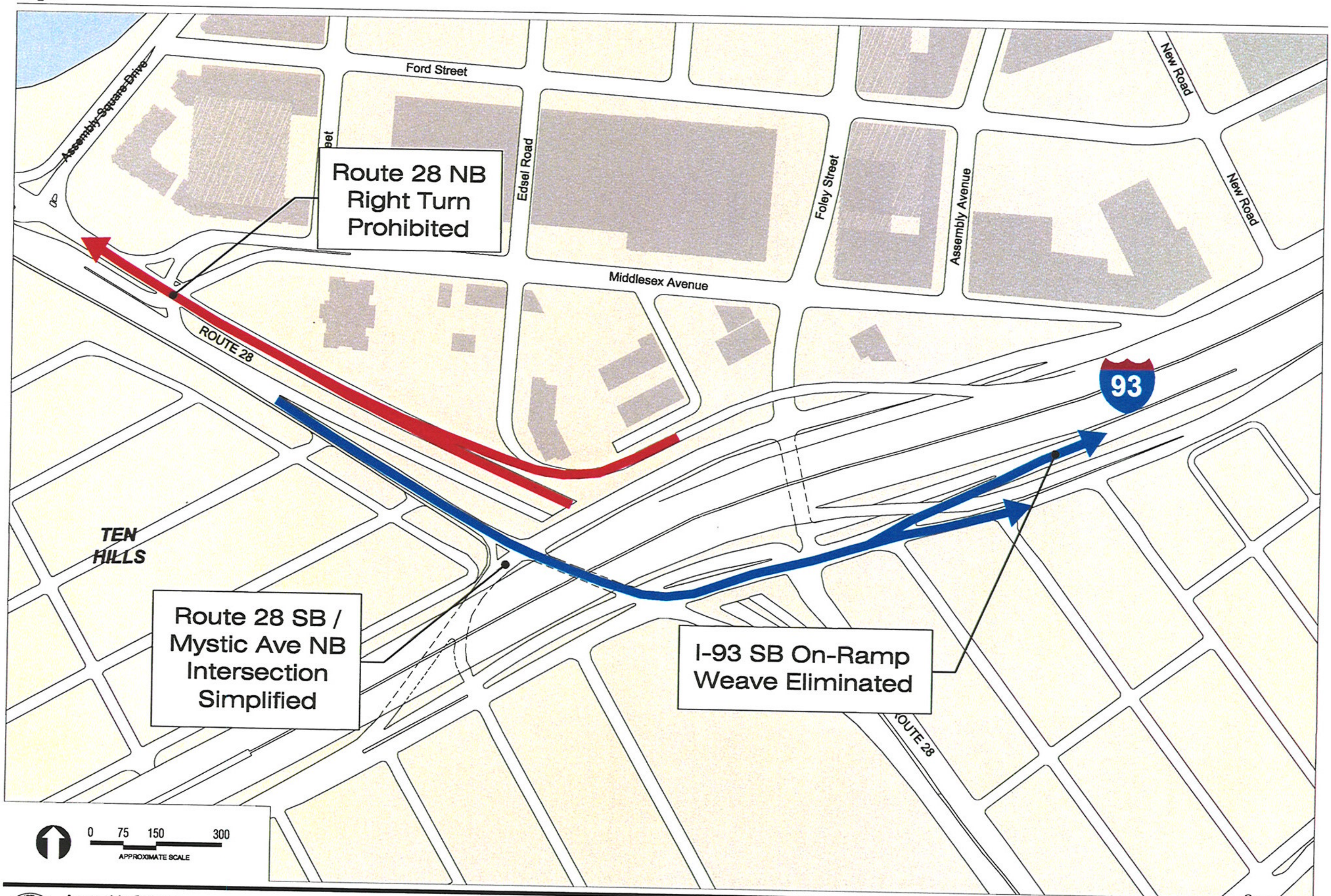
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alternative 1

Figure 4-1

8640_4-02



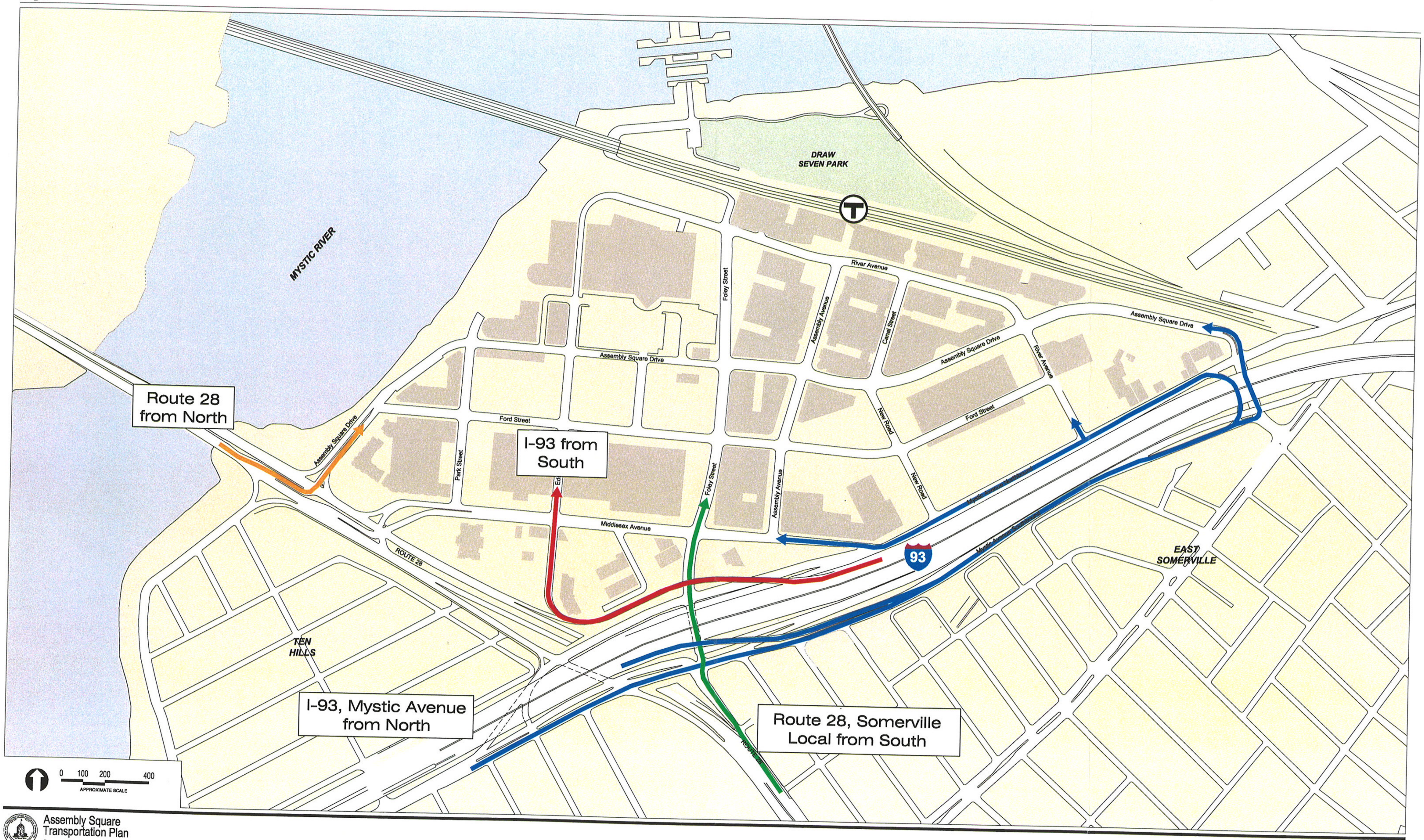
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alternative 1
Safety Improvements

Figure 4-2

8640_4-03

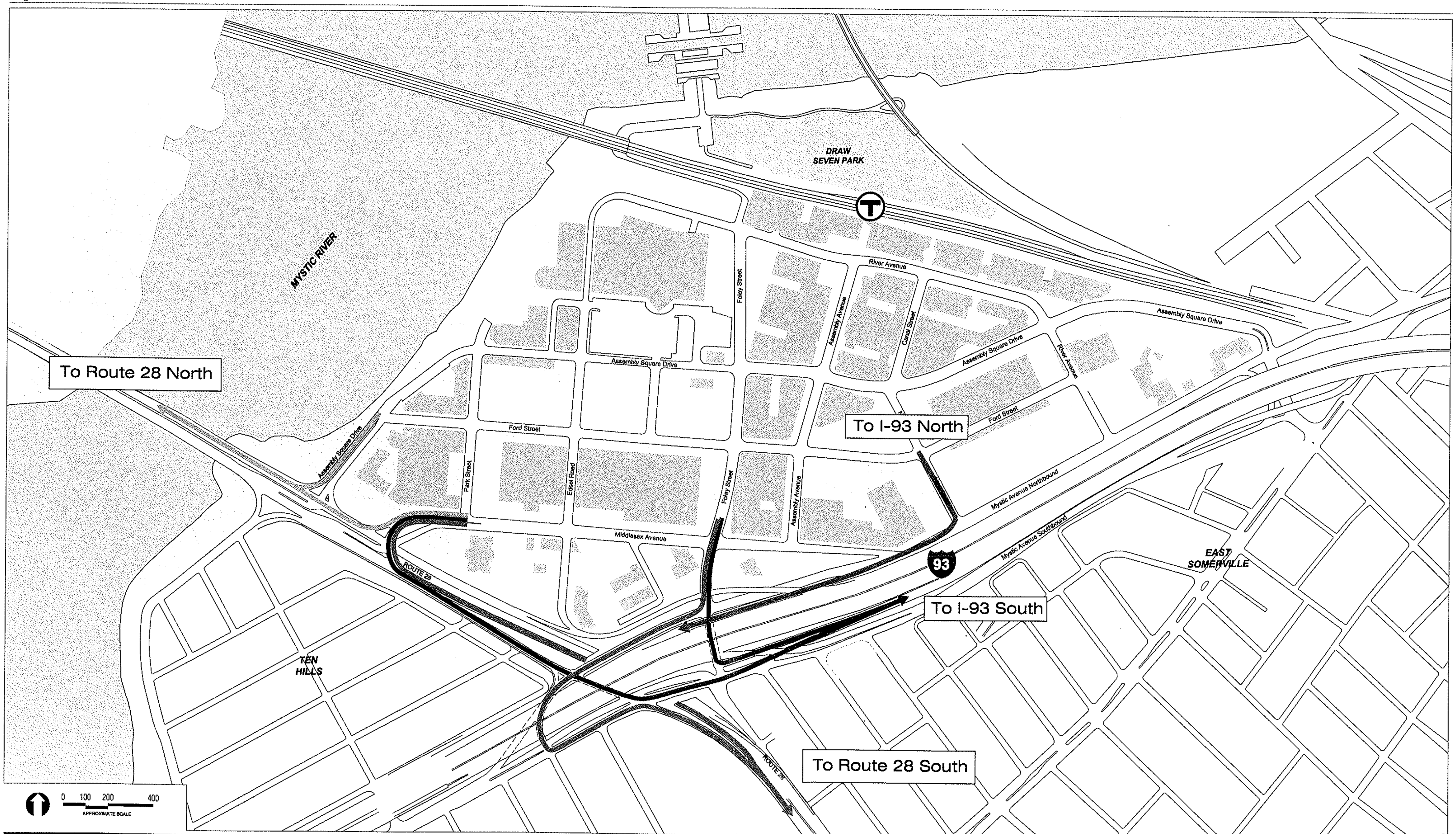


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Alternative 1
Connections Entering
Assembly Square

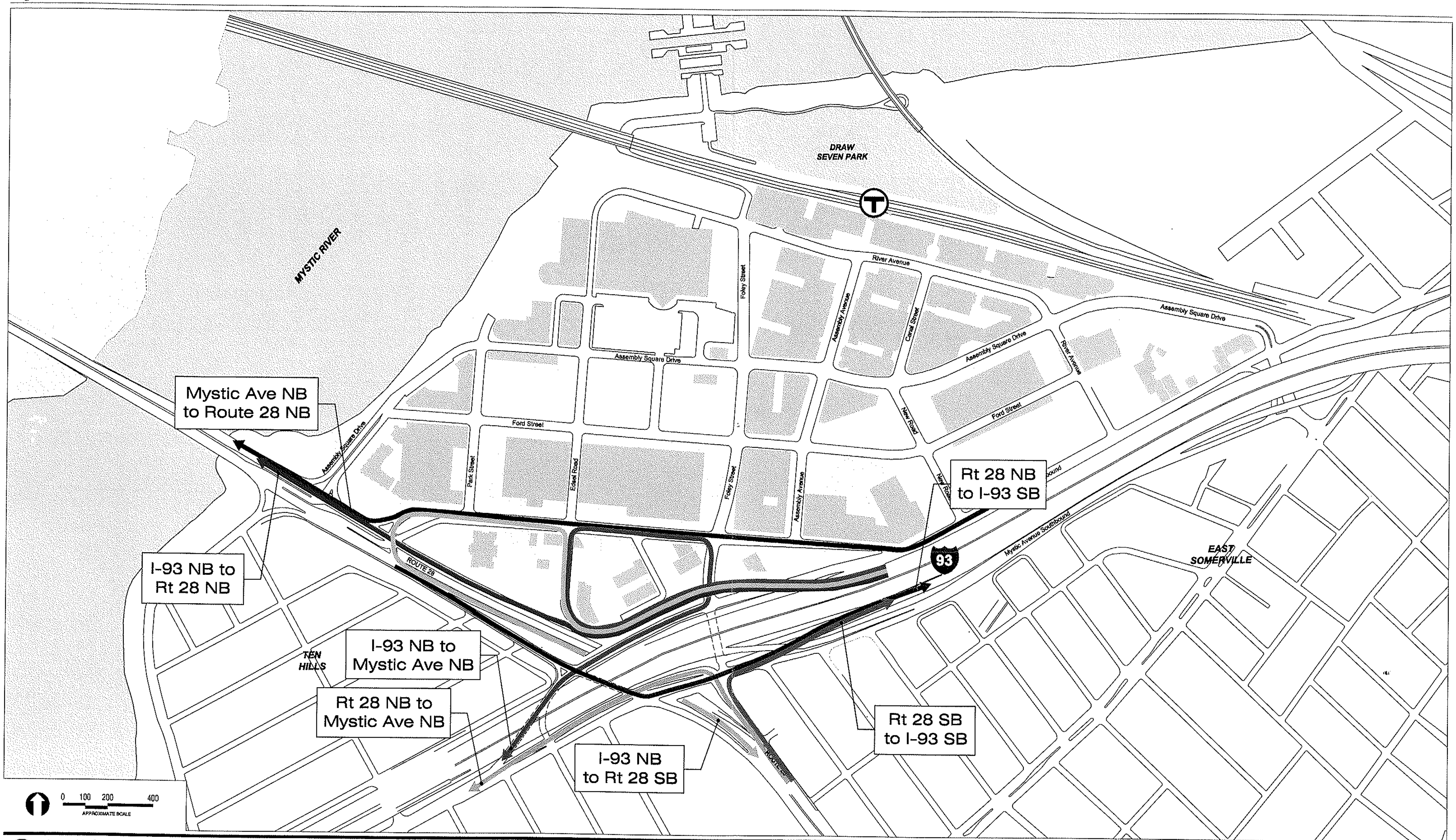
Figure 4-3



Interchange Final Alternative 1
Connections Exiting
Assembly Square

Figure 4-4

8640_4-05

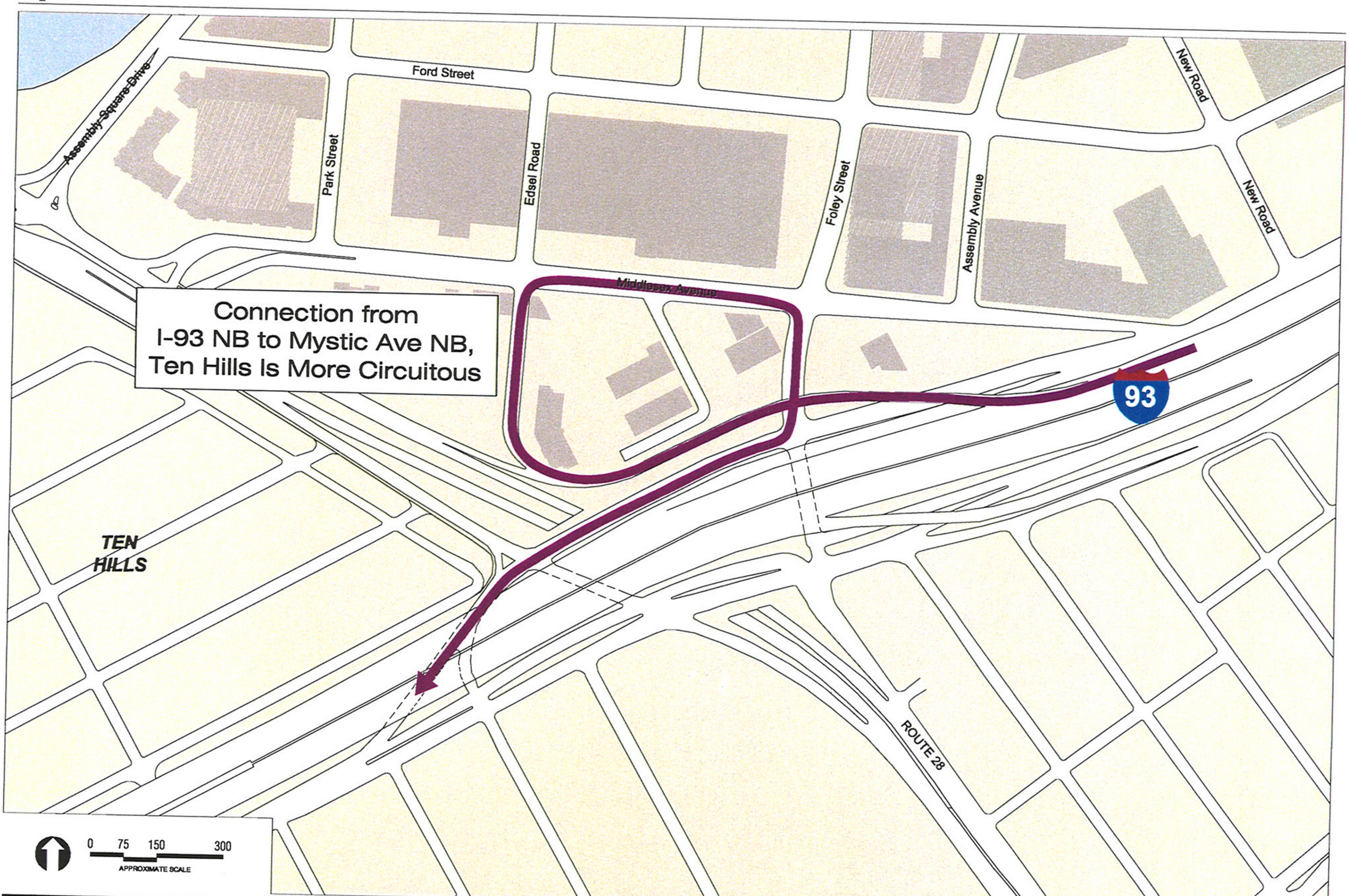


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alternative 1
Regional Connections
Figure 4-5

8640_04-06

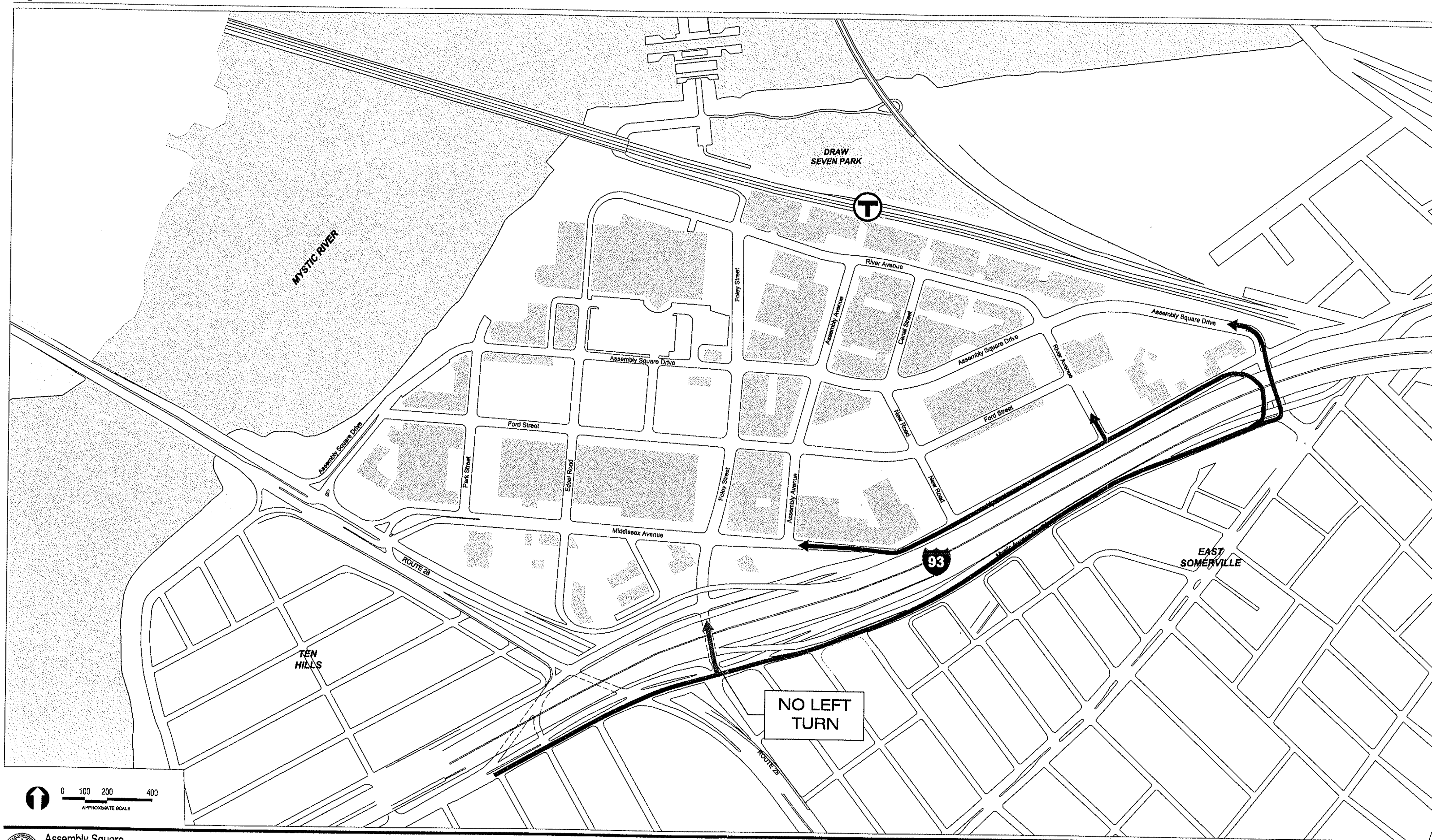


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alt 1
I-93 Northbound to Mystic Avenue
Northbound Connection

Figure 4-6



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alt 1
Mystic Avenue Southbound Traffic
Cannot Enter Via Foley Street Extension

Figure 4-7

8640_4-08

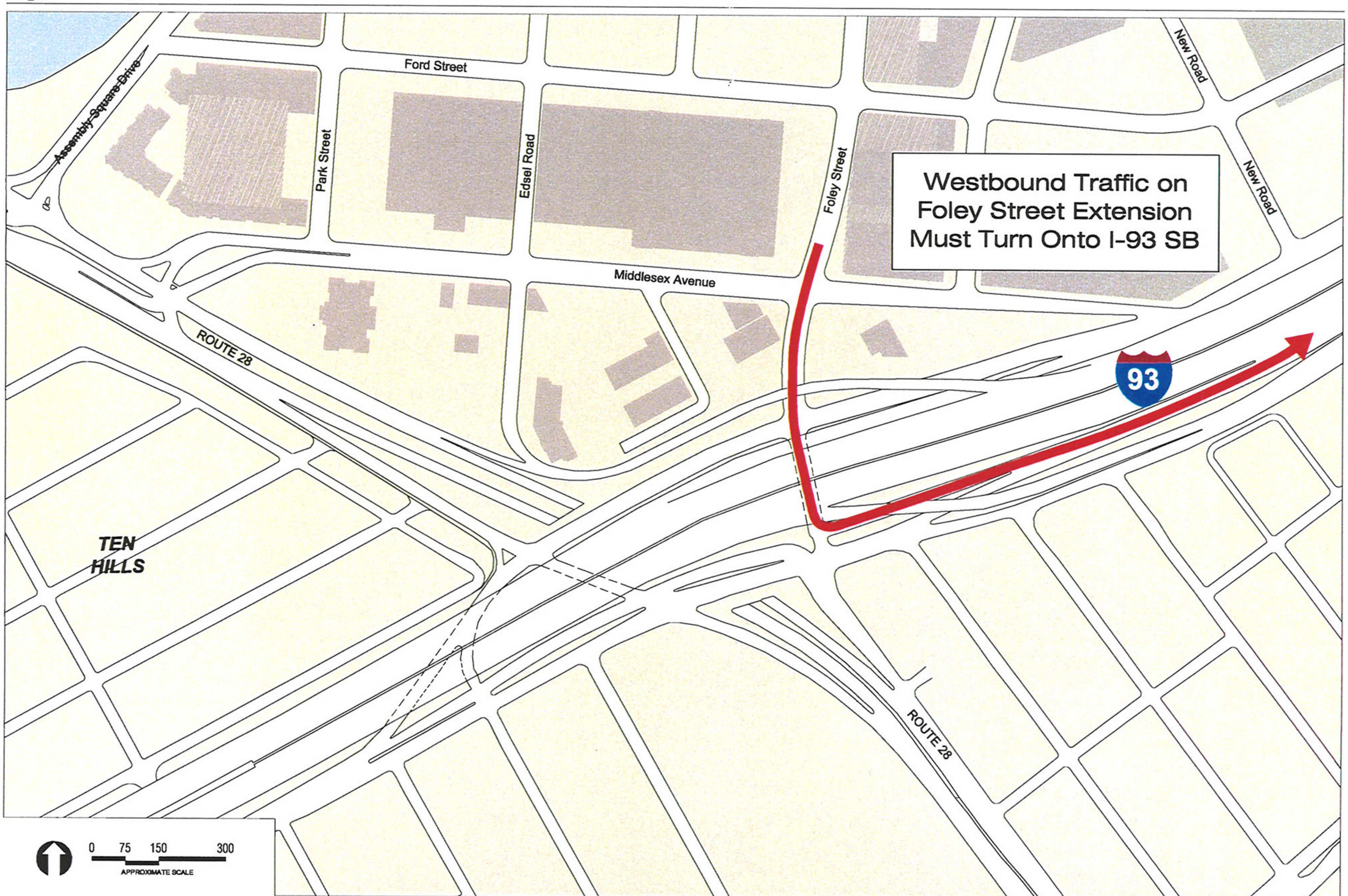
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Interchange Final Alt 1
Two-way Segment of
Mystic Avenue Retained

Figure 4-8

8640_4-09



Assembly Square Transportation Plan
Somerville, Massachusetts

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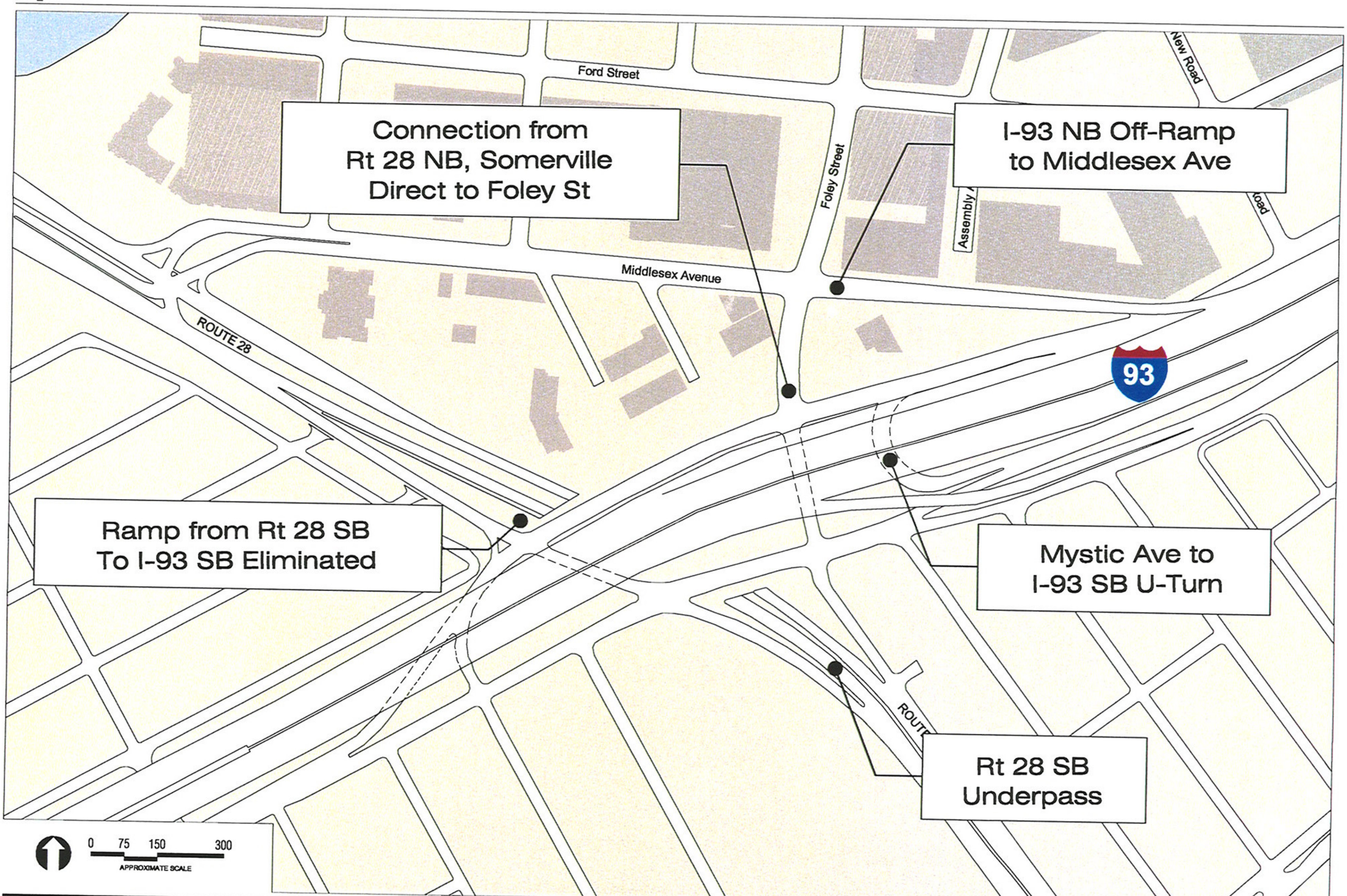
Interchange Final Alt 1
Westbound Foley Street Must Turn Onto I-93 SB On-Ramp

Figure 4-9

8640_4-10



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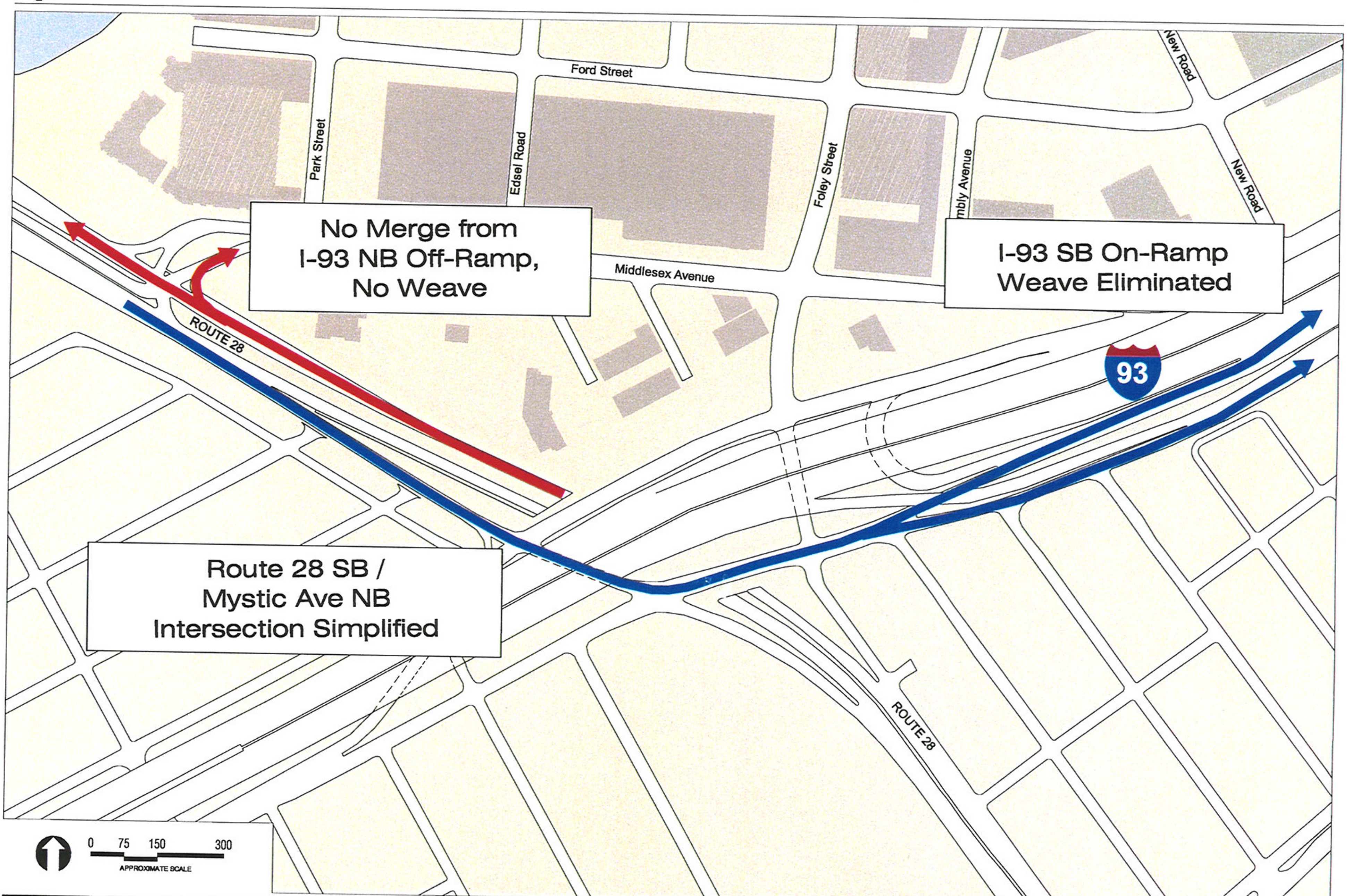
Interchange Final
Alternative 2

Figure 4-10

8640_4-11



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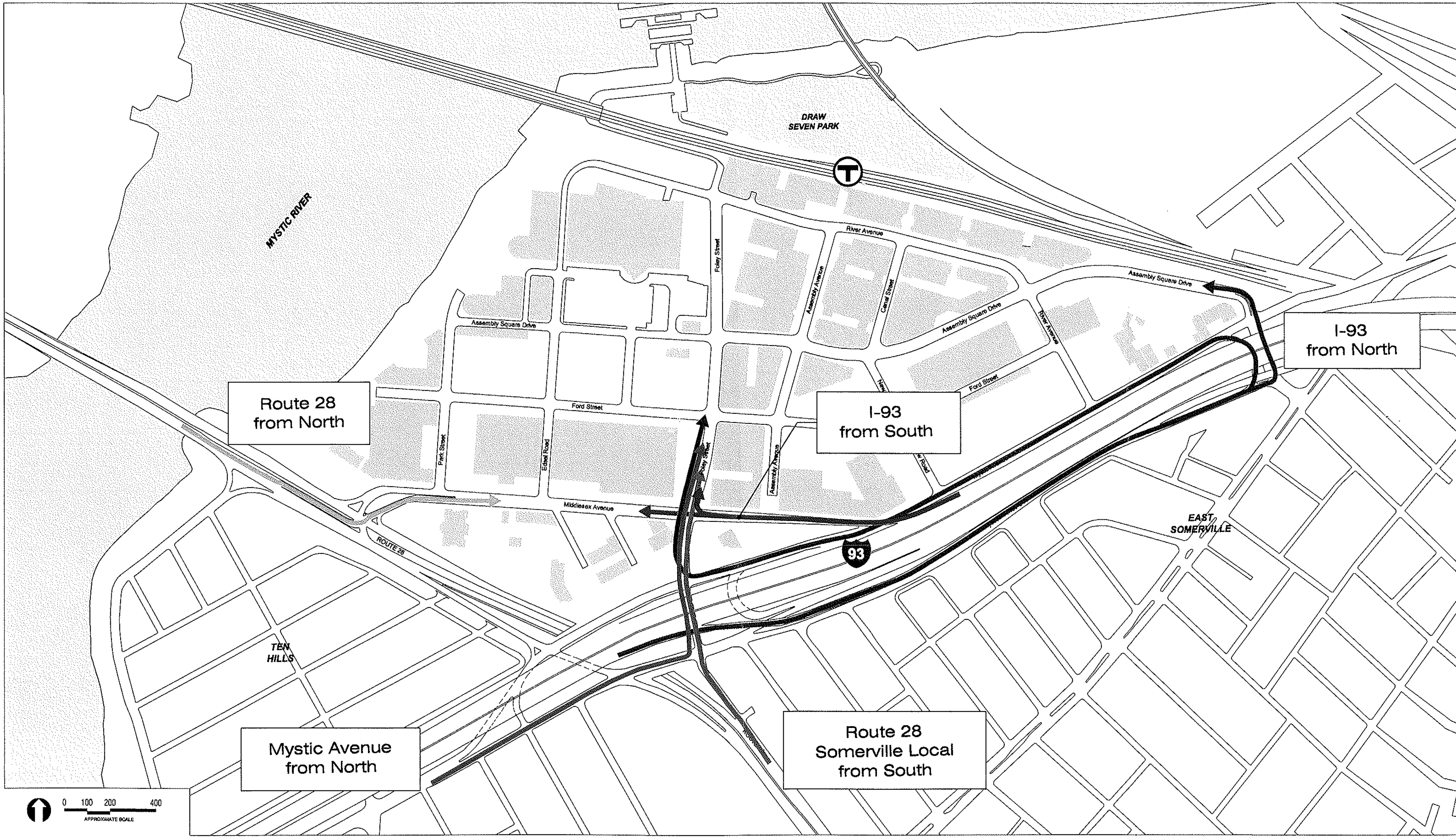
Interchange Final
Alternative 2
Safety Improvements

Figure 4-11



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Somerville, Massachusetts

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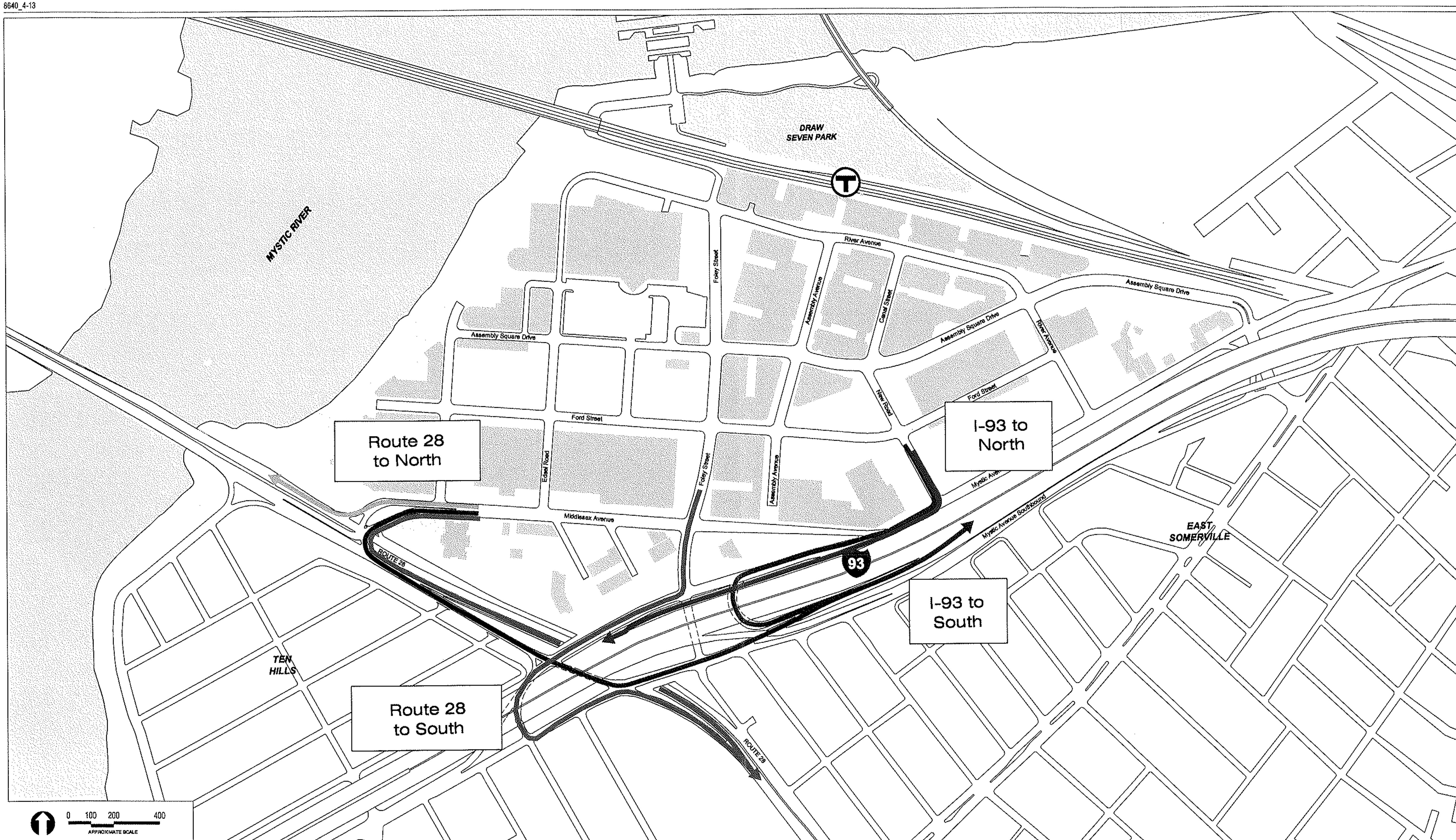
Interchange Final
Alternative 2
Entering Assembly Square

Figure 4-12



Assembly Square Transportation Plan
Somerville, Massachusetts

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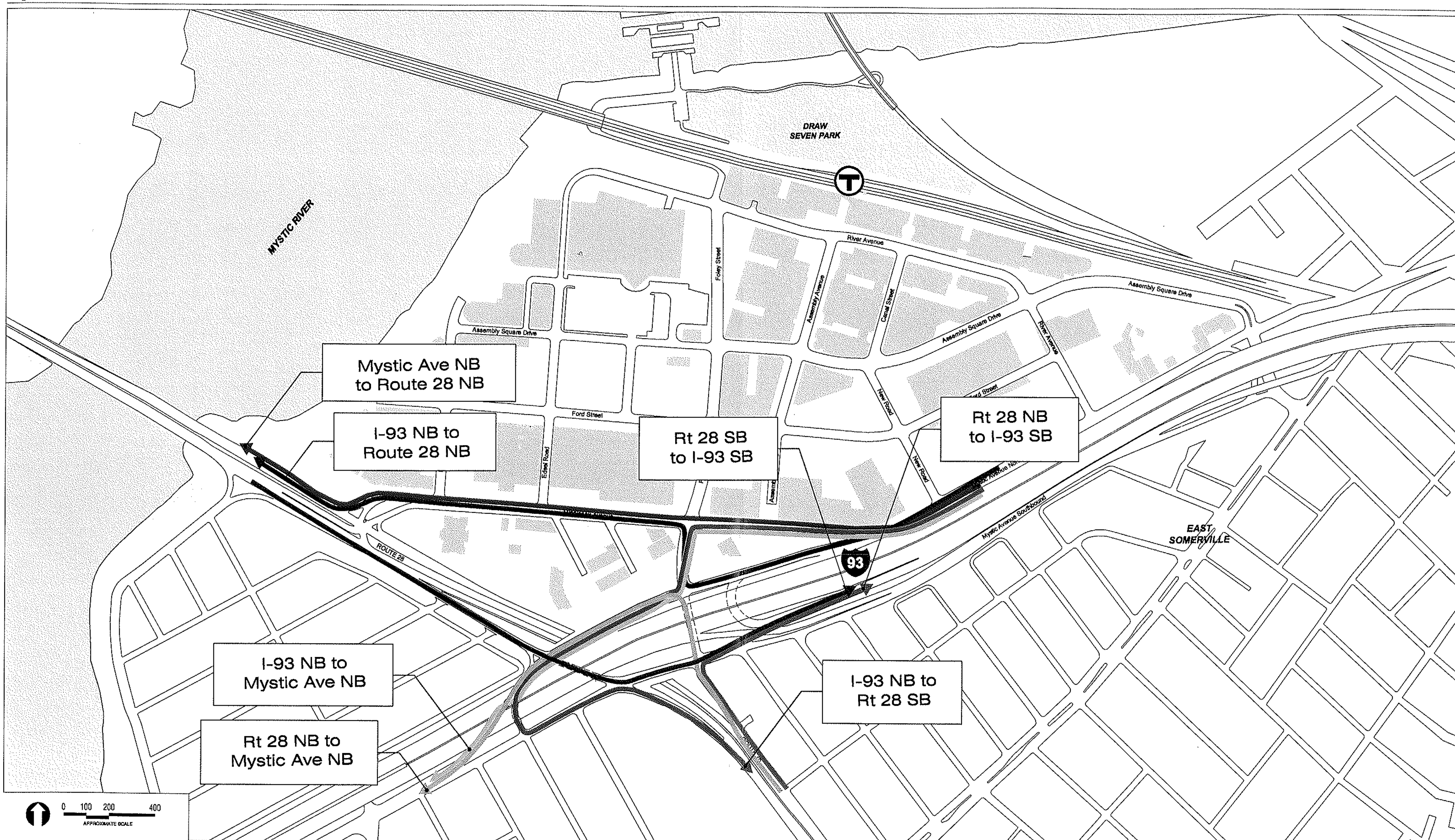
Interchange Final Alternative 2
Connections Entering
Assembly Square

Figure 4-13

8640_4-14



Assembly Square Transportation Plan
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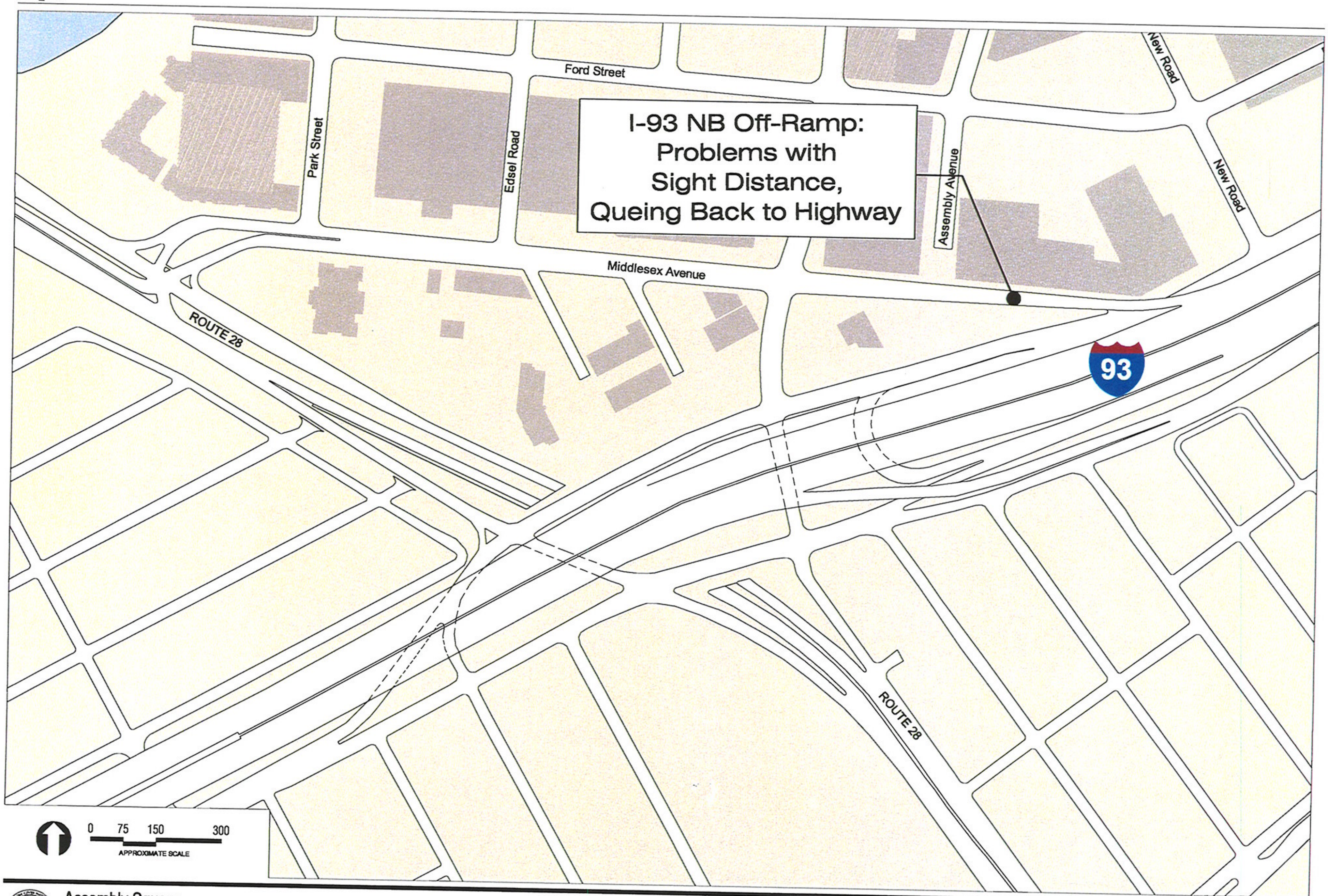
Interchange Final Alternative 2
Regional Connections

Figure 4-14

8640_4-15



Assembly Square Transportation Plan
Somerville, Massachusetts

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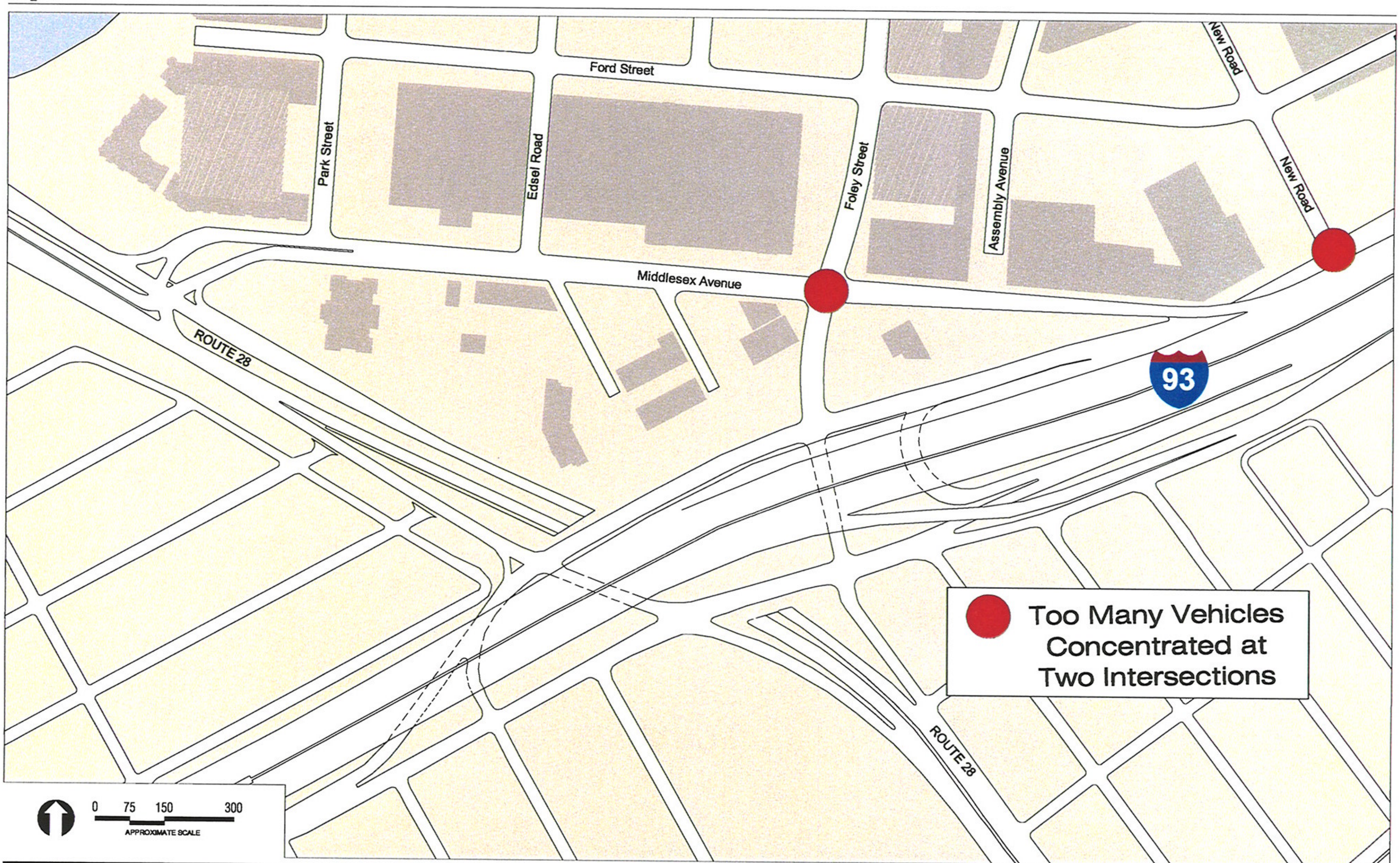
Interchange Final
Alternative 2 I-93 Northbound
Off-Ramp Problems

Figure 4-15

8640_4-16



Assembly Square Transportation Plan
Somerville, Massachusetts

Interchange Final Alternative 2
Concentration of Connections,
Congestion at Mystic Ave NB / New Road,
I-93 NB Off-Ramp / Middlesex Ave /
Roley Street / Foley Street Extension

Figure 4-16

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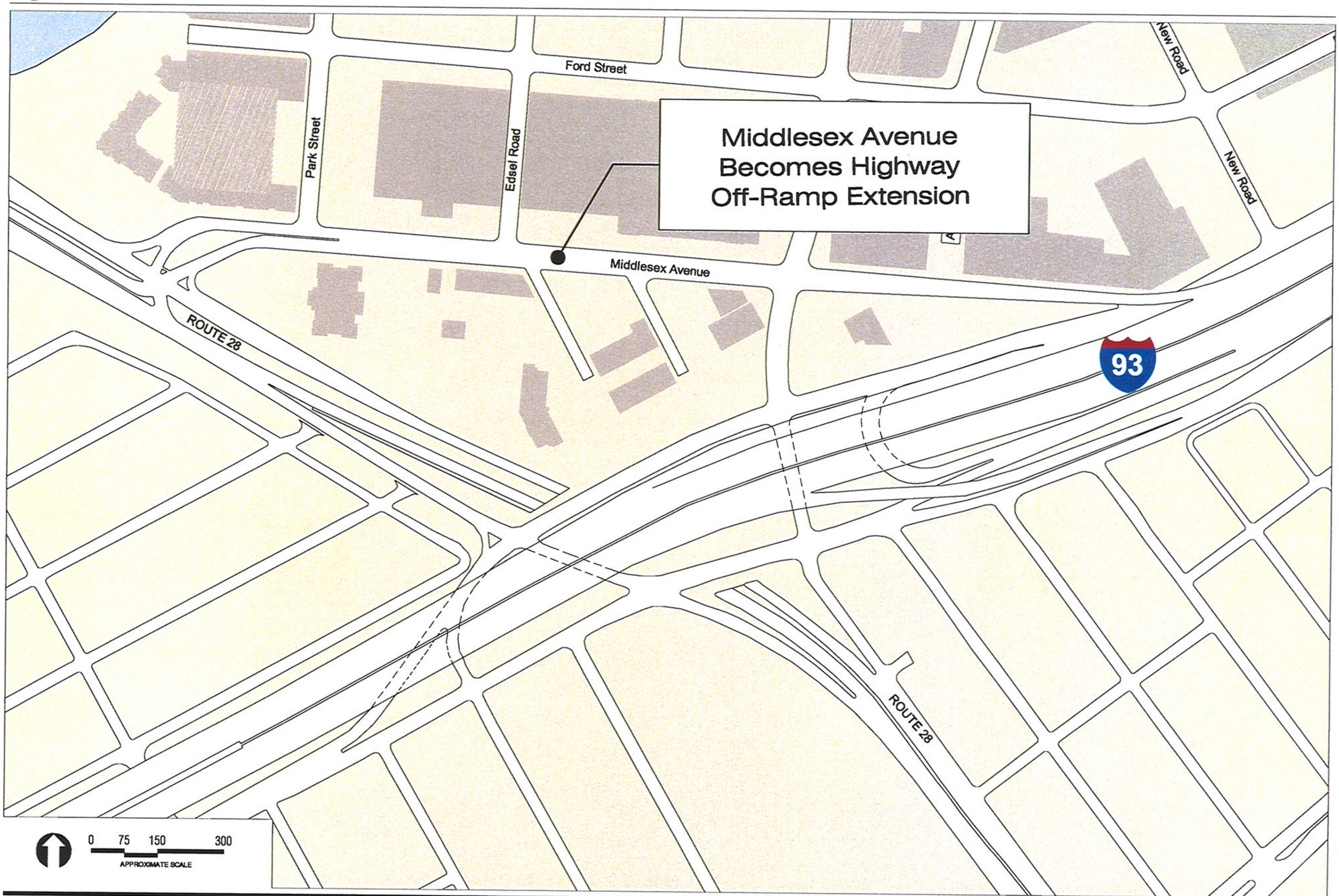
8640_4-10



Assembly Square
Transportation Plan
Somerville, Massachusetts

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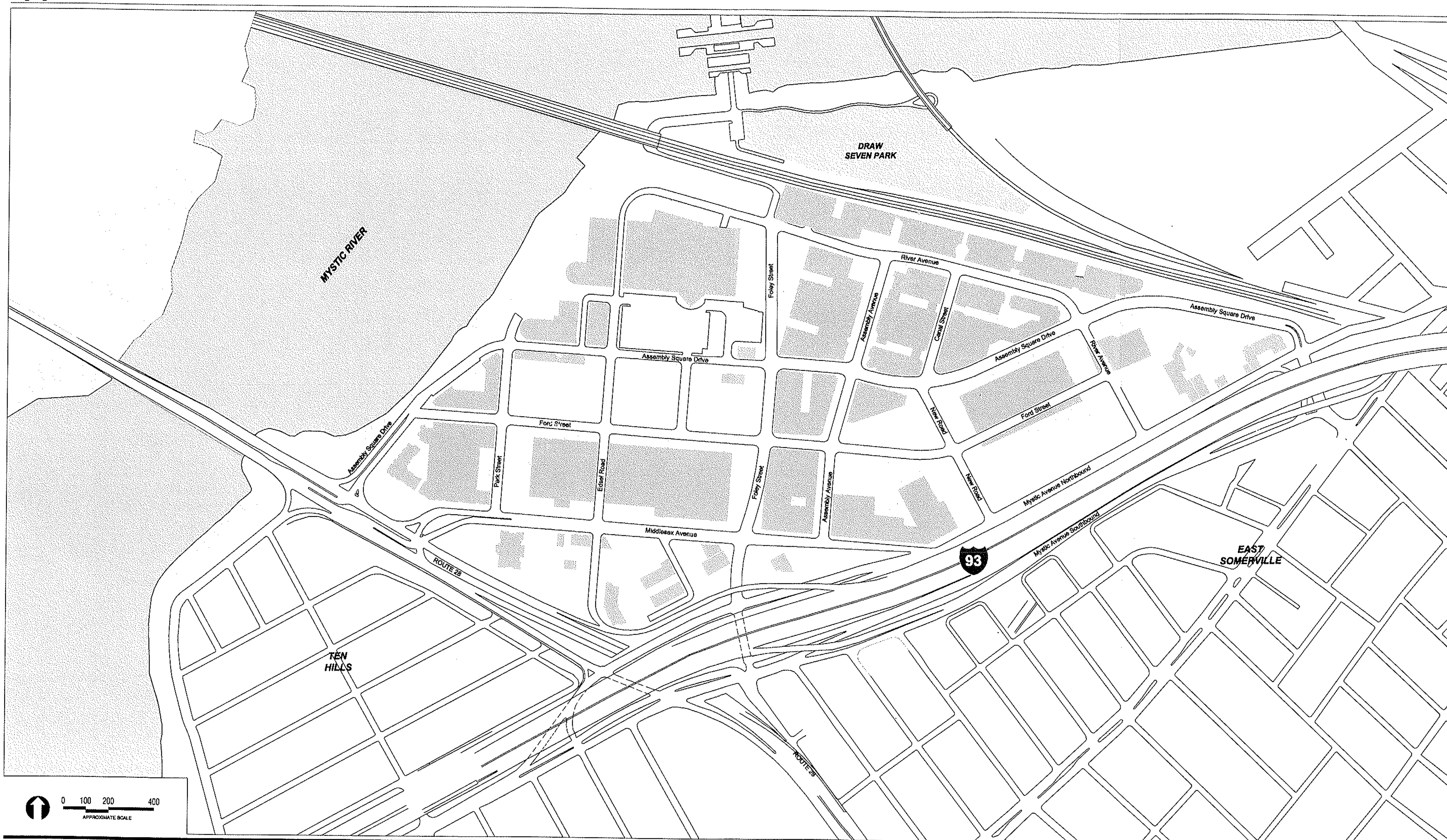
Interchange Final Alternative 2
Middlesex Ave
Becomes an Off-Ramp

Figure 4-17

8640_4-18_RPalt1



Assembly Square Transportation Plan
Somerville, Massachusetts

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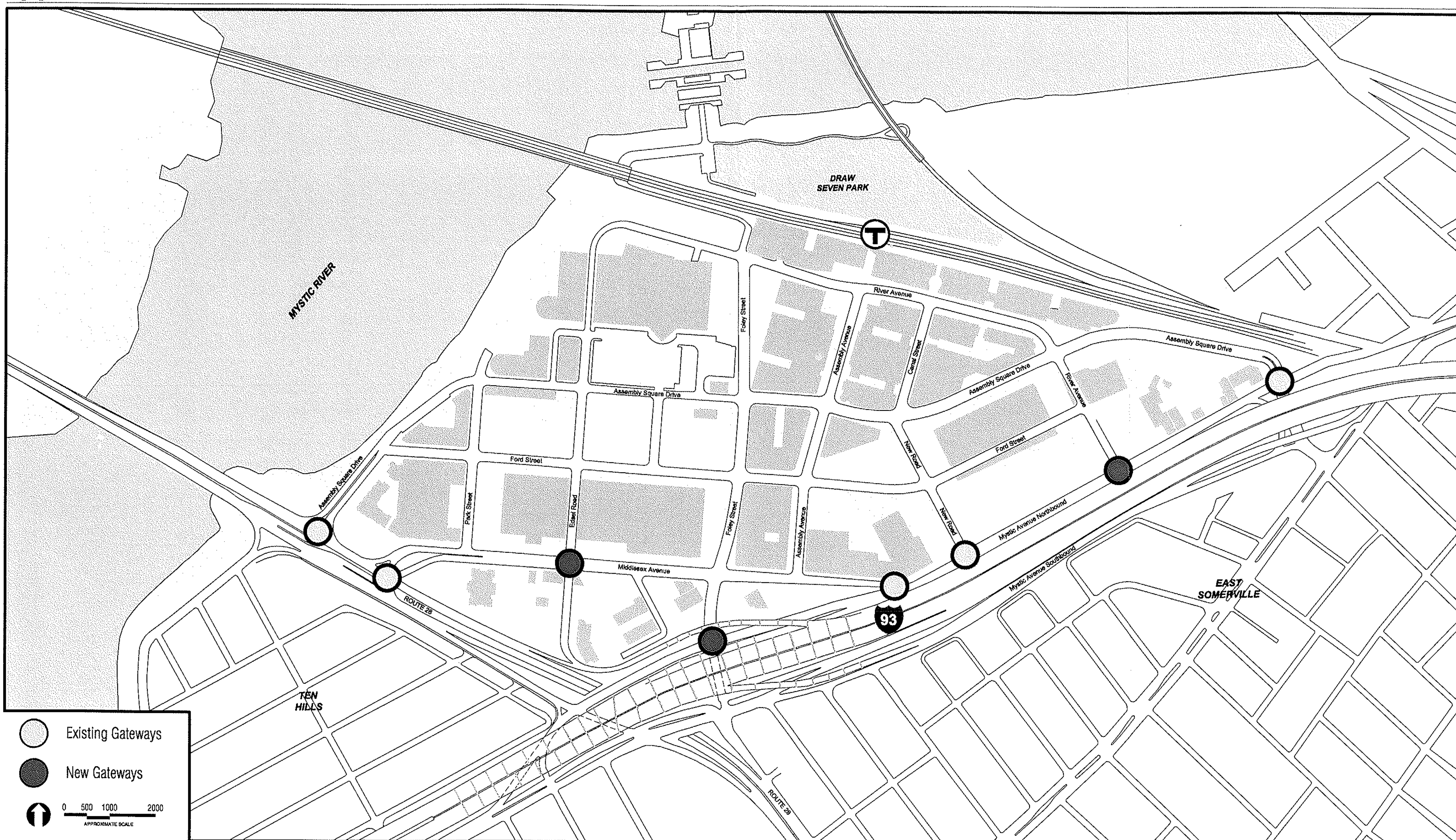
Roadway Plan
Alternative 1

Figure 4-18



Assembly Square Transportation Plan
Somerville, Massachusetts

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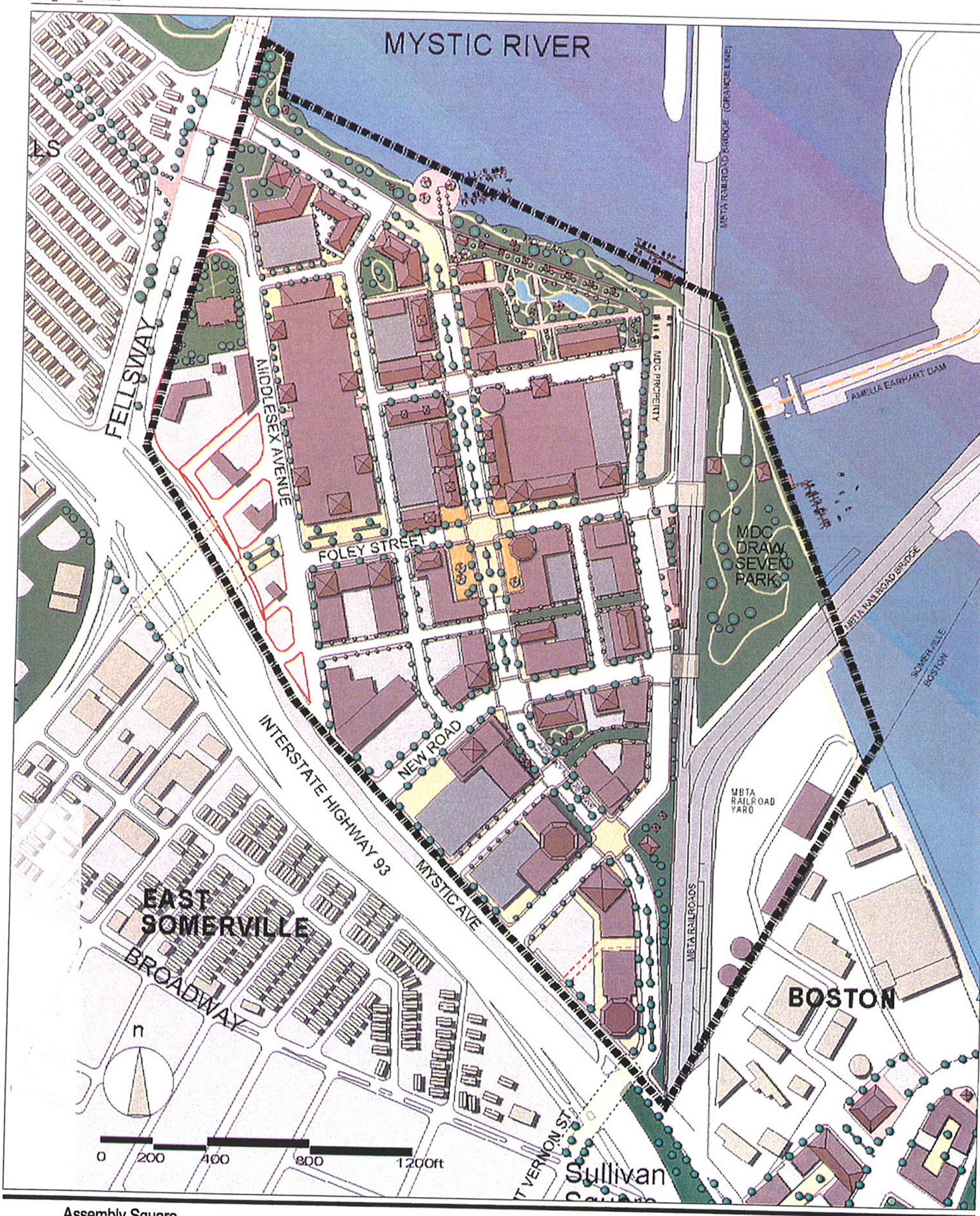
Roadway Plan
Alternative 1
District Gateways

Figure 4-19



Assembly Square Transportation Plan
Somerville, Massachusetts

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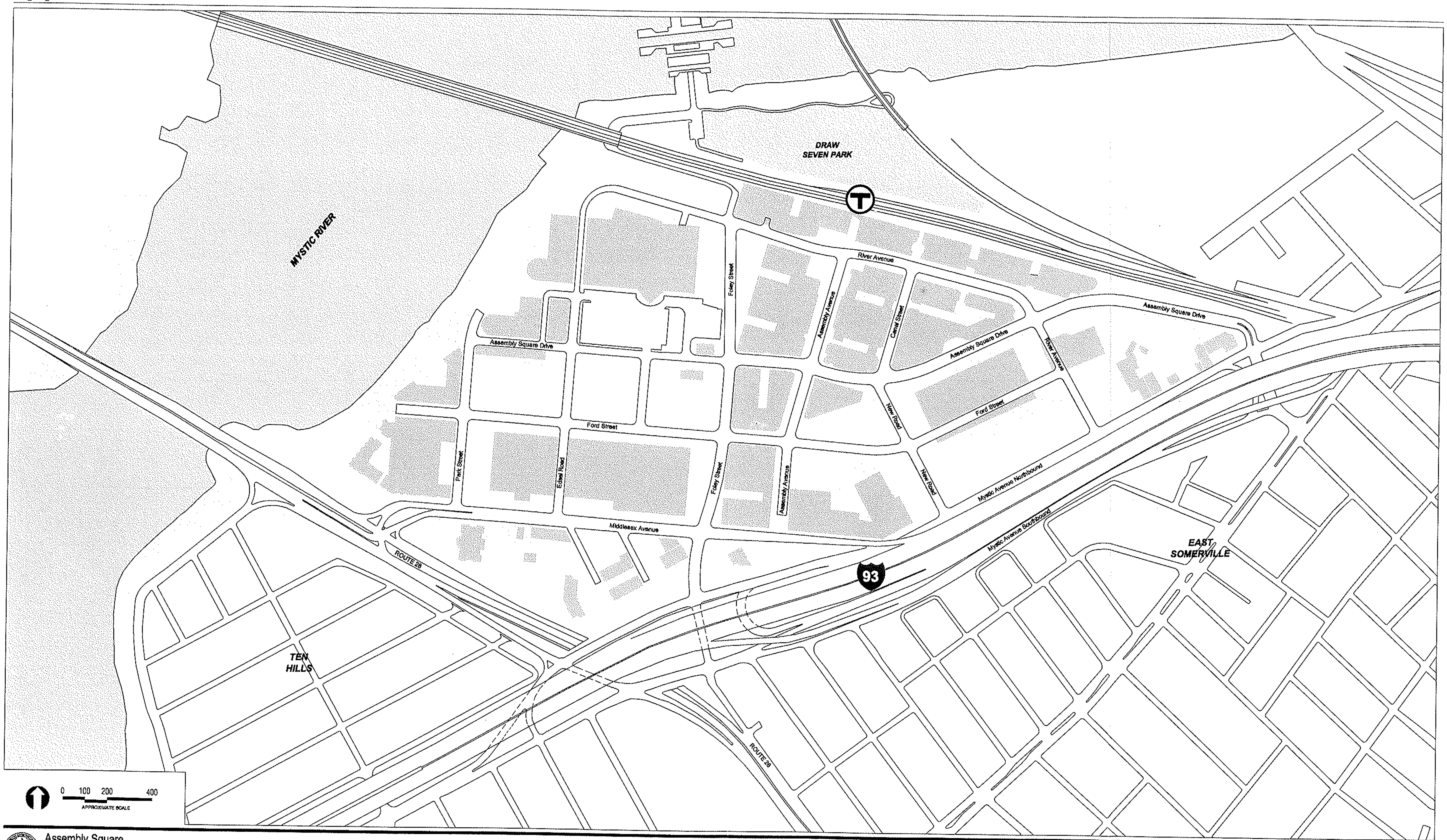
SOURCE: Cecil Group

Assembly Square Planning Study Recommended Plan

Figure 4-20



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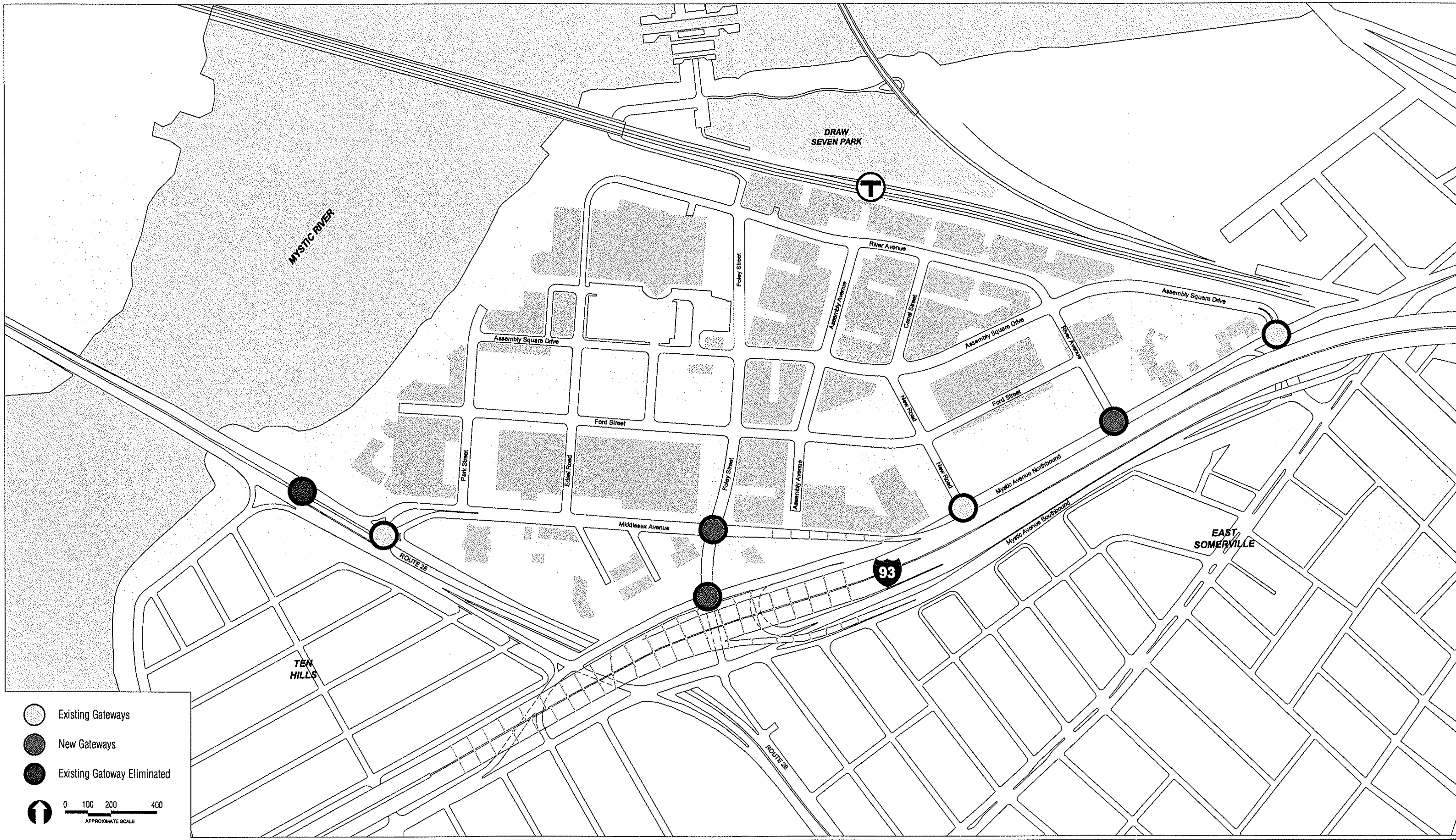
Roadway Plan
Alternative 2

Figure 4-21



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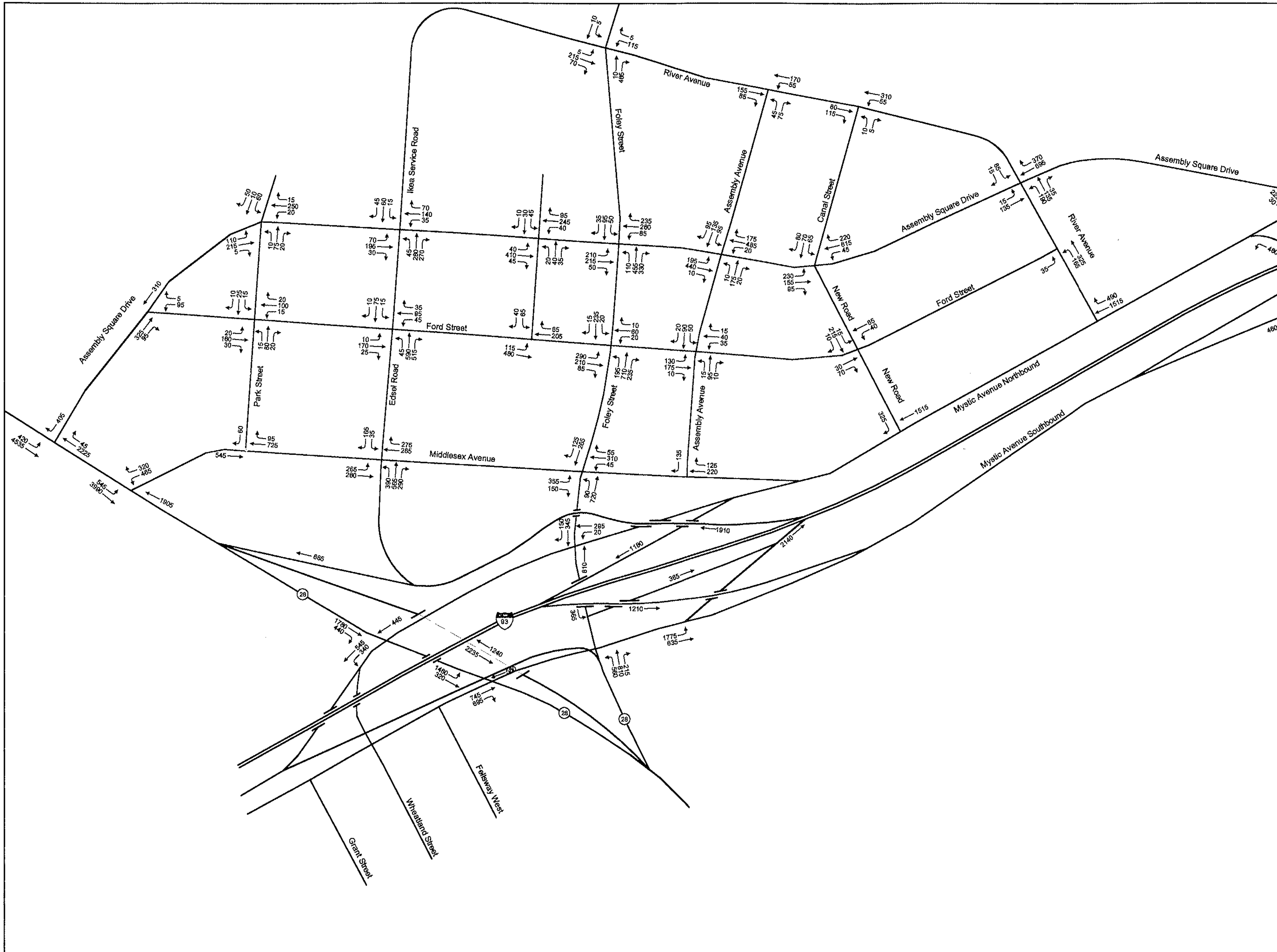
Roadway Plan
Alternative 2
District Gateways

Figure 4-22



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Sheet Title
AM Peak Hour Volumes
Alternative 1

Not to Scale

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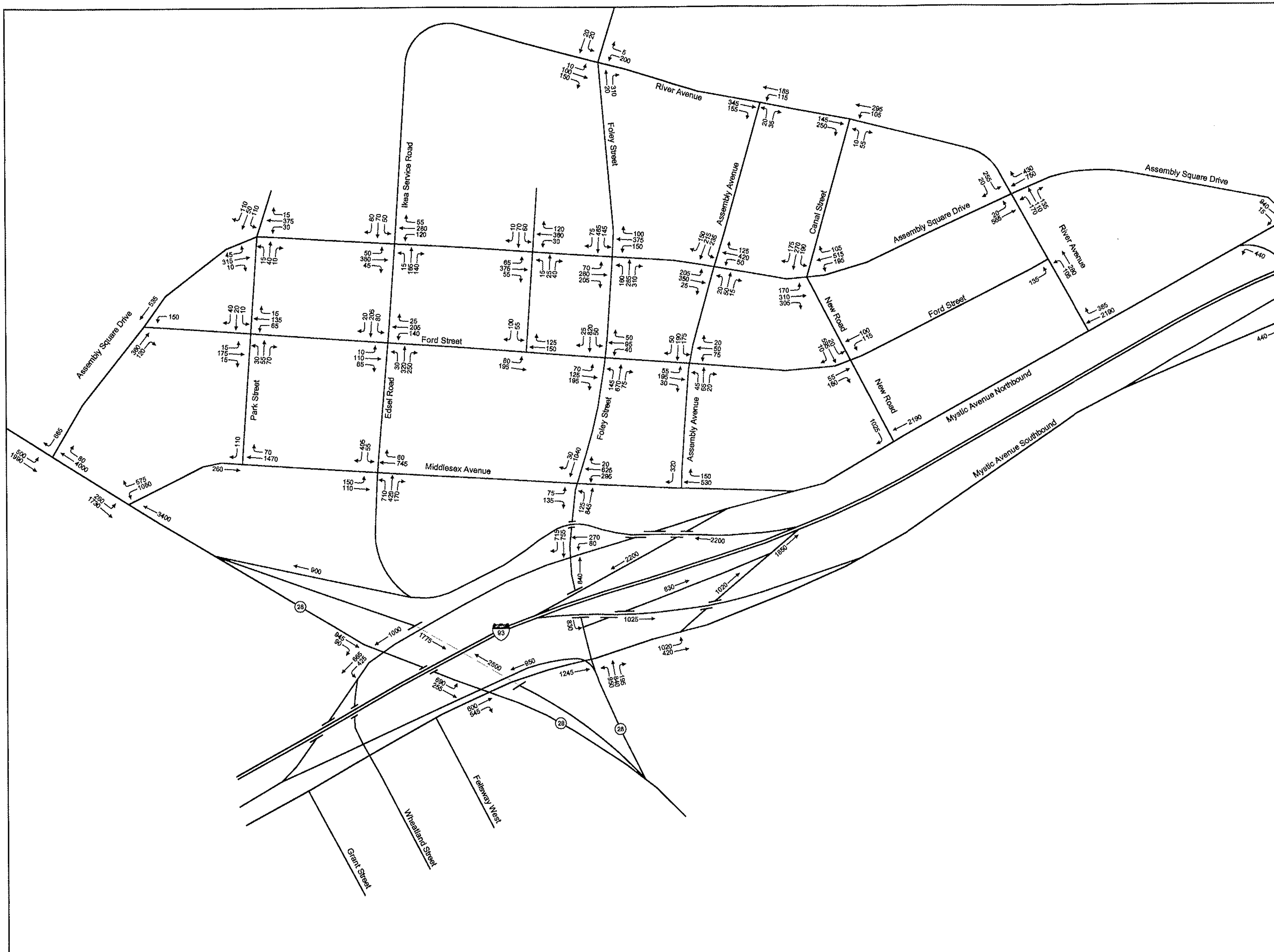

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Sheet Title
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Alternative 1

Not to Scale

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Date: 04/02/03
4-24
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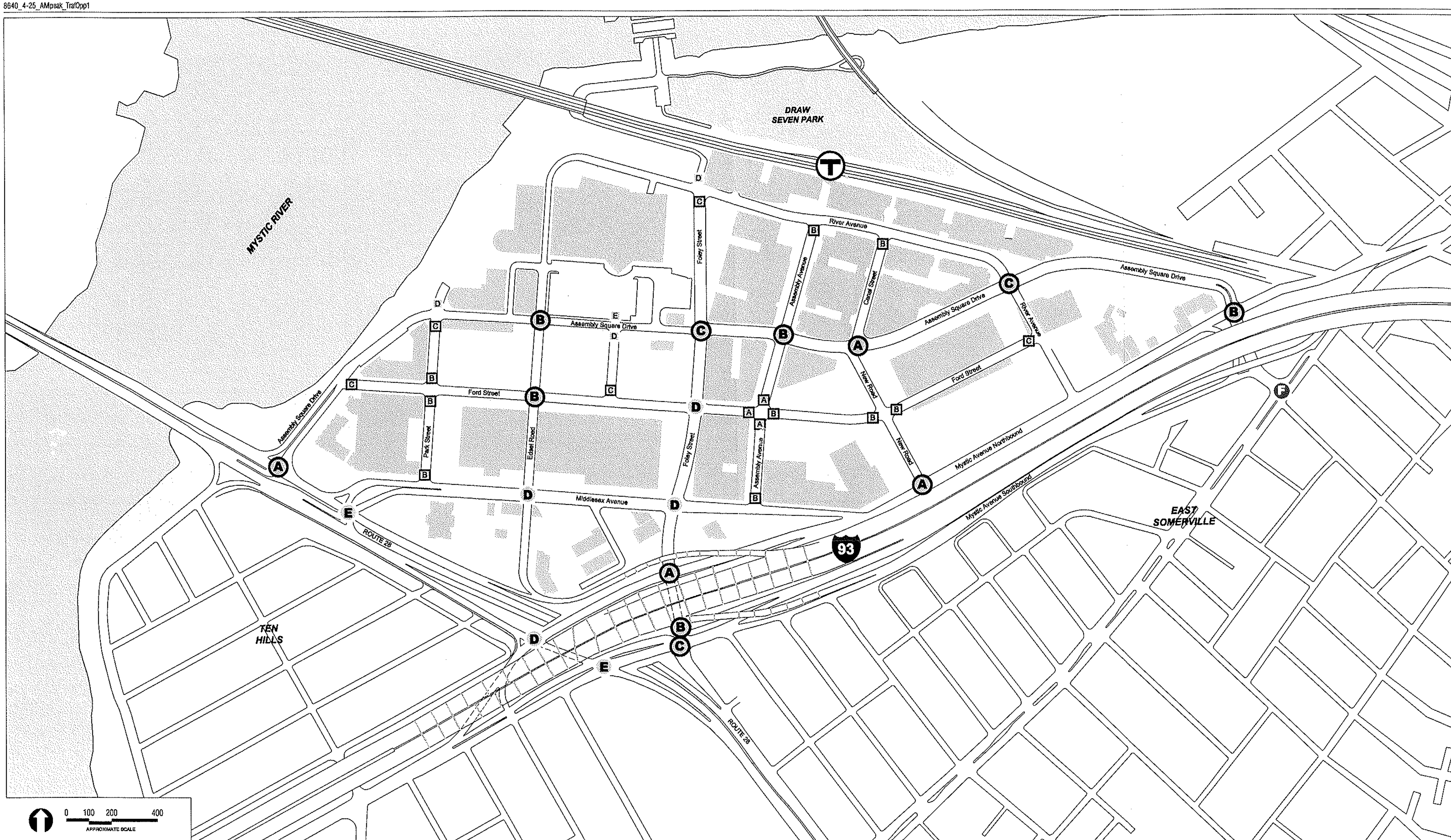

Assembly Square Transportation Plan
Somerville, Massachusetts

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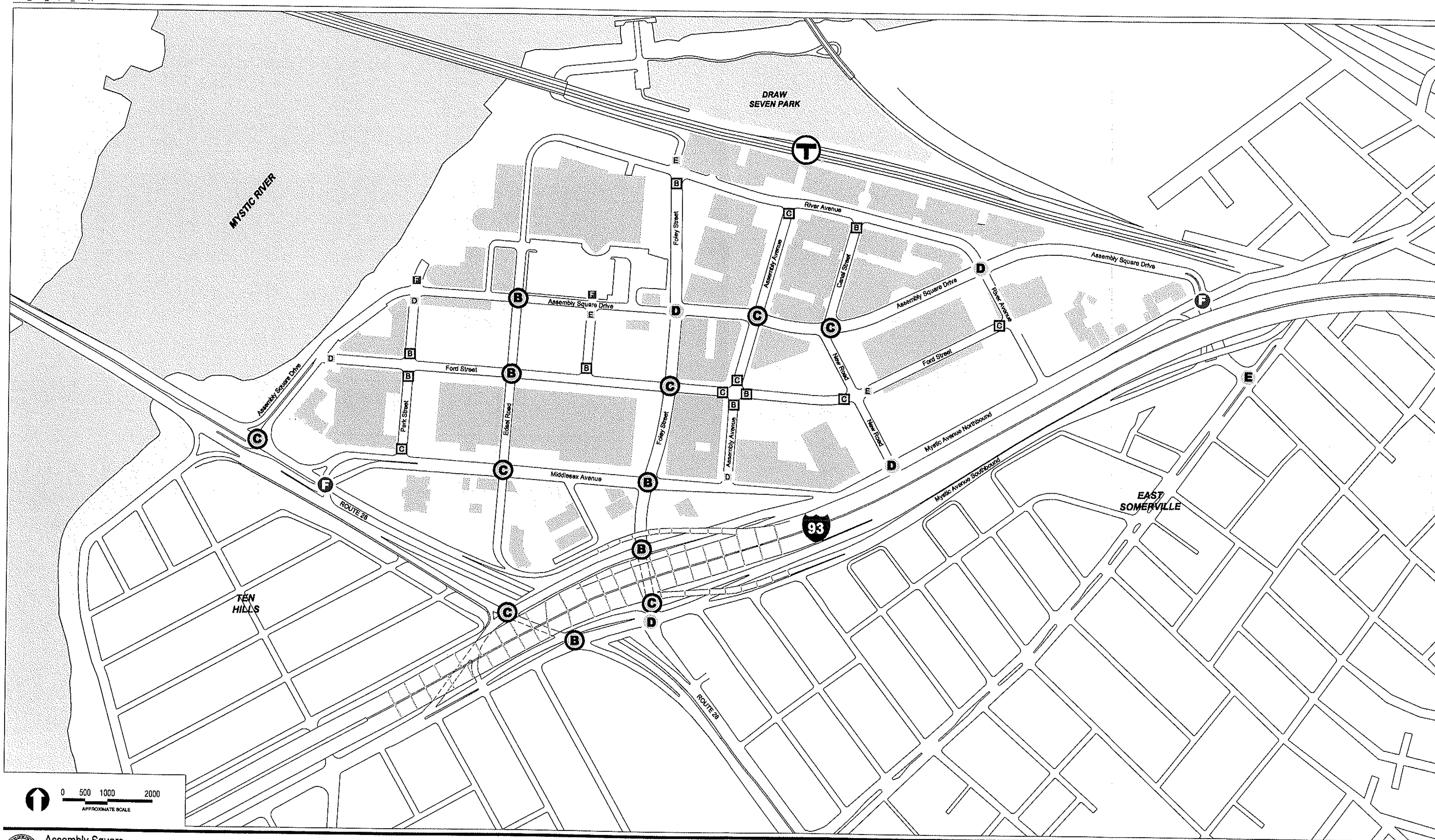
AM Peak Hour
Traffic Operations
Alternative 1

Figure 4-25

8640_4-26_PMpeak_TrafOpp1



Assembly Square Transportation Plan
Somerville, Massachusetts

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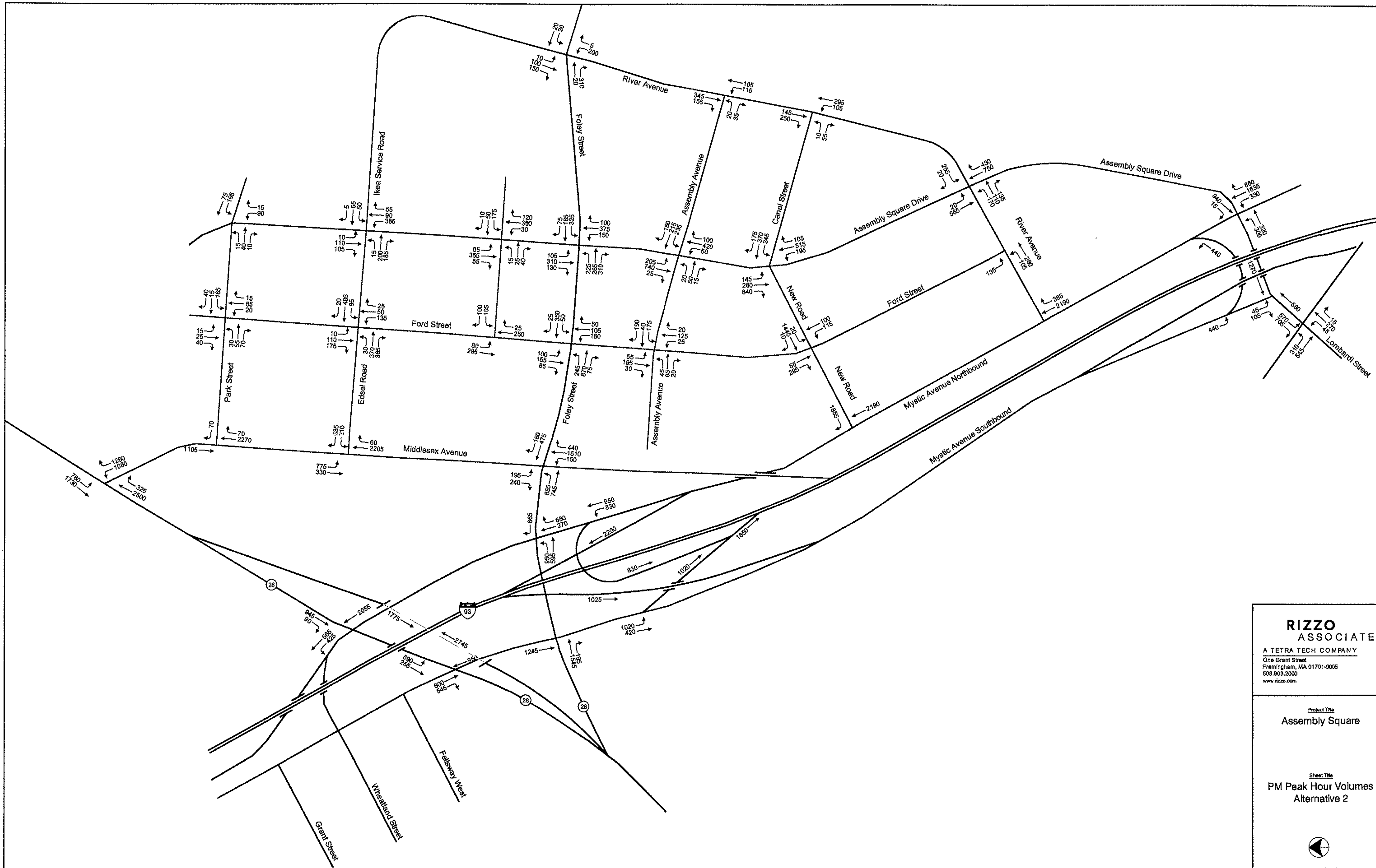
PM Peak Hour Traffic Operations Alternative 1

Figure 4-26



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Alternative 2

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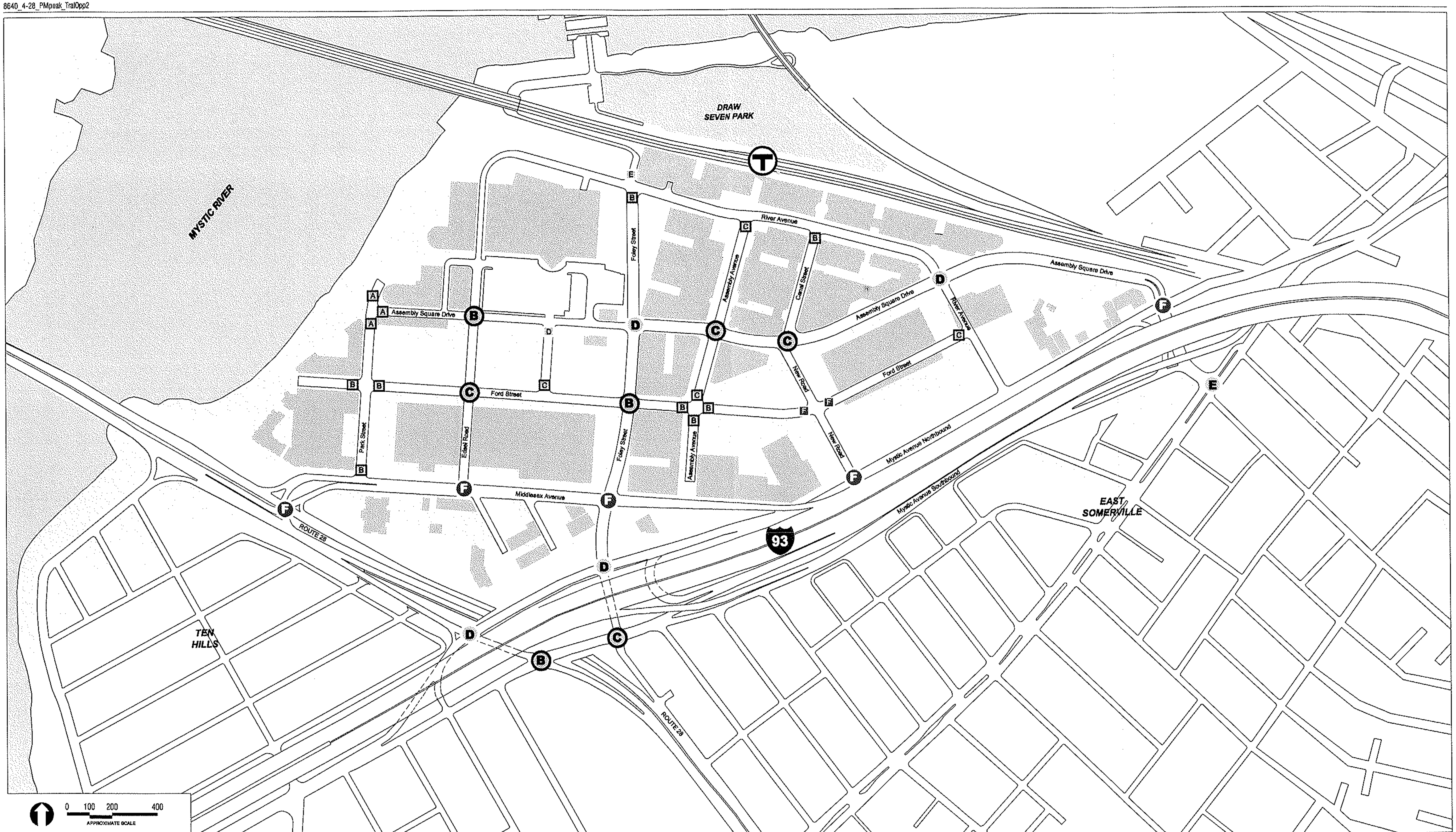

Assembly Square Transportation Plan
Somerville, Massachusetts

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PM Peak Hour
Traffic Operations
Alternative 2

Figure 4-28

5.0 Transportation Plan Recommendations

The findings of the alternatives analysis have produced a comprehensive, multi-modal set of transportation improvement recommendations for the future of Assembly Square. This transportation improvement plan includes recommendations for public transportation, pedestrian and bicycle, and motor vehicle improvements, as well as order-of-magnitude costs for the improvements and proposed policy guidelines for implementing the improvements.

5.1 Public Transportation

Public transportation system improvements are central to enhancing multi-modal access for Assembly Square, reducing automobile reliance, and achieving the dense, urban vision for Assembly Square. The travel demand model results demonstrate the potential for public transit ridership to Assembly Square, especially by the proposed rail transit connections, i.e. the Orange Line and the Urban Ring Phase 3.

The Assembly Square future full-build public transportation system should include the following elements, as shown in Figure 5-1.

5.1.1 Orange Line Station

The Orange Line runs along the eastern edge of Assembly Square, directly adjacent to the Yard 21 site with its proposed dense mixed-use development. The significant obstacles between Assembly Square and the adjacent Orange Line stations at Sullivan Square (the physical and visual barrier of the I-93 viaduct, its ramps, and the Mystic Avenue frontage road system) and Wellington Station (the railroad tracks and parking garage surrounding the station, and the Mystic River) threaten to permanently undermine transit ridership at Assembly Square. Therefore, an Orange Line station within the Assembly Square district is critical for achieving a balanced transportation system at Assembly Square. The subsequent Assembly Square Orange Line Feasibility Study will assess issues of rail operations, station siting, station design, and cost.

5.1.2 Urban Ring Rail

Phase 3 of the Urban Ring circumferential transit system will entail rail transit through the western / southwestern portion of the Urban Ring corridor. The Urban Ring study process is still considering different rail technology and alignment alternatives, such as whether the Urban Ring would be a heavy rail line or a light rail line, and whether its northern terminus would be at Assembly Square (in the case of light rail) or would continue to the north and interline with the Orange Line (in the case of heavy rail). However, these distinctions are not highly relevant for planning Assembly Square's future transportation system. The travel demand model results show that Urban Ring rail can offer significant transit access benefits for Assembly Square, irrespective of the specific alternative. From the perspective of planning for Assembly Square, the relevant characteristics of the Urban Ring rail system are high-capacity rail rapid transit connections to Kendall Square, MIT / Mass Avenue, Kenmore Square / Yawkey Station, Boylston Street / Park Drive, Longwood Avenue / Louis Pasteur, Ruggles Station, and Dudley Square, as well as to the other MBTA rapid transit lines and the other elements of the Urban Ring system.

5.1.3 Urban Ring Bus Rapid Transit (BRT)

Phase 2 of the Urban Ring will entail implementing several bus rapid transit (BRT) routes through the Urban Ring corridor. These BRT routes will continue to operate in the Phase 3 full-build of the Urban Ring. Two of the BRT routes will have implications for Assembly Square. The BRT1 route is proposed to pass through the center of Assembly Square on Assembly Square Drive, with connections to Wellington Station, Everett, and Logan Airport to the north, and to Sullivan Square, New Lechmere, Cambridgeside, Second Street and Kendall / MIT Station to the south. The BRT3 route is currently proposed to run from Wellington Station past Assembly Square on Route 28 to Gilman Square, Union Square, New Lechmere, Cambridgeside, and Kendall / MIT, without directly serving Assembly Square. With the proposed new connection from Route 28 northbound into Assembly Square via Foley Street Extension, diverting the BRT3 route via Foley Street to the center of Assembly Square may be worth investigating. This would provide better transit connections to Assembly Square for much of Somerville (i.e. the Gilman Square and Union Square areas).

5.1.4 Bus

Assembly Square will also be served by a new Urban Ring phase 1 conventional bus route, the CT5. In the future full-build condition, some reorganization of the existing 90, 92, and 95 bus routes may be desirable, in light of the new connections to be provided by the Urban Ring routes. However, some form of these bus routes will likely remain, since they provide connections that the Urban Ring routes will not. Once all these other transit connections are implemented, it is likely that the shuttle bus proposed for the 2007 short-term condition will not be needed.

5.1.5 Commuter Rail

The Haverhill and Newburyport / Rockport commuter rail lines run through Sullivan Square. Providing commuter rail service at Sullivan Square could help to improve the connectivity of the transit system, and enhance the development opportunities at Sullivan Square and Assembly Square. Commuter rail riders could connect to Assembly Square via the many transit modes linking Assembly Square and Sullivan Square (Orange Line, Urban Ring rail, Urban Ring BRT, bus).

5.2 Pedestrian and Bicycle

In order to make Assembly Square into a vibrant, urban village, it is essential that the district's pedestrian and bicycle accommodation be improved, both at the gateways into and out of the district and throughout the interior of the district. Pedestrian and bicycle accommodation should be incorporated into all roadway design and signal timing plans. The following are the future full-build pedestrian and bicycle recommendations for Assembly Square's gateways and its internal street network.

5.2.1 Assembly Square Gateways

Pedestrian and bicycle access at Assembly Square's gateways is critical to opening up the district's boundaries and better integrating Assembly Square with the surrounding neighborhoods. However, these gateways are located on major regional roadways, with very high traffic volumes.

Therefore, pedestrian and bicycle accommodation at the major gateways must be planned carefully. Pedestrians and bicycles should be given as many crossings as possible, and they should be as direct as possible. However, pedestrian and bicycle access should be weighed against pedestrian and bicycle safety, as well as traffic operations considerations.

Figure 5-2 shows the recommended pedestrian and bicycle accommodation at the district gateways. Pedestrian and bicycle access along Assembly Square's boundaries is limited in some locations in order to separate pedestrians and bicycles from highway ramps and from high-speed traffic flows.

The following is a description of the pedestrian and bicycle access at the major gateways that can accommodate pedestrians and bicycles.

Route 28 at the Mystic River

The Mystic Riverfront park connections should be continuous for pedestrians and bicycles. Due to heavy vehicular volumes, wide crossings, and the complex signal coordination at the Route 28 intersections, it is recommended that the pedestrian / bicycle connection be grade-separated. The proposal for a pedestrian / bicycle connection beneath the Route 28 Bridge should be implemented.

Route 28 / Middlesex Avenue

This is a large intersection, with a wide crossing of Route 28 that is broken up into three stages by medians. Currently, there is a concurrent pedestrian crossing of this intersection, but because there is no signal control of the Route 28 northbound right turn onto Middlesex Avenue nor of the Middlesex Avenue northbound right turn onto Route 28, these crossings are not protected. In the recommended plan, the Route 28 northbound right turn is eliminated, and the Middlesex Avenue northbound right turn is signalized, so that all crossings are signal-protected. In addition the crosswalks and the pedestrian signal heads should be upgraded.

Foley Street Extension

The entire length of the new segment of Foley Street, a.k.a. Foley Street Extension, from Mystic Avenue southbound to Middlesex Avenue, essentially becomes the new pedestrian and bicycle gateway. In order to accommodate the significant traffic volumes through the intersections along Foley Street Extension, the pedestrian and bicycle accommodation should all be along the southern side of the road. Therefore, Foley Street Extension should be designed with a generous sidewalk and an off-street, two-way bicycle path along its southern side of Foley Street Extension. The segment of Foley Street Extension beneath the I-93 viaduct should be well-lit and outfitted with attractive, pedestrian and bicycle-scaled finishes.

Assembly Square Drive / Mystic Avenue Northbound / Lombardi Street

This intersection was recently upgraded, and now includes improved crosswalks and pedestrian signal heads. However, the passage beneath the I-93 viaduct is still long and uninviting. As with the Foley Street Extension passage beneath the I-93 viaduct, Lombardi Street should be well-lit and provided with pedestrian and bicycle-scaled finishes.

Assembly Square Rail Station

The Orange Line / Urban Ring rail station will be a pedestrian gateway by virtue of its role as a public transit hub. It should also be designed so that it provides public pedestrian and bicycle access between Assembly Square and Draw Seven Park. The rail station offers an opportunity to better integrate Draw Seven Park into Assembly Square, in spite of the fact that the rail tracks separate the two.

Amelia Earhart Dam

Although the Amelia Earhart Dam across the Mystic River is not currently accessible, a pedestrian and bicycle connection at this point could help to lengthen the Mystic Riverfront park system. This connection could help to close gaps in the East Coast Greenway and the Bike to the Sea.

5.2.2 Assembly Square Internal Street Network

Pedestrian and bicycle accommodation is included in all street layouts for the internal street network. The following are the standard pedestrian and bicycle facilities that are specified for all of Assembly Square's internal streets (roadways layouts described in more detail below in Section 5.3.2).

- 12-foot sidewalks
- Deciduous street trees to provide a buffer between pedestrians and vehicles, to provide shade in warm weather, and to provide an attractive street environment
- 5-foot on-street bicycle lanes (or wide outside lane)
- Crosswalks at all intersection approaches (with the exception of a few gateway intersections, as shown in Figure 5-2)

Pedestrian and bicycle accommodation is also an inherent component of the principles that have guided the roadway planning:

- Robust street grid
- New gateways for Assembly Square
- Street hierarchy
- Small, urban-scaled blocks
- Direct connections into and out of Assembly Square

In addition, the City of Somerville should require developers to provide bicycle storage as an integral part of all developments. This should include both secure storage for employees and/or residents, and publicly-available bicycle storage in convenient locations. Bicycle parking should also be provided at the MBTA station.

5.3 Motor Vehicle

Located directly adjacent to major regional highways, Assembly Square has the potential for excellent motor vehicle access. In order to achieve this, Assembly Square must improve the gateways at its edges, and create a robust, cohesive internal street network.

5.3.1 Regional Roadway Connections

The regional roadway improvement recommendations are designed to create new gateways for Assembly Square, enhance the connectivity between Assembly Square's roadway system and the regional roadway system, and better integrate Assembly Square into the surrounding roadway network.

Central to improving Assembly Square's regional roadway connections and its gateways is the recommended reconstruction of the I-93 Ramps / Route 28 / Mystic Avenue interchange. The proposed interchange improvements include the following components, as shown in Figure 5-3:

- Foley Street Extension: Connects Route 28 Northbound to Assembly Square and Connects Assembly Square to I-93 Southbound On-Ramp
- Rebuilt I-93 Northbound Off-Ramp to Route 28 Northbound, Split to Middlesex Avenue (connections to Assembly Square, Route 28 southbound, Mystic Avenue northbound)
- Route 28 Southbound Underpass

- Elimination of Redundant Route 28 Southbound to I-93 Southbound Ramp
- Retention of Two-Way Segment of Mystic Avenue North of Foley Street Extension

5.3.2 Internal Street Network

The recommended internal street network is shown in Figure 5-4. This figure shows the street network and block layout, and it also shows the lane assignment at the internal intersections. This lane assignment is consistent with the traffic operations analysis summarized in Section 4.4.2 for Roadway Plan Alternative 1, and represents the recommended conceptual roadway layout for the internal street network.

This street network comprises the principal streets that will carry most of the traffic. The blocks created by this street network are generally urban-scaled, but would benefit from further division. These blocks could be divided by alleys, service roads and exclusive pedestrian connections. These connections would not carry major traffic volumes, and would not have a significant impact on traffic operations. Figure 5-5 shows a conceptual plan with the locations of such minor connectors; the City of Somerville should work with developers on a parcel-specific basis to determine the optimal layout of these minor connectors.

For the sake of simplicity and flexibility, it is assumed that the principal street layouts will adhere to one of three general layouts. These layouts, which are summarized in Table 5-1, are shown in Figure 5-6.

Table 5-1 Assembly Square Street Layouts

Roadway Type	Features
Two-way, four-lane streets	Travel lanes: 4 x 11' lanes Bicycle lanes: 2 x 5' lanes Sidewalks: 2 x 12' sidewalks Landscaping: Street trees, both sides, 35' spacing Required right-of-way (back of sidewalk): 80 feet
Two-way, two-lane streets	Travel lanes: 2 x 11' lanes Bicycle lanes: 2 x 5' lanes "Door zones": 2 x 2' clear area Parking lanes: 2 x 8' lanes Sidewalks: 2 x 12' sidewalks Landscaping: Street trees, both sides, 35' spacing Required right-of-way (back of sidewalk): 77 feet

One-way, two-lane streets	Travel lanes: 2 x 11' lanes Shoulders: 2 x 4' shoulders Sidewalks: 2 x 12' sidewalks Landscaping: Street trees, both sides, 35' spacing Required right-of-way (back of sidewalk): 55 feet

In order to provide the most flexible and conservative palette for roadway design in Assembly Square, these proposed roadway layouts are intended to be generous, in facilities provided, right-of-way required, and level of finish. In addition, these layouts can be amended as available right-of-way and budget allows. For example, on the two-way, two-lane streets, the right-of-way may be narrowed by eliminating one or both parking lanes or replacing bicycle lanes with wide outside lanes (i.e. 14' travel lanes instead of 11' travel lanes plus 5' bicycle lanes). On any of these layouts, the street trees may be eliminated, which enables an 8-10' sidewalk and saves the cost of the street trees.

Figure 5-7 shows the layouts that have been assumed for each segment of internal roadway in Assembly Square.

5.4 Implementation Plan

This section presents cost estimates and information regarding the implementation of the recommended plan.

The cost estimates for the proposed transit system improvements are included. The proposed Orange Line station is currently the subject of a more detailed study, the *Assembly Square Rapid Transit Feasibility Study.* This study will evaluate Orange Line station design, planning, and rail operations in greater detail, and is a more appropriate vehicle for undertaking cost estimates for this improvement.

The Urban Ring is the subject of an ongoing, comprehensive environmental review process by the Massachusetts Bay Transportation Authority. It would be difficult and largely irrelevant to assess costs that are related only to Assembly Square.

In most cases, the costs of the proposed pedestrian and bicycle improvements are integrated into the roadway and intersection improvement costs. One exception to this is the Route 28 Bridge Pedestrian / Bicycle Undercarriage connection, which was previously estimated to cost $500,000.

The following are order-of-magnitude cost estimates for the regional highway improvements and the internal street construction.

5.4.1 Cost Estimates for Regional Connections

The recommended reconstruction of the I-93 Ramps / Route 28 / Mystic Avenue interchange includes the following components, as shown in above in Figure 5-3:

- Foley Street Extension: Connects Route 28 Northbound to Assembly Square and Connects Assembly Square to I-93 Southbound On-Ramp
- Rebuilt I-93 Northbound Off-Ramp to Route 28 Northbound, Split to Middlesex Avenue (connections to Assembly Square, Route 28 southbound, Mystic Avenue northbound)
- Route 28 Southbound Underpass
- Elimination of Redundant Route 28 Southbound to I-93 Southbound Ramp
- Retention of Two-Way Segment of Mystic Avenue North of Foley Street Extension

The interchange redesign proposal also incorporates certain traffic signal and adjacent surface roadway improvements for elements of the interchange area that are affected by the reconstruction, but whose configuration is not significantly altered from existing conditions. Table 5-2 summarizes the elements of the interchange reconstruction, along with estimated costs for each element.

Table 5-2 Interchange Construction Costs

Item	Cost
Route 28 Underpass	
Boat section	$10,200,000
Tunnel section	$15,300,000
Reconstruct Rt. 28 SB at grade	$630,000
Reconstruct Rt. 28 NB at grade	$210,000
Total	**$26,340,000**
Route 28 SB Roadway Connector to I-93 SB On-Ramp	
Roadway Demolition	**$55,000**
Mystic Avenue NB / Route 28 SB Intersection	
Reconstruct intersection	$100,000
Upgrade traffic signal	$150,000
Total	**$250,000**
Mystic Avenue SB / Route 28 SB	
Reconstruct intersection	$100,000
Upgrade traffic signal	$150,000
Total	**$250,000**
Roadway Maintenance	
Mystic Avenue NB	$100,000
Mystic Avenue SB	$40,000
Mystic Avenue 2-Way	$105,000
Sidewalk Reconstruction	$225,000
Total	**$470,000**
Route 28 to Assembly Square Connector Road (Foley Street Extension)	
New traffic signals	$600,000
New roadway construction (Rt. 28 to Middlesex Ave)	$240,000
Property takings (truck yard)	$287,000
Property takings (Kmart Garden Center)	$172,000
Total	**$1,299,000**
I-93 Southbound On-Ramp	
Demolish existing ramp from on-ramp to Mystic Ave SB	$525,000
Ramp maintenance (cold plane & overlay)	$96,000
Total	**$621,000**
I-93 Northbound Off-Ramp (to Route 28 NB, split to Middlesex Ave)	
Demolish existing ramp	$864,000
New ramp	
Viaduct section	$4,275,000
Retaining walls and fill	$810,000
At-grade section (to Route 28 northbound)	$243,000
At-grade section (to Middlesex Avenue at Edsel Road)	$162,000
Property takings (behind Tage Inn, Spaulding Brick)	$287,000
Total	**$6,641,000**
Subtotal	**$35,926,000**
Traffic Maintenance (25%)	**$8,981,500**
Contingency (20%)	**$8,981,500**
TOTAL	**$53,889,000**

5.4.2 Cost Estimates for Internal Street Network

The internal street network cost estimate is broken down by street segment in order to facilitate assignment to appropriate contributors. Minor connectors, such as alleys and service roads, have not been included; it is assumed that these would principally be private streets, and should be the responsibility of developers to build for the purpose of improving their own access and parcel planning. The cost of these minor connectors should not be considered mitigation.

These layouts were used to estimate the roadway costs for each segment, as summarized below in Table 5-3:

Table 5-3 Surface Roadway Construction Costs

Roadway and Segment	Length (ft)	Cost	
Assembly Square Drive			
Mystic Avenue NB to River Avenue	1,000	$	199,800
River Avenue to Canal Street / New Road	775	$	376,200
Canal Street / New Road to Assembly Ave	325	$	157,400
Assembly Avenue to Foley Street	350	$	170,000
Foley Street to Center Lane	400	$	183,600
Center Lane to Edsel Road	325	$	149,275
Edsel Road to Park Street	475	$	217,925
Park Street to Ford Street	525	$	241,875
Ford Street to Route 28	500	$	99,900
Assembly Square Drive Total	**4,675**	**$**	**1,795,975**
Foley Street			
Middlesex Avenue to Ford Street	450	$	217,200
Ford Street to Assembly Square Drive	350	$	70,250
Assembly Square Drive to River Avenue	625	$	286,575
Foley Street Total	**1,425**	**$**	**574,025**
River Avenue			
Mystic Avenue NB to Ford Street	300	$	111,800
Ford Street to Assembly Square Drive	275	$	101,950
Assembly Square Drive to Canal Street	575	$	264,225
Canal Street to Assembly Avenue	325	$	149,275
Assembly Avenue to Foley Street	525	$	241,875
River Avenue Total	**2,000**	**$**	**869,125**
Ford Street			
River Avenue to New Road	775	$	356,825
New Road to Assembly Avenue	550	$	252,250
Assembly Avenue to Foley Street	300	$	137,300
Foley Street to Center Lane	400	$	183,600
Center Lane to Edsel Road	325	$	149,275

Edsel Road to Park Street	475	$	217,925
Park Street to Assembly Square Drive	400	$	183,600
Ford Street Total	**3,225**	**$**	**1,480,775**

Table 5-3 Surface Roadway Construction Costs (continued)

Roadway and Segment	Length (ft)		Cost
Middlesex Avenue			
Mystic Avenue NB to Foley Street	850	$	144,650
Foley Street to Route 28	1,500	$	307,200
Middlesex Avenue Total	**2,350**	**$**	**451,850**
New Road / Canal Street			
New Road: Middlesex Ave NB to Ford Street	325	$	76,150
New Road: Ford Street to Assembly Square Dr	325	$	55,025
Canal Street: Assembly Square Dr to River Ave	550	$	252,250
New Road / Canal Street Total	**1,200**	**$**	**383,425**
Assembly Avenue			
Middlesex Avenue to Ford Street	450	$	205,950
Ford Street to Assembly Square Drive	375	$	171,625
Assembly Square Drive to River Avenue	550	$	252,250
Assembly Avenue Total	**1,375**	**$**	**629,825**
Roadway and Segment	**Length (ft)**		**Cost**
Center Lane			
Ford Street to Assembly Square Drive	375	**$**	**171,625**
Edsel Road			
Middlesex Avenue to Ford Street	450	$	205,950
Ford Street to Assembly Square Drive	375	$	171,625
IKEA Road: Assembly Square Dr to River Ave	1,325	$	496,450
Edsel Road Total	**2,150**	**$**	**874,025**
Park Street			
Middlesex Avenue to Ford Street	450	$	205,950
Ford Street to Assembly Square Drive	375	$	171,625
Park Street Total	**825**	**$**	**377,575**
ROADWAY CONSTRUCTION TOTAL	**19,600**	**$**	**7,608,225**

The costs above are based on the following basic assumptions:

- Full-depth construction of most roadway segments
- For existing streets that are in good shape and will remain in their existing location (e.g. Middlesex Avenue, Assembly Square Drive from Mystic Avenue northbound to River Avenue):
  - Significant pavement rehabilitation (cold plane to 1.5" depth, overlay with new pavement)
  - New curbs (granite)
  - New sidewalk (concrete)

- MassHighway average bid prices, 2002
- Granite curbs
- Concrete sidewalks
- Street trees
    - Common street tree
    - 3.5" diameter at installation
    - 35-foot spacing
- Takings for interchange: $500,000 per acre (no taking costs assumed for internal streets: assumed that property is donated by land owners / developers)

In addition to these roadway construction costs, the costs for installing traffic signals have also been estimated and are presented in Table 5-4. At most locations, these costs have been estimated at $250,000, a conservative installed cost for a traffic signal in the Boston area. This cost has been increased to $300,000 at two larger intersections, Foley Street / Assembly Square Drive and Foley Street / Foley Street Extension / Middlesex Avenue. These costs and locations are summarized below:

Table 5-4 Traffic Signal Installation Costs

Location	Cost
Assembly Square Drive / River Avenue	$ 250,000
Assembly Square Drive / New Road / Canal Street	$ 250,000
Assembly Square Drive / Assembly Avenue	$ 250,000
Assembly Square Drive / Foley Street	$ 300,000
Assembly Square Drive / Edsel Road	$ 250,000
Foley Street / Middlesex Avenue	$ 300,000
Foley Street / Ford Street	$ 250,000
I-93 NB Off-Ramp / Middlesex Avenue / Edsel Road	$ 250,000
Edsel Road / Ford Street	$ 250,000
Total	**$ 2,350,000**

These costs do not include signals that are included above as an integral part of the interchange reconstruction project.

5.4.3 Implementation of Improvements

The implementation of these recommendations can best be achieved through a combined public and private funding strategy. Public funding and state agency participation will be essential for the large scale infrastructure improvements. Smaller-scale improvements, such as new roadway construction and traffic signals, can be implemented to some degree through public – private partnerships between the City of Somerville and developers in Assembly Square. This developer participation should be pursued in the context of a comprehensive development impact review and policy framework.

Major Public Improvements

Several of the recommendations for improving the transportation system that serves Assembly Square represent large-scale infrastructure improvements. Such improvements include the I-93 Ramps / Route 28 / Mystic Avenue interchange reconstruction, the Orange Line station at Assembly Square, and the Urban Ring. These projects will require significant public funding and the participation of the appropriate state agencies.

The City of Somerville has identified the I-93 Ramps / Route 28 / Mystic Avenue interchange reconstruction as a public safety priority, and has been pursuing this improvement with the Massachusetts Highway Department (MHD). The transportation plan's recommended interchange redesign would address the City's public safety issues, and also improve local and regional access to Assembly Square. The Boston Metropolitan Planning Organization (MPO) has recognized the interchange improvement as a supplemental project in its 2002 *Transportation Improvement Program (TIP)*, and has assigned a $50 million cost to the project.

The City of Somerville has also been pursuing improved public transportation service to Assembly Square with the Massachusetts Bay Transportation Authority (MBTA). One aspect of this improved transit service is the Urban Ring. The MBTA is moving forward on Urban Ring study and implementation, with Assembly Square as a designated service area for both rail and bus rapid transit (BRT) service.

The other key public transportation improvement for Assembly Square is the creation of a new Orange Line station within the district. The Assembly Square Transportation Plan has identified the potential ridership for this station, and the benefits of direct Orange Line service to creating a balanced multi-modal transportation system and achieving a dense urban village at Assembly Square. The City of Somerville will pursue the Orange Line station further through its transit station feasibility study, and through continuing advocacy with the MBTA.

Although these improvements will rely principally upon public funding through the state government, in cooperation with the City of Somerville, advocacy for these improvements at all levels is important. Somerville residents, business interests, and Assembly Square developers should actively support the major public infrastructure priorities that arise from the Assembly Square Transportation Plan.

Development Impact Review and Mitigation

The City of Somerville should work with developers at Assembly Square to assess the impacts of proposed development, and to assign appropriate mitigation for these impacts. In the case of Assembly Square, this mitigation should entail significant investment in the creation of the public realm, including the transportation network. The developers will reap much of the benefit of this new infrastructure investment.

Public Realm Improvements

Assembly Square's internal transportation network is currently limited, and will require significant improvement. Private developers should participate in the creation of the infrastructure that will make their developments feasible and successful. In general, developers should be required to build roadways and install traffic signals within or adjacent to their development parcels. The allocation of the specific improvements should take into account the following issues:

- **Phasing**
  - Roadways should be built roughly in order of hierarchy and connectivity. Major roadways, such as Assembly Square Drive, Foley Street, and River Avenue, should be built first.
  - Traffic signals should be installed as traffic signal warrants are met. Installation of some traffic signals may lag behind construction of roadways. This will enable some flexibility on staging of mitigation costs, since early developers can build roadways and later developers can install traffic signals.
- **Allocation of costs.** Table 5-3 summarizes the projected costs of new internal streets in Assembly Square, broken down by roadway segment, and Table 5-4 summarizes the projected traffic signal costs.

Responsibility for these improvements should be assigned to developers based on the location of the development, the level of transportation impacts (based on some combination of total trips, peak hour vehicle trips, and parking supply), and other mitigation that the developer may be contributing.

- **Connectivity**. The specific layout of the Assembly Square street network and any changes to Assembly Square's gateways and connections to the regional roadway system should be expected to change from these master plan level recommendations. The regional roadway improvements and Assembly Square gateway improvements should be carefully monitored and coordinated with the creation of the internal street network.

Parking

Parking will be a significant issue in the development of Assembly Square. In order to realize the vision of a dense, urban district, parking supply must be monitored and adjusted to maintain a level of parking that is appropriate to the transportation system.

Parking requirements may be higher for short-term development, before significant transit system improvements, such as BRT or rail service, are in place. Over time, however, the district's parking ratio should be reduced. With long-term phased developments, such as the Yard 21 development, this can be in a staged and coordinated fashion. However, this may be more difficult for smaller developments that may be done all at once. In such cases, developments may be permitted to pursue shared parking arrangements, or temporary use of vacant parcels for shared parking.

Over time, as vacant parcels are built out and Assembly Square's density increases, much of the district's surface parking should be replaced with structured parking and/or underground parking. The IKEA Mixed-Use Development proposal provides an example of how a development can combine underground parking, structured parking, and limited surface parking.

Travel Demand Management

Travel demand management (TDM) comprises a variety of strategies designed to reduce single-occupancy vehicle (SOV) travel and encourage "alternate modes" of transportation (public transit, walking, bicycling). Aggressively pursuing TDM at Assembly Square could help the City of

Somerville to manage transportation impacts throughout the district build-out.

Table 5-5 Transportation Demand Management Measures

General Measure	Action
Transportation Management Association	Create an Assembly Square TMA Require developers to participate in the TMA Encourage commercial tenants to join the TMA
Ridesharing / Carpooling.	Facilitate ridesharing through geographic matching, parking fee discounts, and preferential parking for carpools / vanpools.
Guaranteed Ride Home Program	Offer a "guaranteed ride home" in order to remove an obstacle to transit use and ridesharing
Transit Pass Programs.	Encourage employees to use transit through the following measures: Offer on-site transit pass sales or participate in the MBTA Corporate T-Pass Program Offer federal "Commuter Choice" programs, including pre-tax deductions for transit passes and subsidized transit passes
Information and Promotion of Travel Alternatives	Provide employees and visitors with public transit system maps and other system information Provide an annual (or more frequent) newsletter or bulletin summarizing transit, ridesharing, bicycling, alternative work schedules, and other travel options Sponsor an annual (or more frequent) "Transportation Day" at which employees may obtain information on travel alternatives and register to participate in ridesharing programs Provide information on travel alternatives for employees and visitors via the Internet Provide information on travel alternatives to new employees
Bicycle Facilities and Promotion	Provide secure bicycle storage (number of spaces will be specified depending upon size of development and type of land use) Provide additional publicly-accessible bicycle storage (number of spaces will be specified) Provide shower and changing facilities for bicycle commuters Promote bicycles as an alternative to SOV travel, provide promotional material on bicycle commuting and bicycle safety, and provide incentives for bicycle use
Parking-Related Measures	Charge market-rate parking fees Offer preferential parking to carpools and vanpools Offer reduced parking rates to carpools and vanpools Offer parking "cash-out" option Offer garage space for car rentals Offer parking space for car-sharing Offer parking space, charging facilities for electric vehicles Offer parking / layover space for livery vehicles (hotel development) Enforce a 5-minute limit on vehicle idling, in accordance with Massachusetts state law
Trip Reduction Strategies	Telecommuting. Reduce overall trip demand by enabling employees to telecommute. Flexible Work Schedules. Reduce peak hour and overall trip demand by enabling employees to telecommute, work a compressed work week, or work hours that enable off-peak commuting. Local Hiring. Recruit and hire employees from the local area. Such local employees can more easily use alternatives to SOV travel, including walking, bicycling, and transit.
Transportation Coordinator.	Encourage major developments to designate a full-time, on-site employee as the transportation coordinator.
Transportation Monitoring and Annual	Monitor transportation conditions Conduct employee transportation surveys

Reporting.	Provide the City of Somerville with an annual report on findings.

The City of Somerville should require or encourage developers to implement the TDM measures presented in Table 5-5, as appropriate to the scale and land use of the development. The measures include the potential formation of an Assembly Square Transportation Management Association (TMA). A TMA can facilitate improved travel demand management by providing many of the important TDM measures, including ride-matching, guaranteed ride home, and transit information and promotional materials, and achieving significant economies of scale and scope.

Ridesharing / carpooling can be accomplished through membership in a TMA, participation in CARAVAN for Commuters, and/or use of computerized ridesharing software. Transportation coordinators would oversee all transportation issues for specific developments. This includes managing vehicular operations, service and loading, parking, and TDM programs. In addition, the transportation coordinator would be responsible for the monitoring program and serve as the contact and liaison for the City of Somerville and the Transportation Management Association (TMA).

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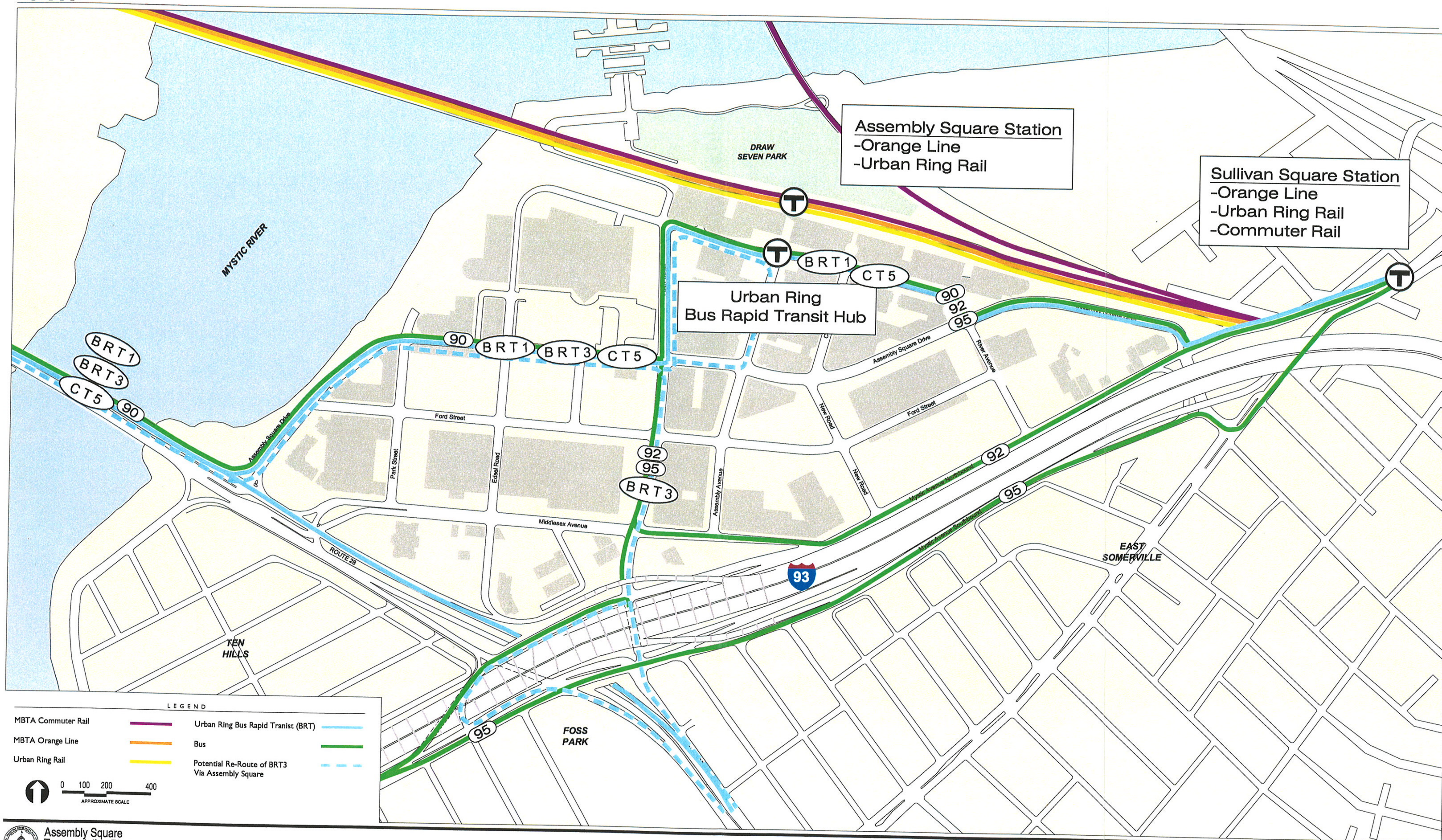
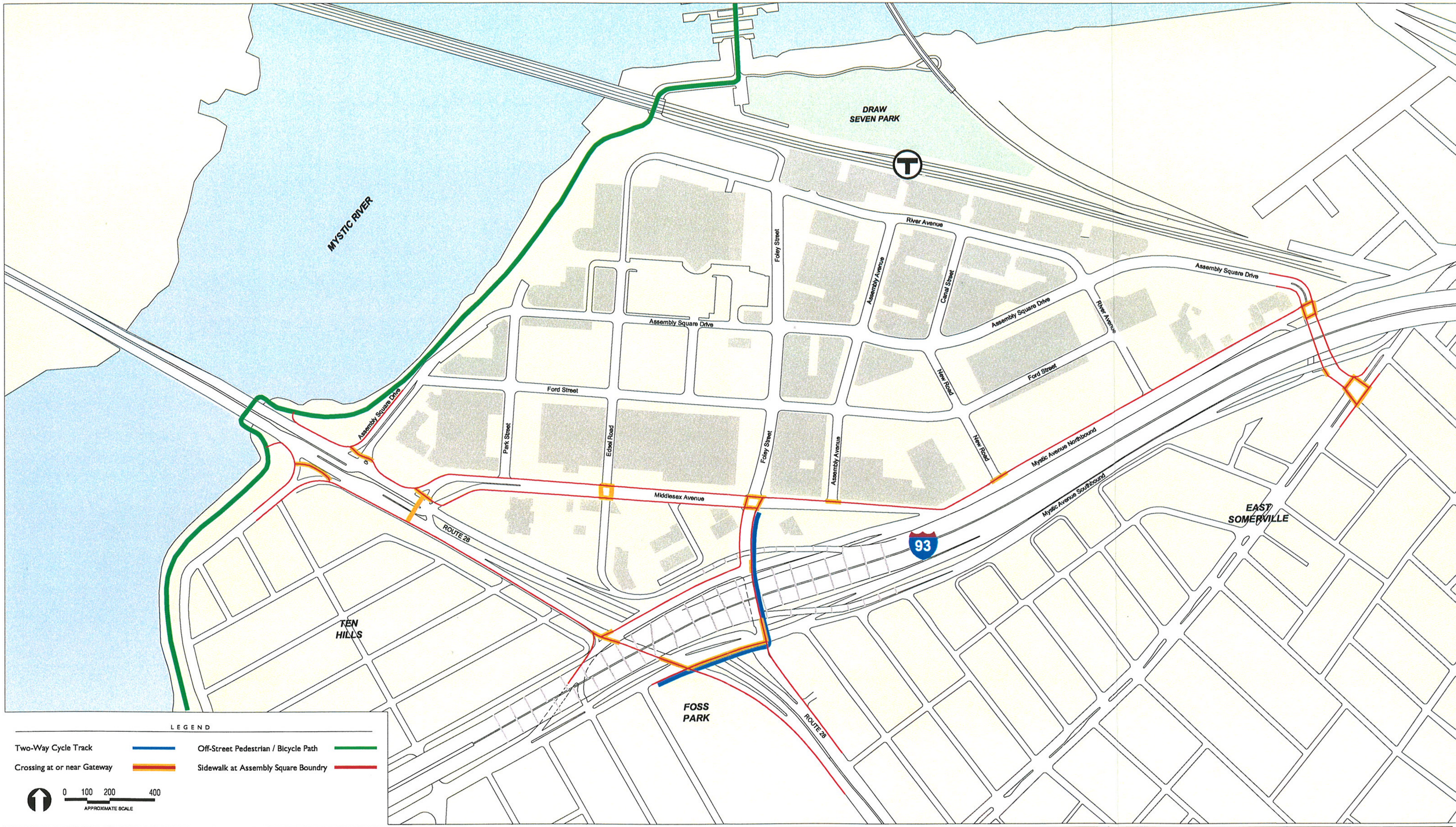


Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Public Transportation Recommendations

Figure 5-1



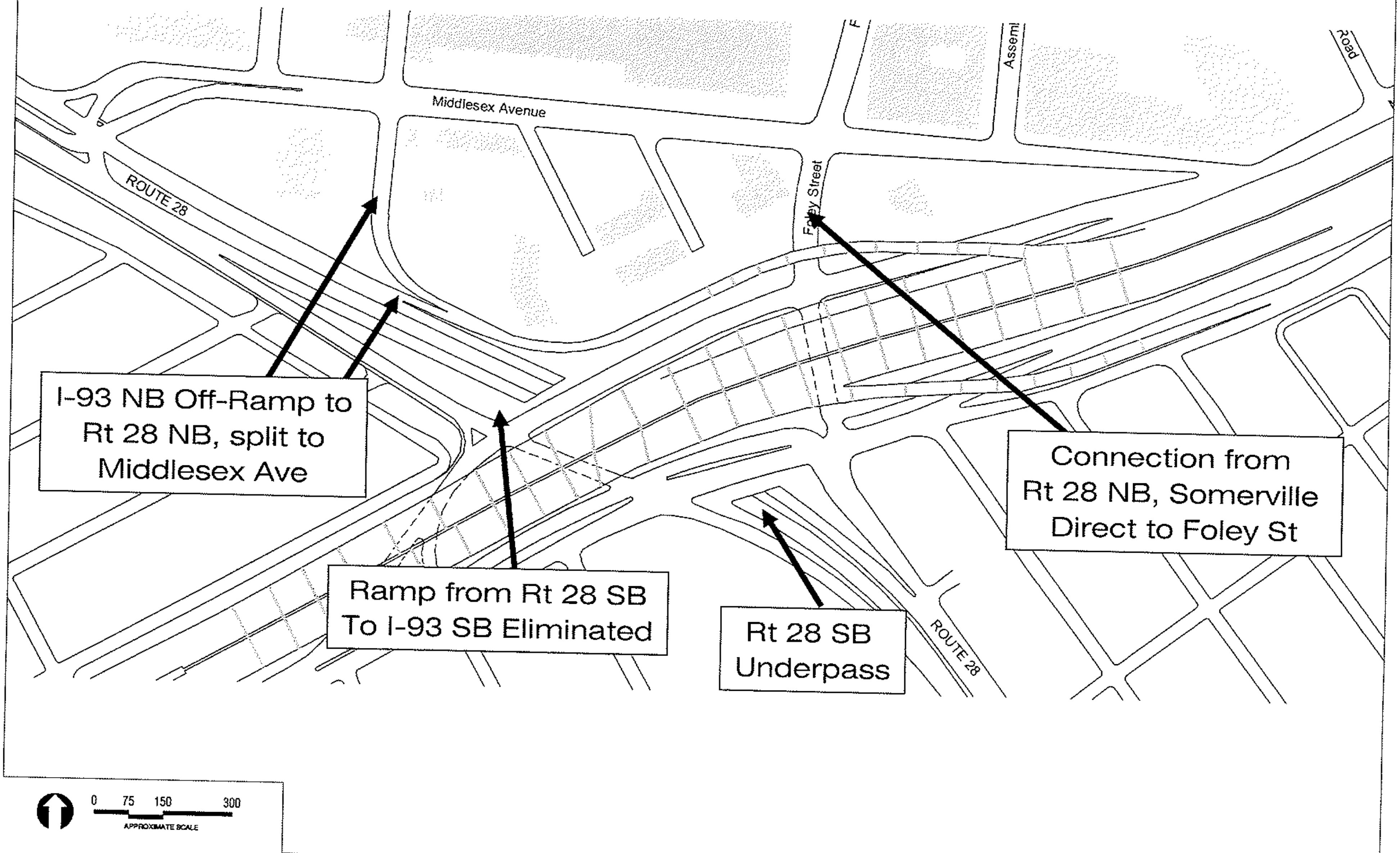
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

Pedestrian and Bicycle Paths

Figure 5-2

8640_5-03_InterchangeAlt1



Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
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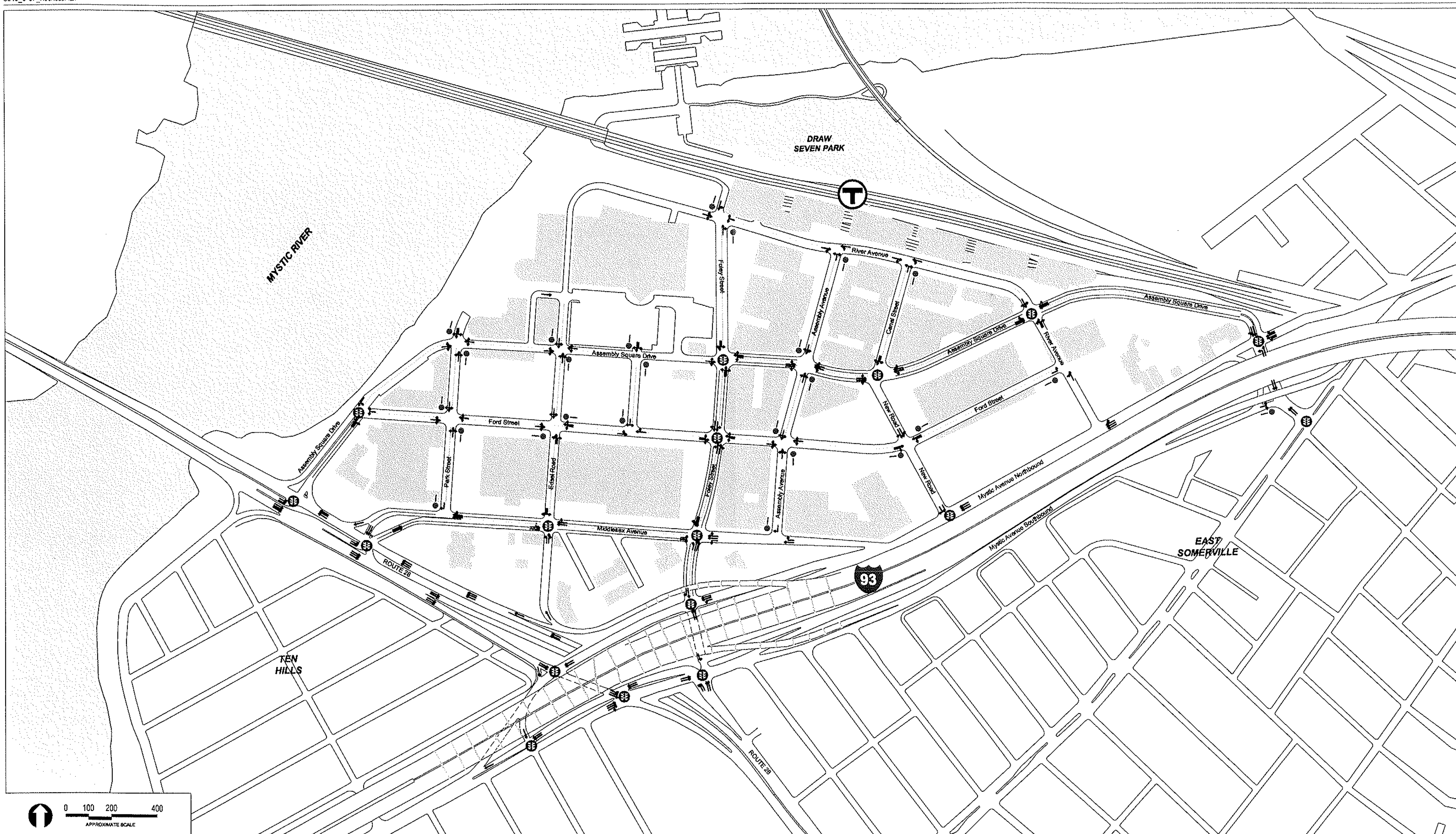
Interchange
Preferred Alternative

Figure 5-3



Assembly Square Transportation Plan
Somerville, Massachusetts

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Recomended Roadway Plan

Figure 5-4

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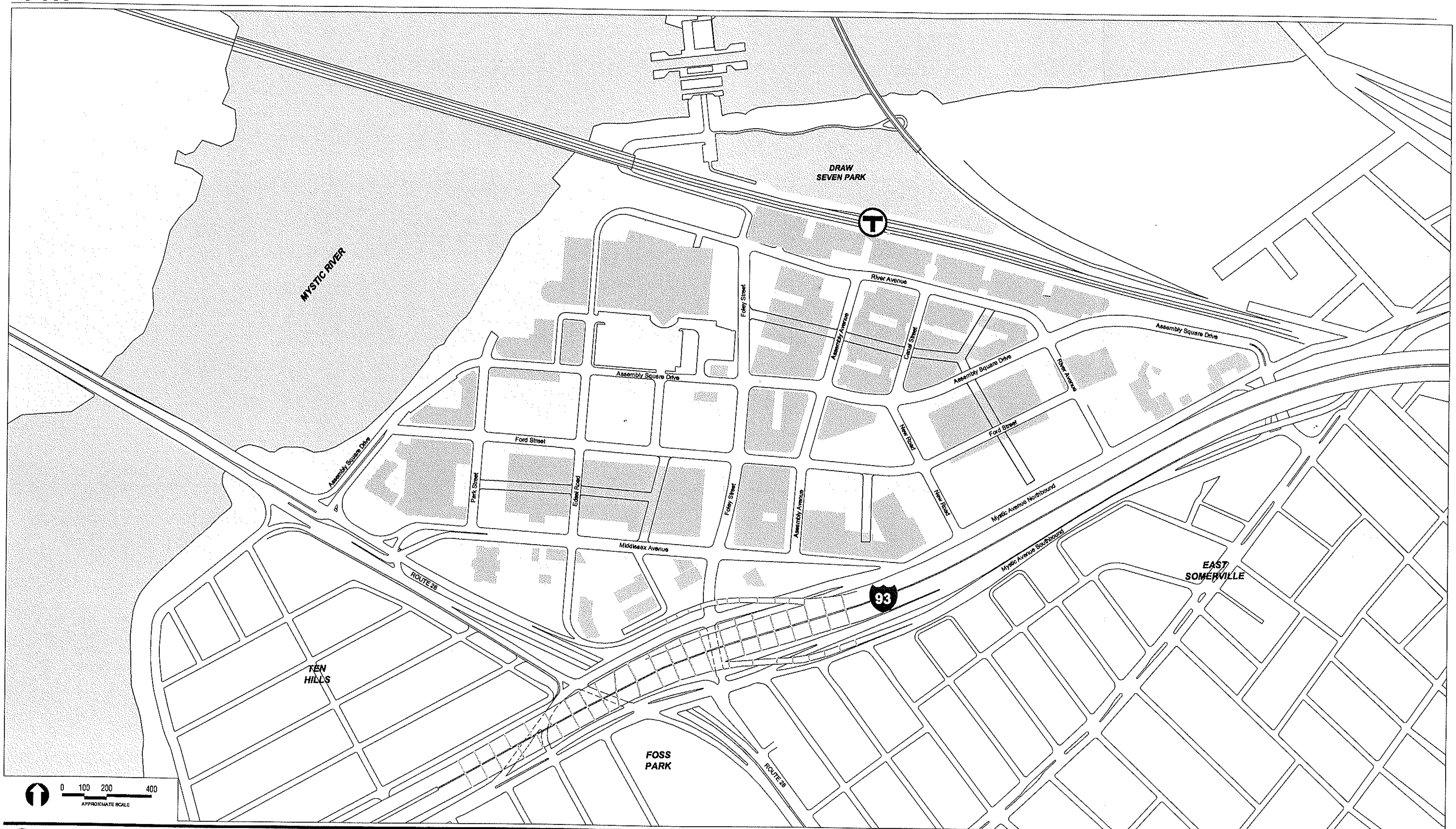


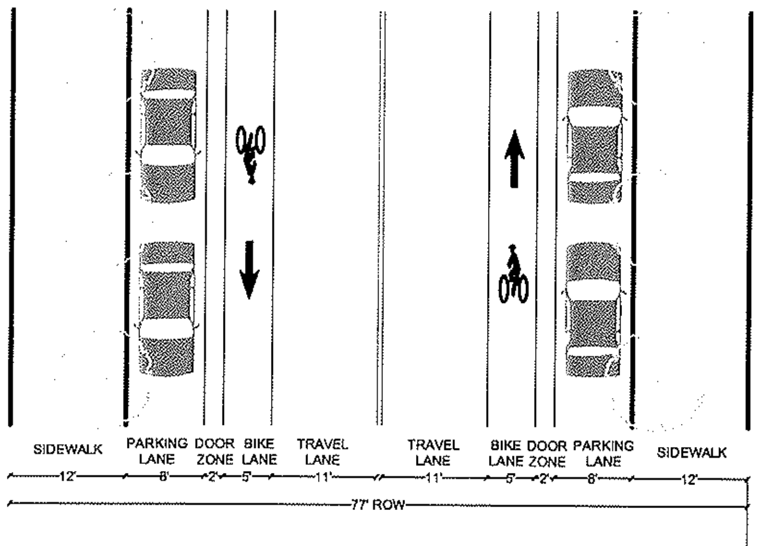
Assembly Square Transportation Plan
Somerville, Massachusetts

RIZZO ASSOCIATES
A TETRA TECH COMPANY

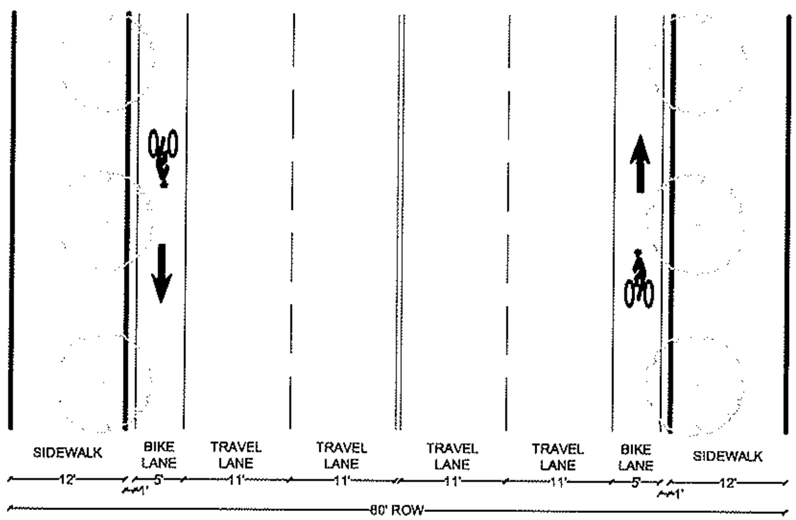
Potential Local Access Roads and Alleys

Figure 5-5

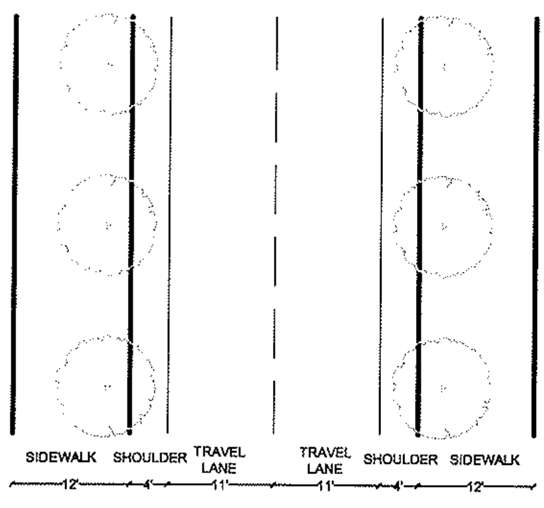
Two-Way
Two Lane Streets



Two-Way
Four Lane Streets



One-Way
Two Lane Streets

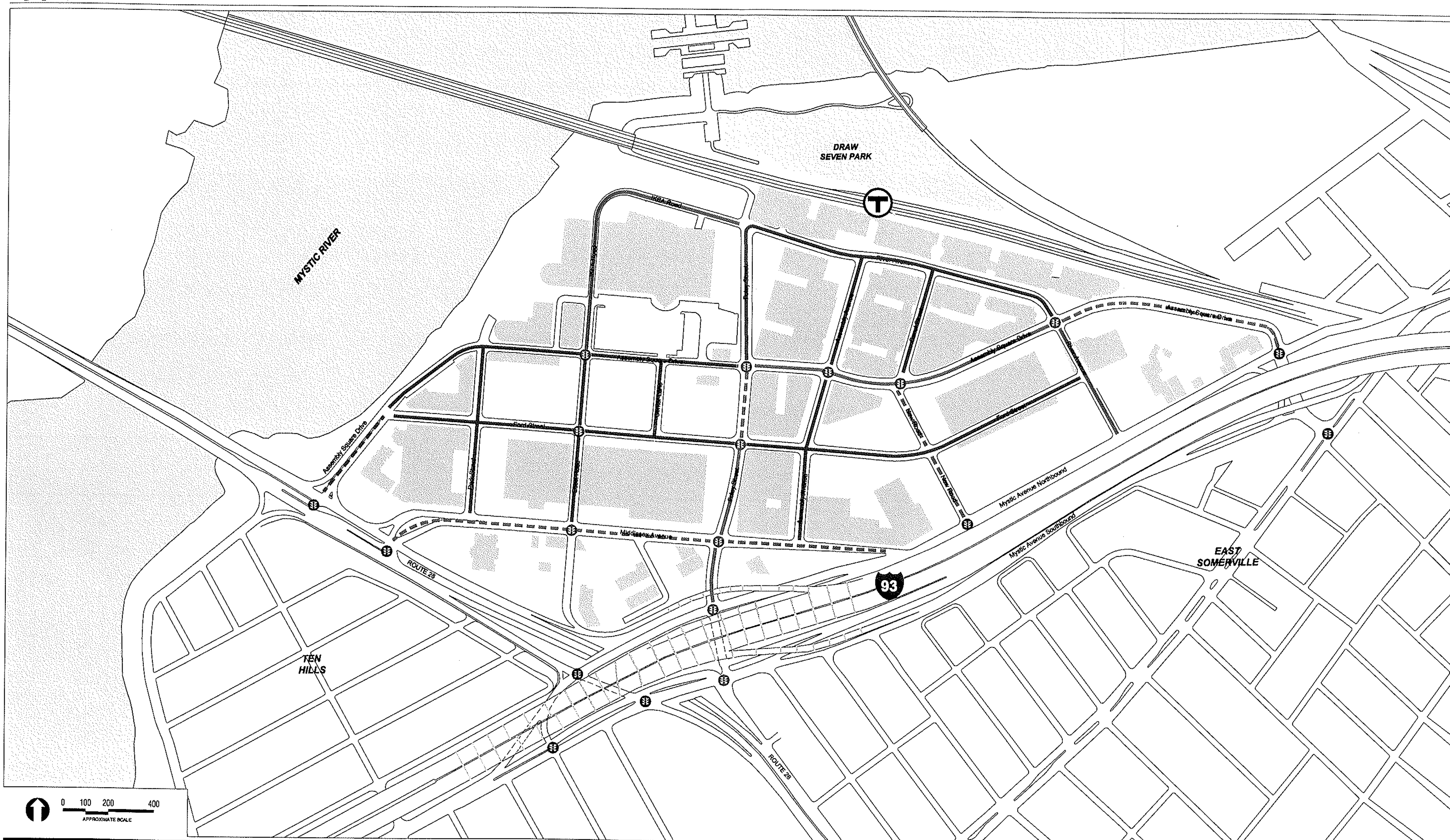


Assembly Square
Transportation Plan
Somerville, Massachusetts

RIZZO
ASSOCIATES
A TETRA TECH COMPANY

Typical Internal
Street Layouts

Figure 5-6



Assembly Square Transportation Plan
Somerville, Massachusetts

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New Construction	Cold Plane & Overlay	
		4 lanes + bike lanes: 56' pavement + 2x 12' sidewalks (24' sidewalk)
		2 lanes + bike lanes + parking lanes: 50' pavement + 2x 12' sidewalks (24' sidewalk)
		2 lanes: 30' pavement + 2x 12' sidewalks (24' sidewalk)

Existing Signal (May need upgrade)

New Signal

Street Layout by Roadway Segment

Figure 5-7

Appendix A

Traffic Count Data

ATR: : Middlesex Avenue north of
Location: : Foley Street, Somerville, MA
Client: : Rizzo/N. Codd

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

Site:
Date: 02/14/02
Day: Thursday

Interval	SB				NB				Combined			
Begin	AM		PM		AM		PM		AM		PM	
12:00	6	18	70	279	23	95	88	427	29	113	158	706
12:15	1		76		23		120		24		196	
12:30	6		75		22		110		28		185	
12:45	5		58		27		109		32		167	
01:00	7	13	78	276	24	57	104	451	31	70	182	727
01:15	2		84		20		108		22		192	
01:30	2		66		6		132		8		198	
01:45	2		48		7		107		9		155	
02:00	2	12	65	242	8	22	103	395	10	34	168	637
02:15	8		64		8		92		16		156	
02:30	1		42		4		94		5		136	
02:45	1		71		2		106		3		177	
03:00	2	15	69	258	4	17	101	466	6	32	170	724
03:15	1		58		3		121		4		179	
03:30	3		60		2		128		5		188	
03:45	9		71		8		116		17		187	
04:00	4	24	66	267	3	26	118	474	7	50	184	741
04:15	0		69		5		124		5		193	
04:30	8		64		8		126		16		190	
04:45	12		68		10		106		22		174	
05:00	19	87	52	244	4	64	135	452	23	151	187	696
05:15	22		54		16		104		38		158	
05:30	17		64		22		109		39		173	
05:45	29		74		22		104		51		178	
06:00	39	154	62	231	30	122	103	381	69	276	165	612
06:15	28		57		30		88		58		145	
06:30	29		60		36		96		65		156	
06:45	58		52		26		94		84		146	
07:00	70	260	70	250	34	158	82	326	104	418	152	576
07:15	77		78		34		86		111		164	
07:30	50		56		34		76		84		132	
07:45	63		46		56		82		119		128	
08:00	91	287	64	192	78	277	72	294	169	564	136	486
08:15	82		46		84		95		166		141	
08:30	56		46		55		69		111		115	
08:45	58		36		60		58		118		94	
09:00	66	270	40	153	58	249	77	267	124	519	117	420
09:15	68		40		56		62		124		102	
09:30	68		35		55		58		123		93	
09:45	68		38		80		70		148		108	
10:00	60	235	24	87	75	294	58	178	135	529	82	265
10:15	74		30		79		46		153		76	
10:30	51		15		68		36		119		51	
10:45	50		18		72		38		122		56	
11:00	58	235	18	55	54	295	35	133	112	530	53	188
11:15	59		10		76		43		135		53	
11:30	58		15		84		27		142		42	
11:45	60		12		81		28		141		40	
Totals	1,610		2,534		1,676		4,244		3,286		6,778	
Split%	49.0		37.4		51.0		62.6					
Day Totals		4,144				5,920				10,064		
Day Splits		41.2				58.8						
Peak Hour	07:45		12:30		09:45		04:15		07:45		03:45	
Volume	292		295		302		491		565		754	
Factor	0.80		0.88		0.94		0.91		0.84		0.98	

Data File : 01871A

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

ATR: : Middlesex Avenue north of
Location: : Foley Street, Somerville, MA
Client: : Rizzo/N. Codd

Site:
Date: 02/15/02

Day: Friday

Interval	SB				NB				Combined			
Begin	AM		PM		AM		PM		AM		PM	
12:00	3	21	76	299	40	104	132	448	43	125	208	747
12:15	4		69		18		114		22		183	
12:30	8		64		30		96		38		160	
12:45	6		90		16		106		22		196	
01:00	6	18	84	290	22	69	114	390	28	87	198	680
01:15	2		72		24		92		26		164	
01:30	4		76		11		92		15		168	
01:45	6		58		12		92		18		150	
02:00	2	9	59	213	5	31	114	409	7	40	173	622
02:15	3		48		17		88		20		136	
02:30	4		48		5		108		9		156	
02:45	0		58		4		99		4		157	
03:00	2	11	74	274	4	17	119	464	6	28	193	738
03:15	1		58		8		110		9		168	
03:30	6		76		2		108		8		184	
03:45	2		66		3		127		5		193	
04:00	8	29	63	291	6	19	103	459	14	48	166	750
04:15	2		70		5		120		7		190	
04:30	5		84		2		126		7		210	
04:45	14		74		6		110		20		184	
05:00	16	81	48	270	14	65	114	450	30	146	162	720
05:15	14		78		15		114		29		192	
05:30	15		74		20		128		35		202	
05:45	36		70		16		94		52		164	
06:00	37	143	76	300	17	111	96	417	54	254	172	717
06:15	21		72		24		127		45		199	
06:30	37		90		22		108		59		198	
06:45	48		62		48		86		96		148	
07:00	75	254	76	305	44	173	100	362	119	427	176	667
07:15	53		70		30		80		83		150	
07:30	64		79		52		96		116		175	
07:45	62		80		47		86		109		166	
08:00	82	265	86	263	56	250	85	307	138	515	171	570
08:15	65		60		57		78		122		138	
08:30	58		74		70		68		128		142	
08:45	60		43		67		76		127		119	
09:00	72	236	57	253	46	250	104	352	118	486	161	605
09:15	46		76		66		92		112		168	
09:30	58		66		68		64		126		130	
09:45	60		54		70		92		130		146	
10:00	50	238	62	182	85	335	66	218	135	573	128	400
10:15	70		42		86		58		156		100	
10:30	58		38		78		46		136		84	
10:45	60		40		86		48		146		88	
11:00	60	230	34	128	84	313	65	244	144	543	99	372
11:15	62		38		84		50		146		88	
11:30	52		34		71		65		123		99	
11:45	56		22		74		64		130		86	
Totals	1,535		3,068		1,737		4,520		3,272		7,588	
Split%	46.9		40.4		53.1		59.6					
Day Totals		4,603				6,257				10,860		
Day Splits		42.4				57.6						
Peak Hour	07:30		12:45		10:00		03:45		10:15		03:45	
Volume	273		322		335		476		582		759	
Factor	0.83		0.89		0.97		0.94		0.93		0.90	

Data File : 01871A

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

ATR: : Middlesex Avenue north of
Location: : Foley Street, Somerville, MA
Client: : Rizzo/N. Codd

Site:
Date: 02/16/02
Day: Saturday

Interval Begin	SB AM		SB PM		NB AM		NB PM		Combined AM		Combined PM	
12:00	26	59	69	299	65	215	93	382	91	274	162	681
12:15	12		82		62		101		74		183	
12:30	9		72		45		90		54		162	
12:45	12		76		43		98		55		174	
01:00	8	26	92	360	58	165	112	407	66	191	204	767
01:15	4		100		67		98		71		198	
01:30	6		80		22		100		28		180	
01:45	8		88		18		97		26		185	
02:00	1	15	110	394	12	51	111	459	13	66	221	853
02:15	3		92		17		118		20		210	
02:30	8		98		12		130		20		228	
02:45	3		94		10		100		13		194	
03:00	4	12	86	395	6	19	112	517	10	31	198	912
03:15	2		94		7		129		9		223	
03:30	2		104		4		137		6		241	
03:45	4		111		2		139		6		250	
04:00	6	8	84	356	8	18	97	444	14	26	181	800
04:15	1		100		4		137		5		237	
04:30	0		82		3		112		3		194	
04:45	1		90		3		98		4		188	
05:00	4	31	77	328	8	22	102	413	12	53	179	741
05:15	6		90		2		107		8		197	
05:30	7		72		6		76		13		148	
05:45	14		89		6		128		20		217	
06:00	6	45	66	310	7	39	136	455	13	84	202	765
06:15	8		78		12		106		20		184	
06:30	13		96		10		110		23		206	
06:45	18		70		10		103		28		173	
07:00	15	67	86	287	13	68	92	359	28	135	178	646
07:15	17		82		8		96		25		178	
07:30	14		56		20		87		34		143	
07:45	21		63		27		84		48		147	
08:00	30	137	52	232	14	101	73	285	44	238	125	517
08:15	33		70		20		84		53		154	
08:30	31		56		31		73		62		129	
08:45	43		54		36		55		79		109	
09:00	39	202	51	231	50	195	62	293	89	397	113	524
09:15	53		76		40		99		93		175	
09:30	52		50		39		56		91		106	
09:45	58		54		66		76		124		130	
10:00	66	256	30	137	56	236	76	233	122	492	106	370
10:15	66		51		60		44		126		95	
10:30	60		35		60		55		120		90	
10:45	64		21		60		58		124		79	
11:00	69	277	42	126	86	344	50	250	155	621	92	376
11:15	62		34		80		58		142		92	
11:30	66		24		82		58		148		82	
11:45	80		26		96		84		176		110	
Totals	1,135		3,455		1,473		4,497		2,608		7,952	
Split%	43.5		43.4		56.5		56.6					

	SB	NB	Combined
Day Totals	4,590	5,970	10,560
Day Splits	43.5	56.5	

	SB AM	SB PM	NB AM	NB PM	Combined AM	Combined PM
Peak Hour	11:00	03:30	11:00	03:00	11:00	03:00
Volume	277	399	344	517	621	912
Factor	0.87	0.90	0.90	0.93	0.88	0.91

Data File : 01871A

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Route 28
E/W: Assembly Square Drive/Shore Drive
City, State: Somerville, MA
Client: Rizzo Associates/N.Codd

File Name : 01871E
Site Code : 0000000[illegible]
Start Date : 02/12/200[illegible]
Page No : 1

Location #1

Groups Printed- Cars - Trucks

	Route 28 From North				Assembly Square Drive From East				Route 28 From South				Shore Drive From West				
Start Time	Right	Thru	Left	UTurn	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	41	668	16	1	6	0	0	0	4	219	0	0	3	0	0	0	95[illegible]
07:15 AM	38	747	16	2	10	0	0	0	1	224	0	0	3	0	0	0	10[illegible]
07:30 AM	31	741	20	0	8	0	0	0	2	272	0	0	14	0	0	0	10[illegible]
07:45 AM	15	763	35	12	8	0	0	0	2	267	0	0	7	0	0	0	1109
Total	125	2919	87	15	32	0	0	0	9	982	0	0	27	0	0	0	419[illegible]
08:00 AM	15	780	29	41	6	0	0	0	2	313	0	0	1	0	0	0	11[illegible]
08:15 AM	12	760	38	8	12	0	0	0	3	295	0	0	4	0	0	0	1132
08:30 AM	10	809	31	1	6	0	0	0	2	267	0	0	5	0	0	0	1131
08:45 AM	16	707	42	1	12	0	0	0	6	234	0	0	5	0	0	0	10[illegible]
Total	53	3056	140	51	36	0	0	0	13	1109	0	0	15	0	0	0	44[illegible]
Grand Total	178	5975	227	66	68	0	0	0	22	2091	0	0	42	0	0	0	8669
Apprch %	2.8	92.7	3.5	1.0	100.0	0.0	0.0	0.0	1.0	99.0	0.0	0.0	100.0	0.0	0.0	0.0	
Total %	2.1	68.9	2.6	0.8	0.8	0.0	0.0	0.0	0.3	24.1	0.0	0.0	0.5	0.0	0.0	0.0	

	Route 28 From North					Assembly Square Drive From East					Route 28 From South					Shore Drive From West					
Start Time	Right	Thru	Left	UTurn	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	52	3112	133	62	3359	32	0	0	0	32	9	1142	0	0	1151	17	0	0	0	17	455[illegible]
Percent	1.5	92.6	4.0	1.8		100.0	0.0	0.0	0.0		0.8	99.2	0.0	0.0		100.0	0.0	0.0	0.0		
08:00 Volume	15	780	29	41	865	6	0	0	0	6	2	313	0	0	315	1	0	0	0	1	11[illegible]
Peak Factor																					0.960
High Int.	08:00 AM					08:15 AM					08:00 AM					07:45 AM					
Volume	15	780	29	41	865	12	0	0	0	12	2	313	0	0	315	7	0	0	0	7	
Peak Factor					0.971					0.667					0.913					0.607	

N/S: Route 28
: Midllesex Avenue
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871J
Site Code : 00000000
Start Date : 02/12/2002
Page No : 1

Location #2

Groups Printed- Cars - Trucks

	Rt 28 From North				Middlesex Ave From East				Rt 28 From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	641	44	0	17	0	7	0	31	221	0	0	961
07:15 AM	0	763	35	0	27	0	3	0	33	207	0	0	1068
07:30 AM	0	697	35	0	34	0	15	0	32	245	0	0	1058
07:45 AM	0	765	38	0	25	0	8	0	36	256	0	0	1128
Total	0	2866	152	0	103	0	33	0	132	929	0	0	4215
08:00 AM	0	704	47	0	26	0	17	0	50	281	0	0	1125
08:15 AM	0	695	40	0	27	0	14	0	33	285	0	0	1094
08:30 AM	0	755	44	0	40	0	14	0	41	235	0	0	1129
08:45 AM	0	660	56	0	35	0	13	0	35	201	0	0	1000
Total	0	2814	187	0	128	0	58	0	159	1002	0	0	4348
Grand Total	0	5680	339	0	231	0	91	0	291	1931	0	0	8563
Apprch %	0.0	94.4	5.6	0.0	71.7	0.0	28.3	0.0	13.1	86.9	0.0	0.0	
Total %	0.0	66.3	4.0	0.0	2.7	0.0	1.1	0.0	3.4	22.6	0.0	0.0	

	Rt 28 From North					Middlesex Ave From East					Rt 28 From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:45 AM															
Volume	0	2919	169	0	3088	118	0	53	0	171	160	1057	0	0	1217	4476
Percent	0.0	94.5	5.5	0.0		69.0	0.0	31.0	0.0		13.1	86.9	0.0	0.0		
08:30 Volume	0	755	44	0	799	40	0	14	0	54	41	235	0	0	276	1129
Peak Factor																0.991
High Int.	07:45 AM					08:30 AM					08:00 AM					
Volume	0	765	38	0	803	40	0	14	0	54	50	281	0	0	331	
Peak Factor					0.961					0.792					0.919	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (NB)
E/W: Route 28/I-93 SB
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871H
Site Code : 00000000
Start Date : 02/13/20[illegible]
Page No : 1

Location #4

Groups Printed- Cars - Trucks

	Mystic Avenue NB From North				Route 28 From East					Mystic Avenue NB From South				I-93 SB onramp/Route 28 (SB) From West				
Start Time	Right	Thru	Left	Peds	Right	Thru (28)	Thru (I-93)	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	29	405	190	0	0	0	67	6	0	0	0	0	0	69
07:15 AM	0	0	0	0	34	441	276	0	0	0	76	3	0	0	0	0	0	83
07:30 AM	0	0	0	0	30	397	256	0	0	0	76	2	0	0	0	0	0	76
07:45 AM	0	0	0	0	36	372	335	0	0	0	74	6	0	0	0	0	0	823
Total	0	0	0	0	129	1615	1057	0	0	0	293	17	0	0	0	0	0	311
08:00 AM	0	0	0	0	27	337	369	0	0	0	107	5	0	0	0	0	0	84
08:15 AM	0	0	0	0	44	308	322	0	0	0	103	6	0	0	0	0	0	783
08:30 AM	0	0	0	0	59	382	339	0	0	0	84	10	0	0	0	0	0	87
08:45 AM	0	0	0	0	57	336	251	0	0	0	80	9	0	0	0	0	0	73
Total	0	0	0	0	187	1363	1281	0	0	0	374	30	0	0	0	0	0	323
Grand Total	0	0	0	0	316	2978	2338	0	0	0	667	47	0	0	0	0	0	6346
Apprch %	0.0	0.0	0.0	0.0	5.6	52.9	41.5	0.0	0.0	0.0	93.4	6.6	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	5.0	46.9	36.8	0.0	0.0	0.0	10.5	0.7	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue NB From North					Route 28 From East						Mystic Avenue NB From South					I-93 SB onramp/Route 28 (SB) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru (28)	Thru (I-93)	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																						
Intersection	07:45 AM																					
Volume	0	0	0	0	0	166	1399	1365	0	0	2930	0	368	27	0	395	0	0	0	0	0	3325
Percent	0.0	0.0	0.0	0.0		5.7	47.7	46.6	0.0	0.0		0.0	93.2	6.8	0.0		0.0	0.0	0.0	0.0		
08:30 Volume	0	0	0	0	0	59	382	339	0	0	780	0	84	10	0	94	0	0	0	0	0	874
Peak Factor																						0.95
High Int.	6:45:00 AM					08:30 AM						08:00 AM					6:45:00 AM					
Volume	0	0	0	0	0	59	382	339	0	0	780	0	107	5	0	112						
Peak Factor											0.939					0.882						

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (SB)
E/W: Route 28 (SB)
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871G
Site Code : 00000000
Start Date : 02/13/2002
Page No : 1

Location #5

Groups Printed- Cars - Trucks

	Mystic Avenue (SB) From North				Route 28 (SB) From East				Mystic Avenue (SB) From South				Route 28 (SB) From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	207	104	0	0	0	359	15	0	0	0	0	0	0	0	0	0	685
07:15 AM	232	112	0	0	0	444	23	0	0	0	0	0	0	0	0	0	811
07:30 AM	241	126	0	0	0	379	13	0	0	0	0	0	0	0	0	0	759
07:45 AM	206	130	0	0	0	375	32	0	0	0	0	0	0	0	0	0	743
Total	886	472	0	0	0	1557	83	0	0	0	0	0	0	0	0	0	2998
08:00 AM	218	152	0	0	0	334	14	0	0	0	0	0	0	0	0	0	718
08:15 AM	160	129	0	0	0	313	27	0	0	0	0	0	0	0	0	0	629
08:30 AM	220	167	0	0	0	378	24	0	0	0	0	0	0	0	0	0	789
08:45 AM	258	125	0	0	0	315	11	0	0	0	0	0	0	0	0	0	709
Total	856	573	0	0	0	1340	76	0	0	0	0	0	0	0	0	0	2845
Grand Total	1742	1045	0	0	0	2897	159	0	0	0	0	0	0	0	0	0	5843
Apprch %	62.5	37.5	0.0	0.0	0.0	94.8	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	29.8	17.9	0.0	0.0	0.0	49.6	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue (SB) From North					Route 28 (SB) From East					Mystic Avenue (SB) From South					Route 28 (SB) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	897	520	0	0	1417	0	1532	82	0	1614	0	0	0	0	0	0	0	0	0	0	3031
Percent	63.3	36.7	0.0	0.0		0.0	94.9	5.1	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
07:15 Volume	232	112	0	0	344	0	444	23	0	467	0	0	0	0	0	0	0	0	0	0	811
Peak Factor																					0.934
High Int.	08:00 AM					07:15 AM					6:45:00 AM					6:45:00 AM					
Volume	218	152	0	0	370	0	444	23	0	467											
Peak Factor					0.957					0.864											

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (NB)
E: New Road
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871i
Site Code : 00000000
Start Date : 02/12/2002
Page No : 1

Location #13

Groups Printed- Cars - Trucks

	Mystic Avenue (NB) From North				New Road From East				Mystic Avenue (NB) From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	10	0	0	0	12	192	0	0	214
07:15 AM	0	0	0	0	13	0	0	0	7	270	0	0	29[illegible]
07:30 AM	0	0	0	0	15	0	0	0	16	290	0	0	32[illegible]
07:45 AM	0	0	0	0	29	0	0	0	8	280	0	0	317
Total	0	0	0	0	67	0	0	0	43	1032	0	0	1142
08:00 AM	0	0	0	0	20	0	0	0	14	326	0	0	36[illegible]
08:15 AM	0	0	0	0	19	0	0	0	7	287	0	0	31[illegible]
08:30 AM	0	0	0	0	14	0	0	0	4	278	0	0	296
08:45 AM	0	0	0	0	20	0	0	0	10	254	0	0	28[illegible]
Total	0	0	0	0	73	0	0	0	35	1145	0	0	125[illegible]
Grand Total	0	0	0	0	140	0	0	0	78	2177	0	0	2395
Apprch %	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	3.5	96.5	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	3.3	90.9	0.0	0.0	

	Mystic Avenue (NB) From North					New Road From East					Mystic Avenue (NB) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:30 AM															
Volume	0	0	0	0	0	83	0	0	0	83	45	1183	0	0	1228	131[illegible]
Percent	0.0	0.0	0.0	0.0		100.0	0.0	0.0	0.0		3.7	96.3	0.0	0.0		
08:00 Volume	0	0	0	0	0	20	0	0	0	20	14	326	0	0	340	360
Peak Factor																0.910
High Int.	6:45:00 AM					07:45 AM					08:00 AM					
Volume	0	0	0	0	0	29	0	0	0	29	14	326	0	0	340	
Peak Factor										0.716					0.903	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Assembly Square Drive
E/W: New Road
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871B
Site Code : 00000000
Start Date : 02/12/2002
Page No : 1

Location #15

Groups Printed- Cars - Trucks

	Assemby Square Drive From North				Assemby Square Drive From South				New Road From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	18	34	0	0	0	17	5	0	5	0	3	0	82
07:15 AM	9	29	0	0	0	14	5	0	6	0	5	0	68
07:30 AM	21	28	0	0	0	18	1	0	5	0	0	0	73
07:45 AM	23	39	0	0	0	15	1	0	5	0	6	0	89
Total	71	130	0	0	0	64	12	0	21	0	14	0	312
08:00 AM	20	28	0	0	0	20	10	0	9	0	8	0	95
08:15 AM	7	25	0	0	0	14	8	0	8	0	7	0	69
08:30 AM	20	42	0	0	0	15	3	0	2	0	2	0	84
08:45 AM	11	19	0	0	0	12	3	0	1	0	1	0	47
Total	58	114	0	0	0	61	24	0	20	0	18	0	295
Grand Total	129	244	0	0	0	125	36	0	41	0	32	0	607
Apprch %	34.6	65.4	0.0	0.0	0.0	77.6	22.4	0.0	56.2	0.0	43.8	0.0	
Total %	21.3	40.2	0.0	0.0	0.0	20.6	5.9	0.0	6.8	0.0	5.3	0.0	

	Assemby Square Drive From North					Assemby Square Drive From South					New Road From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:45 AM															
Volume	70	134	0	0	204	0	64	22	0	86	24	0	23	0	47	337
Percent	34.3	65.7	0.0	0.0		0.0	74.4	25.6	0.0		51.1	0.0	48.9	0.0		
08:00 Volume	20	28	0	0	48	0	20	10	0	30	9	0	8	0	17	95
Peak Factor																0.887
High Int.	07:45 AM					08:00 AM					08:00 AM					
Volume	23	39	0	0	62	0	20	10	0	30	9	0	8	0	17	
Peak Factor					0.823					0.717					0.691	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Assembly Square Drive
E/W: Foley Street
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871C
Site Code : 00000000
Start Date : 02/12/200
Page No : 1

Location #16

Groups Printed- Cars - Trucks

	Assembly Square Drive From North				Foley Street From East				Assembly Square Drive From South				Foley Street From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	4	15	0	0	0	5	4	0	7	2	5	0	30	5	2	0	79
07:15 AM	5	8	0	0	0	2	5	0	3	10	3	0	27	2	0	0	65
07:30 AM	6	13	0	0	1	7	5	0	11	7	8	0	29	5	2	0	94
07:45 AM	5	21	0	0	2	3	13	0	5	5	3	0	37	6	1	0	101
Total	20	57	0	0	3	17	27	0	26	24	19	0	123	18	5	0	339
08:00 AM	5	21	0	0	1	4	9	0	8	9	10	0	34	5	2	0	108
08:15 AM	5	20	0	0	0	1	6	0	5	9	7	0	24	3	7	0	87
08:30 AM	5	24	1	0	1	5	8	0	9	8	4	0	39	2	5	0	111
08:45 AM	9	19	0	0	0	1	12	0	5	9	6	0	31	3	7	0	102
Total	24	84	1	0	2	11	35	0	27	35	27	0	128	13	21	0	408
Grand Total	44	141	1	0	5	28	62	0	53	59	46	0	251	31	26	0	747
Apprch %	23.7	75.8	0.5	0.0	5.3	29.5	65.3	0.0	33.5	37.3	29.1	0.0	81.5	10.1	8.4	0.0	
Total %	5.9	18.9	0.1	0.0	0.7	3.7	8.3	0.0	7.1	7.9	6.2	0.0	33.6	4.1	3.5	0.0	

	Assembly Square Drive From North					Foley Street From East					Assembly Square Drive From South					Foley Street From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	08:00 AM																				
Volume	24	84	1	0	109	2	11	35	0	48	27	35	27	0	89	128	13	21	0	162	408
Percent	22.0	77.1	0.9	0.0		4.2	22.9	72.9	0.0		30.3	39.3	30.3	0.0		79.0	8.0	13.0	0.0		
08:30 Volume	5	24	1	0	30	1	5	8	0	14	9	8	4	0	21	39	2	5	0	46	111
Peak Factor																					0.919
High Int.	08:30 AM					08:00 AM					08:00 AM					08:30 AM					
Volume	5	24	1	0	30	1	4	9	0	14	8	9	10	0	27	39	2	5	0	46	
Peak Factor					0.908					0.857					0.824					0.880	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Middlesex Street
E: Foley Street
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871M
Site Code : 00000000
Start Date : 02/12/2002
Page No : 1

Location #17

Groups Printed- Cars - Trucks

	Middlesex Street From North				Foley Street From East				Middlesex Street From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	4	66	0	11	0	5	0	0	23	0	0	109
07:15 AM	0	3	64	0	8	0	1	0	2	27	0	0	105
07:30 AM	0	2	55	0	16	0	7	0	1	39	0	0	120
07:45 AM	0	4	67	0	12	0	1	0	3	33	0	0	120
Total	0	13	252	0	47	0	14	0	6	122	0	0	454
08:00 AM	0	6	75	0	10	0	2	0	2	33	0	0	128
08:15 AM	0	2	57	0	13	0	3	0	3	30	0	0	108
08:30 AM	0	1	57	0	15	0	2	0	1	41	0	0	117
08:45 AM	0	8	69	0	14	0	4	0	1	43	0	0	139
Total	0	17	258	0	52	0	11	0	7	147	0	0	492
Grand Total	0	30	510	0	99	0	25	0	13	269	0	0	946
Apprch %	0.0	5.6	94.4	0.0	79.8	0.0	20.2	0.0	4.6	95.4	0.0	0.0	
Total %	0.0	3.2	53.9	0.0	10.5	0.0	2.6	0.0	1.4	28.4	0.0	0.0	

	Middlesex Street From North					Foley Street From East					Middlesex Street From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	08:00 AM															
Volume	0	17	258	0	275	52	0	11	0	63	7	147	0	0	154	492
Percent	0.0	6.2	93.8	0.0		82.5	0.0	17.5	0.0		4.5	95.5	0.0	0.0		
08:45 Volume	0	8	69	0	77	14	0	4	0	18	1	43	0	0	44	139
Peak Factor																0.885
High Int.	08:00 AM					08:45 AM					08:45 AM					
Volume	0	6	75	0	81	14	0	4	0	18	1	43	0	0	44	
Peak Factor					0.849					0.875					0.875	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Middlesex Avenue
E: Assembly Square Mall Driveway
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871R
Site Code : 00000000
Start Date : 02/13/20[illegible]2
Page No : 1

Location #3

Groups Printed- Cars - Trucks

	Middlesex Avenue From North				Assembly Square Mall Driveway From East				Middlesex Avenue From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	1	0	0	0	1
07:15 AM	0	0	0	0	1	0	0	0	0	0	0	0	
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	
07:45 AM	0	0	0	0	2	0	0	0	1	0	0	0	3
Total	0	0	0	0	3	0	0	0	2	0	0	0	5
08:00 AM	0	0	0	0	1	0	0	0	1	0	0	0	
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	2	0	0	0	[illegible]
Total	0	0	0	0	1	0	0	0	3	0	0	0	
Grand Total	0	0	0	0	4	0	0	0	5	0	0	0	9
Apprch %	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	44.4	0.0	0.0	0.0	55.6	0.0	0.0	0.0	

	Middlesex Avenue From North					Assembly Square Mall Driveway From East					Middlesex Avenue From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Tot
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:15 AM															
Volume	0	0	0	0	0	4	0	0	0	4	2	0	0	0	2	
Percent	0.0	0.0	0.0	0.0		100.0	0.0	0.0	0.0		100.0	0.0	0.0	0.0		
07:45 Volume	0	0	0	0	0	2	0	0	0	2	1	0	0	0	1	3
Peak Factor																0.500
High Int.	6:45:00 AM					07:45 AM					07:45 AM					
Volume	0	0	0	0	0	2	0	0	0	2	1	0	0	0	1	
Peak Factor										0.500					0.500	

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (NB)
/W: Middlesex Avenue/I-93 NB onramp
City, State: Somerville, MA
Client: Rizzo Associates/N.Codd

File Name : 01871A
Site Code : 00000000
Start Date : 02/12/2002
Page No : 1

Location #14

Groups Printed- Cars - Trucks

	Mystic Avenue (NB) From North				Middlesex Avenue From East				Mystic Avenue (NB) From South				I-93 NB Onramp From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	10	0	0	0	21	29	152	0	0	0	0	0	212
07:15 AM	0	0	0	0	2	0	0	0	33	37	211	0	0	0	0	0	283
07:30 AM	0	0	0	0	10	0	0	0	30	33	236	0	0	0	0	0	309
07:45 AM	0	0	0	0	9	0	0	0	33	56	240	0	0	0	0	0	338
Total	0	0	0	0	31	0	0	0	117	155	839	0	0	0	0	0	1142
08:00 AM	0	0	0	0	3	0	0	0	45	65	249	0	0	0	0	0	362
08:15 AM	0	0	0	0	1	0	0	0	33	52	188	0	0	0	0	0	274
08:30 AM	0	0	0	0	6	0	0	0	47	54	198	0	0	0	0	0	305
08:45 AM	0	0	0	0	7	0	0	0	36	42	189	0	0	0	0	0	274
Total	0	0	0	0	17	0	0	0	161	213	824	0	0	0	0	0	1215
Grand Total	0	0	0	0	48	0	0	0	278	368	1663	0	0	0	0	0	2357
Apprch %	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	12.0	15.9	72.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	11.8	15.6	70.6	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue (NB) From North					Middlesex Avenue From East					Mystic Avenue (NB) From South					I-93 NB Onramp From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:15 AM																				
Volume	0	0	0	0	0	24	0	0	0	24	141	191	936	0	1268	0	0	0	0	0	1292
Percent	0.0	0.0	0.0	0.0		100.0	0.0	0.0	0.0		11.1	15.1	73.8	0.0		0.0	0.0	0.0	0.0		
08:00 Volume	0	0	0	0	0	3	0	0	0	3	45	65	249	0	359	0	0	0	0	0	362
Peak Factor																					0.892
High Int.	6:45:00 AM					07:30 AM					08:00 AM					6:45:00 AM					
Volume	0	0	0	0	0	10	0	0	0	10	45	65	249	0	359						
Peak Factor										0.600					0.883						

N/S: Route 28
E/W: I-93 NB offramp split/Mystic Avenue
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871P
Site Code : 0000000[illegible]
Start Date : 02/13/20[illegible]2
Page No : 1

Location #18

Groups Printed- Cars - Trucks

	From North				I-93 NB offramp split From East				From South				From West				
Start Time	Right	Thru	Left	Peds	Right (28NB)	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	0	0	0	113	35	0	0	0	0	0	0	0	0	0	0	1[illegible]
07:15 AM	0	0	0	0	119	43	0	0	0	0	0	0	0	0	0	0	1[illegible]
07:30 AM	0	0	0	0	120	33	0	0	0	0	0	0	0	0	0	0	15[illegible]
07:45 AM	0	0	0	0	132	42	0	0	0	0	0	0	0	0	0	0	174
Total	0	0	0	0	484	153	0	0	0	0	0	0	0	0	0	0	6[illegible]
08:00 AM	0	0	0	0	110	43	0	0	0	0	0	0	0	0	0	0	1[illegible]
08:15 AM	0	0	0	0	137	48	0	0	0	0	0	0	0	0	0	0	185
08:30 AM	0	0	0	0	131	47	0	0	0	0	0	0	0	0	0	0	17[illegible]
08:45 AM	0	0	0	0	108	31	0	0	0	0	0	0	0	0	0	0	1[illegible]
Total	0	0	0	0	486	169	0	0	0	0	0	0	0	0	0	0	6[illegible]
Grand Total	0	0	0	0	970	322	0	0	0	0	0	0	0	0	0	0	1292
Apprch %	0.0	0.0	0.0	0.0	75.1	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	0.0	75.1	24.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	From North					I-93 NB offramp split From East					From South					From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right (28NB)	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	07:45 AM																				
Volume	0	0	0	0	0	510	180	0	0	690	0	0	0	0	0	0	0	0	0	0	690
Percent	0.0	0.0	0.0	0.0		73.9	26.1	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
08:15 Volume	0	0	0	0	0	137	48	0	0	185	0	0	0	0	0	0	0	0	0	0	1[illegible]
Peak Factor																					0.932
High Int.	6:45:00 AM					08:15 AM					6:45:00 AM					6:45:00 AM					
Volume	0	0	0	0	0	137	48	0	0	185											
Peak Factor										0.932											

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (SB)
E: I-93 SB onramp
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871L
Site Code : 00000000
Start Date : 02/13/2002

Location #7

Groups Printed- Cars - Trucks

	Mystic Avenue (SB) From North				I-93 SB onramp From East				Mystic Avenue (SB) From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	77	74	0	0	0	0	0	0	0	0	0	151
07:15 AM	0	72	80	0	0	0	0	0	0	0	0	0	152
07:30 AM	0	88	89	0	0	0	0	0	0	0	0	0	177
07:45 AM	0	103	86	0	0	0	0	0	0	0	0	0	189
Total	0	340	329	0	0	0	0	0	0	0	0	0	669
08:00 AM	0	104	111	0	0	0	0	0	0	0	0	0	215
08:15 AM	0	92	96	0	0	0	0	0	0	0	0	0	188
08:30 AM	0	114	122	0	0	0	0	0	0	0	0	0	236
08:45 AM	0	87	90	0	0	0	0	0	0	0	0	0	177
Total	0	397	419	0	0	0	0	0	0	0	0	0	816
Grand Total	0	737	748	0	0	0	0	0	0	0	0	0	1485
Apprch %	0.0	49.6	50.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	49.6	50.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue (SB) From North					I-93 SB onramp From East					Mystic Avenue (SB) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:45 AM															
Volume	0	413	415	0	828	0	0	0	0	0	0	0	0	0	0	828
Percent	0.0	49.9	50.1	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
08:30 Volume	0	114	122	0	236	0	0	0	0	0	0	0	0	0	0	236
Peak Factor																0.877
High Int.	08:30 AM					6:45:00 AM					6:45:00 AM					
Volume	0	114	122	0	236											
Peak Factor					0.877											

TDC
Transportation Data Corporation

12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (SB)
E: I-93 SB offramp
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871N
Site Code : 0000000C
Start Date : 02/13/2002

Location #8

Groups Printed- Cars - Trucks

	Mystic Avenue (SB) From North				I-93 (SB) offramp From East				Mystic Avenue (SB) From South				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	0	83	0	0	0	0	202	0	0	0	0	0	28
07:15 AM	0	83	0	0	0	0	228	0	0	0	0	0	31
07:30 AM	0	94	0	0	0	0	238	0	0	0	0	0	33
07:45 AM	0	96	0	0	0	0	254	0	0	0	0	0	350
Total	0	356	0	0	0	0	922	0	0	0	0	0	1278
08:00 AM	0	109	0	0	0	0	300	0	0	0	0	0	40
08:15 AM	0	108	0	0	0	0	284	0	0	0	0	0	392
08:30 AM	0	122	0	0	0	0	277	0	0	0	0	0	399
08:45 AM	0	101	0	0	0	0	253	0	0	0	0	0	35
Total	0	440	0	0	0	0	1114	0	0	0	0	0	155
Grand Total	0	796	0	0	0	0	2036	0	0	0	0	0	2832
Apprch %	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	
Total %	0.0	28.1	0.0	0.0	0.0	0.0	71.9	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue (SB) From North					I-93 (SB) offramp From East					Mystic Avenue (SB) From South					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	08:00 AM															
Volume	0	440	0	0	440	0	0	1114	0	1114	0	0	0	0	0	155
Percent	0.0	100.0	0.0	0.0		0.0	0.0	100.0	0.0		0.0	0.0	0.0	0.0		
08:00 Volume	0	109	0	0	109	0	0	300	0	300	0	0	0	0	0	409
Peak Factor																0.950
High Int.	08:30 AM					08:00 AM					6:45:00 AM					
Volume	0	122	0	0	122	0	0	300	0	300						
Peak Factor					0.902					0.928						

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: I-93 SB onramp
E/W: Mystic Avenue (SB) offramp
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871K
Site Code : 00000000
Start Date : 02/13/2002

Location #9

Groups Printed- Cars - Trucks

	I-93 SB onramp/Mystic Avenue (SB) From North				I-93 SB onramp From South				Mystic Avenue (SB) offramp From West				
Start Time	Right	Thru (93)	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	45	433	0	0	0	0	0	0	0	0	0	0	478
07:15 AM	53	456	0	0	0	0	0	0	0	0	0	0	509
07:30 AM	65	450	0	0	0	0	0	0	0	0	0	0	515
07:45 AM	69	464	0	0	0	0	0	0	0	0	0	0	533
Total	232	1803	0	0	0	0	0	0	0	0	0	0	2035
08:00 AM	86	458	0	0	0	0	0	0	0	0	0	0	544
08:15 AM	91	424	0	0	0	0	0	0	0	0	0	0	515
08:30 AM	97	417	0	0	0	0	0	0	0	0	0	0	514
08:45 AM	85	390	0	0	0	0	0	0	0	0	0	0	475
Total	359	1689	0	0	0	0	0	0	0	0	0	0	2048
Grand Total	591	3492	0	0	0	0	0	0	0	0	0	0	4083
Apprch %	14.5	85.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	14.5	85.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	I-93 SB onramp/Mystic Avenue (SB) From North					I-93 SB onramp From South					Mystic Avenue (SB) offramp From West					
Start Time	Right	Thru (93)	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																
Intersection	07:30 AM															
Volume	311	1796	0	0	2107	0	0	0	0	0	0	0	0	0	0	2107
Percent	14.8	85.2	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
08:00 Volume	86	458	0	0	544	0	0	0	0	0	0	0	0	0	0	544
Peak Factor																0.968
High Int.	08:00 AM					6:45:00 AM					6:45:00 AM					
Volume	86	458	0	0	544											
Peak Factor					0.968											

TDC
Transportation Data Corporation
12 Walnut Street, #9 Natick, MA 01760
Office: 508-651-1610 Fax: 508-651-1229

N/S: Mystic Avenue (SB)
E/W: UTurn/Lombardi Street
City, State: Somerville, MA
Client: Rizzo Associates/N. Codd

File Name : 01871D
Site Code : 00000000
Start Date : 02/12/20[illegible]
Page No : 1

Location #10

Groups Printed- Cars - Trucks

	Mystic Avenue (SB) From North				UTurn Loop From East				Mystic Avenue From South				Lombardi Street From West				
Start Time	Right	Thru	Left (UTurn)	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	36	8	26	0	0	0	0	0	0	0	0	0	0	0	0	0	7[illegible]
07:15 AM	48	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	6[illegible]
07:30 AM	59	2	33	0	0	0	0	0	0	0	0	0	0	0	0	0	94
07:45 AM	45	4	30	0	0	0	0	0	0	0	0	0	0	0	0	0	79
Total	188	14	107	0	0	0	0	0	0	0	0	0	0	0	0	0	30[illegible]
08:00 AM	51	1	34	0	0	0	0	0	0	0	0	0	0	0	0	0	86
08:15 AM	55	1	24	0	0	0	0	0	0	0	0	0	0	0	0	0	80
08:30 AM	77	1	29	0	0	0	0	0	0	0	0	0	0	0	0	0	10[illegible]
08:45 AM	57	2	22	0	0	0	0	0	0	0	0	0	0	0	0	0	8[illegible]
Total	240	5	109	0	0	0	0	0	0	0	0	0	0	0	0	0	354
Grand Total	428	19	216	0	0	0	0	0	0	0	0	0	0	0	0	0	66[illegible]
Apprch %	64.6	2.9	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	64.6	2.9	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

	Mystic Avenue (SB) From North					UTurn Loop From East					Mystic Avenue From South					Lombardi Street From West					
Start Time	Right	Thru	Left (UTurn)	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Intersection	08:00 AM																				
Volume	240	5	109	0	354	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	354
Percent	67.8	1.4	30.8	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0		
08:30 Volume	77	1	29	0	107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10[illegible]
Peak Factor																					0.827
High Int.	08:30 AM					6:45:00 AM					6:45:00 AM					6:45:00 AM					
Volume	77	1	29	0	107																
Peak Factor					0.827																

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TRANSPORTATION DATA CORPORATION
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N/S: Fellsway (Route 28)
E/W: Assembly Square Mall Dr./Shore Road
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238M
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Fellsway (Route 28) From North				Assembly Square Mall Drive From East			Fellsway (Route 28) From South			Shore Drive From West			
Start Time	Right	Thru	Left	UTurn	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	41	348	25	0	53	0	0	1	444	0	2	0	0	914
04:15 PM	43	376	26	1	58	0	0	5	442	0	3	0	0	954
04:30 PM	52	376	27	1	50	0	0	5	456	0	5	0	0	972
04:45 PM	69	411	33	0	57	0	0	5	493	0	3	0	0	1071
Total	205	1511	111	2	218	0	0	16	1835	0	13	0	0	3911
05:00 PM	57	414	32	0	57	0	0	4	486	0	4	0	0	1054
05:15 PM	52	408	27	0	51	0	0	5	443	0	3	0	0	989
05:30 PM	49	432	37	0	41	0	0	4	460	0	4	0	0	1027
05:45 PM	70	414	33	0	44	0	0	2	454	0	2	0	0	1019
Total	228	1668	129	0	193	0	0	15	1843	0	13	0	0	4089
Grand Total	433	3179	240	2	411	0	0	31	3678	0	26	0	0	8000
Apprch %	11.2	82.5	6.2	0.1	100.0	0.0	0.0	0.8	99.2	0.0	100.0	0.0	0.0	
Total %	5.4	39.7	3.0	0.0	5.1	0.0	0.0	0.4	46.0	0.0	0.3	0.0	0.0	

	Fellsway (Route 28) From North					Assembly Square Mall Drive From East				Fellsway (Route 28) From South				Shore Drive From West				
Start Time	Right	Thru	Left	UTurn	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																		
Intersection	04:45 PM																	
Volume	227	1665	129	0	2021	206	0	0	206	18	1882	0	1900	14	0	0	14	4141
Percent	11.2	82.4	6.4	0.0		100.0	0.0	0.0		0.9	99.1	0.0		100.0	0.0	0.0		
04:45 Volume	69	411	33	0	513	57	0	0	57	5	493	0	498	3	0	0	3	1071
Peak Factor																		0.967
High Int.	05:30 PM					04:45 PM				04:45 PM				05:00 PM				
Volume	49	432	37	0	518	57	0	0	57	5	493	0	498	4	0	0	4	
Peak Factor					0.975				0.904				0.954				0.875	

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6

N/S: Fellsway (Route 28)
E: Middlesex Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238F
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Fellsway (Route 28) From North			Middlesex Avenue From East			Fellsway (Route 28) From South			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	329	15	85	0	16	33	341	0	819
04:15 PM	0	337	27	95	0	21	44	348	0	872
04:30 PM	0	360	15	120	0	39	35	374	0	943
04:45 PM	0	380	29	102	0	29	44	408	0	992
Total	0	1406	86	402	0	105	156	1471	0	3626
05:00 PM	0	385	33	95	0	28	52	404	0	997
05:15 PM	0	390	25	93	0	23	38	366	0	935
05:30 PM	0	402	39	114	0	22	51	372	0	1000
05:45 PM	0	364	54	91	0	11	38	367	0	925
Total	0	1541	151	393	0	84	179	1509	0	3857
Grand Total	0	2947	237	795	0	189	335	2980	0	7483
Apprch %	0.0	92.6	7.4	80.8	0.0	19.2	10.1	89.9	0.0	
Total %	0.0	39.4	3.2	10.6	0.0	2.5	4.5	39.8	0.0	

	Fellsway (Route 28) From North				Middlesex Avenue From East				Fellsway (Route 28) From South				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	04:45 PM												
Volume	0	1557	126	1683	404	0	102	506	185	1550	0	1735	3924
Percent	0.0	92.5	7.5		79.8	0.0	20.2		10.7	89.3	0.0		
05:30 Volume	0	402	39	441	114	0	22	136	51	372	0	423	1000
Peak Factor													0.981
High Int.	05:30 PM				05:30 PM				05:00 PM				
Volume	0	402	39	441	114	0	22	136	52	404	0	456	
Peak Factor				0.954				0.930				0.951	

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N/S: Route 28
E/W/SW: Mystic Avenue/Fellsway West
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238J
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Fellsway (Route 28) From North				Mystic Avenue From East				McGrath Highway (Route 28) From South				Mystic Avenue From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Hard Right	Right	Thru	Left	Int. Total
04:00 PM	0	198	26	0	0	287	0	0	0	0	0	0	17	121	83	0	732
04:15 PM	0	190	13	0	0	283	0	0	0	0	0	0	27	118	76	0	707
04:30 PM	0	212	12	0	0	295	0	0	0	0	0	0	34	120	79	0	752
04:45 PM	0	205	13	0	0	289	0	0	0	0	0	0	26	119	80	0	732
Total	0	805	64	0	0	1154	0	0	0	0	0	0	104	478	318	0	2923
05:00 PM	0	194	8	0	0	258	0	0	0	0	0	0	43	148	93	0	744
05:15 PM	0	206	14	0	0	258	0	0	0	0	0	0	41	159	62	0	740
05:30 PM	0	189	15	0	0	248	0	0	0	0	0	0	33	162	71	0	718
05:45 PM	0	182	13	0	0	227	0	0	0	0	0	0	32	151	90	0	695
Total	0	771	50	0	0	991	0	0	0	0	0	0	149	620	316	0	2897
Grand Total	0	1576	114	0	0	2145	0	0	0	0	0	0	253	1098	634	0	5820
Apprch %	0.0	93.3	6.7	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7	55.3	31.9	0.0	
Total %	0.0	27.1	2.0	0.0	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0	4.3	18.9	10.9	0.0	

	Fellsway (Route 28) From North					Mystic Avenue From East					McGrath Highway (Route 28) From South					Mystic Avenue From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Hard Right	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:30 PM																				
Volume	0	817	47	0	864	0	1100	0	0	1100	0	0	0	0	0	144	546	314	0	1004	2968
Percent	0.0	94.6	5.4	0.0		0.0	100.0	0.0	0.0		0.0	0.0	0.0	0.0		14.3	54.4	31.3	0.0		
04:30 Volume	0	212	12	0	224	0	295	0	0	295	0	0	0	0	0	34	120	79	0	233	752
Peak Factor																					0.987
High Int.	04:30 PM					04:30 PM					3:45:00 PM					05:00 PM					
Volume	0	212	12	0	224	0	295	0	0	295	0	0	0	0	0	43	148	93	0	284	
Peak Factor					0.964					0.932										0.884	

TDC
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8A

N/S/SE: Fellsway (Route 28)/Route 93 SB
E/W: Mystic Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238B
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Fellsway (Route 28) From North			Mystic Avenue From East				Fellsway (Route 28) From South			Mystic Avenue From West			
Start Time	Right	Thru	Bear Left	Right	Thru	Left	Hard Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	40	198	108	0	128	8	4	0	0	0	0	0	0	486
04:15 PM	51	184	114	0	137	12	3	0	0	0	0	0	0	501
04:30 PM	49	229	130	0	132	13	8	0	0	0	0	0	0	561
04:45 PM	58	214	120	0	134	7	7	0	0	0	0	0	0	540
Total	198	825	472	0	531	40	22	0	0	0	0	0	0	2088
05:00 PM	66	196	144	0	129	15	8	0	0	0	0	0	0	558
05:15 PM	51	199	149	0	146	16	4	0	0	0	0	0	0	565
05:30 PM	63	222	116	0	133	14	3	0	0	0	0	0	0	551
05:45 PM	59	176	144	0	104	4	3	0	0	0	0	0	0	490
Total	239	793	553	0	512	49	18	0	0	0	0	0	0	2164
Grand Total	437	1618	1025	0	1043	89	40	0	0	0	0	0	0	4252
Apprch %	14.2	52.5	33.3	0.0	89.0	7.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0	
Total %	10.3	38.1	24.1	0.0	24.5	2.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	

	Fellsway (Route 28) From North				Mystic Avenue From East					Fellsway (Route 28) From South				Mystic Avenue From West				
Start Time	Right	Thru	Bear Left	App. Total	Right	Thru	Left	Hard Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																		
Intersection	04:30 PM																	
Volume	224	838	543	1605	0	541	51	27	619	0	0	0	0	0	0	0	0	2224
Percent	14.0	52.2	33.8		0.0	87.4	8.2	4.4		0.0	0.0	0.0		0.0	0.0	0.0		
05:15 Volume	51	199	149	399	0	146	16	4	166	0	0	0	0	0	0	0	0	565
Peak Factor																		0.984
High Int.	04:30 PM				05:15 PM					3:45:00 PM				3:45:00 PM				
Volume	49	229	130	408	0	146	16	4	166									
Peak Factor				0.983					0.932									

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S: McGrath Highway (Route 28)
E/W: Mystic Avenue (8d)
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238L
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Mystic Avenue From East			McGrath Highway (Route 28) From South			Mystic Avenue From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	0	0	30	0	235	0	100	0	365
04:15 PM	0	0	0	27	0	227	0	94	0	348
04:30 PM	0	0	0	28	0	260	0	87	0	375
04:45 PM	0	0	0	35	0	262	0	99	0	396
Total	0	0	0	120	0	984	0	380	0	1484
05:00 PM	0	0	0	39	0	229	0	94	0	362
05:15 PM	0	0	0	43	0	213	0	83	0	339
05:30 PM	0	0	0	30	0	209	0	92	0	331
05:45 PM	0	0	0	32	0	196	0	95	0	323
Total	0	0	0	144	0	847	0	364	0	1355
Grand Total	0	0	0	264	0	1831	0	744	0	2839
Apprch %	0.0	0.0	0.0	12.6	0.0	87.4	0.0	100.0	0.0	
Total %	0.0	0.0	0.0	9.3	0.0	64.5	0.0	26.2	0.0	

	Mystic Avenue From East				McGrath Highway (Route 28) From South				Mystic Avenue From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	04:00 PM												
Volume	0	0	0	0	120	0	984	1104	0	380	0	380	1484
Percent	0.0	0.0	0.0		10.9	0.0	89.1		0.0	100.0	0.0		
04:45 Volume	0	0	0	0	35	0	262	297	0	99	0	99	396
Peak Factor													0.937
High Int.	3:45:00 PM				04:45 PM				04:00 PM				
Volume	0	0	0	0	35	0	262	297	0	100	0	100	
Peak Factor								0.929				0.950	

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N/S: McGrath Highway (Route 28)
E/W: Broadway
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238D
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	McGrath Highway (Route 28) From North				Broadway From East				McGrath Highway (Route 28) From South				Broadway From West				
Start Time	Right	Thru	Left	UTurn	Right	Thru	Left	UTurn	Right	Thru	Left	UTurn	Right	Thru	Left	Peds	Int. Total
04:00 PM	20	297	31	6	50	132	79	1	32	406	50	3	66	91	57	0	1321
04:15 PM	32	279	35	10	58	141	88	2	41	454	55	2	58	103	38	0	1396
04:30 PM	44	304	37	8	84	150	96	1	27	419	80	2	59	104	61	1	1477
04:45 PM	33	260	55	5	67	143	91	3	42	514	65	4	48	123	103	0	1556
Total	129	1140	158	29	259	566	354	7	142	1793	250	11	231	421	259	1	5750
05:00 PM	48	324	64	7	81	187	77	0	48	485	53	2	65	144	62	1	1648
05:15 PM	37	296	49	6	73	177	96	1	39	399	79	1	53	156	79	1	1542
05:30 PM	51	269	45	6	86	164	95	1	57	425	60	3	51	109	55	0	1477
05:45 PM	34	246	33	8	83	131	75	2	26	415	59	3	45	126	59	0	1345
Total	170	1135	191	27	323	659	343	4	170	1724	251	9	214	535	255	2	6012
Grand Total	299	2275	349	56	582	1225	697	11	312	3517	501	20	445	956	514	3	11762
Apprch %	10.0	76.4	11.7	1.9	23.1	48.7	27.7	0.4	7.2	80.9	11.5	0.5	23.2	49.8	26.8	0.2	
Total %	2.5	19.3	3.0	0.5	4.9	10.4	5.9	0.1	2.7	29.9	4.3	0.2	3.8	8.1	4.4	0.0	

	McGrath Highway (Route 28) From North					Broadway From East					McGrath Highway (Route 28) From South					Broadway From West					
Start Time	Right	Thru	Left	UTurn	App. Total	Right	Thru	Left	UTurn	App. Total	Right	Thru	Left	UTurn	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Intersection	04:30 PM																				
Volume	162	1184	205	26	1577	305	657	360	5	1327	156	1817	277	9	2259	225	527	305	3	1060	6223
Percent	10.3	75.1	13.0	1.6		23.0	49.5	27.1	0.4		6.9	80.4	12.3	0.4		21.2	49.7	28.8	0.3		
05:00 Volume	48	324	64	7	443	81	187	77	0	345	48	485	53	2	588	65	144	62	1	272	1648
Peak Factor																					0.944
High Int.	05:00 PM					05:15 PM					04:45 PM					05:15 PM					
Volume	48	324	64	7	443	73	177	96	1	347	42	514	65	4	625	53	156	79	1	289	
Peak Factor					0.890					0.956					0.904					0.917	

VHB Inc.
101 Walnut Street
Watertown, MA 02272

N/S: Broadway Street
E/W: MT. Vernon/Lombardi
Weather: Clear
City: Somerville, MA

File Name : s1
Site Code : 00000000
Start Date : 10/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	Broadway Street From North					Lombardi From East					Broadway Street From South					MT. Vernon From West					
End Time	Right	Through	Left	Peds	App. Total	Right	Through	Left	Peds	App. Total	Right	Through	Left	Peds	App. Total	Right	Through	Left	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
05:15 PM	0	132	43	0	175	203	0	101	0	304	0	0	0	0	0	20	41	18	0	79	558
05:30 PM	0	120	58	0	178	215	0	85	0	300	0	0	0	0	0	25	42	20	0	87	565
05:45 PM	0	112	50	0	162	179	0	74	0	253	0	0	0	0	0	17	34	9	0	60	475
06:00 PM	0	133	47	0	180	172	0	93	0	265	0	0	0	0	0	21	33	12	0	66	511
Total	0	497	198	0	695	769	0	353	0	1122	0	0	0	0	0	83	150	59	0	292	2109
Grand Total	0	497	198	0	695	769	0	353	0	1122	0	0	0	0	0	83	150	59	0	292	2109
Apprch %	0.0	71.5	28.5	0.0		68.5	0.0	31.5	0.0		0.0	0.0	0.0	0.0		28.4	51.4	20.2	0.0		
Total %	0.0	23.6	9.4	0.0	33.0	36.5	0.0	16.7	0.0	53.2	0.0	0.0	0.0	0.0	0.0	3.9	7.1	2.8	0.0	13.8	

TDC TRANSPORTATION DATA CORPORATION
23 Walnut Street
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N/S: Assembly Square Mall Dr/Lombardi St
E/W: Mystic Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238E
Site Code : 00007244
Start Date : 09/26/2000

Groups Printed- Cars - Trucks

	Assembly Square Mall Drive From North			Mystic Avenue From East			Lombardi Street From South			UTurn Ramp From Southwest	Mystic Avenue From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Hard Left	Right	Thru	Left	Int. Total
04:00 PM	4	67	0	30	354	86	0	34	96	65	0	0	0	736
04:15 PM	4	47	0	24	415	86	0	29	88	82	0	0	0	775
04:30 PM	4	85	0	35	443	127	0	48	88	74	0	0	0	904
04:45 PM	2	76	0	53	411	113	0	33	110	97	0	0	0	895
Total	14	275	0	142	1623	412	0	144	382	318	0	0	0	3310
05:00 PM	2	115	0	52	373	110	0	54	121	110	0	0	0	937
05:15 PM	0	116	0	63	379	83	0	62	109	117	0	0	0	929
05:30 PM	1	88	0	59	328	93	0	51	116	123	0	0	0	859
05:45 PM	2	90	0	71	311	143	0	49	107	120	0	0	0	893
Total	5	409	0	245	1391	429	0	216	453	470	0	0	0	3618
Grand Total	19	684	0	387	3014	841	0	360	835	788	0	0	0	6928
Apprch %	2.7	97.3	0.0	9.1	71.1	19.8	0.0	30.1	69.9	100.0	0.0	0.0	0.0	
Total %	0.3	9.9	0.0	5.6	43.5	12.1	0.0	5.2	12.1	11.4	0.0	0.0	0.0	

	Assembly Square Mall Drive From North				Mystic Avenue From East				Lombardi Street From South				UTurn Ramp From Southwest		Mystic Avenue From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Hard Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																			
Intersection	04:30 PM																		
Volume	8	392	0	400	203	1606	433	2242	0	197	428	625	398	398	0	0	0	0	3665
Percent	2.0	98.0	0.0		9.1	71.6	19.3		0.0	31.5	68.5		100.0		0.0	0.0	0.0		
05:00 Volume	2	115	0	117	52	373	110	535	0	54	121	175	110	110	0	0	0	0	937
Peak Factor																			0.978
High Int.	05:00 PM				04:30 PM				05:00 PM				05:15 PM		3:45:00 PM				
Volume	2	115	0	117	35	443	127	605	0	54	121	175	117	117					
Peak Factor				0.855				0.926				0.893		0.850					

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N: New Road
E/W: Mystic Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238C
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	New Road From North			Mystic Avenue From East			Mystic Avenue From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	44	0	0	16	532	0	0	0	0	592
04:15 PM	46	0	0	14	578	0	0	0	0	638
04:30 PM	60	0	0	32	462	0	0	0	0	554
04:45 PM	38	0	0	23	367	0	0	0	0	428
Total	188	0	0	85	1939	0	0	0	0	2212
05:00 PM	57	0	0	36	407	0	0	0	0	500
05:15 PM	45	0	0	31	438	0	0	0	0	514
05:30 PM	40	0	0	40	448	0	0	0	0	528
05:45 PM	48	0	0	40	484	0	0	0	0	572
Total	190	0	0	147	1777	0	0	0	0	2114
Grand Total	378	0	0	232	3716	0	0	0	0	4326
Apprch %	100.0	0.0	0.0	5.9	94.1	0.0	0.0	0.0	0.0	
Total %	8.7	0.0	0.0	5.4	85.9	0.0	0.0	0.0	0.0	

	New Road From North				Mystic Avenue From East				Mystic Avenue From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	04:00 PM												
Volume	188	0	0	188	85	1939	0	2024	0	0	0	0	2212
Percent	100.0	0.0	0.0		4.2	95.8	0.0		0.0	0.0	0.0		
04:15 Volume	46	0	0	46	14	578	0	592	0	0	0	0	638
Peak Factor													0.867
High Int.	04:30 PM				04:15 PM				3:45:00 PM				
Volume	60	0	0	60	14	578	0	592					
Peak Factor				0.783				0.855					

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S: New Road
E/W: Assembly Square Mall Drive
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238G
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	Assembly Square Mall Drive From East			New Road From South			Assembly Square Mall Drive From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	31	3	15	0	20	29	30	0	128
04:15 PM	0	43	4	10	0	20	38	22	0	137
04:30 PM	0	40	6	15	0	33	38	27	0	159
04:45 PM	0	62	8	18	0	28	22	31	0	169
Total	0	176	21	58	0	101	127	110	0	593
05:00 PM	0	57	11	17	0	43	31	47	0	206
05:15 PM	0	71	10	24	0	58	36	41	0	240
05:30 PM	0	74	12	14	0	41	40	39	0	220
05:45 PM	0	73	21	18	0	47	44	51	0	254
Total	0	275	54	73	0	189	151	178	0	920
Grand Total	0	451	75	131	0	290	278	288	0	1513
Apprch %	0.0	85.7	14.3	31.1	0.0	68.9	49.1	50.9	0.0	
Total %	0.0	29.8	5.0	8.7	0.0	19.2	18.4	19.0	0.0	

	Assembly Square Mall Drive From East				New Road From South				Assembly Square Mall Drive From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	05:00 PM												
Volume	0	275	54	329	73	0	189	262	151	178	0	329	920
Percent	0.0	83.6	16.4		27.9	0.0	72.1		45.9	54.1	0.0		
05:45 Volume	0	73	21	94	18	0	47	65	44	51	0	95	254
Peak Factor													0.906
High Int.	05:45 PM				05:15 PM				05:45 PM				
Volume	0	73	21	94	24	0	58	82	44	51	0	95	
Peak Factor				0.875				0.799				0.866	

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N: Foley Street
E/W: Middlesex Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238A
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	Foley Street From North			Middlesex Avenue From East			Middlesex Avenue From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	26	0	6	5	77	0	0	7	48	169
04:15 PM	25	0	6	3	81	0	0	5	56	176
04:30 PM	30	0	4	0	130	0	0	6	76	246
04:45 PM	32	0	4	2	127	1	0	3	43	212
Total	113	0	20	10	415	1	0	21	223	803
05:00 PM	68	0	8	2	98	0	0	13	56	245
05:15 PM	44	0	7	10	89	1	0	15	57	223
05:30 PM	45	0	2	7	127	0	0	26	77	284
05:45 PM	38	0	4	2	115	0	0	15	75	249
Total	195	0	21	21	429	1	0	69	265	1001
Grand Total	308	0	41	31	844	2	0	90	488	1804
Apprch %	88.3	0.0	11.7	3.5	96.2	0.2	0.0	15.6	84.4	
Total %	17.1	0.0	2.3	1.7	46.8	0.1	0.0	5.0	27.1	

	Foley Street From North				Middlesex Avenue From East				Middlesex Avenue From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	05:00 PM												
Volume	195	0	21	216	21	429	1	451	0	69	265	334	1001
Percent	90.3	0.0	9.7		4.7	95.1	0.2		0.0	20.7	79.3		
05:30 Volume	45	0	2	47	7	127	0	134	0	26	77	103	284
Peak Factor													0.881
High Int.	05:00 PM				05:30 PM				05:30 PM				
Volume	68	0	8	76	7	127	0	134	0	26	77	103	
Peak Factor				0.711				0.841				0.811	

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N/S: Foley Street
E/W: Assembly Square Mall Drive
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238H
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	Foley Street From North			Assembly Square Mall Drive From East			Foley Street From South			Assembly Square Mall Drive From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	2	4	5	11	21	14	27	2	19	10	22	0	137
04:15 PM	1	5	11	16	21	13	29	5	14	16	27	1	159
04:30 PM	2	4	9	11	39	11	40	4	16	6	17	0	159
04:45 PM	0	2	10	14	47	16	21	1	11	3	23	2	150
Total	5	15	35	52	128	54	117	12	60	35	89	3	605
05:00 PM	1	3	10	20	43	23	32	6	18	9	26	1	192
05:15 PM	2	2	8	14	72	27	27	3	27	5	27	0	214
05:30 PM	1	2	7	12	61	17	44	2	22	9	27	1	205
05:45 PM	0	2	13	25	53	18	48	7	15	9	24	0	214
Total	4	9	38	71	229	85	151	18	82	32	104	2	825
Grand Total	9	24	73	123	357	139	268	30	142	67	193	5	1430
Apprch %	8.5	22.6	68.9	19.9	57.7	22.5	60.9	6.8	32.3	25.3	72.8	1.9	
Total %	0.6	1.7	5.1	8.6	25.0	9.7	18.7	2.1	9.9	4.7	13.5	0.3	

	Foley Street From North				Assembly Square Mall Drive From East				Foley Street From South				Assembly Square Mall Drive From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Intersection	05:00 PM																
Volume	4	9	38	51	71	229	85	385	151	18	82	251	32	104	2	138	825
Percent	7.8	17.6	74.5		18.4	59.5	22.1		60.2	7.2	32.7		23.2	75.4	1.4		
05:45 Volume	0	2	13	15	25	53	18	96	48	7	15	70	9	24	0	33	214
Peak Factor																	0.964
High Int.	05:45 PM				05:15 PM				05:45 PM				05:30 PM				
Volume	0	2	13	15	14	72	27	113	48	7	15	70	9	27	1	37	
Peak Factor				0.850				0.852				0.896				0.932	

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4

N: Middlesex Avenue
E/W: Mystic Avenue
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238S
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Middlesex Avenue From North			Mystic Avenue From East			Mystic Avenue From West			
Start Time	Right	Thru	Left	Thru	93 NB	Left	Right	Thru	Left	Int. Total
04:00 PM	0	0	0	92	402	0	0	0	0	494
04:15 PM	0	0	0	89	438	0	0	0	0	527
04:30 PM	0	0	0	99	399	0	0	0	0	498
04:45 PM	0	0	0	72	363	0	0	0	0	435
Total	0	0	0	352	1602	0	0	0	0	1954
05:00 PM	0	0	0	92	421	0	0	0	0	513
05:15 PM	0	0	0	103	425	0	0	0	0	528
05:30 PM	0	0	0	75	431	0	0	0	0	506
05:45 PM	0	0	0	62	397	0	0	0	0	459
Total	0	0	0	332	1674	0	0	0	0	2006
Grand Total	0	0	0	684	3276	0	0	0	0	3960
Apprch %	0.0	0.0	0.0	17.3	82.7	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	17.3	82.7	0.0	0.0	0.0	0.0	

	Middlesex Avenue From North				Mystic Avenue From East				Mystic Avenue From West				
Start Time	Right	Thru	Left	App. Total	Thru	93 NB	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	05:00 PM												
Volume	0	0	0	0	332	1674	0	2006	0	0	0	0	2006
Percent	0.0	0.0	0.0		16.6	83.4	0.0		0.0	0.0	0.0		
05:15 Volume	0	0	0	0	103	425	0	528	0	0	0	0	528
Peak Factor													0.950
High Int.	3:45:00 PM				05:15 PM				3:45:00 PM				
Volume	0	0	0	0	103	425	0	528					
Peak Factor								0.950					

13A

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N: Fellsway (Route 28) (13a)
E/W: Route 93 NB Offramp
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238P
Site Code : 00007244
Start Date : 09/27/2000
Page No : 1

Groups Printed- Cars - Trucks

	Fellsway (Route 28) From North			Route 93 NB Offramp From East			Route 93 NB Offramp From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	0	0	104	57	0	0	0	0	161
04:15 PM	0	0	0	99	64	0	0	0	0	163
04:30 PM	0	0	0	97	52	0	0	0	0	149
04:45 PM	0	0	0	101	54	0	0	0	0	155
Total	0	0	0	401	227	0	0	0	0	628
05:00 PM	0	0	0	100	70	0	0	0	0	170
05:15 PM	0	0	0	99	60	0	0	0	0	159
05:30 PM	0	0	0	130	63	0	0	0	0	193
05:45 PM	0	0	0	118	63	0	0	0	0	181
Total	0	0	0	447	256	0	0	0	0	703
Grand Total	0	0	0	848	483	0	0	0	0	1331
Apprch %	0.0	0.0	0.0	63.7	36.3	0.0	0.0	0.0	0.0	
Total %	0.0	0.0	0.0	63.7	36.3	0.0	0.0	0.0	0.0	

	Fellsway (Route 28) From North				Route 93 NB Offramp From East				Route 93 NB Offramp From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1													
Intersection	05:00 PM												
Volume	0	0	0	0	447	256	0	703	0	0	0	0	703
Percent	0.0	0.0	0.0		63.6	36.4	0.0		0.0	0.0	0.0		
05:30 Volume	0	0	0	0	130	63	0	193	0	0	0	0	193
Peak Factor													0.911
High Int.	3:45:00 PM				05:30 PM				3:45:00 PM				
Volume	0	0	0	0	130	63	0	193					
Peak Factor								0.911					

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13B

Mystic Avenue ramp to Route 93 SB
Location (13b)
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238Q
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	From North			From East			From South			Mystic Avenue Ramp (13b) From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	63	108	0	171
04:15 PM	0	0	0	0	0	0	0	0	0	69	122	0	191
04:30 PM	0	0	0	0	0	0	0	0	0	61	158	0	219
04:45 PM	0	0	0	0	0	0	0	0	0	64	129	0	193
Total	0	0	0	0	0	0	0	0	0	257	517	0	774
05:00 PM	0	0	0	0	0	0	0	0	0	78	156	0	234
05:15 PM	0	0	0	0	0	0	0	0	0	90	158	0	248
05:30 PM	0	0	0	0	0	0	0	0	0	83	147	0	230
05:45 PM	0	0	0	0	0	0	0	0	0	70	130	0	200
Total	0	0	0	0	0	0	0	0	0	321	591	0	912
Grand Total	0	0	0	0	0	0	0	0	0	578	1108	0	1686
Apprch %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.3	65.7	0.0	
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.3	65.7	0.0	

	From North				From East				From South				Mystic Avenue Ramp (13b) From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Intersection	05:00 PM																
Volume	0	0	0	0	0	0	0	0	0	0	0	0	321	591	0	912	912
Percent	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0		35.2	64.8	0.0		
05:15 Volume	0	0	0	0	0	0	0	0	0	0	0	0	90	158	0	248	248
Peak Factor																	0.919
High Int.	3:45:00 PM				3:45:00 PM				3:45:00 PM				05:15 PM				
Volume	0	0	0	0	0	0	0	0	0	0	0	0	90	158	0	248	
Peak Factor																0.919	

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13c

Mystic Avenue ramp to Route 93 SB
Location (13c)
City, State: Somerville, MA
Client: VHB/E.Betancourt

File Name : 01238R
Site Code : 00007244
Start Date : 09/26/2000
Page No : 1

Groups Printed- Cars - Trucks

	From North			From East			From South			Mystic Avenue Ramp (13c) From West			
Start Time	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	59	298	0	357
04:15 PM	0	0	0	0	0	0	0	0	0	66	287	0	353
04:30 PM	0	0	0	0	0	0	0	0	0	83	290	0	373
04:45 PM	0	0	0	0	0	0	0	0	0	61	299	0	360
Total	0	0	0	0	0	0	0	0	0	269	1174	0	1443
05:00 PM	0	0	0	0	0	0	0	0	0	63	236	0	299
05:15 PM	0	0	0	0	0	0	0	0	0	69	280	0	349
05:30 PM	0	0	0	0	0	0	0	0	0	59	322	0	381
05:45 PM	0	0	0	0	0	0	0	0	0	69	322	0	391
Total	0	0	0	0	0	0	0	0	0	260	1160	0	1420
Grand Total	0	0	0	0	0	0	0	0	0	529	2334	0	2863
Apprch %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5	81.5	0.0	
Total %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5	81.5	0.0	

	From North				From East				From South				Mystic Avenue Ramp (13c) From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Intersection	04:00 PM																
Volume	0	0	0	0	0	0	0	0	0	0	0	0	269	1174	0	1443	1443
Percent	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0		18.6	81.4	0.0		
04:30 Volume	0	0	0	0	0	0	0	0	0	0	0	0	83	290	0	373	373
Peak Factor																	0.967
High Int.	3:45:00 PM				3:45:00 PM				3:45:00 PM				04:30 PM				
Volume	0	0	0	0	0	0	0	0	0	0	0	0	83	290	0	373	
Peak Factor																0.967	

Appendix B

Traffic Operations Analyses

Movement	WBL	WBR	WBR2	NBL	NBT	NBR	SBU	SBL	SBT	SBR	SEL	SER
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0	4.0		4.0	4.0			4.0
Lane Util. Factor			1.00		0.91	1.00		0.97	0.91			1.00
Frt			0.86		1.00	0.85		1.00	1.00			0.86
Flt Protected			1.00		1.00	1.00		0.95	1.00			1.00
Satd. Flow (prot)			1611		5085	1583		3433	5085			1611
Flt Permitted			1.00		1.00	1.00		0.21	1.00			1.00
Satd. Flow (perm)			1611		5085	1583		763	5085			1611
Volume (vph)	0	0	35	0	1200	10	65	140	3200	0	0	15
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	36	0	1250	10	68	146	3333	0	0	16
Lane Group Flow (vph)	0	0	36	0	1250	10	0	214	3333	0	0	16
Turn Type			Free			Free	custom	Prot				Free
Protected Phases					2			5	14			
Permitted Phases			Free			Free	5					Free
Actuated Green, G (s)			85.0		47.0	85.0		28.0	85.0			85.0
Effective Green, g (s)			85.0		48.0	85.0		29.0	85.0			85.0
Actuated g/C Ratio			1.00		0.56	1.00		0.34	1.00			1.00
Clearance Time (s)					5.0			5.0	2.0			
Vehicle Extension (s)					3.0			3.0	3.0			
Lane Grp Cap (vph)			1611		2872	1583		260	5085			1611
v/s Ratio Prot					0.25				c0.66			
v/s Ratio Perm			0.02			0.01		c0.28				0.01
v/c Ratio			0.02		0.44	0.01		0.82	0.66			0.01
Uniform Delay, d1			0.0		10.7	0.0		25.6	0.0			0.0
Progression Factor			1.00		0.40	1.00		1.00	1.00			1.00
Incremental Delay, d2			0.0		0.5	0.0		18.6	0.3			0.0
Delay (s)			0.0		4.7	0.0		44.2	0.3			0.0
Level of Service			A		A	A		D	A			A
Approach Delay (s)	0.0				4.6				3.0		0.0	
Approach LOS	A				A				A		A	

Intersection Summary			
HCM Average Control Delay	3.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	B
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.91	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	5085	1583	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	5085	1583	3433	5085
Volume (vph)	55	120	1090	165	180	3035
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	56	121	1101	167	182	3066
Lane Group Flow (vph)	56	121	1101	167	182	3066
Turn Type		Free		Free	Prot	
Protected Phases	8		6		1	6
Permitted Phases	8	Free	6	Free		
Actuated Green, G (s)	8.0	85.0	47.0	85.0	15.0	47.0
Effective Green, g (s)	9.0	85.0	48.0	85.0	16.0	48.0
Actuated g/C Ratio	0.11	1.00	0.56	1.00	0.19	0.56
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	187	1583	2872	1583	646	2872
v/s Ratio Prot	c0.03		0.22		c0.05	c0.60
v/s Ratio Perm		0.08		0.11		
v/c Ratio	0.30	0.08	0.38	0.11	0.28	1.07
Uniform Delay, d1	35.1	0.0	10.3	0.0	29.6	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	0.1	0.4	0.1	0.2	36.6
Delay (s)	36.0	0.1	10.7	0.1	29.8	55.1
Level of Service	D	A	B	A	C	E
Approach Delay (s)	11.5		9.3			53.7
Approach LOS	B		A			D

Intersection Summary			
HCM Average Control Delay	40.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	B
c Critical Lane Group			

Movement	WBL	WBT	SBL	SBT	SBR
Lane Configurations					
Ideal Flow (vphpl)	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0
Lane Util. Factor		0.91	0.97	*0.95	1.00
Frt		1.00	1.00	1.00	0.85
Flt Protected		0.99	0.95	1.00	1.00
Satd. Flow (prot)		5049	3433	5309	1583
Flt Permitted		0.99	0.95	1.00	1.00
Satd. Flow (perm)		5049	3433	5309	1583
Volume (vph)	65	380	1415	1500	175
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	68	400	1489	1579	184
Lane Group Flow (vph)	0	468	1489	1579	184
Turn Type	Perm		Split		Perm
Protected Phases		6	4	4	
Permitted Phases	6				4
Actuated Green, G (s)		40.0	34.0	34.0	34.0
Effective Green, g (s)		44.0	38.0	38.0	38.0
Actuated g/C Ratio		0.49	0.42	0.42	0.42
Clearance Time (s)		8.0	8.0	8.0	8.0
Lane Grp Cap (vph)		2468	1449	2242	668
v/s Ratio Prot			c0.43	0.30	
v/s Ratio Perm		0.09			0.12
v/c Ratio		0.19	1.03	0.70	0.28
Uniform Delay, d1		13.0	26.0	21.4	17.0
Progression Factor		1.00	1.00	1.00	1.00
Incremental Delay, d2		0.2	31.0	1.9	1.0
Delay (s)		13.1	57.0	23.3	18.0
Level of Service		B	E	C	B
Approach Delay (s)		13.1		38.4	
Approach LOS		B		D	

Intersection Summary			
HCM Average Control Delay	35.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.3%	ICU Level of Service	A

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations					↰↑↑↑			↑↑	↱		↑↑	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0	4.0		4.0	
Lane Util. Factor					0.91			0.95	1.00		0.95	
Frt					1.00			1.00	0.85		1.00	
Flt Protected					1.00			1.00	1.00		1.00	
Satd. Flow (prot)					5071			3539	1583		3539	
Flt Permitted					1.00			1.00	1.00		1.00	
Satd. Flow (perm)					5071			3539	1583		3539	
Volume (vph)	0	0	0	85	1450	0	0	595	850	0	495	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	93	1593	0	0	654	934	0	544	0
Lane Group Flow (vph)	0	0	0	0	1686	0	0	654	934	0	544	0
Turn Type				Perm					Perm			
Protected Phases					4			2			6	
Permitted Phases				4					2			
Actuated Green, G (s)					34.0			40.0	40.0		40.0	
Effective Green, g (s)					38.0			44.0	44.0		44.0	
Actuated g/C Ratio					0.42			0.49	0.49		0.49	
Clearance Time (s)					8.0			8.0	8.0		8.0	
Lane Grp Cap (vph)					2141			1730	774		1730	
v/s Ratio Prot								0.18			0.15	
v/s Ratio Perm					0.33				0.59			
v/c Ratio					0.79			0.38	1.21		0.31	
Uniform Delay, d1					22.5			14.4	23.0		13.9	
Progression Factor					0.29			1.00	1.00		0.07	
Incremental Delay, d2					2.2			0.6	105.0		0.3	
Delay (s)					8.8			15.1	128.0		1.3	
Level of Service					A			B	F		A	
Approach Delay (s)		0.0			8.8			81.5			1.3	
Approach LOS		A			A			F			A	

Intersection Summary			
HCM Average Control Delay	38.0	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	97.2%	ICU Level of Service	E

c Critical Lane Group

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			
Lane Util. Factor	0.97		0.95			
Frt	1.00		1.00			
Flt Protected	1.00		1.00			
Satd. Flow (prot)	3614		3539			
Flt Permitted	1.00		1.00			
Satd. Flow (perm)	3614		3539			
Volume (vph)	495	0	680	0	0	0
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	516	0	708	0	0	0
Lane Group Flow (vph)	516	0	708	0	0	0
Turn Type						
Protected Phases	9					
Permitted Phases			10 14			
Actuated Green, G (s)	12.0		62.0			
Effective Green, g (s)	16.0		66.0			
Actuated g/C Ratio	0.18		0.73			
Clearance Time (s)	8.0					
Lane Grp Cap (vph)	642		2595			
v/s Ratio Prot	c0.14					
v/s Ratio Perm			0.20			
v/c Ratio	0.80		0.27			
Uniform Delay, d1	35.5		4.0			
Progression Factor	1.00		2.35			
Incremental Delay, d2	10.3		0.2			
Delay (s)	45.8		9.6			
Level of Service	D		A			
Approach Delay (s)	45.8		9.6			0.0
Approach LOS	D		A			A

Intersection Summary			
HCM Average Control Delay	24.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	41.0%	ICU Level of Service	A

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	*0.94		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	5161		1770	5068	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583	1770	5161		1770	5068	
Volume (vph)	260	495	380	235	280	180	190	950	125	50	2200	50
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	271	516	396	245	292	188	198	990	130	52	2292	52
Lane Group Flow (vph)	271	516	396	245	292	188	198	1120	0	52	2344	0
Turn Type	Prot		Perm	Prot		Free	Prot			Prot		
Protected Phases	7	4		3	8		5			1	6	
Permitted Phases			4			Free		2				
Actuated Green, G (s)	21.0	20.0	20.0	18.0	17.0	140.8	16.5	71.6		8.2	63.3	
Effective Green, g (s)	22.0	22.0	22.0	19.0	19.0	140.8	18.5	73.6		10.2	65.3	
Actuated g/C Ratio	0.16	0.16	0.16	0.13	0.13	1.00	0.13	0.52		0.07	0.46	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	277	553	247	239	478	1583	233	2698		128	2350	
v/s Ratio Prot	c0.15	0.15		0.14	0.08		c0.11			0.03	c0.46	
v/s Ratio Perm			0.25			0.12		0.22				
v/c Ratio	0.98	0.93	1.60	1.03	0.61	0.12	0.85	0.42		0.41	1.00	
Uniform Delay, d1	59.2	58.7	59.4	60.9	57.4	0.0	59.8	20.5		62.4	37.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	47.5	22.9	289.6	64.9	2.3	0.2	24.0	0.1		2.1	17.8	
Delay (s)	106.7	81.6	349.0	125.8	59.7	0.2	83.8	20.6		64.5	55.5	
Level of Service	F	F	F	F	E	A	F	C		E	E	
Approach Delay (s)		176.9			66.6			30.1			55.7	
Approach LOS		F			E			C			E	

Intersection Summary			
HCM Average Control Delay	76.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	140.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	97.5%	ICU Level of Service	E
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑					↰	↑↱		↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0					4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00					1.00	1.00		1.00		1.00
Frt	1.00	1.00					1.00	0.92		1.00		0.85
Flt Protected	0.95	1.00					0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863					1770	1711		1770		1583
Flt Permitted	0.95	1.00					0.95	1.00		0.63		1.00
Satd. Flow (perm)	1770	1863					1770	1711		1183		1583
Volume (vph)	70	470	0	0	0	0	45	80	95	355	0	380
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	511	0	0	0	0	49	87	103	386	0	413
Lane Group Flow (vph)	76	511	0	0	0	0	49	190	0	386	0	413
Turn Type	Perm						Perm			custom		custom
Protected Phases		2						8				
Permitted Phases	2						8			4		4
Actuated Green, G (s)	25.0	25.0					26.0	26.0		26.0		26.0
Effective Green, g (s)	27.0	27.0					28.0	28.0		28.0		28.0
Actuated g/C Ratio	0.43	0.43					0.44	0.44		0.44		0.44
Clearance Time (s)	6.0	6.0					6.0	6.0		6.0		6.0
Lane Grp Cap (vph)	759	798					787	760		526		704
v/s Ratio Prot		c0.27						0.11				
v/s Ratio Perm	0.04						0.03			c0.33		0.26
v/c Ratio	0.10	0.64					0.06	0.25		0.73		0.59
Uniform Delay, d1	10.7	14.2					10.0	10.9		14.4		13.2
Progression Factor	1.00	1.00					1.00	1.00		1.00		1.00
Incremental Delay, d2	0.3	3.9					0.2	0.8		8.8		3.6
Delay (s)	11.0	18.1					10.2	11.7		23.2		16.7
Level of Service	B	B					B	B		C		B
Approach Delay (s)		17.2			0.0			11.4			19.9	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM Average Control Delay	17.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	63.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.2%	ICU Level of Service	B

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations				↰	↑↑↑↱		↰	↑			↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0			4.0	
Lane Util. Factor				1.00	0.91		1.00	1.00			0.95	
Frt				1.00	0.99		1.00	1.00			0.95	
Flt Protected				0.95	1.00		0.95	1.00			1.00	
Satd. Flow (prot)				1770	5045		1770	1863			3362	
Flt Permitted				0.95	1.00		0.44	1.00			1.00	
Satd. Flow (perm)				1770	5045		811	1863			3362	
Volume (vph)	0	0	0	265	1070	60	120	30	0	0	230	15
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	0	276	1115	62	125	31	0	0	240	16
Lane Group Flow (vph)	0	0	0	276	1177	0	125	31	0	0	256	0
Turn Type				Perm			pm+pt					
Protected Phases					2		7	4				
Permitted Phases				2			4				8	
Actuated Green, G (s)				28.9	28.9		25.1	25.1			10.3	
Effective Green, g (s)				30.9	30.9		27.1	27.1			12.3	
Actuated g/C Ratio				0.47	0.47		0.41	0.41			0.19	
Clearance Time (s)				6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)				829	2362		490	765			627	
v/s Ratio Prot					c0.23		c0.04	0.02				
v/s Ratio Perm				0.16			0.06				0.08	
v/c Ratio				0.33	0.50		0.26	0.04			0.41	
Uniform Delay, d1				11.1	12.2		12.5	11.7			23.6	
Progression Factor				1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2				0.2	0.2		0.3	0.0			0.4	
Delay (s)				11.3	12.3		12.8	11.7			24.1	
Level of Service				B	B		B	B			C	
Approach Delay (s)		0.0			12.1			12.6			24.1	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM Average Control Delay	13.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	66.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
c Critical Lane Group			

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations			↑↑↑	↱		↱↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.0		4.0
Lane Util. Factor			0.91	1.00		0.88
Frt			1.00	0.85		0.85
Flt Protected			1.00	1.00		1.00
Satd. Flow (prot)			5085	1583		2787
Flt Permitted			1.00	1.00		1.00
Satd. Flow (perm)			5085	1583		2787
Volume (vph)	0	0	1205	50	0	95
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	1354	56	0	107
Lane Group Flow (vph)	0	0	1354	56	0	107
Turn Type				Free		custom
Protected Phases			2			
Permitted Phases				Free		8
Actuated Green, G (s)			69.4	86.6		5.2
Effective Green, g (s)			71.4	86.6		7.2
Actuated g/C Ratio			0.82	1.00		0.08
Clearance Time (s)			6.0			6.0
Vehicle Extension (s)			3.0			3.0
Lane Grp Cap (vph)			4192	1583		232
v/s Ratio Prot			c0.27			
v/s Ratio Perm				0.04		0.04
v/c Ratio			0.32	0.04		0.46
Uniform Delay, d1			1.8	0.0		37.9
Progression Factor			1.00	1.00		1.00
Incremental Delay, d2			0.2	0.0		1.5
Delay (s)			2.0	0.0		39.3
Level of Service			A	A		D
Approach Delay (s)		0.0	1.9		39.3	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	4.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	86.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	36.6%	ICU Level of Service	A
c Critical Lane Group			

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*Rizzo*	Intersection	*Assembly Sq Dr/ New Rd*
Agency/Co.	*Rizzo Associates, Inc.*	Jurisdiction	*Somerville, MA*
Date Performed	*3/18/02*	Analysis Year	*2002 Existing*
Analysis Time Period	*Weekday Morning Peak Hour*		
Project Description	*8640 - Assembly Square Transportation Plan*		
East/West Street:	*New Road*	North/South Street:	*Assembly Square Drive*
Intersection Orientation:	*North-South*	Study Period (hrs):	*0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	65	0	0	140	70
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	28	73	0	0	157	78
Percent Heavy Vehicles	2	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	0	2	0
Configuration	LT	T			T	TR
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	25	0	25
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	0	0	0	28	0	28
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	1	0	1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT					L		R
v (vph)	28					28		28
C (m) (vph)	1329					665		912
v/c	0.02					0.04		0.03
95% queue length	0.06					0.13		0.09
Control Delay	7.8					10.7		9.1
LOS	A					B		A
Approach Delay	--	--				9.9		
Approach LOS	--	--				A		

ALL-WAY STOP CONTROL ANALYSIS

General Information

Analyst	*Rizzo*
Agency/Co.	*Rizzo Associates, Inc.*
Date Performed	*3/18/02*
Analysis Time Period	*Weekday Morning Peak Hour*

Site Information

Intersection	*Assembly Sq Dr/ Foley St*
Jurisdiction	*Somerville, MA*
Analysis Year	*2002 Existing*

Project ID *8640 - Assembly Square Transportation Plan*

East/West Street: *Foley Street*

North/South Street: *Assembly Square Drive*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume	15	20	140	35	15	5
%Thrus Left Lane	50			50		

Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume	25	35	30	1	90	20
%Thrus Left Lane	50			50		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	TR	LTR	
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Flow Rate	26	162	45	13	45	51	119	
% Heavy Vehicles	2	2	2	2	2	2	2	
No. Lanes	2		2		2		1	
Geometry Group	5		5		5		4b	
Duration, T	0.25							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	0.6	0.0	0.8	0.0	0.6	0.0	0.0	
Prop. Right-Turns	0.0	0.9	0.0	0.4	0.0	0.6	0.2	
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
hLT-adj	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
hRT-adj	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
hadj, computed	5.28	5.28	5.28	5.28	5.28	5.28	5.28	

Departure Headway and Service Time

hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	
x, initial	0.02	0.14	0.04	0.01	0.04	0.05	0.11	
hd, final value	5.28	5.28	5.28	5.28	5.28	5.28	5.28	
x, final value	0.04	0.21	0.07	0.02	0.07	0.07	0.17	
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.0	2.3	3.0	2.3	3.0	2.3	3.0	2.3

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity	276	412	295	263	295	301	369	
Delay	8.19	8.49	8.54	7.83	8.45	7.92	8.87	
LOS	A	A	A	A	A	A	A	
Approach: Delay	8.45		8.38		8.17		8.87	
LOS	A		A		A		A	
Intersection Delay	8.49							
Intersection LOS	A							

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*Rizzo*	Intersection	*Middlesex Ave/ Foley St*
Agency/Co.	*Rizzo Associates, Inc.*	Jurisdiction	*Somerville, MA*
Date Performed	*3/18/02*	Analysis Year	*2002 Existing*
Analysis Time Period	*Weekday Morning Peak Hour*		
Project Description	*8640 - Assembly Square Transportation Plan*		
East/West Street:	*Foley Street*	North/South Street:	*Middlesex Avenue*
Intersection Orientation:	*North-South*	Study Period (hrs):	*0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*0*	*150*	*10*	*265*	*15*	*0*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR	*0*	*163*	*10*	*288*	*16*	*0*
Percent Heavy Vehicles	*0*	--	--	*2*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*0*	*0*	*2*	*0*
Configuration		*T*	*TR*	*LT*	*T*	
Upstream Signal		*0*			*0*	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*10*	*0*	*50*	*0*	*0*	*0*
Peak-Hour Factor, PHF	*0.92*	*0.92*	*0.92*	*0.92*	*0.92*	*0.92*
Hourly Flow Rate, HFR	*10*	*0*	*54*	*0*	*0*	*0*
Percent Heavy Vehicles	*2*	*0*	*2*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*1*	*0*	*1*	*0*	*0*	*0*
Configuration	*L*		*R*			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*	*L*		*R*			
v (vph)		*288*	*10*		*54*			
C (m) (vph)		*1401*	*275*		*956*			
v/c		*0.21*	*0.04*		*0.06*			
95% queue length		*0.77*	*0.11*		*0.18*			
Control Delay		*8.2*	*18.6*		*9.0*			
LOS		*A*	*C*		*A*			
Approach Delay	--	--	*10.5*					
Approach LOS	--	--	*B*					

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*Rizzo*	Intersection	*Middlesex/Assembly Sq Mall Dwy*
Agency/Co.	*Rizzo Associates, Inc.*	Jurisdiction	*Somerville, MA*
Date Performed	*3/18/02*	Analysis Year	*2002 Existing*
Analysis Time Period	*Weekday Morning Peak Hour*		

Project Description *8640 - Assembly Square Transportation Plan*

East/West Street: *Middlesex Avenue*	North/South Street: *Assembly Square Mall Drwy*
Intersection Orientation: *East-West*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	345	0	0	170	5
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	0	387	0	0	191	5
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Raised curb					
RT Channelized			0			0
Lanes	0	2	0	0	2	0
Configuration		T			T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	0	0	5
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	0	0	0	0	0	5
Percent Heavy Vehicles	0	0	0	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	1
Configuration						R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration								R
v (vph)								5
C (m) (vph)								939
v/c								0.01
95% queue length								0.02
Control Delay								8.9
LOS								A
Approach Delay	--	--				8.9		
Approach LOS	--	--				A		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	Rizzo	Intersection	Mystic Ave SB/ Lombardi St
Agency/Co.	Rizzo Associates, Inc.	Jurisdiction	Somerville, MA
Date Performed	3/18/02	Analysis Year	2002 Existing
Analysis Time Period	Weekday Morning Peak Hour		

Project Description	8640 - Assembly Square Transportation Plan		
East/West Street:	Mystic Avenue SB	North/South Street:	Lombardi Street
Intersection Orientation:	East-West	Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	150	0	0	495	5
Peak-Hour Factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Hourly Flow Rate, HFR	0	182	0	0	603	0
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	0	2	0
Configuration		T			T	
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	5	0	240
Peak-Hour Factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82
Hourly Flow Rate, HFR	0	0	0	6	0	292
Percent Heavy Vehicles	0	0	0	2	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration							LR	
v (vph)							298	
C (m) (vph)							682	
v/c							0.44	
95% queue length							2.22	
Control Delay							14.3	
LOS							B	
Approach Delay	--	--				14.3		
Approach LOS	--	--				B		

Movement	WBL	WBR	WBR2	NBL	NBT	NBR	SBU	SBL	SBT	SBR	SEL	SER
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0	4.0		4.0	4.0			4.0
Lane Util. Factor			1.00		0.91	1.00		0.97	0.91			1.00
Frt			0.86		1.00	0.85		1.00	1.00			0.86
Flt Protected			1.00		1.00	1.00		0.95	1.00			1.00
Satd. Flow (prot)			1611		5085	1583		3433	5085			1611
Flt Permitted			1.00		1.00	1.00		0.14	1.00			1.00
Satd. Flow (perm)			1611		5085	1583		498	5085			1611
Volume (vph)	0	0	195	0	1910	15	5	130	1690	0	0	15
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	0	201	0	1969	15	5	134	1742	0	0	15
Lane Group Flow (vph)	0	0	201	0	1969	15	0	139	1742	0	0	15
Turn Type			Free			Free	custom	Prot				Free
Protected Phases					2			5	14			
Permitted Phases			Free			Free	5					Free
Actuated Green, G (s)			85.0		47.0	85.0		28.0	85.0			85.0
Effective Green, g (s)			85.0		48.0	85.0		29.0	85.0			85.0
Actuated g/C Ratio			1.00		0.56	1.00		0.34	1.00			1.00
Clearance Time (s)					5.0			5.0	2.0			
Vehicle Extension (s)					3.0			3.0	3.0			
Lane Grp Cap (vph)			1611		2872	1583		170	5085			1611
v/s Ratio Prot					c0.39				0.34			
v/s Ratio Perm			0.12			0.01		c0.28				0.01
v/c Ratio			0.12		0.69	0.01		0.82	0.34			0.01
Uniform Delay, d1			0.0		13.1	0.0		25.6	0.0			0.0
Progression Factor			1.00		0.37	1.00		1.00	1.00			1.00
Incremental Delay, d2			0.2		1.2	0.0		25.3	0.0			0.0
Delay (s)			0.2		6.0	0.0		50.8	0.0			0.0
Level of Service			A		A	A		D	A			A
Approach Delay (s)	0.2				6.0				3.8		0.0	
Approach LOS	A				A				A		A	

Intersection Summary			
HCM Average Control Delay	4.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.91	1.00	0.97	0.91
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1583	5085	1583	3433	5085
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1583	5085	1583	3433	5085
Volume (vph)	85	400	1525	180	150	1540
Peak-hour factor, PHF	0.97	0.97	0.91	0.97	0.97	0.91
Adj. Flow (vph)	88	412	1676	186	155	1692
Lane Group Flow (vph)	88	412	1676	186	155	1692
Turn Type		Free		Free	Prot	
Protected Phases	8		6		1	6
Permitted Phases	8	Free	6	Free		
Actuated Green, G (s)	8.0	85.0	47.0	85.0	15.0	47.0
Effective Green, g (s)	9.0	85.0	48.0	85.0	16.0	48.0
Actuated g/C Ratio	0.11	1.00	0.56	1.00	0.19	0.56
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	187	1583	2872	1583	646	2872
v/s Ratio Prot	c0.05		0.33		0.05	c0.33
v/s Ratio Perm		0.26		0.12		
v/c Ratio	0.47	0.26	0.58	0.12	0.24	0.59
Uniform Delay, d1	35.8	0.0	12.0	0.0	29.3	12.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.4	0.9	0.2	0.2	0.9
Delay (s)	37.6	0.4	12.9	0.2	29.5	12.9
Level of Service	D	A	B	A	C	B
Approach Delay (s)	7.0		11.6			14.3
Approach LOS	A		B			B

Intersection Summary			
HCM Average Control Delay	12.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
c Critical Lane Group			

Movement	WBL2	WBL	WBT	SBL	SBT	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.0	4.0	4.0
Lane Util. Factor			0.91	0.97	*0.95	1.00
Frt			1.00	1.00	1.00	0.85
Flt Protected			0.99	0.95	1.00	1.00
Satd. Flow (prot)			5055	3433	5309	1583
Flt Permitted			0.99	0.95	1.00	1.00
Satd. Flow (perm)			5055	3433	5309	1583
Volume (vph)	20	50	515	555	845	240
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	22	56	572	617	939	267
Lane Group Flow (vph)	0	0	650	617	939	267
Turn Type	Perm	Perm		Split		Perm
Protected Phases			6	4	4	
Permitted Phases	6	6				4
Actuated Green, G (s)			40.0	34.0	34.0	34.0
Effective Green, g (s)			44.0	38.0	38.0	38.0
Actuated g/C Ratio			0.49	0.42	0.42	0.42
Clearance Time (s)			8.0	8.0	8.0	8.0
Lane Grp Cap (vph)			2471	1449	2242	668
v/s Ratio Prot				c0.18	0.18	
v/s Ratio Perm			0.13			0.17
v/c Ratio			0.26	0.43	0.42	0.40
Uniform Delay, d1			13.5	18.3	18.2	18.1
Progression Factor			1.00	1.00	1.00	1.00
Incremental Delay, d2			0.3	0.9	0.6	1.8
Delay (s)			13.8	19.2	18.8	19.9
Level of Service			B	B	B	B
Approach Delay (s)			13.8		19.1	
Approach LOS			B		B	

Intersection Summary			
HCM Average Control Delay	17.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	37.4%	ICU Level of Service	A

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations					↰↑↑↑			↑↑	↱		↑↑	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0			4.0	4.0		4.0	
Lane Util. Factor					0.91			0.95	1.00		0.95	
Frt					1.00			1.00	0.85		1.00	
Flt Protected					1.00			1.00	1.00		1.00	
Satd. Flow (prot)					5071			3539	1583		3539	
Flt Permitted					1.00			1.00	1.00		1.00	
Satd. Flow (perm)					5071			3539	1583		3539	
Volume (vph)	0	0	0	50	845	0	0	300	625	0	1000	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	0	0	51	854	0	0	303	631	0	1010	0
Lane Group Flow (vph)	0	0	0	0	905	0	0	303	631	0	1010	0
Turn Type				Perm					Perm			
Protected Phases					4			2			6	
Permitted Phases				4					2			
Actuated Green, G (s)					34.0			40.0	40.0		40.0	
Effective Green, g (s)					38.0			44.0	44.0		44.0	
Actuated g/C Ratio					0.42			0.49	0.49		0.49	
Clearance Time (s)					8.0			8.0	8.0		8.0	
Lane Grp Cap (vph)					2141			1730	774		1730	
v/s Ratio Prot								0.09			0.29	
v/s Ratio Perm					0.18				0.40			
v/c Ratio					0.42			0.18	0.82		0.58	
Uniform Delay, d1					18.3			12.9	19.5		16.5	
Progression Factor					0.31			1.00	1.00		0.00	
Incremental Delay, d2					0.6			0.2	9.2		0.9	
Delay (s)					6.3			13.1	28.8		0.9	
Level of Service					A			B	C		A	
Approach Delay (s)		0.0			6.3			23.7			0.9	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM Average Control Delay	10.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B

c Critical Lane Group

Movement	NBL	NBR	SET	SER	NWL	NWT
Lane Configurations	↰↰		↑↑			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			
Lane Util. Factor	0.97		0.95			
Frt	1.00		1.00			
Flt Protected	1.00		1.00			
Satd. Flow (prot)	3614		3539			
Flt Permitted	1.00		1.00			
Satd. Flow (perm)	3614		3539			
Volume (vph)	1000	0	370	0	0	0
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1064	0	394	0	0	0
Lane Group Flow (vph)	1064	0	394	0	0	0
Turn Type						
Protected Phases	9					
Permitted Phases			10 14			
Actuated Green, G (s)	31.0		43.0			
Effective Green, g (s)	35.0		47.0			
Actuated g/C Ratio	0.39		0.52			
Clearance Time (s)	8.0					
Lane Grp Cap (vph)	1405		1848			
v/s Ratio Prot	c0.29					
v/s Ratio Perm			0.11			
v/c Ratio	0.76		0.21			
Uniform Delay, d1	23.8		11.6			
Progression Factor	1.00		1.86			
Incremental Delay, d2	3.9		0.3			
Delay (s)	27.7		21.7			
Level of Service	C		C			
Approach Delay (s)	27.7		21.7			0.0
Approach LOS	C		C			A

Intersection Summary			
HCM Average Control Delay	26.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑↑	↱	↰	↑↑	↱	↰	↑↑↑↱		↰	↑↑↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	*0.94		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	1770	5213		1770	5054	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583	1770	5213		1770	5054	
Volume (vph)	280	395	215	155	435	80	285	2045	110	125	1290	55
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	298	420	229	165	463	85	303	2176	117	133	1372	59
Lane Group Flow (vph)	298	420	229	165	463	85	303	2293	0	133	1431	0
Turn Type	Prot		Perm	Prot		Free	Prot			Prot		
Protected Phases	7	4		3	8		5			1	6	
Permitted Phases			4			Free		2				
Actuated Green, G (s)	20.0	20.7	20.7	14.4	15.1	137.3	23.5	66.3		12.9	55.7	
Effective Green, g (s)	21.0	22.7	22.7	15.4	17.1	137.3	25.5	68.3		14.9	57.7	
Actuated g/C Ratio	0.15	0.17	0.17	0.11	0.12	1.00	0.19	0.50		0.11	0.42	
Clearance Time (s)	5.0	6.0	6.0	5.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	271	585	262	199	441	1583	329	2593		192	2124	
v/s Ratio Prot	c0.17	0.12		0.09	c0.13		c0.17			0.08	0.28	
v/s Ratio Perm			0.14			0.05		0.44				
v/c Ratio	1.10	0.72	0.87	0.83	1.05	0.05	0.92	0.88		0.69	0.67	
Uniform Delay, d1	58.2	54.3	55.9	59.7	60.1	0.0	54.9	31.0		59.0	32.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	84.0	4.2	25.9	23.9	56.5	0.1	30.1	4.0		10.3	0.9	
Delay (s)	142.1	58.5	81.8	83.5	116.6	0.1	85.0	34.9		69.3	33.0	
Level of Service	F	E	F	F	F	A	F	C		E	C	
Approach Delay (s)		90.4			95.1			40.8			36.1	
Approach LOS		F			F			D			D	

Intersection Summary			
HCM Average Control Delay	54.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	137.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	E
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑					↰	↱		↰		↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0					4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00					1.00	1.00		1.00		1.00
Frt	1.00	1.00					1.00	0.95		1.00		0.85
Flt Protected	0.95	1.00					0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863					1770	1762		1770		1583
Flt Permitted	0.95	1.00					0.95	1.00		0.56		1.00
Satd. Flow (perm)	1770	1863					1770	1762		1037		1583
Volume (vph)	200	500	0	0	0	0	60	150	85	360	0	780
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	222	556	0	0	0	0	67	167	94	400	0	867
Lane Group Flow (vph)	222	556	0	0	0	0	67	261	0	400	0	867
Turn Type	Perm						Perm			custom		custom
Protected Phases		2						8				
Permitted Phases	2						8			4		4
Actuated Green, G (s)	25.0	25.0					26.0	26.0		26.0		26.0
Effective Green, g (s)	27.0	27.0					28.0	28.0		28.0		28.0
Actuated g/C Ratio	0.43	0.43					0.44	0.44		0.44		0.44
Clearance Time (s)	6.0	6.0					6.0	6.0		6.0		6.0
Lane Grp Cap (vph)	759	798					787	783		461		704
v/s Ratio Prot		c0.30						0.15				
v/s Ratio Perm	0.13						0.04			0.39		0.55
v/c Ratio	0.29	0.70					0.09	0.33		0.87		1.23
Uniform Delay, d1	11.8	14.7					10.1	11.4		15.8		17.5
Progression Factor	1.00	1.00					1.00	1.00		1.00		1.00
Incremental Delay, d2	1.0	5.0					0.2	1.1		19.3		116.4
Delay (s)	12.7	19.7					10.3	12.6		35.2		133.9
Level of Service	B	B					B	B		D		F
Approach Delay (s)		17.7			0.0			12.1			102.7	
Approach LOS		B			A			B			F	

Intersection Summary			
HCM Average Control Delay	62.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	63.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	C

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations				↰	↑↑↑↱		↰	↑			↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0		4.0	4.0			4.0	
Lane Util. Factor				1.00	0.91		1.00	1.00			0.95	
Frt				1.00	0.98		1.00	1.00			0.95	
Flt Protected				0.95	1.00		0.95	1.00			1.00	
Satd. Flow (prot)				1770	5000		1770	1863			3362	
Flt Permitted				0.95	1.00		0.20	1.00			1.00	
Satd. Flow (perm)				1770	5000		372	1863			3362	
Volume (vph)	0	0	0	435	1940	245	460	215	0	0	415	5
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	453	2021	255	479	224	0	0	466	6
Lane Group Flow (vph)	0	0	0	453	2276	0	479	224	0	0	472	0
Turn Type				Perm			pm+pt					
Protected Phases					2		7	4				
Permitted Phases				2			4				8	
Actuated Green, G (s)				40.0	40.0		38.5	38.5			14.3	
Effective Green, g (s)				42.0	42.0		40.5	40.5			16.3	
Actuated g/C Ratio				0.46	0.46		0.45	0.45			0.18	
Clearance Time (s)				6.0	6.0		6.0	6.0			6.0	
Vehicle Extension (s)				3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)				821	2320		479	834			606	
v/s Ratio Prot					c0.46		c0.22	0.12				
v/s Ratio Perm				0.26			c0.22				0.14	
v/c Ratio				0.55	0.98		1.00	0.27			0.78	
Uniform Delay, d1				17.5	23.9		24.0	15.7			35.4	
Progression Factor				1.00	1.00		1.00	1.00			1.00	
Incremental Delay, d2				0.8	14.4		41.1	0.2			6.3	
Delay (s)				18.3	38.3		65.1	15.9			41.7	
Level of Service				B	D		E	B			D	
Approach Delay (s)		0.0			35.0			49.4			41.7	
Approach LOS		A			C			D			D	

Intersection Summary			
HCM Average Control Delay	38.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	90.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	94.3%	ICU Level of Service	E
c Critical Lane Group			

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations			↑↑↑	↱		↱↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	4.0		4.0
Lane Util. Factor			0.91	1.00		0.88
Frt			1.00	0.85		0.85
Flt Protected			1.00	1.00		1.00
Satd. Flow (prot)			5085	1583		2787
Flt Permitted			1.00	1.00		1.00
Satd. Flow (perm)			5085	1583		2787
Volume (vph)	0	0	2825	145	0	190
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	0	0	3247	167	0	218
Lane Group Flow (vph)	0	0	3247	167	0	218
Turn Type				Free		custom
Protected Phases			2			
Permitted Phases				Free		8
Actuated Green, G (s)			57.0	76.0		7.0
Effective Green, g (s)			59.0	76.0		9.0
Actuated g/C Ratio			0.78	1.00		0.12
Clearance Time (s)			6.0			6.0
Vehicle Extension (s)			3.0			3.0
Lane Grp Cap (vph)			3948	1583		330
v/s Ratio Prot			c0.64			
v/s Ratio Perm				0.11		0.08
v/c Ratio			0.82	0.11		0.66
Uniform Delay, d1			5.3	0.0		32.0
Progression Factor			1.00	1.00		1.00
Incremental Delay, d2			2.1	0.1		4.9
Delay (s)			7.3	0.1		36.9
Level of Service			A	A		D
Approach Delay (s)		0.0	7.0		36.9	
Approach LOS		A	A		D	

Intersection Summary			
HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	76.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.0%	ICU Level of Service	C
c Critical Lane Group			

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*Rizzo*
Agency/Co.	*Rizzo Associates, Inc.*
Date Performed	*3/18/02*
Analysis Time Period	*Weekday Evening Peak Hour*

Site Information

Intersection	*Assembly Sq Dr/ New Rd*
Jurisdiction	*Somerville, MA*
Analysis Year	*2002 Existing*

Project Description *8640 - Assembly Square Transportation Plan*

East/West Street: *New Road*

North/South Street: *Assembly Square Drive*

Intersection Orientation: *North-South*

Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*55*	*275*	*0*	*0*	*180*	*150*
Peak-Hour Factor, PHF	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*
Hourly Flow Rate, HFR	*61*	*308*	*0*	*0*	*202*	*168*
Percent Heavy Vehicles	*2*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*0*	*0*	*2*	*0*
Configuration	*LT*	*T*			*T*	*TR*
Upstream Signal		*0*			*0*	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*190*	*0*	*75*
Peak-Hour Factor, PHF	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*	*0.89*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*213*	*0*	*84*
Percent Heavy Vehicles	*0*	*0*	*0*	*2*	*0*	*2*
Percent Grade (%)	*0*			*0*		
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*1*	*0*	*1*
Configuration				*L*		*R*

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*					*L*		*R*
v (vph)	*61*					*213*		*84*
C (m) (vph)	*1185*					*433*		*826*
v/c	*0.05*					*0.49*		*0.10*
95% queue length	*0.16*					*2.65*		*0.34*
Control Delay	*8.2*					*21.1*		*9.9*
LOS	*A*					*C*		*A*
Approach Delay	--	--				*17.9*		
Approach LOS	--	--				*C*		

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ALL-WAY STOP CONTROL ANALYSIS

General Information		Site Information	
Analyst	*Rizzo*	Intersection	*Assembly Sq Dr/ Foley St*
Agency/Co.	*Rizzo Associates, Inc.*	Jurisdiction	*Somerville, MA*
Date Performed	*3/18/02*	Analysis Year	*2002 Existing*
Analysis Time Period	*Weekday Evening Peak Hour*		

Project ID *8640 - Assembly Square Transportation Plan*

East/West Street: *Foley Street*	North/South Street: *Assembly Square Drive*

Volume Adjustments and Site Characteristics

Approach	Eastbound			Westbound		
Movement	L	T	R	L	T	R
Volume	80	20	150	40	10	5
%Thrus Left Lane	50			50		
Approach	Northbound			Southbound		
Movement	L	T	R	L	T	R
Volume	35	230	70	1	105	30
%Thrus Left Lane	50			50		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	TR	LTR	
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Flow Rate	96	173	48	10	162	200	147	
% Heavy Vehicles	2	2	2	2	2	2	2	
No. Lanes	2		2		2		1	
Geometry Group	5		5		5		4b	
Duration, T	0.25							

Saturation Headway Adjustment Worksheet

Prop. Left-Turns	0.9	0.0	0.9	0.0	0.2	0.0	0.0	
Prop. Right-Turns	0.0	0.9	0.0	0.5	0.0	0.4	0.2	
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
hLT-adj	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
hRT-adj	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
hadj, computed	6.15	6.15	6.15	6.15	6.15	6.15	6.15	

Departure Headway and Service Time

hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	
x, initial	0.09	0.15	0.04	0.01	0.14	0.18	0.13	
hd, final value	6.15	6.15	6.15	6.15	6.15	6.15	6.15	
x, final value	0.16	0.26	0.09	0.02	0.25	0.30	0.23	
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.9	3.1	3.9	3.1	3.9	3.1	3.9	3.1

Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Capacity	346	423	298	260	412	450	397	
Delay	10.05	9.98	9.76	8.77	10.29	10.38	10.18	
LOS	B	A	A	A	B	B	B	
Approach: Delay	10.01		9.59		10.34		10.18	
LOS	B		A		B		B	
Intersection Delay	10.15							
Intersection LOS	B							

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	Rizzo	Intersection	Middlesex Ave/ Foley St
Agency/Co.	Rizzo Associates, Inc.	Jurisdiction	Somerville, MA
Date Performed	3/18/02	Analysis Year	2002 Existing
Analysis Time Period	Weekday Evening Peak Hour		
Project Description	8640 - Assembly Square Transportation Plan		
East/West Street:	Foley Street	North/South Street:	Middlesex Avenue
Intersection Orientation:	North-South	Study Period (hrs):	0.25

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	435	20	265	70	0
Peak-Hour Factor, PHF	0.88	0.90	0.90	0.88	0.88	0.88
Hourly Flow Rate, HFR	0	483	22	301	79	0
Percent Heavy Vehicles	0	--	--	2	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	2	0	0	2	0
Configuration		T	TR	LT	T	
Upstream Signal		0			0	

Minor Street	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	20	0	195	0	0	0
Peak-Hour Factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Hourly Flow Rate, HFR	22	0	221	0	0	0
Percent Heavy Vehicles	2	0	2	0	0	0
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	1	0	1	0	0	0
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		LT	L		R			
v (vph)		301	22		221			
C (m) (vph)		1056	140		748			
v/c		0.29	0.16		0.30			
95% queue length		1.18	0.54		1.23			
Control Delay		9.8	35.4		11.8			
LOS		A	E		B			
Approach Delay	--	--	14.0					
Approach LOS	--	--	B					

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	Rizzo
Agency/Co.	Rizzo Associates, Inc.
Date Performed	3/18/02
Analysis Time Period	Weekday Evening Peak Hour

Site Information

Intersection	Middlesex/Assembly Sq Mall Dwy
Jurisdiction	Somerville, MA
Analysis Year	2002 Existing

Project Description	8640 - Assembly Square Transportation Plan
East/West Street: Middlesex Avenue	North/South Street: Assembly Square Mall Drwy
Intersection Orientation: East-West	Study Period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	0	330	0	0	460	40
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	0	370	0	0	516	44
Percent Heavy Vehicles	0	--	--	0	--	--
Median Type	Raised curb					
RT Channelized			0			0
Lanes	0	2	0	0	2	0
Configuration		T			T	TR
Upstream Signal		0			0	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	0	0	0	0	0	25
Peak-Hour Factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Hourly Flow Rate, HFR	0	0	0	0	0	28
Percent Heavy Vehicles	0	0	0	0	0	2
Percent Grade (%)	0			0		
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	0	0	0	0	1
Configuration						R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration								R
v (vph)								28
C (m) (vph)								717
v/c								0.04
95% queue length								0.12
Control Delay								10.2
LOS								B
Approach Delay	--	--				10.2		
Approach LOS	--	--				B		

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*Rizzo*	Intersection	*Mystic Ave SB/ Lombardi St*
Agency/Co.	*Rizzo Associates, Inc.*	Jurisdiction	*Somerville, MA*
Date Performed	*3/18/02*	Analysis Year	*2002 Existing*
Analysis Time Period	*Weekday Evening Peak Hour*		

Project Description *8640 - Assembly Square Transportation Plan*

East/West Street: *Mystic Avenue SB* | North/South Street: *Lombardi Street*

Intersection Orientation: *East-West* | Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	*0*	*655*	*0*	*0*	*850*	*5*
Peak-Hour Factor, PHF	*0.82*	*0.93*	*0.82*	*0.82*	*0.93*	*0.82*
Hourly Flow Rate, HFR	*0*	*704*	*0*	*0*	*913*	*0*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*2*	*0*	*0*	*2*	*0*
Configuration		*T*			*T*	
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	*0*	*0*	*0*	*20*	*0*	*290*
Peak-Hour Factor, PHF	*0.82*	*0.82*	*0.82*	*0.93*	*0.82*	*0.93*
Hourly Flow Rate, HFR	*0*	*0*	*0*	*21*	*0*	*311*
Percent Heavy Vehicles	*0*	*0*	*0*	*2*	*0*	*2*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*0*	*0*
Configuration					*LR*	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration							*LR*	
v (vph)							*332*	
C (m) (vph)							*478*	
v/c							*0.69*	
95% queue length							*5.29*	
Control Delay							*27.9*	
LOS							*D*	
Approach Delay	--	--				*27.9*		
Approach LOS	--	--				*D*		

Movement	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0		4.0	4.0			4.0
Lane Util. Factor			1.00		0.91		0.97	0.91			1.00
Frt			0.86		1.00		1.00	1.00			0.86
Flt Protected			1.00		1.00		0.95	1.00			1.00
Satd. Flow (prot)			1611		5070		3433	5085			1611
Flt Permitted			1.00		1.00		0.95	1.00			1.00
Satd. Flow (perm)			1611		5070		3433	5085			1611
Volume (vph)	0	0	405	0	2225	45	420	4095	0	0	15
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	422	0	2318	47	438	4266	0	0	16
Lane Group Flow (vph)	0	0	422	0	2365	0	438	4266	0	0	16
Turn Type			Free				Prot				Free
Protected Phases					2		5	14			
Permitted Phases			Free								Free
Actuated Green, G (s)			90.0		63.0		17.0	90.0			90.0
Effective Green, g (s)			90.0		64.0		18.0	90.0			90.0
Actuated g/C Ratio			1.00		0.71		0.20	1.00			1.00
Clearance Time (s)					5.0		5.0	2.0			
Vehicle Extension (s)					3.0		3.0	3.0			
Lane Grp Cap (vph)			1611		3605		687	5085			1611
v/s Ratio Prot					0.47		0.13	c0.84			
v/s Ratio Perm			0.26								0.01
v/c Ratio			0.26		0.66		0.64	0.84			0.01
Uniform Delay, d1			0.0		7.0		33.0	0.0			0.0
Progression Factor			1.00		0.38		1.00	1.00			1.00
Incremental Delay, d2			0.4		0.8		1.9	1.3			0.0
Delay (s)			0.4		3.5		35.0	1.3			0.0
Level of Service			A		A		C	A			A
Approach Delay (s)	0.4				3.5			4.5		0.0	
Approach LOS	A				A			A		A	

Intersection Summary			
HCM Average Control Delay	3.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	85.8%	ICU Level of Service	D

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.88	0.91		0.97	0.91
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	2787	5085		3433	5085
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	2787	5085		3433	5085
Volume (vph)	465	320	1905	0	545	3990
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	470	323	1924	0	551	4030
Lane Group Flow (vph)	470	323	1924	0	551	4030
Turn Type		pt+ov			Prot	
Protected Phases	8	8 1	6		1	6
Permitted Phases	8		6			
Actuated Green, G (s)	10.0	26.0	54.0		11.0	54.0
Effective Green, g (s)	11.0	27.0	55.0		12.0	55.0
Actuated g/C Ratio	0.12	0.30	0.61		0.13	0.61
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	420	836	3108		458	3108
v/s Ratio Prot	c0.14	0.12	0.38		c0.16	c0.79
v/s Ratio Perm						
v/c Ratio	1.12	0.39	0.62		1.20	1.30
Uniform Delay, d1	39.5	24.9	10.9		39.0	17.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	80.4	0.3	0.9		103.7	135.0
Delay (s)	119.9	25.2	11.9		142.7	152.5
Level of Service	F	C	B		F	F
Approach Delay (s)	81.3		11.9			151.3
Approach LOS	F		B			F

Intersection Summary			
HCM Average Control Delay	107.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	E

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0						4.0	
Lane Util. Factor					0.95						*0.95	
Frt					1.00						1.00	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					3539						3539	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					3539						3539	
Volume (vph)	0	0	0	0	445	0	0	0	0	0	1780	440
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	0	468	0	0	0	0	0	1874	463
Lane Group Flow (vph)	0	0	0	0	468	0	0	0	0	0	2337	0
Turn Type												
Protected Phases					6						4	
Permitted Phases												
Actuated Green, G (s)					22.0						52.0	
Effective Green, g (s)					26.0						56.0	
Actuated g/C Ratio					0.29						0.62	
Clearance Time (s)					8.0						8.0	
Vehicle Extension (s)					3.0						3.0	
Lane Grp Cap (vph)					1022						2202	
v/s Ratio Prot					c0.13						c0.66	
v/s Ratio Perm												
v/c Ratio					0.46						1.06	
Uniform Delay, d1					26.2						17.0	
Progression Factor					0.87						1.00	
Incremental Delay, d2					1.5						37.9	
Delay (s)					24.4						54.9	
Level of Service					C						D	
Approach Delay (s)		0.0			24.4			0.0			54.9	
Approach LOS		A			C			A			D	

Intersection Summary			
HCM Average Control Delay	49.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.2%	ICU Level of Service	D
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor				0.97	1.00			0.95	1.00		0.95	
Frt				1.00	1.00			1.00	0.85		1.00	
Flt Protected				0.95	1.00			1.00	1.00		1.00	
Satd. Flow (prot)				3433	1863			3539	1583		3539	
Flt Permitted				0.95	1.00			1.00	1.00		1.00	
Satd. Flow (perm)				3433	1863			3539	1583		3539	
Volume (vph)	0	0	0	1460	515	0	0	745	695	0	560	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	1604	566	0	0	819	764	0	615	0
Lane Group Flow (vph)	0	0	0	1604	566	0	0	819	764	0	615	0
Turn Type				Perm					Perm			
Protected Phases					4			2			6	
Permitted Phases				4					2			
Actuated Green, G (s)				52.0	52.0			22.0	22.0		22.0	
Effective Green, g (s)				56.0	56.0			26.0	26.0		26.0	
Actuated g/C Ratio				0.62	0.62			0.29	0.29		0.29	
Clearance Time (s)				8.0	8.0			8.0	8.0		8.0	
Vehicle Extension (s)				3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)				2136	1159			1022	457		1022	
v/s Ratio Prot					0.30			0.23			0.17	
v/s Ratio Perm				c0.47					c0.48			
v/c Ratio				0.75	0.49			0.80	1.67		0.60	
Uniform Delay, d1				12.1	9.2			29.6	32.0		27.5	
Progression Factor				0.41	0.51			1.00	1.00		0.40	
Incremental Delay, d2				0.6	0.1			6.6	311.8		2.0	
Delay (s)				5.5	4.8			36.2	343.8		13.0	
Level of Service				A	A			D	F		B	
Approach Delay (s)		0.0			5.3			184.7			13.0	
Approach LOS		A			A			F			B	

Intersection Summary			
HCM Average Control Delay	71.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.7%	ICU Level of Service	D

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0				
Lane Util. Factor	0.91	0.91	1.00					0.95				
Frt	1.00	1.00	0.85					1.00				
Flt Protected	0.95	0.99	1.00					1.00				
Satd. Flow (prot)	1610	3369	1583					3539				
Flt Permitted	0.95	0.99	1.00					1.00				
Satd. Flow (perm)	1610	3369	1583					3539				
Volume (vph)	560	810	215	0	0	0	0	1240	0	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	609	880	234	0	0	0	0	1348	0	0	0	0
Lane Group Flow (vph)	479	1010	234	0	0	0	0	1348	0	0	0	0
Turn Type	Prot		custom									
Protected Phases	4							6 3				
Permitted Phases		4	4									
Actuated Green, G (s)	41.2	41.2	41.2					38.8				
Effective Green, g (s)	42.2	42.2	42.2					39.8				
Actuated g/C Ratio	0.47	0.47	0.47					0.44				
Clearance Time (s)	5.0	5.0	5.0									
Vehicle Extension (s)	3.0	3.0	3.0									
Lane Grp Cap (vph)	755	1580	742					1565				
v/s Ratio Prot	0.30							c0.38				
v/s Ratio Perm		c0.30	0.15									
v/c Ratio	0.63	0.64	0.32					0.86				
Uniform Delay, d1	18.1	18.1	14.9					22.6				
Progression Factor	1.00	1.00	1.00					0.99				
Incremental Delay, d2	4.0	2.0	1.1					3.3				
Delay (s)	22.1	20.1	16.0					25.6				
Level of Service	C	C	B					C				
Approach Delay (s)		20.1			0.0			25.6			0.0	
Approach LOS		C			A			C			A	

Intersection Summary			
HCM Average Control Delay	22.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	NBR2	SWL2	SWL	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0					4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00					1.00	1.00		1.00		1.00
Frt	1.00	1.00					1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00					0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863					1770	1583		1770		1583
Flt Permitted	0.95	1.00					0.95	1.00		0.49		1.00
Satd. Flow (perm)	1770	1863					1770	1583		908		1583
Volume (vph)	445	705	0	0	0	0	5	90	115	560	0	445
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	484	766	0	0	0	0	5	98	125	609	0	484
Lane Group Flow (vph)	484	766	0	0	0	0	5	223	0	609	0	484
Turn Type	custom						Perm			custom		custom
Protected Phases	2	2						8				2
Permitted Phases	2						8			4		4 2
Actuated Green, G (s)	35.2	35.2					52.3	52.3		52.3		87.5
Effective Green, g (s)	37.2	37.2					54.3	54.3		54.3		91.5
Actuated g/C Ratio	0.35	0.35					0.51	0.51		0.51		0.85
Clearance Time (s)	6.0	6.0					6.0	6.0		6.0		6.0
Vehicle Extension (s)	3.0	3.0					3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	614	646					896	801		460		1409
v/s Ratio Prot	0.27	c0.41						0.14				0.12
v/s Ratio Perm							0.00			c0.67		0.19
v/c Ratio	0.79	1.19					0.01	0.28		1.32		0.34
Uniform Delay, d1	31.5	35.0					13.1	15.2		26.5		1.6
Progression Factor	1.00	1.00					1.00	1.00		1.00		1.00
Incremental Delay, d2	6.7	98.7					0.0	0.2		160.3		0.1
Delay (s)	38.2	133.7					13.1	15.4		186.8		1.8
Level of Service	D	F					B	B		F		A
Approach Delay (s)		96.7			0.0		15.4				104.9	
Approach LOS		F			A		B				F	

Intersection Summary			
HCM Average Control Delay	93.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	107.3	Sum of lost time (s)	15.8
Intersection Capacity Utilization	97.9%	ICU Level of Service	E
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor				1.00	0.95	1.00	1.00	1.00			0.95	
Frt				1.00	1.00	0.85	1.00	1.00			0.95	
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	
Satd. Flow (prot)				1770	3539	1583	1770	1863			3362	
Flt Permitted				0.95	1.00	1.00	0.36	1.00			1.00	
Satd. Flow (perm)				1770	3539	1583	662	1863			3362	
Volume (vph)	0	0	0	335	1320	715	195	350	0	0	225	30
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	0	349	1375	745	203	365	0	0	234	31
Lane Group Flow (vph)	0	0	0	349	1375	745	203	365	0	0	265	0
Turn Type				custom		custom	pm+pt					
Protected Phases				2	2	2	7	4			8	
Permitted Phases				2		2	4				8	
Actuated Green, G (s)				51.4	51.4	51.4	29.2	29.2			10.9	
Effective Green, g (s)				53.4	53.4	53.4	31.2	31.2			12.9	
Actuated g/C Ratio				0.58	0.58	0.58	0.34	0.34			0.14	
Clearance Time (s)				6.0	6.0	6.0	6.0	6.0			6.0	
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)				1021	2041	913	394	628			468	
v/s Ratio Prot				0.20	0.39	c0.47	0.08	c0.20			0.08	
v/s Ratio Perm							0.09					
v/c Ratio				0.34	0.67	0.82	0.52	0.58			0.57	
Uniform Delay, d1				10.3	13.6	15.7	23.3	25.3			37.2	
Progression Factor				1.00	1.00	1.00	1.00	1.00			1.00	
Incremental Delay, d2				0.2	0.9	5.7	1.1	1.4			1.6	
Delay (s)				10.5	14.5	21.4	24.4	26.7			38.8	
Level of Service				B	B	C	C	C			D	
Approach Delay (s)		0.0			16.0			25.9			38.8	
Approach LOS		A			B			C			D	

Intersection Summary			
HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	92.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.0%	ICU Level of Service	C

c Critical Lane Group

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations			↑↑↑			↱↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0			4.0
Lane Util. Factor			0.91			0.88
Frt			1.00			0.85
Flt Protected			1.00			1.00
Satd. Flow (prot)			5085			2787
Flt Permitted			1.00			1.00
Satd. Flow (perm)			5085			2787
Volume (vph)	0	0	1515	0	0	325
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	1702	0	0	365
Lane Group Flow (vph)	0	0	1702	0	0	365
Turn Type						custom
Protected Phases			2			
Permitted Phases						8
Actuated Green, G (s)			39.5			12.9
Effective Green, g (s)			41.5			14.9
Actuated g/C Ratio			0.64			0.23
Clearance Time (s)			6.0			6.0
Vehicle Extension (s)			3.0			3.0
Lane Grp Cap (vph)			3277			645
v/s Ratio Prot			c0.33			
v/s Ratio Perm						c0.13
v/c Ratio			0.52			0.57
Uniform Delay, d1			6.1			21.9
Progression Factor			1.00			1.00
Incremental Delay, d2			0.6			1.1
Delay (s)			6.7			23.0
Level of Service			A			C
Approach Delay (s)		0.0	6.7		23.0	
Approach LOS		A	A		C	

Intersection Summary			
HCM Average Control Delay	9.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	64.4	Sum of lost time (s)	8.0
Intersection Capacity Utilization	52.3%	ICU Level of Service	A

c Critical Lane Group

Movement	WBL2	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			
Lane Util. Factor	1.00	1.00			0.95			0.95			
Frt	1.00	0.92			0.96			0.97			
Flt Protected	0.95	0.98			1.00			0.98			
Satd. Flow (prot)	1770	1675			3401			3353			
Flt Permitted	0.95	0.98			0.91			0.55			
Satd. Flow (perm)	1770	1675			3101			1877			
Volume (vph)	65	70	80	45	615	220	230	155	95	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.92	0.92	0.89	0.89	0.89	0.92
Adj. Flow (vph)	71	76	87	51	691	239	250	174	107	0	0
Lane Group Flow (vph)	71	163	0	0	981	0	0	531	0	0	0
Turn Type	Perm			Prot			Perm				
Protected Phases		8		2!				6!			
Permitted Phases	8				2		6				
Actuated Green, G (s)	6.6	6.6			28.4			28.4			
Effective Green, g (s)	7.6	7.6			29.4			29.4			
Actuated g/C Ratio	0.17	0.17			0.65			0.65			
Clearance Time (s)	5.0	5.0			5.0			5.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0			
Lane Grp Cap (vph)	299	283			2026			1226			
v/s Ratio Prot		c0.10									
v/s Ratio Perm	0.04				c0.32			0.28			
v/c Ratio	0.24	0.58			0.48			0.86dl			
Uniform Delay, d1	16.2	17.2			4.0			3.8			
Progression Factor	1.00	1.00			1.00			1.00			
Incremental Delay, d2	0.4	2.8			0.8			1.1			
Delay (s)	16.6	20.0			4.8			4.9			
Level of Service	B	C			A			A			
Approach Delay (s)		19.0			4.8			4.9		0.0	
Approach LOS		B			A			A		A	

Intersection Summary			
HCM Average Control Delay	6.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
! Phase conflict between lane groups.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	12	16	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0			4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.95			0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			0.98	
Satd. Flow (prot)	1770	1863	1583	1770	1787		1770	1770			2036	
Flt Permitted	0.67	1.00	1.00	0.22	1.00		0.95	1.00			0.46	
Satd. Flow (perm)	1243	1863	1583	417	1787		1770	1770			967	
Volume (vph)	110	455	330	50	95	35	85	260	235	210	215	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	120	495	359	54	103	38	92	283	255	228	234	54
Lane Group Flow (vph)	120	495	359	54	141	0	92	538	0	0	516	0
Turn Type	Perm		Perm	Perm			Prot			Perm		
Protected Phases		4			8		2!				6!	
Permitted Phases	4		4	8				2		6		
Actuated Green, G (s)	19.5	19.5	19.5	19.5	19.5		30.5	30.5			30.5	
Effective Green, g (s)	20.5	20.5	20.5	20.5	20.5		31.5	31.5			31.5	
Actuated g/C Ratio	0.34	0.34	0.34	0.34	0.34		0.52	0.52			0.52	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0			5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)	425	637	541	142	611		929	929			508	
v/s Ratio Prot		c0.27			0.08		0.05					
v/s Ratio Perm	0.10		0.23	0.13				0.30			c0.53	
v/c Ratio	0.28	0.78	0.66	0.38	0.23		0.10	0.58			1.02	
Uniform Delay, d1	14.4	17.7	16.8	14.9	14.1		7.1	9.7			14.2	
Progression Factor	1.00	1.00	1.00	1.02	1.03		1.00	1.00			0.83	
Incremental Delay, d2	1.7	9.0	6.3	7.6	0.9		0.0	0.9			43.5	
Delay (s)	16.0	26.7	23.1	22.9	15.4		7.2	10.6			55.3	
Level of Service	B	C	C	C	B		A	B			E	
Approach Delay (s)		24.1			17.4			10.1			55.3	
Approach LOS		C			B			B			E	

Intersection Summary			
HCM Average Control Delay	26.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.4%	ICU Level of Service	F

! Phase conflict between lane groups.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	15	12	12	15	12
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	0.95			0.95		1.00	1.00		1.00		1.00
Frt	1.00	1.00			0.95		1.00	0.98		1.00		0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	3539			3369		1770	2003		1770		1583
Flt Permitted	0.43	1.00			1.00		0.95	1.00		0.95		1.00
Satd. Flow (perm)	794	3539			3369		1770	2003		1770		1583
Volume (vph)	90	720	0	0	265	125	45	310	55	355	0	150
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	783	0	0	288	136	49	337	60	386	0	163
Lane Group Flow (vph)	98	783	0	0	424	0	49	397	0	386	0	163
Turn Type	Perm						Split			custom		custom
Protected Phases		4			8		2	2		6		6
Permitted Phases	4									6		6
Actuated Green, G (s)	28.4	28.4			28.4		17.0	17.0		21.6		21.6
Effective Green, g (s)	29.4	29.4			29.4		18.0	18.0		22.6		22.6
Actuated g/C Ratio	0.33	0.33			0.33		0.20	0.20		0.25		0.25
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0		5.0		5.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	259	1156			1101		354	401		444		398
v/s Ratio Prot		c0.22			0.13		0.03	c0.20		c0.22		0.10
v/s Ratio Perm	0.12											
v/c Ratio	0.38	0.68			0.39		0.14	0.99		0.87		0.41
Uniform Delay, d1	23.3	26.2			23.3		29.6	35.9		32.3		28.1
Progression Factor	0.96	0.85			1.35		1.00	1.00		1.00		1.00
Incremental Delay, d2	3.9	3.0			1.0		0.2	42.2		16.4		0.7
Delay (s)	26.3	25.3			32.4		29.8	78.1		48.7		28.8
Level of Service	C	C			C		C	E		D		C
Approach Delay (s)		25.4			32.4			72.8			42.8	
Approach LOS		C			C			E			D	

Intersection Summary			
HCM Average Control Delay	40.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	C

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	60	725	95	0	545
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	0	65	788	103	0	592
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			453			413
pX, platoon unblocked						
vC, conflicting volume	1136	446			891	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1136	446			891	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	88			100	
cM capacity (veh/h)	196	560			756	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	65	525	366	296	296
Volume Left	0	0	0	0	0
Volume Right	65	0	103	0	0
cSH	560	1700	1700	1700	1700
Volume to Capacity	0.12	0.31	0.22	0.17	0.17
Queue Length (ft)	10	0	0	0	0
Control Delay (s)	12.3	0.0	0.0	0.0	0.0
Lane LOS	B				
Approach Delay (s)	12.3	0.0		0.0	
Approach LOS	B				

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	35.8%	ICU Level of Service	A

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	0	535	560	0	10	445
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (veh/h)	0	652	683	0	12	543
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)		123	298			
pX, platoon unblocked	0.95				0.95	0.95
vC, conflicting volume	683				1009	341
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	613				956	253
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				95	23
cM capacity (veh/h)	914				243	709

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	326	326	341	341	12	543
Volume Left	0	0	0	0	12	0
Volume Right	0	0	0	0	0	543
cSH	1700	1700	1700	1700	243	709
Volume to Capacity	0.19	0.19	0.20	0.20	0.05	0.77
Queue Length (ft)	0	0	0	0	4	182
Control Delay (s)	0.0	0.0	0.0	0.0	20.6	24.7
Lane LOS					C	C
Approach Delay (s)	0.0		0.0		24.6	
Approach LOS					C	

Intersection Summary			
Average Delay	7.2		
Intersection Capacity Utilization	59.1%	ICU Level of Service	A

Movement	WBL	WBR	WBR2	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SER
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0		4.0		4.0	4.0			4.0
Lane Util. Factor			1.00		0.91		0.97	0.91			1.00
Frt			0.86		1.00		1.00	1.00			0.86
Flt Protected			1.00		1.00		0.95	1.00			1.00
Satd. Flow (prot)			1611		5070		3433	5085			1611
Flt Permitted			1.00		1.00		0.95	1.00			1.00
Satd. Flow (perm)			1611		5070		3433	5085			1611
Volume (vph)	0	0	685	0	4000	80	500	1990	0	0	15
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	714	0	4167	83	521	2073	0	0	16
Lane Group Flow (vph)	0	0	714	0	4250	0	521	2073	0	0	16
Turn Type			Free				Prot				Free
Protected Phases					2		5	14			
Permitted Phases			Free								Free
Actuated Green, G (s)			90.0		71.0		9.0	90.0			90.0
Effective Green, g (s)			90.0		72.0		10.0	90.0			90.0
Actuated g/C Ratio			1.00		0.80		0.11	1.00			1.00
Clearance Time (s)					5.0		5.0	2.0			
Vehicle Extension (s)					3.0		3.0	3.0			
Lane Grp Cap (vph)			1611		4056		381	5085			1611
v/s Ratio Prot					c0.84		c0.15	0.41			
v/s Ratio Perm			0.44								0.01
v/c Ratio			0.44		1.05		1.37	0.41			0.01
Uniform Delay, d1			0.0		9.0		40.0	0.0			0.0
Progression Factor			1.00		0.68		1.00	1.00			1.00
Incremental Delay, d2			0.9		22.4		181.4	0.1			0.0
Delay (s)			0.9		28.5		221.4	0.1			0.0
Level of Service			A		C		F	A			A
Approach Delay (s)	0.9				28.5			44.5		0.0	
Approach LOS	A				C			D		A	

Intersection Summary			
HCM Average Control Delay	31.3	HCM Level of Service	C
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	103.9%	ICU Level of Service	F

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.88	0.91		0.97	0.91
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	2787	5085		3433	5085
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	2787	5085		3433	5085
Volume (vph)	1080	575	3400	0	260	1730
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1091	581	3434	0	263	1747
Lane Group Flow (vph)	1091	581	3434	0	263	1747
Turn Type		pt+ov			Prot	
Protected Phases	8	8 1	6		1	6
Permitted Phases	8		6			
Actuated Green, G (s)	21.0	31.0	49.0		5.0	49.0
Effective Green, g (s)	22.0	32.0	50.0		6.0	50.0
Actuated g/C Ratio	0.24	0.36	0.56		0.07	0.56
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		3.0		3.0	3.0
Lane Grp Cap (vph)	839	991	2825		229	2825
v/s Ratio Prot	c0.32	0.21	c0.68		c0.08	0.34
v/s Ratio Perm						
v/c Ratio	1.30	0.59	1.22		1.15	0.62
Uniform Delay, d1	34.0	23.6	20.0		42.0	13.5
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	143.9	0.9	100.5		103.4	1.0
Delay (s)	177.9	24.5	120.5		145.4	14.5
Level of Service	F	C	F		F	B
Approach Delay (s)	124.6		120.5			31.6
Approach LOS	F		F			C

Intersection Summary			
HCM Average Control Delay	96.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.23		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.0%	ICU Level of Service	G
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑						↑↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0						4.0	
Lane Util. Factor					0.95						*0.95	
Frt					1.00						1.00	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					3539						3539	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					3539						3539	
Volume (vph)	0	0	0	0	1000	0	0	0	0	0	945	90
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	0	0	0	1053	0	0	0	0	0	995	95
Lane Group Flow (vph)	0	0	0	0	1053	0	0	0	0	0	1090	0
Turn Type												
Protected Phases					6						4	
Permitted Phases												
Actuated Green, G (s)					36.0						38.0	
Effective Green, g (s)					40.0						42.0	
Actuated g/C Ratio					0.44						0.47	
Clearance Time (s)					8.0						8.0	
Vehicle Extension (s)					3.0						3.0	
Lane Grp Cap (vph)					1573						1652	
v/s Ratio Prot					c0.30						c0.31	
v/s Ratio Perm												
v/c Ratio					0.67						0.66	
Uniform Delay, d1					19.8						18.5	
Progression Factor					1.00						1.00	
Incremental Delay, d2					2.3						1.0	
Delay (s)					22.1						19.5	
Level of Service					C						B	
Approach Delay (s)		0.0			22.1			0.0			19.5	
Approach LOS		A			C			A			B	

Intersection Summary			
HCM Average Control Delay	20.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.3%	ICU Level of Service	B

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0			4.0	4.0		4.0	
Lane Util. Factor				0.97	1.00			0.95	1.00		0.95	
Frt				1.00	1.00			1.00	0.85		1.00	
Flt Protected				0.95	1.00			1.00	1.00		1.00	
Satd. Flow (prot)				3433	1863			3539	1583		3539	
Flt Permitted				0.95	1.00			1.00	1.00		1.00	
Satd. Flow (perm)				3433	1863			3539	1583		3539	
Volume (vph)	0	0	0	690	255	0	0	600	545	0	950	0
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	0	0	0	758	280	0	0	659	599	0	1044	0
Lane Group Flow (vph)	0	0	0	758	280	0	0	659	599	0	1044	0
Turn Type				Perm					Perm			
Protected Phases					4			2			6	
Permitted Phases				4					2			
Actuated Green, G (s)				38.0	38.0			36.0	36.0		36.0	
Effective Green, g (s)				42.0	42.0			40.0	40.0		40.0	
Actuated g/C Ratio				0.47	0.47			0.44	0.44		0.44	
Clearance Time (s)				8.0	8.0			8.0	8.0		8.0	
Vehicle Extension (s)				3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)				1602	869			1573	704		1573	
v/s Ratio Prot					0.15			0.19			0.29	
v/s Ratio Perm				c0.22					c0.38			
v/c Ratio				0.47	0.32			0.42	0.85		0.66	
Uniform Delay, d1				16.4	15.1			17.1	22.3		19.7	
Progression Factor				0.27	0.29			1.00	1.00		1.00	
Incremental Delay, d2				0.2	0.2			0.8	12.3		2.2	
Delay (s)				4.6	4.6			17.9	34.7		21.9	
Level of Service				A	A			B	C		C	
Approach Delay (s)		0.0			4.6			25.9			21.9	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM Average Control Delay	18.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	58.5%	ICU Level of Service	A

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations	↰	↰↑	↱					↑↑				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0					4.0				
Lane Util. Factor	0.91	0.91	1.00					0.95				
Frt	1.00	1.00	0.85					1.00				
Flt Protected	0.95	0.98	1.00					1.00				
Satd. Flow (prot)	1610	3339	1583					3539				
Flt Permitted	0.95	0.98	1.00					1.00				
Satd. Flow (perm)	1610	3339	1583					3539				
Volume (vph)	950	840	195	0	0	0	0	1240	0	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1033	913	212	0	0	0	0	1348	0	0	0	0
Lane Group Flow (vph)	626	1320	212	0	0	0	0	1348	0	0	0	0
Turn Type	Split		Perm									
Protected Phases	4	4						6 3				
Permitted Phases		4	4									
Actuated Green, G (s)	21.0	21.0	21.0					29.0				
Effective Green, g (s)	22.0	22.0	22.0					30.0				
Actuated g/C Ratio	0.37	0.37	0.37					0.50				
Clearance Time (s)	5.0	5.0	5.0									
Vehicle Extension (s)	3.0	3.0	3.0									
Lane Grp Cap (vph)	590	1224	580					1770				
v/s Ratio Prot	0.39	c0.40						c0.38				
v/s Ratio Perm			0.13									
v/c Ratio	1.06	1.08	0.37					0.76				
Uniform Delay, d1	19.0	19.0	13.9					12.1				
Progression Factor	1.00	1.00	1.00					1.00				
Incremental Delay, d2	54.3	49.7	1.8					2.0				
Delay (s)	73.3	68.7	15.7					14.1				
Level of Service	E	E	B					B				
Approach Delay (s)		64.8			0.0			14.1			0.0	
Approach LOS		E			A			B			A	

Intersection Summary			
HCM Average Control Delay	45.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.8%	ICU Level of Service	D

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	NBR2	SWL2	SWL	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0					4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	1.00					1.00	1.00		1.00		1.00
Frt	1.00	1.00					1.00	0.85		1.00		0.85
Flt Protected	0.95	1.00					0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	1863					1770	1583		1770		1583
Flt Permitted	0.95	1.00					0.95	1.00		0.53		1.00
Satd. Flow (perm)	1770	1863					1770	1583		990		1583
Volume (vph)	310	545	0	0	0	0	45	270	15	670	0	710
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	337	592	0	0	0	0	49	293	16	728	0	772
Lane Group Flow (vph)	337	592	0	0	0	0	49	309	0	728	0	772
Turn Type	Perm						Perm			custom		custom
Protected Phases		2						8				
Permitted Phases	2						8			4		4
Actuated Green, G (s)	30.0	30.0					58.0	58.0		58.0		58.0
Effective Green, g (s)	32.0	32.0					60.0	60.0		60.0		60.0
Actuated g/C Ratio	0.32	0.32					0.60	0.60		0.60		0.60
Clearance Time (s)	6.0	6.0					6.0	6.0		6.0		6.0
Lane Grp Cap (vph)	566	596					1062	950		594		950
v/s Ratio Prot		c0.32						0.20				
v/s Ratio Perm	0.19						0.03			c0.74		0.49
v/c Ratio	0.60	0.99					0.05	0.33		1.23		0.81
Uniform Delay, d1	28.6	33.9					8.2	9.9		20.0		15.6
Progression Factor	1.00	1.00					1.00	1.00		1.00		1.00
Incremental Delay, d2	4.6	35.3					0.1	0.9		115.9		7.5
Delay (s)	33.1	69.2					8.3	10.9		135.9		23.2
Level of Service	C	E					A	B		F		C
Approach Delay (s)		56.1			0.0		10.5				77.9	
Approach LOS		E			A		B				E	

Intersection Summary			
HCM Average Control Delay	62.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.14		
Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	100.7%	ICU Level of Service	F

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				4.0	4.0	4.0	4.0	4.0			4.0	
Lane Util. Factor				1.00	0.95	1.00	1.00	1.00			0.95	
Frt				1.00	1.00	0.85	1.00	1.00			0.95	
Flt Protected				0.95	1.00	1.00	0.95	1.00			1.00	
Satd. Flow (prot)				1770	3539	1583	1770	1863			3362	
Flt Permitted				0.95	1.00	1.00	0.15	1.00			1.00	
Satd. Flow (perm)				1770	3539	1583	287	1863			3362	
Volume (vph)	0	0	0	330	1835	860	305	320	0	0	940	15
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	0	0	0	344	1911	896	318	333	0	0	979	16
Lane Group Flow (vph)	0	0	0	344	1911	896	318	333	0	0	995	0
Turn Type				custom		custom	pm+pt					
Protected Phases				2	2	2	7	4			8	
Permitted Phases				2		2	4				8	
Actuated Green, G (s)				42.0	42.0	42.0	44.8	44.8			20.0	
Effective Green, g (s)				44.0	44.0	44.0	46.8	46.8			22.0	
Actuated g/C Ratio				0.45	0.45	0.45	0.47	0.47			0.22	
Clearance Time (s)				6.0	6.0	6.0	6.0	6.0			6.0	
Vehicle Extension (s)				3.0	3.0	3.0	3.0	3.0			3.0	
Lane Grp Cap (vph)				788	1576	705	448	882			749	
v/s Ratio Prot				0.19	0.54	c0.57	c0.15	0.18			c0.30	
v/s Ratio Perm							0.19					
v/c Ratio				0.44	1.21	1.27	0.71	0.38			1.33	
Uniform Delay, d1				18.9	27.4	27.4	21.8	16.7			38.4	
Progression Factor				1.00	1.00	1.00	1.00	1.00			1.00	
Incremental Delay, d2				0.4	101.8	132.9	5.1	0.3			157.0	
Delay (s)				19.3	129.2	160.3	26.9	16.9			195.4	
Level of Service				B	F	F	C	B			F	
Approach Delay (s)		0.0			126.0			21.8			195.4	
Approach LOS		A			F			C			F	

Intersection Summary			
HCM Average Control Delay	126.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	98.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	108.0%	ICU Level of Service	F
c Critical Lane Group			

Movement	SEL	SET	NWT	NWR	SWL	SWR
Lane Configurations			↑↑↑			↱↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0			4.0
Lane Util. Factor			0.91			0.88
Frt			1.00			0.85
Flt Protected			1.00			1.00
Satd. Flow (prot)			5085			2787
Flt Permitted			1.00			1.00
Satd. Flow (perm)			5085			2787
Volume (vph)	0	0	2190	0	0	1025
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	2461	0	0	1152
Lane Group Flow (vph)	0	0	2461	0	0	1152
Turn Type						custom
Protected Phases			2			
Permitted Phases						8
Actuated Green, G (s)			35.0			28.0
Effective Green, g (s)			37.0			30.0
Actuated g/C Ratio			0.49			0.40
Clearance Time (s)			6.0			6.0
Vehicle Extension (s)			3.0			3.0
Lane Grp Cap (vph)			2509			1115
v/s Ratio Prot			c0.48			
v/s Ratio Perm						c0.41
v/c Ratio			0.98			1.03
Uniform Delay, d1			18.7			22.5
Progression Factor			1.00			1.00
Incremental Delay, d2			14.0			35.9
Delay (s)			32.7			58.4
Level of Service			C			E
Approach Delay (s)		0.0	32.7		58.4	
Approach LOS		A	C		E	

Intersection Summary			
HCM Average Control Delay	40.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	94.5%	ICU Level of Service	E
c Critical Lane Group			

Movement	WBL2	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0			
Lane Util. Factor	1.00	1.00			0.95			0.95			
Frt	1.00	0.94			0.98			0.94			
Flt Protected	0.95	0.97			0.99			0.99			
Satd. Flow (prot)	1770	1701			3432			3297			
Flt Permitted	0.95	0.97			0.99			0.59			
Satd. Flow (perm)	1770	1701			3432			1978			
Volume (vph)	190	270	175	195	515	105	170	310	305	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.89	0.89	0.92	0.92	0.89	0.89	0.89	0.92
Adj. Flow (vph)	207	293	190	219	579	114	185	348	343	0	0
Lane Group Flow (vph)	207	483	0	0	912	0	0	876	0	0	0
Turn Type	Perm			Perm			Perm				
Protected Phases		8			2			6			
Permitted Phases	8			2	2		6				
Actuated Green, G (s)	14.7	14.7			20.3			20.3			
Effective Green, g (s)	15.7	15.7			21.3			21.3			
Actuated g/C Ratio	0.35	0.35			0.47			0.47			
Clearance Time (s)	5.0	5.0			5.0			5.0			
Vehicle Extension (s)	3.0	3.0			3.0			3.0			
Lane Grp Cap (vph)	618	593			1624			936			
v/s Ratio Prot		c0.28			0.27						
v/s Ratio Perm	0.12							c0.44			
v/c Ratio	0.33	0.81			0.56			0.94			
Uniform Delay, d1	10.8	13.3			8.5			11.2			
Progression Factor	1.00	1.00			1.00			1.00			
Incremental Delay, d2	0.3	8.4			1.4			16.0			
Delay (s)	11.1	21.8			9.9			27.2			
Level of Service	B	C			A			C			
Approach Delay (s)		18.6			9.9			27.2		0.0	
Approach LOS		B			A			C		A	

Intersection Summary			
HCM Average Control Delay	18.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	D

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↱		↰	↱		↰	↱	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	12	12	12	16	12
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.95		1.00	0.92	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1863	1583	1770	1824		1770	1770		1770	1947	
Flt Permitted	0.30	1.00	1.00	0.45	1.00		0.31	1.00		0.21	1.00	
Satd. Flow (perm)	554	1863	1583	847	1824		586	1770		397	1947	
Volume (vph)	60	365	310	145	465	75	150	375	100	70	190	205
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	397	337	158	505	82	163	408	109	76	207	223
Lane Group Flow (vph)	65	397	337	158	587	0	163	517	0	76	430	0
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4		4	8			2	2		6		
Actuated Green, G (s)	29.8	29.8	29.8	29.8	29.8		20.2	20.2		20.2	20.2	
Effective Green, g (s)	30.8	30.8	30.8	30.8	30.8		21.2	21.2		21.2	21.2	
Actuated g/C Ratio	0.51	0.51	0.51	0.51	0.51		0.35	0.35		0.35	0.35	
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	284	956	813	435	936		207	625		140	688	
v/s Ratio Prot		0.21			c0.32			c0.29			0.22	
v/s Ratio Perm	0.12		0.21	0.19			0.28			0.19		
v/c Ratio	0.23	0.42	0.41	0.36	0.63		0.79	0.83		0.54	0.62	
Uniform Delay, d1	8.1	9.0	9.0	8.7	10.5		17.4	17.7		15.5	16.1	
Progression Factor	0.96	0.98	1.58	1.00	1.00		1.00	1.00		1.46	1.70	
Incremental Delay, d2	1.3	0.9	1.1	2.3	3.2		17.7	8.8		4.0	1.7	
Delay (s)	9.0	9.7	15.3	11.1	13.7		35.1	26.5		26.7	29.0	
Level of Service	A	A	B	B	B		D	C		C	C	
Approach Delay (s)		12.0			13.1			28.6			28.6	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM Average Control Delay	19.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	82.0%	ICU Level of Service	D

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	12	15	12	12	15	12
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0		4.0
Lane Util. Factor	1.00	0.95			0.95		1.00	1.00		1.00		1.00
Frt	1.00	1.00			1.00		1.00	1.00		1.00		0.85
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95		1.00
Satd. Flow (prot)	1770	3539			3523		1770	2039		1770		1583
Flt Permitted	0.16	1.00			1.00		0.95	1.00		0.19		1.00
Satd. Flow (perm)	292	3539			3523		1770	2039		355		1583
Volume (vph)	70	800	0	0	1040	32	295	625	20	75	0	135
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	76	870	0	0	1130	35	321	679	22	82	0	147
Lane Group Flow (vph)	76	870	0	0	1165	0	321	701	0	82	0	147
Turn Type	Perm						Perm			custom		custom
Protected Phases		4			8			2				
Permitted Phases	4						2			6		6
Actuated Green, G (s)	30.0	30.0			30.0		20.0	20.0		20.0		20.0
Effective Green, g (s)	31.0	31.0			31.0		21.0	21.0		21.0		21.0
Actuated g/C Ratio	0.52	0.52			0.52		0.35	0.35		0.35		0.35
Clearance Time (s)	5.0	5.0			5.0		5.0	5.0		5.0		5.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	151	1828			1820		620	714		124		554
v/s Ratio Prot		0.25			c0.33			c0.34				
v/s Ratio Perm	0.26						0.18			0.23		0.09
v/c Ratio	0.50	0.48			0.64		0.52	0.98		0.66		0.27
Uniform Delay, d1	9.5	9.3			10.5		15.5	19.3		16.5		14.0
Progression Factor	0.29	0.06			0.30		1.00	1.00		1.37		1.69
Incremental Delay, d2	10.6	0.8			0.9		0.7	29.0		10.9		0.2
Delay (s)	13.4	1.4			4.1		16.2	48.3		33.4		23.9
Level of Service	B	A			A		B	D		C		C
Approach Delay (s)		2.4			4.1			38.2			27.3	
Approach LOS		A			A			D			C	

Intersection Summary			
HCM Average Control Delay	15.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.5%	ICU Level of Service	E

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	110	1470	70	0	260
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (veh/h)	0	120	1598	76	0	283
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			453			413
pX, platoon unblocked	0.72	0.72			0.72	
vC, conflicting volume	1777	837			1674	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1690	382			1546	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	73			100	
cM capacity (veh/h)	61	443			305	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	120	1065	609	141	141
Volume Left	0	0	0	0	0
Volume Right	120	0	76	0	0
cSH	443	1700	1700	1700	1700
Volume to Capacity	0.27	0.63	0.36	0.08	0.08
Queue Length (ft)	27	0	0	0	0
Control Delay (s)	16.1	0.0	0.0	0.0	0.0
Lane LOS	C				
Approach Delay (s)	16.1	0.0		0.0	
Approach LOS	C				

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	60.7%	ICU Level of Service	B

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↰	↱
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	0	580	1270	0	45	105
Peak Hour Factor	0.82	0.82	0.82	0.82	0.82	0.82
Hourly flow rate (veh/h)	0	707	1549	0	55	128
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)		123	298			
pX, platoon unblocked	0.79				0.79	0.79
vC, conflicting volume	1549				1902	774
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1427				1876	445
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				0	71
cM capacity (veh/h)	372				50	442

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	354	354	774	774	55	128
Volume Left	0	0	0	0	55	0
Volume Right	0	0	0	0	0	128
cSH	1700	1700	1700	1700	50	442
Volume to Capacity	0.21	0.21	0.46	0.46	1.10	0.29
Queue Length (ft)	0	0	0	0	122	30
Control Delay (s)	0.0	0.0	0.0	0.0	291.0	16.4
Lane LOS					F	C
Approach Delay (s)	0.0		0.0		98.8	
Approach LOS					F	

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	57.4%	ICU Level of Service	A