SAFETY AND OPERATIONAL IMPROVEMENTS FOR THE I-93/ROUTE 24 INTERCHANGE

BOSTON REGION
METROPOLITAN
PLANNING
ORGANIZATION

Safety and Operational Improvements for the I-93/Route 24 Interchange

Project Manager
Seth Asante

Project Principal
Efi Pagitsas

Modeling Processes
Bruce Kaplan
Seth Asante

License Plate Survey
Seth Asante
Paul Reim
Hiral Gandhi

Geographic Information Systems
Kathy Jacob
Mark Scannell

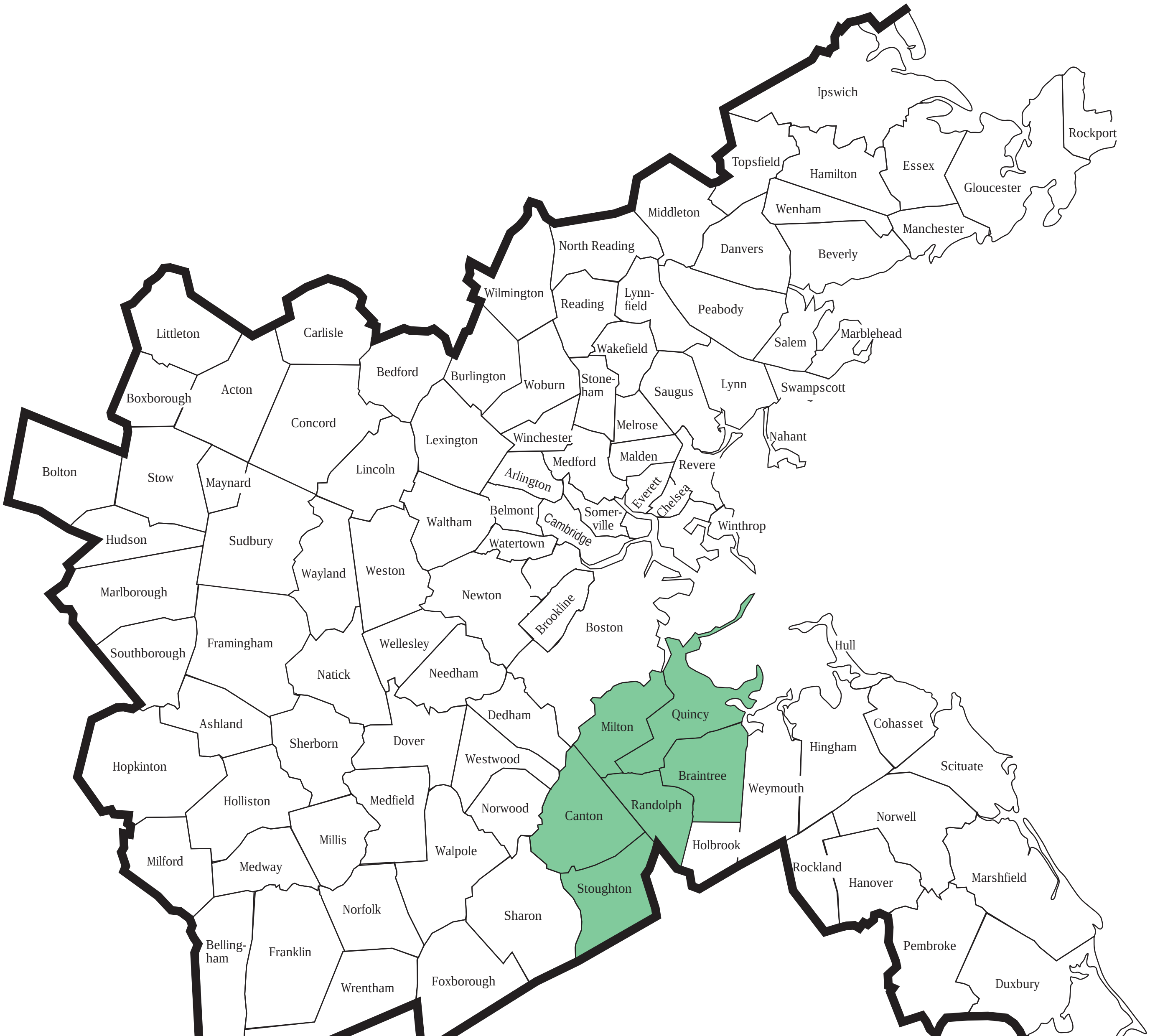
Cover Design
Maciej Citowicki

The preparation of this document was supported by Massachusetts Highway Department Contract 3C PL #48696.

Central Transportation Planning Staff

Directed by the **Boston Region Metropolitan Planning Organization**. The MPO is composed of state and regional agencies and authorities, and local governments.

September 2007



The Cities and Towns of the Boston Region Metropolitan Planning Organization Area

Communities involved in the study

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

ORIGIN OF STUDY

This study originated from the findings in the 2004 Mobility Management System (MMS) report[1] and from recommendations made in the report *I-93/Southeast Expressway/Route 3 (Braintree Split): Operational Assessment and Potential Improvements*.[2] Both studies identified the I-93/ Route 24 interchange as a bottleneck that causes traffic congestion on I-93 and Route 24 during peak travel periods. This interchange is also ranked #48 on MassHighway's list of the top 1,000 high-crash locations, with 229 crashes between 1999 and 2001. The proponent of this study, the Boston Region Metropolitan Planning Organization (MPO), was concerned with the traffic operations and safety at the interchange and requested that it be studied in detail. The Central Transportation Planning Staff (CTPS), which is the staff for the MPO, conducted the study.

THE STUDY AREA

The I-93/Route 24 interchange is located partly in Randolph, partly in Quincy, and partly in Milton. It is the sixth most heavily used interchange in Eastern Massachusetts, and it carries about 280,000 vehicles a day, whose drivers encounter a complex driving environment that includes weaving, merging, traffic congestion, and other conditions that create safety problems at the interchange. It is a three-legged directional interchange with direct connections; that is, traffic does not deviate from its intended direction of travel (loop around) when connecting to another highway.

The study area comprises a primary and a secondary study area. The primary study area, where safety and operational improvements were examined, extends from I-93 interchange 5 (Route 28, Quincy and Randolph) to I-93 interchange 4 (Route 24, Randolph), and from Route 24 interchange 21 (I-93, Randolph) to Route 24 interchange 20 (Route 139, Stoughton). The secondary study area, where impacts of the proposed improvements were examined, extends from I-93 interchange 2 (Route 138, Canton) to the Braintree split.

To the east of the I-93/Route 24 interchange, I-93 has four travel lanes in each direction; to the west, I-93 has three lanes in each direction; to the south, Route 24 has three lanes in each direction. Some of the I-93 interchanges in the study area are closely spaced, with less than 2,000 feet between them, creating traffic safety and operations problems. The study area supports a variety of land uses, including residential, industrial, commercial, recreational, and open space.

---

1 Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, *Mobility in the Boston Region: Existing Conditions and Next Steps: The 2004 Congestion Management System Report,* December 2004.

2 Central Transportation Planning Staff report, March 2006.

Specific uses include office and industrial parks and shopping centers. Future development can be expected mostly along the Route 24 corridor.

The Massachusetts Highway Department (MassHighway) has jurisdiction over the major highways and their interchanges, and the arterial road segments near the interchanges. Consequently, all of the safety and operational improvements recommended in this study would be under MassHighway's jurisdiction for implementation.

OBJECTIVES

The objectives of this study were twofold:

- Identify the traffic safety and operations problems on the ramps and roadways that compose the I-93/Route 24 interchange.

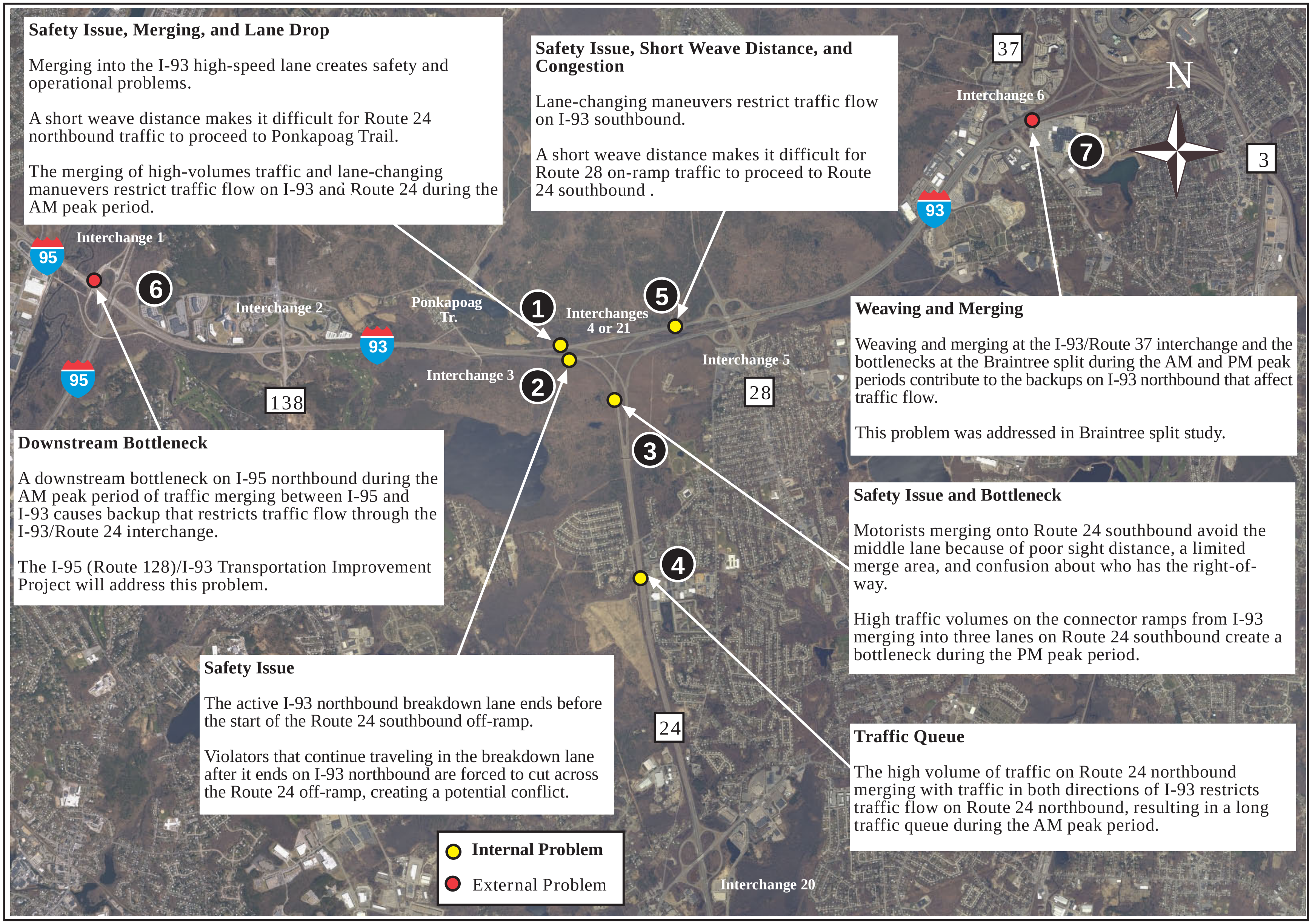
- Develop, evaluate, and recommend safety and operational improvements for MassHighway to implement.

CTPS conducted the study in conjunction with an advisory task force composed of representatives from the communities of Avon, Braintree, Canton, Milton, Quincy, Randolph, and Stoughton; from MassHighway, the Massachusetts Bay Transportation Authority (MBTA), the Metropolitan Area Planning Council (MAPC), the Southeastern Regional Planning and Economic Development District (SRPEDD), the Old Colony Planning Council (OCPC), the South Shore Coalition, the South Shore Chamber of Commerce, the Stoughton Chamber of Commerce; and elected officials. The advisory task force met two times during the course of the study (at Stoughton Town Hall). At these meetings, the work program for the study and the task products were presented for comments and feedback. Appendix A contains information on the public participation efforts, including comments on this study and attendance at task force meetings.

TRANSPORTATION PROBLEMS

Through field reconnaissance and analysis of field data, CTPS developed an inventory of traffic safety and operations problems in the study area and its vicinity. The identified problems were grouped into two categories: internal and external. The traffic problems at each location are shown in Figure ES-1 and are discussed in detail in Chapter 2.

The internal problems are those traffic safety and operations problems that exist within the study area, such as weaving, merging, diverging, short sight distance, lane drops, bottlenecks, queuing, and congestion. The short weave distances between the I-93/Route 24 interchange and I-93 interchanges 3 (Ponkapoag Trail) and 5 (Route 28) create traffic weaving and lane-changing maneuvers that are safety and operational problems contributing to traffic crashes and queuing. Also, the lane drop on the two-lane connector ramp from northbound Route 24 to southbound I-93, and the limited merge area for the left-side-entrance merge, force motorists to merge quickly into the southbound I-93 high-speed lane, creating safety and operational problems on both roadways.



CTPS

FIGURE ES-1
Traffic Safety and Operational Problems

Safety and Operational Improvements for the I-93/Route 24 Interchange

The external problems are bottlenecks existing outside of the study area that have a major impact on traffic safety and operations in the study area because of traffic queue spillbacks. The direct impacts of these traffic safety and operations problems in the I-93 and Route 24 corridors during the peak travel periods are the high number of crashes and reduced traffic flow that create congestion, traffic queues, and longer travel times. All of these problem locations are analyzed in detail in Chapter 3 and are summarized below.

EXISTING CONDITIONS

CTPS collected and assembled traffic-volume, travel-time and travel-speed, and highway crash data. CTPS conducted existing-conditions analyses of the current traffic volumes and historical trends, characteristics of travel times and speeds, levels of service, and crash characteristics. The analyses show traffic congestion, queuing, and safety problems in the study area.

Traffic Operations

Due to the high peak-hour traffic volumes on I-93 during the AM and PM peak hours, highway segments in both directions operate at level of service (LOS) E or F. Also, because of the high traffic volume on northbound Route 24, the AM peak-hour LOS is generally poor (LOS F) in that direction; the PM peak-hour LOS is generally poor (LOS E) in the southbound direction. The ramp-arterial junctions in the study area operate satisfactorily, without traffic queues, except for one of the junctions at I-93 interchange 2 (Route 138) and one at I-93 interchange 6 (Route 37) that operate at LOS E or F, with occasional traffic queues that sometimes extend onto the freeway.

During the AM peak period, traveling at 45 mph, it takes about 8 to 9 minutes to travel the 6.8 miles between the I-93/I-95 interchange and the Braintree split (in either direction); during the PM peak period, traveling at 37 mph, it takes about 10 to 11 minutes.

On Route 24 during the AM peak period, traveling the 6.5 miles between interchange 19 (Harrison Boulevard) and interchange 21 (I-93) at 30 mph takes about 13 minutes in the northbound direction, and about 6 minutes, traveling at 65 mph, in the southbound direction. During the PM peak period, traveling northbound at 65 mph it takes about 6 minutes; traveling southbound at 50 mph it takes about 8 minutes.

Traffic Safety

Safety was the central goal in improving the I-93/Route 24 interchange. All of the interchanges in the study area are high-crash locations. The safety analysis indicated that there were no fatal crashes—that all of the crashes resulted only in injury or property damage for the 1999–2001 dataset. From 2002 to 2005, there were nine fatal crashes in the study area: four of them occurred at Route 24 interchange 20 (Route 139), two at I-93 interchange 3 (Ponkapoag Trail), and one each at I-93 interchange 4 (Route 24), I-93 interchange 5 (Route 28), and I-93 interchange 6 (Route 37).

The predominant crash types at each interchange were rear-end and angle/sideswipe collisions (together, they accounted for 60% to 80% of the crashes). Rear-end and angle/sideswipes crashes are prevalent on highways and interchanges with traffic congestion and queuing. Vehicles stopping unexpectedly, stop-and-go traffic conditions, and reduced vehicle headways, all of which occur under congested traffic conditions, are the main reasons for the high number of rear-end collisions. Weaving and merging maneuvers, lane-changing maneuvers, and short acceleration/deceleration distances also contribute to angle/sideswipes crashes.

The majority of the crashes at each interchange, both in 1999–2001 and in 2002–2005, occurred on dry pavement and under daylight conditions (between 60% and 85%). This percentage is consistent with the percentage of the ADT (average daily traffic) that experienced daylight conditions between 6:00 AM and 6:00 PM on I-93 and Route 24, which ranged from 70% to 80%.

PLANNED AND PROPOSED TRANSPORTATION IMPROVEMENTS

Four highway projects have been planned or proposed for the area to increase traffic flow, improve safety and mobility, and facilitate redevelopment in the area. Of these projects, the Route 128 Improvement Program (under construction) and the I-95 (Route 128)/I-93 Interchange Project are the most significant.

The Route 128 Improvement Program will add a travel lane and restore the breakdown lane in each direction. It will also provide a full auxiliary lane and an acceleration lane to connect the two-lane ramp from northbound Route 24 to southbound I-93 so that the ramp traffic can continue on southbound I-93 without merging directly into the southbound I-93 high-speed lane. The I-95 (Route 128)/I-93 Interchange Project will reconfigure the existing interchange to provide direct connections between I-93 and I-95.

Other significant highway projects are the proposed extension of the I-93/Granite Street (Route 37) northbound off-ramp and the I-93/Southeast Expressway/Route 3 (Braintree split) study that proposed safety and operational improvements at the split, including four travel lanes in each direction of Route 3 between Burgin Parkway and Union Street and five travel lanes on I-93 southbound between Route 37 and Route 24.

South Coast Rail (New Bedford/Fall River Commuter Rail) is the proposed transit project that will impact traffic on Route 24. The project is expected to remove 3,600 daily one-direction vehicles that were bound for Boston from the roadway. This translates into 7,200 round-trips. This reduction in vehicles would also reduce the total vehicle-miles of travel (VMT) on the roadways.

The planned and proposed transportation projects are detailed in Chapter 4.

DEVELOPMENT OF ALTERNATIVES

With the assistance of the advisory task force, CTPS staff formulated seven alternatives to address the traffic safety and operations problems that were identified in the study area, including the no-build alternative. These alternatives, shown in Figures ES-2 to ES-5, are described in detail in Chapter 5. Excluding the no-build alternative, the alternatives were grouped into two sets:

- All of the alternatives in Set A (Alternatives 1A, 2A, and 3A) have the existing four travel lanes on I-93 southbound from the Route 37 southbound on-ramp to Route 24.

- All of the alternatives in Set B (Alternatives 1B, 2B, and 3B) have five travel lanes on I-93 southbound from the Route 37 southbound on-ramp to Route 24.

The reason for these two sets of alternatives is that the Braintree split study recommended five travel lanes on southbound I-93 between Route 37 and Route 24 and reconfigured the lane assignments by dedicating two travel lanes to Route 24. Therefore, this study's work program specified that each improvement alternative be evaluated with and without potential improvements on southbound I-93, as it is possible that the changes proposed on Route 24 could eliminate the need for them.

Besides the seven alternatives, additional improvements for further consideration were developed to address safety and operational problems in the study area. These additional improvements are shown in Figures ES-6 and ES-7.

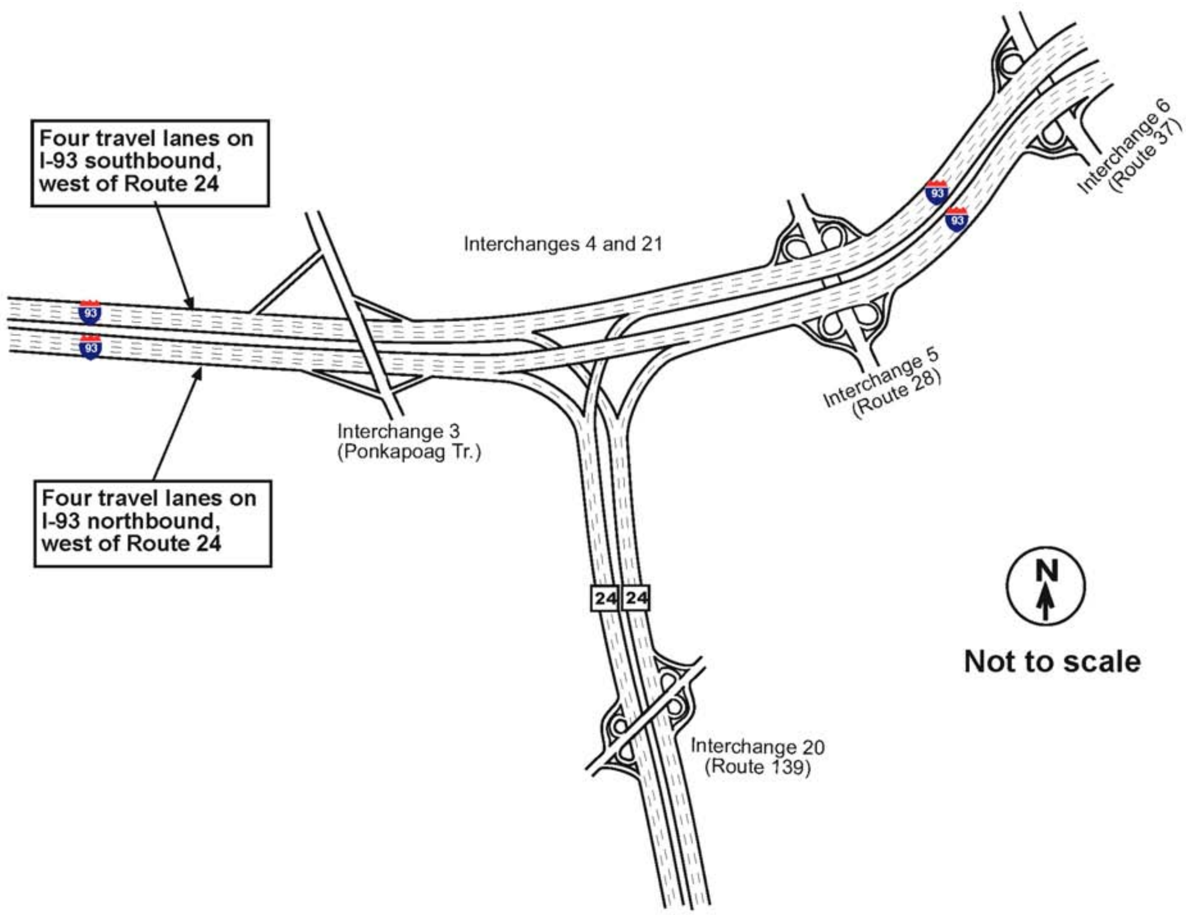
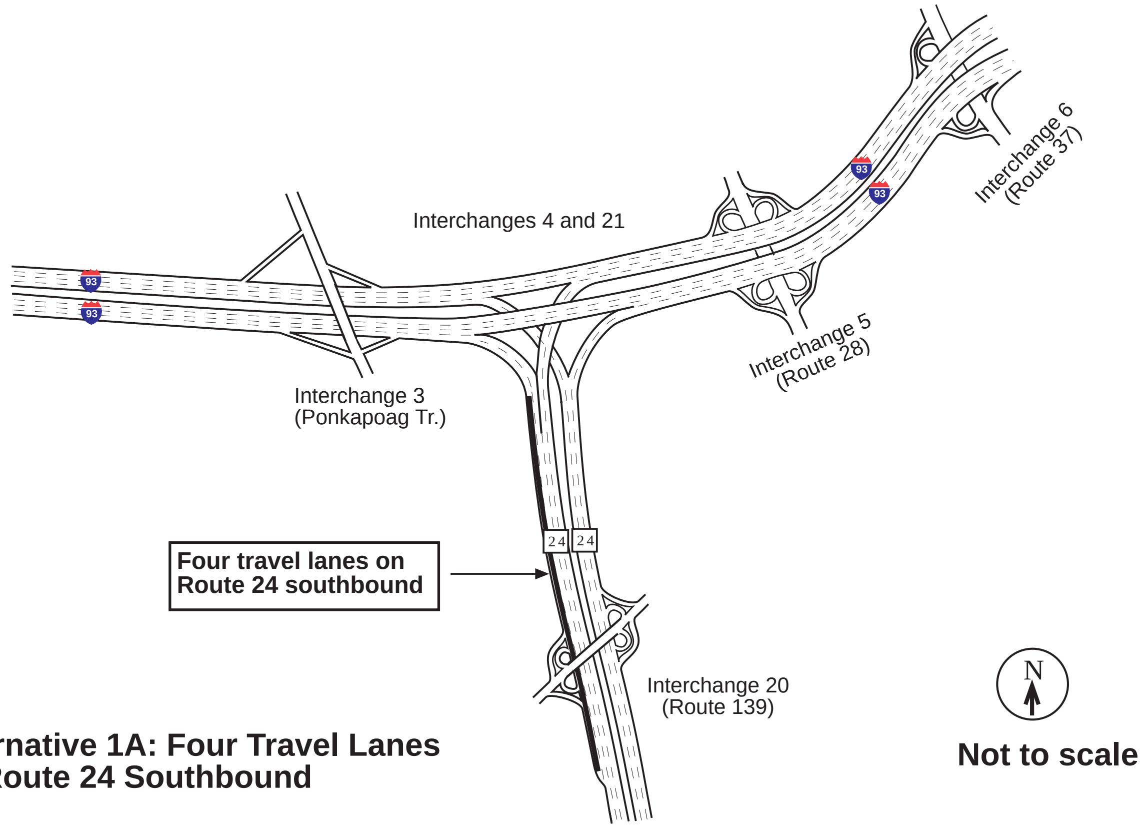
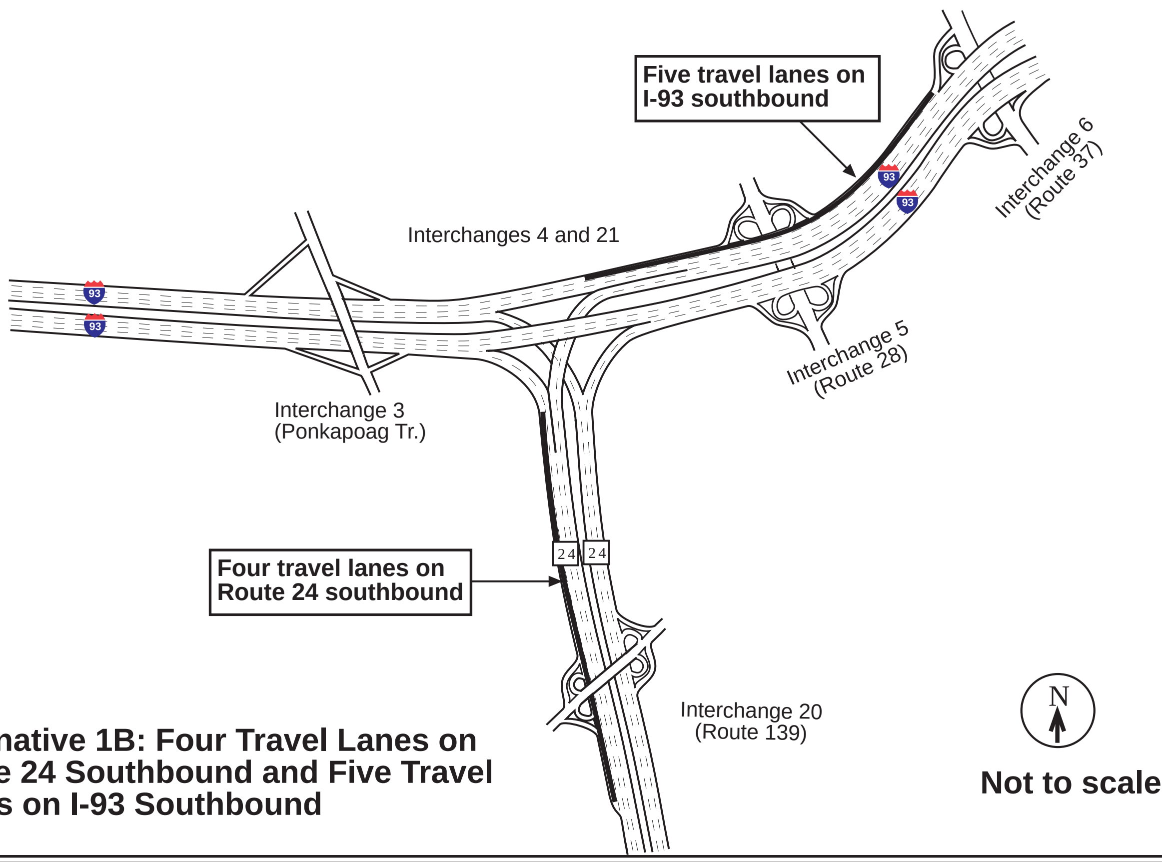


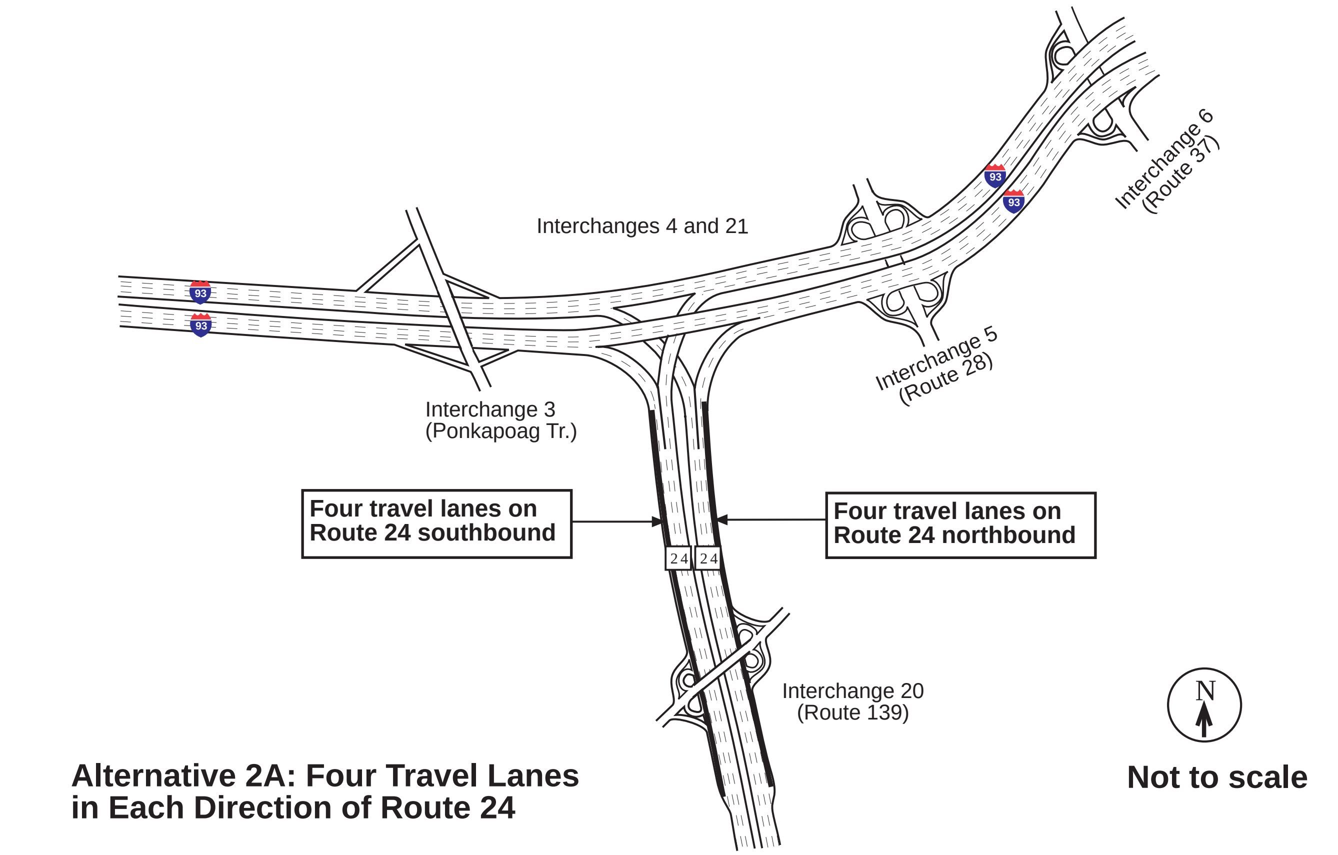
FIGURE ES-2
2030 No-Build Alternative

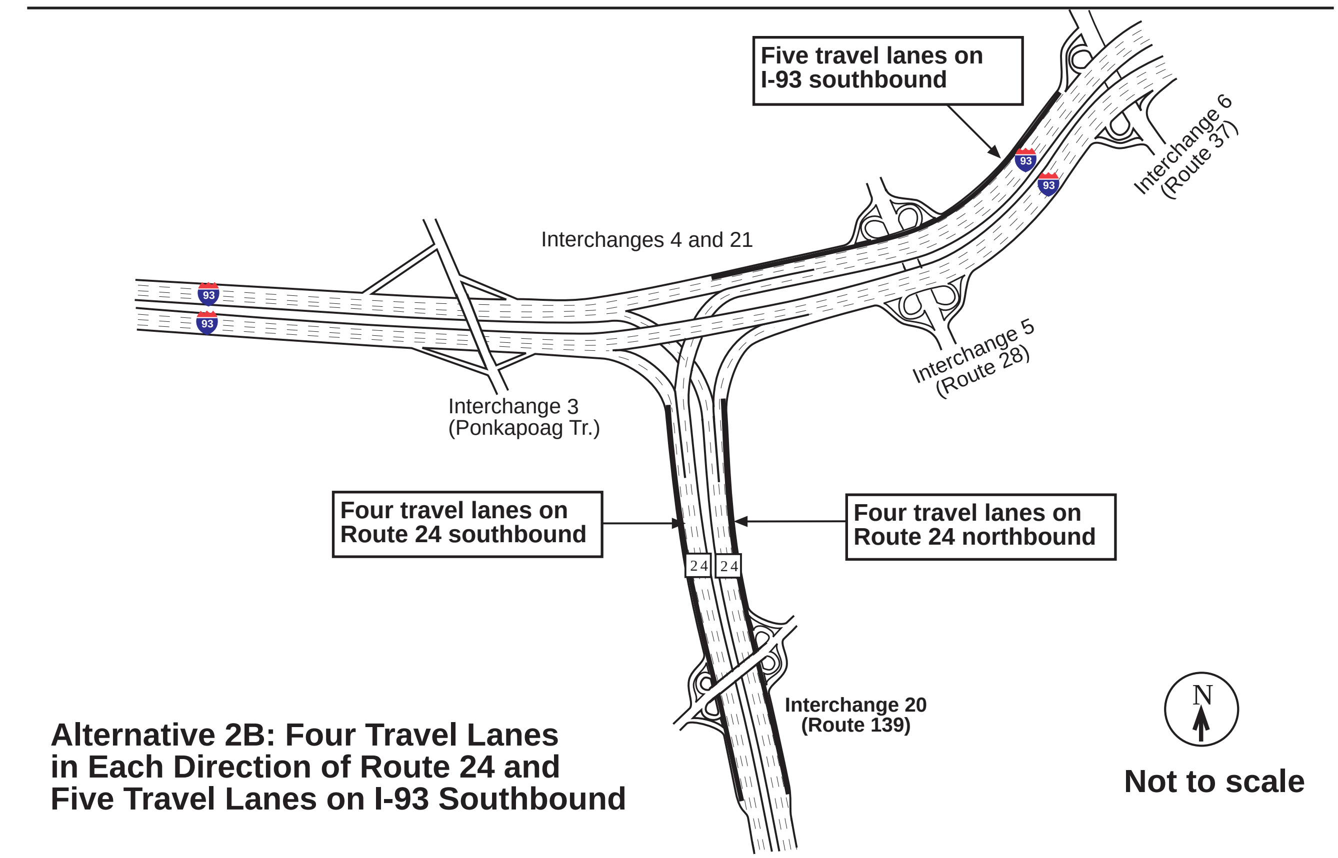


Alternative 1A: Four Travel Lanes on Route 24 Southbound



Alternative 1B: Four Travel Lanes on Route 24 Southbound and Five Travel Lanes on I-93 Southbound

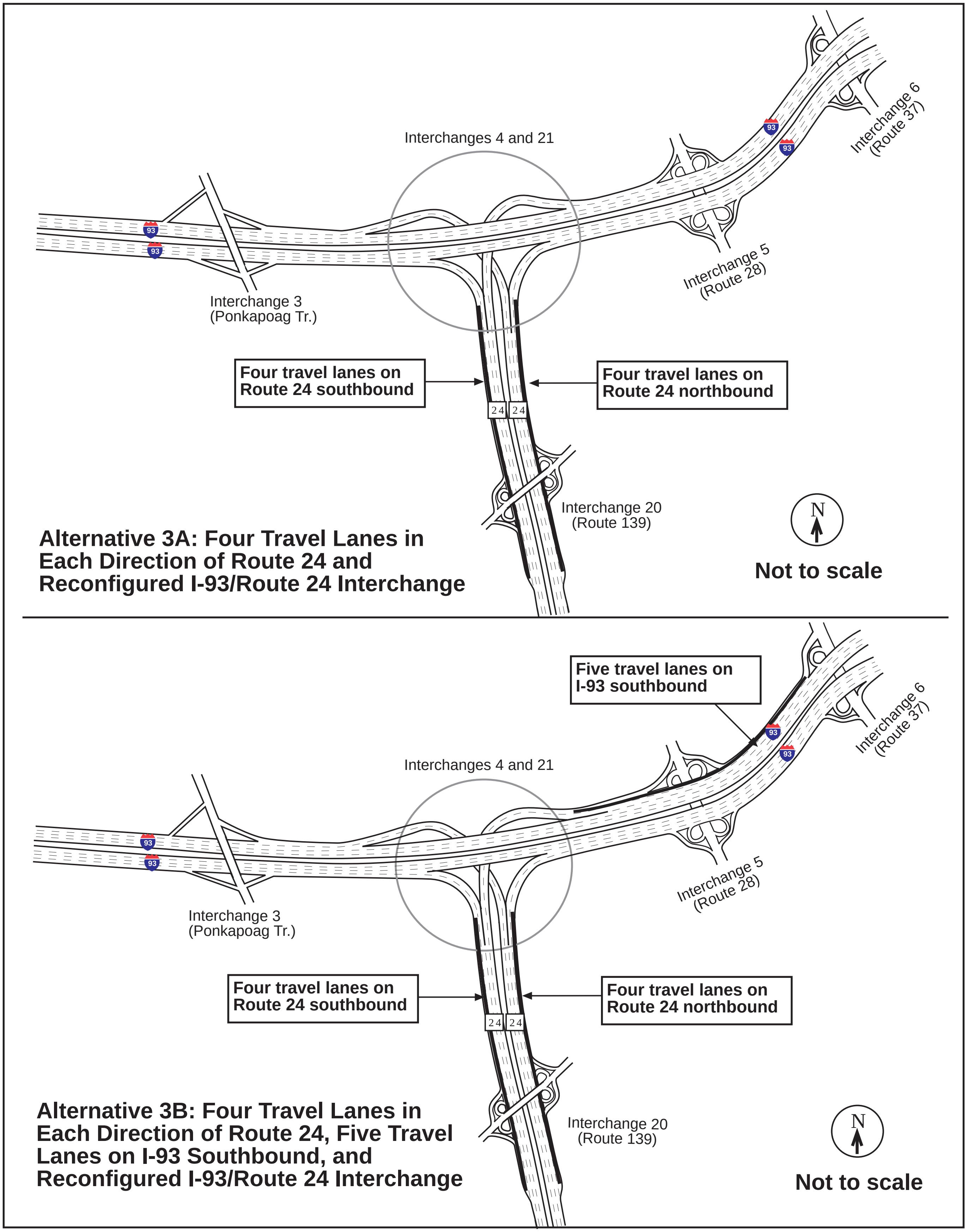




CTPS

FIGURE ES-4
2030 Alternatives 2A and 2B

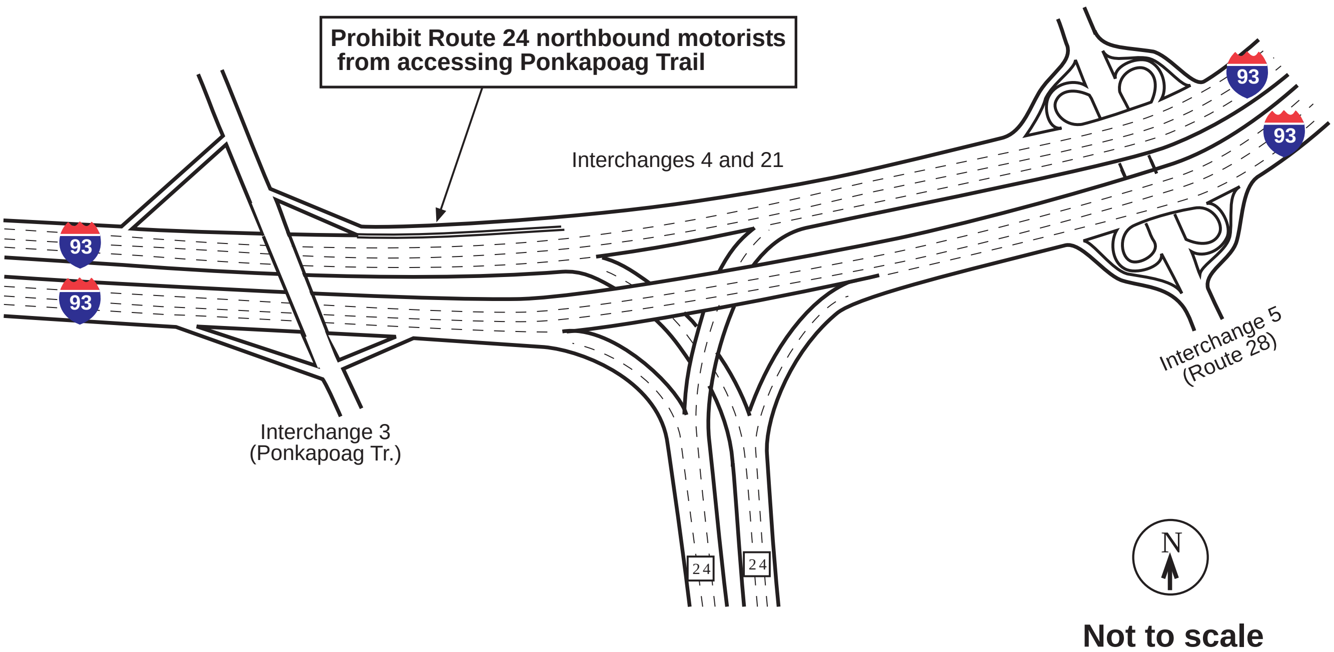
Safety and Operational
Improvements for the
I-93/Route 24 Interchange Sudy



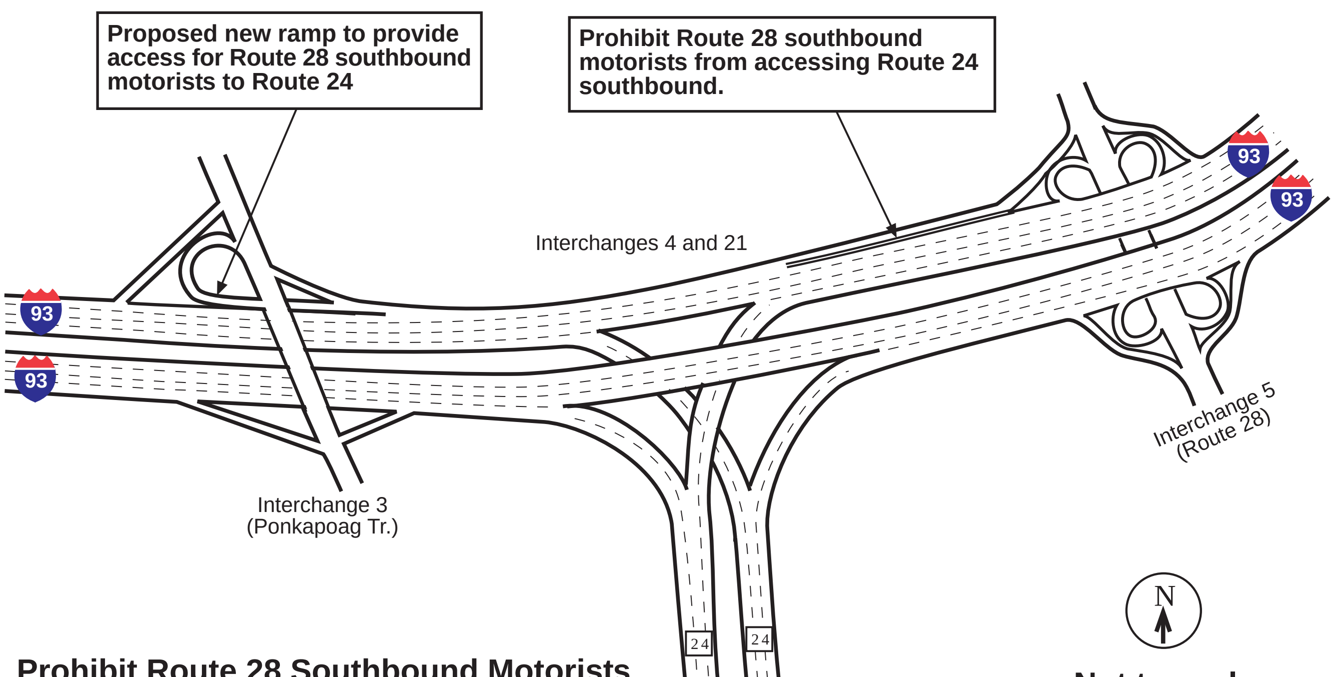
CTPS

FIGURE ES-5
2030 Alternatives 3A and 3B

Safety and Operational
Improvements for the
I-93/Route 24 Interchange Sudy



Prohibit Route 24 Northbound Motorists from Accessing Ponkapoag Trail



Prohibit Route 28 Southbound Motorists from Accessing Route 24 Southbound

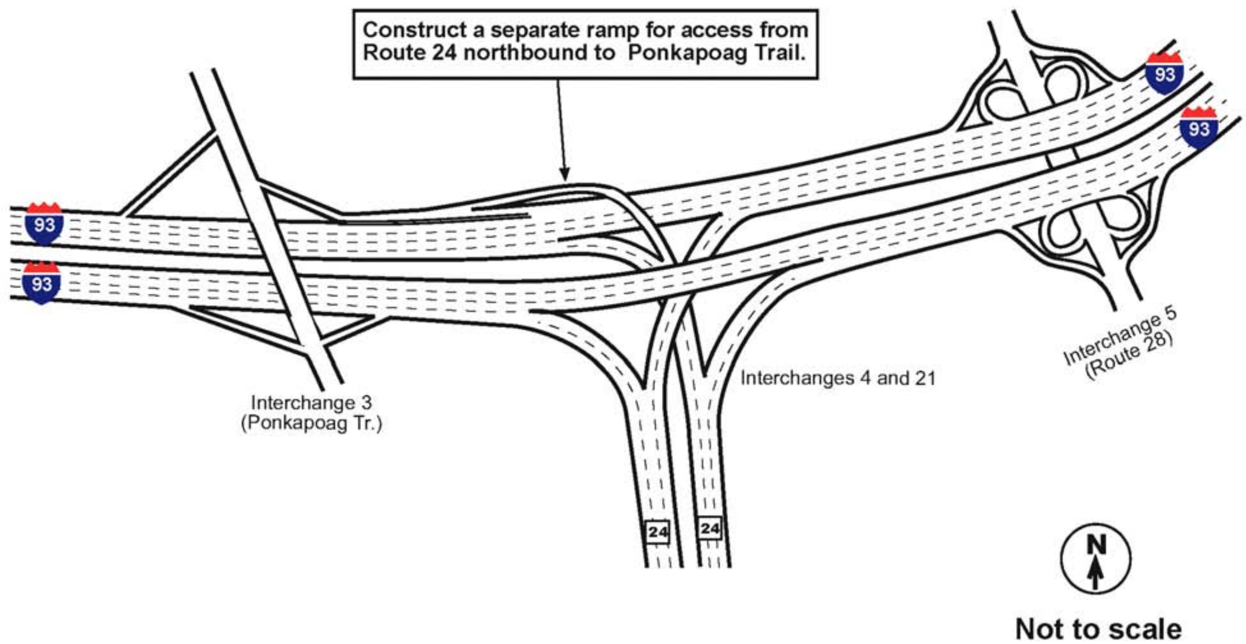


FIGURE ES-7
Provide a Separate Ramp for Access from Route 24 Northbound to Ponkapoag Trail

EVALUATION OF ALTERNATIVES

The purpose of the evaluation is to use the regional transportation planning model and traffic simulation model to assess the traffic impacts of the alternatives and to provide detailed information for making informed decisions. The evaluation of impacts is detailed in Chapter 6, with tables showing performance measures.

Traffic Forecasts

The Boston Region MPO transportation planning model was used to project traffic growth for estimating the impacts of the proposed improvement alternatives. The traffic forecasts were based on MAPC's population, employment, and household forecasts, which were inputs for the regional transportation planning model. A number of roadway and transit projects in the Boston Region MPO area are expected to have been completed by 2030. These projects were coded in the 2030 roadway and transit networks in order to reflect the anticipated changes in the supply of transportation services. Furthermore, the 2030 highway networks were modified to reflect the proposed improvements in each alternative. The entire model set was run for each alternative for two peak periods: AM (6:00 to 9:00) and PM (3:00 to 6:00).

The 2030 no-build AM and PM peak-period traffic volumes serve as the baseline for comparing the forecasts of the build alternatives. That is, for each alternative, the traffic increases/decreases compared to the 2030 no-build are presented. Overall, the model projected peak-period traffic growth on major roadways in the study area that ranges from 2% to 9% per peak period on Route 24 and 2% to 8% on I-93. The 2030 no-build forecasts indicated that in the future, peak-period travel demand on I-93 and Route 24 would increase. The forecasts also show that adding a travel lane in each direction of Route 24 or adding a travel lane on I-93 southbound would increase usage on either route.

Traffic Operations

Both quantitative and qualitative measures were used in assessing the impacts of the alternatives. The quantitative measures included the following networkwide performance measures: average speeds, total vehicles-miles traveled, total delay, and average delay per mile. The traffic simulation performance measures reflect the effects of traffic weaving, lane-changing, and geometrics on traffic operations. However, the model does not estimate how safety would be improved by addressing these issues—even though it is obvious that addressing them would improve safety. Therefore, the traffic safety impacts and benefits resulting from geometric improvements are described qualitatively.

The following section presents summary results of the evaluation. The summary is in two parts: one based on the type of improvement and the other based on the different alternatives.

Based on the Type of Improvement

- The highway improvements expected in the vicinity by 2030 (using no-build alternative) would address the safety problems associated with the use of the breakdown lanes as travel lanes on I-93 west of Route 24. They would also help to reduce to some degree the extent and duration of congestion on I-93 west of Route 24 and on Route 24 northbound during the AM peak period. The AM peak-period average traffic queue on northbound Route 24 would extend to interchange 20 (Route 139), in Stoughton, about 3.4 miles south of the I-93 interchange. Currently, the AM peak-period traffic queue on Route 24 extends to interchange 18 (Route 27), in Brockton, about 8.0 miles south of the I-93 interchange.

- Providing four travel lanes on Route 24 southbound (all of the alternatives) would address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of short sight distance, a limited merge area, and lack of clarity about who has the right-of-way. To some degree (depending on which alternative is used), this improvement would address the traffic congestion and bottleneck on Route 24 southbound; and it would improve traffic flow from both directions of I-93 to Route 24 southbound.

- Providing five travel lanes on I-93 southbound (Alternatives 1B, 2B, and 3B) would address the PM peak-period traffic congestion and bottleneck in this corridor, especially when it is coupled with the lane addition on Route 24 southbound. This improvement, and the reconfiguration of the lane assignments at the diverge area, would improve traffic safety by reducing traffic weaving and lane-changing maneuvers involving the traffic that is diverging onto Route 24 from I-93 southbound.

- Providing four travel lanes on Route 24 northbound (Alternatives 2A, 2B, 3A, and 3B) would moderately improve traffic flow on Route 24 northbound and reduce the long AM peak-period traffic congestion and queuing of traffic heading to the I-93 corridor. With four travel lanes, the traffic queue on Route 24 northbound during the AM peak period would be reduced to one half that of the no-build alternative. It would extend midway between interchange 20 (Route 139) and interchange 21 (I-93), about 1.7 miles.

- Reconfiguring the I-93/Route 24 interchange as described in Alternatives 3A and 3B would address some of the safety problems identified in the study area that were not addressed by Alternatives 1A, 1B, 2A, and 2B:

    - Traffic weaving and lane-changing maneuvers involving the traffic that is diverging onto Route 24 from I-93 southbound

    - Two short weave distances on I-93 southbound: one short weave distance for the Route 28 southbound traffic that is headed for Route 24, and the other for the Route 24 northbound traffic that is headed for Ponkapoag Trail

  However, this reconfiguration may not be a cost-effective solution, as it would have significant environmental impacts. The right-side entry and exit are outside of the roadway; this would require land taking and would impact the Blue Hills Reservation. In addition, the reconfiguration would create two new merge/weave sections on I-93 that might impact traffic safety. An environmental impact study and a detailed review of this alternative might be required to determine if the reconfiguration is feasible.

- Prohibiting Route 24 northbound motorists from accessing Ponkapoag Trail and limiting the I-93 southbound off-ramp to Ponkapoag Trail to serve only the traffic coming from I-93 southbound would prevent the weaving and lane-changing maneuvers of Route 24 northbound traffic proceeding to Ponkapoag Trail. Specifically, it would eliminate the 800 to 900 vehicles from Route 24 that merge and change lanes in order to access Ponkapoag Trail during the AM peak period. Motorists would have the option of using two equally attractive alternative access routes: one via Route 28 at I-93 interchange 5, and the other via Route 138 at I-93 interchange 2. Therefore this improvement is not expected to have any major adverse traffic impact at interchange 2 or interchange 5.

- Prohibiting the Route 28 southbound motorists from accessing Route 24 and limiting the I-93 southbound on-ramp to serve only the traffic continuing on I-93 southbound would prevent lane-changing and weaving maneuvers across the I-93 southbound lanes and would improve safety. Specifically, the prohibition would eliminate the 800 and 850 vehicles that weave and change lanes in a short distance in order to get to Route 24 during the PM peak-period. However, this improvement would be expected to increase traffic at I-93 interchange 3 (Ponkapoag Trail) during the PM peak period, when the diverted traffic taking U-turns at interchange 3 would be expected to increase the traffic volume on the northbound on-ramp. Interchange 3 would need some geometric improvements to accommodate the U-turns.

- Constructing a new loop ramp in the northwest quadrant of I-93 interchange 3 (Ponkapoag Trail) for use by Route 28 southbound motorists to access Route 24 would supplement the existing ramp in the northeast quadrant and would prevent the U-turn maneuvers described above.

- Constructing a new ramp off of the Route 24 northbound connector to I-93 southbound to provide separate access to Ponkapoag Trail would eliminate the weaving and lane-changing maneuvers on southbound I-93 by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area.

Based on Alternatives

Alternatives 1A and 1B

- Alternatives 1A and 1B do not significantly address the problem of traffic congestion on northbound Route 24 during the AM peak period.
- Alternative 1B addresses the PM peak-period congestion on southbound I-93, which is not addressed by Alternative 1A.
- Both Alternatives 1A and 1B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of short sight distance, a limited merge area, and lack of clarity about who has the right-of-way.
- Alternatives 1A and 1B do not address the safety problem of the two short weave distances on I-93 southbound: one short weave distance for the Route 28 southbound traffic that is headed for Route 24, and the other for the Route 24 northbound traffic that is headed for Ponkapoag Trail.

Alternatives 2A and 2B

- Alternatives 2A and 2B address traffic congestion on northbound Route 24 during the AM peak period.
- Alternative 2B addresses the PM peak-period congestion on southbound I-93, which is not addressed by Alternative 2A.
- Both Alternatives 2A and 2B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of short sight distance, a limited merge area, and lack of clarity about who has the right-of-way.
- Alternatives 2A and 2B do not address the safety problem of short weave distances on I-93 southbound: one for the Route 28 southbound traffic that is headed for Route 24, and the other for the Route 24 northbound traffic that is headed for Ponkapoag Trail.

Alternatives 1B and 2B

- Alternatives 1B and 2B, which include five travel lanes on southbound I-93, would reduce the PM peak-period congestion, but would make maneuvers from Route 28 southbound to Route 24 southbound more difficult, as the number of required lane changes would increase.

Prohibiting Route 28 southbound motorists from accessing Route 24 southbound and limiting the I-93 southbound on-ramp to serve only the traffic continuing on I-93 southbound would prevent the lane-changing and weaving maneuvers across the I-93 southbound lanes, which would improve safety. However, this improvement would be expected to divert traffic to interchange 3 (Ponkapoag Trail).

Alternative 3A and 3B

- Alternatives 3A and 3B address traffic congestion on northbound Route 24 during the AM peak period.
- Alternative 3B addresses the PM peak-period congestion on southbound I-93, which is not addressed by Alternative 3A.
- Both Alternatives 3A and 3B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of short sight distance, a limited merge area, and lack of clarity about who has the right-of-way.
- Reconfiguring the I-93/Route 24 interchange as described in Alternative 3A and 3B would address some of safety problems identified in the study area that involve weaving traffic and lane-changing maneuvers of traffic that is diverging onto Route 24 from I-93 southbound, as well as the two short weave distances on I-93 southbound: one short weave for the Route 28 southbound traffic that is headed for Route 24, and the other for the Route 24 northbound traffic that is headed for Ponkapoag Trail.

  However, the reconfiguration may not be a cost-effective solution, as it would have adverse environmental impacts on the Blue Hills Reservation, and would replace the current weaving and lane-changing maneuvers with merge/weave problems. The reconfiguration would need to have more review to determine if it is feasible.

RECOMMENDATIONS

The recommendations of this study were based on suggestions from the Advisory Task Force. One of the responsibilities of the task force was to assist in making recommendations for implementation of proposed projects by MassHighway. At the second task force meeting, the results of the study were presented to members of the task force for comments, feedback, and decisions about which of the alternatives developed for this study should be recommended for implementation.

Members of the task force suggested that this study's recommended improvements should be staged or structured rather than just recommending one alternative. They suggested that the recommended improvements be separated into short-term alternatives that can be constructed in a short time frame (less than 10 years), intermediate-term alternatives that can be constructed within 10 to 15 years, and long-term alternatives, which might take more than 15 years to implement. The reasons for staging or structuring the recommended improvements were to focus first on effective low-cost safety improvements and improvements that would eliminate peak-period capacity deficiencies and bottlenecks. Additional reasons were that staging the recommended improvements would allow some flexibility in implementing the recommended improvements, considering the limited transportation funding available. Also, by staging the improvements, the impact of some of the projects (changes from the no-build scenario) would be known, and that would provide flexibility for making future changes.

The following criteria were used in staging the recommended improvements:

- The degree to which an improvement addresses safety and/or peak-period capacity deficiencies or bottlenecks
- The cost of implementing the improvement
- If an improvement can be constructed within the existing right-of-way
- The magnitude of the environmental impact study involved

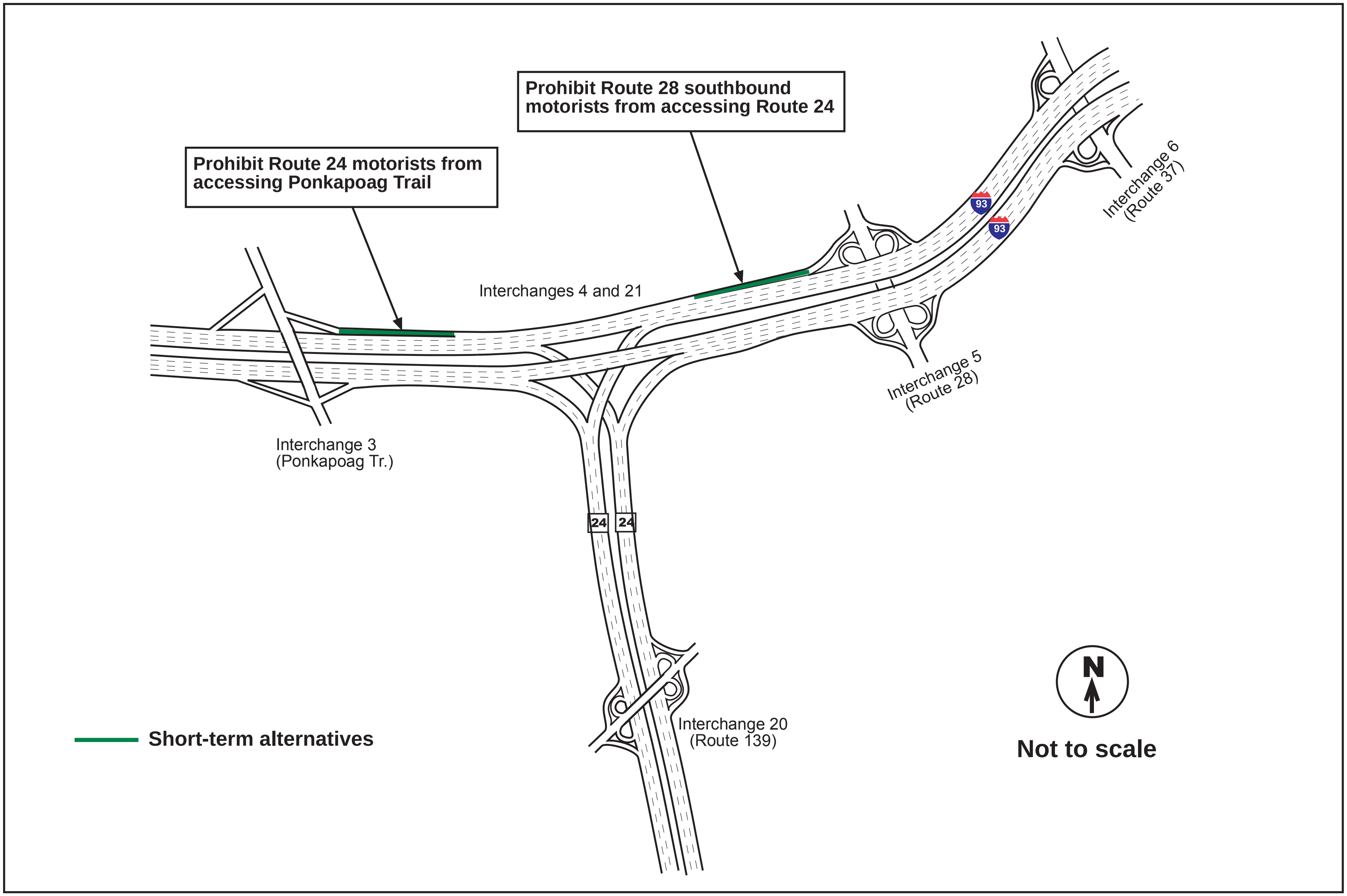
Because some of the projects involve adding a travel lane that would require widening of the bridges along Route 24 and I-93, the American Association of State Highway and Transportation Officials (AASHTO) ratings of the bridges along I-93 and Route 24 were obtained to identify which bridges are structurally deficient, functionally obsolete, or in good condition. The data were obtained from MassHighway's 2006 bridge inventory system. Two of the bridges on Route 24 that are within the part of the study area for which improvements were proposed are structurally deficient and have to be replaced soon. They are the Route 139 bridge over Route 24, and the Department of Conservation and Recreation (DCR) Horse Access Bridge over Route 24. Canton Street bridge which is under Route 24, is in good condition and meets AASHTO standards. The remaining bridges in the study area on I-93, are functionally obsolete, meaning that they do not meet some of the current design standards. Based on the criteria described above and on conditions of bridges in the study areas, the improvements were staged into short-term, intermediate-term, and long-term alternatives.

Short-Term Alternatives

The short-term alternatives are shown in green in Figure ES-8. The short-term alternatives are low-cost, quick fixes, and effective safety improvements. They would not require environmental impact studies as they can be carried out within the existing right-of-way. These short-term alternatives are described in detail in Chapters 5 and 6.

Prohibit Route 24 Northbound Motorists from Directly Accessing Ponkapoag Trail (Cost: $2.0–4.0 million)

This change would prohibit motorists on Route 24 northbound from having direct access to Ponkapoag Trail, and would limit the I-93 southbound off-ramp to Ponkapoag Trail to serve only the traffic coming from I-93 southbound. This improvement would be expected to improve safety and facilitate traffic flow at the I-93/Route 24 interchange, especially during the AM peak travel period, when high volumes of traffic from Route 24 weave across I-93 to exit at Ponkapoag Trail. It would eliminate the short weave distance for the Route 24 northbound motorists that are headed to Ponkapoag Trail, and prevent the weaving and lane-changing



CTPS

FIGURE ES-8
Recommended Improvements:
Short-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

maneuvers that take place at that location. Specifically, the prohibition would eliminate the 800 to 950 vehicles (data from a CTPS license plate survey) from Route 24 during the AM peak period that weave and change lanes in order to access Ponkapoag Trail.

A large portion of the Route 24 northbound traffic is commuter traffic heading to Milton or Boston using Blue Hills Parkway via Unquity Road, Hillside Street, and Blue Hill River Road. If ramp access were prohibited, Route 24 northbound motorists would have two alternative access routes, which would be equally attractive to drivers. Consequently, the prohibition would be expected to split traffic evenly onto the two alternative routes.

The first alternative access route would be the I-93 southbound off-ramp to Route 138 northbound, about 1.3 miles to the west of the Ponkapoag Trail exit. Motorists would then have the option of taking Route 138 northbound or using Blue Hill River Road/Hillside Street and Unquity Road to continue their journey to Milton or Boston. The second alternative access route is the I-93 northbound off-ramp to Route 28 northbound, about 1.5 miles to the east of the Ponkapoag Trail exit. From Route 28, motorists would have the option of continuing on Route 28 or using Chickatawbut Road and Unquity Road to continue their journey to Milton or Boston. Because motorists would have two equally attractive alternatives, the prohibition would not be expected to have any major adverse traffic impact at I-93 interchange 2 (Route 138) or interchange 5 (Route 28).

Prohibit Route 28 Southbound Motorists from Directly Accessing Route 24 Southbound (Cost: $2.0–4.0 million)

This change would prohibit Route 28 southbound motorists from having direct access to Route 24 southbound by limiting the I-93 southbound on-ramp to serve only the traffic continuing on I-93 southbound. This prohibition would prevent lane-changing and weaving maneuvers across the I-93 southbound lanes by traffic proceeding to Route 24 southbound. This prohibition would also increase safety at the I-93/Route 24 interchange and eliminate the short weave distance. Specifically, the prohibition would eliminate the 800 to 850 vehicles (data from a CTPS license plate survey) during the three-hour PM peak period that weave and change lanes within a short distance in order to get to Route 24. If the ramp were restricted to serve only the traffic continuing on I-93 southbound, motorists would have two alternative access routes to Route 24.

The primary alternative access for motorists heading to the Route 24 corridor would be a U-turn at interchange 3 (Ponkapoag Trail), about 1.5 miles to the west of that interchange. This alternative access route to Route 24 would not affect residential or commercial land uses. At I-93 interchange 3, the ramp terminals are presently controlled by stop and yield signs, and they would need some geometric improvements to accommodate the U-turns.

The secondary alternative access route for motorists heading to Route 24 from Route 28 southbound is via Routes 28 and 139 in Randolph. In Randolph, Route 28 is congested in the southbound direction during the PM peak period. It serves many residential and commercial land uses, and has severe capacity restrictions in the sections with only two lanes, one in each direction. Route 139 in Randolph and Stoughton serves residential and commercial land uses, and is also congested during the PM peak travel period. Based on the land uses and capacity restrictions in these corridors, not many motorists would choose this detour, as it is longer and slower than traveling on Route 24 southbound.

Intermediate-Term Alternatives

The intermediate-term alternatives are shown in blue in Figure ES-9, along with the short-term alternatives, which are shown in green. The intermediate-term alternatives are medium-cost safety and operational improvements and are largely located in the highway sections with structurally deficient bridges that could be considered for replacement in the intermediate term. Implementing any of the intermediate-term alternatives described below, or a combination of them, could result in implementation of Alternative 1A, Alternative 1B, Alternative 2A, or Alternative 2B (see Chapters 5 and 6). All of the intermediate-term alternatives would require environmental impact studies.

Construct a Loop Ramp in the Northwest Quadrant of Interchange 3 (Ponkapoag Trail) for Use by Route 28 Southbound Motorists Accessing Route 24 (Cost: $3–$5 million)

This alternative consists of constructing a new loop ramp in the northwest quadrant of I-93 interchange 3 (Ponkapoag Trail) for use by Route 28 southbound motorists accessing Route 24. It is subject to the implementation of the improvements described above that would prohibit Route 28 southbound motorists from weaving across I-93 southbound lanes to access Route 24.

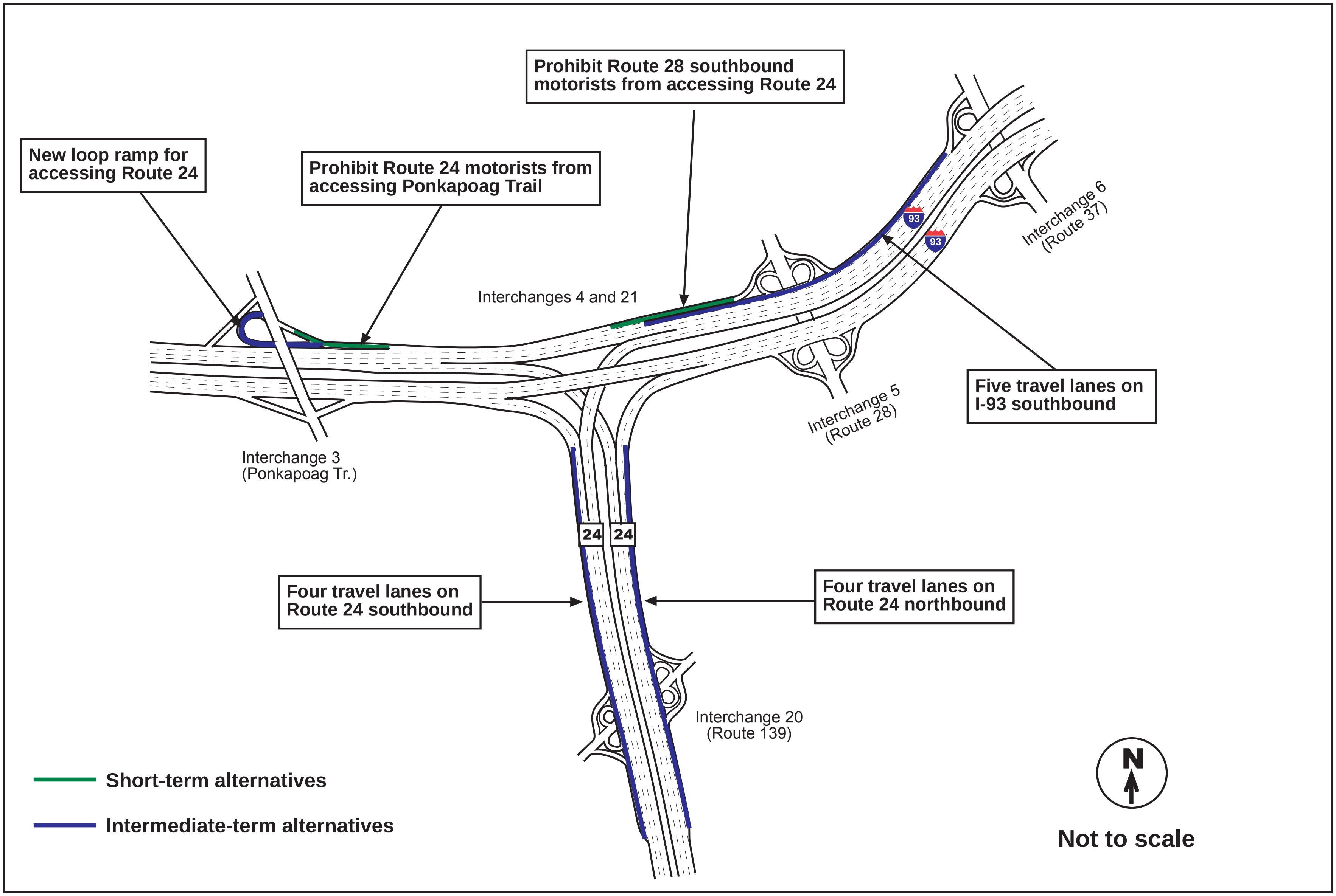
Constructing the loop ramp would allow only right turns from the I-93 southbound exit ramps to Ponkapoag Trail; that is, the existing ramp would serve traffic heading northbound on Ponkapoag Trail, while the new loop ramp would serve traffic heading southbound on Ponkapoag Trail. Operating the ramps as right-turn-only would improve traffic operations at the interchange because it is more efficient than the U-turn operation, which involves left-turn maneuvers.

The loop ramp would supplement the existing ramp in the northeast quadrant and prevent the U-turn maneuvers described above. The new ramp would handle about 300 vehicles during the PM peak hour and about 800 to 850 vehicles during the three-hour PM peak period. The construction cost for the loop ramp is estimated to be $3 to $5 million.

Construct Four Travel Lanes on Route 24 Southbound (Cost: $25–$30 million)

This alternative constitutes Alternative 1A. It consists of four travel lanes on southbound Route 24 beginning at interchange 21 (I-93) in Randolph and ending just after interchange 20 (Route 139) in Stoughton. Additional modifications include reconfigured lanes at the entrance to southbound Route 24 to receive four travel lanes from the two two-lane ramps, lengthening of the Route 139 bridge and the DCR Horse Access Bridge, which are both over Route 24 (and are both structurally deficient), Canton Street bridge (in good condition), and new or modified signs to guide motorists to Route 24.

Constructing a fourth travel lane on Route 24 southbound would help address the safety problems at the merge area on southbound Route 24, where motorists avoid the middle travel lane because of lack of clarity about who has the right-of-way, limited merge area, and poor sight distance. Additionally, it is expected to moderately reduce the extent and duration of the PM peak-period traffic bottleneck and congestion created by high volumes of traffic from I-93 merging into three lanes on Route 24 southbound. The construction cost for the fourth lane on southbound Route 24 is estimated to be $25 to $30 million. This cost includes lengthening of the bridges crossing Route 24 to accommodate the fourth lane.



CTPS

FIGURE ES-9
Recommended Improvements:
Short- and Intermediate-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

Construct a Fifth Travel Lane on I-93 Southbound (Cost: $20–$25 million)

The fifth travel lane on I-93 southbound, beginning from the southbound on-ramp from Route 37 to just after the exit ramp to southbound Route 24, would be constructed after the completion of the fourth southbound lane on Route 24. The reason for this is that the five travel lanes on I-93 southbound would facilitate traffic flow to Route 24 and to I-93 southbound past the Route 24 exit.

Therefore, a downstream bottleneck on Route 24 southbound could reduce the benefits of five travel lanes on I-93 southbound during the PM peak period. Additional changes linked with the construction of a fifth travel lane on I-93 southbound are: reconfiguring lanes in the area where traffic diverges from southbound I-93 onto Route 24 to provide two exclusive travel lanes going to Route 24 and three lanes continuing on I-93; and lengthening of the I-93 bridge over Route 28 (a functionally obsolete bridge). New or modified signs on I-93 to guide motorists are also included.

Five travel lanes on I-93 southbound, coupled with four travel lanes on southbound Route 24 and the short-term alternatives described above, would improve safety and operations. In addition, the short-term alternatives described above would eliminate the difficult maneuver that the fifth lane would otherwise pose to Route 28 southbound motorists trying to access Route 24. The five travel lanes would reduce the PM peak-period congestion and bottleneck and facilitate traffic flow on I-93 southbound in general, and I-93 traffic to Route 24, to take advantage of the proposed four southbound travel lanes, which in turn would improve safety at the merge area and facilitate traffic flow on Route 24.

The construction cost for the fifth travel lane is estimated to be $20 to $25 million. This cost includes lengthening of the I-93 Bridge over Route 28 to accommodate the additional lane.

Construct Four Travel Lanes on Route 24 Northbound (Cost: $25–30 million)

Even though the Route 128 Transportation Improvement Program is expected to moderately reduce the AM peak-period congestion on Route 24, construction of the proposed fourth northbound lane on Route 24 is included in the intermediate-term alternatives because it ties in with the lengthening of the bridges over the southbound lanes. The modifications include constructing a fourth travel lane on northbound Route 24 from just south of interchange 20 (Route 139) in Stoughton to interchange 21 (I-93) in Randolph, and reconfiguring lanes at the diverge area to I-93 to provide two travel lanes that would connect to each of the two-lane ramps to I-93. Additional modifications are lengthening of the Route 139 bridge and the DCR Horse Access Bridge over Route 24 (structurally deficient bridges), and new or modified signs on northbound Route 24 to guide motorists to I-93.

Four travel lanes in the northbound direction of Route 24 northbound would improve traffic flow on Route 24 northbound. It would also reduce the long AM peak-period traffic congestion and queuing of traffic heading to the I-93 corridor.

The construction cost for the fourth northbound lane is estimated to be $25 to $30 million. This cost includes lengthening of the Route 139 bridge over Route 24, the DCR Horse Access Bridge over Route 24, and the Route 24 bridge over Canton Street to accommodate the additional lane. It is should be noted that the costs of widening the bridges are also included in the construction costs of the fourth southbound travel lane.

Long-Term Alternatives

The long-term alternatives are high-cost safety and operational improvements located in an area with functionally obsolete bridges that might not be considered for replacement in the intermediate term. Additionally, the long-term alternatives would require significant environmental impact studies to determine their feasibility.

Implementing the long-term alternatives described below, in addition to some of the intermediate-term alternatives described above, would result in implementation of either Alternative 3A or Alternative 3B. The following are the long-term alternatives; their locations are circled in red in Figure ES-10 in the following page. Also in Figure ES-10 are the intermediate-term alternatives, shown in blue.

Provide a Separate Ramp for Accessing Ponkapoag Trail from Route 24 Northbound (Cost $10–$15 million)

Create a new ramp off of the Route 24 northbound connector to I-93 southbound to provide a separate access route to Ponkapoag Trail (Figure ES-10, top). The objective is to eliminate the weaving and lane-changing maneuvers on southbound I-93 by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area; that is, to provide another way for the Route 24 northbound motorists to access Ponkapoag Trail.

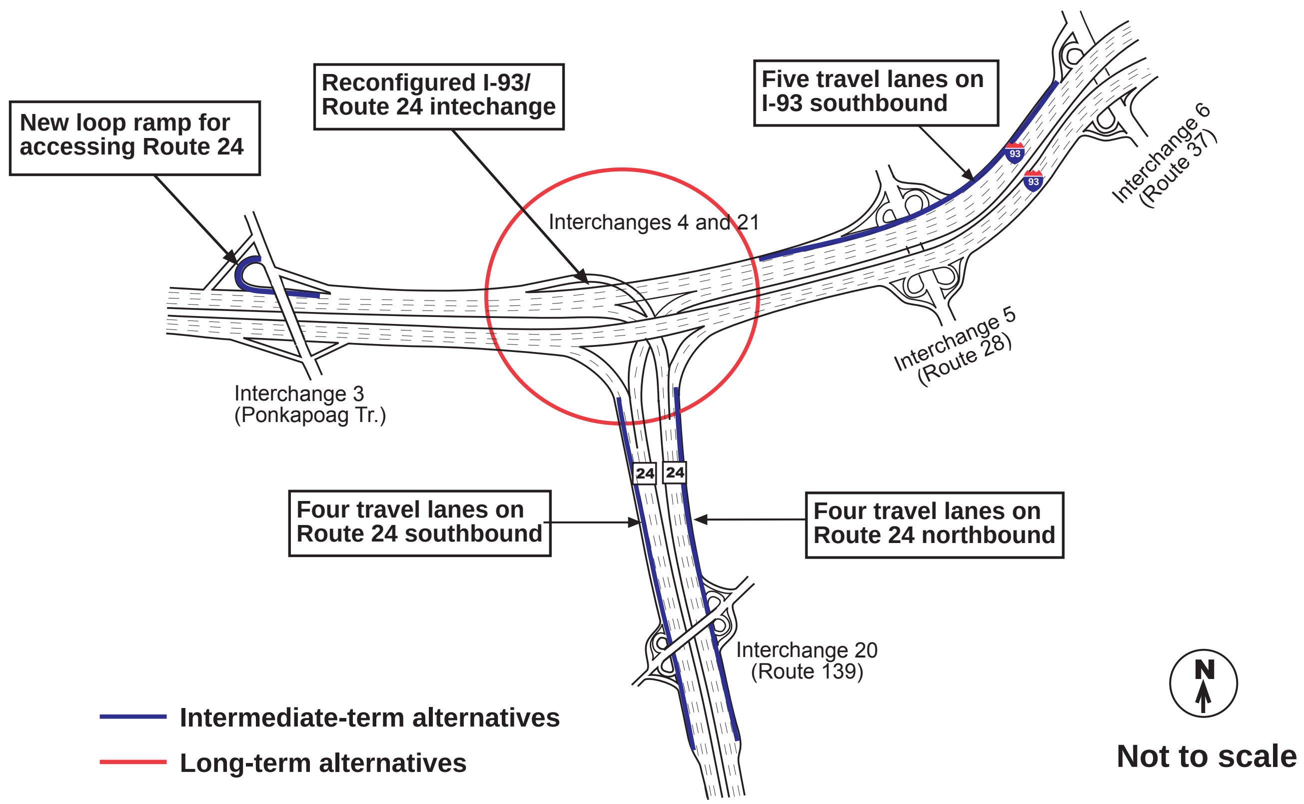
The new ramp would provide a right merge with the I-93 southbound traffic exiting to Ponkapoag Trail. A physical barrier would be constructed to channel the traffic exiting from I-93 southbound to Ponkapoag Trail and to prevent a merge/weave problem on I-93 southbound in that vicinity.

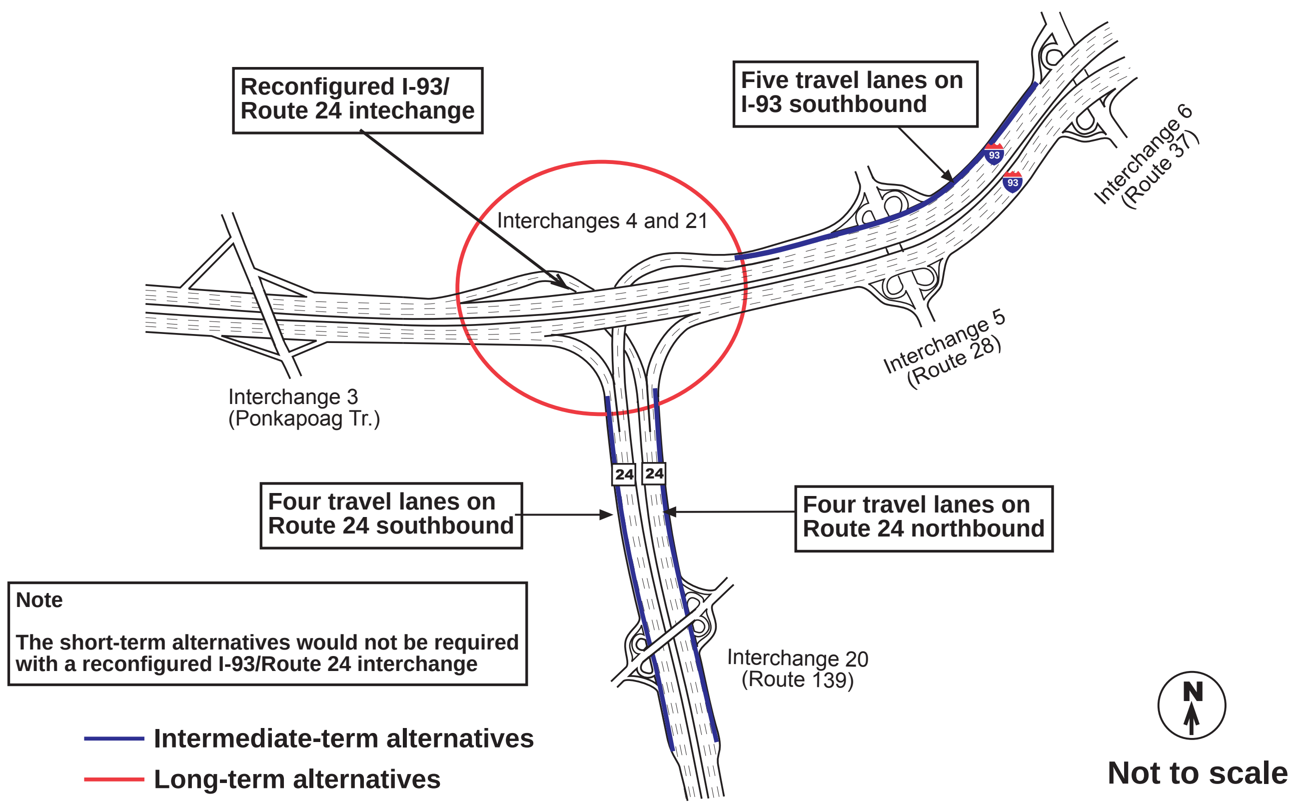
The new ramp would handle the 850 to 900 vehicles (from a CTPS license plate survey) from Route 24 during the AM peak period that weave and change lanes in order to access Ponkapoag Trail. A large portion of the traffic on the I-93 southbound off-ramp to the Ponkapoag Trail is commuter traffic heading to Milton or Boston. This alternative addresses some of the safety problems that Alternatives 3A and 3B were meant to address on I-93 southbound west of Route 24, and it may offer a less costly alternative to either of those alternatives. The construction cost for these alternatives is estimated to be $10 to $15 million.

Reconfigure the I-93/Route 24 Interchange ($60–$80 million)

This improvement includes redesigning and upgrading the I-93/Route 24 interchange. These potential geometric improvements are necessary for upgrading Route 24 to interstate standards and the bridges from functionally obsolete to current standards. All four ramps from I-93 to Route 24 would need to be reconstructed in order for the three bridges to be raised to meet the 16.5-foot-high clearance standard.

On the one hand, this alternative would eliminate the short weave distances created by the closely spaced interchanges by providing right-side entry and exit ramps. In other words, it would address the safety problems created by the difficult maneuvers from Route 28 southbound to Route 24 southbound and from Route 24 northbound to Ponkapoag Trail.





CTPS

FIGURE ES-10
Recommended Improvements:
Intermediate- and Long-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

On the other hand, the interchange is located in the Blue Hills Reservation, so the reconfigured interchange with right-side entry and exit ramps would require land taking because the right-side ramps would be located outside of the roadway. The reconfiguration may not be a cost-effective solution, considering its high construction cost, adverse environmental impact on the Blue Hills Reservation, and two merge/weave sections it would create on I-93 southbound. An environmental impact study and a detailed review of the reconfiguration would be required to determine if this improvement is feasible. The construction cost for these alternatives is estimated to be $60 to $80 million. This cost includes upgrading the bridges and ramps at the interchange.

BENEFITS OF THE ALTERNATIVES

By 2030, increased traffic volumes are expected to increase traffic delays and the extent and duration of congestion if the no-build option is chosen. The build alternatives indicate that the proposed alternatives would improve traffic safety and reduce congestion in the study area.

The proposed alternatives described in this report are conceptual in nature. They primarily address traffic safety and operational problems in the highway system. Although preliminary analysis of the improvements indicates that they would provide significant safety and operational benefits, they would have to undergo further review and analysis before final recommendations could be made. Such review and analysis would include, but not be limited to, environmental and right-of-way issues, public support and participation, benefit and cost analysis, design, and prioritization of the improvements. In all cases, MassHighway would be the implementing agency.

NEXT STEPS

Further review and analysis will be performed, including, but not limited to, environmental and right-of-way issues, public support and participation, benefit and cost analysis, design, and prioritization of the improvements before final recommendations are made.

1 INTRODUCTION

1.1 BACKGROUND

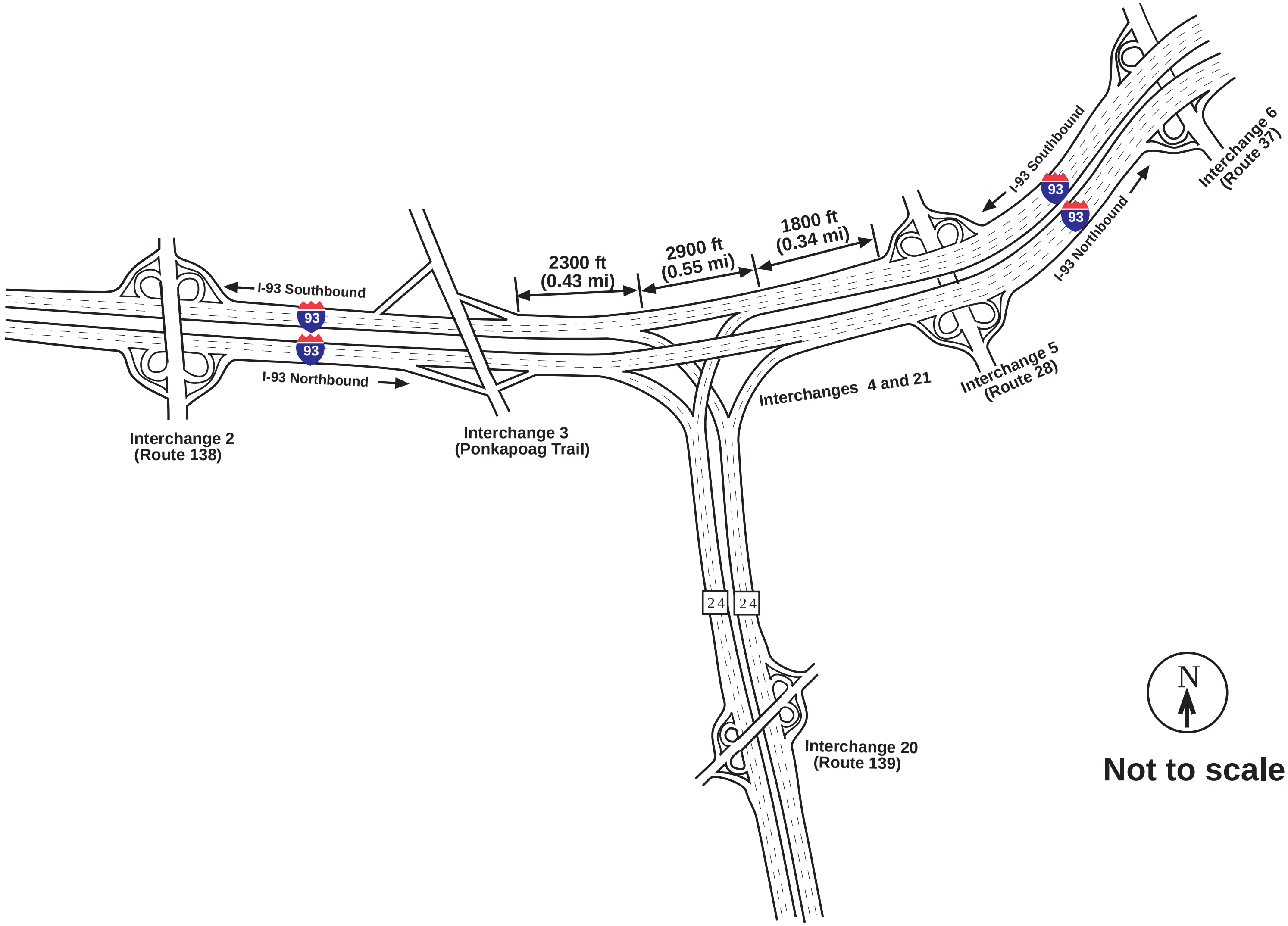
This study originated from the findings in the 2004 Mobility Management System (MMS) report[1] and from recommendations made in a report on the Braintree split.[2] Both studies identified the I-93/Route 24 interchange as a bottleneck that causes congestion on I-93 and Route 24 during peak travel periods. This interchange is also ranked #48 on the Massachusetts Highway Department's list of the top 1,000 crash locations, with 229 crashes during the period 1999 to 2001, and 292 crashes during the period 2002 to 2005. The proponent of this study, the Boston Region Metropolitan Planning Organization (MPO), was concerned with the traffic operations and traffic safety at the interchange and requested that it be studied in detail. The MPO staff, which is the Central Transportation Planning Staff (CTPS), conducted the study.

The I-93/Route 24 interchange is located partly in Randolph, partly in Quincy, and partly in Milton (see Figure 1). It is the sixth most heavily used interchange in Eastern Massachusetts, and it carries about 280,000 vehicles a day, whose drivers encounter a complex driving environment that includes weaving, merging, congestion, and other conditions that create safety problems at the interchange. The I-93/Route 24 interchange is designated as interchange 4 on I-93 and as interchange 21 on Route 24. It is a three-legged directional interchange, that is, traffic does not deviate from its intended direction of travel (loop around) when connecting to another highway. Each of the four direct connector ramps has two lanes.

To the east of the I-93/Route 24 interchange, I-93 has four travel lanes in each direction; to the west, I-93 has three lanes in each direction; to the south, Route 24 has three lanes in each direction. There are five interchanges on I-93 in the vicinity of the I-93/Route 24 interchange, some of which are closely spaced, with less than 2,000 feet between them. About 1,800 feet to the east of the I-93/Route 24 interchange is I-93 interchange 5 (Route 28, Quincy and Randolph), and about 2,300 feet to the west is I-93 interchange 3 (Ponkapoag Trail, Milton). To the south, about 3.4 miles away, is Route 24 interchange 20 (Route 139, Stoughton). Interchanges 2 (Route 138), 5 (Route 28), and 6 (Route 37) are partial or full cloverleaf interchanges, while interchanges 3 (Ponkapoag Trail) and 4 (Route 24) are diamond and three-legged directional interchanges, respectively.

[1] Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, *Mobility in the Boston Region: Existing Conditions and Next Steps: The 2004 Congestion Management System Report,* December 2004.

[2] Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, *I-93/Southeast Expressway/Route 3 (Braintree Split): Operational Assessment and Potential Improvements*, March 2006.



CTPS

FIGURE 1
I-93/Route 24 Interchange and Vicinity

Safety and Operational Improvements for the I-93/Route 24 Interchange

1.2 OBJECTIVES

The objectives of this study were twofold:

- Identify the traffic safety and operations problems on the ramps and roadways that compose the I-93/Route 24 interchange.

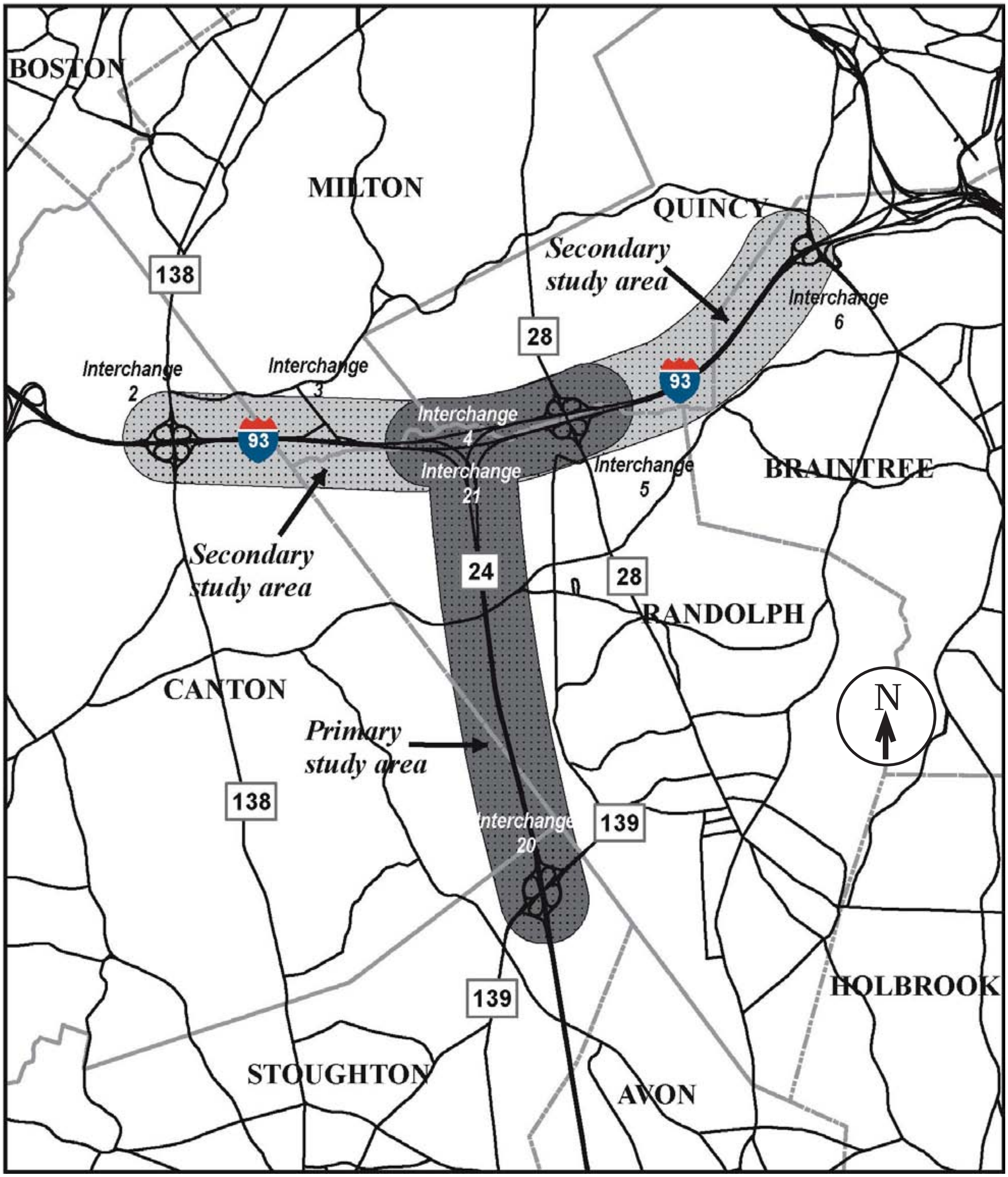
- Develop, evaluate, and recommend safety and operational improvements for the Massachusetts Highway Department (MassHighway) to implement.

The study area shown in Figure 2 comprises a primary and a secondary study area. The primary study area, for which safety and operational improvements were developed and tested, extends from I-93 interchange 5 (Route 28, Quincy and Randolph) to I-93 interchange 4 (Route 24, Randolph) and from Route 24 interchange 21 (I-93, Randolph) to Route 24 interchange 20 (Route 139, Stoughton). The secondary study area, for which impacts of the proposed improvements were evaluated, extends from I-93 interchange 2 (Route 138, Canton) to the Braintree split.

To meet the study objectives, CTPS first collected and assembled traffic-volume data, travel-time and travel-speed data, and highway crash data to determine the existing travel conditions. Next, an advisory task force was established to guide the study to a successful completion. CTPS analyzed existing traffic operations and traffic safety conditions in the primary and secondary study areas, developed alternatives with contributions from the advisory task force, forecast travel demand for the year 2030, simulated existing traffic operations, and reran the simulation model with the traffic and safety assumptions for future years. Based on the analysis and on contributions from the advisory task force, CTPS suggested traffic safety and operations improvements.

The advisory task force was composed of representatives from the communities of Avon, Braintree, Canton, Milton, Quincy, Randolph, and Stoughton; the Executive Office of Transportation and Public Works (EOTPW), MassHighway, the Massachusetts Bay Transportation Authority (MBTA), the Metropolitan Area Planning Council (MAPC), the Southeastern Regional Planning and Economic Development District (SRPEDD), the Old Colony Planning Council (OCPC), the South Shore Coalition, the South Shore Chamber of Commerce, the Stoughton Chamber of Commerce; and elected officials. The advisory task force met two times during the course of the study, both times at Stoughton Town Hall. At these meetings, the work program for the study and task products were presented for comments and feedback. Appendix A contains information on the public participation efforts, including comments on this study and attendance at task force meetings.

The report is organized into nine sections: an executive summary and eight chapters. Chapter 1 gives the background of the study. Chapter 2 documents the existing traffic operations and safety problems in the study area. Chapter 3 describes the analysis of the existing travel conditions. Chapter 4 presents the planned and proposed projects in the study area. Chapter 5 describes the alternatives that were developed to improve traffic safety and operations. Chapter 6 presents the computer model travel-demand forecasts and microsimulation used in evaluating the impacts of the alternatives. Chapter 7 presents recommendations from this study and Chapter 8 describes the process for implementing them and for helping the communities with the initial project development.



CTPS

FIGURE 2
Primary and Secondary Study Areas

Safety and Operational Improvements for the I-93/Route 24 Interchange

2 TRAFFIC SAFETY AND OPERATIONS PROBLEMS

Through field reconnaissance and analysis of field data, CTPS developed an inventory of traffic safety and operations problems in the primary and secondary study areas and their vicinity. The inventory of traffic and safety problems is shown in Figure 3. The numbers in the circles and the text in the boxes in Figure 3 represent specific locations and identify the particular problem at each location. The internal problems, which are located in the primary area, are indicated in Figure 3 by yellow dots. The external problems, which are located in the secondary area, are indicated by red dots.

The identified problems were grouped into two categories: internal and external. The internal problems are traffic safety and operations problems that exist within the study area, such as weaving, merging, diverging, short sight distance, lane drops, bottlenecks, queuing, and congestion. The external problems are bottlenecks existing outside of the study area that have a major impact on traffic and safety operations in the study area because of traffic queue spillbacks. The next two sections describe in detail the internal and external problems.

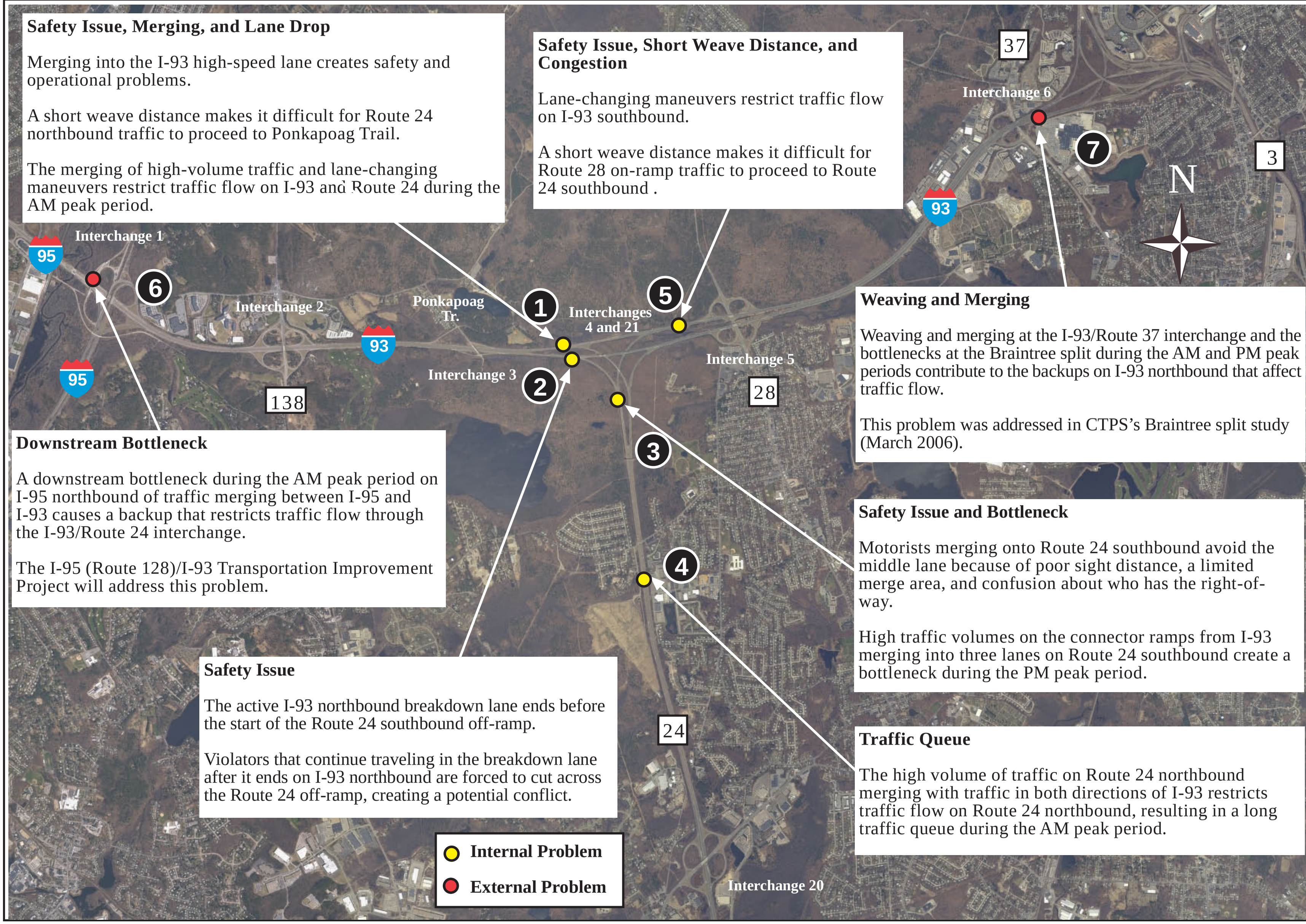
2.1 INTERNAL PROBLEMS (PRIMARY AREA)

AM Peak Period

During the AM peak period, the high volume of traffic on the two-lane connector from Route 24 northbound to I-93 southbound merging with the high volume of traffic from I-93 southbound (location #1 in Figure 3) creates a bottleneck that prevents traffic from continuing on southbound I-93 or from northbound Route 24. The two-lane ramp connector from Route 24 northbound merges into three through lanes on I-93 southbound. Even though one lane is dropped on the two-lane connector ramp before it merges with the I-93 southbound lanes, motorists drive during peak periods as if it has two lanes all the way through. Thus, during the AM peak period, this merge area with three travel lanes receives, in effect, five lanes of vehicles. Currently, the length of the merge distance is about 500 feet; the design standard specifies a length of 600 to 840 feet. The limited merge distance at this location not only compounds this operations problem but also makes it unsafe, as motorists have to merge quickly into the southbound I-93 high-speed lane.

The Route 128 Improvement Program, currently under construction, will reduce the impact of the left-side merge by providing a left full lane (fourth lane) and an acceleration lane for the two-lane connector ramp from northbound Route 24 to southbound I-93 so that vehicles will not have to merge in a short distance directly into the high-speed lane.

As Figure 1 shows, the close proximity of interchange 3 (Ponkapoag Trail) to the I-93/Route 24 interchange) creates another problem, which is the lane-changing maneuvers within a short weave distance required of the Route 24 northbound motorists headed for Ponkapoag Trail (location #1).



CTPS

FIGURE 3
Traffic Safety and Operations Problems

Safety and Operational Improvements for the I-93/Route 24 Interchange

After merging into the high-speed lane on I-93 southbound, the Route 24 northbound motorists have only about 1,700 feet to make two lane changes in order to exit to Ponkapoag Trail.

The lane-changing maneuvers within the short weave distance are not only a safety concern, but also interrupt traffic flow on I-93 southbound, contributing to a traffic queue. Although this queuing problem occurs during both the AM and PM peak periods, it occurs mostly during the AM peak period, when there are high traffic volumes on the connector from Route 24 northbound to I-93 southbound, as well as on I-93 southbound and its exit ramp to Ponkapoag Trail.

During the off-peak period and at the shoulders of the peak periods, when there is less traffic and therefore higher speeds on both southbound I-93 and the connector from northbound Route 24, the left-side merge creates a safety problem. Because of the limited merge distance at location #1, motorists are forced to merge quickly into the high-speed lane of the through traffic and some have to change lanes quickly for a right-exit ramp at Ponkapoag Trail, a short distance away. These maneuvers create safety problems that contribute to the large number of rear-end and sideswipe collisions at the I-93/Route 24 interchange. The Route 128 Improvement Program will reduce the impact of the left-side merge as described above, but the project will not eliminate the short weave distance and associated lane-changing maneuvers.

In addition, the high volume of traffic from Route 24 northbound merging with the high volume of traffic in both directions of I-93, and the associated lane-changing maneuvers, slow down traffic on both I-93 and Route 24. These operational conditions cause a traffic queue on Route 24 northbound that extends beyond the study's primary area (location #4).

PM Peak Period

During the PM peak travel period, the high volume of traffic on the two two-lane connectors from I-93 merging into three lanes on Route 24 southbound (location #3) is the reason for a bottleneck that affects traffic flow in both directions on I-93. Motorists merging from the I-93 ramps onto Route 24 southbound avoid the middle lane because of poor sight distance, a fairly limited merge distance, and lack of clarity about who has the right-of-way. Presently, the length of the merge area is about 500 feet; the design standard specifies a length of 600 to 840 feet for merging into the middle lane and an acceleration length of 1,000 feet. These conditions reduce the capacity of the merge area on Route 24, thus creating a bottleneck during the PM peak travel period, when it receives high volumes of traffic from the four lanes that feed into it (two from each ramp).

The use of the breakdown lane as a travel lane on I-93 northbound ends between interchange 3 (Ponkapoag Trail, Milton) and interchange 4 (Route 24, Randolph), before the off-ramp to Route 24 southbound. However, some drivers violate this restriction and continue to use the breakdown lane as a travel lane as far north as the off-ramp to Route 24. This violation occurs during the both the AM and PM peak periods, but primarily during the PM peak period, when there are high traffic volumes on both the off-ramp to Route 24 and on I-93 northbound. The northbound through vehicles that violate this restriction are forced to cut across the off-ramp due to its two-lane configuration, creating a potential conflict if they try to merge in the gore area in order to proceed on I-93 northbound (location #2). The Route 128 Improvement Program, currently under construction, which will provide two travel lanes for motorists headed for Route 24 southbound, eliminates this problem.

In addition, as shown in Figure 1, the close proximity of I-93 interchange 5 (Route 28) to the I-93/ Route 24 interchange creates another problem, which is the lane-changing maneuvers within a short weave distance required of the Route 28 southbound motorists that is headed for southbound Route 24 (location #5). The Route 28 southbound motorists have only about 1,200 feet to make two lane changes in order to get to Route 24 southbound. The lane-changing maneuvers within the short weave distance are not only a safety concern, but also interrupt traffic on I-93 southbound, contributing to a traffic queue. This queuing problem occurs during both the AM and PM peak periods, but it is most common during the PM peak period, when there are high traffic volumes on I-93 southbound, as well as on the connector to Route 24 southbound.

2.2 EXTERNAL PROBLEMS (SECONDARY AREA)

Traffic bottlenecks at the I-95/I-93 interchange and at the Braintree split are the external problems that have major impacts on safety and traffic operations at the I-93/Route 24 interchange area (Figure 3).

AM Peak Period

During the AM peak period, the traffic safety and operations problems in the study area are also compounded by a traffic queue that extends into the area as a result of the high-volume I-95 northbound traffic merging with the high-volume I-93 southbound traffic to continue on northbound I-95 (Route 128). Even though the merge area is located about 3.3 miles west of the I-93/Route 24 interchange, the high traffic volumes on both highways cause the queue of vehicles to spill back into the study area, limiting traffic flow on southbound I-93 and northbound Route 24 during most of the AM peak travel period. The Route 128 Improvement Program, currently under construction, which will add a travel lane and restore the breakdown lane in each direction of I-95/I-93 between Randolph and Wellesley, addresses this problem.

PM Peak Period

During the PM peak period, and to some extent the AM peak period, the traffic safety and operations problems in the study area, on some occasions, are compounded by a traffic queue that extends into the area as a result of the traffic bottlenecks at the Braintree split. The lane drop from two to one on the connector ramp from I-93 northbound to Route 3 southbound before the merge with traffic from the Southeast Expressway, and the traffic congestion on Route 3 itself are the major causes of this traffic queue. Recommendations in the recent report on the Braintree split (CTPS, March 2006) address these problems.[3]

[3] Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, *I-93/Southeast Expressway/Route 3 (Braintree Split): Operational Assessment and Potential Improvements,* March 2006.

2.3 IMPACTS OF THE SAFETY AND OPERATIONS PROBLEMS

The direct impacts of these traffic safety and operations problems are the high crash numbers and reduced traffic flow that create congestion, traffic queues, and longer travel times on I-93 and on Route 24 during peak travel periods. These conditions are described in detail in the following chapter, which documents the analysis of the existing travel conditions. That chapter also contains detailed analysis of traffic crash data, including the characteristics of the individual crashes and crash rates.

3 EXISTING CONDITIONS

In the previous chapter, the locations and descriptions of traffic safety and operations problems were presented without any quantification of the magnitude of problems or analysis of existing data indicating the problems. In this chapter, we present detailed analyses of traffic and crash data and provide quantitative measures and other information in support of the identification of problems in the previous chapter. The analyses include current traffic volumes and historical trends, characteristics of travel times and speeds, levels of service, and crash characteristics. Other information includes a roadway inventory of the study area.

3.1 ROADWAY INVENTORY

Brief descriptions of major roadways in the study area, including their jurisdictions, functional classifications, status in the National Highway System (NHS), environmental features, and right-of-way width are presented below.

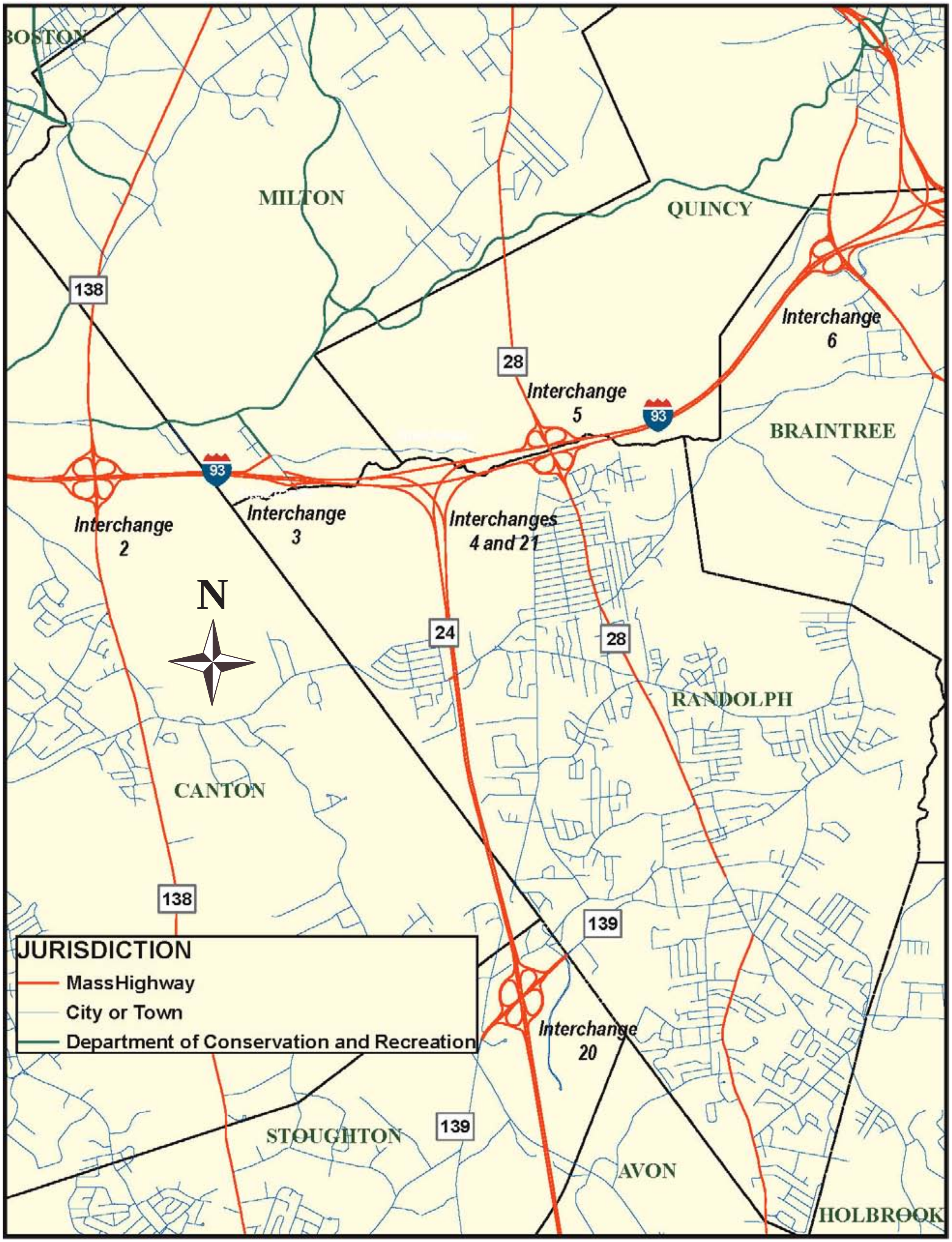
The major highways in the study area that carry most of the traffic are I-93, Route 24, Route 28, Route 37, Route 138, and Route 139. MassHighway has jurisdiction over these major highways, their interchanges, and the arterial road segments near the interchanges (Figure 4). Consequently, the implementation of all of the safety and operational improvements recommended in this study will be under MassHighway's jurisdiction.

Interstate 93

I-93 is an NHS interstate with eight lanes (four in each direction) east of Route 24, and six lanes (three in each direction) west of Route 24. West of Route 24, motorists traveling in either direction are allowed to use the breakdown lanes as travel lanes on weekdays during the AM peak period, from 6:00 to 10:00 AM, and during the PM peak period, from 3:00 to 7:00 PM. Traveling in the breakdown lanes east of Route 24 is prohibited at all times. There are five interchanges on the six-mile section of I-93 within the study area, some of which are closely spaced, with less than 2,000 feet between them (interchanges 3, 4, and 5). Interchanges 2 (Route 138), 5 (Route 28), and 6 (Route 37) are partial or full cloverleaf interchanges; interchanges 3 (Ponkapoag Trail) and 4 (Route 24) are diamond and three-legged directional interchanges, respectively.

Route 24

Route 24 is classified as a rural principal arterial, although the section within the study area operates with all the characteristics of a freeway. It has six lanes (three in each direction) and is part of the NHS. Traveling in the breakdown lane is prohibited at all times. Route 24 intersects I-93 with a three-legged directional interchange (interchange 21); it also intersects Route 139 with a full cloverleaf interchange (interchange 20). Interchanges 20 and 21 are about 3.4 miles apart.



CTPS

FIGURE 4
Roadway Jurisdiction

Safety and Operational Improvements for the I-93/Route 24 Interchange

Routes 28, 37, 138, and 139

Routes 28, 37, 138, and 139 are all classified as urban principal arterials for part of their lengths, within the study area. Each of these routes forms an interchange with either I-93 or Route 24. At each interchange, each of these urban principal arterials has four lanes (two in each direction); however, outside of the interchanges, some become two-lane roads. The sections of Routes 28 and 138 north of I-93 are classified in the NHS.

3.2 BUS SERVICE ON ROUTE 24

Bloom's Bus Lines operates a route from Taunton to downtown Boston, with intermediate stops in Raynham, Easton, West Bridgewater, and Brockton. A schedule appearing on their website in July 2006 showed 15 inbound and 14 outbound trips on weekdays. Six of the inbound trips were due in Boston between 6:30 and 9:20 AM. Five of the outbound trips left Boston between 3:35 and 6:05 PM.

DATTCO operates a route from Fairhaven to Boston (South Station), with intermediate stops in New Bedford and Taunton. A schedule appearing on their website in July 2006 showed 11 round-trips on weekdays. Five of the inbound trips were due in Boston between 6:15 and 8:45 AM. Four of the outbound trips left Boston between 4:00 and 5:45 PM, with two others at 3:00 and 6:45 PM.

Peter Pan/Bonanza Bus Lines operates two routes that use Route 24. One route runs from Woods Hole and Falmouth to South Station, in Boston, with most trips continuing through to Logan Airport. Service frequency on this route varies seasonally. In 2006 the minimum service level, running from January to April, provided 9 round-trips on weekdays. Three inbound trips were due in downtown Boston between 6:45 and 8:25 AM, and 4 departed between 4:00 and 6:00 PM. The peak summer schedule had increased service—11 inbound and 13 outbound trips on weekdays—but all of the extra service was during off-peak hours. Also during the summer, 3 inbound trips and 1 outbound trip running between Woods Hole and Logan Airport, with no South Station stop, were added. These were all in off-peak hours, except for one trip leaving Logan at 3:15 PM. Peter Pan/Bonanza's other line on Route 24 runs from Newport, Rhode Island, to Boston (South Station), with an intermediate stop in Fall River. A schedule appearing on Bonanza's website in July 2006 showed 6 round-trips on this route on weekdays, including inbound trips due in Boston at 7:25, 8:10, and 9:40 AM. Outbound, 3 of the trips left Boston between 4:30 and 6:30 PM. The winter schedule had only four weekday round-trips, but the frequencies during peak travel times were the same.

3.3 LAND USE AND RIGHT-OF-WAY

Land Use

The land use in the study area, which is shown in Figure 5, varies considerably, from public reservations to industrial/commercial uses. The following sections describe in detail the land use in the study area.

I-93 Corridor

In the northeastern end of the study area, near interchange 6 in Braintree, the land use is primarily industrial/commercial, with office parks, shopping mall, hotels, and retail. Around interchanges 3, 4, and 5 in Quincy, Milton, and Randolph, the major land use is the Blue Hills Reservation, which stretches over 7,000 acres, from Quincy to Dedham, and Milton to Randolph. The reservation's green oasis and rich archaeological and historic resources are set aside for public recreation. South of interchange 5 in Randolph, the land use is mixed, consisting of residential and commercial uses. The land use near interchange 2 in Canton is also mixed, with office parks and recreational sports facilities, such as golf courses.

Route 24

The Blue Hills Reservation is also the major land use near the northern section of Route 24 near I-93 interchange 4 in Randolph. South of the Blue Hills Reservation in Randolph, the land use is mixed, primarily residential areas interspersed with forest and industrial/commercial areas. Around interchange 20 in Stoughton, the land uses are mostly industrial/commercial, interspersed with forestlands.

Right-of-Way Width

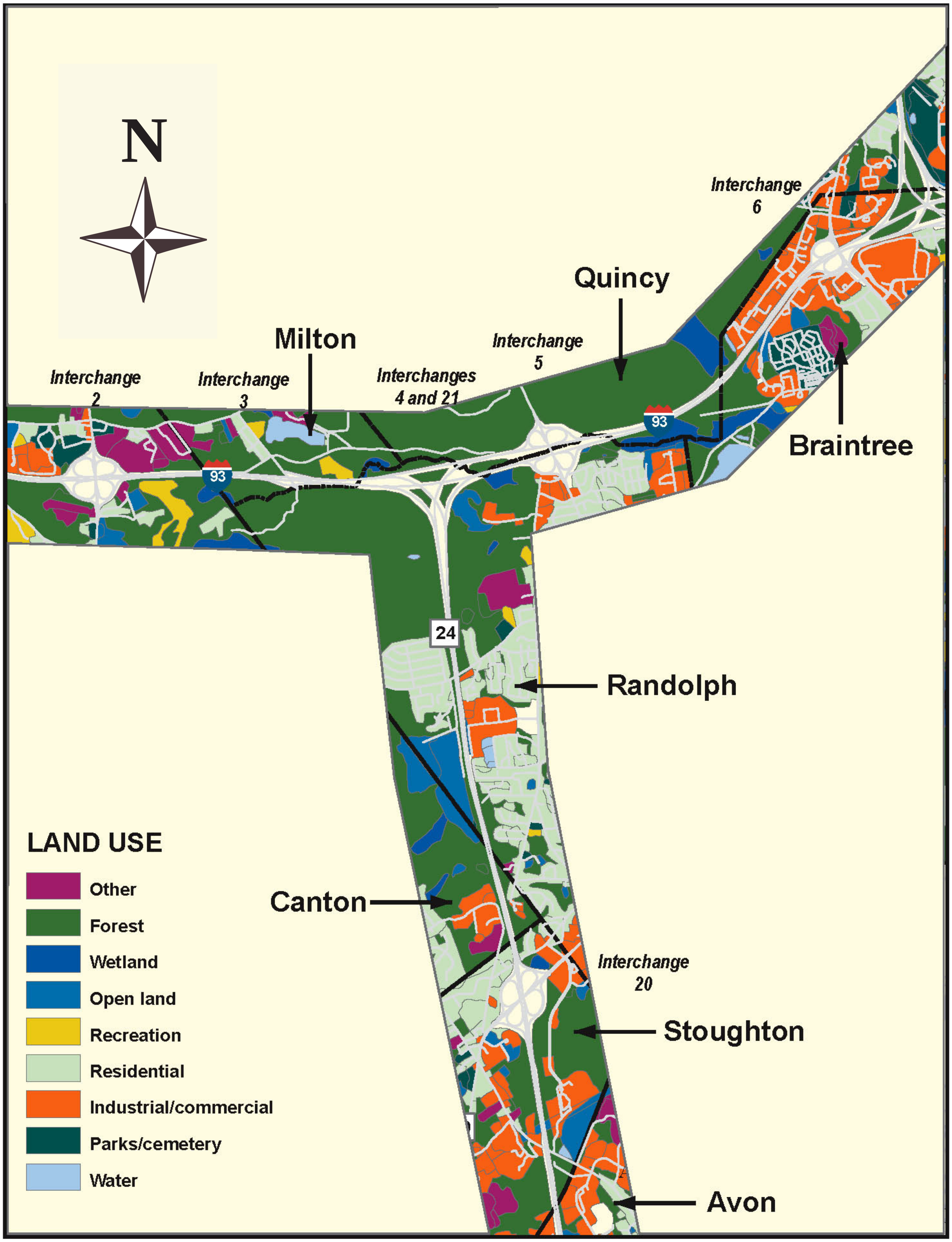
All roadway properties such as travel lanes, shoulders, signs, utilities, drainage, and buffer areas are within the right-of-way. The available right-of-way width along I-93 and Route 24 in the study area varies. The width of the right-of-way along I-93 from Braintree to the Canton town line is about 300 feet. In Canton, the I-93 right-of-way width is about 200 feet. The northern section of Route 24, in Randolph, has a right-of-way width of about 300 feet; however, in the southern section of Route 24, in Canton and Stoughton, the right-of-way widths range from 150 feet to 200 feet.

3.4 TRAFFIC VOLUMES

CTPS used data from various traffic counts that were conducted by MassHighway, consultants, and CTPS to prepare balanced traffic flow diagrams. MassHighway conducted Automatic Traffic Recorder (ATR) counts in 2005 for Route 24, and in 2006 for the section of I-93 between the I-95 junction and the Braintree split. In addition, the Route 24/Route 139 interchange counts are from March 2006. CTPS conducted selected ramp counts at the interchanges of I-93 with Routes 28 and 138 in October 2006.

Average Weekday Traffic Volume

The I-93/Route 24 interchange carries about 280,000 vehicles during an average weekday; these vehicles encounter weaving, merging, lane-changing maneuvers, safety problems, and congestion (Figure 6). The safety and operations problems are described in detail in Chapter 2. Table 1 shows the average weekday traffic (AWDT) volumes on I-93 and Route 24 for the years 1990, 2000, and 2005. The AWDT on I-93 grew an average of 10%, and on Route 24 by 20 %, over the 15-year period from 1990 to 2005.



CTPS

FIGURE 5
Land Use

Safety and Operational Improvements for the I-93/Route 24 Interchange

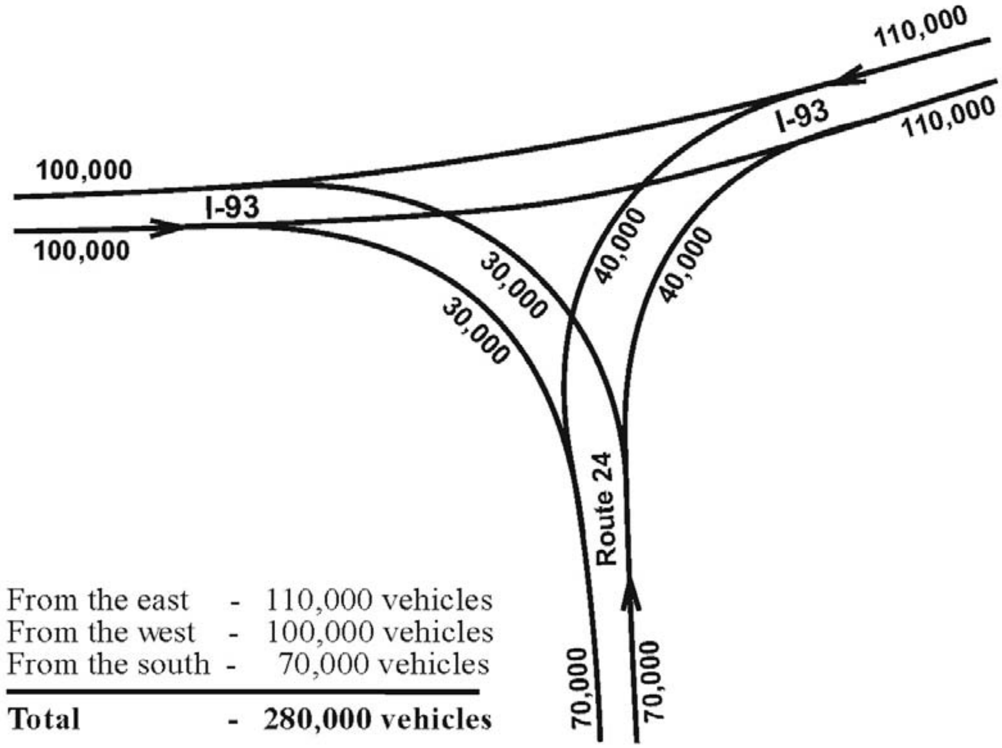


FIGURE 6
2005 Average Weekday Traffic through the I-93/Route 24 Interchange

Peak-Hour Traffic Volumes

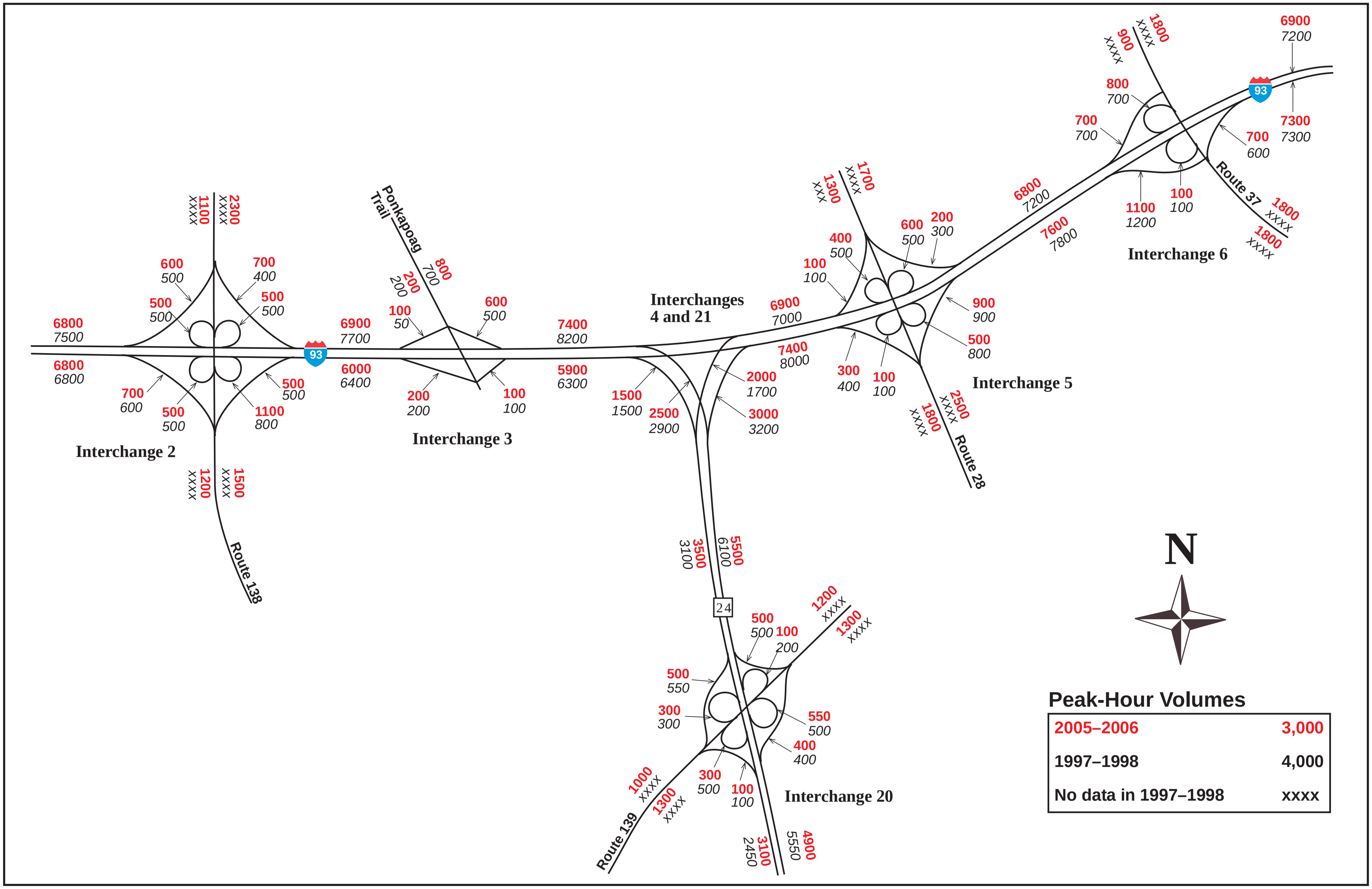
Figures 7 and 8 show the 1997–1998 and 2005–2006 balanced peak-hour traffic volumes. Examination of the balanced AM and PM peak-hour traffic volumes shows some decreases in the traffic volumes on I-93 and Route 24 for the 2005–2006 period compared to the 1997–1998 period. These decreases are attributed to the bottlenecks in the study area (the Braintree split, I-93/Route 24 interchange, and I-93/I-95 interchange) that limit capacity, increase congestion, and restrict traffic flow during the peak travel periods. Also, the peak direction of travel differs between the segment of I-93 east of Route 24 and the segment west of Route 24. East of Route 24, the peak direction is northbound in the AM and southbound in the PM. West of Route 24, the peak direction is southbound in the AM and northbound in the PM. On Route 24, the peak direction is northbound in the AM and southbound in the PM.

Unlike the peak-hour traffic volumes, which show decreasing traffic volumes for the 2005–2006 period compared to the 1997–1998 period (Figures 7 and 8), the AWDT values show increasing traffic volumes from 1990 to 2005 (Table 1). The explanations behind these observations are twofold. First, at peak travel hours when there is congestion due to bottlenecks or insufficient capacity, the volume of traffic observed at a given point on the highway is reduced significantly because of traffic queuing and slow speeds. Second, the growth in the AWDT volumes is a result of the increase in traffic volumes during the off-peak period and shoulders of the peak periods.

TABLE 1
Average Weekday Traffic Volumes (Both Directions)

Location (Between Exits)	Town	Description of Highway Segment	Lanes	1990	2000	2005	Traffic Growth (1990–2005)
Exits 1 and 2	Canton	I-93, south of Route 138	6	176,000	193,000	193,000	9.7%
Exits 2 and 3	Milton	I-93, north of Route 138	6	176,000	193,000	193,000	9.7%
Exits 3 and 4	Randolph	I-93, north of Ponkapoag Trail	6	180,000	197,000	196,000	8.9%
Exits 4 and 5	Randolph	I-93, north of Route 24	8	200,000	216,000	223,000	11.5%
Exits 5 and 6	Braintree	I-93, north of Route 28	8	200,000	217,000	225,000	12.5%
Exits 6 and 7	Braintree	I-93, north of Route 37	8	200,000	217,000	226,000	13.0%
Exits 19 and 20	Avon	Route 24, north of Harrison Blvd.	6	102,000	119,000	123,000	20.5%
Exits 20 and 21	Stoughton	Route 24, north of Route 139	6	116,000	133,000	140,000	20.5%

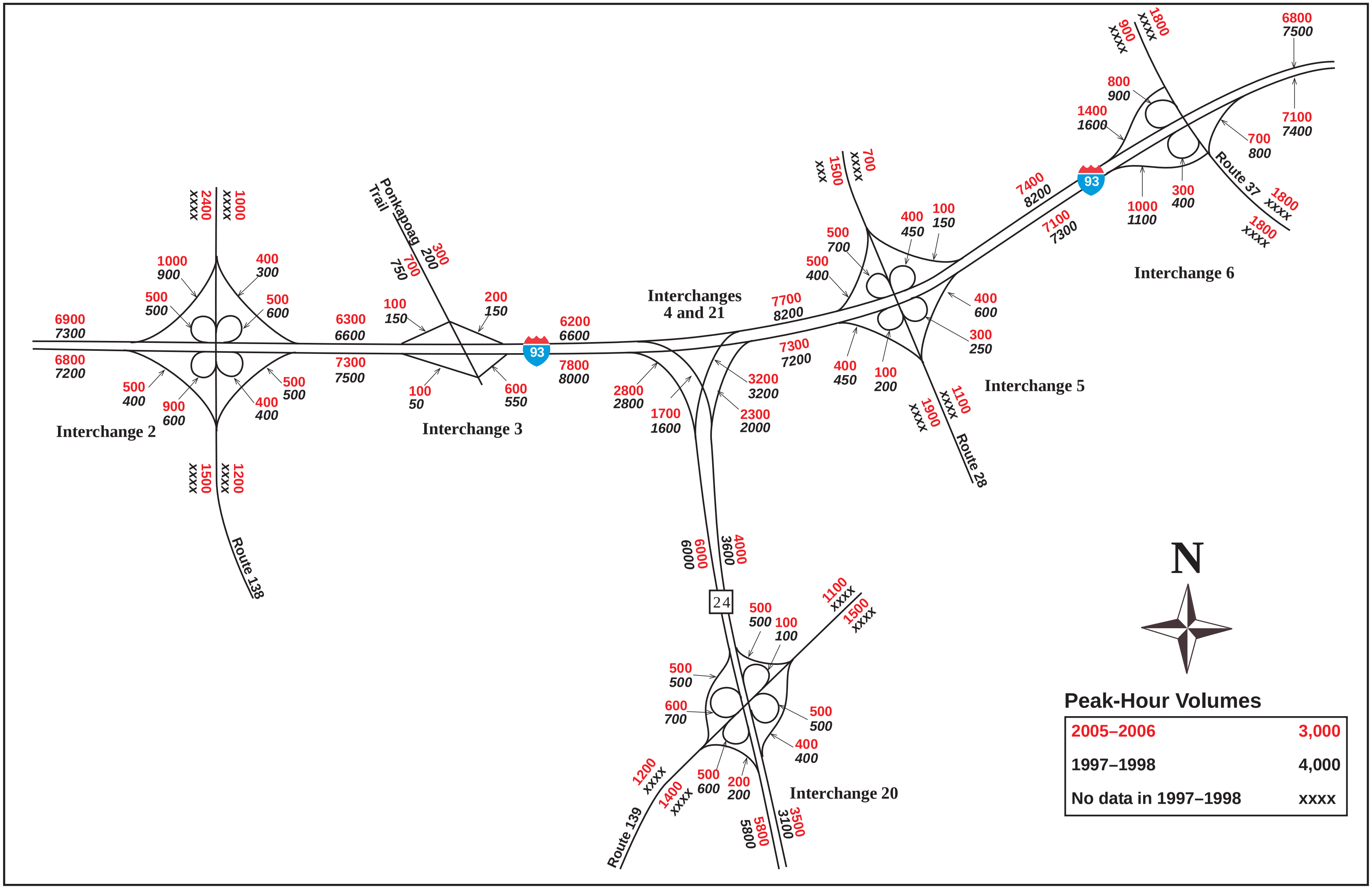
Source: Central Transportation Planning Staff of the Boston Region Metropolitan Planning Organization, *Traffic Volumes on Major Highways in Massachusetts,* September 2006.



CTPS

FIGURE 7
1997–1998 and 2005–2006 AM Peak-Hour Traffic Volumes

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 8
1997–1998 and 2005–2006 PM Peak-Hour Traffic Volumes

Safety and Operational Improvements for the I-93/Route 24 Interchange

3.5 NUMBER OF HOURS OF CONGESTION

The number of hours of congestion is defined as the hours during which traffic volumes are at or near capacity. In this analysis, capacity is considered to be approximately 2,000 vehicles per hour per lane, even though there have been observations that are as high 2,400 vehicles per hour per lane in other parts of the country, as well as on Massachusetts highways such as I-95 (Route 128).[4] Figure 9 shows the late 1980s and the current hours of congestion per peak period, respectively. As the figure shows, the hours of congestion on I-93 and Route 24 in the study area increased from two to three hours per peak period in the late 1980s to three to four hours currently.

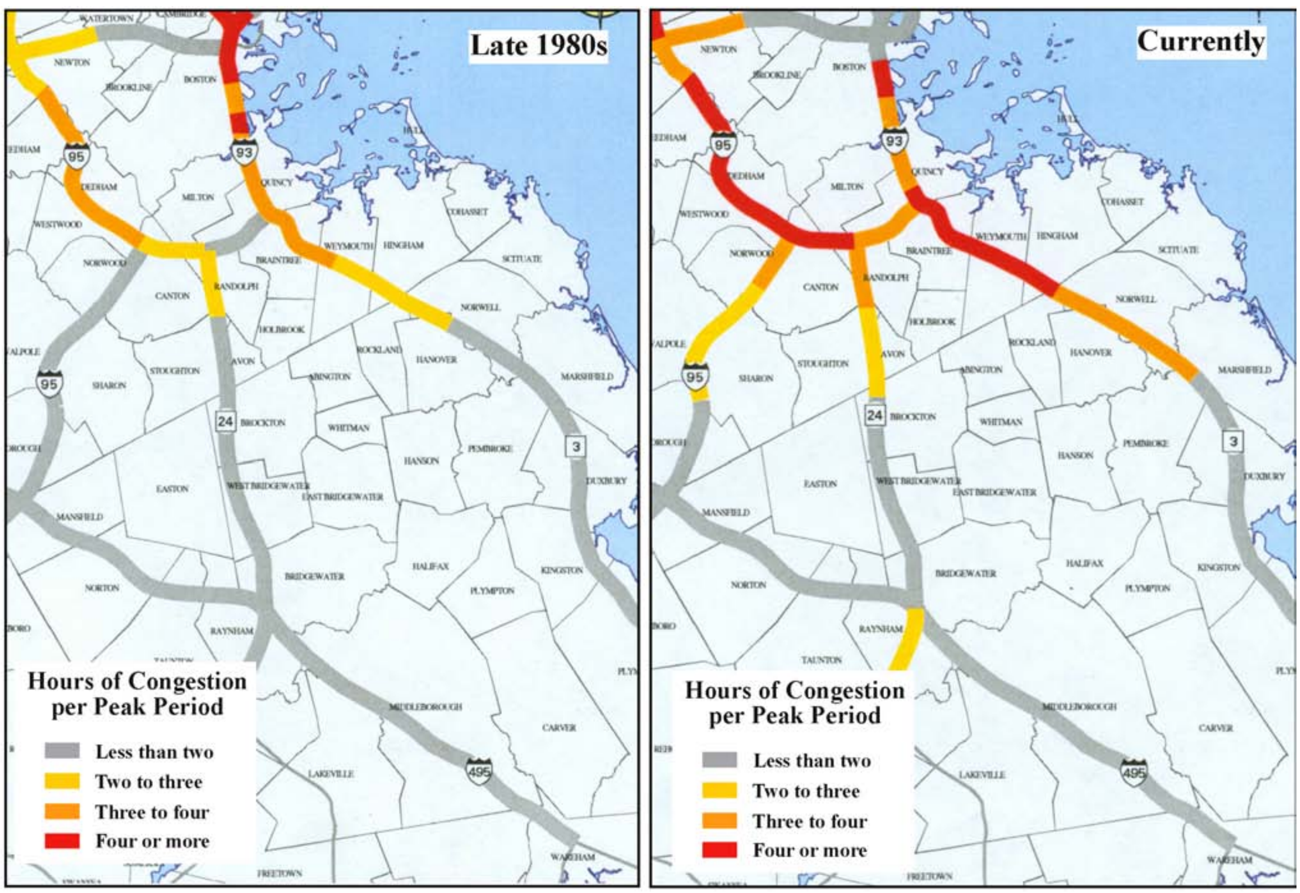


FIGURE 9
Hours of Congestion for the Late 1980s and Currently

---

4 Transportation Research Board, National Research Council, *Highway Capacity Manual,* Washington, D.C., 2000, Chapter 8, pages 8-17 to 8-20.

3.6 TRAVEL TIMES AND SPEEDS

A travel-time survey was conducted as part of the freeway monitoring for the MMS to determine the average travel times and speeds on I-93 and Route 24 in the study area. Each route was surveyed during the AM and PM peak periods over several weeks in 2005–2006. The results of the travel-time survey, expressed in terms of speed, are shown in Figures 10 and 11. These travel-speed maps are also indicative of the extent of traffic queues in the study area. Based on field reconnaissance observations, there are traffic queues at the highway sections where travel speeds are below 45 mph. The following sections provide brief descriptions of the travel conditions along I-93 and Route 24 during the AM and PM peak periods.

I-93: AM Peak Period
Northbound, traveling the 6.8 miles from point A (I-95 interchange) to point B (Braintree split) takes 8 minutes, which results in an average speed of 51 mph. Southbound, traveling the same 6.8 miles from point B to point A, takes 9 minutes, which results in an average speed of 45 mph.

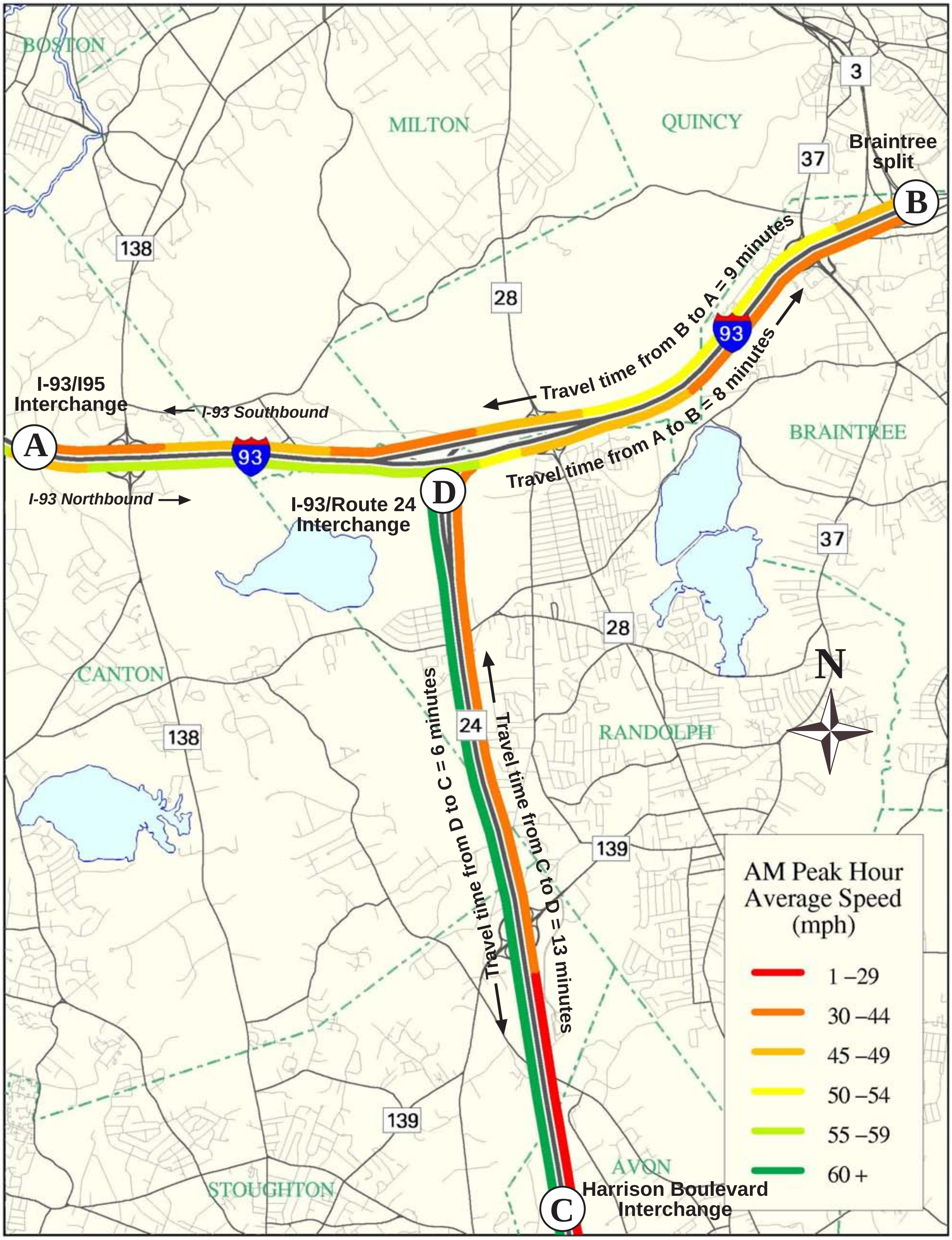
I-93: PM Peak Period
Northbound, traveling the 6.8 miles from point A (I-95 interchange) to point B (Braintree split) takes 11 minutes, which results in an average speed of 37 mph. Southbound, traveling the same 6.8 miles from point B to point A takes 10 minutes, which results in an average speed of 41 mph.

Route 24: AM Peak Period
Northbound, traveling the 6.5 miles from point C (Harrison Boulevard) to point D (I-93 interchange) takes 13 minutes, which results in an average speed of 30 mph. Southbound, traveling the same 6.5 miles from point D to point C takes 6 minutes, which results in an average speed of 65 mph.

Route 24: PM Peak Period
Northbound, traveling the 6.5 miles from point C (Harrison Boulevard) to point D (I-93 interchange) takes 6 minutes, which results in an average speed of 65 mph. Southbound, traveling the same 6.5 miles from point D to point C takes 8 minutes, which results in an average speed of 49 mph.

3.7 LEVEL OF SERVICE

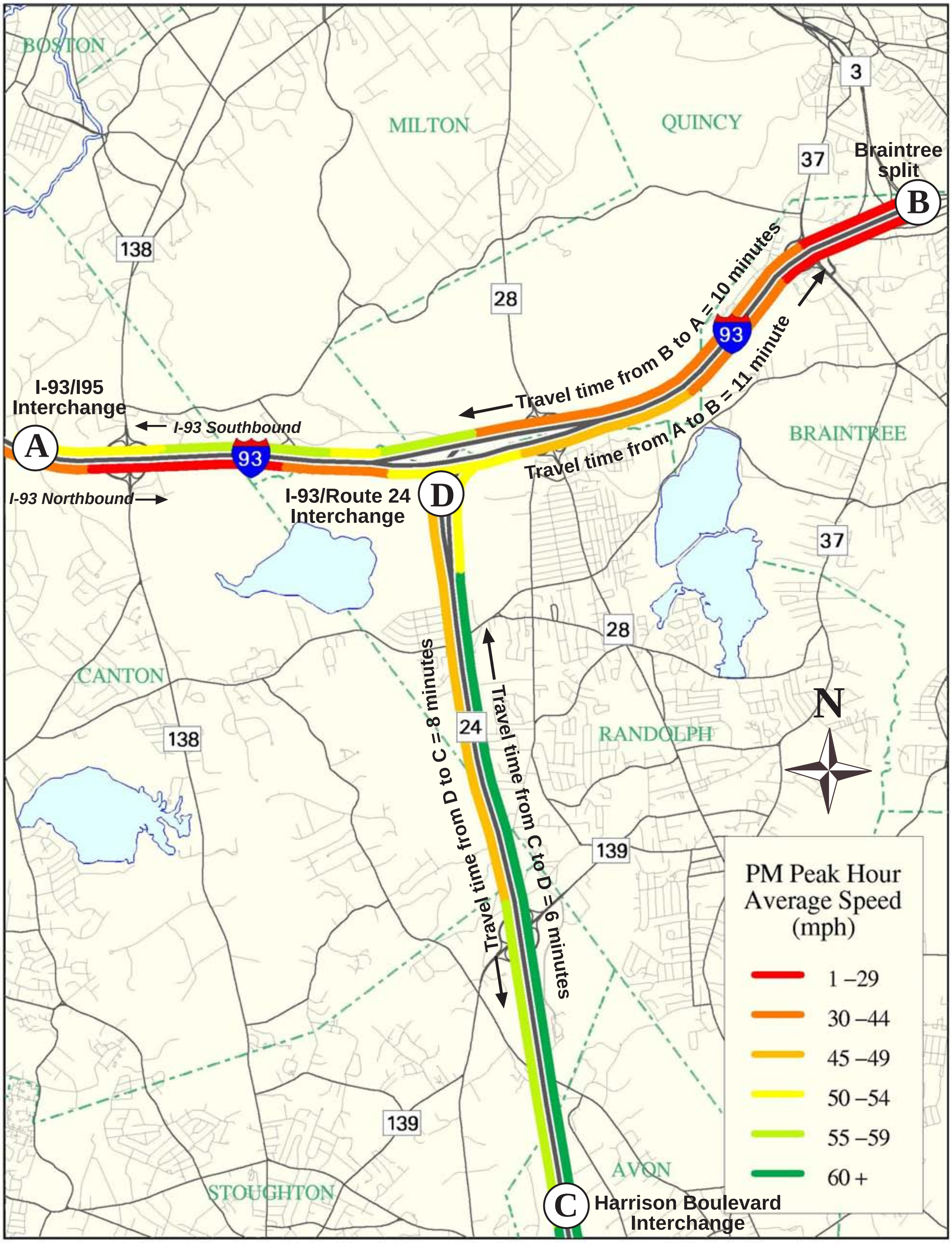
To rate the performance of highway system elements, traffic planners and engineers use the concept of level of service (LOS) to rate the effectiveness of peak-hour traffic operating conditions. It takes into account such factors as volumes of automobiles and trucks, roadway capacity, speeds, grades, traffic control devices, roadway types and width, as well as delays. Level of service rating basically summarizes the quality of traffic flow on highways, at intersections, and on ramps, and expresses them using a grading format. There are six levels of service grades: LOS A, which is the optimal condition, where highway, intersection, or ramp operations are at their best, through LOS F, indicating congested conditions. The range of LOS A through LOS D is considered acceptable; LOS E and LOS F are considered unacceptable—the facility is either at capacity or unable to handle traffic demands. For the different elements of a highway system, different measures of performance are used to assess the level of service.



CTPS

FIGURE 10
AM Peak-Hour Travel Speeds and Travel Times

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 11
PM Peak-Hour Travel Speeds and Travel Times

Safety and Operational Improvements for the I-93/Route 24 Interchange

Freeway Facilities

Freeway facilities are composed of connected segments consisting of the freeway itself, ramps, and weaving segments. These segments are connected in various sequences and there are significant interactions between them. For example, weaving and merging activities that take place when motorists enter or exit a freeway can interrupt traffic flow on the mainline, reducing capacity and creating a traffic queue. For freeway facilities, the performance measure is the density of vehicles, which is defined as the number of vehicles per lane-mile. Density provides a measure of the average spacing between vehicles within the traffic stream. The freeway levels of service criteria are listed in Appendix C.

CTPS used the procedures defined in Chapter 22, "Freeway Facilities," of the Highway Capacity Manual (HCM)[5] for the analysis of oversaturated flow and used special applications to determine the level of service. These procedures were implemented as part of the Highway Capacity Software (HCS) package.[6] The procedures in Chapter 22 were used because both I-93 and Route 24 are congested during the peak travel periods, with traffic queues extending across many interchanges and significant interaction between entering, exiting, and through traffic. For uncongested freeways or isolated freeway segments, which are assumed to have no significant interactions, a procedure that integrates the methodologies in Chapter 23, "Basic Freeway Segments," Chapter 24, "Freeway Weaving," and Chapter 25, "Ramp and Ramp Junctions," can be used, with several limitations.[5] The results of the levels-of-service analysis are presented in Table 2.

Due to the high traffic demand in both directions of I-93 during the AM and PM peak hours, both northbound and southbound traffic operates at LOS E or F during the peak hours. Also, due to the high directionality of traffic demand on Route 24, the AM peak-hour LOS is generally poor (LOS F) in the northbound direction, while in the less traveled southbound direction it is usually acceptable (LOS C). Similarly, the PM peak-hour LOS is generally poor (LOS E) in the southbound direction, while in the less traveled northbound direction it is usually acceptable (LOS C).

In summary, levels of service during peak travel periods on I-93 and Route 24 are mostly in the unacceptable LOS E or F range, with traffic queues.

Weaving Segments

CTPS used the procedures in Chapter 24, "Freeway Weaving," of the Highway Capacity Manual (HCM)[5] for the analysis of weaving segments.[5] There are two weaving sections on I-93 southbound in the study area. They are the weaving segment between Route 28 and Route 24 and the weaving segment between Route 24 to Ponkapoag Trail. The analysis of the weaving segments indicated that the during AM peak travel period, the weaving segment between Route 24 and Ponkapoag Trail operates at LOS F. The analysis also indicated that during the PM peak travel period, the weaving segment between Route 28 and Route 24 operates at LOS F. The speed and density for the weaving segment between Route 24 and Ponkapoag Trail were 47 mph and 56 pc/mi/ln, respectively, while those for the weaving segment between Route 28 and Route 24 were 39 mph and 69 pc/mi/ln, respectively.

---

[5] Transportation Research Board, National Research Council, *Highway Capacity Manual*, Washington, D.C., 2000.

[6] McTrans Center, University of Florida, *Highway Capacity Software (HCS)*, Gainesville, Florida, 2003.

TABLE 2
Estimated Segment Densities and Level of Service

Roadway Segment	**AM**		**PM**	
I-93 Northbound	**Density (pc/mi/ln)**	**LOS***	**Density (pc/mi/ln)**	**LOS***
Exit 1 to Exit 2	41	**E**	61	**F**
Exit 2 to Exit 3	35	D	65	**F**
Exit 3 to Exit 4	35	D	56	**F**
Exit 4 to Exit 5	45	**E**	38	**E**
Exit 5 to Exit 6	49	**F**	44	**E**
Exit 6 to Exit 7	55	**F**	60	**F**
I-93 Southbound				
Exit 1 to Exit 2	55	**F**	35	D
Exit 2 to Exit 3	55	**F**	32	D
Exit 3 to Exit 4	42	**E**	34	D
Exit 4 to Exit 5	33	D	49	**F**
Exit 5 to Exit 6	35	D	56	**F**
Exit 6 to Exit 7	33	D	59	**F**
Route 24 Northbound				
Exit 19 to Exit 20	62	**F**	22	C
Exit 20 to Exit 21	62	**F**	25	C
Route 24 Southbound				
Exit 19 to Exit 20	19	C	38	E
Exit 20 to Exit 21	22	C	45	E

** A bold font for LOS indicates an unacceptable level of service.*

Ramp-Arterial Junctions

Freeway facility procedures deal with traffic operations of freeway segments, ramp segments, and weaving segments; they do not address ramp-arterial junctions. The procedures in Chapter 26, “Interchange Ramp Terminals,” Chapter 16, “Signalized Intersections,” and Chapter 17, “Unsignalized Intersections,” of the HCM address traffic operations at ramp-arterial junctions.[7] For ramp-arterial junctions, the performance measure is the delay per vehicle. Ramp-arterial junctions are critical to efficient operations of arterial and freeway networks, as they must accommodate the need for local access to the freeway and vice versa. The levels of service of the ramp-arterial junctions were computed using Synchro 6,[8] which uses the same procedures as those recommended in the HCM. The results of the computations for the ramp-arterial junctions are presented in Table 3.

[7] Transportation Research Board, National Research Council, *Highway Capacity Manual*, Washington, D.C., 2000.

[8] Trafficware Corporation, *Synchro 6 and SimTraffic 6: Traffic Signal Timing, Capacity, and Simulation,* Albany, California, May 2004.

The ramp-arterial junctions in the study area operate satisfactorily, without traffic queues, except for a couple of ramp-arterial junctions, I-93 interchange 2 (Route 138) and I-93 interchange 6 (Route 37), which operate at LOS E or F, with occasional traffic queues that sometimes extend onto the freeway. At interchange 2, the ramp-arterial junctions on Route 138 northbound operate at LOS E or F during the AM peak hour due to the high volume of traffic that is headed to Boston and the office park on Royall Street in Canton. At interchange 6, the ramp-arterial junctions on Route 37 operate at LOS E or F during the PM peak period due to high-volume commuter and shopping traffic occurring at the same time in the area.

TABLE 3
Estimated Delay and Level of Service at Ramp-Arterial Junctions

		AM		PM	
Interchange	**Ramp Junctions**	**Delay (veh/sec)**	**LOS***	**Delay (veh/sec)**	**LOS***
I-93 Exit 2, (Route 138)	I-93 NB to Route 138 SB	11	B	16	C
	I-93 NB to Route 138 NB	96	**F**	11	B
	I-93 SB to Route 138 NB	42	**E**	10	A
	I-93 SB to Route 138 SB	10	A	31	D
I-93 Exit 3 (Ponkapoag Tr.)	I-93 NB to Ponkapoag Tr.	10	A	23	C
	I-93 SB to Ponkapoag Tr.	12	B	8	A
I-93 Exit 5 (Route 28)	I-93 NB to Route 28 SB	16	C	21	C
	I-93 NB to Route 28 NB	26	D	10	A
	I-93 SB to Route 28 NB	13	B	9	A
	I-93 SB to Route 28 SB	15	B	16	C
I-93 Exit 6 (Route 37)	I-93 NB to Route 37 EB/WB	45	D	92	**F**
	I-93 SB to Route 37 EB/WB	32	C	142	**F**
Route 24 Exit 20 (Route 139)	Route 24 NB to Route 139 EB	24	C	16	C
	Route 24 NB to Route 139 WB	12	B	9	A
	Route 24 SB to Route 139 WB	19	C	9	A
	Route 24 SB to Route 139 EB	29	D	19	C

** A bold font for LOS indicates an unacceptable level of service.*

Note: There are no ramp-arterial junctions at exit 1, where I-93 begins, exit 4, where I-93 connects to Route 24, and exit 7 where I-93 connects to Route 3 South.

3.8 SAFETY ANALYSIS

Safety is an important concern in planning improvements for the I-93/Route 24 interchange. In Chapter 2, the safety and operational problems were discussed in general, without any crash data to support them. This section presents the analysis of crash data and discusses the characteristics of the crashes. We identified the following areas that potentially pose safety concerns and may contribute to the high number of crashes at the interchange.

- Limited merge area for the high traffic volumes from Route 24 northbound merging with I-93 southbound through traffic. This substandard design condition may create safety problems that lead to rear-end and angle/sideswipe collisions.

- The close proximity of interchange 3 (Ponkapoag Trail), 4 (Route 24), and 5 (Route 28) creates short weave distances that contribute to aggressive lane-changing and substantial weaving and merging maneuvers that are potential safety concerns, especially during peak travel periods. These problems are also compounded by the left-side diverge from I-93 southbound onto Route 24.

- Motorists merging from the I-93 ramps onto Route 24 southbound avoid the middle lane because of poor sight distance, a fairly limited merge area, and the lack of clarity about who has the right-of-way.

- Merging traffic at some ramp-arterial junctions and freeway entrances also poses safety concerns due to short acceleration lanes.

Crash Data

MassHighway uses crash data collected by the Registry of Motor Vehicles (RMV). Although the data elements required on the crash forms are standardized, there are several limitations in the crash data collected by the RMV. First, reports are not always filled out and filed, or are incomplete, for various reasons, such as motorists not waiting for police to respond if the crash does not involve major damage. The reports may not have all the information that would be desirable for the safety analysis; in particular, the exact location of the crash may not be well specified.

MassHighway uses crash data for a number of functions. The primary function, however, is to provide the foundation for developing safety improvement projects. Given the fact that vehicle collisions are random events and that the data collection system is imperfect, it is difficult to draw inferences from year-to-year trends in the data, and this is the primary reason why MassHighway traditionally reviews a combined average of three consecutive years of data. By using crash data over a three-year period, the effects of anomalies in the data are minimized.

In 2002, a new form for collecting crash data was introduced. Because of this transition, two crash datasets were used in the safety analysis: the 1999–2001 data which were collected before the change took place, and 2002–2005 crash data, which were collected after the change.

Characteristics of the Crashes

Table 4 shows the total number of crashes and annual averages for each interchange in the study area for both the 1999–2001 and 2002–2005 datasets. The annual average number of crashes at interchanges in the study area is also shown (in Figure 12) for the two datasets. The 2002–2005 crash dataset generally indicates higher annual average crashes for most of the interchanges than in previous years. The results of a safety analysis performed to determine the characteristics of the individual crashes are shown in Table 5 for the 1999–2001 dataset and in Table 6 for the 2002–2005 dataset. Tables 5 and 6 have different data elements because of the change in how crash information is reported to the RMV.

TABLE 4
Total Number Crashes and Annual Average Crashes at the Interchanges (1999–2001 and 2002–2005)

Interchange	Town	1999–2001 (3 years)	2002–2005 (4 years)	1999–2001 Annual Average	2002–2005 Annual Average
I-93 Interchange 2 (Route 138)	Canton	131	203	44	51
I-93 Interchange 3 (Ponkapoag Trail)	Milton	72	120	24	30
I-93 Interchanges 4 (Route 24)	Randolph	229	292	77	73
I-93 Interchange 5 (Route 28)	Randolph	109	176	37	44
I-93 Interchange 6 (Route 37)	Braintree	272	392	91	98
Route 24 Interchange 20 (Route 139)	Stoughton	150	196	50	49

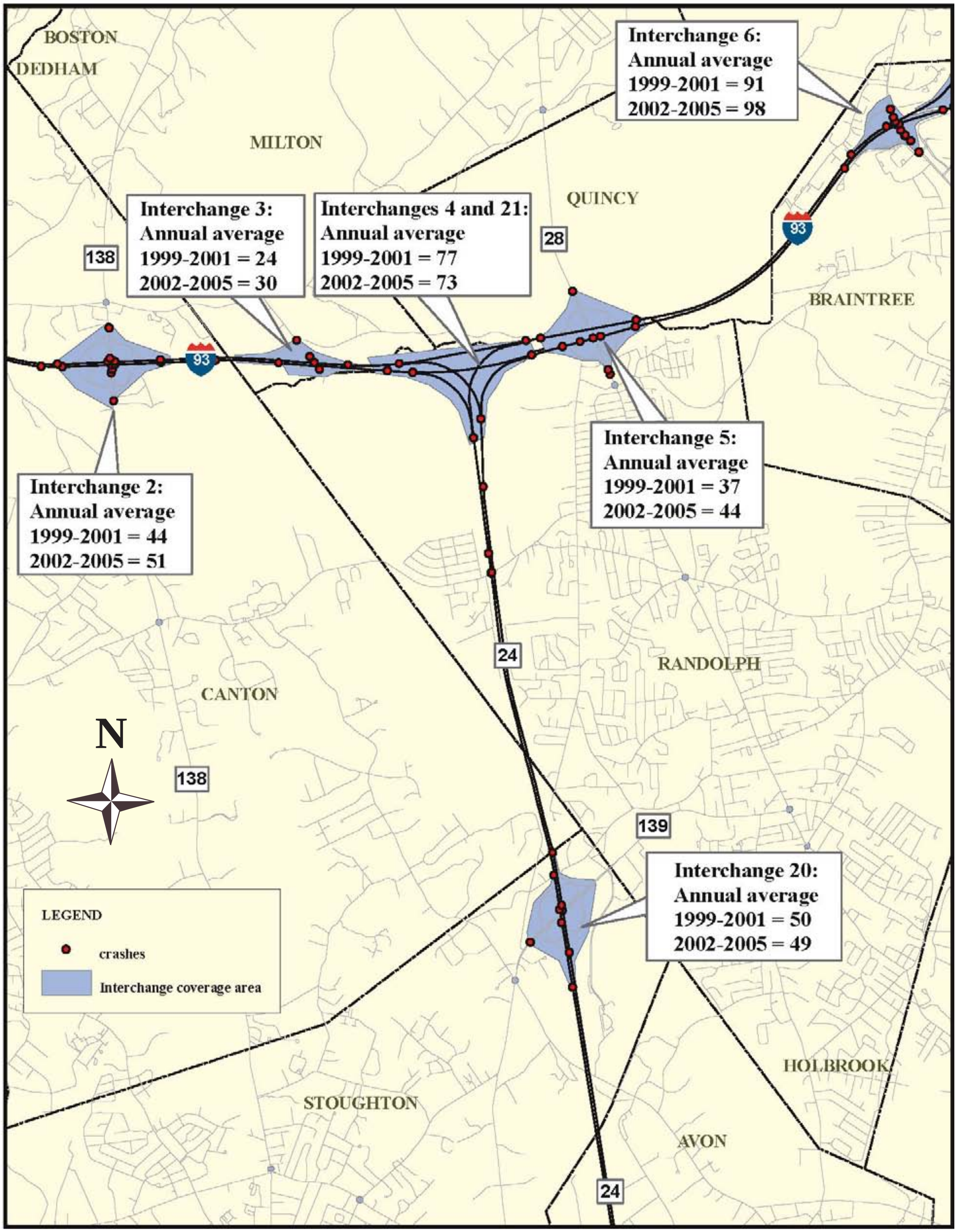
The analysis indicated that there were no fatal crashes and that all of the crashes resulted in injury or property damage for the 1999–2001 dataset. There were nine fatalities in the 2002–2005 dataset: four of which occurred at Route 24 interchange 20 (Route 139), two at I-93 interchange 3 (Ponkapoag Trail), and one each at I-93 interchange 4 (Route 24), I-93 interchange 5 (Route 28), and I-93 interchange 6 (Route 37).

The predominant crash types at each interchange for both crash datasets were rear-end and angle/sideswipe collisions (between 60% and 80% of the crashes). Rear-end and angle/sideswipe crashes are prevalent on highways and interchanges with traffic congestion and queuing. Vehicles stopping unexpectedly, stop-and-go traffic conditions, and reduced vehicle headways, all of which occur under congested traffic conditions, are some of the reasons for the high numbers of rear-end collisions. Weaving and merging maneuvers, lane-changing maneuvers, and short acceleration/deceleration distances usually contribute to angle/sideswipes crashes.

The majority of the crashes at each interchange for both crash datasets occurred on dry pavement and under daylight conditions (between 60% and 85%). This percentage is consistent with the percentage of the ADT occurring under daylight conditions between 6:00 AM and 6:00 PM on I-93 and Route 24, which ranged from 70% to 80%.

High-Crash Locations

Prior to 2002, MassHighway used crash data to rank high-crash locations, with lower numbers representing the worst locations. Their list is called *Top 1000 High Crash Locations*. All of the interchanges in the study area were on that list. MassHighway will not develop a *Top 1000 High-Crash Locations* report for the 2002–2005 data; instead, each MPO region will use the data to create its own safety priority lists—one for freeway interchanges and another for arterial intersections. The objective is to address some of the shortcomings of creating the *Top 1000 High-Crash Locations* report. On the one hand, the disadvantages of using the *Top 1000 High Crash Locations* list are that it tends to give more weight to crashes involving fatalities, which occur more often on freeways and parkways, that is, the highway facilities with high speeds, high traffic volumes, and high number of injuries and fatal collisions. On the other hand, it gives less weight to arterial intersections, with traffic congestion, slower speeds, lower volumes, and mostly property-damage-only collisions.



CTPS

FIGURE 12
Annual Average Number of Crashes at Interchanges (1999–2001 and 2002–2005)

Safety and Operational Improvements for the I-93/Route 24 Interchange

TABLE 5
Crash Characteristics (1999–2001)

	Interchange											
	2		3		4		5		6		20	
	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)
Crash Severity												
Fatality	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0	(0)
Injury	56	(43)	24	(33)	93	(41)	53	(49)	124	(46)	73	(49)
Property damage only	75	(57)	48	(67)	136	(59)	56	(51)	148	(54)	77	(51)
Total	*131*	*(100)*	*72*	*(100)*	*229*	*(100)*	*109*	*(100)*	*272*	*(100)*	*150*	*(100)*
Collision Type												
Rear-end	75	(57)	37	(51)	103	(45)	53	(49)	118	(43)	71	(47)
Angle/sideswipe	21	(16)	15	(21)	69	(30)	25	(23)	101	(37)	34	(23)
Head-on	1	(1)	2	(3)	4	(2)	3	(2)	4	(2)	4	(3)
Hit guardrail/curbing	15	(11)	6	(8)	32	(14)	14	(13)	25	(9)	23	(15)
Other	19	(15)	12	(17)	21	(9)	14	(13)	24	(9)	18	(12)
Total	*131*	*(100)*	*72*	*(100)*	*229*	*(100)*	*109*	*(100)*	*272*	*(100)*	*150*	*(100)*
Roadway Condition												
Dry	110	(84)	52	(72)	160	(70)	84	(77)	207	(76)	102	(68)
Wet	18	(14)	16	(22)	58	(25)	18	17)	53	(19)	35	(7)
Snow	1	(1)	1	(2)	6	(3)	6	(5)	7	(3)	9	(6)
Other	2	(1)	3	(4)	5	(2)	1	(1)	5	(2)	4	(3)
Total	*131*	*(100)*	*72*	*(100)*	*229*	*(100)*	*109*	*(100)*	*272*	*(100)*	*150*	*(100)*
Light Condition												
Daylight	88	67)	48	(67)	136	(59)	74	(68)	186	(68)	101	(67)
Dawn	9	(7)	2	(3)	14	(6)	4	(4)	10	(4)	10	(7)
Dark road–lighted	9	(7)	7	(10)	50	(22)	10	(9)	49	(18)	5	(3)
Dark road–unlighted	10	(7)	12	(17)	24	(10)	19	(17)	22	(8)	32	(21)
Other	15	(12)	3	(3)	5	(3)	2	(2)	5	(2)	2	(2)
Total	*131*	*(100)*	*72*	*(100)*	*229*	*(100)*	*109*	*(100)*	*272*	*(100)*	*150*	*(100)*
Year												
1999	47	(36)	26	(36)	79	(34)	26	(24)	115	(42)	36	(24)
2000	43	(33)	30	(42)	91	(40)	48	(44)	91	(33)	52	(35)
2001	41	(31)	16	(28)	59	(26)	35	(32)	66	(25)	62	(41)
Total	*131*	*(100)*	*72*	*(100)*	*229*	*(100)*	*109*	*(100)*	*272*	*(100)*	*150*	*(100)*

Note: Shown in parentheses is the percent of crashes.

TABLE 6
Crash Characteristics (2002–2005)

	Interchange											
	2		3		4		5		6		20	
	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)	#	(%)
Crash Severity												
Fatality	0	(0)	2	(2)	1	(1)	1	(1)	1	(0)	4	(2)
Injury	76	(37)	32	(26)	79	(30)	53	(30)	139	(35)	78	(40)
Property damage only	108	(53)	74	(62)	170	(58)	102	(58)	212	(54)	92	(47)
Not Reported	16	(8)	10	(8)	35	(12)	18	(10)	37	(10)	17	(9)
Unknown	3	(2)	2	(2)	7	(2)	2	(1)	3	(1)	5	(2)
Total	*203*	*(100)*	*120*	*(100)*	*292*	*(100)*	*176*	*(100)*	*392*	*(100)*	*196*	*(100)*
Collision Type												
Rear-end	107	(53)	70	(58)	128	(44)	82	(46)	197	(50)	77	(39)
Angle/sideswipe	35	(17)	27	(23)	70	(24)	51	(29)	100	(26)	41	(21)
Head-on	2	(1)	1	(1)	0	(0)	3	(2)	6	(1)	2	(1)
Single-vehicle crash	47	(23)	11	(9)	80	(27)	29	(16)	73	(19)	71	(36)
Not reported	10	(5)	9	(8)	14	(5)	9	(5)	15	(4)	4	(2)
Unknown	2	(1)	2	(1)	0	(0)	2	(1)	1	0)	1	(1)
Total	*203*	*(100)*	*120*	*(100)*	*292*	*(100)*	*176*	*(100)*	*392*	*(100)*	*196*	*(100)*
Roadway Condition												
Dry	151	(74)	91	(76)	200	(68)	130	(74)	263	(67)	133	(68)
Wet	40	(20)	20	(17)	66	(23)	34	(19)	105	27)	44	(23)
Snow	4	(2)	1	(1)	23	(8)	8	(5)	5	(1)	14	(7)
Not reported	7	(3)	6	(5)	3	(1)	4	(2)	14	(4)	3	(1)
Other	1	(0)	2	(1)	0	(0)	0	(0)	4	(1)	2	(1)
Total	*203*	*(100)*	*120*	*(100)*	*229*	*(100)*	*176*	*(100)*	*392*	*(100)*	*196*	*(100)*
Light Condition												
Daylight	129	(64)	75	(63)	175	(60)	110	(63)	223	(57)	122	(62)
Dawn	2	(1)	4	(3)	6	(2)	7	(4)	14	(4)	2	(1)
Dusk	4	(2)	9	(8)	0	(0)	6	(3)	0	(0)	4	(4)
Dark road–lighted	19	(9)	8	(7)	58	(20)	23	(13)	82	(21)	11	(6)
Dark road–unlighted	39	(19)	19	(16)	32	(11)	25	(14)	49	(14)	53	(27)
Not Reported	8	(4)	4	(3)	5	(2)	3	(2)	4	(1)	3	(1)
Other	2	(1)	1	(1)	16	(5)	2	(1)	20	(5)	1	(0)
Total	*203*	*(100)*	*120*	*(100)*	*292*	*(100)*	*176*	*(100)*	*392*	*(100)*	*196*	*(100)*
Year												
2002	48	(24)	37	(30)	99	(34)	52	(30)	130	(33)	50	(26)
2003	48	(24)	26	(22)	57	(19)	27	(15)	65	(17)	35	(17)
2004	48	(24)	27	(23)	55	(19)	34	(19)	103	(26)	50	(26)
2005	59	(28)	30	(25)	81	(28)	63	(36)	94	(24)	61	(31)
Total	*203*	*100)*	*120*	*(100)*	*292*	*(100)*	*176*	*(100)*	*392*	*(100)*	*196*	*(100)*

Note: Shown in parentheses is the percent of crashes.

Crash Rates

Another way of analyzing the crashes is to consider exposure to vehicular traffic. It involves calculation of the crash rate to evaluate an interchange based on exposure to vehicular traffic and to gain a better understanding of how a particular interchange compares to others. A crash rates is calculated by taking the average number of crashes on an annual basis (a three-year or a four-year average in this study), and dividing it by the annual average daily traffic volume. The formula for calculating the crash rate for an interchange is presented below. The crash rate (R) is expressed in Million Entering Vehicles (MEV), which is a standard practice.

$$\text{Crash rate (R)}^{9} = \frac{A * 1{,}000{,}000}{V * T}$$

A = Annual average number of crashes at the interchange
V = Annual average daily traffic volume through the interchange
T = Time, numbers of days in a year (365)

The crash rates in Table 7 provide another picture of the safety problems in the study area than the raw number of crashes or the top 1,000 high-crash locations because it eliminates the effect of traffic volumes. With the effect of traffic volumes controlled, the crash rates better reflect the geometric conditions and other conditions at the interchange that are likely contributors to the comparatively higher crash rate, such as shorter weaving and merging distances, tighter ramp curvatures, shorter acceleration and deceleration lanes, and poor sight distances.

TABLE 7
Crash Rates at the Interchanges

Interchange	Total Crashes	Annual Average Crashes	*Entering Volumes per day	**Crash Rate (MEV)
1999–2001				
2 (Route 138)	131	44	207,000	0.58
3 (Ponkapoag Trail)	72	24	176,000	0.37
4 (Route 24)	229	77	246,000	0.85
5 (Route 28)	109	37	225,000	0.44
6 (Route 37)	272	91	227,000	0.91
20 (Route 139)	150	50	145,000	0.94
2002–2005				
2 (Route 138)	203	51	213,000	0.66
3 (Ponkapoag Trail)	120	30	181,000	0.45
4 (Route 24)	292	73	253,000	0.79
5 (Route 28)	176	44	231,000	0.52
6 (Route 37)	392	98	233,000	1.15
20 (Route 139)	196	49	152,000	0.88

Note: Shading denotes high rash rates
*****The entering volumes are the annual average daily traffic volume entering an interchange.
****** The crash rate is expressed as per million entering vehicles.

[9] This tool is used primarily for intersections. The MMS adopted it for interchanges, although the nature of the conflicts is somewhat different.

4 PLANNED AND PROPOSED PROJECTS

The federal fiscal years 2007–2010 Transportation Improvement Program (TIP) and the Boston Region MPO's current transportation plan[10] (Transportation Plan) were reviewed to identify planned and approved transportation projects that might affect traffic operations at the I-93/Route 24 interchange. Figure 13 shows the projects that were identified. These projects are described below are also summarized in Table 8, which gives information on the status and funding of each project.

4.1 ROUTE 128 IMPROVEMENT PROGRAM

This project is already approved and programmed in the current TIP for federal fiscal years 2007 through 2010, and it is currently under construction (location #1 in Figure 13). It will add two general-purpose lanes, one northbound and one southbound, on I-95/I-93 from Randolph to Wellesley, and will replace or reconstruct the I-95 bridges within the project limits. The project will also restore the breakdown lanes in both directions, which are currently used as travel lanes during the morning and afternoon peak travel periods.

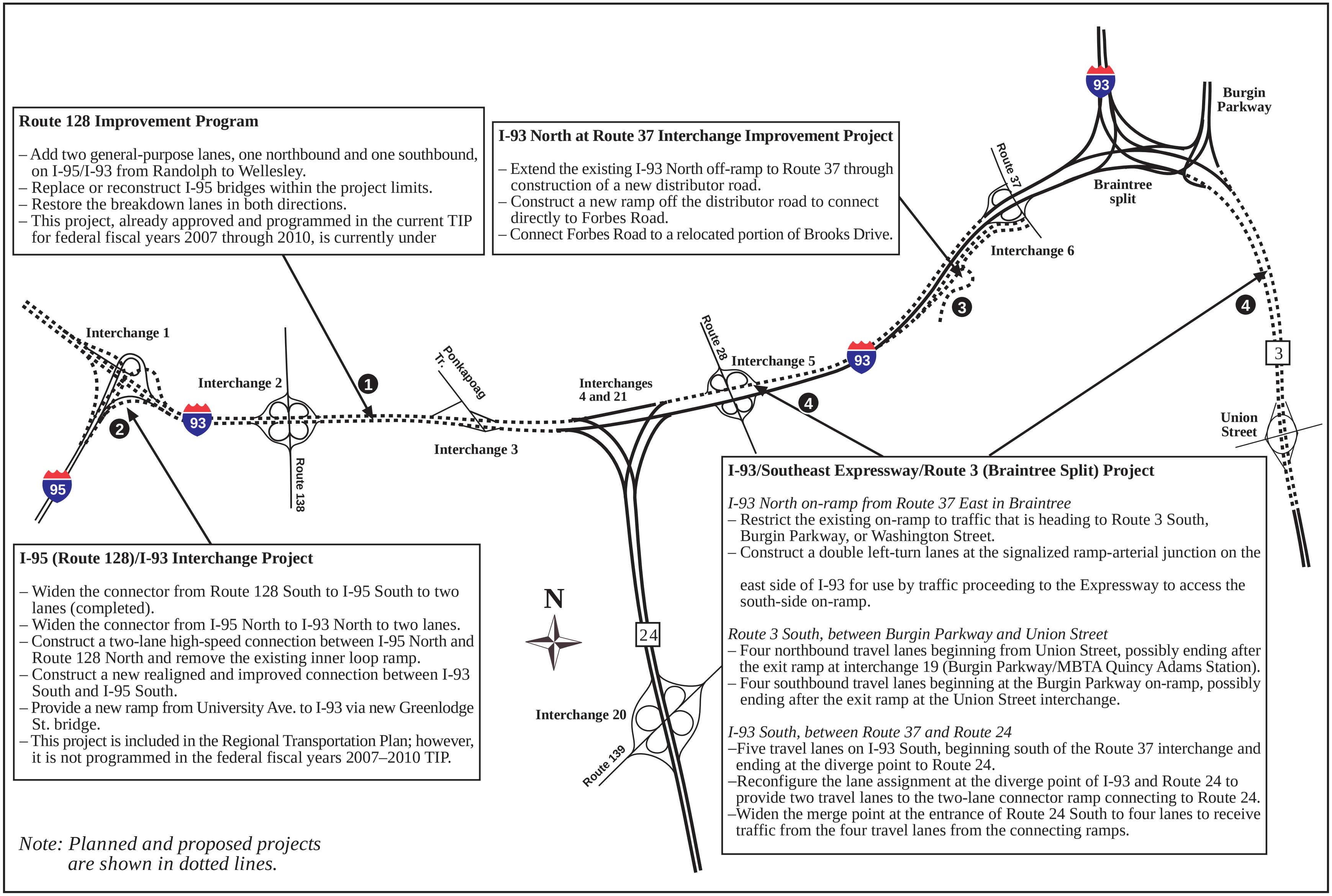
4.2 I-95 (ROUTE 128)/I-93 INTERCHANGE PROJECT

This project is in the current Transportation Plan, but it is not programmed in the federal fiscal years 2007–2010 TIP. It would address traffic safety, congestion, and operations at the interchange and vicinity (location #2 in Figure 13), and would replace the I-95 northbound entrance ramp with a two-lane direct connector ramp and eliminate the current one-lane loop ramp that slows down traffic on I-95 northbound and creates a long queue. In addition, the project would construct a realigned, two-lane, direct connection between I-93 southbound and I-95 southbound to improve safety and eliminate the current loop ramp. Additionally, the project would construct a realigned, two-lane, direct connection from I-95 northbound to I-93 northbound. The realigned, two-lane, direct connections will improve traffic safety at the interchange and facilitate traffic flow through it.

The project would also construct a new ramp to Blue Hill Drive and a new entrance ramp from University Avenue to I-93 northbound, including use of the discontinued Greenlodge Street bridge west of Elm Street to enhance access and attractiveness of Amtrak and MBTA commuter rail services at the Route 128 Station, as well as shuttle bus services connecting the station to residential and business centers in the area. These improvements will also facilitate greater recreational use of the Blue Hills Reservation trail system that runs through the area.

---

[10] Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, JOURNEY TO 2030: Transportation Plan of the Boston Region Metropolitan Planning Organization, April 2007.



CTPS

FIGURE 13
Planned and Proposed Projects

Safety and Operational Improvements for the I-93/Route 24 Interchange

TABLE 8
Current Status of Proposed Transportation Projects

Project Name	Project ID #	Design Status	JOURNEY TO 2030 (Transportation Plan)	FFY 2007–2010 TIP Status	Cost Estimate	Funding Sources
Route 128 Improvement Program	087800	75%	Included	Programmed	$354 million	National Highway System
Improvements near the I-93 and Route 37 Interchange in Braintree	603134	25%		Not programmed	$2.5 million	To be determined
I-95 (Route 128)/I-93 Interchange Project	87790	25%	Included	Not programmed	$120 million	To be determined
I-93/Southeast Expressway/Route 3 (Braintree Split)	NA	NA	Included	Not programmed	$33.3 million	To be determined
South Coast Rail (New Bedford/Fall River Commuter Rail)	NA	NA	Included	Outside Boston Region MPO area	$1.4 billion	To be determined
*Route 24 Interstate Conversion	NA	NA	Not included	Mostly outside of the Boston Region MPO area	$200 million (1998 estimate)	To be determined

NA = Not available
* The Route 24 Interstate Conversion project is included in the transportation plans of the SRPEDD and OCPC.

4.3 IMPROVEMENTS NEAR THE I-93/ROUTE 37 INTERCHANGE IN BRAINTREE

This project was included in the list of recommendations in the Braintree split study.[11] It is not programmed in the federal fiscal years 2007–2010 TIP. The purpose of this project is to reconstruct the I-93 northbound off-ramp to Granite Street (Route 37) and improve traffic circulation on Forbes Road and Brooks Drive (location #3 in Figure 13).

This project will create an extension of the existing I-93 northbound off-ramp to Route 37 (Granite Street) by constructing a new distributor road paralleling I-93, which will connect the off-ramp to Granite Street. The new distributor road will begin as an off-ramp on I-93 northbound midway between Routes 28 and 37. A new ramp will provide a direct connection from the new distributor road to Forbes Road.

The improvements will also include a connection from Brooks Drive to Forbes Road in order to facilitate circulation and access to businesses and residences in the area. The new distributor road will not only create more storage room for the exiting traffic destined to Route 37, but it will also minimize traffic queues that interrupt traffic flow on I-93, therefore improving safety. The project will also reduce the off-ramp traffic volumes at Route 37, as traffic destined to developments on Forbes Road from I-93 would now arrive there directly from the proposed collector/distributor road.

4.4 I-93/SOUTHEAST EXPRESSWAY/ROUTE 3 (BRAINTREE SPLIT)

This project is in the current Transportation Plan, but it is not programmed in the federal fiscal years 2007–2010 TIP. The proposed project addresses mobility and safety issues at the Braintree split and vicinity (location #4 in Figure 13). Recommended improvements include:

I-93 North on-ramp from Route 37 East in Braintree

- Restrict the existing on-ramp to traffic that is heading to Route 3 South, Burgin Parkway, or Washington Street.
- Construct a double left-turn bay at the signalized ramp-arterial junction on the east side of I-93 for use by traffic proceeding to the Expressway to access the south-side on-ramp.
- Install new signs or modify existing signs on Route 37 to guide motorists to the appropriate ramps.

---

[11] Central Transportation Planning Staff, Boston Region Metropolitan Planning Organization, *I-93/Southeast Expressway/Route 3 (Braintree Split): Operational Assessment and Potential Improvements*, March 2006.

Route 3 South between Burgin Parkway and Union Street

- Upgrade the northbound acceleration lane from Union Street into an auxiliary lane (a fourth lane northbound), possibly ending after the exit ramp at interchange 19 (Burgin Parkway/MBTA Quincy Adams Station).

- Add a fourth southbound travel lane beginning at the Burgin Parkway on-ramp, possibly ending after the exit ramp at the Union Street interchange.

- Provide a right-turn bypass lane or slip lane at the southbound ramp-rotary junction for use by the high volume of right-turn traffic.

I-93 South between Route 37 and Route 24

- Add a travel lane on I-93 South, beginning south of the Route 37 interchange and ending at the diverge point to Route 24.

- Reconfigure the lane assignment at the diverge point of I-93 and Route 24 to provide two travel lanes to the two-lane connector ramp that connects to Route 24.

- Widen the merge point at the entrance of Route 24 South to four lanes to receive the four travel lanes from the connecting ramps.

- Install new signs or modify existing signs on I-93 South to guide motorists to Route 24.

4.5 SOUTH COAST RAIL (FALL RIVER/NEW BEDFORD COMMUTER RAIL)

This project is outside of the Boston Region MPO area, and therefore it is not programmed in the federal fiscal years 2007–2020 TIP. However, the Boston Region MPO has endorsed this project in its Transportation Plan. In the current Transportation Plan, the Boston Region MPO endorsed additional projects that are funded in other MPO areas that affect travel within the Boston region. One of these projects is the South Coast Rail project. The MPO has also included these projects in the travel-demand model for air quality conformity purposes.

This proposal is for an extension of MBTA commuter rail service from the cities of Taunton, Fall River, and New Bedford to Boston. Several alternate routes were evaluated by the MBTA in a series of environmental studies conducted from 1995 to 2002. The 2000 Supplemental Draft Environmental Impact Report concluded that the Stoughton alternative is the only practical alternative that would meet the project’s objectives. The Stoughton Alternative would provide service through an extension of the existing Stoughton Line, which currently provides Boston service by connecting to the Shore Line. The South Coast Rail project will impact traffic on Route 24. The project would remove 3,600 daily one-direction vehicles that were bound for Boston from the roadway. This translates into 7,200 round trips.

4.6 ROUTE 24, INTERSTATE CONVERSION

In 1998 MassHighway completed a technical report on the potential reclassification of Route 24 from a state highway to an interstate highway.[12] The study examined the potential geometric improvements necessary for Route 24 to be improved to meet interstate highway standards, and it provided an estimate of associated construction costs. The study was intended to address the requirements contained in the 1997 Transportation Bond Bill, Chapter 11, which dictated that "... the department of highways conducts a study in order to determine what improvements to state highway Route 24 may be necessary for it to be reclassified as an interstate highway."

The project limits for that study are from the I-93/Route 24 interchange in Randolph to the Route 24/I-195 interchange in Fall River. The total length of the project is about 36 miles. Route 24 is currently classified as an urban principal arterial for most of its length, except in Berkeley and Freetown, where it is a rural principal arterial. It was constructed in the 1950s to design standards of the time. It has been reconstructed along various portions over time to address some design deficiencies associated with updated standards. Its current configuration, however, does not meet the stricter standards for an interstate highway within the national highway system, which is a network of regional highways serving the needs of states and regions.

The project limits include three regional planning agencies; the Metropolitan Area Planning Council (MAPC) to the north, the Old Colony Planning Council (OCPC) in the middle, and the Southeastern Regional Planning and Economic Development District (SRPEDD) to the south. Both OCPC and SRPEDD have been actively working on this project. They have included this project in their respective transportation plan and have requested that the Boston Region MPO endorse the project. OCPC and SRPEDD support the Route 24 conversion for two principal reasons. First, the road serves as an interstate highway. Second, and more importantly, Route 24 is not as safe as it should be because the highway does not meet modern design standards. Congestion frequently occurs because of inadequate acceleration/deceleration lanes at the interchanges. Additional problems include inadequate road and shoulder widths and inadequate vertical clearance.

The initial project assessment by MassHighway indicates that the upgrades needed in this study area are mostly upgrading the bridges at the I-93/Route 24 interchange and at the Route 24/Route 139 interchange to comply with the minimum vertical clearances, and also raising the ramps and approach roads. These upgrades are suggested as part of the improvements in Alternative 3, which is described in the following chapter.

[12] Massachusetts Highway Department, Highway Location and Design Section, Route 24, Interstate Conversion Study and Cost Estimates, May 1998.

5 DEVELOPMENT OF ALTERNATIVES

This chapter describes the alternatives that were developed to address the traffic safety and operations problems identified in the study area. As was defined in the work program for this study, the development of traffic safety and operations improvements was focused on the primary study area. However, the planning model and simulation model that were used for evaluating the alternatives included both the primary and secondary areas in order to identify the impacts of the improvements upstream and downstream of the I-93/Route 24 interchange.

The proposal in the study's work program was to develop up to three improvement alternatives, including adding a southbound travel lane on Route 24 from Route 24 interchange 21 (I-93, Randolph) to Route 24 interchange 20 (Route 139, Stoughton) to improve safety and to reduce the bottleneck created by traffic merging into three lanes on Route 24 southbound. Additionally, the work program specified that each improvement alternative be evaluated with and without potential improvements along I-93 southbound to Route 24, as it is possible that the changes proposed on Route 24 could eliminate the need for I-93 improvements.[13]

Seven different alternatives, including the no-build alternative, were formulated to address the traffic safety and operational problems that were identified in the study area. The six build alternatives were grouped into two sets:

- All of the alternatives in Set A (Alternatives 1A, 2A, and 3A) assume the existing four travel lanes on I-93 southbound from the Route 37 southbound on-ramp to Route 24.
- All of the alternatives in Set B (Alternatives 1B, 2B, and 3B) assume five travel lanes on I-93 southbound from the Route 37 southbound on-ramp to Route 24.

Besides these seven alternatives, additional improvements for further consideration were also developed. The additional improvements were meant to address some of the safety and operations problems that were not addressed by the seven alternatives.

The alternatives were developed with the guidance of the advisory task force, with discussions about the traffic, safety, and operations problems in the study area, including future plans for the Route 24 corridor. CTPS also utilized the results of a technical review, completed by MassHighway in 1998, on the potential reclassification of state highway Route 24 to an interstate highway.[14] That study was intended to address the requirements contained in the 1997 Transportation Bond Bill, Chapter 11, which dictated that " . . . the department of highways

[13] Adding a travel lane on I-93 southbound beginning from the southbound on-ramp at Route 37 and ending after the exit ramp to southbound Route 24 was recommended in the report *I-93/Southeast Expressway/Route 3 (Braintree Split): Operational Assessment and Potential Improvements..*

[14] Massachusetts Highway Department, Highway Location and Design Section, Route 24: *Interstate Conversion Study and Cost Estimates*, May 1998.

conduct a study in order to determine what improvements to state highway route 24 may be necessary for it to be reclassified as an interstate highway," The study examined the potential geometric improvements necessary for Route 24 to be improved to meet interstate standards and it provided an estimate of associated construction costs.

Thus, in developing the alternatives, we considered the potential geometric improvements necessary for the segments of Route 24 within the current study area to be improved to meet interstate standards (Alternatives 3A and 3B), as well as improvements needed to address the traffic safety problems identified in the study area. The purpose was to upgrade all substandard ramps, shoulders/ breakdown lanes, vertical bridge clearances, offsets, and design speed to current standards. The following are brief descriptions of the alternatives and potential geometric improvements.

5.1 NO-BUILD ALTERNATIVE

Figure 14 shows the no-build alternative, which was the baseline used in assessing the impacts of the build alternatives, as well as the impacts of existing conditions. It includes all of the transportation projects in the study area that are scheduled to be completed by 2030. These transportation projects, shown in Figure 13 in the previous chapter, are in the 2007 Transportation Plan, and are therefore included in the no-build analysis:

- Route 128 Improvement Program
- I-95/I-93 Interchange Improvement Project
- I-93/Southeast Expressway/Route 3 (Braintree Split)
- Improvements near the I-93/Route 37 Interchange in Braintree
- South Coast Rail Project (not shown in Figure 13)

The no-build alternative addresses some of the traffic safety and operations problems identified in this study. For instance, the construction of the Route 128 Improvement Program will add a travel lane and restore the shoulder/breakdown lane in each direction of I-93. These improvements will eliminate the use of the breakdown lanes as travel lanes and the associated safety problems. The same project will also address the traffic safety and operations problems of the left-side-entrance merge, where the limited merge area forces motorists to merge directly into the southbound I-93 high-speed lane. The project will provide a full left travel lane and an acceleration lane to connect to the two-lane ramp from northbound Route 24, which will remove the lane drop on the connector ramp and prevent motorists from merging directly into the southbound I-93 high-speed lane.

The no-build alternative would not address the safety problems identified in the study area that are created by:

- Traffic merging onto Route 24 southbound, where motorists avoid the middle travel lane because of lack of clarity about who has the right-of-way, a limited merge area, and poor sight distance

- The short weave distance on southbound I-93 for the Route 28 southbound motorists that are headed for Route 24, or the Route 24 northbound motorists that are headed for Ponkapoag Trail

- Traffic weaving and lane-changing maneuvers involving motorists that are diverging from I-93 southbound to Route 24 southbound

All of the alternatives listed below build on the no-build alternative and therefore include the projects listed above.

5.2 ALTERNATIVE 1A: FOUR TRAVEL LANES ON ROUTE 24 SOUTHBOUND

Alternative 1A (see Figure 15) includes the following improvements:

- Four travel lanes on southbound Route 24 from interchange 21 (I-93) in Randolph to just after interchange 20 (Route 139) in Stoughton

- Reconfigured lanes at the entrance to southbound Route 24 to receive four travel lanes from the two two-lane ramps

- New or modified signs to inform motorists and guide them to Route 24

The goal of Alternative 1A is to address the traffic safety and operations problems at the merge area on southbound Route 24, where motorists avoid the middle travel lane because of lack of clarity about who has the right-of-way, a limited merge area, and poor sight distance. Another goal of Alternative 1A is to reduce the PM peak-period bottleneck created by high volumes of traffic merging into three lanes on Route 24 southbound. The improvements in Alternative 1A would provide four southbound travel lanes on Route 24, which would provide two lanes each to connect to each of the two two-lane ramps coming from I-93.

Because there are no modifications to other elements of the I-93/Route 24 interchange, Alternative 1A would not address the safety problems identified earlier that are created by:

- The short weave distance on southbound I-93 for the Route 28 southbound motorists that are headed for Route 24, or the Route 24 northbound motorists that are headed for Ponkapoag Trail

- Traffic weaving and lane-changing maneuvers involving motorists that are diverging from I-93 southbound to Route 24 southbound

5.3 ALTERNATIVE 1B: FOUR TRAVEL LANES ON ROUTE 24 SOUTHBOUND AND FIVE TRAVEL LANES ON I-93 SOUTHBOUND

Alternative 1B (see Figure 16) includes the following improvements:

- All of the improvements included in Alternative 1A

- Five travel lanes on southbound I-93 from the southbound on-ramp from Route 37 to just after the exit ramp to southbound Route 24

- Reconfigured lanes in the area where traffic diverges from southbound I-93 onto Route 24, to provide two exclusive travel lanes to Route 24 and three through travel lanes that will continue on I-93

- New or modified signs on I-93 and Route 24 to guide and inform motorists

The goal of Alternative 1B is to address the traffic safety and operations problems at the merge area on southbound Route 24 (as in Alternative 1A) and on southbound I-93, where traffic diverging onto Route 24 southbound creates weaving and lane-changing maneuvers that impact traffic flow and safety.

Alternative 1B does not address the safety problems at the I-93/Route 24 interchange that are created by the short weave distance on southbound I-93 for the Route 28 southbound motorists that are headed for Route 24, or the Route 24 northbound motorists that are headed for Ponkapoag Trail.

5.4 ALTERNATIVE 2A: FOUR TRAVEL LANES IN EACH DIRECTION OF ROUTE 24

Alternative 2A (see Figure 17) includes the following improvements:

- All the improvements in Alternative 1A

- Four travel lanes on northbound Route 24, beginning south of interchange 20 (Route 139) and ending at the point where Route 24 ends at I-93

- Reconfigured lanes in the area where traffic diverges from Route 24 northbound onto I-93 to provide two travel lanes to connect to each two-lane ramp connecting Route 24 to I-93

- New or modified signs on Route 24 to guide and inform motorists

The goals of Alternative 2A are to address the traffic safety and operations problems at the merge area on southbound Route 24 (as in Alternative 1A) and to reduce congestion on northbound Route 24 during the AM peak period.

Alternative 2A does not address the safety problems at the I-93/Route 24 interchange that are created by the short weave distance on southbound I-93 for the Route 28 southbound motorists that are headed for Route 24, or the Route 24 northbound motorists that are headed for Ponkapoag Trail. It also does not address the safety problems created by traffic weaving and lane-changing maneuvers of the traffic that is diverging from I-93 southbound to Route 24 southbound.

5.5 ALTERNATIVE 2B: FOUR TRAVEL LANES IN EACH DIRECTION OF ROUTE 24 AND FIVE TRAVEL LANES ON I-93 SOUTHBOUND

Alternative 2B (see Figure 18) builds on Alternative 2A and includes the following improvements:

- All of the improvements in Alternative 2A
- Five travel lanes on southbound I-93 from the southbound on-ramp from Route 37 to just after the exit ramp to southbound Route 24
- Reconfigured lanes in the area where traffic diverges from southbound I-93 onto Route 24, in order to provide two exclusive travel lanes to Route 24 and three through travel lanes that will continue on I-93
- New or modified signs on I-93 and Route 24 to guide and inform motorists

The goals of Alternative 2B are to address the traffic safety and operations problems at the merge area on southbound Route 24 (Alternative 1A), on southbound I-93 (Alternative 1B), and on northbound Route 24 (Alternative 2A). Alternative 2B incorporates all of the improvements from Alternatives 1A, 1B, and 2A, and hence it offers all of their traffic safety and operational benefits.

Alternative 2B does not address the safety problems at the I-93/Route 24 interchange that are created by the short weave distance on southbound I-93 for the Route 28 southbound motorists that are headed for Route 24, or the Route 24 northbound motorists that are headed for Ponkapoag Trail.

5.6 ALTERNATIVE 3A: FOUR TRAVEL LANES IN EACH DIRECTION OF ROUTE 24 AND RECONFIGURED I-93/ROUTE 24 INTERCHANGE

The goals of Alternative 3A (see Figure 19) are to address safety problems at the I-93/Route 24 interchange that are created by the short weave distances and to upgrade the section of Route 24 within the study area to interstate standards. Although these safety problems are experienced by motorists and have been identified, our crash data do not contain the detailed information needed to link each of the crashes at the I-93/Route 24 interchange to the exact position where it occurred. Therefore, it was not possible to associate the crashes with maneuvers at the interchange such as weaving, merging, lane-changing, and short weave distances.

Alternative 3A includes major improvements in both directions of Route 24 and at the I-93/ Route 24 interchange. It builds on Alternative 2A and includes the following improvements:

- All of the improvements in Alternative 2A
- A reconfigured I-93/Route 24 interchange to address the safety problems created by the short weave distances on southbound I-93 by providing right-side entrance and exit ramps. The right-side entrance and exit ramps would replace the current merge/weave maneuvers in the

high-speed lane and the lane-changes on the mainline with merge/weave maneuvers in the low-speed and acceleration lanes.

- New or modified signs on I-93 and Route 24 to guide and inform motorists

The following potential geometric improvements would be necessary for an upgrade of Route 24 to interstate standards.[15]

- The I-93/Route 24 interchange would require major reconstruction. (All four ramps from I-93 to Route 24 would need to be reconstructed in order for three bridges to be raised to meet the 16.5-foot clearance standard.)

- The Route 139 interchange would require minor modifications (eight ramps would need to be reconstructed for the bridge to be raised to provide for the 16.5-foot clearance). All underpass bridges (Route 24 under other roads) would need to be raised to attain 16.5 feet of vertical clearance. Intersecting roadways at underpass bridges would need to be reconstructed to accommodate raised bridge profiles

- Provide 12-foot left and right shoulders, and construct a median barrier. Overhead sign structures and drainage structures in the median would need minor modifications

5.7 ALTERNATIVE 3B: FOUR TRAVEL LANES IN EACH DIRECTION OF ROUTE 24, RECONFIGURED I-93/ROUTE 24 INTERCHANGE, AND FIVE TRAVEL LANES ON I-93 SOUTHBOUND

Alternative 3B (see Figure 20) builds on Alternative 3A. It includes the following improvements:

- All of the improvements in Alternative 3A

- Five travel lanes on southbound I-93 from the southbound on-ramp from Route 37 to just after the exit ramp to southbound Route 24

- Reconfigured lanes in the area where traffic diverges from southbound I-93 onto Route 24, to provide two exclusive travel lanes to Route 24 and three through travel lanes that will continue on I-93

Alternative 3B shares some goals with Alternative 3A: to address traffic safety and operations problems in the study area and concurrently upgrade all substandard ramps, shoulders/breakdown lanes, vertical clearances of the bridges, offsets, and design speeds to meet current standards. It incorporates all of the improvements from Alternatives 1A, 1B, 2A, 2B, and 3A.

---

[15] Massachusetts Highway Department, Highway Location and Design Section, *Route 24: Interstate Conversion Study and Cost Estimates*, May 1998.

5.8 OTHER IMPROVEMENTS FOR CONSIDERATION

The following are additional improvements. They could be added as part of Alternatives 1A, 1B, 2A, and 2B. These improvements cannot be added to Alternatives 3A or 3B, as the problems they are meant to address are already being addressed in Alternatives 3A and 3B.

Prohibit Route 24 Motorists from Accessing Ponkapoag Trail

Prohibit Route 24 northbound motorists from directly accessing Ponkapoag Trail by constructing a physical barrier that would channel only the traffic exiting from I-93 southbound to the off-ramp, and would prevent motorists from accessing the off-ramp from Route 24 northbound (see Figure 21). The goal of this improvement is to address the traffic safety and operations problems caused by the short weave distance on southbound I-93 for the Route 24 northbound motorists that are headed for Ponkapoag Trail.

If ramp access were prohibited, Route 24 northbound motorists would have two alternative access routes. The first would be the I-93 southbound off-ramp to Route 138 northbound, about 1.3 miles to the west of the Ponkapoag Trail exit. Motorists would then have the option of taking Route 138 northbound or using Blue Hill River Road/Hillside Road and Unquity Road to continue their journey to Milton or Boston. The second would be the I-93 northbound off-ramp to Route 28 northbound, about 1.5 miles to the east of the Ponkapoag Trail exit. From Route 28, motorists would have the option of continuing on Route 28 or using Chickatawbut Road and Unquity Road to continue their journey to Milton or Boston.

Prohibit Route 28 Southbound Motorists from Accessing Route 24 Southbound

Prohibit Route 28 southbound motorists from accessing Route 24 southbound by constructing a physical barrier that would channel this traffic to I-93 southbound but prevent access to Route 24 (see Figure 22). The goal of this improvement is to address safety and operational problems caused by the short weave distance on southbound I-93 for the Route 28 southbound traffic that is headed for Route 24 southbound.

If this prohibition is implemented, the alternative access routes for the traffic heading to the Route 24 corridor would be a U-turn at I-93 interchange 3 (Ponkapoag Trail) or Route 139 via Route 28 in Randolph.

Construct a Loop Ramp in the Northwest Quadrant of Interchange 3 (Ponkapoag Trail) to Allow Route 28 Southbound Motorists to Access Route 24

Construct a new loop ramp in the northwest quadrant of interchange 3 (Ponkapoag Trail) to allow Route 28 southbound motorists to access Route 24 (see Figure 22). This improvement is subject to the implementation of the improvements described above that would prohibit Route 28 southbound motorists from weaving across I-93 southbound lanes to access Route 24.

With the construction of the loop ramp, only right turns could be made from the I-93 southbound exit ramps to Ponkapoag Trail; that is, the existing ramp would serve traffic heading to Ponkapoag Trail northbound, while the new loop ramp would serve traffic heading to southbound Ponkapoag Trail. The loop ramp would supplement the existing ramp in the northeast quadrant and prevent the U-turn maneuvers described above.

Provide a Separate Ramp for Accessing Ponkapoag Trail from Route 24 Northbound

Create a new ramp off of the Route 24 northbound connector to I-93 southbound to provide additional access to Ponkapoag Trail (see Figure 23). The objectives are to eliminate the weaving and lane-changing maneuvers on southbound I-93 by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area; that is, to provide another way for Route 24 motorists to access Ponkapoag Trail.

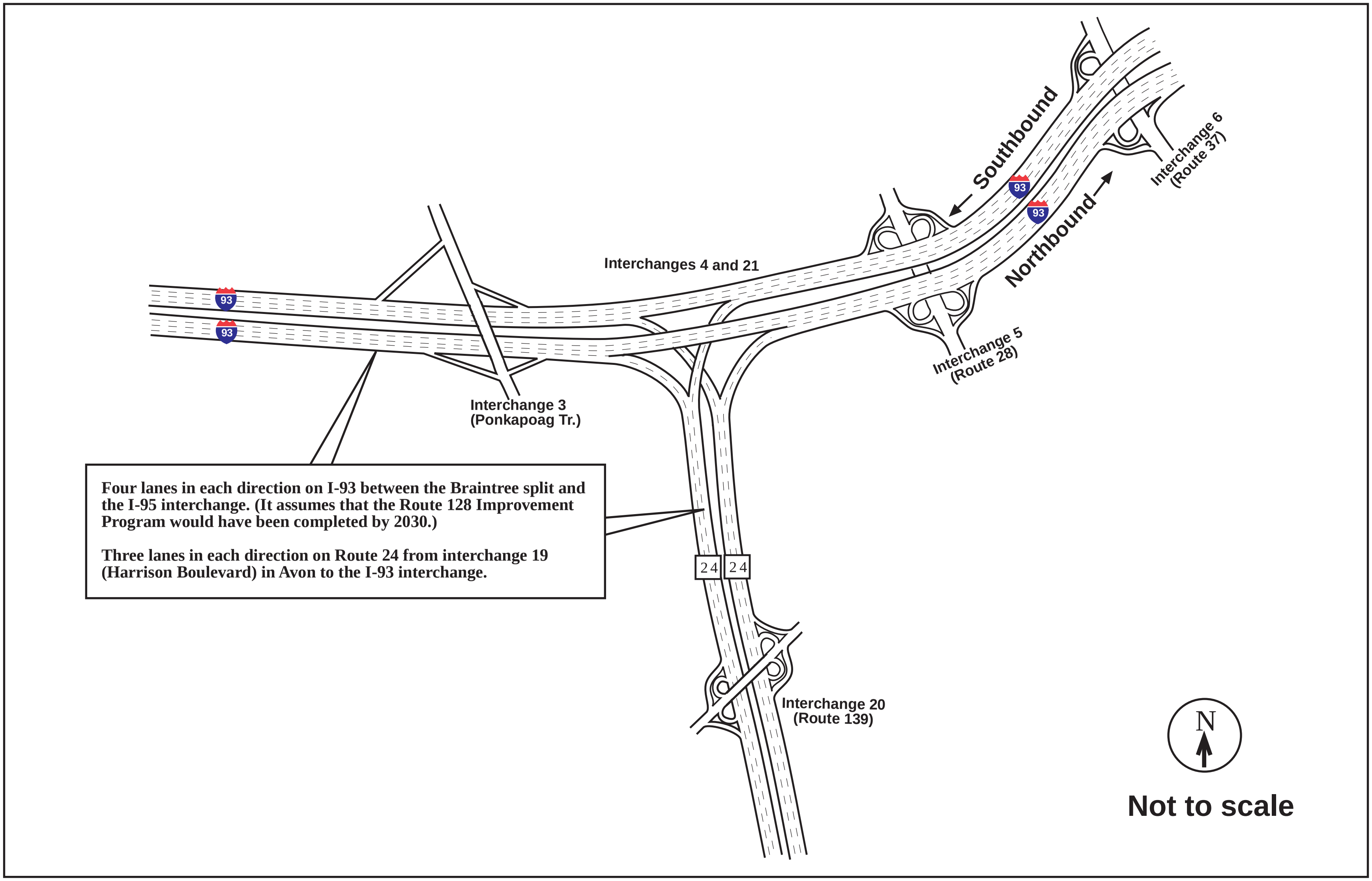
The new ramp would provide a right merge/weave with the I-93 southbound traffic exiting to Ponkapoag Trail. A physical barrier would be constructed to channel the traffic exiting from I-93 southbound to Ponkapoag Trail and to prevent a merge/weave problem on I-93 southbound in that vicinity.

This improvement addresses some of the safety problems that Alternatives 3A and 3B were meant to address on I-93 southbound west of Route 24 and may offer a less costly alternative to either of those alternatives.

High-Occupancy-Vehicle (HOV) Lane on Route 24

This proposal would create an HOV lane on Route 24 beginning at Route 139 and terminating on I-93 in the vicinity of the Route 28 interchange. The intent is to encourage motorists to carpool or use bus transit to save time on the congested stretch of Route 24. Currently there are carpools, vanpools, and private-carrier buses bound for Boston and Logan Airport that use Route 24 during the AM peak period.

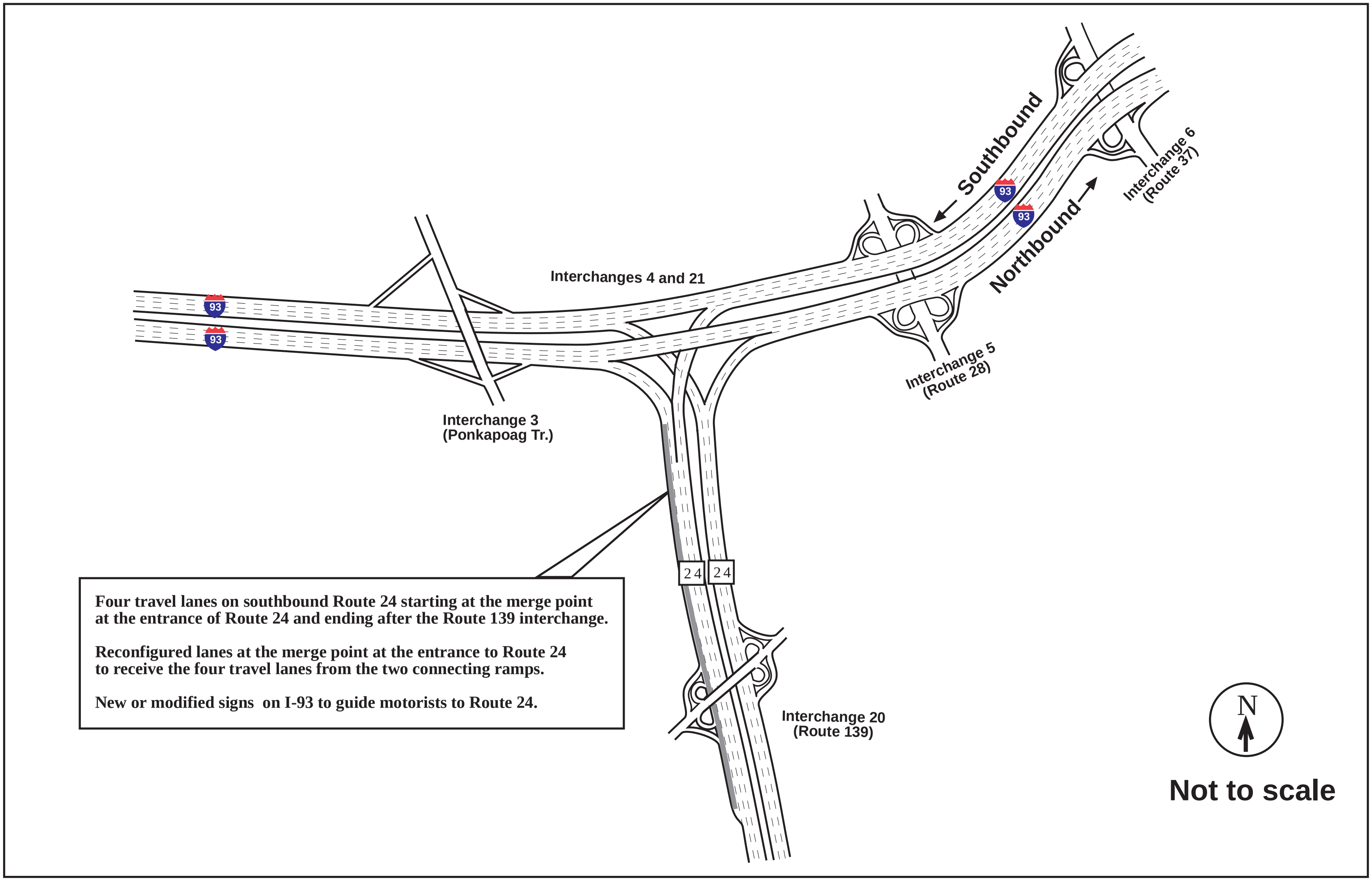
The challenge with this proposal is how to extend a new HOV facility through the I-93/Route 24 interchange. Currently, the I-93/Route 24 interchange has safety and operational problems (short weave distances, weaving, merging, congestion, and queues), described in Chapter 2. Therefore an HOV lane terminating on I-93 in the vicinity of Routes 24 and 28 could present additional safety and operational problems. Also, it would be difficult to extend this new HOV lane to connect to the one on the Southeast Expressway because of operational issues such as HOV access to Routes 28 and 37.



CTPS

FIGURE 14
No-Build Alternative

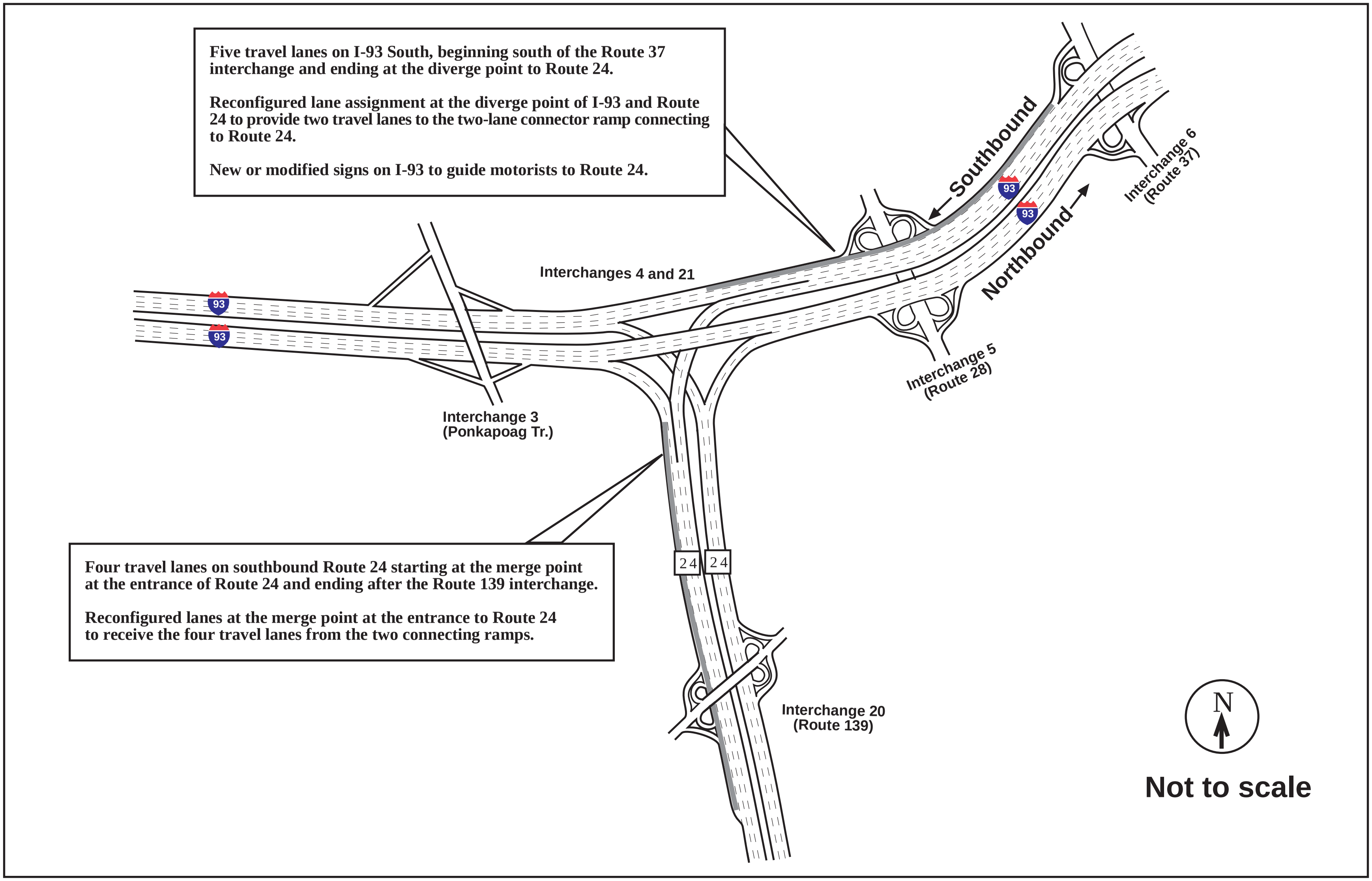
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 15
Alternative 1A: Four Travel Lanes on Route 24 Southbound

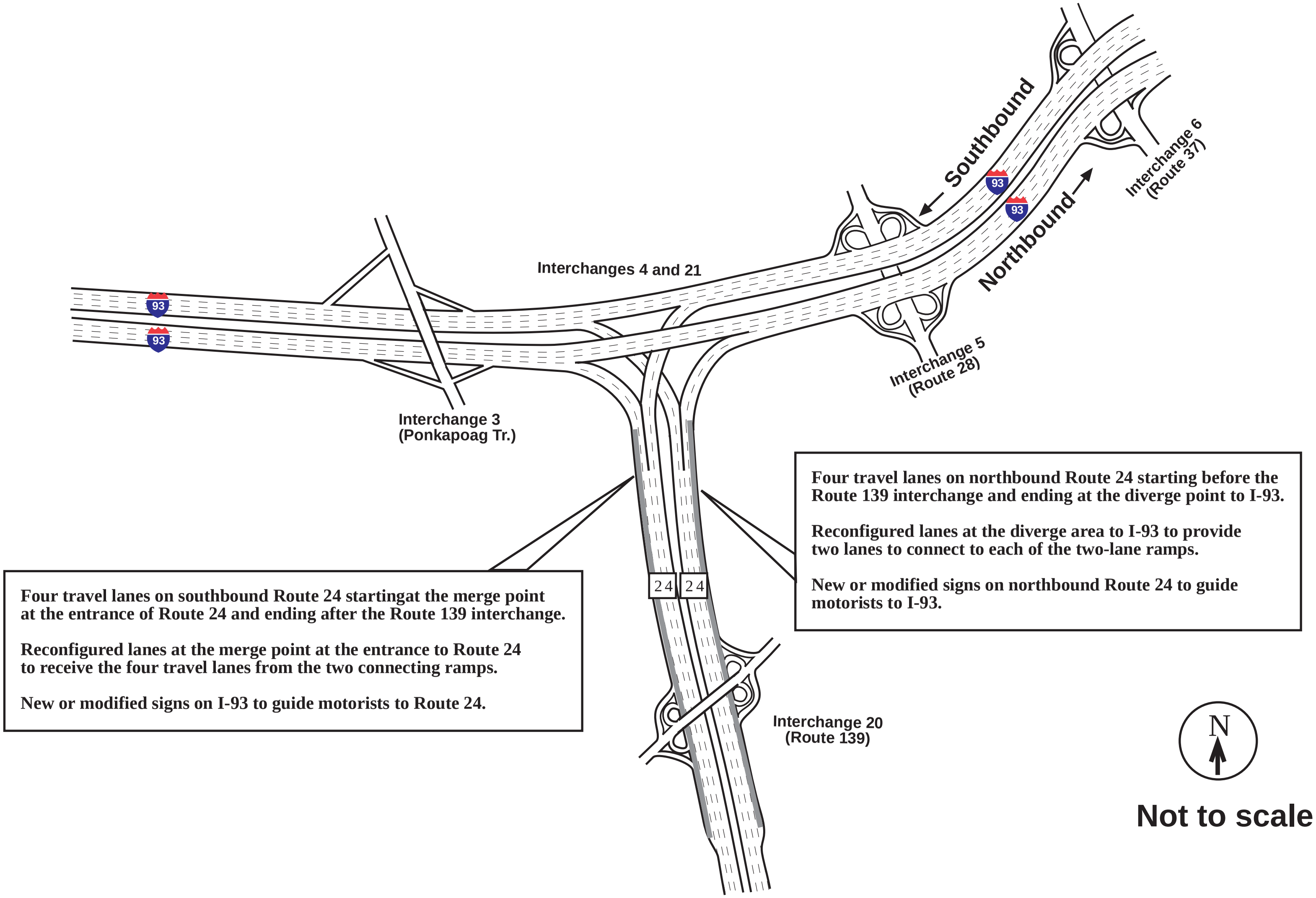
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 16
Alternative 1B: Four Travel Lanes on Route 24 Southbound and Five on I-93 Southbound

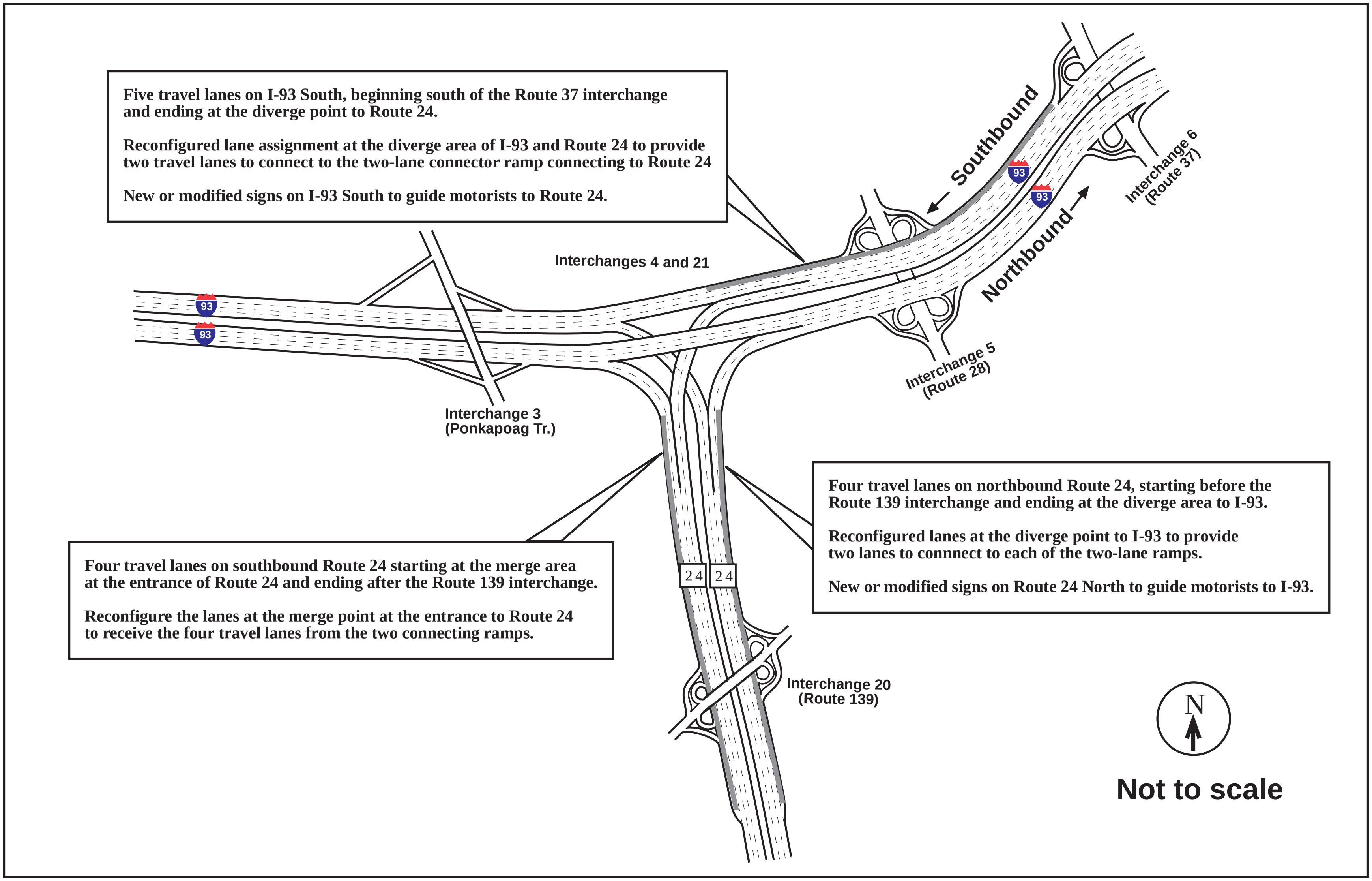
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 17
Alternative 2A: Four Travel Lanes in Each Direction on Route 24

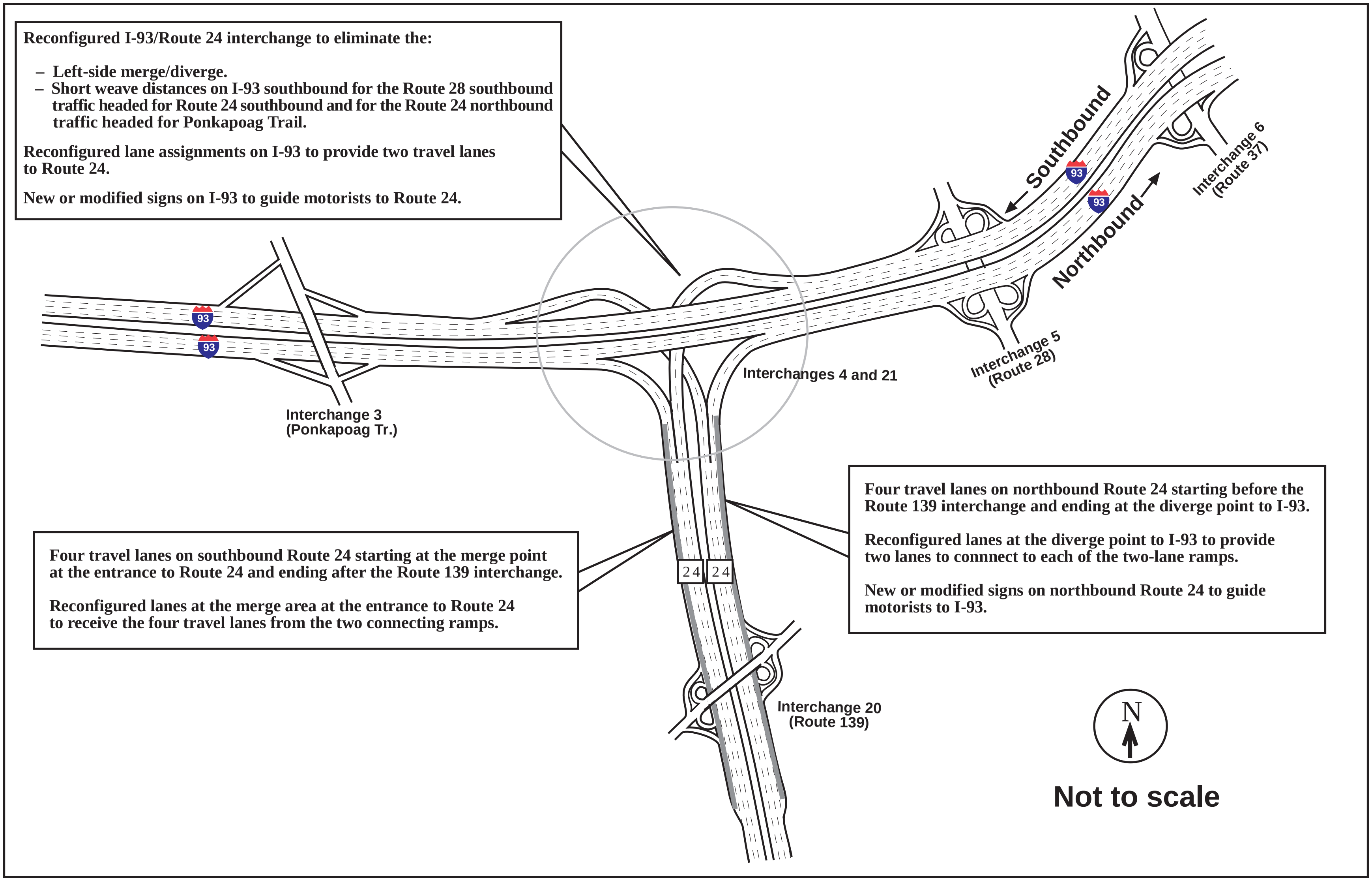
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 18
Alternative 2B: Four Travel Lanes in Each Direction on Route 24 and Five on I-93 Southbound

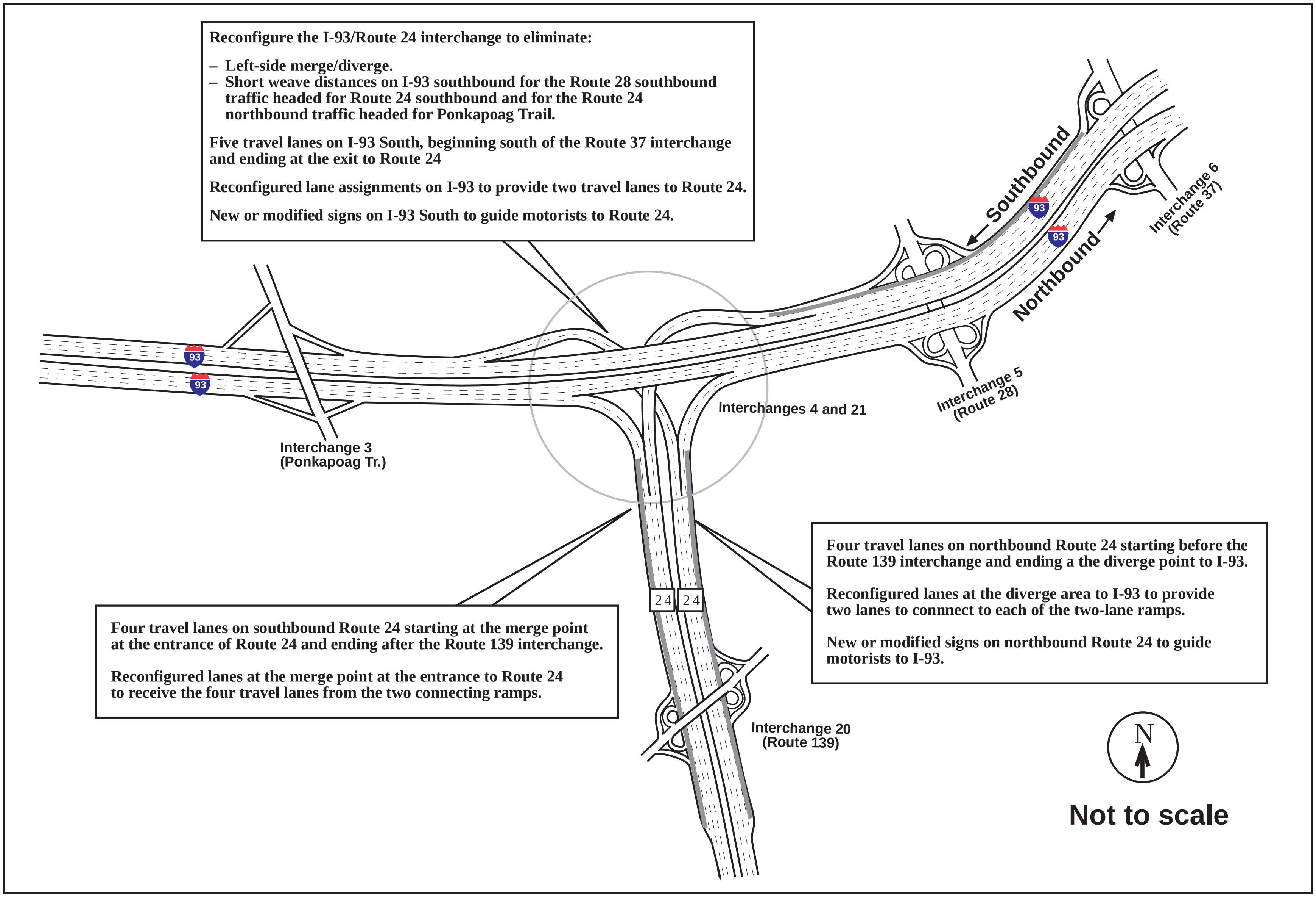
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 19
Alternative 3A: Four Travel Lanes in Each Direction of Route 24 and Reconfigured I-93/Route 24 Interchange

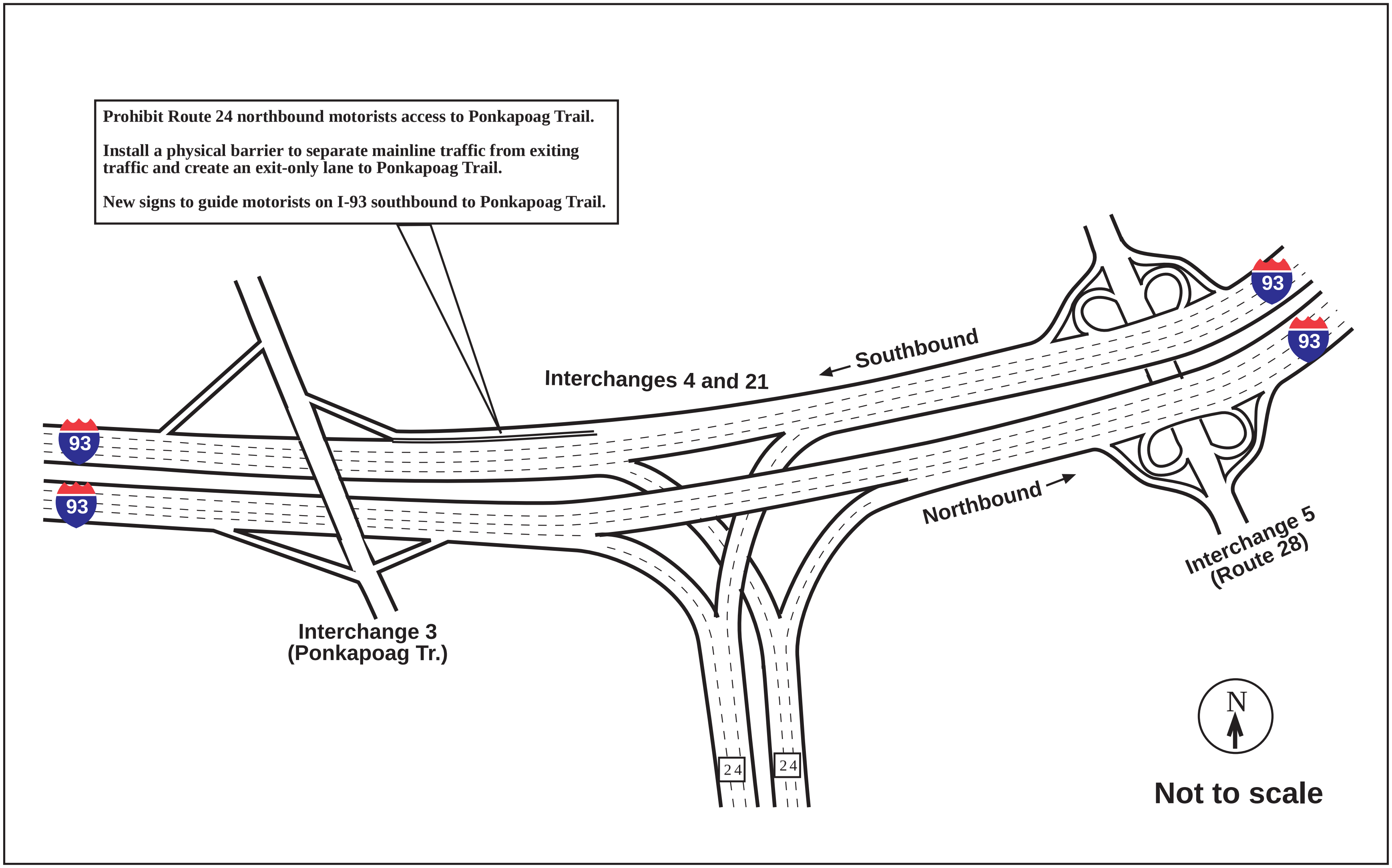
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 20
Alternative 3B: Four Travel Lanes in Each Direction of Route 24, Five on I-93 Southbound, and Reconfigured I-93/Route 24 Interchange

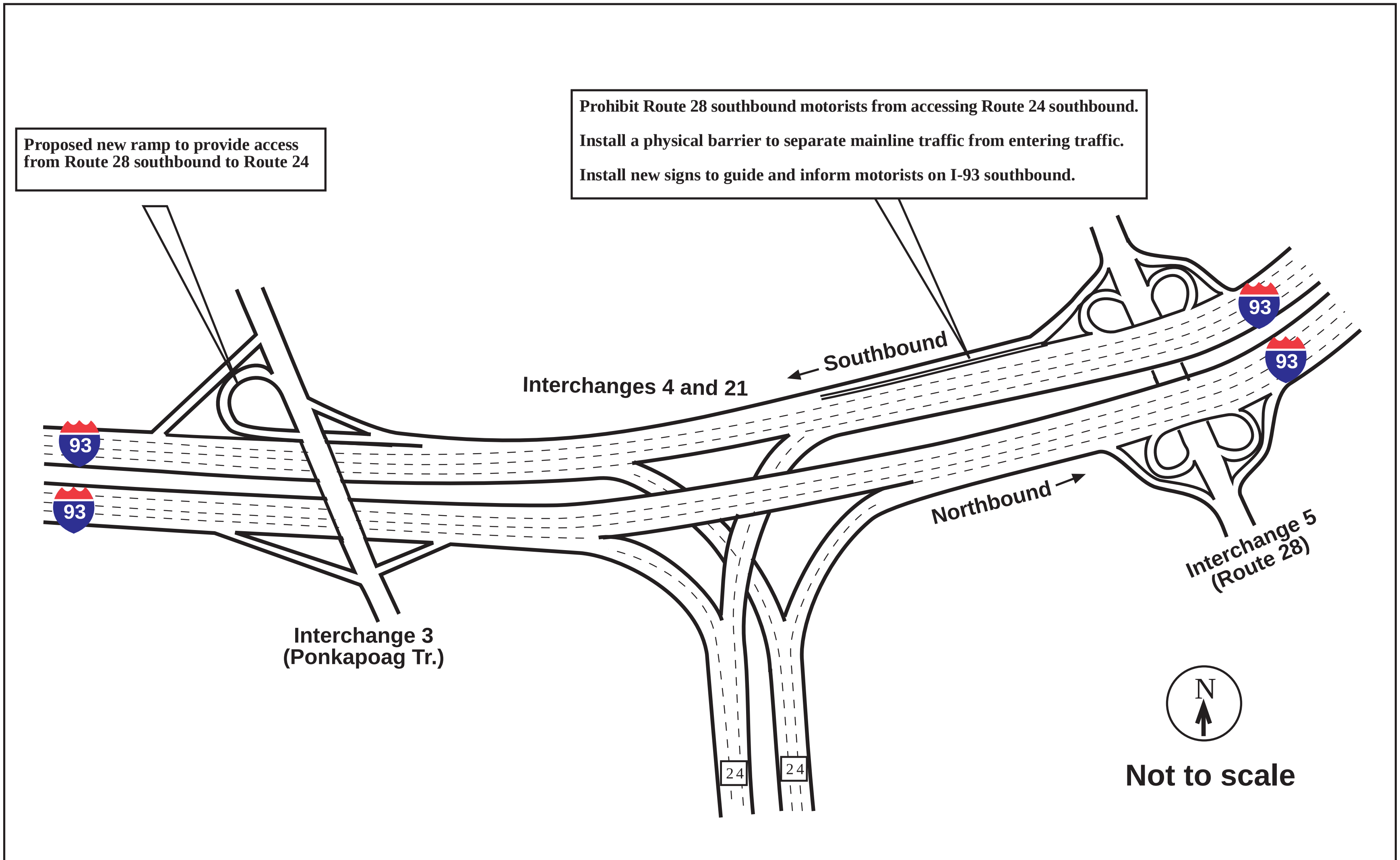
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 21
Prohibit Route 24 Northbound Motorists from Accessing Ponkapoag Trail

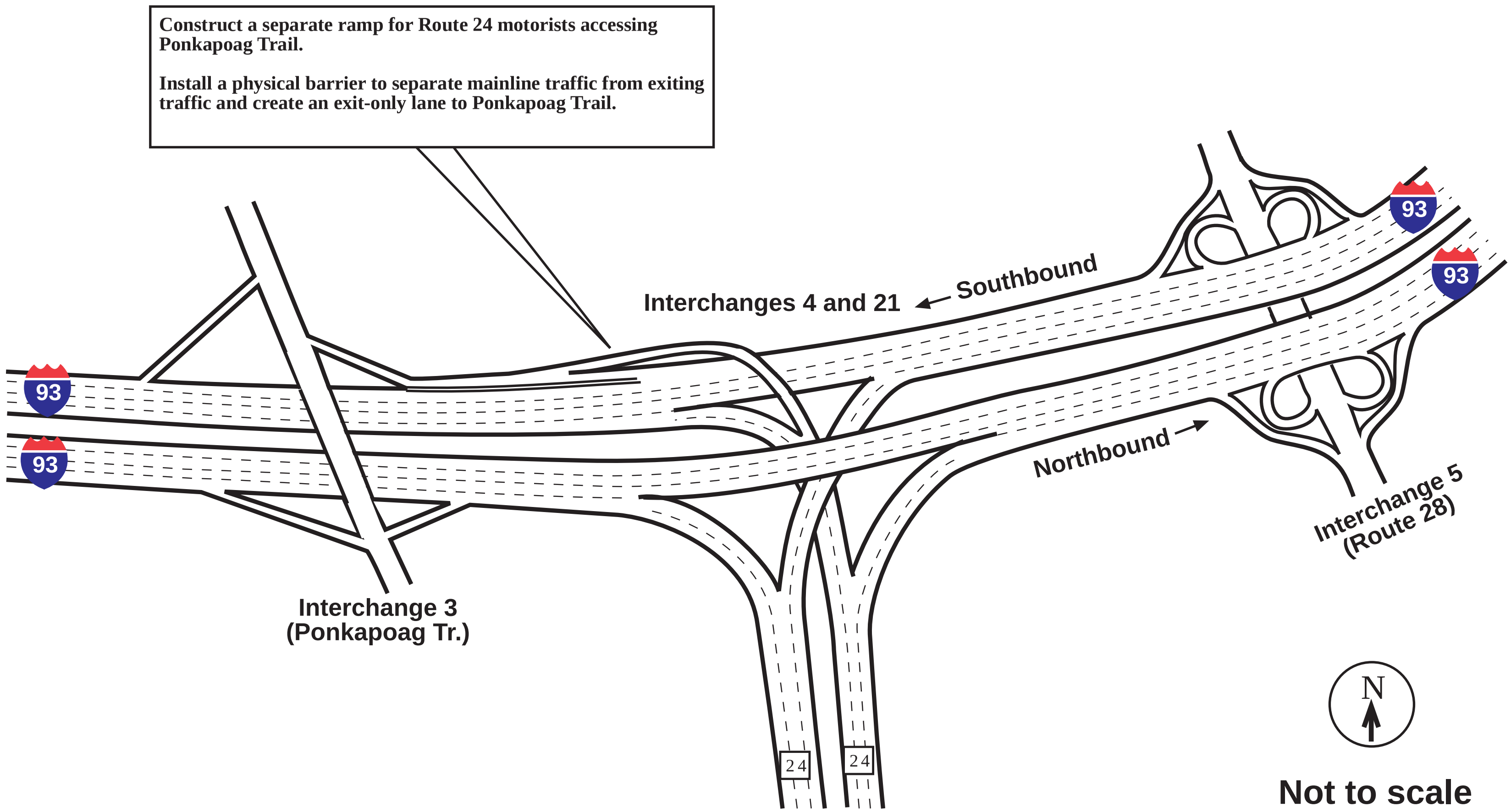
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 22
Prohibit Route 28 Southbound Motorists from Accessing Route 24 Southbound

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE 23
Provide a Separate Ramp for Access from Route 24 Northbound to Ponkapoag Trail

Safety and Operational Improvements for the I-93/Route 24 Interchange

6 EVALUATION OF IMPACTS

This chapter describes the evaluation of the impacts of the alternatives. The purpose of the evaluations is to provide detailed information for making informed decisions. Two models were used to evaluate the impacts of the alternatives. They are the Boston Region MPO's transportation planning model and a microscopic traffic simulation model. The transportation planning model was used to project traffic growth on the roadways for the no-build and build alternatives. After that, the microscopic traffic simulation model was used to evaluate the traffic operations impacts.

Brief descriptions of the transportation analyses, key inputs, and assumptions used to adjust the regional transportation planning model to the requirements of this study, and traffic projections are provided in this chapter. In addition, brief descriptions of the microscopic traffic simulation model, the data requirements, and the traffic operations impacts are presented in this chapter.

6.1 REGIONAL TRANSPORTATION PLANNING MODEL

The 2030 forecasts were produced through a series of transportation analysis. The following section is a brief description of the procedures, the key inputs, and assumption used to adjust the regional transportation planning model to the requirements of this study. The most updated regional transportation planning model contains 2,727 transportation analysis zones (TAZ) and associated roadway and transit networks. A TAZ is a geographic area within the planning region that has similar land use for facilitating modeling of the origins and destinations of trips. The regional transportation planning model simulates travel on the entire transit and highway system in Eastern Massachusetts. In the highway system, all express highways and principal arterial roadways, as well as many minor arterial and local roadways, are included. In the transit system, all MBTA rail and bus lines, all MBTA ferry service, all private express bus carriers, and some local bus services are included.

The outputs of the model set contain detailed information relating to the transportation system. On the highway side, the model output contains traffic volumes, travel speeds, vehicle-miles traveled, average travel times on the roadway links, etc. On the transit side, the output provides information relating to the average weekday ridership on different transit submodes (commuter rail, rapid transit, local buses, express buses, and private carriers), station boarding, park-and-ride demand, peak-load volumes, etc.

The regional model sets are based on the traditional four-step, sequential process: the four steps are trip generation, trip distribution, mode choice, and trip assignment. The model set employs sophisticated and involved techniques in each step of the process. The following paragraphs describe very briefly what each step does.

Trip Generation: This is the most important step of the model chain. In this step, the model estimates the number of trips produced in and attracted to each transportation zone. To do this, the model uses estimates of projected population, employment, and other socioeconomic and household characteristics of that zone. Trips are divided into four major purposes: home-based work trips, home-based school trips, home-based other trips, and non-home-based trips.

Trip Distribution: In this step, the distribution model links the trip ends estimated from the trip generation to form zonal trip interchanges, or movement between zones. The output of this second step is a trip table, which is a matrix containing the number of trips occurring between every origin-destination zone combination. Trip distribution is performed for each trip purpose.

Mode Choice: The mode-choice model set consists of four models, one for each trip purpose. The model allocates the person-trips estimated from the trip distribution step to the two primary competing modes: automobile and transit. This allocation is based on the desirability or utility of each choice a traveler faces, based on the attributes of that choice and the characteristics of the individual. The resulting output of the mode choice model is estimates of the percentage of trips that use the automobile and transit for each trip interchange. The transit trips are further divided into two modes of access: walk-access transit trips and drive-access transit trips (park-and-ride trips). The auto trips are further divided into single-occupancy and multiple-occupancy trips.

Trip Assignment: In this final step, the model assigns the transit trips to different transit modes, such as subway, commuter rail, local bus, and express bus. To do this, it uses the shortest transit path from one zone to another. This path may involve just one mode, such as a local bus or commuter rail, or multiple modes, such as a local bus and a transfer to a subway line. The highway trips are assigned to the highway network. Thus, the future-year traffic volumes on the highways and forecasted transit ridership on different transit lines can be obtained from the model outputs.

6.2 MODELING PROCESS: TRAFFIC FORECASTS

The Boston Region MPO transportation planning model was used to project traffic growth for estimating the impacts of the proposed improvement alternatives. Before applying the model set, it was adjusted several times until it replicated the existing highway volumes and transit ridership data in the study area at an acceptable level of accuracy. This adjustment is called model calibration. After calibration, the inputs to the model set for the forecast year (2030) were created, and the entire model set was run to simulate 2030 traffic volumes for each alternative.

The traffic forecasts were based on Metropolitan Area Planning Council population, employment, and household forecasts, which were inputs to the regional transportation planning model. In the future, a number of roadway and transit projects are expected to be in operation in the Boston Region MPO area. These projects were coded in the 2030 roadway and transit networks in order to reflect the anticipated changes in the supply of transportation services. Appendix B contains the transportation projects that were coded in the 2030 network. The list was derived from the recent transportation plan of the Boston Region MPO. Furthermore, the 2030 highway networks were modified to reflect each of the proposed improvement alternatives. The entire model set was run for each improvement alternative for two peak periods: AM (6:00 to 9:00) and PM (3:00 to 6:00).

The results of the 2030 AM and PM peak-period traffic forecasts for the alternatives are presented in Appendix B, along with the 2005 AM and PM peak-period traffic volumes. The

2030 no-build peak-period traffic volumes serve as the baseline for comparing the forecasts of the build alternatives. That is, for each alternative, the increase or decrease in traffic compared to the no-build conditions is presented. Overall, the model projected peak-period traffic growth on major roadways in the study area that ranged from 2% to 9% per peak period on Route 24, and 2% to 8% on I-93. The 2030 no-build forecasts indicated that in the future, peak-period travel demand on I-93 and Route 24 is expected to increase. The forecasts also show that adding a lane on either Route 24 and/or I-93 southbound would increase usage on that route. This increase in usage over the no-build alternative is expected because of the reduced travel time.

6.3 MODELING PROCESS: TRAFFIC OPERATIONS

The CORSIM traffic simulation model was used in this study to evaluate the impacts of the alternatives. CORSIM was developed by the Federal Highway Administration and has been improved and enhanced several times over the years. It consists of an integrated set of two microscopic traffic simulation models that represent the entire traffic environment: NETSIM represents traffic on surface streets and FRESIM represents traffic on freeways.

CORSIM accounts for queuing, weaving, merging, and diverging through the car-following model, driver-behavior model, and the vehicular-characteristic-and-performance model. In CORSIM, vehicles are moved according to car-following logic in response to traffic control devices and other demands. Thus, each time a vehicle is moved, its position and relationship to other vehicles nearby is recalculated, as are its speed, acceleration, and other variables. These data are accumulated every “time step” (every second), and at the end of the simulation the accumulated data are used to produce measures of effectiveness to estimate the performance of the highway system.

The simulation model was calibrated to 2005 peak-period conditions using available ground counts by adjusting CORSIM calibration parameters to match existing conditions (speeds, travel times, and observed queues). After calibration, CORSIM was used to evaluate the alternatives using the 2030 traffic forecasts.

There were seven scenarios: the no-build alternative and six build alternatives. The no-build alternative was the baseline used in assessing the impacts of the build alternatives. Additional safety and operational improvements that would enhance some of the seven alternatives were also developed, for further consideration. For each alternative, the highway network for the simulation model was coded to reflect the specific improvements in that alternative and the highway projects expected to occur in the study area by 2030. All of the alternatives have a similar highway network, except for the specific improvements in each alternative.

6.4 EVALUATION OF EFFECTIVENESS AND OTHER IMPACTS

Both quantitative and qualitative measures were used in assessing the impacts of the alternatives. The quantitative measures include the following networkwide performance measures: average speeds, total vehicles-miles traveled, total delay, and average delay per mile. Networkwide performance measures assess performance over the entire highway network in the study area (primary and secondary areas).

The average speed is the mean speed of all vehicles that travel on the network. Given similar highway networks, higher average speeds imply less traffic congestion on the network. The total vehicle-miles is the total distance traveled over the network by all vehicles. Given similar highway networks for the alternatives, a higher total of vehicle-miles implies that there is a higher number of vehicles that travel on the network. The total delay is the total amount of delay experienced by all vehicles that travel on the network; a vehicle accumulates delay if it travels below the free-flow speed. Lower numbers of total delay imply less traffic congestion on the network. The vehicle delay per vehicle-mile is the average delay experienced by all vehicles while traveling one mile on the network.

The traffic simulation performance measures reflect the effects of traffic weaving, lane-changing, and geometrics on traffic operations. However, the traffic simulation model does not estimate how many crashes would be reduced by addressing these safety issues—even though it is obvious that addressing them would improve safety. Therefore, the traffic safety impacts and benefits resulting from geometric improvements are described qualitatively.

The results from the traffic simulations are presented in Tables 9, 10, and 11 and are discussed in the following subsections. Table 9 gives the network performance measures for the various alternatives, the no-build conditions, and the existing conditions. In addition, the highway sections with congestion and queuing in the no-build alternative were compared to the improvement alternatives in order to assess the changes from the no-build due to the improvements (see Table 10, which shows the length of queuing, average speeds, and change from the no-build for improvement alternatives). Qualitative comparisons of the benefits of the safety improvements, that is, changes from the no-build alternative, are presented in Table 11.

6.4.1 No-Build Alternative (see Figure 14)

Traffic Operations

As Table 9 shows, the existing conditions have the worst average travel speeds and delays of all of the alternatives evaluated. The average travel speeds, total vehicle-miles, and total delay for the no-build alternative indicate an improvement over the existing conditions. This increase in performance for the no-build alternative is a result of the transportation improvement projects that will be implemented in the study area by 2030. These improvement projects are described in Chapter 4.

The widening of I-93 west of Route 24 (currently under construction) will add a travel lane and restore the breakdown lane in each direction. It will also provide a full travel lane and an acceleration lane to connect the two-lane ramp from northbound Route 24 to southbound I-93 so that the traffic from Route 24 can continue on southbound I-93 without merging directly into the I-93 southbound high-speed lane. The improvements under the no-build alternative will:

- Reduce the extent and duration of traffic congestion on I-93 (both directions) west of Route 24 during the AM peak period

TABLE 9
Comparison of Alternatives: Networkwide Performance Measures

			Total Peak-Period Traffic Volume		Average Speed (MPH)		Total Vehicle-Miles		Total Delay (Vehicle-Hours)		Delay (Seconds/Mile)		Cost
Alternative	**Concept Elements**	**Purpose of Improvement**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	(Construction cost does not include land takings)
Existing	None		77,500	82,700	30	29	528,052	545,407	7,010	7,934	48	52	None
2030 No-Build	• Construction of a fourth lane and a shoulder in each direction of I-93 west of Route 24.	• Restore the use of the breakdown lanes as travel lanes.	82,300	86,600	42	36	557,024	592,240	3,216	4,859	21	29	None
Alternative 1A	• Four travel lanes on Route 24 southbound. • Reconfigure the lanes at the entrance of Route 24 southbound.	• Improve safety at the entrance of Route 24 southbound • Reduce PM peak bottleneck on I-93 and Route 24 southbound.	82,500	87,450	44	44	561,541	607,182	2,713	2,881	18	17	$25–$30 million
Alternative 1B	• Four travel lanes on Route 24 southbound and five travel lanes on I-93 southbound. • Reconfigure the lanes at the entrance of Route 24 southbound and at the area where traffic diverges onto Route 24 from I-93 southbound.	• Improve safety at the entrance of Route 24 southbound. • Improve safety at area where traffic diverges onto Route 24 from I-93 southbound. • Reduce PM peak bottleneck on I-93 and Route 24 southbound.	82,650	88,600	44	47	564,197	616,442	2,646	2,278	17	13	$45–$50 million
Alternative 2A	• Four travel lanes in each direction of Route 24 southbound. • Reconfigure the lanes at the terminals of Route 24.	• Improve safety at the terminus of Route 24 (northbound and southbound) • Reduce AM and PM peak bottlenecks on I-93 and Route 24.	83,150	87,600	46	44	568,995	606,210	2,601	3,002	16	17	$45–$50 million
Alternative 2B	• Four travel lanes in each direction of Route 24 and five on I-93 southbound. • Reconfigure the lanes at the terminus of Route 24 and at the area where traffic diverges onto Route 24 from I-93 southbound.	• Improve safety at the terminus of Route 24 (northbound and southbound). • Improve safety at area where traffic diverges onto Route 24 from I-93 southbound. • Improve traffic operations on southbound I-93 and Route 24.	83,400	88,900	46	47	569,089	616,429	2,604	2,273	15	13	$65–$75 million
Alternative 3A	• Reconfigure the I-93/Route 24 interchange. • Four travel lanes in each direction of Route 24 southbound. • Reconfigure the lanes at the terminals of Route 24.	• Improve safety at the terminus of Route 24 (northbound and southbound). • Improve safety at the I-93/Route 24 interchange by eliminating the short weave distances. • Reduce AM and PM peak bottlenecks on I-93 and Route 24.	83,150	87,600	49	44	578,040	607,214	1,450	3,305	10	16	$100–$120 million
Alternative 3B	• Reconfigure the I-93/Route 24 interchange. • Four travel lanes in each direction of Route 24 and five on I-93 southbound. • Reconfigure the lanes at the terminus of Route 24 and at the area where traffic diverges onto Route 24 from I-93 southbound.	• Improve safety at the terminus of Route 24 (northbound and southbound). • Improve safety at the I-93/Route 24 interchange by eliminating the short weave distances. • Reduce AM and PM peak bottlenecks on I-93 and Route 24. • Improve traffic operations on southbound I-93 and Route 24.	83,400	88,900	49	49	579,969	620,214	1,503	1,805	10	10	$130–$150 million

TABLE 10
Comparison of Alternatives: Traffic Operations Improvements

Traffic Operations Problem	2030 No-Build		2030 Alt. 1A		2030 Alt. 1B		2030 Alt. 2A		2030 Alt. 2B		2030 Alt. 3A		2030 Alt. 3B	
	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)	Queue (miles)	Speed (mph)
Route 24 NB AM peak-period queue*	5.0	30	5.0	30	5.0	30	1.5	48	1.5	48	< 0.5	60	< 0.5	60
I-93 NB west of Route 24 PM peak-period queue	3.3	25	3.3	35	3.3	35	3.3	35	3.3	36	3.3	32	3.3	33
I-93 SB east of Route 24 PM peak-period queue**	3.5	25	3.5	30	< 0.5	52	3.5	30	< 0.5	52	3.5	30	< 0.5	52

Change from 2030 No Build
(Based on the above performance measures)

Traffic Operations Problem	2030 Alt. 1A	2030 Alt. 1B	2030 Alt. 2A	2030 Alt. 2B	2030 Alt. 3A	2030 Alt. 3B
Route 24 NB AM peak-period queue	Low	Low	Medium	Medium	High	High
I-93 NB west of Route 24 PM peak-period queue	Medium	Medium	Medium	Medium	Medium	Medium
I-93 SB east of Route 24 PM peak-period queue	Low	High	Low	High	Low	High

Alternatives 1A and 1B: Queue extends beyond interchange 20 (Route 139) on Route 24. Alternatives 2A and 2B: Queue extends midway between interchange 20 (Route 139) and interchange 21 (I-93) on Route 24. Alternatives 3A and 3B: No significant queue.

Alternatives 1A, 2A, and 3A: Queue extends into the Braintree split. Alternatives 1B, 2B, and 3B: No significant traffic queue.

TABLE 11
Comparison of Alternatives: Safety Improvements,
Change from the No-Build

Safety Problem	**2030 Alternative 1A**	**2030 Alternative 1B**	**2030 Alternative 2A**	**2030 Alternative 2B**	**2030 Alternative 3A**	**2030 Alternative 3B**
Traffic merging into 3 lanes on Route 24 SB	High	High	High	High	High	High
Traffic weaving and diverging onto Route 24 from I-93	None	Medium	None	Medium	High	High
Short weave distances on I-93 SB for the Route 28 SB traffic that is headed to Route 24 SB	None	None	None	None	High	High
Short weave distances on I-93 SB for the Route 24 NB traffic that is headed to Ponkapoag Trail	None	None	None	None	High	High

Note: Ratings are based on the degree that the improvement alternative addresses operations that contributes to the identified safety problem and qualitative assessment of the traffic safety impacts. The limited left-side merge distance on I-93 SB is addressed in the no-build scenario through the Route 128 Improvement Program.

- Moderately reduce the extent and duration of traffic congestion on Route 24 northbound during the AM peak period; there would still be traffic congestion and queuing on Route 24 that would extend to interchange 20 (Route 139)

The no-build alternative would not address traffic congestion and bottlenecks at these locations:

- I-93 northbound west of Route 24 during the PM peak period

- I-93 southbound east of Route 24 during the PM peak period

Traffic Safety

The no-build alternative would address the safety problems associated with the use of the breakdown lanes as travel lanes on I-93 west of Route 24. The widening in that section of I-93 would add a travel lane and restore the breakdown lane in each direction. The no-build alternative would also address the limited merge distance for the northbound Route 24 motorists merging on the left side directly into the I-93 high-speed lane. The widening of that section of I-93 would provide a full travel lane and an acceleration lane to connect the two-lane ramp from northbound Route 24 to southbound I-93 so that the traffic from Route 24 could continue on southbound I-93 without merging directly into the I-93 southbound high-speed lane.

The no-build alternative would not address safety problems identified in the study area that are created by:

- Traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge distance, and lack of clarity of who has the right-of-way

- Traffic weaving and lane-changing maneuvers involving motorists who are diverging from I-93 southbound onto Route 24 southbound

Two short weave distances on I-93 southbound: one for the Route 28 southbound traffic that is headed for Route 24, and the other for the Route 24 northbound traffic that is headed for Ponkapoag Trail

6.4.2 Alternative 1A: Four Travel Lanes on Route 24 Southbound (see Figure 15)

Traffic Operations

As Table 9 shows, the average travel speeds, total vehicle-miles, and total delay for Alternative 1A indicate an improvement over the no-build alternative for the PM peak period. This increase in performance under Alternative 1A is a result of addressing the traffic congestion and bottleneck problems on Route 24 southbound, which in turn would moderately improve traffic flow from both directions of I-93 to Route 24 southbound, especially during the PM peak period, when high volumes of traffic head southbound on Route 24. There would still be traffic congestion and queuing along the I-93 northbound and southbound segments that feed traffic to Route 24 southbound.

Alternative 1A would have the same impact on Route 24 northbound traffic as the no-build alternative during the AM peak period. There would still be traffic congestion and queuing on Route 24 that would extend to interchange 20 (Route 139).

Traffic Safety

Alternative 1A would provide all of the traffic safety benefits expected under the no-build alternative. In addition, it would lessen the safety problem involving traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge area, and lack of clarity about who has the right-of-way. This increase in traffic safety would result from the lane addition on Route 24 southbound, which would provide four travel lanes, including two for connecting each of the two-lane ramps from I-93, hence eliminating the merge area currently in operation.

Because there are no modifications to other elements of the I-93/Route 24 interchange, Alternative 1A would not address safety problems identified in the study area that are created by:

- Traffic weaving and lane-changing maneuvers involving motorists that are diverging onto Route 24 from I-93 southbound

- Two short weave distances on I-93 southbound: one for Route 28 southbound traffic that is headed for Route 24, and the other for Route 24 northbound traffic that is headed for Ponkapoag Trail

6.4.3 Alternative 1B: Four Travel Lanes on Route 24 Southbound and Five on I-93 Southbound (see Figure 16)

Traffic Operations

Alternative 1B would provide all the traffic operations benefits expected under Alternative 1A. In addition, as Tables 9 and 10 show, the average travel speeds, total vehicle-miles, and total delays for Alternative 1B indicate an improvement over Alternative 1A, especially during the PM peak period, when there are high traffic volumes heading south on I-93 and southbound on Route 24. This increase in performance under Alternative 1B is a result of addressing traffic congestion and bottleneck issues on I-93 southbound, which would help to reduce the PM peak-period traffic congestion in that corridor.

Alternative 1B does not offer any significant improvement over Alternative 1A during the AM peak period. This is because during the AM peak period on southbound I-93 there is no traffic congestion in the area where the additional lane was suggested. Alternative 1B would have the same impact on Route 24 northbound traffic as the no-build alternative and Alternative 1A during the AM peak period. There would still be traffic congestion and queuing on Route 24 that would extend to interchange 20 (Route 139).

Traffic Safety

Alternative 1B would provide all of the traffic safety benefits expected under Alternative 1A. In addition, it would lessen, to some extent, the safety problem involving weaving and lane-changing maneuvers of the traffic that is diverging onto Route 24 southbound from I-93 southbound (see Table 11). Providing five travel lanes and reconfiguring lane assignments on I-93 southbound would improve traffic flow on I-93 southbound. However, it would create another safety problem—the maneuver from Route 28 southbound to Route 24 southbound would become more difficult as an increased number of lane-changes would be required.

Alternative 1B would not address safety problems identified in the study area that are created by the two short weave distances on I-93 southbound: one for Route 28 southbound traffic that is headed for Route 24, and the other for Route 24 northbound traffic that is headed for Ponkapoag Trail.

6.4.4 Alternative 2A: Four Travel Lanes in Each Direction of Route 24 Southbound (see Figure 17)

Traffic Operations

Alternative 2A would provide all of the traffic operations benefits of Alternative 1A. In addition, as Tables 9 and 10 show, the average travel speeds, total vehicle-miles, and total delays for Alternative 2A would be an improvement over Alternatives 1A and 1B only during the AM peak period. This increase in performance results from adding a travel lane on Route 24 northbound that would make available four travel lanes: two for connecting to each two-lane ramp to I-93. Alternative 2A would reduce the congestion on Route 24 northbound and improve the AM peak-period traffic flow to the I-93 corridor. Alternative 2A would reduce the AM peak-period traffic queuing on Route 24 northbound to halfway in between interchange 20 (Route 139) and interchange 21 (I-93).

For PM peak-period operations, Alternative 1B would perform better than Alternative 2A; and Alternative 1B would reduce the extent and duration of PM peak-period congestion and bottlenecks on I-93 southbound from the Braintree split to Route 24, which Alternative 2A does not.

Traffic Safety

Alternative 2A would have the same traffic safety benefits and disadvantages as Alternative 1A (see Table 11). The additional travel lane on northbound Route 24 would primarily address traffic operations problems.

6.4.5 Alternative 2B: Four Travel Lanes in Each Direction of Route 24 Southbound and Five on I-93 Southbound (see Figure 18)

Traffic Operations

Alternative 2B would provide all of the traffic operations benefits of Alternative 1B. In addition, as Tables 9 and 10 show, the average travel speeds, total delays, and total vehicle-miles for Alternative 2B indicate improvement over Alternatives 1A, 1B, and 2A. This increase in performance under Alternative 2B is a result of addressing PM peak-period congestion and bottlenecks on I-93 southbound and AM peak-period congestion on Route 24 northbound by increasing the traffic capacities in those corridors. Alternative 2B would provide comprehensive traffic congestion relief in the study area.

Traffic Safety

Alternative 2B shares the same traffic safety benefits and disadvantages as Alternative 1B (see Table 11). Four travel lanes northbound on Route 24 would offer little in terms of traffic safety improvements.

6.4.6 Alternative 3A: Four Travel Lanes in Each Direction of Route 24 Southbound and Reconfigured I-93/Route 24 Interchange (see Figure 19)

Traffic Operations

Alternative 3A would provide all of the traffic operations benefits of Alternative 2A. In addition, as Table 9 shows, Alternative 3A would provide greater traffic operations benefits than Alternative 2A during the AM peak period—an indication that the reconfiguration would offer some improvement in terms of traffic operations benefits, as it would eliminate the weaving and lane-changing maneuvers at the I-93/Route 24 interchange. For PM peak-period operations, Alternatives 1B and 2B would perform better than Alternative 3A, as Alternatives 1B and 2B address PM peak-period congestion on I-93 southbound from the Braintree split to Route 24, which Alternative 3A does not.

On the other hand, the interchange is located in the Blue Hills Reservation and the reconfigured interchange with right-side entry and exit ramps would require land taking because the right-side ramps are outside of the roadway. Therefore the reconfiguration does not seem to be a cost-effective solution, considering its high construction costs and adverse environmental impacts on the Blue Hills Reservation. In addition, it would create two merge/weave sections on I-93 southbound. Environmental impact studies and a detailed review of the reconfiguration would be required to determine if this improvement is feasible.

Traffic Safety

The major benefit of Alternative 3A is that reconfiguration of the I-93/Route 24 interchange would address the traffic safety problems of short weave distances (lane changes and weaving) due to the close proximity of interchange 3 (Ponkapoag Trail) and interchange 5 (Route 28). Additional safety benefits of Alternative 3A are the increased safety provided through potential geometric improvements that are necessary for upgrading Route 24 to interstate standards. Such improvements include higher bridge clearances, wider shoulders, and a median barrier. However, the reconfiguration would also create two merge/weave sections on I-93 southbound that might impact safety at the interchange.

6.4.7 Alternative 3B: Four Travel Lanes in Each Direction of Route 24 Southbound, Five on I-93 Southbound, and Reconfigured I-93/Route 24 Interchange (see Figure 20)

Traffic Operations

Alternative 3B would have all the traffic operations benefits and shortcomings of Alternative 3A. In addition, as Tables 9 and 10 show, Alternative 3B offers improvement in traffic operations benefits over Alternative 2B during the AM peak period because the reconfiguration would eliminate the weaving and lane-changing maneuvers of Route 24 motorists accessing the Ponkapoag Trail exit. Alternative 3B would provide increased traffic congestion relief in the study area as it addresses the traffic congestion and bottlenecks on I-93 southbound east of Route 24 during the PM peak period, which were not addressed in Alternative 3A.

Traffic Safety

Alternative 3B would have the same safety benefits and disadvantages as Alternative 3A (see Table 11).

6.4.8 Other Improvements for Consideration (see Figures 21, 22, and 23)

The following section describes the impacts of additional improvements, which include prohibiting access to or from some ramps for safety reasons. As described earlier, these improvements could be added to Alternatives 1A, 1B, 2A, and 2B. They could not be added to Alternatives 3A or 3B, as the problems those alternatives are meant to address are already being addressed in Alternatives 3A and 3B.

Prohibit Route 24 Motorists from Accessing Ponkapoag Trail

This change would prohibit Route 24 northbound motorists from accessing Ponkapoag Trail and limit the I-93 southbound off-ramp to Ponkapoag Trail to serve only the traffic on I-93. This improvement would be expected to increase safety and facilitate traffic flow at the I-93/Route 24 interchange, especially during the AM peak travel period, when a high volume of traffic from Route 24 weaves across I-93 to exit at Ponkapoag Trail. It would eliminate the short weave distance for the Route 24 northbound motorists that are headed to Ponkapoag Trail and prevent the weaving and lane-changing maneuvers that take place at that location.

Currently, the off-ramp handles about 600 vehicles during AM peak hour and about 1,500 vehicles during AM peak period. A license plate survey conducted on the ramp indicated that about 60% of this traffic comes from the Route 24 corridor. The PM peak-period traffic volume is much lower. Specifically, the prohibition would eliminate from the ramp the 850 to 900 vehicles from Route 24 during the AM peak period that weave and change lanes in order to access Ponkapoag Trail.[16] A large portion of the traffic on the I-93 southbound off-ramp to Ponkapoag Trail is commuter traffic heading to Milton or Boston using the Blue Hill Parkway via Unquity Road, Hillside Street, and Blue Hill River Road.

[16] The data were obtained by a license plate survey that was conducted on May 9, 2007.

If the ramp access were prohibited for Route 24 northbound motorists, they would have two alternative access routes that would be equally attractive. As a result, the prohibition would be expected to split traffic evenly between these two alternative access routes. The first alternative would be the I-93 southbound off-ramp to Route 138 northbound, about 1.3 miles to the west of the Ponkapoag Trail exit. Motorists would then have the option of taking Route 138 northbound or using Blue Hill River Road/Hillside Road and Unquity Road to continue their journey to Milton or Boston. The second alternative would be the I-93 northbound off-ramp to Route 28 northbound, about 1.5 miles to the east of the Ponkapoag Trail exit. From Route 28, motorists would have the option of continuing on Route 28 or using Chickatawbut Road and Unquity Road, to continue their journey to Milton or Boston.

Therefore, prohibiting Route 24 motorists from accessing Ponkapoag Trail could send about 180 vehicles during the AM peak hour, or about 450 vehicles during the three-hour AM peak period, to I-93 interchange 2 (Route 138) and the same volumes to interchange 5 (Route 28). Because motorists would have two alternative access routes, the prohibition would not be expected to have any major adverse traffic impacts at either interchange 2 or interchange 5.

Prohibit Route 28 Southbound Motorists from Accessing Route 24 Southbound

Route 28 southbound motorists would be prohibited from accessing Route 24 southbound by limiting the I-93 southbound on-ramp to traffic continuing on I-93 southbound. This prohibition would prevent lane-changing and weaving maneuvers across the I-93 southbound lanes by the traffic proceeding to Route 24 southbound, eliminate the short weave distance, and increase safety at the I-93/Route 24 interchange.

Currently, the off-ramp handles about 500 vehicles during the PM peak hour and about 1,400 vehicles during the PM peak period. A license plate survey conducted on the ramp indicated that about 60% of this traffic goes to the Route 24 corridor. The AM peak-period traffic volume is lower than the PM volume. Specifically, the prohibition would eliminate from the ramp about 300 vehicles during the PM peak-hour and about 800 to 850 vehicles during the three-hour PM peak period that currently need to weave and change lanes within a short distance to get to Route 24.

If the ramp were restricted to serve only the traffic continuing on I-93 southbound, motorists would have two alternative access routes to Route 24. The primary alternative access for motorists heading to the Route 24 corridor would be a U-turn at interchange 3 (Ponkapoag Trail), which is about 1.5 miles to the west of the Route 28 on-ramp. This alternative access to Route 24 would not affect residential or commercial land uses. At I-93 interchange 3, the ramp terminals are presently controlled by stop and yield signs. During the PM peak period, when high volumes of traffic head southbound to Route 24, the I-93 northbound and southbound ramps at the Ponkapoag Trail exit currently handle about 200 and 600 vehicles per hour, respectively. Therefore, the prohibition could increase the volumes on the northbound and southbound ramps to about 500 and 900 vehicles per hour, respectively.

Some geometric improvements might be needed at the interchange to accommodate the U-turns. In addition, a loop ramp could be constructed in the northwest quadrant of interchange 3 (Ponkapoag Trail) as shown in Figure 22, to handle the traffic that would be diverted to the interchange as a result of the prohibition.

The secondary alternative access to Route 24 is via Routes 28 and 139 in Randolph. Route 28 through Randolph is congested during the AM and PM peak periods. It serves many residential and commercial land uses, and has severe capacity restrictions in the sections with only two lanes (one in each direction). Route 139 in Randolph and Canton serves residential and commercial land uses and is also congested during the peak travel periods. Based on the land uses and capacity restrictions in these corridors, not many motorists would choose this detour, as it is longer and slower than traveling on Route 24 southbound.

Construct a Loop Ramp in the Northwest Quadrant of I-93 Interchange 3 (Ponkapoag Trail) for Use by Route 28 Southbound Motorists Accessing Route 24

Construct a new loop ramp in the northwest quadrant of I-93 interchange 3 (Ponkapoag Trail) to allow Route 28 southbound motorists to access Route 24 (see Figure 22). This improvement is subject to the implementation of the improvements described above that would prohibit Route 28 southbound motorists from weaving across I-93 southbound lanes to access Route 24.

With the construction of the loop ramp, only right turns could be made from the I-93 southbound exit ramps to Ponkapoag Trail; that is the existing ramp would serve traffic heading to northbound Ponkapoag Trail, while the new loop ramp would serve traffic heading to southbound Ponkapoag Trail. The right-turn-only operation is more efficient than the U-turn operation, which involves left-turn maneuvers.

The loop ramp would supplement the existing ramp in the northeast quadrant and prevent the U-turn maneuvers described above. From the license plate survey data, it is estimated that the new ramp would handle about 300 vehicles during PM peak-hour and about 800 to 850 vehicles during the three-hour PM peak period.[17] This is the distribution of the traffic that currently weaves and change lanes within a short distance to get to Route 24.

Provide a Separate Ramp for Accessing Ponkapoag Trail from Route 24 Northbound

Construct a new ramp off of the Route 24 northbound connector to I-93 southbound to provide separate access to Ponkapoag Trail (see Figure 23). Construction of this ramp would eliminate the weaving and lane-changing maneuvers on southbound I-93 by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area. A physical barrier would be constructed to channel the traffic exiting from I-93 southbound to Ponkapoag Trail and to prevent a merge/weave problem on I-93 southbound in that vicinity.

A license plate survey conducted on the existing ramp during the AM peak period indicated that about 60% of the traffic on the Ponkapoag Trail exit ramp comes from the Route 24 corridor. Currently, the ramp handles about 600 vehicles during AM peak hour and about 1,500 vehicles during AM peak period. Thus, based on the license plate survey, the new ramp would handle about 850 to 900 vehicles on Route 24 during the AM peak period that weave and change lanes in order to access Ponkapoag Trail.[18]

[17] The data were obtained by a license plate survey that was conducted on May 9, 2007
[18] Ibid

This improvement addresses some of the safety problems that Alternatives 3A and 3B were meant to address on I-93 southbound west of Route 24 and may offer a less costly alternative than those alternatives.

6.5 SUMMARY

A brief summary of the results of the evaluation follows. The summary is in two parts: one based on the type of improvement and the other based on the different alternatives.

Based on the Type of Improvement

- The highway improvements expected in the vicinity of the I-93/Route 24 interchange by 2030 (the no-build alternative) would address the safety problems associated with the use of the breakdown lanes as travel lanes on I-93 west of Route 24. They would also help to reduce to some degree the extent and duration of congestion on I-93 west of Route 24 and on Route 24 northbound during the AM peak period. The AM peak-period average traffic queue on northbound Route 24 would extend to interchange 20 (Route 139).

- Four travel lanes on Route 24 southbound (in all of the alternatives) would address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge area, and lack of clarity about who has the right-of-way. To some degree (depending on the alternative), this improvement would address traffic congestion and bottlenecks on Route 24 southbound, which would improve traffic flow from both directions of I-93 to Route 24 southbound.

- Five travel lanes on I-93 southbound (Alternatives 1B, 2B, and 3B) would address the PM peak-period traffic congestion and bottlenecks in this corridor, especially when coupled with the lane addition on Route 24 southbound. This improvement, combined with the reconfiguration of the lane assignments at the diverge area, would improve traffic safety by reducing traffic weaving and lane-changing maneuvers involving motorists that are diverging onto Route 24 from I-93 southbound.

  However, five travel lanes would make the maneuver from Route 28 southbound across the I-93 southbound lanes to Route 24 more difficult. Prohibiting Route 28 southbound motorists from accessing Route 24 by channeling all the ramp traffic to continue on I-93 southbound would prevent the lane-changing and weaving maneuvers across the I-93 southbound lanes. Motorists would have to make a U-turn at interchange 3 in order to go to Route 24.

- Four travel lanes on Route 24 northbound (Alternatives 2A, 2B, 3A, and 3B) would improve traffic flow on Route 24 northbound and reduce the long AM peak-period traffic congestion and queuing of traffic heading to the I-93 corridor. With four travel lanes, the traffic queue on Route 24 northbound during the AM peak period would be reduced to one-half that of the no-build alternative. It would extend to midway between interchange 20 (Route 139) and interchange 21 (I-93).

- Reconfiguring the I-93/Route 24 interchange as in Alternatives 3A and 3B would address the safety problems identified in the study area that were created by the two short weave distances on I-93 southbound: one for the Route 28 southbound motorists that are headed for Route 24, and the other for the Route 24 northbound motorists that are headed for Ponkapoag Trail. The reconfiguration would also improve traffic flow from Route 24 northbound to I-93 during the AM peak period, and would reduce the recurring traffic queue considerably.

  On the other hand, the interchange is located in the Blue Hills Reservation, the reconfigured interchange with right-side entry and exit ramps would require land taking because the right-side ramps would be outside of the roadway, therefore, the reconfiguration does not seem to be a cost-effective solution, considering its high construction cost and adverse environmental impact on the Blue Hills Reservation. In addition, it would create two merge/weave sections on I-93 southbound that would impact traffic safety. Environmental impact studies and a detailed review of the reconfiguration would be required to determine if this improvement is feasible.

- Prohibiting Route 24 northbound motorists from accessing the Ponkapoag Trail exit, and restricting its use to serve only the traffic from I-93 southbound, would prevent weaving and lane-changing maneuvers across I-93 southbound lanes. However, this improvement would divert traffic to interchange 2 (Route 138) and interchange 5 (Route 28).

- Prohibiting Route 28 southbound motorists from accessing Route 24 by channeling all the ramp traffic to continue on I-93 southbound would prevent the lane-changing and weaving maneuvers across the I-93 southbound lanes. This improvement could present a problem at interchange 3 (Ponkapoag Trail) during the PM peak period, when the diverted traffic making U-turns at interchange 3 would be expected to increase the traffic volume on the northbound on-ramp. Some geometric improvements might be needed at the interchange to accommodate the U-turns.

- Constructing a new loop ramp in the northwest quadrant of interchange 3 (Ponkapoag Trail) to allow Route 28 southbound motorists to access Route 24 would supplement the existing ramp in the northeast quadrant and prevent the U-turn maneuvers described above.

- Constructing a new ramp off of the Route 24 northbound connector to I-93 southbound to provide a separate right-side access to Ponkapoag Trail would eliminate the weaving and lane-changing maneuvers across the southbound I-93 lanes by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area.

Based on Alternatives

Alternatives 1A and 1B

- Alternatives 1A and 1B do not address traffic congestion on northbound Route 24 during the AM peak period.

- Alternative 1B addresses the PM peak-period congestion on southbound I-93, which is not addressed by Alternative 1A.

- Both Alternatives 1A and 1B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge area, and lack of clarity about who has the right-of-way.

- Neither Alternative 1A nor 1B addresses the safety problem of short weave distances on I-93 southbound: one for the Route 28 southbound motorists that are headed for Route 24, and the other for the Route 24 northbound motorists that are headed for Ponkapoag Trail.

Alternatives 2A and 2B

- Alternatives 2A and 2B would moderately reduce traffic congestion on northbound Route 24 during the AM peak period.

- Alternative 2B addresses the PM peak-period congestion on southbound I-93 during the PM peak period, which is not addressed by Alternative 2A.

- Both Alternatives 2A and 2B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge area, and lack of clarity of who has the right-of-way.

- Alternatives 2A and 2B do not address the safety problem of the short weave distances on I-93 southbound; one for the Route 28 southbound motorists that are headed for Route 24, and the other for the Route 24 northbound motorists that are headed for Ponkapoag Trail.

Alternatives 1B and 2B

- Alternatives 1B and 2B, which include five travel lanes on southbound I-93, would reduce the PM peak-period congestion, but would make maneuvers from Route 28 southbound to Route 24 southbound more difficult as they would increase the number of lane-changes required.

  Prohibiting Route 28 southbound motorists from accessing Route 24 by channeling the I-93 southbound on-ramp to continue on I-93 southbound would prevent the lane-changing and weaving maneuvers across the I-93 southbound lanes and therefore increase safety. However, this improvement would be expected to divert traffic to interchange 3 (Ponkapoag Trail).

Alternatives 3A and 3B

- Alternatives 3A and 3B address traffic congestion on northbound Route 24 during the AM peak period.

- Alternative 3B addresses the PM peak-period congestion on southbound I-93 during the PM peak period, which is not addressed by Alternative 3A.

- Both Alternatives 3A and 3B address the traffic safety problems associated with traffic merging into three lanes on Route 24 southbound, where motorists avoid the middle lane because of a short sight distance, limited merge area, and lack of clarity about who has the right-of-way.

- Reconfiguring the I-93/Route 24 interchange as described in Alternatives 3A and 3B would address the safety problems identified in the study area that were created by two short weave distances on I-93 southbound: one for the Route 28 southbound motorists that are headed for Route 24, and the other for the Route 24 northbound motorists that are headed for Ponkapoag Trail.

- Reconfiguring the I-93/Route 24 interchange would have significant environmental impacts. The interchange is located in the Blue Hills Reservation and the reconfigured interchange, with right-side entry and exit ramps, would require land taking because the right-side ramps would be outside of the roadway.

- The reconfiguration would create two merge/weave sections on I-93 southbound that would impact traffic safety.

- The reconfiguration may not be a cost-effective solution, considering its high construction costs and adverse environmental impact on the Blue Hills Reservation. Environmental impact studies and a detailed review of the reconfiguration would be required to determine if this improvement is feasible.

7 RECOMMENDATIONS: POTENTIAL IMPROVEMENTS AND STAGING

The recommendations of this study were made based on the suggestions from the advisory task force. One of the responsibilities of the task force was to assist in making recommendations for implementation by MassHighway. At the second task force meeting, the results of the study were presented to members of the task force for comments, feedback, and what they thought should be the recommendations of this study.

7.1 STAGING OF IMPROVEMENTS

Members of the task force suggested that the recommended improvements from the study should be staged or structured rather than just choosing one alternative to recommend. They suggested that the recommended improvements be separated into short-term projects that can be constructed in a short time frame (less than 10 years), intermediate-term projects that can be constructed within 10 to 15 years, and long-term projects, which may take more than 15 years to implement.

The reasons for staging or structuring the recommended improvements were to focus first on effective low-cost safety improvements and improvements that eliminate peak-period capacity deficiencies and bottlenecks. Additional reasons were that staging the recommended improvements would allow some flexibility in implementing the recommended improvements, an important consideration because of the limited transportation funding available. Also, by staging the improvements, the impact of some of the projects in the no-build and build scenarios would be known, and that would provide information for making changes in the future.

7.2 CRITERIA FOR STAGING

The following criteria were used in staging the recommended improvements:

- The degree to which an improvement addresses safety and/or peak-period capacity deficiencies/bottlenecks
- The cost of implementing the improvement
- Whether an improvement can be constructed within the existing right-of-way
- The magnitude of the environmental impact studies involved

Because some of the projects involve would adding a travel lane that would require widening of the bridges along Route 24 and I-93, the American Association of State Highway and Transportation Officials (AASHTO) bridge rating of the bridges along I-93 and Route 24 were obtained to identify which bridges are structurally deficient, functionally obsolete, or in good condition.

Table 12 lists the conditions of the bridges in the study's primary area, where improvements were proposed. The data were obtained from MassHighway's 2006 bridge inventory system. Two bridges on Route 24 within the study area where improvements were proposed are structurally deficient and have to be replaced soon. They are the Route 139 bridge over Route 24 and the Department of Conservation and Recreation (DCR) Horse Access Bridge over Route 24. The Route 24 bridge over Canton Street and the I-93 bridge over Route 28 are in good condition. The remaining bridges across I-93 are functionally obsolete, meaning that they do not meet some of the current design standards.

Structurally deficient bridges need to be replaced or rehabilitated within a short time period, while functionally obsolete bridges need to be upgraded to conform to current standards. Structurally deficient refers to bridges needing significant maintenance attention, rehabilitation, or replacement. A structurally deficient bridge is one that has experienced deterioration significant enough to potentially reduce its load-carrying capacity, but that does not mean that it is an unsafe structure. A functionally obsolete bridge is one that does not meet all of the current highway design standards—the evaluation criteria include bridge width, traffic volumes, lane widths, shoulder widths, vertical clearances, and the condition of approach roadways. Functional obsolescence is not necessarily caused by a deficiency in the bridge itself, nor is it an immediate safety concern. Based on the criteria described above and on conditions of bridges in the study areas, the improvements were staged as short-term, intermediate-term, and long-term projects.

7.3 SHORT-TERM ALTERNATIVES

The following section describes the short-term alternatives (shown in green in Figure 24). The short-term alternatives are low-cost, quick fixes, and would result in safety improvements. They would require few if any, environmental impact studies as they can be carried out within the existing right-of-way. These short-term alternatives are described in detail in Chapters 5 and 6.

Prohibit Route 24 Motorists from Accessing Ponkapoag Trail (Cost: $2.0–4.0 million).

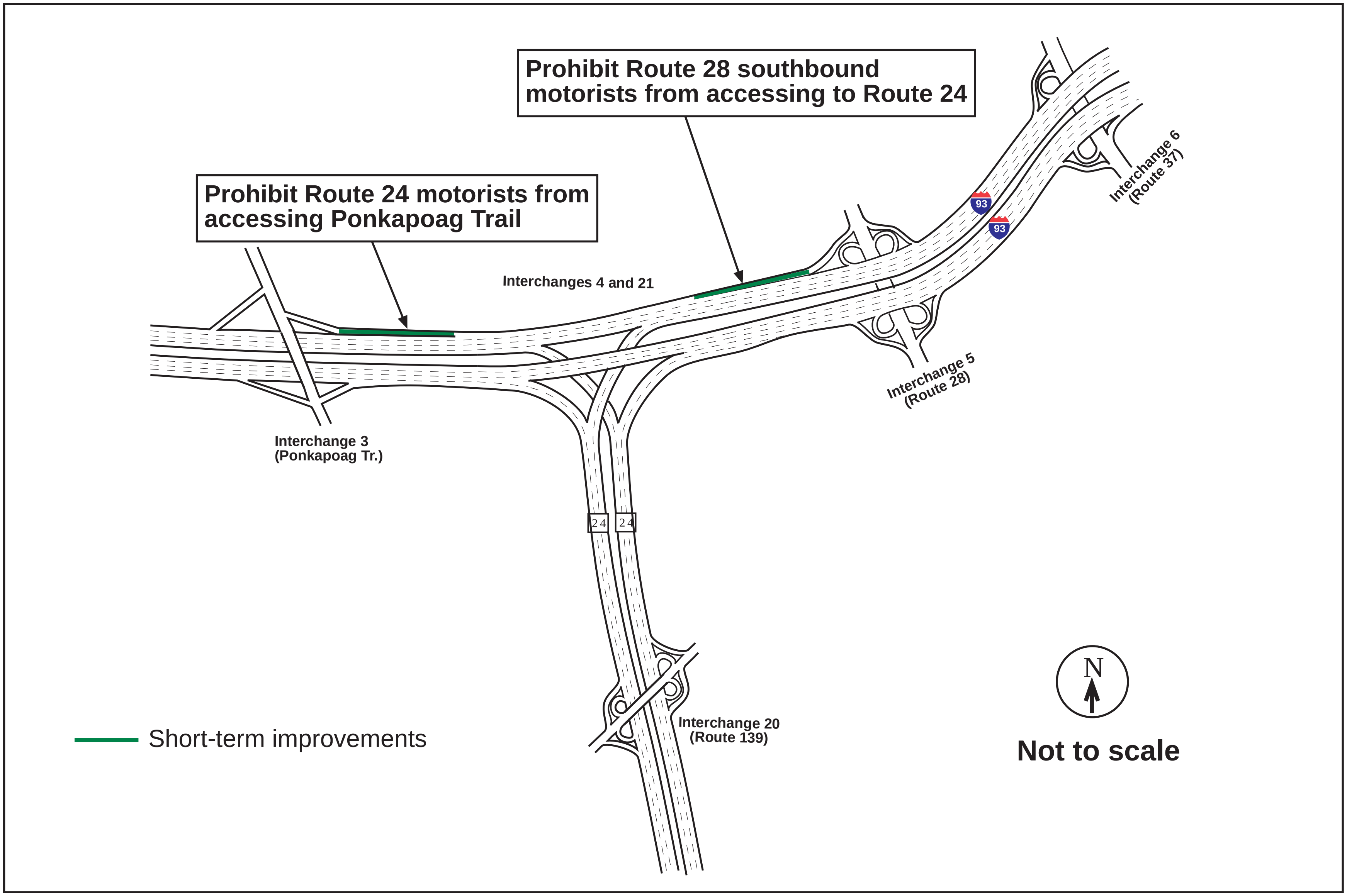
This change would prohibit Route 24 northbound motorists from accessing Ponkapoag Trail and would limit the I-93 southbound off-ramp to Ponkapoag Trail to serving only the traffic coming from I-93 southbound. This improvement would be expected to increase safety and facilitate traffic flow at the I-93/Route 24 interchange, especially during the AM peak travel period, when a high volume of traffic from Route 24 weaves across I-93 southbound lanes to exit at Ponkapoag Trail. It would eliminate the short weave distance for the Route 24 northbound motorists that are headed to Ponkapoag Trail and prevent the weaving and lane-changing maneuvers that take place at that location. Specifically, the prohibition would eliminate the 850 to 900 vehicles from Route 24 during the AM peak period that weave and change lanes across I-93 southbound lanes in order to access Ponkapoag Trail.[19]

[19] A license plate survey conducted on May 9, 2007.

TABLE 12
Condition of Bridges in the Study Area

Bridge	Town	Bridge Overpass	Bridge Underpass	Owner	Year Built	AASHTO Rating	Deficiency
I-93/Route 28	Randolph	I-93 NB	Route 28	MassHighway	1958	83.0	Meets standards
I-93/Route 28	Quincy	I-93 SB	Route 28	MassHighway	1958	79.0	Functionally Obsolete
I-93/Route 24	Randolph	1-93 NB	Route 24 SB	MassHighway	1958	62.3	Functionally Obsolete
I-93/Route 24	Randolph	1-93 NB	Route 24 NB	MassHighway	1958	75.4	Functionally Obsolete
I-93/ Ponkapoag Trail	Milton	Ponkapoag Trail	I-93	MassHighway	1958	79.4	Functionally Obsolete
DCR's Horse Access Bridge/Route 24	Randolph	DCR's Horse Access Bridge	Route 24	MassHighway	1958	46.1	Structurally deficient
Route 139/Route 24	Stoughton	Route 139	Route 24	MassHighway	1956	73.5	Structurally deficient
Route 24/Canton St.	Randolph	Route 24	Canton St.	MassHighway	1957	64.9	Meets Standards

Note: Shading denotes structurally deficient bridges.
*NA = Not applicable



CTPS

FIGURE 24
Recommended Improvements:
Short-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

A large portion of Route 24 northbound traffic is commuter traffic to Milton or Boston using Blue Hill Parkway via Unquity Road, Hillside Street, and Blue Hill River Road. If ramp access were prohibited, Route 24 northbound motorists would have two alternative access routes.

The first alternative access route would be the I-93 southbound off-ramp to Route 138 northbound, about 1.3 miles to the west of the Ponkapoag Trail exit. Motorists would then have the option of taking Route 138 northbound or using Blue Hill River Road/Hillside Road and Unquity Road to continue their journey to Milton or Boston. The second alternative access route would be the I-93 northbound off-ramp to Route 28 northbound, about 1.5 miles to the east of the Ponkapoag Trail exit. From Route 28, motorists would have the option of continuing on Route 28 or using Chickatawbut Road and Unquity Road to continue their journey to Milton or Boston.

Because motorists would have two attractive alternative access routes, the prohibition would be expected to split traffic evenly onto the two access routes and would not be expected to have any major adverse traffic impact at interchange 2 (Route 138) or interchange 5 (Route 28).

Prohibit Route 28 Motorists from Accessing Route 24 Southbound (Cost: $2.0–4.0 million).

This change would prohibit Route 28 southbound motorists from accessing Route 24 southbound by limiting the I-93 southbound on-ramp to traffic continuing on I-93 southbound. This prohibition would prevent lane-changing and weaving maneuvers across the I-93 southbound lanes by motorists proceeding to Route 24 southbound. It would also increase safety at the I-93/ Route 24 interchange and eliminate the short weave distance. Specifically, the prohibition is expected to eliminate the 800 to 850 vehicles on Route 28 during the three-hour PM peak period that weave and change lanes within a short distance in order to get to Route 24.[20]

If the ramp were restricted to serving only the traffic continuing on I-93 southbound, motorists would have two alternative access routes to Route 24. The primary alternative access route for motorists heading to the Route 24 corridor would be a U-turn at interchange 3 (Ponkapoag Trail), which is about 1.5 miles to the west of interchange 5 (Route 28). At I-93 interchange 3, the ramp terminals are presently controlled by stop and yield signs, and the ramps would need some geometric improvements to accommodate the U-turns. This alternative access to Route 24 would not affect residential or commercial land uses.

The secondary alternative access route for motorists heading to Route 24 is via Routes 28 and 139 in Randolph. Route 28 through Randolph is congested in the southbound direction during the PM peak period. It serves many residential and commercial land uses, and has severe capacity restrictions in the sections with only two lanes (one lane in each direction). Route 139 in Randolph and Canton serves residential and commercial land uses and is also congested during the PM peak travel period. Based on the land uses and capacity restrictions in these corridors, not many motorists would choose this detour, as it is longer and slower compared to traveling on Route 24 southbound.

[20] Data from a license plate survey was conducted on May 9, 2007.

7.4 INTERMEDIATE-TERM ALTERNATIVES

The following section describes the intermediate-term alternatives (shown in Figure 25 in blue, along with the short-term alternatives, in green). The intermediate-term alternatives are medium-cost safety and operational improvements and are largely located in the highway sections with structurally deficient bridges that could be considered for replacement in the intermediate term. Implementing any of the intermediate-term alternatives described below, or a combination of them, could result in implementation of Alternative 1A, Alternative 1B, Alternative 2A, or Alternative 2B (see Chapters 5 and 6). All of the intermediate-term alternatives would require environmental impact studies.

Construct a Loop Ramp in the Northwest Quadrant of Interchange 3 (Ponkapoag Trail) to Allow Route 28 Southbound Motorists to Access Route 24 (Cost: $3–5 million)

Construct a new loop ramp in the northwest quadrant of interchange 3 (Ponkapoag Trail) to allow Route 28 southbound motorists to access Route 24 (see Figure 22). This improvement would be subject to implementation of the improvements described above that would prohibit Route 28 southbound motorists from weaving across I-93 southbound lanes to access Route 24.

With the construction of the loop ramp, only right turns could be made from the I-93 southbound exit ramps to Ponkapoag Trail; that is, the existing ramp would serve traffic heading northbound on Ponkapoag Trail, while the new loop ramp would serve traffic heading southbound on Ponkapoag Trail. The right-turn-only operation would be more efficient than the U-turn operation, which involves left-turn maneuvers.

The loop ramp would supplement the existing ramp in the northeast quadrant and prevent the U-turn maneuvers described above. The new ramp would handle about 300 vehicles during the PM peak hour and about 800 to 850 vehicles during the three-hour PM peak period based, on the license plate survey.[21]

Construct a Fourth Travel Lane on Route 24 Southbound (Cost: $25–$30 million)

This improvement constitutes Alternative 1A and includes the following modifications:

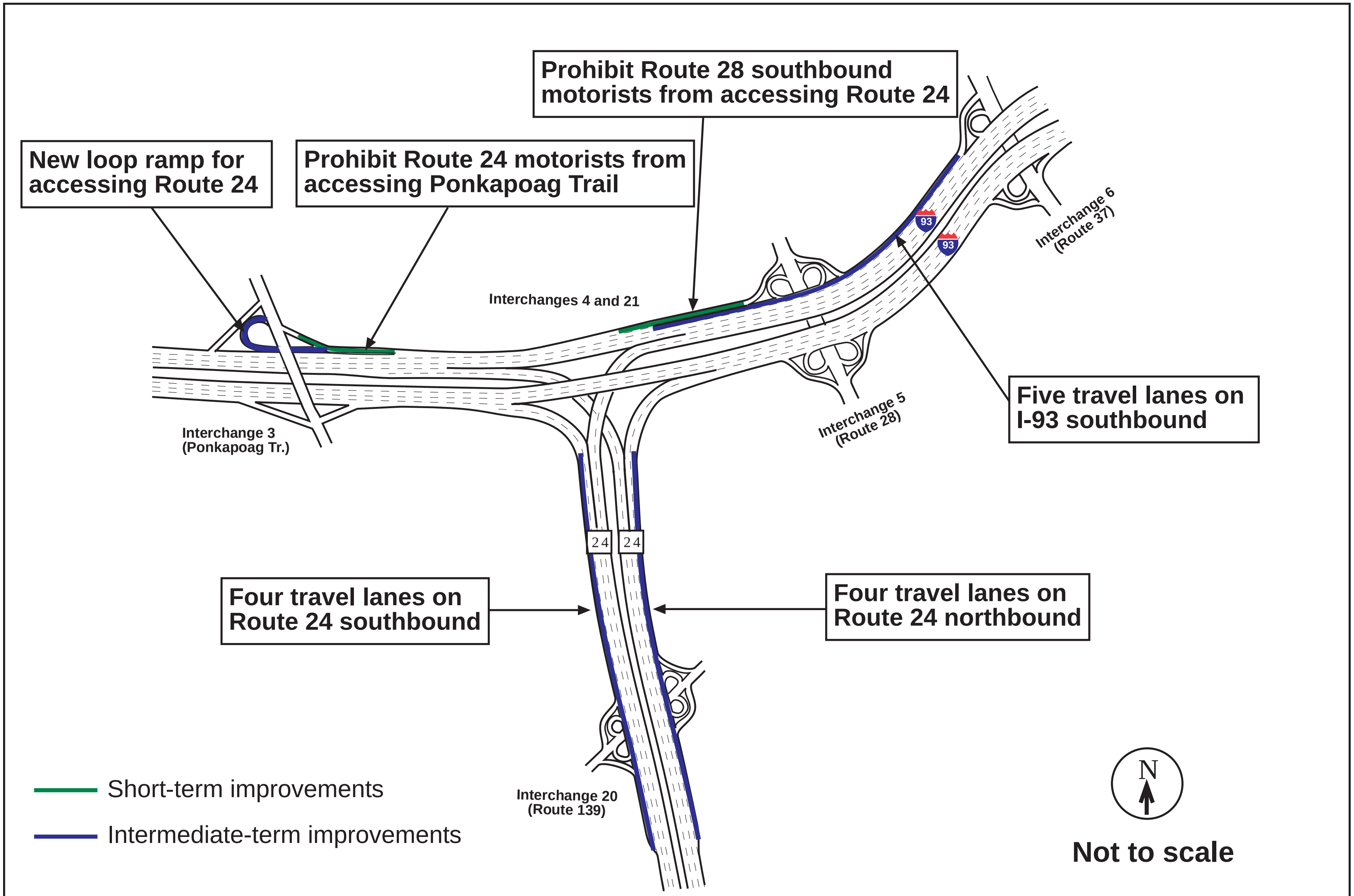
- Four travel lanes on southbound Route 24, beginning at interchange 21 (I-93) in Randolph and ending just after interchange 20 (Route 139) in Stoughton.

- Reconfigured lanes at the entrance to southbound Route 24 to receive four travel lanes from the two two-lane ramps.

- Widening the Route 139 bridge, Route 24 bridge over Canton Street, and the DCR's Horse Access Bridge over Route 24 (structurally deficient bridges).

- New or modified signs to guide and inform motorists to Route 24.

[21] Data from a license plate survey was conducted on May 9, 2007.



CTPS

FIGURE 25
Recommended Improvements:
Short- and Intermediate-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

The construction of a fourth southbound travel lane would help address the safety problems at the merge area on southbound Route 24, where motorists avoid the middle travel lane because of lack of clarity about who has the right-of-way, a limited merge area, and poor sight distance. Additionally, it would be expected to moderately reduce the extent and duration of the PM peak-period traffic bottleneck and congestion created by high volumes of traffic from I-93 merging into three lanes on Route 24 southbound.

The construction cost for the fourth travel lane is estimated to be $25 to $30 million. This cost includes lengthening of the Route 139 bridge over Route 24, the Route 24 bridge over Canton Street, and the DCR'S Horse Access Bridge over Route 24 to accommodate the additional lane.

Construct a Fifth Travel Lane on I-93 Southbound (Cost: $20-$25 million)

A fifth travel lane on I-93 southbound from the southbound on-ramp from Route 37 to just after the exit ramp to southbound Route 24 should be constructed after the completion of the fourth southbound lane on Route 24. The reason for this is that the five travel lanes on I-93 southbound would facilitate traffic flow to Route 24 and to I-93 southbound past Route 24. Therefore, a downstream bottleneck on Route 24 southbound could reduce the benefits of five travel lanes on I-93 southbound during the PM peak period. Additional improvements linked with the construction of the fifth travel lane on I-93 southbound are:

- Reconfigured lanes in the area where traffic diverges from southbound I-93 onto Route 24, to provide two exclusive travel lanes to Route 24 and three lanes to continue on I-93

- Lengthening of the I-93 bridge over Route 28 (a functionally obsolete bridge)

- New or modified signs on I-93 to guide motorists

Five travel lanes on I-93 southbound, coupled with four travel lanes on southbound Route 24 and the short-term alternatives described above, would improve safety and operations. In addition, the short-term alternatives described above would eliminate the difficult maneuver that the fifth lane would pose to Route 28 southbound motorists accessing Route 24. The five travel lanes would reduce the PM peak-period congestion and bottleneck and facilitate traffic flow on I-93 southbound especially traffic going to Route 24 to take advantage of the proposed four southbound travel lanes. Also, those four travel lanes would improve safety at the merge area and facilitate traffic flow on Route 24.

The construction cost for the fifth travel lane is estimated to be $20 to $25 million. This cost includes lengthening of the I-93 bridge over Route 28 to accommodate the additional lane.

Construct a Fourth Travel Lane on Route 24 Northbound (Cost: $25–$30 million)

Even though Route 128 Improvement Program is expected to moderately reduce the AM peak-period congestion on Route 24, construction of the proposed fourth lane on Route 24 northbound is included in the intermediate-term alternatives because it ties in with the lengthening of the bridges for the southbound lanes. The improvements would include:

- Four travel lanes on northbound Route 24 from just south of interchange 20 (Route 139) in Stoughton to interchange 21 (I-93) in Randolph
- Reconfigured lanes at the diverge area to I-93 to provide two lanes to connect to each of the two-lane ramps
- Lengthening the Route 139 bridge, the Route 24 bridge over Canton Street, and the DCR's Horse Access Bridge over Route 24 (structurally deficient bridges)
- New or modified signs on northbound Route 24 to guide motorists to I-93

Four travel lanes in the northbound direction of Route 24 would improve traffic flow on Route 24 northbound. It would reduce the long AM peak-period traffic congestion and queuing of vehicles heading to the I-93 corridor.

The construction cost for the fourth northbound lane is estimated to be $25 to $30 million. This cost includes lengthening of the Route 139 bridge over Route 24, the Route 24 bridge over Canton Street, and the DCR'S Horse Access Bridge over Route 24 to accommodate the additional lane. The cost of lengthening the bridges over Route 24 has also been included in the construction cost for the fourth southbound travel lane.

7.5 LONG-TERM ALTERNATIVES

The long-term alternatives are high-cost safety and operational improvements located in an area with functionally obsolete bridges that may not be considered for replacement in the intermediate term. Additionally, the long-term alternatives would require significant environmental impact studies to determine their feasibility.

Implementing the long-term alternatives, in addition to some of the intermediate-term alternatives described above, would result in implementation of either Alternative 3A or Alternative 3B. The long-term alternatives are described below and are also shown in Figure 26, enclosed with a red circle. Also shown in Figure 26 are the intermediate-term alternatives, shown in blue.

Provide a Separate Ramp for Accessing Ponkapoag Trail from Route 24 Northbound (Cost: $10–15 million)

Create a new ramp off of the Route 24 northbound connector to I-93 southbound to provide separate access to Ponkapoag Trail (see Figure 23). The objectives are to eliminate the weaving and lane-changing maneuvers across southbound I-93 lanes by the Route 24 northbound motorists that are headed for Ponkapoag Trail without diverting them to other interchanges in the study area; that is, to provide another way for the Route 24 motorists to access Ponkapoag Trail. The new ramp would provide a right merge with the I-93 southbound traffic exiting to Ponkapoag Trail, and would handle about 850 to 900 vehicles from Route 24 during the AM peak period that weave and change lanes in order to access Ponkapoag Trail.[22] A large portion of

[22] Data from a license plate survey was conducted on May 9, 2007.

the traffic on the I-93 southbound exit ramp to Ponkapoag Trail is commuter traffic heading to Milton or Boston. This improvement addresses some of the safety problems that Alternatives 3A and 3B were meant to address on I-93 southbound west of Route 24, and it may offer a less costly alternative than either of those alternatives. The construction cost for these improvements is estimated to be $10 to $15 million.

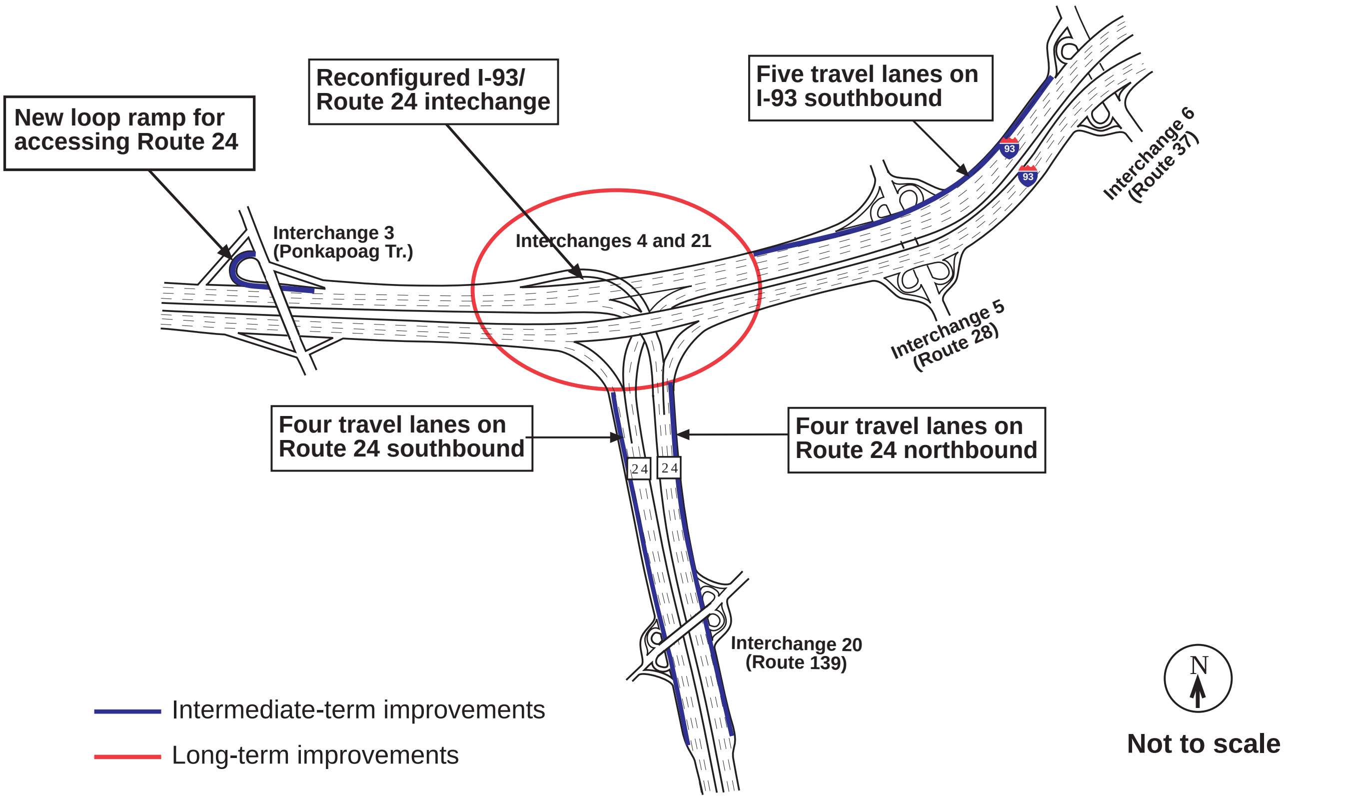
Reconfigure the I-93/Route 24 Interchange ($60–$80 million)

This improvement includes redesigning and upgrading the I-93/Route 24 interchange. These potential geometric improvements are necessary for upgrading Route 24 to interstate standards and would include upgrading the bridges from functionally obsolete to current standards. All four ramps from I-93 to Route 24 would need to be reconstructed in order for three bridges to be raised to meet the 16.5-foot clearance standard.

On the one hand, this improvement would eliminate the short weave distances created by the closely spaced interchanges by providing right-side entry and exit ramps. In other words, it would address the safety problems created by the difficult maneuvers from Route 28 southbound to Route 24 southbound and from Route 24 northbound to Ponkapoag Trail that occur when there are no prohibitions.

On the other hand, the interchange is located in the Blue Hills Reservation, therefore, the reconfigured interchange with right-side entry and exit ramps would require land-taking because the right-side ramps would be located outside of the roadway. The reconfiguration is not a cost-effective solution, considering its high construction cost, adverse environmental impact on the Blue Hills Reservation, and two merge/weave sections it would create on I-93 southbound. Environmental impact studies and detailed review of the reconfiguration would be required to determine if this improvement is feasible.

The construction cost for these improvements is estimated to be $60 to $80 million. This cost includes upgrading the bridges and ramps at the interchange.



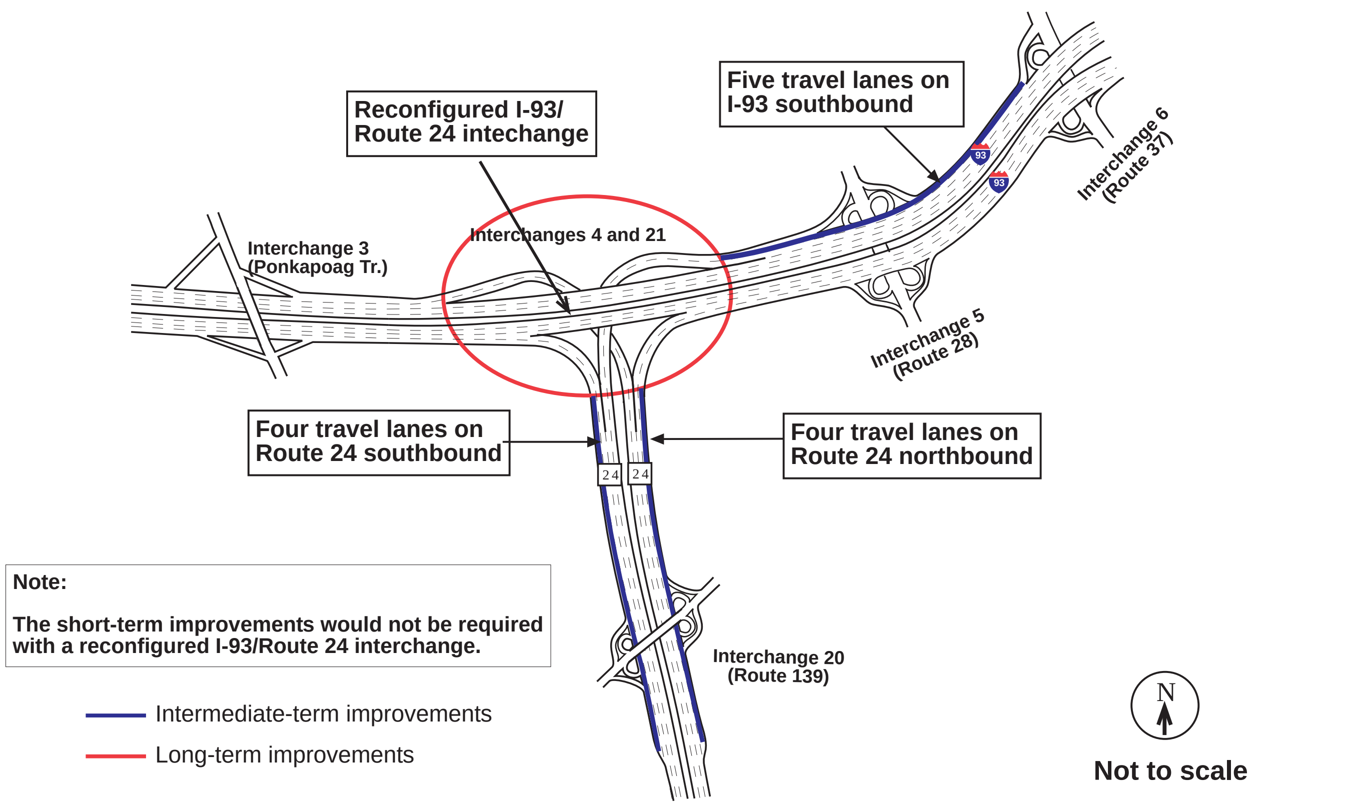


FIGURE 26
Recommended Improvements:
Intermediate- and Long-Term Alternatives

Safety and Operational Improvements for the I-93/Route 24 Interchange

8 IMPLEMENTATION PROCESS

This chapter describes the processes by which the recommendations may be implemented. In general, all the recommended improvements are located on roadways administered by MassHighway. Therefore, MassHighway is responsible for the implementation of any of these improvements. The implementation of improvements would follow the standard process, outlined below, that any proponent of a roadway improvement is required to follow. As described, the process provides for the participation of the general public, community representatives, and other agencies. The projects would be eligible for state and federal funding.

The following description of the implementation process is based on Chapter 2 of the *Massachusetts Highway Department Project Development and Design Guide* (2005). The text below borrows heavily from that document.

Needs Identification

For each of the locations at which an improvement is to be implemented, MassHighway leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassHighway meets with potential participants, such as the Boston Region Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassHighway district office whose jurisdiction includes the location of the proposed project. MassHighway also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

Project Initiation

At this point in the process, the proponent, MassHighway, fills out, for each improvement, a Project Initiation Form (PIF), which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the Capital Expenditure Program Office (CEPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the Executive Office of Transportation and Public Works's statewide priorities and criteria. If the result is positive, MassHighway moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign a project evaluation criteria score, possibly a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

Environmental, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP.

Programming

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, where the MPO receives preliminary information on the proposed project, the proponent requests that the MPO place the project in the region's TIP. The MPO considers the project in terms of regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

Procurement

Following project design and programming, MassHighway publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

Construction

After a construction contract is awarded, MassHighway and the contractor develop a public participation plan and a management plan for the construction process.

Project Assessment

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassHighway can apply what is learned in this process to future projects.

APPENDIX A Public Participation

A.1 Advisory Task Force Meetings

A.2 Public Comments

A.1 Advisory Task Force Meetings

1st Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall
November 13, 2006

Agenda

- Introductions
- Scope of study
- Inventory of traffic concerns
- Analysis of existing conditions
- Development of improvement alternatives
- Feedback and discussion
- Other business

Minutes of the 1st Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall

November 13, 2006

The meeting started at 10:15 AM with introductions. The agenda and list of people who attended the meeting are attached.

Seth Asante, the project manager, presented the existing traffic safety and operational conditions in the study area. The presentation included the origin and scope of the study, an inventory of traffic and safety concerns, and analyses of existing conditions (traffic and crash characteristics), planned and proposed projects, and development of improvements.

After the presentation, the task force agreed that the data and information on safety and traffic operations in the presentation accurately reflect the existing travel conditions in the study area.

The task force also asked that a detailed breakdown of the crashes be made available. Seth Asante indicated that the breakdown of the crashes at each interchange by crash type, severity, time of day, light conditions, and roadway conditions is available. It would be distributed at the next meeting of the advisory task force.

A member of advisory task force suggested that the study be expanded southward on Route 24 to Brockton. Upon further discussion, the task force determined that the study area should stay within the Boston Region MPO as it was defined in the work program, because of funding and jurisdictional issues. However, the advisory task force agreed that in the testing of the improvements the model area should be extended on Route 24 to Harrison Boulevard (interchange 19). The task force also suggested that the Old Colony Planning Council (OCPC) and the Southeastern Regional Planning and Economic Development District (SRPEDD) could expand on this study within their jurisdictions.

A member of the task force asked that the study include a bus lane or an HOV lane on Route 24 from the Route 139 interchange up to the Braintree Split on I-93. An official from MassHighway indicated that this proposal has been examined before and that it would be difficult to extend the HOV lane through the Braintree Split because of merging, weaving, and right-of-way issues. The task force asked the project manager to determine the right-of-way and environmental issues in the Route 24 and I-93 corridors within the study area.

A member of the task force raised the issue of Route 24 interstate conversion. A representative from EOT said she would look into it.

On the development of improvement alternatives, the advisory task force agreed that the following improvements should be included in testing:

1. A right-hand merge for the connector from Route 24 northbound to I-93 southbound.
2. An additional lane in the southbound direction of Route 24 (included in the work program).
3. An additional lane in the northbound direction of Route 24.
4. Eliminate the lane drop on the connector from northbound Route 24 to southbound I-93 and reconfigure the lane assignment at the merge area.

The task force also suggested that the lane additions on Route 24 should extend beyond Route 139 for traffic operations and safety purposes.

The town of Stoughton informed the task force that they would be looking at connector roads in the near future, to provide access to proposed zoning and redevelopment of the lands along Route 24. After further discussion, it was determined that the proposed zoning and redevelopment are in the early stages and that final plans would not be available for consideration in this study.

The meeting ended at 12:00 noon.

Safety and Operational Improvements for the I-93/Route 24 Interchange

Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall

November 13, 2006

	NAME	AFFILIATION	TELEPHONE
1	JIM GALLAGHER	MAPC	617-451-2770 x 2053
2	STEVE WINTER	MAPC	617-451-2770 x 2067
3	TONY CENTORE	RIZZO ASSOC	508-903-2090
4	Stanley Wood	Mass Highway - Design	617-973-7721
5	FRANK HEGARTY	Town of Avon	508-588-0414
6	MARK STANKIEWICZ	STOUGHTON	781-341-1300
7	ROBERT B WOOD	BRIDGEWATER OCPC JTC	508 697 7617
8	RAY GUARINO	OCPC	(508) 583-1833
9	Charlie Kilmer	OCPC	508 583 1833
10	Hardy Patel	MassHighway - Design	617-973-7728
11	John Stagnone	Stoughton Planning Board	978-251-6627
12	JON BEDER	STOUGHTON ENG.	781-341-1300 x 267
13	Joe Onorato	MHD D4	781-641-8479
14	Michael Carroll	Randolph	781-961-0911
15	Adriel Edwards	EOT	617 973 8062
16	Robert Campbell	Town of Braintree	781 794 8010
17	ROLAND HEBERT	SRPEDD	508 824 1367
18	Seth Asante	CTPS	617 973 7098

2nd Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall
May 2, 2007

Agenda

- Introductions
- Review of improvement alternatives
- Evaluation of impacts
- Recommendations
- Feedback, discussion, and other business

Minutes of the 2nd Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall

May 2, 2007

The meeting started at 10:15 AM with introductions. The agenda and list of people who attended the meeting are attached.

Seth Asante, the project manager, briefed members about the existing traffic safety and operational conditions in the study area and then described the impacts of the projects, including the no-build alternative. He followed this with detailed descriptions of the improvement alternatives to address the safety and operations problems identified in the study area. The impacts of each alternative were also presented, along with their performance measures. Copies of the draft report were distributed at the meeting and members of the task force were asked to submit their comments by May 14, 2007.

After the presentation, Seth Asante informed the task force that no recommendations have been made and that the input from the task force is needed for making recommendations. The floor was then opened for questions and comments. Members of the task force commented on the crash data. A member of the task force asked if by fixing the safety problems in the study area we are introducing new safety problems. Seth Asante answered that we are not introducing any new safety problems; and that improvements have been developed to make safer all of the difficult maneuvers in the study area. A member of the task forced asked if our models also predict future crashes occurring in the study area. Seth Asante replied that it would be great to have such a model but presently the MPO does not have any crash prediction model.

A member of the task force requested that the study examine the feasibility of an HOV lane on Route 24, beginning from Route 139 and ending on I-93 northbound at the vicinity of Route 28. The intent here is to encourage motorists to carpool or use bus transit to save time on the congested stretch of Route 24. Currently there are car and vanpoolers and private carrier buses bound for Boston and Logan Airport that use Route 24 during the AM peak period. Members of the task force from EOT and MassHighway pointed out that this would be difficult and could cause problems. They pointed out that the challenge with this proposal is how to extend new a HOV facility through the I-93/Route 24 interchange. Currently, the I-93/Route 24 interchange has safety and operational problems (short weave distances, weaving, merging, congestion, and queues) as described in Chapter 2. Therefore an HOV lane terminating on I-93 in the vicinity of Routes 24 and 28 could present additional safety and operational problems. Also, it would be difficult to extend this new HOV lane to connect to the one on the Southeast Expressway because of operational issues such as HOV access to Routes 28 and 37.

A member of the task force suggested that cost can be a factor and that in making the recommendations we should consider it as some of the improvements are low-cost effective improvements and others require substantial planning and environmental impact studies to determine their feasibility. Members of the task force also pointed out that some of the big budget improvements also have long-term benefits for the Route 24 corridor, considering the future growth expected in the area.

After a long discussion, a member of the task force suggested that the recommendations should be staged into short-term, intermediate-term, and long-term. Staging of the improvements would provide the flexibility to implement the short-term improvements and the intermediate-term improvements. It would also allow time to observe the impacts of the projects in the no-build alternative, and the short- and intermediate-term projects recommended in this study, and allow time to make changes in the long-term recommendations in the future if necessary. The task force agreed with this suggestion that the improvements should be staged.

The meeting ended at 12:00 noon.

Safety and Operational Improvements for the I-93/Route 24 Interchange

Advisory Task Force Meeting
Fitzpatrick Conference Room
Stoughton Town Hall

May 2, 2007

NAME	AFFILIATION	TELEPHONE
Lisa Greger	Town of Canton - DPW	781-821-5063
Tony Centore	Tetra Tech Rizzo	508 903 2090
JIM GALLAGHER	MAPC	617-451-2770 X 2053
STEVE WINTER	MAPC	617 451 2770 X 2067
Stanley Wood	Mass Highway / Design	617-973-7721
ASHISH PATEL	Mass Highway / Traffic	617-973-7834
Adriel Edwards	EOT Planning	617 973 8062
Joe Onorato	MHD / D4	781-641-8479
JONATHAN BEDER	STOUGHTON ENG.	781-341-1300 x 267
Pat Ciarramella	OCPC	508 583-1833
John Stagnone	Stoughton Planning Board	978-251-6627
Ray Guarino	OCPC	(508) 583-1833
MARK V. CARMICHAEL	MHD DIST 5 TAUNTON	(508) 884-4253
KRISTINA JOHNSON	City of Quincy	(617) 376-1373
Efi Pagitsas	CTPS	617 973-7106
Seth Asante	"	617 973-7100.
ROLAND HEBERT	SRPEDD	508 824-1367
Diane Madden	MassHighway Env.	617-973-7477
Walter Timilty	State Representative	617-722-2810

A2 Public Comments

To: Seth Asante, CTPS

Fr: Anthony Centore, P.E.

Re: **I-93/Route 24 Interchange**

Dt: May 10, 2007

The following comments are offered for the "Traffic Safety and Operational Improvements for the I-93/Route24 Interchange", Draft May 2007.

1. Who is the audience for this document? Design professionals? General public?

2. Clarify with a graphic the I-93 directional conundrum east west north south???

3. Figure 1: is Rte 24 NB ramp to I-93 WB over or under I-93 WB to Rte 24 SB?

4. It would help to understand planned adjacent projects if a table were added listing Adjacent Project Name, Implementation Time Frame, and % Chance Will Actually Happen.

5. What is chance Rte 24 will be accepted as an interstate highway during planning horizon for this project? What impact would it have to Alternatives?

6. Figure 7, why do some 05-06 traffic volumes drop compared to 1997/1998?

7. Figures 10 and 11 are the most effective at describing traffic flow thru the interchange. Suggest adding after "Travel time = 8 minutes" the nodes involved A-B, the travel distance, LOS, Construction costs, and average speed. Use same graphic for all alternatives including "no Build 2030" as an easy way to understand and compare benefits/impacts of all alternatives.

8. Could you list communities involved or show a simple graphic.

9. What is the remaining life of bridge structures involved? The three ramp bridges in Randolph were all built in 1958 and are listed as Deck Condition Fair while Substructure and Superstructure are Satisfactory. These bridges are 50 years old and their replacement would be justified based solely on age and structural condition. Rte 139 bridge in Stoughton was built in 1956 and its Deck Condition is listed as Critical, Superstructure Satisfactory and Substructure as Fair. Based on age and structural condition this bridge as well could be considered for replacement. Also consider current bridge underclearance as a measure of criticality.

10. Page 35 top bullet. Rte 24 SB off Ramp from I-93 is striped as two lanes. What is middle lane described? Limited sight distance to left and striping may be causing delays on ramp merge. Basically it's a 2 lane on ramp merging with a 3 lane highway. Maybe the ramp could be necked down to one lane and adding lane continuity or lane edge treatment would let traffic flow smoother. Could this be corrected without adding a lane on Rte 24 SB? See below.

11. Figure 14 Check whether ramps are over or under.

12. Figure 15 Alternative 1A, why is added lane necessary on Rte 24 SB when current AM and PM peak period speeds are 65 and 49 MPH respectively? Existing LOS is good on Rte 24 SB. If it is traffic safety could this be accomplished by other techniques other than adding a lane? If the Rte 139 Interchange will be upgraded as part of this Alternative then adding a lane both sides of Rte 24 would make more sense.

13. Table 8: Why is Rte 37 not included in "Journey to 2030" while South Coast Rail is included? Rte 37 is at 25% Design while South Coast Rail is still being reexamined for viability/funding. In my opinion there is more likelihood of Rte 37 being built than South Coast Rail by 2030.

14. Page 47 second paragraph: Explain rational of adding another lane to Rte 24 SB without requiring a complete revamp of the Rte 139/Rte 24 Interchange. Ie adding a SB lane without fixing Rte 139 interchange does not make sense. Look at the big picture.

15. Figure 16 Alt 1B Why not an alternate consisting of 5 lanes on I-93 SB without added lane for Rte 24 SB?

16. Figures 21and 22 Ramp access restrictions on Rte 28 and Ponkapoag interchanges sounds like a cheap fix and a good safety improvement. What are the drawbacks? Can they be remedied by low cost/impact measures?

17. Table 9 Include year of cost estimate. Should costs be given in a range rather than a hard number? At this stage costs are very approximate. Using a single cost number leads to over confidence in a number that is extremely approximate and subject to significant variation. Alternates A and B have a lower risk of cost escalation compared to Alt 3. Alt 3 with more construction in Blue Hills Reservation represents a significant risk of cost escalation and decades of delay. How can this be presented when weighing alternatives.

18. Table 9: Should cost benefits of Alternates be presented? For instance 2030 No Build peak speeds are 42 and 36 MPH at no cost representing a 40% increase in AM and 24% increase in PM over current spped s. For $20M we increase speeds to 44 and 44 MPH. For $35M we increase speeds to 44 and 47 MPH. Etc. Could we measure cost per increase of MPH over 2030 No Build? Based on numbers in Table 9 Alt 1A would cost $4M/MPH gain while Alt 1B, 2A, 2B, 3A and 3B would cost $5M/MPH, $8M/MPH, $7.8M/MPH, $14M/MPH and $13.5M/MPH respectively. I know that this is a simplistic view but it has some relevance to deciding how to spend our limited transportation dollars. Are these alts worth the cost? I know there are other parameters like delay etc.

19. Table 9: Where are these average speeds measured over? Figs 10 and 11 show speeds of 65 MPH and 49 MPH based on travel times on links from I-93 south into Rte 24. Existing speeds over north/south and east/west links don't agree with Table 9 existing speeds of 30 MPH AM and 29 MPH PM.

20. It also appears that the Rte 139 interchange in Stoughton is a key part of this transportation network and improvements in this interchange should be included as party of the scope or else assumed to be reconstructed as part of an adjacent project. Its relevance is almost as important as the I-93 lane additions and certainly much more that the Rte 37 improvements or the South Coast Rail project.

Seth Asante

From: Edwards, Adriel (EOT) [Adriel.Edwards@state.ma.us]

Sent: Monday, April 23, 2007 4:33 PM

Cc: Edwards, Adriel (EOT); Mohler, David (EOT)

Subject: Crash data meeting recap

Hello Karl,

Today a meeting was held to discuss whether and how to use the more recent crash data in the Route 24 / I-93 interchange report. I wanted to provide a summary of the meeting.

Attendees:
Seth Asante
Kathy Jacob
Efi Pagitsas
Adriel Edwards
Richard Conard
Bonnie Polin

Concerns were raised about the differences in results between the 1999-2001 and 2003-2005 crash data sets. In particular, several locations seem to have far fewer accidents in the new data set than in the previous data set. If this were indeed the case, this would weaken the justification for the study and may also threaten the integrity of the recommendations.

The number of 2003-2005 crashes was determined by the number of crashes which were automatically geocoded by the crash recording system. Bonnie explained that there is probably not a sharp decline in the crashes at these locations but rather that a shortcoming with the automatic geocoding system is to blame. (She added that this shortcoming is currently being addressed.) Bonnie explained that if the crash report and its corresponding record in the crash database has "extra" information regarding the location of the crash, then the geocoder can not decide where to put the point, and does not geocode the accident at all. This is more common for interchanges than for intersections. Overall, the geocoder can automatically geocode 75% of the reported accidents, but the percentage is lower for interchanges. Fewer accidents at interchanges are automatically geocoded. They are still in the database, however. Bonnie's group is working with Geonetics to devise an algorithm so that the system can determine where to put the points. In the meantime, the best way to determine the total number of accidents at a location is to search the database by town and then by the location fields to find the other accidents in the vicinity that are not geocoded. Bonnie strongly suggested that this be done to have a complete count of the recorded accidents in the 2003-2005 time period and to get a better idea of how the number of crashes in the two time periods compare to each other.

Efi agreed to direct Seth and Kathy to look at the database of crash records to get a more complete view of all the accidents in the vicinity of I-93 and Route 24. They will track the time it takes to do this.

If the information is comparable, Efi and Seth will consider using only the new data in the crash analysis section of the report. The crash analysis will be very similar except that **rank** will not be provided in figure 12 and table 5, nor will it be discussed in the narrative. They have not yet decided whether to include the older data if the new data is sufficient. If there are still discrepancies between the two time periods, then the older data may be included as well. I feel strongly that if the newer data is not used, a more complete explanation is needed. Many people at MassHighway - and outside of MassHighway - have been working very hard to improve the crash data and deliver it more efficiently. There are still some shortcomings that may present some challenges but published reports should reflect the positive side of those efforts.

The larger issue remains of how to handle this going forward. Whereas previously, Kathy Jacob did the geocoding, now an automated system is doing it - but not completely - yet. One option may be to utilize Kathy's skills to fill the gaps until the system can geocode all the reported accidents properly. Perhaps Kathy and Efi can determine how to best do this and Planning/MassHighway may consider allocating the resources? I am not sure - not my decision - but there should be a discussion about this.

Bonnie raised some other issues with which her group is struggling - which also affects Efi's group's ability to use the new data: The City of Boston does not submit their accident reports. This is a big problem especially for bike and ped accident analysis. She asked that the Boston MPO rep strongly encourage the Boston Police Dept to submit the reports. Another issue is that the RMV no longer stores the full report longer than 2 years. Apparently they don't have the room. There are security issues with this data and they can not store them simply. This is a problem because only the full report has the narrative. The narrative is the only part of the report that can truly give the full picture of the accident. For our 93/95 study, we read through over 100 narratives as part of our crash analysis. (These issues also affect our office and other professionals in the field.) If we have an opportunity to address these issues as well, that would be a good thing.

Thanks for everyone's time today.

I hope this helps.

- Adriel

Adriel Edwards
Transportation Planner
Massachusetts Office of Transportation Planning
10 Park Plaza, Room 4150
Boston, MA 02116
(617) 973-8062
Please reply to adriel.edwards@eot.state.ma.us for proper delivery

Seth Asante

From: Edwards, Adriel (EOT) [Adriel.Edwards@state.ma.us]
Sent: Thursday, April 19, 2007 1:59 PM
To: seth.asante@ctps.org
Subject: Comments on the Route 24 report

Hello Seth,

Below are the items we discussed on the phone. Thank you for taking the time to chat with me and take my input.

If it is to be assumed that the Braintree split study recommendations will be implemented fully, then why is the addition of a lane between Route 37 and Route 24 considered part of the alternatives?

I would advise that "Not drawn to scale" be added to figures 1, 7, 14-22 and all the figures in Appendix C.

Unless I shuffled my papers, Table 6 has an incorrect page number. Table 6 is entitled "Highway Projects" but has the rail project listed. Would it be okay to entitle the table "Transportation Projects"? - Or is that too general and other projects would then have to be listed as well? Also, the Table of Contents lists the South Coast Rail discussion as starting on page 40 when it starts on page 44.

Figure 13: missing the closing parentheses in box on right-hand side.

Several places in section 5: "...traffic, safety, and operational problems…" The commas are missing. Or the word traffic is redundant.

Bottom of page 54: PM and PM numbers for Route 28 to Route 24.

Page 78: Following are brief summary… (should be : is a brief summary)

Page 78: expected vicinity

Section 7: Phasing?

Modeling - seen at next meetings?

- Adriel

Adriel Edwards
Transportation Planner
Massachusetts Office of Transportation Planning
10 Park Plaza, Room 4150
Boston, MA 02116
(617) 973-8062
Please reply to adriel.edwards@eot.state.ma.us for proper delivery

Seth Asante

From: Onorato, Joseph (MHD) [Joseph.Onorato@state.ma.us]

Sent: Tuesday, May 08, 2007 8:26 AM

To: Seth Asante

Subject: RE: Bridge ratings

The AASTHO rating of I-93 over Route 28 is 94. All the ratings I have given you come from the NBIS Master List 2004. While the ratings don't change much from year to year, if you are going to include these #'s in the study, you may want to check them against more current data.

From: Seth Asante [mailto:setha@ctps.org]
Sent: Monday, May 07, 2007 12:01 PM
To: Onorato, Joseph (MHD)
Subject: RE: Bridge ratings

Hi Joe,

Thanks for the information. Could you please also find out what is the AASTHO rating of I-93 over Route 28. I appreciate your time and efforts.

Seth

-----Original Message-----
From: Onorato, Joseph (MHD) [mailto:Joseph.Onorato@state.ma.us]
Sent: Thursday, May 03, 2007 11:17 AM
To: seth.asante@ctps.org
Subject: Bridge ratings

Hi Seth. Route I-93 NB over Route 24 NB has an AASHTO rating of 78 out of 100. While it is functionally obsolete it is not structurally deficient and, therefore, will not need to be replaced for a long time. Route 139 over 24 has a rating of 74, however it is listed as structurally deficient.

APPENDIX B Regional Transportation Planning Model

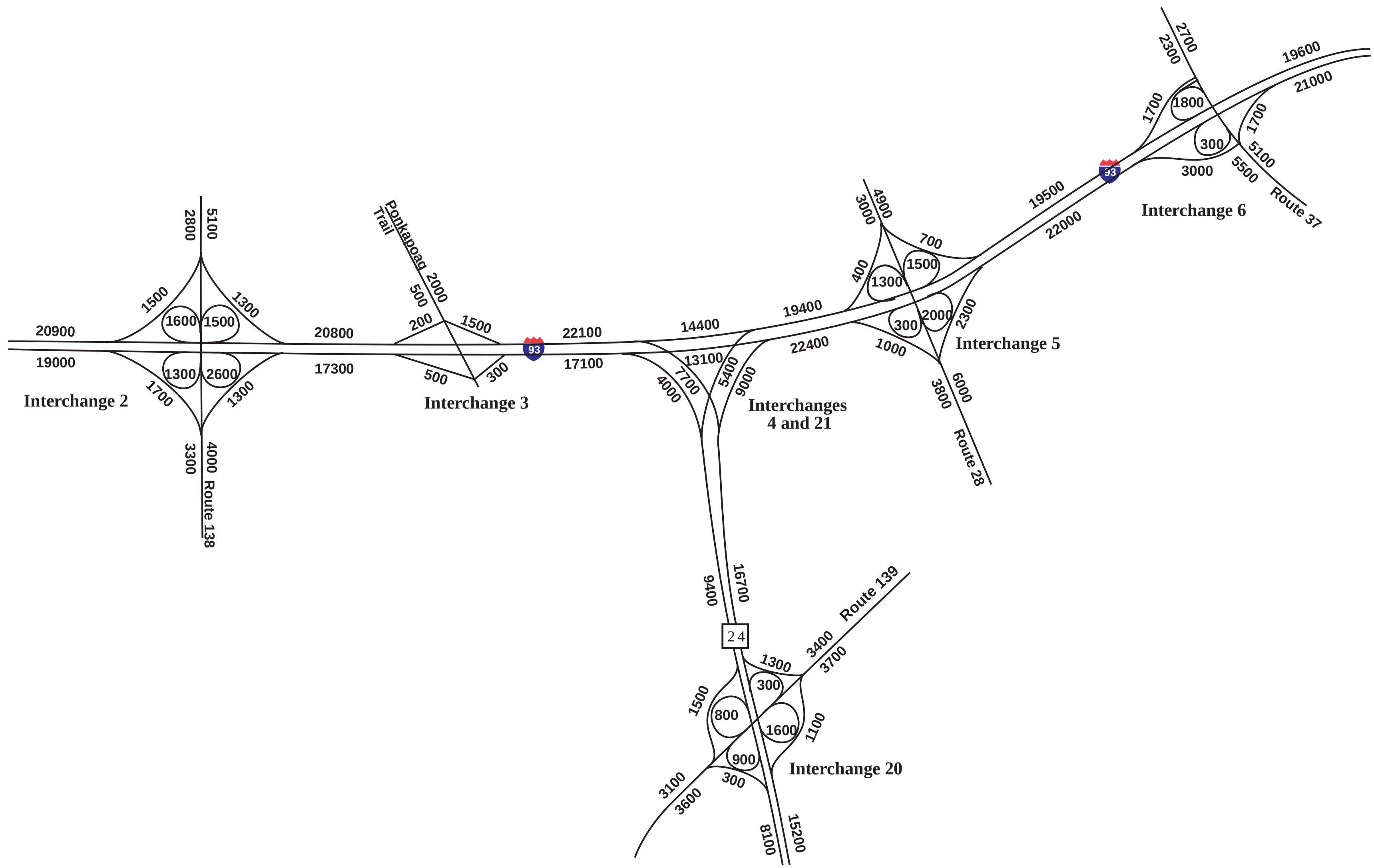
B.1 Transportation Projects in the 2030 Build Network

B.2 Traffic Growth and Comparisons of Alternatives

TABLE B.1
Transportation Projects in the 2030 No-Build Network

Project	Note
Crosby Drive (Bedford)	Roadway Project
Miiddlesex Turnpike (Bedford & Burlington)	Roadway Project
Rt. 128 Capacity Improvements (Beverly to Peabody)	Roadway Project
East Boston Haul Road/Chelsea Truck Route (Boston)	Roadway Project
Arborway Restoration (Boston)	Transit System
Red Line-Blue Line Connector (Boston)	Transit System
Fairmount Line Improvements (Boston)	Transit System
Route 1A/Boardman Street Grade Separation (Boston)	Roadway Project
Russia Wharf Ferry Terminal (Boston)	Transist System
Rutherford Avenue (Boston)	Roadway Project
Silver Line Phase III (50/50) (Boston)	Transit System
Old Colony/Greenbush Commuter Rail (Boston to Scituate)	Transit System
Green Line to Medford Hillside (Boston, Medford, & Somerville)	Transit System
Urban Ring Phases I & 2 (Compact Communities)	Transit System
I-93/Route 3 Interchange - Braintree Split (Braintree)	Roadway Project
I-95(Route 128)/I-93 Transportation Improvement Project	Roadway Project
I-93/I-95 Interchange (Canton)	Roadway Project
I-95 (NB)/Dedham Street Ramp (Canton)	Roadway Project
Concord Rotary (Concord)	Roadway Project
Route 2/Crosby's Corner (Concord and Lincoln)	Roadway Project
Route 1/114 Corridor Improvements (Danvers & Peabody)	Roadway Project
Telecom City Boulevard (Everet, Maiden, & Medford)	Roadway Project
Revere Beach Parkway (Everett & Medford)	Roadway Project
Route 126/135 Grade Separation (Framingham)	Roadway Project
Route 9/126 Interchange (Framingham)	Roadway Project
Route 53 (Hanover)	Roadway Project
Route 53/228 (Hingham and Norwell)	Roadway Project
Rte. 128 Capacity Improvements (Lynnfield to Reading)	Roadway Project
Route 1 Improvements (Malden & Revere)	Roadway Project
I-495/I-290/Route 85 Interchange (Marlborough)	Roadway Project
Needham Street/Highland Avenue (Newton & Needham)	Roadway Project
Burgin Parkway (Quincy)	Roadway Project
Quincy Center Concourse, Phase 2 (Quincy).	Roadway Project
1-93/1-95 Initiative (Reading & Woburn)	Roadway Project
Mahoney Circle Grade Separation (Revere)	Roadway Project
Route 1/Route 16 Interchange (Revere)	Roadway Project
Route 1A/Route 16 Connection (Revere)	Roadway Project
North Shore Transit Improvements (Revere to Salem)	Transit System
Boston Street (Salem)	Roadway Project
Bridge Street (Salem)	Roadway Project
Assembly Square Orange Line Station (Somerville)	Transit System
I-93/Mystic Avenue Interchange (Somerville)	Roadway Project
Naval Air Station Access Improvements (Weymouth)	Roadway Project
Route 18 (Weymouth)	Roadway Project
Route 3 South Additional Lanes (Weymouth to Duxbury)	Roadway Project
I-93/Ballardvale Street Interchange (Wilmington)	Roadway Project
I-93/Route 129 Interchange (Wilmington)	Roadway Project
New Boston Street Bridge (Woburn)	Roadway Project
Worcester Commuter Rail (Full Service with Four New Stations)	Transit System
100 Additional Buses to Improve Service on Existing Routes	Transit System
Additional Park & Ride Spaces	Transit System
South Coast Rail	Transit System

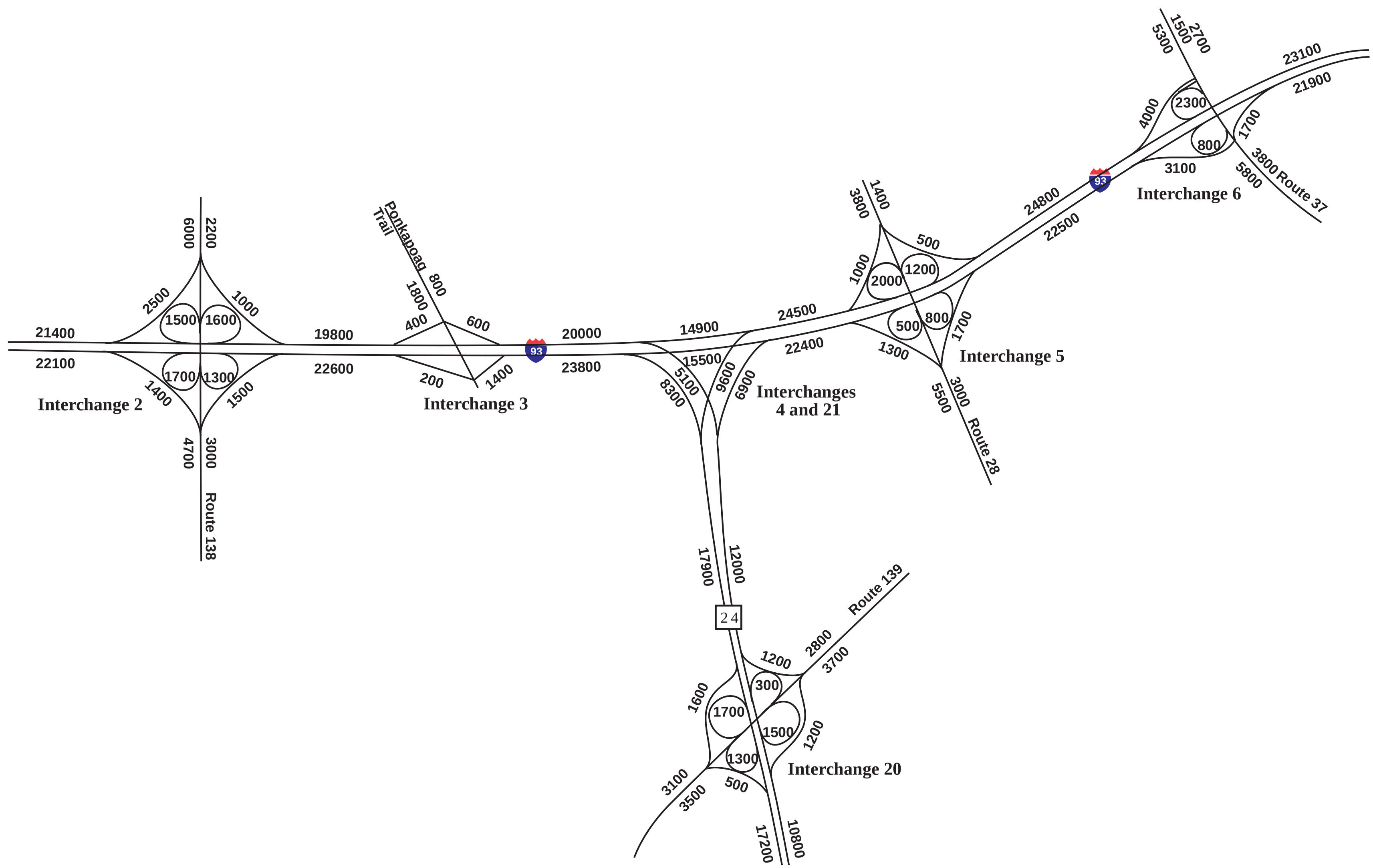
B.2 Traffic Growth and Comparisons of Alternatives



CTPS

FIGURE B-1
Base Year 2005: AM Peak-Period Traffic Volumes

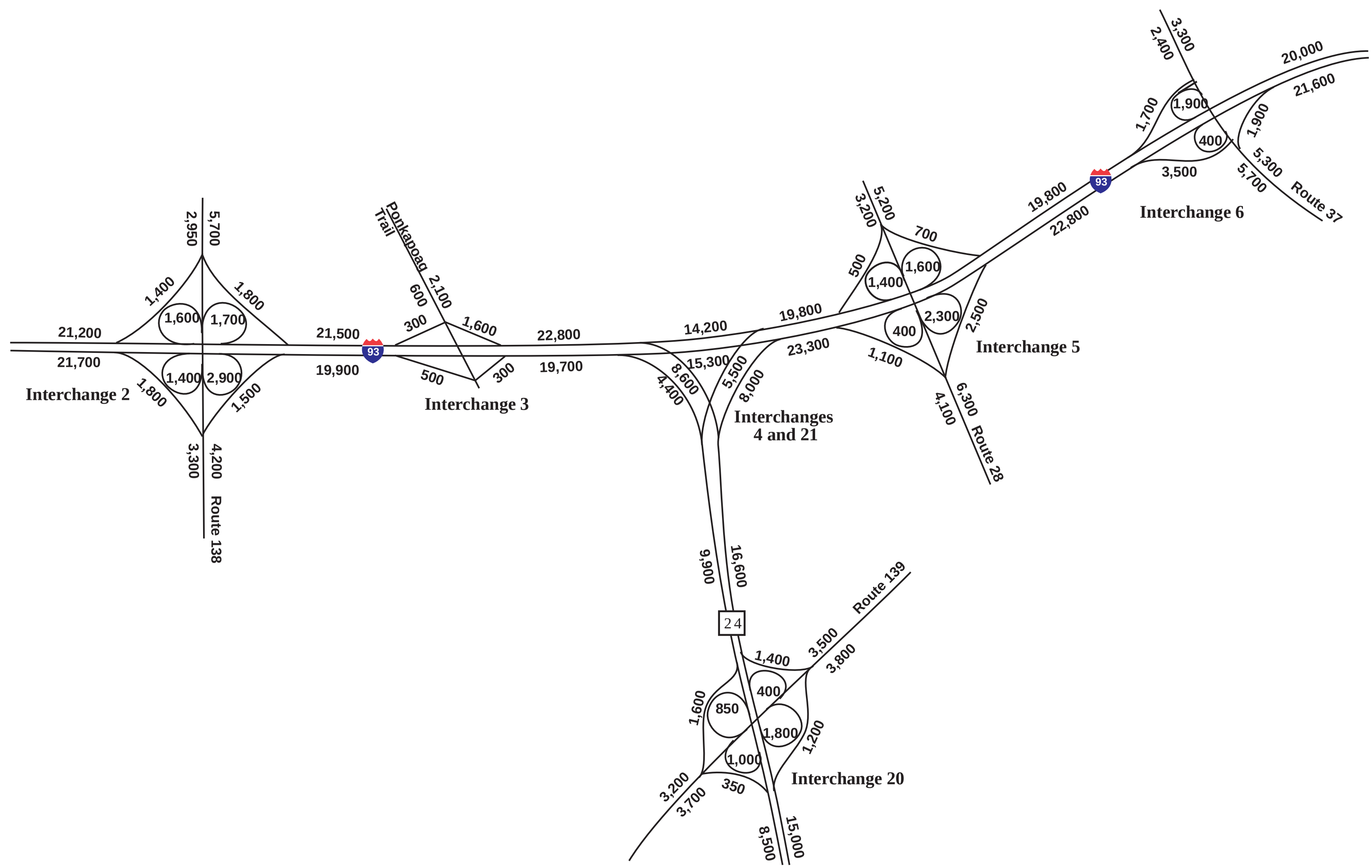
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-2
Base Year 2005: PM Peak-Period Traffic Volumes

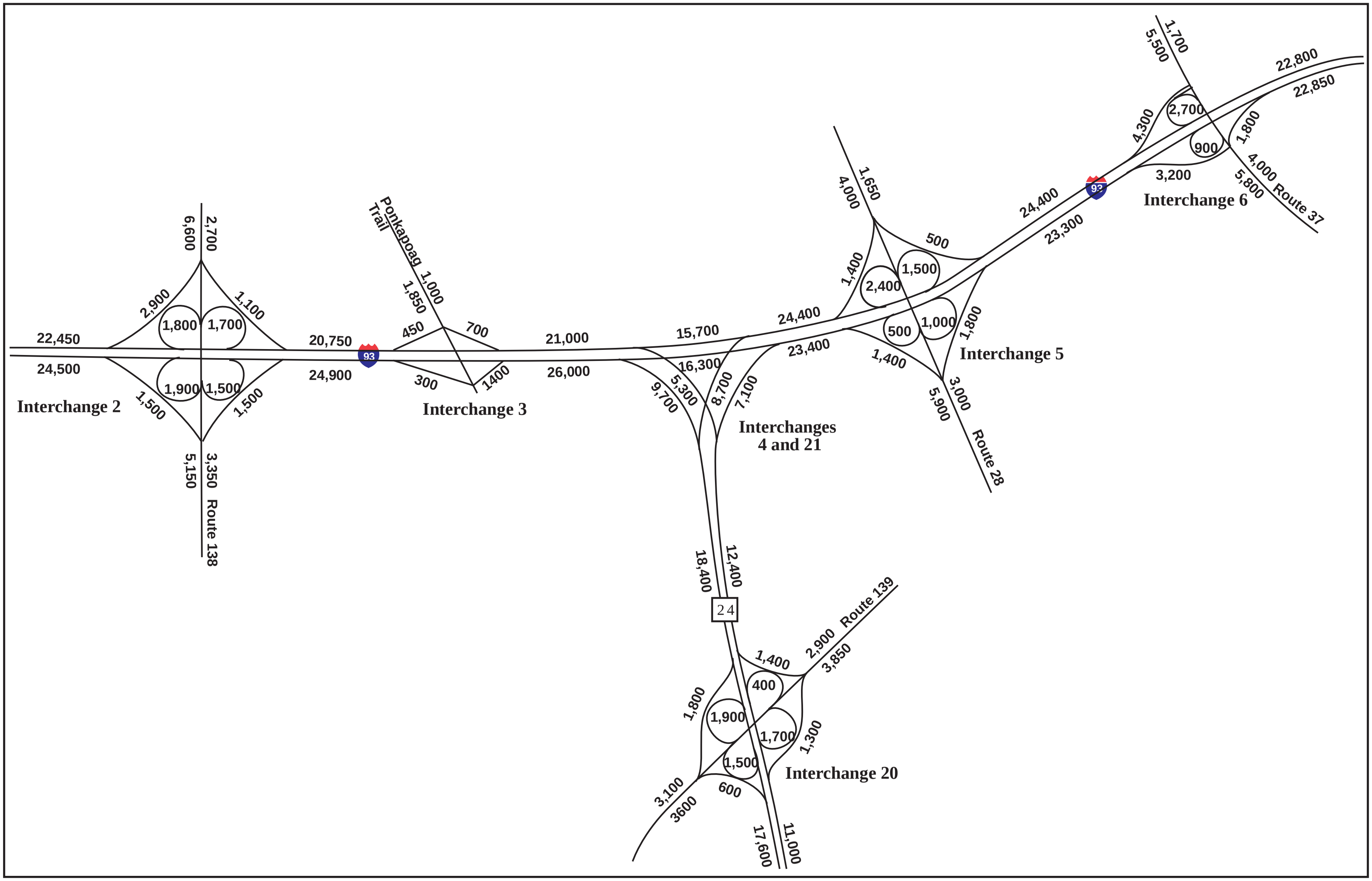
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-3
2030 No-Build:
AM Peak-Period Traffic Volumes

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-4
2030 No-Build:
PM Peak-Period Traffic Volumes

Safety and Operational Improvements for the I-93/Route 24 Interchange

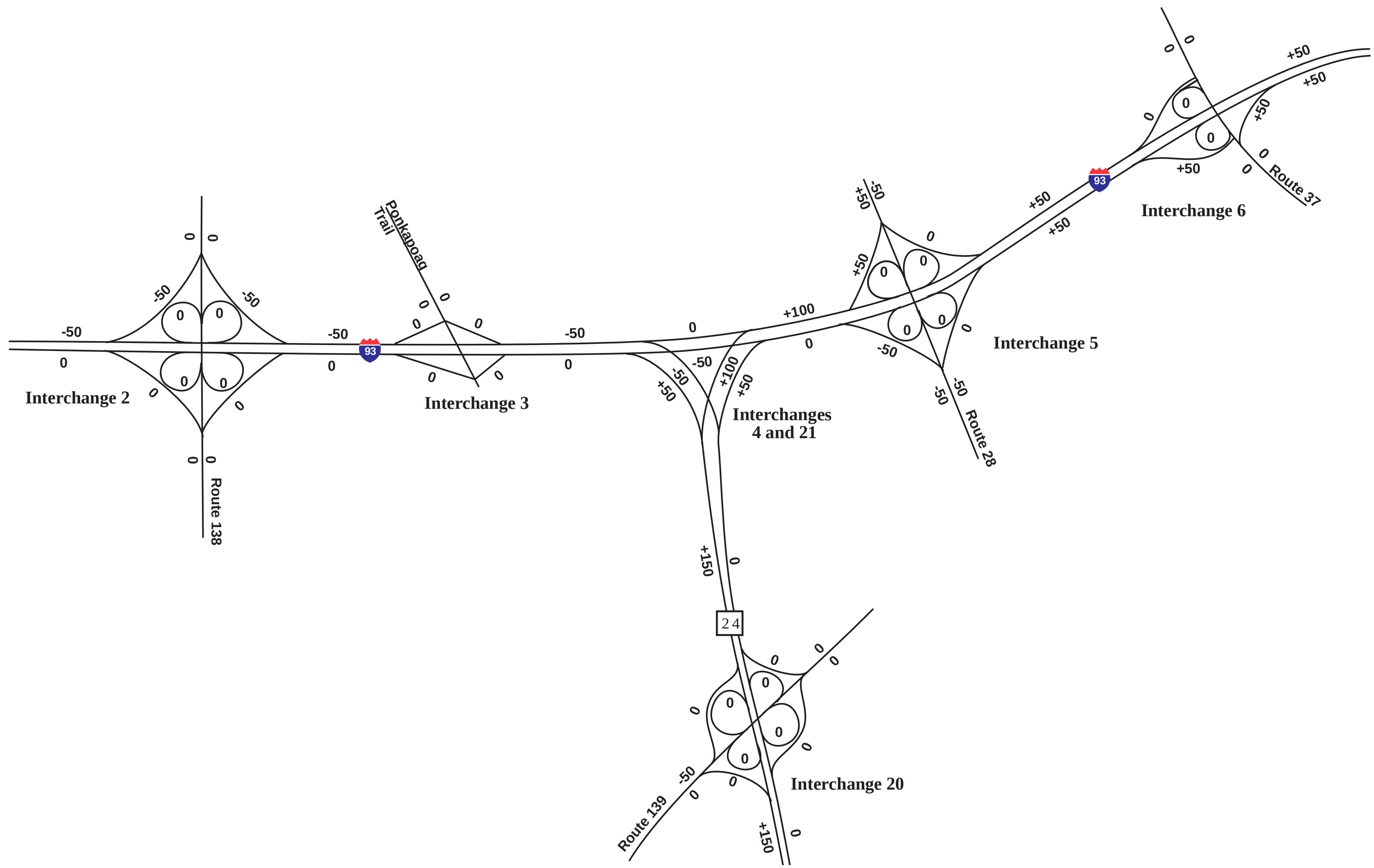
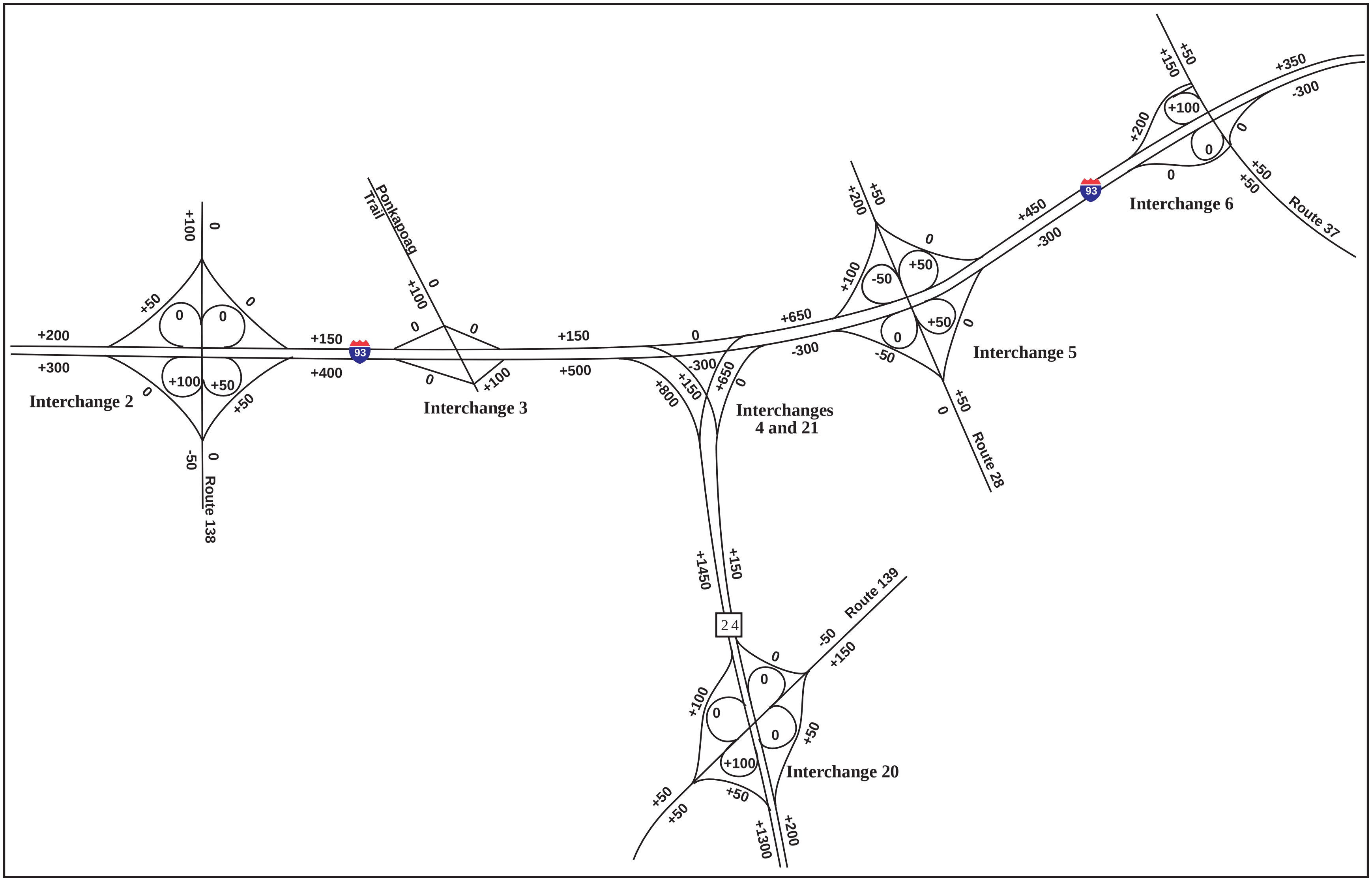


FIGURE B-5
Alternative 1A: 2030 AM Peak-Period
Traffic Increase/Decrease Compared to No-Build

CTPS

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-6
Alternative 1A: 2030 PM Peak-Period
Traffic Increase/Decrease Compared to No-Build

Safety and Operational Improvements for the I-93/Route 24 Interchange

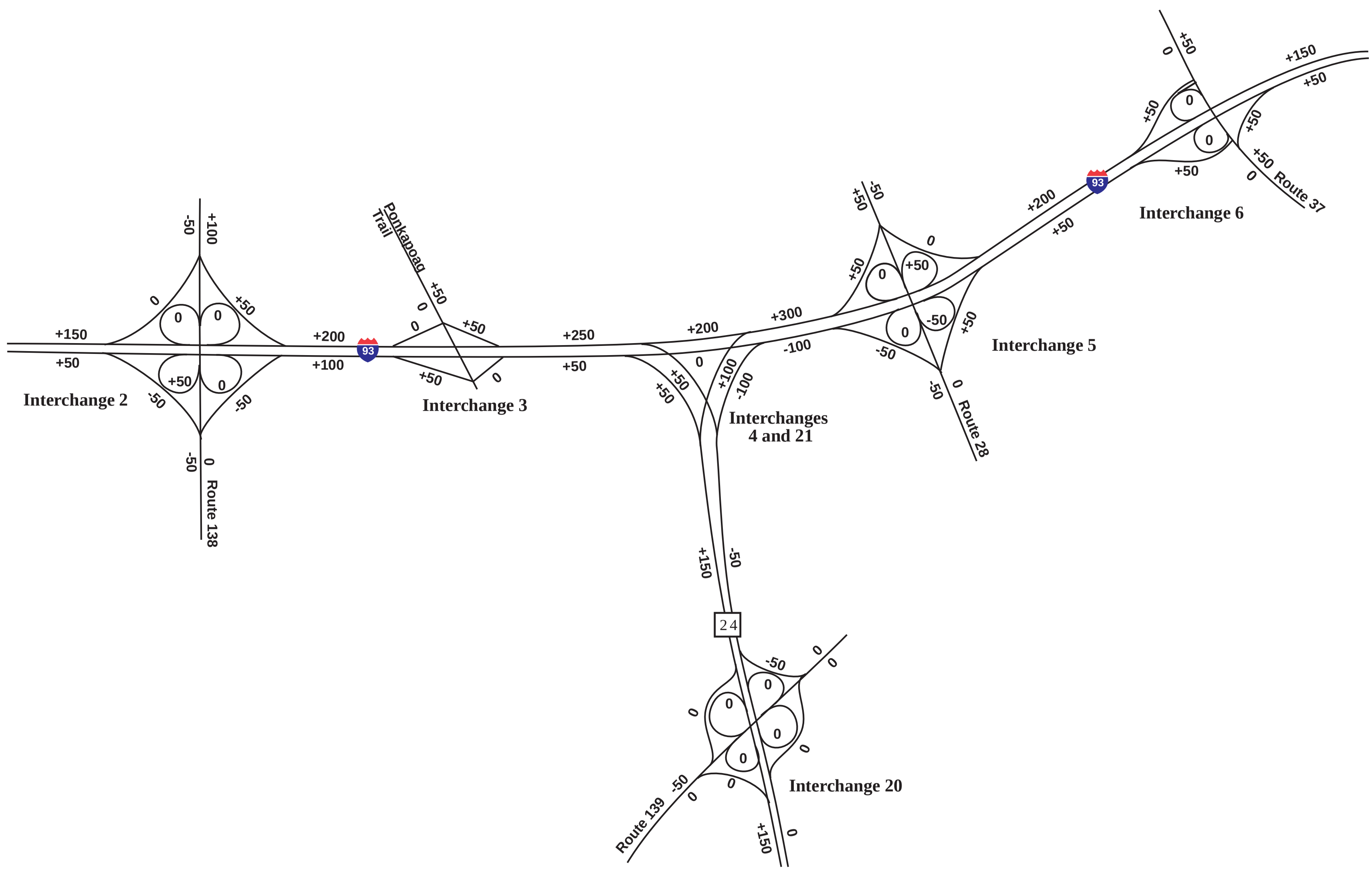
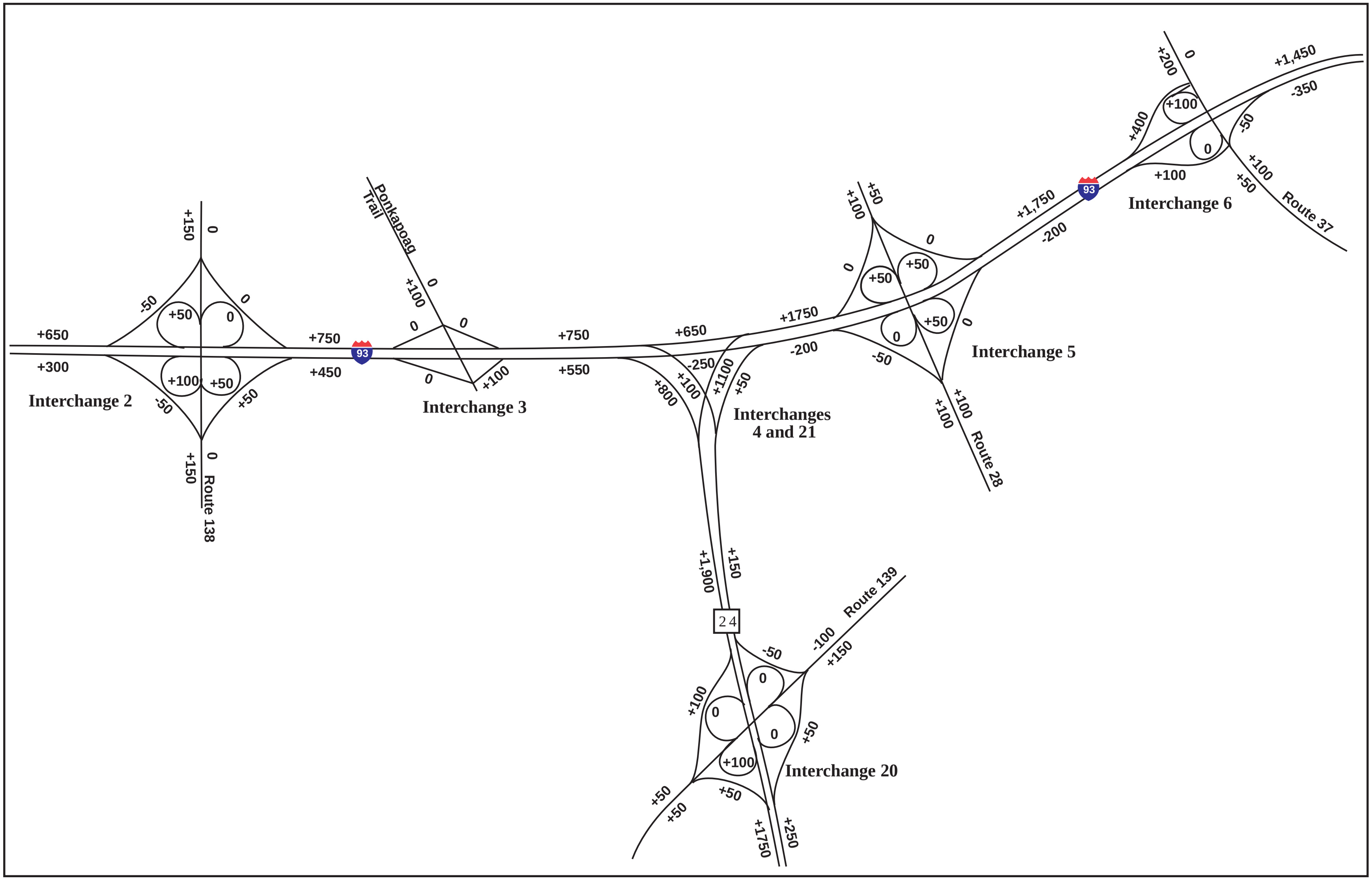


FIGURE B-7

Alternative 1B: 2030 AM Peak-Period Traffic Increase/Decrease Compared to No-Build

CTPS

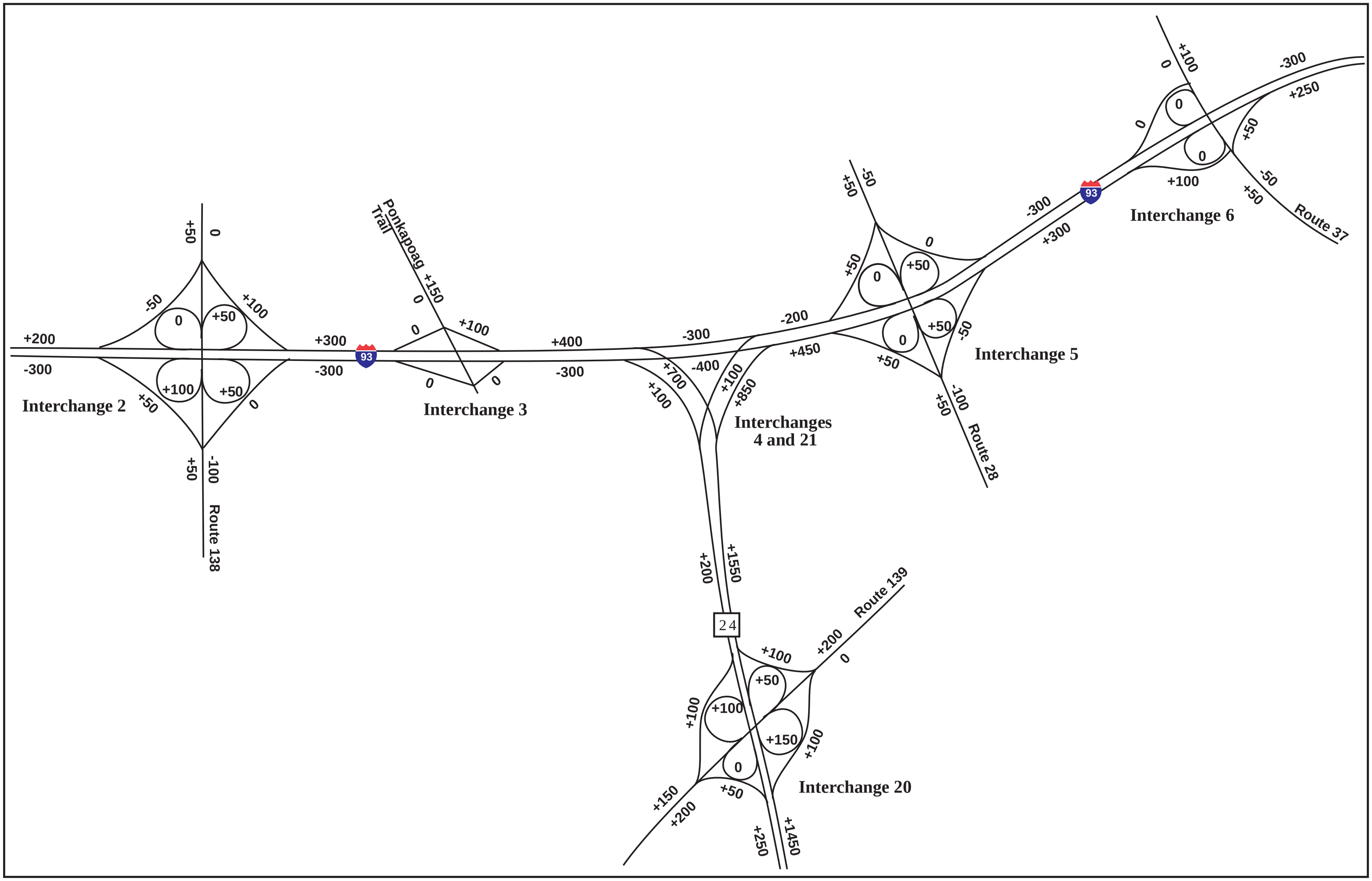
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-8
Alternative 1B: 2030 PM Peak-Period
Traffic Increase/Decrease Compared to No-Build

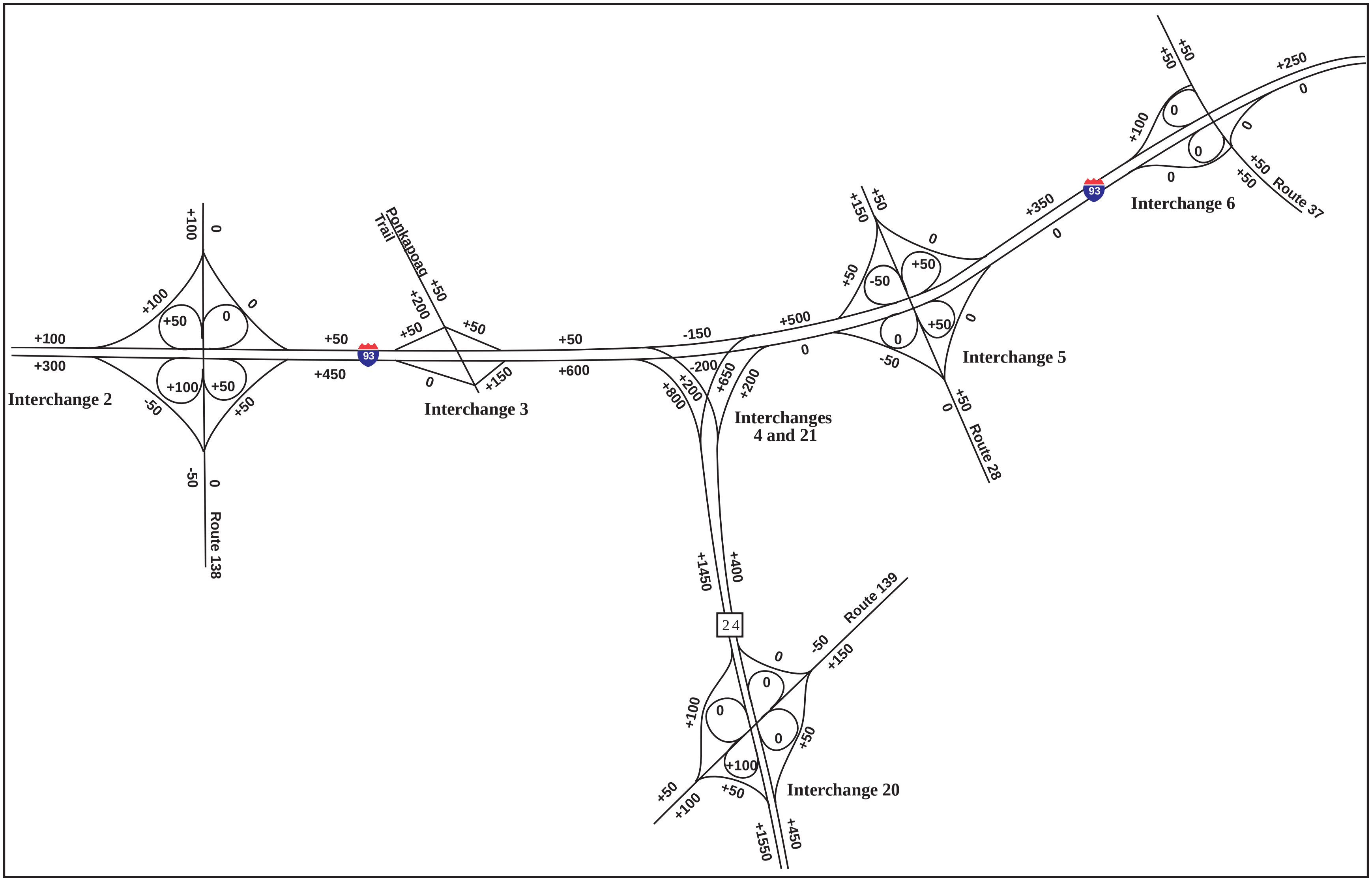
Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-9
Alternative 2A or 3A: 2030 AM Peak-Period
Traffic Increase/Decrease Compared to No-Build

Safety and Operational Improvements for the I-93/Route 24 Interchange



CTPS

FIGURE B-10
Alternative 2A or 3A: 2030 PM Peak-Period
Traffic Increase/Decrease Compared to No-Build

Safety and Operational Improvements for the I-93/Route 24 Interchange

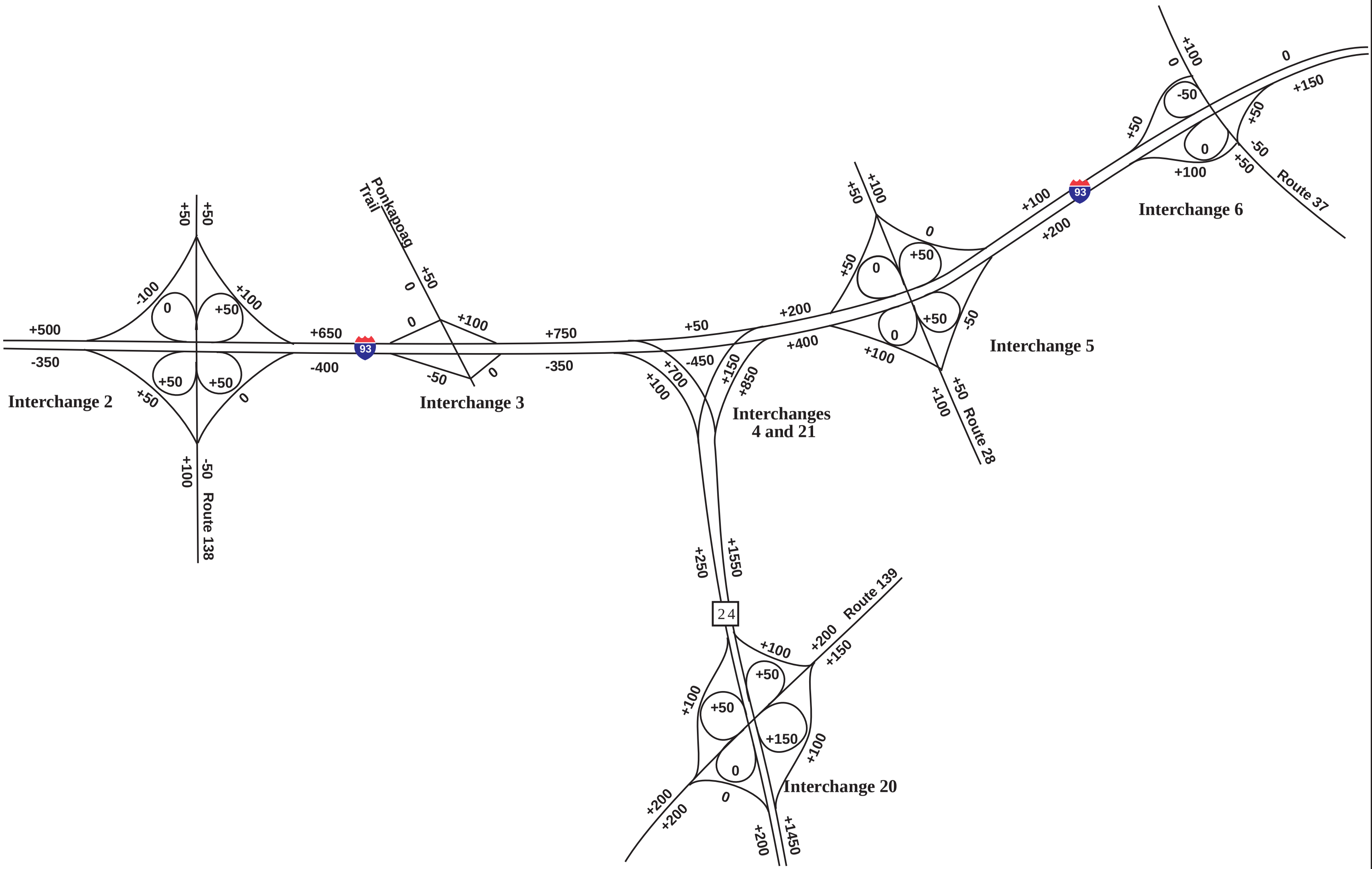


FIGURE B-11
Alternative 2B or 3B: 2030 AM Peak-Period
Traffic Increase/Decrease Compared to No-Build

CTPS

Safety and Operational Improvements for the I-93/Route 24 Interchange

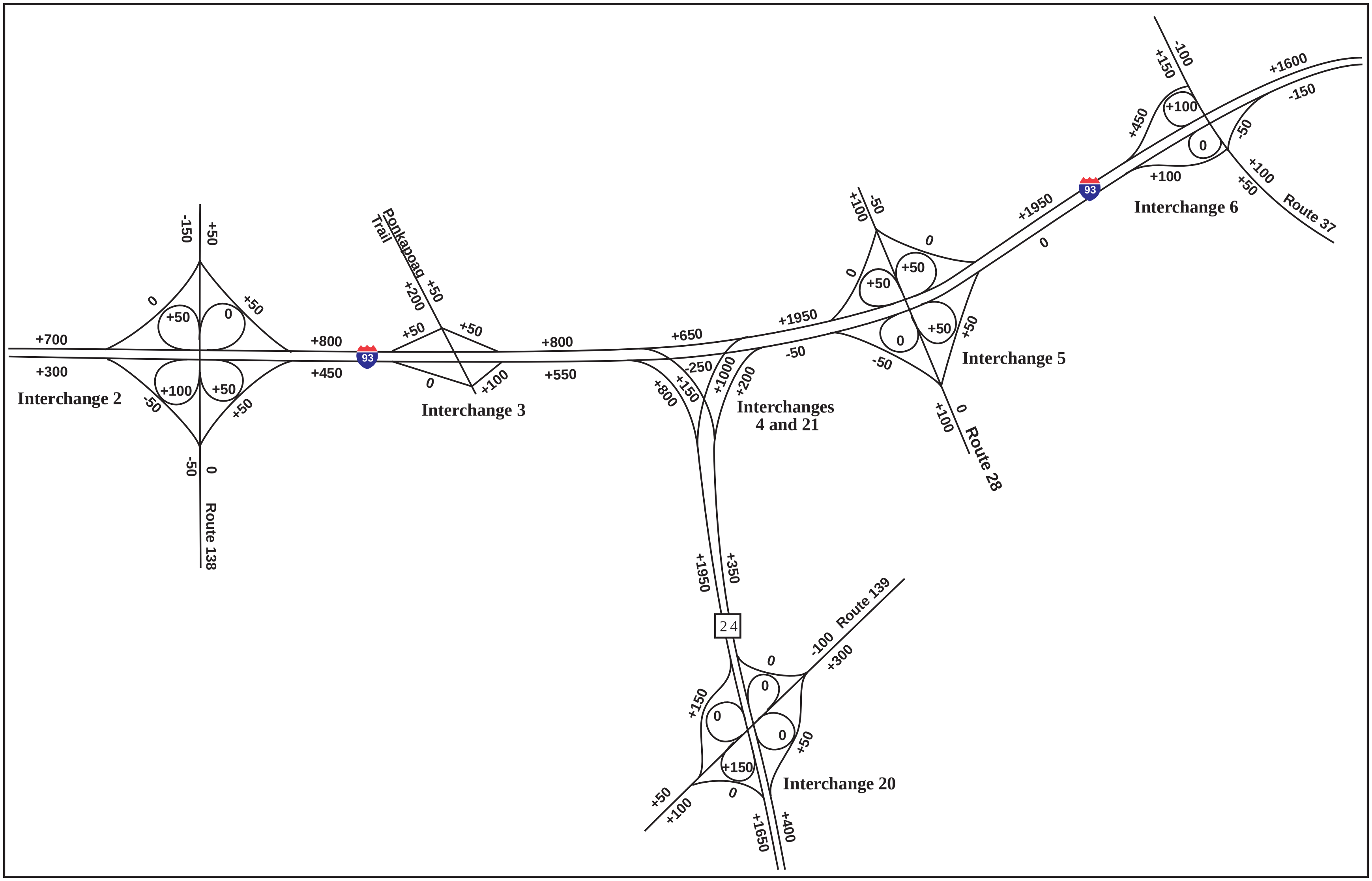


FIGURE B-12
Alternative 2B or 3B: 2030 PM Peak-Period
Traffic Increase/Decrease Compared to No-Build

CTPS

Safety and Operational Improvements for the I-93/Route 24 Interchange

APPENDIX C

Level-of-Service Criteria[1]

[1] Transportation Research Board, *Highway Capacity Manual* (2000).

Signalized Intersections

LOS	Control Delay (sec/veh)
A	≤ 10
B	> 10–20
C	> 20–35
D	> 35–55
E	> 55–80
F	> 80

sec/veh denotes seconds per vehicle

Unsignalized Intersections

LOS	Control Delay (sec/veh)
A	≤ 10
B	> 10–15
C	> 15–25
D	> 25–35
E	> 35–50
F	> 50

sec/veh denotes seconds per vehicle

Freeways: Basic Segments

LOS	Density (pc/mi/ln)
A	≤ 0–11
B	> 11–18
C	> 18–26
D	> 26–35
E	> 35–45
F	> 45

pc/mi/ln denotes passenger cars per mile per lane

Freeways: Weaving Segments

LOS	Density (pc/mi/ln)
A	≤ 10
B	> 10–20
C	> 20–28
D	> 28–35
E	> 35–43
F	> 43

pc/mi/ln denotes passenger cars per mile per lane

Freeways: Ramp Merge and Diverge Areas

LOS	Density (pc/mi/ln)
A	≤ 10
B	> 10–20
C	> 20–28
D	> 28–35
E	> 35
F	Demand exceeds capacity

pc/mi/ln denotes passenger cars per mile per lane