CA/T Traffic Signal Optimization Study

Recommendations Report

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Background

At the request of the Boston Transportation Department (BTD), Howard/Stein-Hudson Associates (HSH) has compiled data on existing traffic volumes and operations at 81 signalized intersections located around the Central Artery region within the City of Boston. These data include signal timing and phasing, vehicle, bicycle, and pedestrian counts, crash data, and travel time studies. This information was used to develop new signal timings to help reduce delays and travel times at the different locations and to help improve safety, where possible. This report documents the methodologies used to create the new signal timings and the results of proposed conditions analysis.

Study Area

The study area consists of 81 signalized intersections

- Pearl Street/Atlantic Avenue;
- Pearl Street/Purchase Street;
- Seaport Boulevard/Atlantic Avenue;
- Oliver Street/ Purchase Street;
- High Street/Atlantic Avenue;
- High Street/Purchase Street;
- Broad Street/Purchase Street;
- East India Row/Atlantic Avenue;
- India Street/Surface Artery Southbound (SASB);
- Milk Street/Atlantic Avenue;
- Milk Street/SASB;
- State Street/Atlantic Avenue;
- State Street/SASB;
- Mercantile Street/Atlantic Avenue/Cross Street;
- Mercantile Street/SASB;
- Commercial Street/Cross Street;
- Clinton Street/SASB;
- Kneeland Street/SASB;
- Beach Street/SASB;
- Essex Street/Lincoln Street/SASB;
- Essex Street/South Street;
- Summer Street/Purchase Street/SASB;
- Congress Street/Purchase Street;
- Kneeland Street/Lincoln Street;
- North Street/SASB;
- North Street/Cross Street;
- Hanover Street/SASB;
- Hanover Street/Cross Street;
- New Sudbury Street/SASB;
- New Sudbury Street/Cross Street;
- New Chardon Street/SASB;
- North Washington Street/Cross Street;
- North Washington Street/Beverly Street;
- Valenti Way/Beverly Street;
- Valenti Way/ North Washington Street;

- Congress Street/Atlantic Avenue;
- Summer Street/Atlantic Avenue;
- Essex Street/Atlantic Avenue;
- Beach Street/Atlantic Avenue;
- Kneeland Street/Atlantic Avenue/I-93 Ramps;
- North Street/Clinton Street;
- Purchase Street/Fire Station;
- State Street/Congress Street/Devonshire Street;
- North Street/Congress Street;
- North Street/Union Street;
- Hanover Street/Congress Street;
- New Sudbury Street/Congress Street/Merrimac Street;
- New Chardon Street/Merrimac Street;
- Summer Street/Dorchester Avenue;
- Summer Street/Melcher Street;
- Summer Street/Pump House Road;
- Massport Haul Road/Pump Station Connector;
- Summer Street/D Street;
- Ramp DB (I-90 WB On Ramp)/D Street;
- Transitway/D Street;
- Congress Street/D Street;
- Congress Street/B Street/Ramps D & F;
- Congress Street/East Service Road/Ramps I & C;
- Congress Street/Boston Wharf Road;
- Seaport Boulevard(Northern Avenue)/B Street;
- Seaport Boulevard/East Service Road;
- Seaport Boulevard/Sleeper Street;
- Congress Street/Dorchester Avenue;
- Congress Street/A Street;
- Summer Street/West Side Drive;
- Summer Street/World Trade Center (WTC) Avenue;
- Seaport Boulevard/Boston Wharf Road;
- South Station Connector (SSCONN)/Albany Street;
- Broadway Bridge/Frontage Road;
- Bennington Street/Neptune Road;
- SSCONN/Ramps K&X;
- East Berkeley Street/Albany Street & West 4th Street/Frontage Road NB;
- Traveler Street/Albany Street;
- Herald Street/Albany Street;
- Albany Street/Frontage Road SB;
- Ramp A2/Ramp I/Frontage Road SB;
- Martha Road/Nashua Street;
- Rutherford Avenue/North Washington Street/Chelsea Street;
- Rutherford Avenue/LT-TL;
- Albany Street Extension/Frontage Road NB; and
- Neptune Road/Route 1A Off-ramp.

Existing Conditions Reports have been completed and accepted by BTD on May 23, 2009.

Existing Conditions Analysis

Data Collection

HSH took 11-hour manual turning movement counts for vehicles, bicycles, and pedestrian for all of the above intersections on Tuesdays, Wednesdays, or Thursday on non-holidays between November 2008 and March 2009. Existing turning movement diagrams and pedestrian diagrams can be found in **Appendix A.**

HSH also conducted an on-street parking inventory and survey of the study area. On-street parking was recorded as well as irregular parking maneuvers noted.

BTD provided all signal timings and offsets used in the Existing Conditions analysis. In addition, HSH conducted several field visits to check signal phasing and existing "Walk" and "Flashing Don't Walk" pedestrian timings.

Crash Analysis

HSH compiled motor vehicle crash data for all study area intersections from the Massachusetts Highway Department (MassHighway) Crash Records System for the most recent 3-year period for which they are available (2004–06).

Table 1 summarizes the number of crashes and the crash rates for all study area intersections over a 3-year period. West 4th Street/Frontage Road NB (60 crashes) had the most crashes over a 3-year period. The crash rates for these intersections were determined based on the number of crashes per million vehicles entering the intersection. At Congress Street/Dorchester Street, a reported crash involved a pedestrian and resulted in an injury.

Table 1. MassHighway Crash History

Intersection	2004	2005	2006	Total Crashes	Crash Rate	District 4 Crash Rate
Pearl Street/Atlantic Avenue	0	0	1	1	0.05	
Pearl Street/Purchase Street	0	1	0	1	0.05	
Seaport Boulevard/Atlantic Avenue	0	4	8	12	0.35	
Oliver Street/ Purchase Street	0	2	0	2	0.06	
High Street/Atlantic Avenue	0	0	1	1	0.08	
High Street/Purchase Street	0	1	2	3	0.19	
Broad Street/Purchase Street	0	0	1	1	0.08	
East India Row/Atlantic Avenue	0	0	0	0	0.00	
India Street/Surface Artery Southbound (SASB)	0	0	0	0	0.00	
Milk Street/Atlantic Avenue	3	2	0	5	0.36	
Milk Street/SASB	0	1	1	2	0.18	
State Street/Atlantic Avenue	1	0	1	1	0.14	
State Street/SASB	0	0	0	0	0.00	
Mercantile Street/Atlantic Avenue/Cross Street	3	5	1	9	0.57	
Mercantile Street/SASB	0	0	1	1	0.08	
Commercial Street/Cross Street	0	0	0	0	0.00	
Clinton Street/SASB	0	2	2	4	0.33	
Kneeland Street/SASB	8	12	15	35	1.05	
Beach Street/SASB	2	2	0	4	0.24	
Essex Street/Lincoln Street/SASB	0	4	5	9	0.33	
Essex Street/South Street	0	1	0	1	0.16	0.88
Summer Street/Purchase Street/SASB	1	7	1	9	0.40	
Congress Street/Purchase Street	6	18	8	32	0.95	
Kneeland Street/Lincoln Street	2	3	4	9	0.48	
North Street/SASB	0	1	2	3	0.24	
North Street/Cross Street	1	0	2	3	0.18	
Hanover Street/SASB	0	1	0	1	0.12	
Hanover Street/Cross Street	1	2	1	4	0.21	
New Sudbury Street/SASB	0	0	2	2	0.13	
New Sudbury Street/Cross Street	1	0	2	3	0.14	
New Chardon Street/SASB	0	2	1	3	0.09	
North Washington Street/Cross Street	1	1	0	2	0.15	
North Washington Street/Beverly Street	0	0	0	0	0.00	
Valenti Way/Beverly Street	0	0	0	0	0.00	
Valenti Way/ North Washington Street	1	2	1	4	0.14	
Congress Street/Atlantic Avenue	4	7	5	16	0.61	
Summer Street/Atlantic Avenue	1	6	11	18	0.74	
Essex Street/Atlantic Avenue	0	2	2	4	0.29	
Beach Street/Atlantic Avenue	1	2	2	5	0.46	
Kneeland Street/Atlantic Avenue/I-93 Ramps	0	4	7	11	0.73	
North Street/Clinton Street	1	3	0	4	0.40	
Purchase Street/Fire Station	0	0	0	0	0.00	

Table 1. (cont.) MassHighway Crash History

Intersection	2004	2005	2006	Total Crashes	Crash Rate	District 4 Crash Rate
State Street/Congress Street/Devonshire Street	7	6	2	18	0.77	
North Street/Congress Street	4	5	6	15	0.66	
North Street/Union Street	0	0	1	1	0.07	
Hanover Street/Congress Street	1	0	0	1	0.05	
New Sudbury Street/Congress Street/ Merrimac Street	4	6	3	13	0.49	
New Chardon Street/Merrimac Street	7	4	3	14	0.50	
Summer Street/Dorchester Avenue	4	7	4	15	0.72	
Summer Street/Melcher Street	0	1	1	2	0.12	
Summer Street/Pump House Road	0	0	0	0	0.00	
Massport Haul Road/Pump Station Connector	0	0	0	0	0.00	
Summer Street/D Street	2	7	10	19	0.77	
Ramp DB (I-90 WB On Ramp)/D Street	0	1	1	2	0.10	
Transitway/D Street	0	1	2	3	0.17	
Congress Street/D Street	2	3	4	9	0.41	
Congress Street/B Street/Ramps D & F	2	1	3	6	0.25	
Congress Street/East Service Road/Ramps I & C	1	1	0	2	0.14	
Congress Street/Boston Wharf Road	1	0	0	1	0.07	
Seaport Boulevard(Northern Avenue)/B Street	0	2	2	4	0.19	
Seaport Boulevard/East Service Road	0	1	1	2	0.08	0.88
Seaport Boulevard/Sleeper Street	2	2	3	7	0.17	
Congress Street/Dorchester Avenue	2	2	3	7	0.49	
Congress Street/A Street	0	0	3	3	0.21	
Summer Street/West Side Drive	1	2	1	4	0.29	
Summer Street/WTC Avenue	2	2	2	6	0.38	
Seaport Boulevard/Boston Wharf Road	1	0	0	1	0.06	
SSCONN/Albany Street	0	0	0	0	0.00	
Broadway Bridge/Frontage Road NB	10	20	23	53	2.16	
Bennington Street/Neptune Road	0	8	7	15	0.74	
SSCONN/Ramps K&X	0	0	0	0	0.00	
East Berkeley Street/Albany Street	4	5	2	12	0.56	
West 4th Street/Frontage Road NB	22	13	25	60	2.32	
Traveler Street/Albany Street	5	3	3	11	0.54	
Herald Street/Albany Street	0	4	11	15	0.61	
Albany Street/Frontage Road SB	0	0	1	1	0.05	
Ramp A2/Ramp I/Frontage Road SB	0	0	3	3	0.14	
Martha Road/Nashua Street	0	0	0	0	0.00	
Rutherford Avenue/North Washington Street/Chelsea Street	4	3	8	15	0.30	
Rutherford Avenue/LT-TL	1	0	0	1	0.02	
Albany Street Ext./Frontage Road NB	7	9	6	22	0.93	
Neptune Road/Route 1A Off-ramp	0	2	1	3	0.18	

Five of the intersections in the study area exceeded the MassHighway District 4 crash rate of 0.88 crashes per million entering vehicles. These locations are Kneeland Street/SASB (1.05), Congress Street/Purchase Street (0.95), West 4th Street/Frontage Road NB (2.32), Broadway Bridge/Frontage Road NB (2.16), and Albany Street Extension/Frontage Road NB (0.93). **Table 2** summarizes the crash data received from MassHighway for those locations.

Table 2. MassHighway Crash Data Summary

Scenario	**# of Crashes**				
	Kneeland Street/SASB	**Congress/ Purchase**	**W. 4th/ Frontage**	**Broadway/ Frontage**	**Albany Street Ext./ Frontage Road NB**
Year					
2004	8	10	22	10	7
2005	12	20	13	20	9
2006	15	23	25	23	6
Type					
Single vehicle	2	1	0	0	3
Angle	6	7	42	37	9
Rear-end	4	8	5	10	2
Rear-to-rear	0	0	0	0	0
Head-on	1	0	0	0	0
Sideswipe	12	11	8	3	7
Unknown/other	10	5	5	3	1
Severity					
Property damage only	23	22	35	29	18
Personal injury	7	5	23	22	4
Fatality	0	0	0	0	0
Hit and run	0	0	0	0	0
Unknown	5	5	2	2	0
Total	**35**	**32**	**60**	**53**	**22**

Of the 25 known crashes at Kneeland Street/SASB, 12 were classified as sideswipe, same direction. Sideswipe crashes occurring between vehicles traveling in the same direction are most likely due to vehicles trying to maneuver around traffic that is waiting to make a left turn at approach. Also 6 of those 25 crashes were classified as Angle crashes. These are most commonly caused by drivers accepting gaps that are too small to safely make a left turn. HSH examined clearance times and clarity of signals at this location.

11 out of 27 known crashes at Congress Street/Purchase Street were sideswipe same direction. 7 out of the 27 were angle crashes and 8 out of the 27 were rear-end crashes. At this intersection, the sideswipe crashes are most likely caused by cars attempting to maneuver to or away from the I-90 on-ramp on the far side of Purchase Street southbound approach. With advanced warning through signage and pavement markings, these crashes could be minimized. Angle crashes typically occur when a vehicle making a left turn does not have an adequate gap in oncoming traffic. However, the traffic signal is set up to give each approach its own phase at this intersection. Rear-end crashes are commonly caused by poor clearance timing, or signal faces that are out of the cone of vision causing last minute lane change reactions. HSH examined the clearance times at this location for Phase 1 improvements.
Of the 55 known crashes at West 4th Street/Frontage Road NB, 42 were classified as angle crashes. Angle

crashes typically occur on two-way streets when a vehicle making a left turn does not have an adequate gap in oncoming traffic. However, both West 4th Street and Frontage Road are one-way streets at this intersection. It is likely that these crashes are caused by signals that are not clearly visible, causing some vehicles to run red indications. Not having sufficient clearance time for the vehicles could also be a factor. Currently, right-turn-on-red is not allowed on the westbound approach due to sight distance restrictions. Some crashes could be caused by vehicles that violate this.

Of the 50 known crashes at Broadway Bridge/Frontage Road NB, 37 were classified as angle crashes. Since each phase is set up to prevent conflicting movements, visibility and clearance times are likely to be a factor. HSH examined both the clearance timing and do a field review of the vehicle indications.

Of the 21 known crashed at Albany Street Extension/Frontage Road NB, 9 were classified as angle crashes. HSH examined the clearance timing and did a field review of the vehicle indications.

Signal Warrant Analysis

Based on Chapter 4C of the 2003 *Manual on Uniform Traffic Control Devices* (*MUTCD*) and existing volumes, HSH performed a traffic signal warrant analysis at every intersection in the study to determine if a traffic signal is still warranted. Warrant 3–Peak Hour was examined for all locations, even though the *MUTCD* states that it should be used only in unusual circumstances. Warrant 4–Pedestrian Volume and Warrant 5–School Crossing could not be completed for any location, because a gap study would be needed to satisfy the warrant. Warrant 5 also requires the counting of students, but the counts taken for this study included all pedestrians. Warrant 5 was only considered for locations that are within ¼-mile of a primary or secondary school. Warrant 6–Coordinated Signal System is not applicable at locations that are within 1000 feet of existing traffic signals. Although HSH entered the data into all of the worksheets, Warrant 7–Crash Experience is not applicable at any of the locations under study, because its purpose is to determine unsignalized locations that would expect to see a decrease in crashes due to the installation of a traffic signal. **Table 3** shows the results of the signal warrant analysis.

Table 3. Signal Warrant Analysis Results

	Warrant							
Intersection	**8-hour**	**4-hour**	**Peak-hour**	**Pedestrian Volume**	**School Crossing**	**Coordinated Signal System**	**Crash Experience**	**Roadway Network**
Pearl Street/Atlantic Avenue	n/a	n/a	n/a	No	n/a	n/a	No	n/a
Pearl Street/Purchase Street	Yes	No	No	Yes*	n/a	n/a	No	Yes
Seaport Boulevard/Atlantic Avenue	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
Oliver Street/ Purchase Street	No	Yes	Yes	Yes*	n/a	n/a	No	Yes
High Street/Atlantic Avenue	No	No	No	Yes*	n/a	n/a	No	No
High Street/Purchase Street	Yes	No	No	Yes*	n/a	n/a	No	No
Broad Street/Purchase Street	No	No	No	Yes*	n/a	n/a	No	No
East India Row/Atlantic Avenue	No	No	No	No	n/a	n/a	No	No
India Street/SASB	No	No	No	Yes*	n/a	n/a	No	No
Milk Street/Atlantic Avenue	No	No	No	Yes*	n/a	n/a	No	No
Milk Street/SASB	No	No	No	Yes*	n/a	n/a	No	No
State Street/Atlantic Avenue	No	No	No	Yes*	n/a	n/a	No	No
State Street/SASB	Yes	Yes	Yes	Yes*	n/a	n/a	No	Yes
Mercantile Street/Atlantic Avenue/Cross Street	No	No	No	Yes*	n/a	n/a	No	No
Mercantile Street/SASB	No	No	Yes	No	n/a	n/a	No	Yes
Commercial Street/Cross Street	No	No	No	Yes*	n/a	n/a	No	No
Clinton Street/SASB	Yes	Yes	Yes	Yes*	n/a	n/a	No	Yes
Kneeland Street/SASB	Yes	Yes	Yes	No	n/a	n/a	Yes**	Yes
Beach Street/SASB	Yes	No	No	Yes*	n/a	n/a	No	No
Essex Street/Lincoln Street/SASB	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
Essex Street/South Street	n/a	n/a	n/a	Yes*	n/a	n/a	No	n/a
Summer Street/Purchase Street/SASB	Yes	Yes	Yes	Yes*	n/a	n/a	No	Yes
Congress Street/Purchase Street	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
Kneeland Street/Lincoln Street	Yes	Yes	Yes	No	n/a	n/a	No	No
North Street/SASB	No	Yes	Yes	Yes*	n/a	n/a	No	Yes
North Street/Cross Street	No	Yes	Yes	Yes*	n/a	n/a	No	Yes
Hanover Street/SASB	No	No	No	Yes*	n/a	n/a	No	No
Hanover Street/Cross Street	No	No	Yes	Yes*	n/a	n/a	No	No
New Sudbury Street/SASB	No	No	No	Yes*	n/a	n/a	No	No
New Sudbury Street/Cross Street	Yes	Yes	Yes	Yes*	n/a	n/a	No	No
New Chardon Street/SASB	Yes	Yes	Yes	No	n/a	n/a	No	Yes
North Washington Street/Cross Street	No	No	No	No	n/a	n/a	No	No
North Washington Street/Beverly Street	Yes	Yes	Yes	No	n/a	n/a	No	No
Valenti Way/Beverly Street	n/a	n/a	n/a	No	n/a	n/a	No	n/a
Valenti Way/ North Washington Street	n/a	n/a	n/a	Yes*	n/a	n/a	No	n/a

Table 4. (cont.) Signal Warrant Analysis Results

	Warrant							
Intersection	**8-hour**	**4-hour**	**Peak-hour**	**Pedestrian Volume**	**School Crossing**	**Coordinated Signal System**	**Crash Experience**	**Roadway Network**
Congress Street/Atlantic Avenue	No	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
Summer Street/Atlantic Avenue	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
Essex Street/Atlantic Avenue	No	Yes	Yes	Yes*	n/a	n/a	No	Yes
Beach Street/Atlantic Avenue	n/a	n/a	n/a	Yes*	n/a	n/a	No	n/a
Kneeland Street/Atlantic Avenue/I-93 Ramps	No	No	Yes	Yes*	n/a	n/a	Yes**	Yes
North Street/Clinton Street	Yes	No	No	Yes*	n/a	n/a	No	No
Purchase Street/Fire Station	No	No	No	No	n/a	n/a	No	No
State Street/Congress Street/Devonshire Street	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	Yes
North Street/Congress Street	Yes	Yes	Yes	Yes*	n/a	n/a	Yes**	No
North Street/Union Street	n/a	n/a	n/a	Yes*	n/a	n/a	No	No
Hanover Street/Congress Street	No	No	No	Yes*	n/a	n/a	No	No
New Sudbury Street/Congress Street/ Merrimac Street	Yes	Yes	Yes	Yes*	n/a	n/a	No	No
New Chardon Street/Merrimac Street	Yes	Yes	Yes	Yes*	n/a	n/a	No	Yes
Summer St./Dorchester Ave.	Yes	Yes	Yes	Yes*	n/a	n/a	No	No
Summer St./Melcher St.	Yes	Yes	Yes	Yes*	n/a	n/a	No	No
Summer St./Pump House Rd.	Yes	No	Yes	No	n/a	n/a	No	No
Massport Haul Rd./ Pump Station Connector	No	No	No	No	n/a	n/a	No	No
Summer St./D St.	Yes	Yes	Yes	No	n/a	n/a	Yes**	Yes
Ramp DB/D St.	n/a	n/a	n/a	No	n/a	n/a	No	n/a
Transitway/D St.	No	No	No	No	n/a	n/a	No	No
Congress St./D St.	No	No	Yes	No	n/a	n/a	No	Yes
Congress St./B St./Ramps D & F	No	Yes	Yes	No	n/a	n/a	No	Yes
Congress St./East Service Rd./ Ramps I & C	No	No	Yes	No	n/a	n/a	No	No
Congress St./Boston Wharf Rd.	No	No	Yes	No	n/a	n/a	No	No
Seaport Blvd.(Northern Ave.)/B St.	Yes	Yes	Yes	Yes*	n/a	n/a	No	No
Seaport Blvd./East Service Rd.	Yes	Yes	Yes	No	n/a	n/a	No	No
Seaport Blvd./Sleeper St.	No	Yes	Yes	No	n/a	n/a	No	No
Congress St./Dorchester Ave.	Yes	Yes	Yes	No	n/a	n/a	No	No
Congress St./A St.	Yes	Yes	Yes	No	n/a	n/a	No	No
Summer St./West Side Dr.	No	No	No	No	n/a	n/a	No	No
Summer St./ World Trade Center Ave.	No	No	No	Yes*	n/a	n/a	No	No
Seaport Blvd./Boston Wharf Rd.	No	No	No	No	n/a	n/a	No	No

Table 4. (cont.) Signal Warrant Analysis Results

	Warrant							
Intersection	**8-hour**	**4-hour**	**Peak-hour**	**Pedestrian Volume**	**School Crossing**	**Coordinated Signal System**	**Crash Experience**	**Roadway Network**
SSCONN/Albany Street	No	No	No	No	n/a	n/a	No	No
Broadway Bridge/Frontage Road NB	Yes	Yes	Yes	No	n/a	n/a	Yes**	Yes
Bennington Street/Neptune Road	Yes	Yes	Yes	No	n/a	n/a	Yes**	No
SSCONN/Ramps K&X	No	No	No	No	n/a	n/a	No	No
East Berkeley Street/Albany Street	Yes	Yes	Yes	No	n/a	n/a	No	Yes
West 4th Street/Frontage Road NB	Yes	Yes	Yes	No	n/a	n/a	No	Yes
Traveler Street/Albany Street	Yes	Yes	Yes	No	n/a	n/a	No	No
Herald Street/Albany Street	Yes	Yes	Yes	No	n/a	n/a	Yes**	No
Albany Street/Frontage Road SB	Yes	Yes	Yes	No	n/a	n/a	No	Yes
Ramp A2/Ramp I/Frontage Road SB	Yes	Yes	Yes	No	n/a	n/a	No	Yes
Martha Road/Nashua Street	No	No	Yes	Yes*	n/a	n/a	Yes**	Yes
Rutherford Avenue/North Washington Street/Chelsea Street	Yes	Yes	Yes	No	n/a	n/a	Yes**	Yes
Rutherford Avenue/LT-TL	Yes	Yes	Yes	No	n/a	n/a	No	Yes
Albany Street Extension/ Frontage Road NB	Yes	Yes	Yes	No	n/a	n/a	Yes**	Yes
Neptune Road/Route 1A Off-ramp	No	Yes	Yes	No	n/a	n/a	No	No

*A gap study is necessary to complete this warrant.
** Intersection exceeds warrant minimum of 5 crashes per 12 months but is currently signalized. Based on traffic volumes, HSH does not recommend removing traffic signals to decrease crash rates.

Of the 81 intersections, 11 of them do not meet any of the signal warrants. Pearl Street/Atlantic Avenue did not meet any of the warrants, but was very close to meeting the pedestrian warrant. During the count period, 3 of the highest pedestrian hours had more than 100 pedestrians. The next highest hour had only 94 pedestrians cross the major road. It is likely that this intersection would meet the pedestrian warrant if counted on another day.

North Washington Street/Cross Street did not meet any of the signal warrants. However, the intersection was likely signalized because of the relatively high pedestrian volumes crossing the I-93 ramp. Valenti Way/Beverly Street does not meet any of the signal warrants and is currently running on a flashing red indication. Purchase Street/Fire Station is signalized to give emergency vehicles priority. The signal gives Purchase Street all green time unless there is emergency pre-emption.

Although Transitway/D Street did not meet any of the signal warrants, the intersection is currently signalized to allow MBTA Silver Line buses to cross the intersection.

SSCONN/Albany Street and SSONN/Ramps K&X are likely signalized due to sight distance issues.

Signal warrant worksheets appear in **Appendix B.**

Synchro Analysis

The Synchro analysis for Existing Conditions was structured to match the existing traffic operations as closely as possible. Existing geometries were used for all approaches, and No Turn on Red restrictions were put in place at all relevant locations. Conflicting pedestrian settings were used at all locations that have a pedestrian phase that runs concurrent with a vehicle turn; pedestrian calls per hour settings were used at locations that had an exclusive pedestrian phase. HSH used heavy vehicle percentage, peak-hour factors, and the central business district factor at all locations. Vehicle speeds reflected posted speed limits at all locations. Vehicle clearance times, minimum and maximum green times, extension times, recall, and other controller settings were all taken from the signal schedules provided by BTD.

Table 4 shows the adjustment factors used in the analysis.

Table 4. Adjustment Factors Used in the Synchro Analysis

Adjustment Factor	Used in Analysis?	Notes
Lane widths	Yes	Measured in field
Area type	Yes	CBD at all locations
Right turn on red	Yes	Based on field restrictions
Conflicting peds	Yes	At locations with concurrent pedestrian crossings
Conflicting bikes	No	
Peak-hour factor	Yes	From turning movement counts
Heavy vehicle %	Yes	From turning movement counts
Bus blockages/hour	Yes	At locations that had buses that block a travel lane
Adjacent parking lane	Yes	Based on field notes
Parking maneuvers/hour	No	

At Seaport Boulevard (Northern Avenue)/B Street, adjustments were made to the lane usage to reflect field observations. While the eastbound Seaport Boulevard approach is marked and signed as a through lane and an exclusive right-turn lane, vehicles often use the right-turn lane as a through lane because there are 2 receiving lanes on the east side of the intersection. Therefore, HSH modeled the eastbound approach as a through lane and a shared through/right-turn lane.

At Seaport Boulevard/Sleeper Street, the left-most lane on the eastbound approach appears to be a de facto left-turn lane during both the morning and mid-day peak hours. While normally the approach would be adjusted to show the de facto lane as an exclusive turn lane, HSH has opted to keep the current lane usage as a shared left-turn/through lane, an exclusive through lane, and a right-turn lane. This lane usage most accurately depicts the existing delay and level of service at this intersection.

Table 5 through **Table 7** show the results of the Existing Conditions analysis. The Synchro analysis can be found on the CD-ROM that accompanies this memo. Existing Operations Schedules can be found in **Appendix C.**

Table 5. Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**2.8**		
Atlantic WB left/thru | thru | thru	A	2.8	0.43	m72
Pearl Street/Purchase Street	**C**	**30.1**		
Pearl WB left	E	66.8	0.35	59
Pearl WB left/thru | thru	E	73.2	0.70	130
Purchase SB thru | thru | thru/right	B	19.0	0.55	m185
Seaport Boulevard/Atlantic Avenue	**F**	**114.9**		
Seaport EB left/thru | thru	F	265.7	0.91	m382
Seaport WB thru/bear right	E	78.3	0.93	197
Seaport WB bear right/right	D	47.4	0.57	149
Seaport WB right	B	11.7	0.71	45
Atlantic NB left/bear left	D	47.7	0.93	#452
Atlantic NB left/thru | thru/right	C	34.5	0.94	#433
Oliver Street/Purchase Street	**F**	**132.4**		
Oliver WB left/thru | thru	F	90.5	1.09	m#177
Purchase SB thru | thru | thru/right	D	50.2	0.89	#263
I-93 SWB left	F	263.5	0.98	#941
I-93 SWB thru | right	D	45.1	0.86	#440
High Street/Atlantic Avenue	**B**	**17.2**		
High EB left | left	D	41.0	0.27	66
Atlantic NB thru | thru	B	12.8	0.47	162
High Street/Purchase Street	**A**	**8.9**		
High EB thru | thru/right	B	13.1	0.38	56
Purchase SB left/thru | thru | thru	A	7.9	0.51	40
Broad Street/Purchase Street	**A**	**9.5**		
Broad EB right	A	0.8	0.18	0
Purchase SB thru | thru | thru/right	B	10.0	0.40	333
East India Row/Atlantic Avenue	**A**	**3.0**		
East India WB thru/right	C	23.3	0.25	41
Atlantic NB left/thru | thru/right	A	1.9	0.37	56
India Street/SASB	**A**	**8.1**		
India WB left | left	C	32.0	0.45	79
India WB thru	C	32.1	0.35	70
SASB SB thru | thru | thru/right	A	3.0	0.34	90
Milk Street/Atlantic Avenue	**C**	**22.3**		
Milk EB left | left	C	25.9	0.20	m36
Milk EB thru	E	61.0	0.75	163
Milk WB right	A	0.1	0.03	0
Atlantic NB thru | thru/right	B	10.7	0.47	177
Milk Street/SASB	**C**	**21.3**		
Milk EB thru | thru/right	C	21.8	0.22	51
SASB SB left/thru | thru | thru	C	21.3	0.61	204
State Street/Atlantic Avenue	**B**	**12.8**		
State WB thru/right	B	19.2	0.20	34
Atlantic NB left/thru | thru | thru/right	B	12.2	0.28	160

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/SASB	**C**	**24.5**		
State WB left	D	46.2	0.22	50
State WB thru | thru	D	45.4	0.36	85
SASB SB thru | thru | thru/right	C	21.5	0.80	442
Mercantile Street/Atlantic Avenue/Cross Street	**C**	**21.3**		
Mercantile EB left/thru | thru	D	46.1	0.35	87
Atlantic WB thru | thru/right	D	36.5	0.54	122
Atlantic NB left/thru | thru	A	6.7	0.18	26
Atlantic NB right	A	2.0	0.29	0
Mercantile Street/SASB	**F**	**81.8**		
Mercantile WB left | left	C	21.4	0.52	61
SASB SB left/thru | thru | thru	F	92.6	0.58	m185
Commercial Street/Cross Street	**A**	**1.5**		
Commercial WB right	A	0.3	0.10	0
Cross NB thru | thru	A	1.8	0.18	10
Clinton Street/SASB	**F**	**120.5**		
I-93 WB left	E	68.5	1.00	#562
I-93 WB left/thru	E	70.4	1.01	#611
SASB SB thru | thru | thru/right	F	173.1	0.84	273
Kneeland Street/SASB	**E**	**64.1**		
Kneeland EB thru | thru	D	45.0	0.66	158
Kneeland EB right	A	9.0	0.41	51
Kneeland WB left	C	20.7	0.38	m76
Kneeland WB thru | thru	F	136.7	0.77	382
SASB SB left/thru | thru | thru/right	A	5.8	0.43	48
Beach Street/SASB	**A**	**4.6**		
Beach WB left	D	36.5	0.35	m75
SASB SB thru | thru | thru	A	2.0	0.28	21
Essex Street/Lincoln Street/SASB	**D**	**36.8**		
Essex EB left/thru | thru	E	69.5	0.97	#313
Essex EB right/hard right	B	19.1	0.42	96
SASB SB left/thru | thru | thru/right	B	13.8	0.47	174
I-93 Ramp NWB left/thru | thru | thru/right	D	38.2	0.73	193
Essex Street/South Street	**A**	**6.8**		
Essex EB thru | thru/right	A	2.9	0.29	m4
South WB left | left	D	35.6	0.18	m24
Summer Street/Purchase Street/SASB	**D**	**45.2**		
Summer EB thru	D	46.5	0.40	85
Summer EB right	B	13.9	0.24	20
Summer WB left	D	44.4	0.83	m#207
Summer WB left/thru | thru	D	53.1	0.94	m#275
Purchase SB left/thru | thru/right	D	47.5	0.90	#271
I-90 off-ramp SWB left/thru | thru/right	D	37.5	0.68	235

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**C**	**22.5**		
Congress EB thru | thru | thru/right	C	24.3	0.41	135
Congress EB right	C	26.0	0.34	132
Purchase SB hard left	C	23.7	0.73	282
Purchase SB left/thru | thru	B	19.7	0.74	248
Kneeland Street/Lincoln Street	**C**	**24.7**		
Kneeland EB left/thru | thru/right	C	24.1	0.72	203
Kneeland WB left/thru | thru | thru/right	C	26.4	0.79	m161
Lincoln NB left/thru | thru	C	29.1	0.63	#514
Lincoln NB right	A	5.5	0.34	71
North Street/SASB	**B**	**18.1**		
North Street EB right	A	4.8	0.05	20
I-93 WB left/thru | thru	A	8.3	0.56	240
SASB SB thru | thru/right	D	44.8	0.82	173
North Street/Cross Street	**C**	**29.3**		
I-93 EB left	B	16.3	0.39	205
I-93 EB left/thru	B	16.6	0.42	207
Cross NB thru | thru/right	D	46.2	0.79	181
Hanover Street/SASB	**B**	**14.6**		
Hanover EB thru | thru/right	C	28.8	0.05	10
Hanover WB left	C	24.5	0.15	56
Hanover WB thru	C	27.9	0.26	132
SASB SB left/thru | thru/right	A	6.8	0.33	m53
Hanover Street/Cross Street	**A**	**6.9**		
Hanover EB left	D	42.7	0.12	16
Hanover EB thru	D	41.3	0.10	31
Hanover WB thru/right	C	27.2	0.60	71
Cross NB left/thru | thru/right	A	2.2	0.42	41
New Sudbury Street/SASB	**D**	**43.3**		
New Sudbury EB thru | thru	B	11.1	0.14	59
New Sudbury EB right	A	3.0	0.21	22
SASB SB left/thru | thru	E	57.3	0.70	181
Haymarket Station SEB right	F	116.7	0.93	30
New Sudbury Street/Cross Street	**B**	**11.1**		
New Sudbury EB left | left	A	8.5	0.17	36
Cross NB left/thru | thru	B	12.2	0.74	235
New Chardon Street/SASB	**C**	**24.2**		
New Chardon EB bear right | bear right	D	44.4	0.61	186
New Chardon EB right	C	32.9	0.27	56
SASB SB left	B	14.0	0.72	74
SASB SB left/thru | thru/right	B	10.5	0.71	70
SASB SB right	B	15.3	0.74	79
I-93 NWB left | left	D	41.6	0.75	#240

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**C**	**22.5**		
Cooper Street WB right	A	0.9	0.15	0
I-93 NB thru | thru	D	45.6	0.52	82
Cross NWB bear right | bear right	B	17.8	0.44	227
North Washington Street/Beverly Street	**B**	**17.5**		
N. Washington SB thru | thru | thru	C	20.7	0.68	290
Beverly SEB right | right | right	A	1.6	0.14	m4
Valenti Way/Beverly Street	**A**			
Valenti WB left	A	0.5	0.19	17
Valenti Way/North Washington Street	**C**	**21.5**		
N. Washington NB left (de facto)	F	90.0	1.00	#309
N. Washington NB thru/right	B	18.8	0.70	369
N. Washington SB left/thru | thru | thru/right	A	9.0	0.58	191
Congress Street/Atlantic Avenue	**C**	**29.4**		
Congress EB left | left	D	35.7	0.67	m142
Congress EB thru | thru	A	7.2	0.41	101
Congress WB right | right	A	0.5	0.24	0
Atlantic NB thru | thru | thru/right	D	43.6	1.01	m#305
Summer Street/Atlantic Avenue	**E**	**73.1**		
Summer EB left/thru | thru	D	37.8	0.61	m188
Summer WB thru | thru | thru/right	D	39.9	0.59	139
Atlantic NB left/thru | thru | thru	F	83.6	0.98	#428
Atlantic NB right	F	107.8	1.05	#455
Essex Street/Atlantic Avenue	**B**	**12.4**		
Essex EB left | left	D	35.6	0.69	126
Atlantic NB left/thru | thru | thru	A	8.4	0.62	368
Beach Street/Atlantic Avenue	**A**	**9.4**		
Atlantic NB left/thru | thru | thru	A	9.4	0.53	m313
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**E**	**73.2**		
Kneeland EB left	E	61.3	0.89	m#254
Kneeland EB left/thru	D	48.6	0.81	m#230
MBTA Drive WB thru/right	D	39.0	0.05	18
Frontage NB left	D	40.3	0.51	#262
Frontage NB left/thru	D	44.9	0.64	#385
I-90 WB Off-Ramp NWB left	F	116.6	1.13	#568
I-90 WB Off-Ramp NWB thru	E	75.0	1.04	#1038
North Street/Clinton Street	**C**	**33.4**		
North EB thru	B	12.9	0.16	41
North WB thru | thru	C	30.7	0.48	234
Clinton NB left | left/right	D	46.9	0.72	135
Purchase Street/Fire Station	**A**			
Fire Station EB right	A	9.3	0.04	3
Purchase SB thru | thru | thru/right	A	0.0	0.29	0

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**D**	**51.5**		
State WB left/thru | thru/right	F	97.9	1.10	#317
Congress NB thru | thru	B	10.0	0.19	37
Congress SB thru | thru/bear right	C	27.9	0.74	282
Congress SB right	C	32.4	0.73	307
North Street/Congress Street	**D**	**42.3**		
North WB left | left/right	C	27.0	0.97	#475
Congress NB thru| thru | thru/right	A	3.6	0.38	4
Congress SB left/thru | thru | thru	F	93.2	1.07	#249
North Street/Union Street	**B**	**17.2**		
North EB left/thru | thru	A	1.1	0.06	m1
North WB thru | thru/right	B	18.7	0.71	398
Hanover Street/Congress Street	**B**	**11.0**		
Hanover WB left	C	21.1	0.56	119
Congress NB thru | thru | thru/right	B	12.1	0.27	m82
Congress SB thru | thru | thru	A	4.6	0.25	33
New Sudbury Street/Congress Street/Merrimac Street	**C**	**35.0**		
New Sudbury EB left	D	52.2	0.68	165
New Sudbury EB thru | thru	D	38.5	0.42	106
New Sudbury EB right	A	9.9	0.43	54
Congress NB thru | thru | thru/right	D	40.5	0.88	#321
Merrimac SB left	D	38.8	0.53	m58
Merrimac SB thru | thru | thru	C	20.2	0.23	m70
New Chardon Street/Merrimac Street	**E**	**79.1**		
New Chardon EB left/thru | thru/right	A	6.9	0.38	8
New Chardon WB hard left/left	F	297.5	1.53	#365
New Chardon WB thru | thru/right	B	16.2	0.37	126
Merrimac NB hard left/left	F	120.4	1.19	m#480
Merrimac NB thru | thru/right	C	22.1	0.74	m102
Merrimac SB left/thru | thru | thru/right	D	45.7	0.76	102
Summer Street/Dorchester Avenue	**E**	**66.4**		
Summer EB left/thru | thru/right	E	65.9	1.02	m#434
Summer WB left/thru | thru/right	B	12.9	0.69	182
Dorchester NB left/thru/right	C	29.7	0.39	45
Dorchester SB left	F	228.6	1.38	#434
Dorchester SB thru/right	B	14.8	0.26	42
Summer Street/Melcher Street	**C**	**23.5**		
Summer EB thru | thru/right	B	18.5	0.64	m238
Summer WB left/thru | thru	C	25.7	0.64	239
Melcher NB left/right	D	50.7	0.65	152
Summer Street/Pump House Road	**B**	**10.4**		
Summer EB left/thru | thru	A	7.8	0.31	164
Summer WB thru | thru | thru/right	A	9.3	0.38	194
Driveway NB left/thru/right	—	—	—	—
Pump House SB left	D	43.2	0.28	67
Pump House SB left/right	C	30.2	0.28	61

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Massport Haul Road/Pump Station Connector	**C**	**34.4**		
Haul EB thru	B	11.5	0.10	63
Haul EB right	A	3.7	0.12	23
Haul WB left	A	7.1	0.02	13
Haul WB thru	A	6.8	0.08	25
Pump Station NB left | left/right	E	56.3	0.73	141
Summer Street/D Street	**C**	**31.3**		
Summer EB left	C	26.1	0.29	110
Summer EB thru | thru/right	C	21.5	0.28	165
Summer WB left/thru | thru	D	46.8	0.61	#189
Summer WB right	B	12.7	0.42	128
D Street NB left	D	48.4	0.51	87
D Street NB thru | thru/right	D	37.5	0.47	83
D Street SB left	D	48.7	0.63	93
D Street SB thru | thru/right	C	32.0	0.52	73
Ramp DB (I-90 WB On Ramp)/D Street	**B**	**13.5**		
D Street NB left	E	55.5	0.70	#207
D Street NB thru | thru	A	1.5	0.18	68
D Street SB thru | thru/right	A	9.3	0.27	88
Transitway/D Street	**A**	**7.0**		
Transitway EB thru	D	48.5	0.36	43
Transitway WB thru	D	47.0	0.32	47
D Street NB thru | thru | thru/right	A	6.1	0.18	44
D Street SB thru | thru	A	2.4	0.23	62
Congress Street/D Street	**C**	**35.0**		
Congress EB left/thru | thru/right	C	23.2	0.36	m109
Congress EB right	A	7.1	0.52	M67
Congress WB left/thru | thru/right	C	34.6	0.42	35
D Street NB left	E	77.3	0.91	#253
D Street NB left/thru | thru/right	D	47.3	0.81	106
D Street SB left/thru | thru/right	D	41.6	0.55	93
Congress Street/B Street/Ramps D&F	**E**	**64.4**		
Congress EB left/thru | thru	D	50.4	0.91	m#206
Congress EB right	A	9.8	0.12	m1
Congress WB left	A	9.8	0.34	m27
Congress WB left/thru | thru/right	A	7.0	0.34	m19
Ramp NB left	F	302.2	1.55	#425
Ramp NB thru	C	34.6	0.63	209
Ramp NB right	A	6.2	0.60	63
B Street SB thru | thru	D	53.7	0.13	23
B Street SB right	D	35.2	0.10	m14

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**E**	**57.8**		
Congress EB left	B	17.6	0.12	28
Congress EB thru | thru	B	17.6	0.11	m46
Congress WB thru | thru	A	8.1	0.21	m23
Congress WB right	A	1.5	0.10	m1
Ramp I NB left/thru | thru	E	58.3	0.86	#204
Ramp I NB right	B	10.8	0.60	48
Ramp C NEB thru | thru/right	F	103.6	1.11	#414
Congress Street/Boston Wharf Road	**C**	**28.9**		
Congress EB left/thru	D	38.1	0.71	m#160
Congress EB right	A	6.8	0.09	m10
Congress WB left	B	15.5	0.08	m14
Congress WB thru | thru/right	B	14.7	0.31	m123
Boston Wharf NB left	D	46.5	0.60	163
Boston Wharf NB thru/right	C	30.5	0.23	51
Boston Wharf SB left/thru	E	70.1	0.46	66
Boston Wharf SB right	C	32.3	0.35	m61
Seaport Boulevard (Northern Avenue)/ B Street	**C**	**26.6**		
Seaport EB thru | thru/right	C	28.3	0.68	367
Seaport WB left/thru | thru	B	19.4	0.50	179
B Street NB left | left	D	41.7	0.60	m81
B Street NB right	A	9.4	0.45	m8
Seaport Boulevard/Northern Avenue/East Service Road	**C**	**25.1**		
Seaport EB left	B	14.6	0.19	25
Seaport EB thru | thru	B	14.2	0.45	162
Seaport WB thru | thru/right	C	23.5	0.62	205
East Service NB left	D	49.7	0.54	m95
East Service NB thru	D	53.7	0.70	m131
East Service NB right	B	16.3	0.58	m72
Northern SB left	D	45.3	0.26	38
Northern SB left/right	C	30.0	0.24	41
Seaport Boulevard/Sleeper Street	**C**	**23.9**		
Seaport EB left/thru | thru	D	37.1	3.56dl	#505
Seaport EB right	A	2.1	0.16	20
Seaport WB left	A	1.8	0.09	m3
Seaport WB thru | thru/right	A	2.0	0.27	82
Sleeper NB left/thru/right	D	48.0	0.71	77
Sleeper SB left/thru	D	38.3	0.23	27
Sleeper SB right	B	13.2	0.19	22
Congress Street/Dorchester Avenue	**C**	**21.9**		
Congress EB thru | thru/right	A	8.6	0.47	117
Congress WB left/thru	C	20.8	0.46	150
Dorchester NB left/right	D	52.0	0.85	228

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**D**	**39.1**		
Congress EB left/thru | thru	C	22.1	0.28	95
Congress EB right	A	5.9	0.18	29
Congress WB left	C	29.8	0.65	#412
Congress WB thru/right	B	18.9	0.24	198
A Street NB left/thru/right	F	96.5	1.03	112
Thompson SB left/thru/right	C	29.0	0.14	5
Summer Street/West Side Drive	**A**	**6.2**		
Summer EB thru | thru/right	A	4.4	0.37	132
Summer WB left	A	9.8	0.11	16
Summer WB thru | thru	A	7.5	0.24	91
West Side NB left	D	39.2	0.02	13
West Side NB right	C	22.5	0.05	6
Summer Street/WTC Avenue	**A**	**8.6**		
Summer EB left	A	2.2	0.06	2
Summer EB thru | thru	A	3.4	0.31	14
Summer EB right	A	0.4	0.08	0
Summer WB left	A	8.6	0.19	m23
Summer WB thru | thru/right	B	10.6	0.30	65
WTC NB left	D	42.2	0.17	39
WTC NB thru/right	B	17.1	0.18	9
WTC SB left	D	43.7	0.20	36
WTC SB thru/right	A	0.0	0.02	0
Seaport Boulevard/Boston Wharf Road	**B**	**16.1**		
Seaport EB thru | thru/right	C	23.8	0.61	m#390
Seaport WB left	A	5.9	0.14	m20
Seaport WB thru| thru	A	4.5	0.26	110
Boston Wharf NB left | left/right	C	27.1	0.26	m17
SSCONN/Albany Street	**A**	**8.7**		
SSCONN WB left | left	D	42.4	0.33	42
Albany SB left/thru | thru | thru	A	4.4	0.20	92
Broadway Bridge/Frontage Road	**F**	**121.3**		
Traveler EB hard left	D	37.9	0.17	m40
Traveler EB left	F	257.6	0.68	m145
Traveler EB thru | thru	B	19.2	0.40	165
Broadway WB right	E	65.2	0.93	#389
Broadway WB hard right (de facto)	F	350.0	1.70	#854
Frontage NB thru | thru	B	14.2	0.18	m30
Frontage NB right | right | right/hard right	C	20.8	0.64	64
Bennington Street/Neptune Road	**F**	**111.5**		
Bennington EB left/thru | thru/right	D	53.4	0.55	103
Bennington WB left/thru | thru/right	C	21.6	0.72	m43
Neptune NB left/thru | thru/right	C	27.7	0.62	#218
Neptune SB left (de facto)	F	291.8	1.58	#1112
Neptune SB thru/right	B	19.0	0.56	#544

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**10.3**		
SSCONN EB left/thru	D	46.9	0.29	40
SSCONN EB right	B	14.5	0.09	6
SSCONN WB left	D	47.9	0.25	32
SSCONN WB thru/right	C	28.4	0.36	35
Ramp NB left/thru | thru/right	A	7.8	0.45	280
Ramp SB left	A	8.5	0.06	7
Ramp SB left/thru | thru/right	A	3.7	0.04	6
East Berkeley Street/Albany Street	**D**	**52.5**		
East Berkeley WB left/thru | thru | thru	E	65.8	0.66	m93
Albany SB thru | thru | thru/right	C	27.4	0.48	109
West 4th Street/Frontage Road	**E**	**64.2**		
West 4th WB thru | thru | thru/right	F	132.9	1.03	#366
Frontage NB left	B	16.9	0.62	m#567
Frontage NB thru | thru/right	B	14.2	0.61	#466
Traveler Street/Albany Street	**B**	**13.6**		
Traveler EB thru/right	E	62.6	0.72	169
Albany SB left	A	9.6	0.51	306
Albany SB left/thru | thru/right	A	7.5	0.52	290
Herald Street/Albany Street	**C**	**22.7**		
Herald EB right | right | right	B	13.6	0.53	184
Albany SB thru | thru | thru	C	29.2	0.83	224
MBTA Bus Lot (near Randolph)/Albany Street	**C**	**20.7**		
MBTA EB thru/right	C	31.0	0.05	11
Albany SB left	C	23.9	0.18	m83
Albany SB left/bear left | bear left	C	23.4	0.18	71
Albany SB thru/right	B	10.4	0.56	84
Albany NB right | right	C	29.7	0.76	44
Ramp A2/Ramp I/Frontage Road	**E**	**72.7**		
Frontage SB thru	B	15.3	0.40	94
Frontage SB right	B	12.6	0.10	29
Ramp SWB left/thru | thru	F	84.3	1.11	#754
Nashua Street/Martha Road	**B**	**12.2**		
Nashua WB left | left	C	23.5	0.66	110
Martha SB thru | thru	A	5.1	0.34	111
Chelsea Street/Rutherford Avenue/North Washington St.	**D**	**46.4**		
Chelsea WB left	F	206.2	1.36	#723
Chelsea WB thru	D	43.4	0.77	#366
Chelsea WB right	A	5.8	0.34	36
N. Washington NB thru | thru | thru	C	23.7	0.25	79
N. Washington NB right	A	6.8	0.67	86
Rutherford SB left	F	114.8	1.11	m#387
Rutherford SB thru | thru | thru	A	3.3	0.51	m60
Rutherford SB right	A	4.0	0.62	m39

Table 5. (cont.) Existing (2008) Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**C**	**28.2**		
Ramp EB left | left	C	33.4	0.56	163
Ramp EB right | right	D	43.7	0.81	224
Rutherford NB left	E	64.4	0.91	m#244
Rutherford NB thru | thru | thru | thru	A	6.4	0.11	m33
Rutherford SB thru | thru | thru | thru	C	26.1	0.72	343
Rutherford SB right	A	4.4	0.25	72
Albany Street/Frontage Road	**B**	**18.7**		
Albany EB left | left	C	22.7	0.78	132
Albany EB thru	A	9.3	0.07	m6
Albany WB right	B	16.9	0.43	36
Frontage NB thru | thru | thru/right	B	17.3	0.55	290
Neptune Road/Route 1A Off-ramp	**D**	**40.7**		
Neptune EB left/thru | thru	A	3.6	0.06	m5
Neptune WB thru | thru/right	B	15.5	0.30	48
Off-Ramp NB left	E	76.0	0.89	#345
Off-Ramp NB thru/right	D	38.9	0.38	122

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

Table 6. Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**2.0**		
Atlantic WB left/thru | thru | thru	A	2.0	0.32	79
Pearl Street/Purchase Street	**C**	**29.8**		
Pearl WB left	D	44.1	0.30	56
Pearl WB left/thru | thru	D	43.0	0.40	54
Purchase SB thru | thru | thru/right	C	28.0	0.49	m264
Seaport Boulevard/Atlantic Avenue	**C**	**33.8**		
Seaport EB left/thru | thru	B	18.6	0.53	150
Seaport WB thru/bear right	E	59.8	0.81	#214
Seaport WB bear right/right	E	56.6	0.77	146
Seaport WB right	A	9.8	0.55	24
Atlantic NB left/bear left	D	41.7	0.75	#417
Atlantic NB left/thru | thru/right	C	34.1	0.75	#357
Oliver Street/Purchase Street	**D**	**37.6**		
Oliver WB left/thru | thru	D	40.2	0.77	m105
Purchase SB thru | thru | thru/right	D	49.9	0.85	229
I-93 SWB left	B	11.5	0.44	191
I-93 SWB thru | right	C	32.0	0.49	187
High Street/Atlantic Avenue	**B**	**16.1**		
High EB left | left	D	38.4	0.34	64
Atlantic NB thru | thru	A	9.9	0.38	184
High Street/Purchase Street	**B**	**10.7**		
High EB thru | thru/right	B	15.9	0.37	35
Purchase SB left/thru | thru | thru	A	9.2	0.39	30
Broad Street/Purchase Street	**A**	**3.2**		
Broad EB right	A	1.5	0.31	0
Purchase SB thru | thru | thru/right	A	3.5	0.27	31
East India Row/Atlantic Avenue	**A**	**2.8**		
East India WB thru/right	C	22.8	0.29	39
Atlantic NB left/thru | thru/right	A	1.4	0.30	63
India Street/SASB	**B**	**14.0**		
India WB left | left	D	48.7	0.28	53
India WB thru	D	50.1	0.25	66
SASB SB thru | thru | thru/right	A	6.3	0.22	70
Milk Street/Atlantic Avenue	**B**	**14.6**		
Milk EB left | left	D	43.0	0.38	54
Milk EB thru	D	50.1	0.50	86
Milk WB right	A	0.1	0.04	0
Atlantic NB thru | thru/right	A	4.6	0.42	19
Milk Street/SASB	**A**	**9.0**		
Milk EB thru | thru/right	B	17.3	0.29	43
SASB SB left/thru | thru | thru	A	6.7	0.36	47
State Street/Atlantic Avenue	**A**	**5.1**		
State WB thru/right	B	19.2	0.18	44
Atlantic NB left/thru | thru | thru/right	A	3.8	0.24	41

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/SASB	**D**	**37.1**		
State WB left	C	33.6	0.24	60
State WB thru | thru	C	32.7	0.31	76
SASB SB thru | thru | thru/right	D	38.2	0.44	182
Mercantile Street/Atlantic Avenue/Cross Street	**B**	**19.2**		
Mercantile EB left/thru | thru	D	47.6	0.36	85
Atlantic WB thru | thru/right	C	32.4	0.45	93
Atlantic NB left/thru | thru	A	8.1	0.22	38
Atlantic NB right	A	2.9	0.34	0
Mercantile Street/SASB	**B**	**13.2**		
Mercantile WB left | left	B	11.5	0.37	18
SASB SB left/thru | thru | thru	B	13.6	0.31	135
Commercial Street/Cross Street	**A**	**1.9**		
Commercial WB right	A	0.2	0.07	0
Cross NB thru | thru	A	2.1	0.17	20
Clinton Street/SASB	**C**	**22.8**		
I-93 WB left	D	43.1	0.69	171
I-93 WB left/thru	D	42.7	0.70	207
SASB SB thru | thru | thru/right	A	8.1	0.37	62
Kneeland Street/SASB	**C**	**24.5**		
Kneeland EB thru | thru	E	75.8	0.86	#205
Kneeland EB right	A	8.7	0.48	53
Kneeland WB left	B	16.0	0.42	m24
Kneeland WB thru | thru	B	17.8	0.54	101
SASB SB left/thru | thru | thru/right	A	6.8	0.50	60
Beach Street/SASB	**A**	**6.3**		
Beach WB left	D	41.8	0.56	104
SASB SB thru | thru | thru	A	1.2	0.31	15
Essex Street/Lincoln Street/SASB	**C**	**26.7**		
Essex EB left/thru | thru	D	39.1	0.75	170
Essex EB right/hard right	C	32.9	0.71	161
SASB SB left/thru | thru | thru/right	B	14.4	0.52	175
I-93 Ramp NWB left/thru| thru | thru/right	C	31.1	0.51	112
Essex Street/South Street	**A**	**8.6**		
Essex EB thru | thru/right	A	5.6	0.28	30
South WB left | left	C	33.3	0.13	25
Summer Street/Purchase Street/SASB	**D**	**41.6**		
Summer EB thru	D	37.9	0.28	73
Summer EB right	B	12.2	0.24	5
Summer WB left	D	39.8	0.72	m#117
Summer WB left/thru | thru	C	32.1	0.73	m#113
Purchase SB left/thru | thru/right	E	57.0	0.96	m#265
I-90 off-ramp SWB left/thru | thru/right	C	27.7	0.34	105

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**D**	**38.2**		
Congress EB thru | thru | thru/right	B	19.7	0.37	118
Congress EB right	C	21.9	0.37	138
Purchase SB hard left	C	30.0	0.63	246
Purchase SB left/thru | thru	E	59.4	0.88	#316
Kneeland Street/Lincoln Street	**E**	**61.3**		
Kneeland EB left (de facto)	E	73.3	0.93	m#212
Kneeland EB thru/right	F	183.7	0.64	m268
Kneeland WB left/thru | thru | thru/right	C	30.7	0.75	90
Lincoln NB left/thru | thru	B	17.5	0.32	175
Lincoln NB right	A	4.7	0.24	41
North Street/SASB	**B**	**12.4**		
North Street EB right	A	3.6	0.19	51
I-93 WB left/thru | thru	A	5.1	0.29	97
SASB SB thru | thru/right	C	30.0	0.66	146
North Street/Cross Street	**C**	**22.0**		
I-93 EB left	B	15.8	0.27	123
I-93 EB left/thru	B	15.9	0.28	91
Cross NB thru | thru/right	C	27.1	0.73	168
Hanover Street/SASB	**A**	**9.9**		
Hanover EB thru | thru/right	B	15.1	0.08	10
Hanover WB left	C	21.9	0.17	m42
Hanover WB thru	C	23.0	0.20	67
SASB SB left/thru | thru/right	A	3.7	0.28	28
Hanover Street/Cross Street	**A**	**9.6**		
Hanover EB left	C	34.9	0.17	27
Hanover EB thru	D	35.6	0.25	37
Hanover WB thru/right	C	30.3	0.64	112
Cross NB left/thru | thru/right	A	2.0	0.36	25
New Sudbury Street/SASB	**C**	**25.6**		
New Sudbury EB thru | thru	A	8.7	0.14	63
New Sudbury EB right	A	2.6	0.29	28
SASB SB left (de facto)	E	55.4	0.85	40
SASB SB thru	D	35.8	0.69	166
Haymarket Station SEB right	E	58.9	0.50	14
New Sudbury Street/Cross Street	**B**	**16.3**		
New Sudbury EB left | left	B	11.9	0.16	m59
Cross NB left/thru | thru	B	19.1	0.72	161
New Chardon Street/SASB	**C**	**22.6**		
New Chardon EB bear right | bear right	C	30.9	0.52	183
New Chardon EB right	C	22.0	0.17	62
SASB SB left	B	19.9	0.60	67
SASB SB left/thru | thru/right	B	17.1	0.60	59
SASB SB right	C	20.8	0.61	65
I-93 NWB left | left	C	21.3	0.29	92

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**B**	**10.3**		
Cooper Street WB right	A	0.9	0.18	0
I-93 NB thru | thru	D	39.2	0.37	51
Cross NWB bear right | bear right	A	5.1	0.41	60
North Washington Street/Beverly Street	**B**	**15.8**		
N. Washington SB thru | thru | thru	B	18.0	0.47	125
Beverly SEB right | right | right	A	9.8	0.13	m45
Valenti Way/Beverly Street	**A**			
Valenti WB left | left/thru | thru	A	0.5	0.18	16
Valenti Way/North Washington Street	**A**	**8.4**		
N. Washington NB left/thru | thru/right	A	2.4	0.53	13
N. Washington SB left/thru | thru | thru/right	B	14.0	0.72	221
Congress Street/Atlantic Avenue	**D**	**35.6**		
Congress EB left | left	C	34.6	0.64	136
Congress EB thru | thru	A	8.1	0.30	66
Congress WB right | right	A	0.5	0.23	0
Atlantic NB thru | thru | thru/right	E	62.2	0.80	175
Summer Street/Atlantic Avenue	**C**	**34.6**		
Summer EB left/thru | thru	D	37.3	0.35	m110
Summer WB thru | thru | thru/right	C	29.8	0.47	117
Atlantic NB left/thru | thru | thru	C	34.3	0.75	208
Atlantic NB right	D	42.0	0.70	#217
Essex Street/Atlantic Avenue	**B**	**11.2**		
Essex EB left | left	C	26.6	0.58	56
Atlantic NB left/thru | thru | thru	A	7.2	0.34	102
Beach Street/Atlantic Avenue	**A**	**3.8**		
Atlantic NB left/thru | thru | thru	A	3.8	0.28	m57
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**D**	**46.2**		
Kneeland EB left	F	89.7	0.94	#278
Kneeland EB left/thru	E	79.4	0.90	#272
MBTA Drive WB thru/right	C	33.0	0.02	6
Frontage NB left	C	26.4	0.34	162
Frontage NB left/thru	C	26.9	0.37	176
I-90 WB Off-Ramp NWB left	E	56.2	0.82	165
I-90 WB Off-Ramp NWB thru	B	12.0	0.37	174
North Street/Clinton Street	**C**	**29.4**		
North EB thru	B	12.9	0.21	75
North WB thru | thru	C	21.1	0.36	188
Clinton NB left | left/right	D	53.9	0.66	135
Purchase Street/Fire Station	**A**			
Fire Station EB right	A	9.4	0.06	5
Purchase SB thru | thru | thru/right	A	0.0	0.23	0

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**C**	**21.1**		
State WB left/thru | thru/right	C	24.4	0.57	164
Congress NB thru | thru	B	15.1	0.26	51
Congress SB thru | thru/bear right	B	19.8	0.61	214
Congress SB right	C	23.0	0.59	229
North Street/Congress Street	**B**	**18.6**		
North WB left | left/right	C	22.4	0.86	#30
Congress NB thru| thru | thru/right	A	2.0	0.33	4
Congress SB left/thru | thru | thru	C	27.9	0.60	136
North Street/Union Street	**D**	**50.8**		
North EB left/thru | thru	A	1.1	0.10	1
North WB thru | thru/right	E	63.0	0.54	284
Hanover Street/Congress Street	**B**	**10.6**		
Hanover WB left	A	8.6	0.30	61
Congress NB thru | thru | thru/right	B	16.2	0.23	m89
Congress SB thru | thru | thru	A	4.6	0.19	36
New Sudbury Street/Congress Street/Merrimac Street	**C**	**31.2**		
New Sudbury EB left	D	42.8	0.62	156
New Sudbury EB thru | thru	C	32.6	0.37	93
New Sudbury EB right	A	8.6	0.48	51
Congress NB thru | thru | thru/right	D	38.9	0.77	#216
Merrimac SB left	C	26.8	0.41	m41
Merrimac SB thru | thru | thru	B	18.5	0.17	m48
New Chardon Street/Merrimac Street	**D**	**37.5**		
New Chardon EB left/thru | thru/right	A	8.3	0.54	11
New Chardon WB hard left/left	E	61.6	0.75	104
New Chardon WB thru | thru/right	A	6.6	0.21	45
Merrimac NB hard left/left	F	88.9	1.06	m#356
Merrimac NB thru | thru/right	C	32.6	0.62	m128
Merrimac SB left/thru | thru | thru/right	C	32.1	0.58	94
Summer Street/Dorchester Avenue	**C**	**27.6**		
Summer EB left/thru | thru/right	C	22.9	0.72	#470
Summer WB left/thru | thru/right	C	20.5	0.54	#261
Dorchester NB left/thru/right	C	24.4	0.44	72
Dorchester SB left	E	65.6	0.87	197
Dorchester SB thru/right	B	19.3	0.29	44
Summer Street/Melcher Street	**B**	**13.3**		
Summer EB thru | thru/right	A	5.6	0.49	m102
Summer WB left/thru | thru	B	18.0	0.52	180
Melcher NB left/right	D	40.6	0.66	133
Summer Street/Pump House Road	**B**	**10.5**		
Summer EB left/thru | thru	A	6.7	0.27	123
Summer WB thru | thru | thru/right	A	9.2	0.23	98
Driveway NB left/thru/right	—	—	—	—
Pump House SB left	D	42.3	0.34	45
Pump House SB left/right	C	26.0	0.34	43

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Massport Haul Road/Pump Station Connector	**B**	**11.6**		
Haul EB thru	B	14.0	0.08	51
Haul EB right	A	5.4	0.11	29
Haul WB left	A	7.9	0.06	14
Haul WB thru	A	7.9	0.07	39
Pump Station NB left | left/right	B	17.1	0.23	46
Summer Street/D Street	**C**	**27.3**		
Summer EB left	B	13.2	0.27	69
Summer EB thru | thru/right	A	9.6	0.22	74
Summer WB left/thru | thru	C	29.9	0.44	104
Summer WB right	C	22.6	0.29	158
D Street NB left	D	39.2	0.36	74
D Street NB thru | thru/right	C	21.9	0.37	56
D Street SB left	D	46.1	0.50	129
D Street SB left/thru | thru/right	C	28.4	0.49	64
Ramp DB (I-90 WB On Ramp)/D Street	**A**	**7.8**		
D Street NB left	C	31.1	0.49	131
D Street NB thru | thru	A	1.3	0.12	27
D Street SB thru | thru/right	A	4.4	0.25	110
Transitway/D Street	**A**	**4.4**		
Transitway EB thru	D	39.9	0.19	25
Transitway WB thru	D	38.6	0.19	29
D Street NB thru | thru | thru/right	A	3.0	0.11	0
D Street SB thru | thru	A	2.4	0.18	68
Congress Street/D Street	**C**	**25.1**		
Congress EB left/thru | thru/right	B	16.8	0.27	66
Congress EB right	A	5.3	0.33	52
Congress WB left/thru | thru/right	D	35.1	0.48	42
D Street NB left	D	38.5	0.60	70
D Street NB left/thru | thru/right	C	27.4	0.54	53
D Street SB left/thru | thru/right	D	36.4	0.51	84
Congress Street/B Street/Ramps D&F	**C**	**25.5**		
Congress EB left/thru | thru	D	45.0	0.60	121
Congress EB right	B	10.8	0.31	4
Congress WB left	B	17.1	0.21	94
Congress WB left/thru | thru/right	B	14.7	0.20	56
Ramp NB left	D	52.6	0.51	101
Ramp NB thru	C	30.8	0.18	66
Ramp NB right	A	8.1	0.49	61
B Street SB thru | thru	D	43.7	0.23	32
B Street SB right	B	18.0	0.21	15

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**B**	**18.9**		
Congress EB left	A	9.1	0.04	10
Congress EB thru | thru	A	8.0	0.09	32
Congress WB thru | thru	A	8.0	0.09	31
Congress WB right	A	3.6	0.02	6
Ramp I NB left/thru | thru	D	38.7	0.30	49
Ramp I NB right	B	13.1	0.46	24
Ramp C NEB thru | thru/right	D	36.0	0.32	59
Congress Street/Boston Wharf Road	**B**	**20.2**		
Congress EB left/thru	C	20.7	0.25	m112
Congress EB right	B	10.0	0.13	m34
Congress WB left	B	16.6	0.08	28
Congress WB thru | thru/right	B	13.0	0.12	61
Boston Wharf NB left	C	31.9	0.14	46
Boston Wharf NB thru/right	C	22.0	0.15	21
Boston Wharf SB left/thru	D	42.0	0.48	74
Boston Wharf SB right	B	14.2	0.28	48
Seaport Boulevard (Northern Avenue)/ B Street	**B**	**17.7**		
Seaport EB thru| thru/right	B	12.1	0.67	131
Seaport WB left	D	36.1	0.59	63
Seaport WB thru	B	19.4	0.59	256
B Street NB left | left	D	39.4	0.47	80
B Street NB right	B	11.5	0.55	48
Seaport Boulevard/Northern Avenue/East Service Road	**C**	**24.7**		
Seaport EB left	C	23.8	0.52	58
Seaport EB thru | thru	B	15.2	0.55	128
Seaport WB thru | thru/right	C	23.7	0.77	206
East Service NB left	D	47.7	0.63	162
East Service NB thru	D	44.0	0.54	139
East Service NB right	C	21.4	0.68	85
Northern SB left	D	41.6	0.51	100
Northern SB left/right	B	17.1	0.47	82
Seaport Boulevard/Sleeper Street	**A**	**8.5**		
Seaport EB left/thru | thru	A	9.7	1.27dl	65
Seaport EB right	A	2.1	0.07	m8
Seaport WB left	A	2.2	0.08	6
Seaport WB thru | thru/right	A	2.0	0.22	21
Sleeper NB left/thru/right	C	33.9	0.45	17
Sleeper SB left/thru	D	39.5	0.24	32
Sleeper SB right	B	13.7	0.42	19
Congress Street/Dorchester Avenue	**B**	**17.1**		
Congress EB thru | thru/right	A	9.6	0.32	22
Congress WB left/thru	C	20.2	0.41	m189
Dorchester NB left/right	D	50.4	0.72	112

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**C**	**21.9**		
Congress EB left/thru | thru	B	15.4	0.26	54
Congress EB right	A	2.3	0.17	m4
Congress WB left	B	14.8	0.33	111
Congress WB thru/right	B	12.0	0.15	101
A Street NB left/thru/right	D	51.4	0.85	26
Thompson SB left/thru/right	C	24.8	0.12	23
Summer Street/West Side Drive	**B**	**12.2**		
Summer EB thru | thru/right	B	17.5	0.28	153
Summer WB left	A	4.8	0.05	4
Summer WB thru | thru	A	3.6	0.14	27
West Side NB left	C	30.6	0.09	17
West Side NB right	B	11.8	0.20	6
Summer Street/WTC Avenue	**C**	**22.0**		
Summer EB left	C	25.0	0.06	44
Summer EB thru | thru	C	29.3	0.27	157
Summer EB right	C	23.7	0.07	48
Summer WB left	B	11.3	0.10	30
Summer WB thru | thru/right	B	16.1	0.17	90
WTC NB left	C	31.8	0.16	20
WTC NB thru/right	A	0.1	0.05	0
WTC SB left	C	31.1	0.10	27
WTC SB thru/right	A	0.1	0.03	0
Seaport Boulevard/Boston Wharf Road	**B**	**18.7**		
Seaport EB thru | thru/right	C	24.6	0.49	#277
Seaport WB left	A	8.9	0.27	56
Seaport WB thru | thru	A	7.0	0.14	m102
Boston Wharf NB left | left/right	C	34.8	0.30	33
SSCONN/Albany Street	**A**	**7.5**		
SSCONN WB left | left	D	38.0	0.25	41
Albany SB left/thru | thru | thru	A	4.8	0.23	102
Broadway Bridge/Frontage Road	**E**	**72.1**		
Traveler EB hard left	D	40.6	0.17	m54
Traveler EB left	F	424.7	0.71	#185
Traveler EB thru | thru	B	13.7	0.26	62
Broadway WB right	C	24.0	0.31	86
Broadway WB hard right (de facto)	E	59.8	0.94	#334
Frontage NB thru | thru	B	18.3	0.16	47
Frontage NB right | right | right/hard right	C	24.6	0.61	128
Bennington Street/Neptune Road	**C**	**28.5**		
Bennington EB left/thru | thru/right	E	56.3	0.56	68
Bennington WB left/thru | thru/right	C	31.8	0.77	m73
Neptune NB left/thru | thru/right	C	32.3	0.59	#357
Neptune SB left/ thru | thru/right	B	16.7	0.51	253

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**10.5**		
SSCONN EB left/thru	C	27.7	0.11	14
SSCONN EB right	C	29.3	0.11	16
SSCONN WB left	D	40.8	0.23	26
SSCONN WB thru/right	C	22.4	0.49	23
Ramp NB left/thru | thru/right	A	8.0	0.39	151
Ramp SB left	A	9.5	0.04	5
Ramp SB left/thru | thru/right	A	5.4	0.04	15
East Berkeley Street/Albany Street	**A**	**9.3**		
East Berkeley WB left/thru | thru | thru	A	7.4	0.39	38
Albany SB thru | thru | thru/right	B	11.6	0.32	77
West 4th Street/Frontage Road	**C**	**20.2**		
West 4th WB thru | thru | thru/right	D	37.3	0.69	160
Frontage NB left	B	11.1	0.33	219
Frontage NB thru | thru/right	B	11.2	0.51	272
Traveler Street/Albany Street	**B**	**10.2**		
Traveler EB thru/right	D	40.0	0.65	105
Albany SB left	A	7.1	0.37	192
Albany SB left/thru | thru/right	A	5.8	0.37	159
Herald Street/Albany Street	**C**	**23.1**		
Herald EB right | right | right	A	8.4	0.43	114
Albany SB thru | thru | thru	D	35.5	0.78	257
MBTA Bus Lot (near Randolph)/Albany Street	**E**	**79.9**		
MBTA EB thru/right	C	23.3	0.05	4
Albany SB left	B	12.1	0.19	51
Albany SB left/bear left | bear left	B	11.6	0.19	58
Albany SB thru/right	A	6.3	0.41	79
Albany NB right | right	F	207.6	1.14	m#144
Ramp A2/Ramp I/Frontage Road	**C**	**26.6**		
Frontage SB thru	C	24.3	0.41	161
Frontage SB right	C	22.1	0.22	83
Ramp SWB left/thru | thru	C	27.5	0.89	364
Nashua Street/Martha Road	**A**	**2.6**		
Nashua WB left | left	A	0.7	0.29	0
Martha SB thru | thru	A	4.0	0.20	49
Chelsea Street/Rutherford Avenue/North Washington Street	**B**	**17.2**		
Chelsea WB left	E	57.4	0.83	#227
Chelsea WB thru	D	46.8	0.72	185
Chelsea WB right	A	8.0	0.39	47
N. Washington NB thru | thru | thru	B	14.9	0.19	72
N. Washington NB right	A	3.9	0.38	46
Rutherford SB left	D	52.6	0.64	m141
Rutherford SB thru | thru | thru	A	3.9	0.23	m55
Rutherford SB right	A	4.7	0.50	m132

Table 6. (cont.) Existing (2008) Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**D**	**37.2**		
Ramp EB left | left	C	30.7	0.34	70
Ramp EB right | right	A	5.2	0.29	19
Rutherford NB left	F	190.8	1.31	#432
Rutherford NB thru | thru | thru | thru	A	4.0	0.14	32
Rutherford SB thru | thru | thru | thru	C	24.3	0.75	296
Rutherford SB right	A	5.7	0.45	95
Albany Street/Frontage Road	**B**	**16.8**		
Albany EB left | left	B	17.9	0.79	m91
Albany EB thru	A	5.0	0.08	m2
Albany WB right	A	7.0	0.33	17
Frontage NB thru | thru | thru/right	B	17.5	0.50	192
Neptune Road/Route 1A Off-ramp	**D**	**39.9**		
Neptune EB left/thru | thru	A	3.4	0.08	m8
Neptune WB thru | thru/right	C	21.1	0.49	78
Off-Ramp NB left	E	79.7	0.90	#366
Off-Ramp NB thru/right	D	43.0	0.48	133

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

Table 7. Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**0.9**		
Atlantic WB left/thru | thru | thru	A	0.9	0.45	16
Pearl Street/Purchase Street	**B**	**18.4**		
Pearl WB left	E	61.5	0.36	48
Pearl WB left/thru | thru	E	62.6	0.53	57
Purchase SB thru | thru | thru/right	B	13.2	0.70	204
Seaport Boulevard/Atlantic Avenue	**E**	**67.3**		
Seaport EB left/thru | thru	F	91.9	0.71	219
Seaport WB thru/bear right	F	141.1	1.19	#531
Seaport WB bear right/right	F	101.8	1.07	#445
Seaport WB right	A	6.3	0.46	55
Atlantic NB left/bear left	D	45.3	0.94	#594
Atlantic NB left/thru | thru/right	C	33.2	0.93	#483
Oliver Street/Purchase Street	**C**	**27.0**		
Oliver WB left/thru | thru	D	40.5	0.80	m91
Purchase SB thru | thru | thru/right	C	27.0	0.83	290
I-93 SWB left	B	12.3	0.48	205
I-93 SWB thru | right	D	39.4	0.59	#211
High Street/Atlantic Avenue	**B**	**11.2**		
High EB left | left	D	43.6	0.41	77
Atlantic NB thru | thru	A	3.6	0.45	m58
High Street/Purchase Street	**B**	**13.0**		
High EB thru | thru/right	B	16.8	0.50	68
Purchase SB left/thru | thru | thru	B	11.9	0.46	240
Broad Street/Purchase Street	**A**	**2.3**		
Broad EB right	A	2.3	0.38	0
Purchase SB thru | thru | thru/right	A	2.3	0.28	42
East India Row/Atlantic Avenue	**A**	**1.9**		
East India WB thru/right	C	26.1	0.22	29
Atlantic NB left/thru | thru/right	A	1.0	0.45	20
India Street/SASB	**A**	**9.1**		
India WB left | left	D	42.8	0.41	65
India WB thru	D	43.1	0.30	57
SASB SB thru | thru | thru/right	A	0.6	0.23	9
Milk Street/Atlantic Avenue	**C**	**23.3**		
Milk EB left | left	D	38.2	0.65	100
Milk EB thru	C	30.7	0.33	55
Milk WB right	A	2.0	0.31	0
Atlantic NB thru | thru/right	C	22.2	0.59	247
Milk Street/SASB	**B**	**16.8**		
Milk EB thru | thru/right	C	34.5	0.41	103
SASB SB left/thru | thru | thru	B	11.2	0.33	134
State Street/Atlantic Avenue	**A**	**4.1**		
State WB thru/right	C	21.5	0.26	72
Atlantic NB left/thru | thru | thru/right	A	2.7	0.37	72

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/SASB	**B**	**11.2**		
State WB left	C	33.0	0.33	97
State WB thru | thru	C	31.2	0.34	74
SASB SB thru | thru | thru/right	A	5.4	0.38	131
Mercantile Street/Atlantic Avenue/Cross Street	**C**	**24.4**		
Mercantile EB left/thru | thru	D	54.7	0.61	117
Atlantic WB thru | thru/right	D	38.9	0.53	110
Atlantic NB left/thru | thru	B	15.2	0.32	163
Atlantic NB right	A	8.7	0.46	169
Mercantile Street/SASB	**A**	**8.4**		
Mercantile WB left | left	B	12.9	0.50	23
SASB SB left/thru | thru | thru	A	7.2	0.32	73
Commercial Street/Cross Street	**A**	**1.1**		
Commercial WB right	A	0.8	0.15	0
Cross NB thru | thru	A	1.2	0.29	44
Clinton Street/SASB	**C**	**29.7**		
I-93 WB left	D	51.1	0.73	223
I-93 WB left/thru	D	50.4	0.73	190
SASB SB thru | thru | thru/right	B	15.2	0.31	100
Kneeland Street/SASB	**D**	**42.7**		
Kneeland EB thru | thru	F	144.0	0.79	210
Kneeland EB right	B	15.4	0.77	107
Kneeland WB left	C	28.0	0.70	m82
Kneeland WB thru | thru	B	18.5	0.45	m116
SASB SB left/thru | thru | thru/right	C	26.6	0.80	#419
Beach Street/SASB	**A**	**8.5**		
Beach WB left	D	50.5	0.61	98
SASB SB thru | thru | thru	A	3.8	0.45	68
Essex Street/Lincoln Street/SASB	**C**	**30.9**		
Essex EB left (de facto)	D	53.9	0.87	294
Essex EB thru	C	32.1	0.47	167
Essex EB right/hard right	C	30.7	0.69	174
SASB SB left/thru | thru | thru/right	C	21.0	0.73	270
I-93 Ramp NWB left/thru | thru | thru/right	D	36.8	0.52	124
Essex Street/South Street	**B**	**15.4**		
Essex EB thru | thru/right	A	4.7	0.25	38
South WB left | left	D	50.5	0.33	71
Summer Street/Purchase Street/SASB	**C**	**34.8**		
Summer EB thru	E	59.2	0.71	#169
Summer EB right	B	11.1	0.36	24
Summer WB left	D	36.1	0.77	m#250
Summer WB left/thru | thru	C	27.5	0.77	m208
Purchase SB left/thru | thru/right	D	35.2	0.79	210
I-90 off-ramp SWB left/thru | thru/right	D	37.1	0.67	246

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**F**	**106.7**		
Congress EB thru	C	33.7	0.66	254
Congress EB bear right (de facto)	F	220.8	1.40	#793
Congress EB right	C	28.0	0.34	132
Purchase SB hard left	B	14.4	0.62	206
Purchase SB left (de facto)	F	175.5	1.22	#881
Purchase SB left/thru | thru	B	10.9	0.50	159
Kneeland Street/Lincoln Street	**D**	**36.7**		
Kneeland EB left/thru | thru/right	D	42.0	0.81	271
Kneeland WB left/thru | thru | thru/right	D	52.2	0.82	186
Lincoln NB left/thru | thru	B	19.7	0.36	195
Lincoln NB right	A	4.9	0.19	23
North Street/SASB	**C**	**23.1**		
North Street EB right	A	9.4	0.17	m124
I-93 WB left/thru | thru	A	5.7	0.21	82
SASB SB thru | thru/right	D	44.1	0.77	179
North Street/Cross Street	**D**	**40.8**		
I-93 EB left	C	29.1	0.52	252
I-93 EB left/thru	C	30.4	0.57	223
Cross NB thru | thru/right	D	48.2	0.80	307
Hanover Street/SASB	**A**	**9.0**		
Hanover EB thru | thru/right	B	18.9	0.15	30
Hanover WB left	B	16.9	0.27	m59
Hanover WB thru	B	16.2	0.20	m66
SASB SB left/thru | thru/right	A	3.5	0.28	m27
Hanover Street/Cross Street	**B**	**12.6**		
Hanover EB left	D	38.3	0.29	44
Hanover EB thru	D	35.8	0.29	71
Hanover WB thru/right	D	45.5	0.76	176
Cross NB left/thru | thru/right	A	4.3	0.63	272
New Sudbury Street/SASB	**D**	**37.8**		
New Sudbury EB thru | thru	B	12.4	0.41	183
New Sudbury EB right	A	4.0	0.34	36
SASB SB left/thru | thru	D	42.2	0.75	156
Haymarket Station SEB right	F	227.9	1.31	39
New Sudbury Street/Cross Street	**B**	**12.1**		
New Sudbury EB left | left	B	12.8	0.48	254
Cross NB left/thru | thru	B	11.6	0.83	373
New Chardon Street/SASB	**F**	**146.7**		
New Chardon EB bear right | bear right	F	387.1	1.28	#638
New Chardon EB right	C	29.5	0.26	58
SASB SB left | left	B	16.4	0.69	119
SASB SB thru/right	C	20.3	0.69	109
SASB SB right	C	20.3	0.68	102
I-93 NWB left | left	D	35.6	0.88dl	162

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**B**	**11.6**		
Cooper Street WB right	A	1.2	0.18	0
I-93 NB thru | thru	D	45.9	0.51	74
Cross NWB bear right | bear right	A	6.5	0.64	127
North Washington Street/Beverly Street	**B**	**15.7**		
N. Washington SB thru | thru | thru	B	15.5	0.51	199
Beverly SEB right | right | right	B	16.4	0.26	m63
Valenti Way/Beverly Street	**A**			
Valenti WB left | left/thru | thru	A	0.6	0.21	20
Valenti Way/North Washington Street	**B**	**18.9**		
N. Washington NB left/thru | thru/right	C	20.7	1.07dl	#254
N. Washington SB left/thru | thru | thru/right	B	17.2	0.82	406
Congress Street/Atlantic Avenue	**B**	**17.4**		
Congress EB left | left	D	35.4	0.83	210
Congress EB thru | thru	A	6.6	0.46	71
Congress WB right | right	A	2.1	0.40	m5
Atlantic NB thru | thru | thru/right	C	21.1	0.81	239
Summer Street/Atlantic Avenue	**C**	**32.8**		
Summer EB left/thru | thru	D	36.2	0.62	m205
Summer WB thru | thru | thru/right	C	32.7	0.51	155
Atlantic NB left/thru | thru | thru	C	30.3	0.81	182
Atlantic NB right	D	36.0	0.73	m204
Essex Street/Atlantic Avenue	**C**	**25.3**		
Essex EB left | left	E	56.6	0.74	163
Atlantic NB left/thru | thru | thru	B	13.4	0.36	180
Beach Street/Atlantic Avenue	**A**	**5.6**		
Atlantic NB left/thru | thru | thru	A	5.6	0.36	78
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**D**	**42.6**		
Kneeland EB left	F	88.8	0.93	m#217
Kneeland EB left/thru	E	79.5	0.89	m#210
MBTA Drive WB thru/right	D	40.0	0.10	8
Frontage NB left	C	29.1	0.35	163
Frontage NB left/thru	C	31.5	0.48	217
I-90 WB Off-Ramp NWB left	D	48.3	0.71	180
I-90 WB Off-Ramp NWB thru	B	12.5	0.42	195
North Street/Clinton Street	**C**	**21.4**		
North EB thru	B	12.2	0.15	82
North WB thru | thru	B	10.3	0.26	m100
Clinton NB left | left/right	D	39.8	0.70	136
Purchase Street/Fire Station	**A**			
Fire Station EB right	B	10.8	0.26	26
Purchase SB thru | thru | thru/right	A	0.0	0.33	0

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**C**	**32.2**		
State WB left/thru | thru/right	D	42.3	0.80	232
Congress NB thru | thru	B	14.9	0.42	77
Congress SB thru | thru/bear right	B	16.0	0.55	170
Congress SB right	B	17.6	0.54	229
North Street/Congress Street	**B**	**11.7**		
North WB left | left/right	B	19.3	0.82	27
Congress NB thru| thru | thru/right	A	4.7	0.46	19
Congress SB left/thru | thru | thru	B	11.9	0.59	60
North Street/Union Street	**B**	**19.2**		
North EB left/thru | thru	A	0.6	0.06	0
North WB thru | thru/left	C	22.4	0.62	108
Hanover Street/Congress Street	**A**	**2.9**		
Hanover WB left	B	17.7	0.25	75
Congress NB thru | thru | thru/right	A	0.4	0.29	0
Congress SB thru | thru | thru	A	2.8	0.23	33
New Sudbury Street/Congress Street/Merrimac Street	**D**	**54.2**		
New Sudbury EB left	F	137.0	1.15	#375
New Sudbury EB thru | thru	D	46.5	0.75	202
New Sudbury EB right	A	9.3	0.53	34
Congress NB thru | thru	D	45.4	0.72	270
Congress NB right (de facto)	E	77.2	0.95	#351
Merrimac SB left	D	45.1	0.65	m79
Merrimac SB thru | thru | thru	B	17.2	0.20	m59
New Chardon Street/Merrimac Street	**E**	**57.8**		
New Chardon EB left/thru | thru/right	A	8.8	0.75	2
New Chardon WB hard left/left	F	192.9	1.27	60
New Chardon WB thru | thru/right	B	1531	0.31	92
Merrimac NB hard left/left	C	24.0	0.74	m121
Merrimac NB thru	B	19.8	0.62	m100
Merrimac NB right (de facto)	B	19.1	0.55	m104
Merrimac SB left (de facto)	F	216.3	1.18	#337
Merrimac SB thru | thru/right	D	35.4	0.58	114
Summer Street/Dorchester Avenue	**D**	**36.2**		
Summer EB left/thru | thru/right	D	44.8	0.71	#330
Summer WB left/thru | thru/right	C	22.8	0.70	#274
Dorchester NB left/thru/right	B	17.4	0.33	37
Dorchester SB left	E	70.0	0.91	m#290
Dorchester SB left/thru/right	B	16.3	0.28	m75
Summer Street/Melcher Street	**C**	**22.5**		
Summer EB thru | thru/right	B	11.5	0.50	m182
Summer WB left/thru | thru	C	21.3	0.39	216
Melcher NB left/right	D	53.4	0.83	250

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Summer Street/Pump House Road	**B**	**17.9**		
Summer EB left/thru | thru	B	12.5	0.43	236
Summer WB thru | thru | thru/right	B	11.6	0.29	153
Driveway NB left/thru/right	—	—	—	—
Pump House SB left	D	46.7	0.65	147
Pump House SB left/right	D	36.5	0.59	121
Massport Haul Road/Pump Station Connector	**B**	**13.0**		
Haul EB thru	B	12.9	0.06	29
Haul EB right	A	3.1	0.25	48
Haul WB left	A	6.3	0.10	47
Haul WB thru	A	6.2	0.15	90
Pump Station NB left | left/right	C	30.5	0.51	47
Summer Street/D Street	**C**	**24.4**		
Summer EB left	B	16.1	0.61	155
Summer EB thru | thru/right	A	7.5	0.40	141
Summer WB left/thru | thru	C	33.4	0.49	146
Summer WB right	C	25.0	0.22	189
D Street NB left	D	47.6	0.52	89
D Street NB thru | thru/right	D	41.0	0.49	102
D Street SB left	D	40.6	0.71	m119
D Street SB left/thru | thru/right	C	25.0	0.68	m58
Ramp DB (I-90 WB On Ramp)/D Street	**B**	**16.7**		
D Street NB left	E	71.2	0.90	#319
D Street NB thru | thru	A	2.2	0.16	82
D Street SB thru | thru/right	A	8.8	0.47	371
Transitway/D Street	**A**	**7.8**		
Transitway EB thru	D	47.1	0.34	43
Transitway WB thru	D	48.4	0.40	50
D Street NB thru | thru | thru/right	A	6.2	0.16	5
D Street SB thru | thru	A	5.1	0.39	147
Congress Street/D Street	**D**	**42.8**		
Congress EB left/thru | thru/right	D	44.0	0.45	100
Congress EB right	C	23.9	0.54	m204
Congress WB left/thru | thru/right	D	42.7	0.66	94
D Street NB left	E	63.6	0.87	#241
D Street NB left/thru | thru/right	D	36.5	0.71	176
D Street SB left/thru | thru/right	D	50.2	0.84	#264
Congress Street/B Street/Ramps D&F	**C**	**32.9**		
Congress EB left/thru | thru	D	51.7	0.75	211
Congress EB right	B	14.0	0.47	m95
Congress WB left	C	33.4	0.62	275
Congress WB left/thru | thru/right	C	26.5	0.52	215
Ramp NB left	E	57.4	0.67	139
Ramp NB thru	C	23.5	0.18	60
Ramp NB right	A	5.0	0.45	29
B Street SB thru | thru	D	51.7	0.58	94
B Street SB right	C	20.0	0.25	32

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**C**	**24.9**		
Congress EB left	B	16.7	0.06	m21
Congress EB thru | thru	B	14.3	0.19	m103
Congress WB thru | thru	B	12.2	0.17	m85
Congress WB right	A	7.3	0.04	m10
Ramp I NB left/thru | thru	D	44.6	0.34	52
Ramp I NB right	B	14.2	0.50	36
Ramp C NEB thru | thru/right	D	42.6	0.70	119
Congress Street/Boston Wharf Road	**C**	**28.2**		
Congress EB left/thru	C	35.3	0.54	m224
Congress EB right	B	12.1	0.40	m78
Congress WB left	D	38.7	0.44	88
Congress WB thru | thru/right	C	24.0	0.25	132
Boston Wharf NB left	D	37.0	0.16	52
Boston Wharf NB thru/right	C	22.7	0.11	13
Boston Wharf SB left/thru	D	40.7	0.77	243
Boston Wharf SB right	A	5.6	0.18	24
Seaport Boulevard (Northern Avenue)/ B Street	**C**	**22.0**		
Seaport EB thru | thru/right	B	16.6	0.62	210
Seaport WB left/thru | thru	B	18.7	0.57	181
B Street NB left | left	D	48.3	0.70	110
B Street NB right	B	11.4	0.45	m32
Seaport Boulevard/Northern Avenue/East Service Road	**C**	**26.2**		
Seaport EB left	B	14.4	0.24	24
Seaport EB thru | thru	B	13.9	0.50	134
Seaport WB thru | thru/right	C	25.2	0.75	#405
East Service NB left	D	51.3	0.66	171
East Service NB thru	D	36.3	0.11	m22
East Service NB right	C	23.0	0.58	80
Northern SB left	D	49.1	0.63	158
Northern SB left/right	D	36.6	0.57	142
Seaport Boulevard/Sleeper Street	**B**	**13.4**		
Seaport EB left/thru | thru	A	9.1	0.42	m154
Seaport EB right	A	1.4	0.10	m12
Seaport WB left	A	3.6	0.01	m2
Seaport WB thru | thru/right	A	5.4	0.35	88
Sleeper NB left/thru/right	E	59.7	0.79	95
Sleeper SB left/thru	D	35.5	0.32	56
Sleeper SB right	B	12.7	0.56	70
Congress Street/Dorchester Avenue	**C**	**30.9**		
Congress EB thru | thru/right	A	7.5	0.42	61
Congress WB left/thru	D	49.2	0.91	m#223
Dorchester NB left/right	E	60.5	0.82	273

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**E**	**73.5**		
Congress EB left/thru | thru	C	22.9	0.36	m126
Congress EB right	B	3.1	0.25	m8
Congress WB left	B	14.2	0.55	79
Congress WB thru/right	A	9.1	0.24	64
A Street NB left/thru/right	F	219.7	1.38	99
Thompson SB left/thru/right	C	29.2	0.22	31
Summer Street/West Side Drive	**A**	**6.5**		
Summer EB thru | thru/right	A	7.7	0.44	m32
Summer WB left	A	3.9	0.11	4
Summer WB thru | thru	A	2.1	0.20	31
West Side NB left	D	40.7	0.10	30
West Side NB right	B	14.8	0.23	11
Summer Street/WTC Avenue	**B**	**13.6**		
Summer EB left	B	13.0	0.06	22
Summer EB thru | thru	B	13.8	0.36	158
Summer EB right	A	6.5	0.16	42
Summer WB left	A	7.7	0.25	m55
Summer WB thru | thru/right	B	12.5	0.22	146
WTC NB left	D	44.6	0.29	49
WTC NB thru/right	A	0.2	0.09	0
WTC SB left	D	45.0	0.28	42
WTC SB thru/right	B	19.0	0.13	0
Seaport Boulevard/Boston Wharf Road	**C**	**24.0**		
Seaport EB thru | thru/right	C	29.3	0.45	m#215
Seaport WB left	B	16.4	0.20	m79
Seaport WB thru | thru	B	16.6	0.38	258
Boston Wharf NB left | left/right	D	43.8	0.49	87
SSCONN/Albany Street	**A**	**9.8**		
SSCONN WB left | left	D	47.5	0.44	62
Albany SB thru | thru | thru/right	A	6.5	0.44	268
Broadway Bridge/Frontage Road	**E**	**68.6**		
Traveler EB hard left	F	178.8	0.49	57
Traveler EB left	F	326.3	0.69	m156
Traveler EB thru | thru	C	21.4	0.44	m221
Broadway WB right	C	21.4	0.09	42
Broadway WB hard right (de facto)	F	99.7	1.09	#564
Frontage NB thru | thru	B	11.5	0.03	m4
Frontage NB right | right | right/hard right	B	18.7	0.64	52
Bennington Street/Neptune Road	**E**	**77.0**		
Bennington EB left/thru | thru/right	D	45.6	0.26	60
Bennington WB left/thru | thru/right	E	78.6	0.82	m41
Neptune NB left/thru | thru/right	F	132.0	1.18	#535
Neptune SB left/thru | thru/right	B	18.5	0.52	237

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**15.5**		
SSCONN EB left/thru	C	34.8	0.23	15
SSCONN EB right	C	24.9	0.56	99
SSCONN WB left	D	54.1	0.44	35
SSCONN WB thru/right	C	28.7	0.51	55
Ramp NB left/thru | thru/right	A	8.8	0.24	122
Ramp SB left	A	9.8	0.02	7
Ramp SB left/thru | thru/right	A	5.1	0.10	31
East Berkeley Street/Albany Street	**B**	**16.0**		
East Berkeley WB left/thru | thru | thru	A	4.9	0.48	28
Albany SB thru | thru | thru/right	C	30.6	0.50	m92
West 4th Street/Frontage Road	**C**	**23.7**		
West 4th WB thru | thru | thru/right	D	42.0	0.82	259
Frontage NB left	A	4.0	0.36	m89
Frontage NB thru | thru/right	B	14.8	0.63	#464
Traveler Street/Albany Street	**E**	**68.2**		
Traveler EB thru/right	F	388.7	1.05	#317
Albany SB left	A	3.4	0.52	31
Albany SB left/thru | thru/right	A	6.9	0.47	238
Herald Street/Albany Street	**C**	**25.1**		
Herald EB right | right | right	B	10.9	0.58	251
Albany SB thru | thru | thru	D	42.3	0.76	272
MBTA Bus Lot (near Randolph)/Albany Street	**F**	**140.1**		
MBTA EB thru/right	C	31.6	0.08	11
Albany SB left	A	3.0	0.29	16
Albany SB left/bear left | bear left	B	11.5	0.29	90
Albany SB thru/right	A	4.5	0.40	132
Albany NB right | right	F	301.4	1.40	m#354
Ramp A2/Ramp I/Frontage Road	**C**	**26.1**		
Frontage SB thru	B	15.9	0.36	153
Frontage SB right	A	6.2	0.23	56
Ramp SWB left/thru | thru	C	30.3	0.89	316
Nashua Street/Martha Road	**B**	**12.7**		
Nashua WB left | left	B	19.8	0.75	135
Martha SB thru | thru	A	4.8	0.27	96
Chelsea Street/Rutherford Avenue/North Washington Street	**C**	**34.0**		
Chelsea WB left	F	155.6	1.23	#580
Chelsea WB thru	E	61.4	0.90	#424
Chelsea WB right	B	14.3	0.61	70
N. Washington NB thru | thru | thru	C	21.1	0.55	214
N. Washington NB right	A	4.8	0.61	28
Rutherford SB left	E	61.7	0.80	m135
Rutherford SB thru | thru | thru	A	6.9	0.30	m66
Rutherford SB right	A	5.4	0.41	m71

Table 7. (cont.) Existing (2008) Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**C**	**34.6**		
Ramp EB left | left	D	35.3	0.32	90
Ramp EB right | right	A	5.8	0.44	25
Rutherford NB left	F	115.1	1.16	m#647
Rutherford NB thru | thru | thru | thru	A	1.8	0.25	26
Rutherford SB thru | thru | thru | thru	D	41.1	0.93	#409
Rutherford SB right	B	13.2	0.64	320
Albany Street/Frontage Road	**B**	**13.8**		
Albany EB left | left	A	8.7	0.86	m5
Albany EB thru	A	6.5	0.02	m1
Albany WB right	B	12.1	0.19	2
Frontage NB thru | thru | thru/right	B	19.4	0.46	245
Neptune Road/Route 1A Off-ramp	**E**	**70.4**		
Neptune EB left/thru | thru	A	3.3	0.04	m2
Neptune WB thru | thru/right	B	10.2	0.53	96
Off-Ramp NB left	F	170.2	1.10	#622
Off-Ramp NB thru/right	E	58.9	0.83	#416

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

At Seaport Boulevard/Atlantic Avenue, the overall intersection operates at LOS F and E in morning and evening peak hours, respectively. During the both peak hours, the Seaport Boulevard eastbound approach and the Seaport Boulevard westbound through/bear right movement operate at LOS F. The poor levels of service are due to insufficient green time given to the approaches and poor coordination with adjacent intersections in the eastbound/westbound direction.

Oliver Street/Purchase Street operates at a LOS F during the morning peak hour. This is due to the Oliver Street westbound approach and the I-93 off-ramp left-turn movement also operating at LOS F. Adding more green time and improving coordination with adjacent intersections in the eastbound/westbound directions will improve the level of service.

During the morning peak hour, Mercantile Street/SASB operates at LOS F. This is due to the SASB left-turn/through movements operating at LOS F. Coordinating the southbound movement with adjacent intersections will alleviate some of the problem.

During the morning peak hour, Clinton street/SASB operates at LOS F. This is due to the SASB operating at LOS F, and the I-93 left-turn and through movement operating at LOS E. Improving coordination will help alleviate some of the problem.

During the morning hour, the Kneeland Street westbound through movement at Kneeland Street/SASBoperates at a LOS F during the morning peak hour due to insufficient green time. During the evening peak, Kneeland Street eastbound through movement operates at LOS F. The main cause for delay is inadequate coordination with adjacent intersections in the eastbound direction.

During the evening peak hour Congress Street/Purchase Street operates at LOS F. This can be attributed

to the high Congress Street eastbound left turn volumes and Purchase Street southbound left turn volumes. Both of these movement operate at LOS F. Adding more time to these phases will improve operations.

Kneeland Street/Lincoln Street operates at LOS E during the mid-day peak hour. This is due to the eastbound through/right-turn movement operating at LOS F. Adding more time to the eastbound phase may help to decrease delays.

At New Sudbury Street/SASB, the Haymarket Station approach operates at LOS F during the morning and mid-day peak hours.

During the evening peak hour, the SASB approach at New Chardon Street/SASB operates at LOS F. This is due to the New Chardon eastbound bear right movement operates at LOS F. Adding time to the respective phases will help decrease delay.

Valenti Way/North Washington Street, the North Washington Street northbound de facto left-turn movement operates at LOS F. This is due to poor signal timing for the north and southbound approaches. It is suggested that more time be given to the North Washington northbound approach.

The Summer Street/Atlantic Avenue operates at LOS E during the morning peak hour. This is due to the Atlantic Avenue northbound left-turn, through, and right-turn movements operate at LOS F during the morning peak hour. This is due to an insufficient amount of time given to this approach.

During the morning peak hour, Kneeland Street/Atlantic Avenue/I-93 Ramps operates at LOS E. At Kneeland Street/Atlantic Avenue/I-93 Ramps, the Kneeland Street eastbound approach left-turn and through movements operate at LOS E or F during all peak hours. Also, the I-90 northbound left-turn movement operates at LOS F in the morning peak hour. Adding more time to these phases and improving coordination with adjacent intersection for the eastbound movement will alleviate the problem.

During the morning peak hour, State Street westbound approach at State Street/Congress Street operates at a LOS F. Adding more time to the westbound phase will help alleviate some of the problem.

The Congress Street southbound approach at Congress Street/North Street operates at LOS F. Adding more time to these phases will help decrease the delay.

At New Sudbury Street/Congress Street/Merrimac Street, the New Sudbury Street eastbound left-turn movement operates at LOS F during the evening peak hour. Adding more time to the eastbound phase may help alleviate the problem.

At New Chardon Street/Merrimac Street, northbound hard left/left-turn approach operates at a LOS F during the morning and mid-day peak hours. This is due to the high numbers of vehicles that turn left during the morning and mid-day from the northbound approach. Adding more time to the northbound phase will help alleviate some of the problem. During the evening peak hour, the Merrimac Street southbound de facto left-turn is operating at a LOS F. Adding more time to the southbound phase may help alleviate some of the problem.

During the morning peak hour, Summer Street/Dorchester Avenue operates at LOS E. Most of the delay is due to the Dorchester Avenue southbound left turn movement, which operates at LOS F. Adding more time to the northbound and southbound phases may help decrease delay.

Congress Street/B Street/Ramps D&F operates at LOS E during the morning peak hour. The northbound left turn operates at LOS F. This is due to the high number of vehicle that turn left from the northbound approach. Adding more time to the northbound phase will help alleviate some of the problem.

During the morning peak hour, Congress Street/East Service Road/Ramps I&C operates at LOS E. Most of the delay is caused by Ramp C, which is at LOS F. Adding more time to this phase may help decrease the delay.

During the evening peak hour, Congress Street/A Street operates at LOS E. This is mainly due to the A Street northbound approach. This approach operates at LOS F during the morning and evening peak hours. Adding more time to this phase may help decrease the delay.

Broadway Bridge/Frontage Road NB operates at LOS F during the all peak hours. This is mostly due to the Traveler Street eastbound left turn and the Broadway Bridge hard right-turn volumes. Improving coordination may help decrease delay.

Bennington Street/Neptune Road operates at LOS F during the morning peak hour. This is due to the heavy volumes turning left on the southbound approach.

At West 4th Street/Frontage Road, the westbound approach operates at LOS F during the morning peak hour. Giving more time to this phase will help decrease delay.

At Traveler Street/Albany Street, the Traveler Street eastbound approach operates at LOS F during the evening peak hour. Adding more time to this approach will help alleviate some of the problem.

MBTA Bus Lot (near Randolph)/Albany Street operates at LOS F during the all peak hours due to excessive delay on the Albany Street northbound approach. Giving more time to this approach will help alleviate some of the problem.

At Chelsea Street/Rutherford Avenue/North Washington Street, the westbound and southbound left turn movements operate at LOS F. Improving coordination and giving more time to these phases may help alleviate some of the problem.

At LT-TL/Rutherford Avenue, the northbound left turn movement operates at LOS F during the mid-day and evening peak hours. Giving more time to this phase will help decrease the delay.

Re-timing Objectives

The Central Artery traffic signals have both high vehicle volumes in some areas as well as heavy pedestrian traffic, making it crucial to service both types of transportation. While progression throughout the area is of importance, pedestrian safety concerns must be noted. Currently, some of the signals within the study area are out of date and do not currently meet MUTCD standards. One of HSH's objectives is to bring all of the locations up to code. For example, many of the intersections in the study area have All-Red clearance times that are too short. By bringing the clearance times up to standard, the number of angle crashes at these locations can be reduced. Updating the Flashing Don't Walk clearance times will also make it safer for pedestrians.

Areas that need improvement were noted from field observations, the Existing Conditions Synchro analysis, and the time-delay trials. Three major corridors in the study area are crucial to the progression throughout the Central Artery and Financial District: Congress Street, Surface Artery Southbound, and Atlantic Avenue. While HSH does not want to increase speeds along these corridors, improving timing between intersections will help in reduction of delay, fuel consumption, and CO emissions.

Phase 1 Improvements

Improvements identified in Phase 1 consisted of changes to ***turn on red restrictions, pedestrian recall operation, splits, offsets, cycle lengths, and clearance intervals.***

Pedestrian Recall Operation

Currently, most intersections within the study area that have exclusive pedestrian phases operate on pedestrian recall from 7 a.m. to 8 or 10 p.m. Due to the high volumes of pedestrians in this area, HSH recommends that this setup should remain. HSH proposes that the exclusive pedestrian phase at Atlantic Avenue/Pearl Street, Atlantic Avenue/Essex Street, and Atlantic Avenue/Beach Street be set to pedestrian recall between the hours of 7 a.m. to 8 p.m. so that pedestrians will not have to push the button to cross during these times.

Turn on Red Restrictions

Essex Street/Lincoln Street/SASB

The right-turns on the eastbound Essex Street approach are currently controlled by a traffic signal that has green, yellow, and red right-arrows. According to the 11/1/03 version of the *City of Boston Traffic Rules and Regulations,* turns on red arrows are prohibited. However, many drivers continue to turn right on red at this approach. Drivers making this illegal turn onto SASB create a potential conflict with pedestrians who are legally crossing in the crosswalk during their walk phase. In addition, many vehicles that are turning right on red are not just turning onto SASB, but actually crossing Surface Artery to turn onto the Interstate 93 South On-Ramp. Due to the number of pedestrians that cross the surface artery and the geometry of the intersection, HSH recommends adding a No Turn on Red sign to further emphasize this restriction.

Albany Street Extension/Frontage Road NB

The Public Works driveway approach to this intersection has limited sight distance to the south due to some of the concrete structures supporting the overhead highway. This location has a high crash rate, as discussed below. Therefore, HSH recommends implementing No Turn On Red out of the Public Works driveway.

Clearance Intervals

The Yellow, All-Red, and Flashing Don't Walk Clearance Intervals were recalculated and updated at all locations. The Yellow interval was determined based upon a 30 m.p.h. traveling speed. The All-Red interval was calculated based on intersection geometry and posted speed limit. Flashing Don't Walk times were calculated based upon the *Manual on Uniform Traffic Control Device's* recommended pedestrian travel time of 4 feet per second. HSH proposes to extend Walk times and Flashing Don't Walk times to account for either a walking speed of 3.5 feet per second at a crosswalk or 4 feet per second diagonally across the intersection at certain locations that have excess capacity upon BTD's approval.

Many of the locations have All-Red intervals that are too short for vehicles that arrive at the end of the yellow period to safely cross the intersection before the next conflicting phase begins. For example, at Bennington Street/Neptune Road in East Boston, the All-Red time is currently set at 1 second. Based on the posted speed limit and the distance from the stop-bar to the far side of the crosswalk on the opposite side of the street, all phases at this intersection should have an All-Red time of 3 seconds. At this intersection there were 15 reported crashes within the past 2 years of available data. Increasing the All-Red interval should lower the likelihood of angle crashes at this intersection.

High Crash Locations

Kneeland Street/SASB

Kneeland Street/SASB exceeds the District 4 crashes rate with a rate of 1.05 crashes per million entering vehicles. At this location, 12 of the 25 known crashes in the past 3 years were classified as sideswipe crashes. These types of crashes between vehicles traveling in the same direction are most likely due to vehicles trying to maneuver around traffic waiting to make a left turn. 6 of the 25 known crashes were classified as angle crashes. Since the vehicle indications are mast-arm mounted at this location, these types of crashes are most likely caused by drivers accepting gaps that are too small to safely make a left turn. HSH recommends increasing the clearance intervals at this location.

Congress Street/Purchase Street

Congress Street/Purchase Street exceeds the District 4 crashes rate with a rate of 0.95 crashes per million entering vehicles. Of the 27 known crashes at Congress Street/Purchase Street, 7 were classified as angle crashes, 8 were rear-end crashes, and 11 were sideswipe crashes. At this intersection, the sideswipe crashes are most likely caused by vehicles attempting to maneuver to or away from the I-90 off-ramp. The southbound Purchase Street approach consists of an exclusive left-turn lane, a shared bear left/through lane, and a through lane. However, many vehicles use the exclusive left-turn lane to bear left onto I-90 causing 2 lanes to merge into 1 receiving lane on the I-90 ramp. HSH recommends adding advanced warning signs and pavement markings may help to decrease sideswipe crashes.

Broadway Bridge/Frontage Road NB

Broadway Bridge/Frontage Road NB exceeds the District 4 crashes rate with a rate of 2.16 crashes per million entering vehicles. Of the 50 known crashes, 37 were classified as angle crashes. Due to the highway structure above this intersection, visibility of vehicle indications is a major issue at this intersection. HSH recommends that the Massachusetts Turnpike Authority (MTA) evaluate possible alternatives to improve the visibility of vehicle indications.

Bennington Street/Neptune Road

At Bennington Street/Neptune Road, there were 15 crashes within the past 2 years, which is a crash rate of 1.11 crashes per million entering vehicles over the 2 year time period. Of the 11 known crashes, 5 were classified as angle crashes, and 4 were classified as rear-end crashes. Since mast-arms are provided at this intersection, visibility is not likely a factor. Clearance times are mostly the cause of crashes at this intersection. Currently, this intersection has a 4 second yellow and a 1 second all-red time for all vehicle phases. Due to the size of this intersection, HSH recommends increasing the all-red time to 3 seconds for all phases.

West 4th Street/Frontage Road Northbound

West 4th Street/Frontage Road NB exceeds the District 4 crashes rate with a rate of 2.32 crashes per million entering vehicles. Of the 55 known crashes, 42 were classified as angle crashes. As with Broadway Bridge/Frontage Road NB, visibility of vehicle indications is a major issue at this intersection. HSH recommends that the MTA evaluate possible alternatives to improve the visibility of vehicle indications.

Albany Street Extension/Frontage Road NB

Albany Street/Frontage Road NB exceed the District 4 crash rate with a rate of 0.93 crashes per million entering vehicles. Of the 21 known crashes, 9 were classified as angle crashes, and 7 were classified as sideswipe crashes. HSH recommends implementing No Turn On Red out of the Public Works driveway as stated previously.

Traffic Signal Sections

In order to optimally time the Central Artery intersections and improve progression throughout the area, intersections from Work Order #7 in the Financial District will be coordinated along with the above intersections during the morning and evening peak hours. With the guidance of BTD, HSH proposes new groupings for the traffic signal sections within the study area. **Figure 1** shows the proposed sections including the addition of 2 new sections.

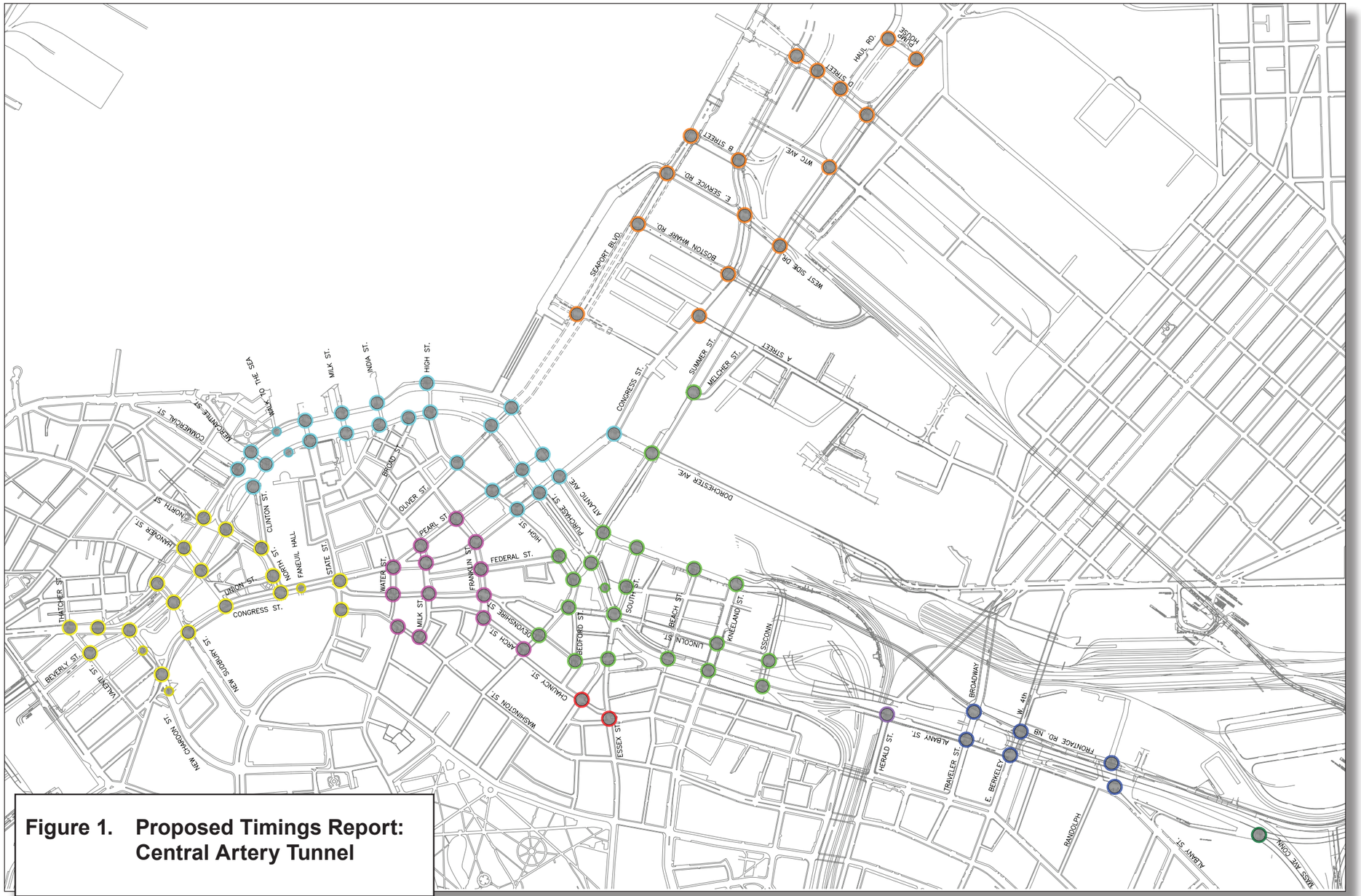


Figure 1. Proposed Timings Report: Central Artery Tunnel

HOWARD/STEIN-HUDSON ASSOCIATES

Not to scale.

Cycle Length

Minimizing the cycle length at an intersection will help to reduce delays for pedestrians, queue lengths for vehicles, and helps to reduce vehicular delay as well. In order to improve progression throughout the network, the majority of the intersections need to run on the same cycle length or a half cycle.

80-second Cycle

For the network to progress and work efficiently, the cycle length cannot be lower than 90 seconds due to the number of phases, and the minimum timings needed for each phase due to concurrent pedestrian phases at some locations. While many of the intersections can operate at an 80-second cycle, some key intersections that rely on coordination to operate acceptably have minimums that exceed 80 seconds. These locations include: Seaport Boulevard/Atlantic Avenue, Essex Street/Lincoln Street/SASB, Kneeland Street/Lincoln Street, Congress Street/Atlantic Avenue, New Sudbury Street/Congress Street/ Merrimac Street, New Chardon Street/Merrimac Street.

90-second Cycle

At locations with ramps, such as Oliver Street/Purchase Street and Summer Street/Purchase Street, a cycle length of 90 seconds is too short to accommodate the high number of vehicles during the morning and evening peak hours, resulting in a poor overall LOS. For the mid-day peak hour, a 90-second cycle is chosen because vehicle volumes are lower. Pedestrians benefit from the lower cycle length with a decrease in delay.

100-second Cycle

A cycle length of at least 100 seconds is necessary during the morning and evening peak periods. After testing a 100-second and a 110-second cycle for the network, HSH found that there is not a significant difference between the total delays for the two trials. Due to the large amount of pedestrian traffic in the area, HSH recommends using a shorter cycle length to reduce the delay for pedestrians. A 100-second cycle length provides a sufficient amount of time for vehicles to progress through the network, without increasing delay for pedestrians.

Phase 1 Synchro Analysis

Table 8 through **Table 10** show the results of the Phase 1 Synchro analysis. Phase 1 Operations Schedules can be found in **Appendix D.**

Table 8. Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**3.4**		
Atlantic WB left/thru | thru | thru	A	3.4	0.48	81
Pearl Street/Purchase Street	**B**	**12.3**		
Pearl WB left	C	34.1	0.31	53
Pearl WB left/thru | thru	D	37.6	0.63	132
Purchase SB thru | thru | thru/right	A	5.7	0.47	m78
Seaport Boulevard/Atlantic Avenue	**C**	**33.4**		
Seaport EB left/thru | thru	D	35.1	0.91	m183
Seaport WB thru/bear right	D	50.6	0.81	184
Seaport WB bear right/right	D	36.4	0.50	m139
Seaport WB right	B	12.5	0.68	142
Atlantic NB left/bear left	D	42.4	0.88	#453
Atlantic NB left/thru | thru/right	C	31.3	0.89	#238
Oliver Street/Purchase Street	**E**	**61.5**		
Oliver WB left/thru | thru	D	49.6	0.95	m#192
Purchase SB thru | thru | thru/right	D	43.5	0.93	#275
I-93 SWB left	F	91.8	0.97	#972
I-93 SWB thru | right	D	41.7	0.83	#461
High Street/Atlantic Avenue	**B**	**12.4**		
High EB left | left	D	48.2	0.35	57
Atlantic NB thru | thru	A	5.9	0.43	m87
High Street/Purchase Street	**A**	**5.4**		
High EB thru | thru/right	B	12.5	0.45	47
Purchase SB left/thru | thru | thru	A	3.8	0.43	58
Broad Street/Purchase Street	**A**	**2.3**		
Broad EB right	A	0.7	0.16	0
Purchase SB thru | thru | thru/right	A	2.4	0.41	71
East India Row/Atlantic Avenue	**A**	**8.8**		
East India WB thru/right	C	22.3	0.22	41
Atlantic NB left/thru | thru/right	A	8.0	0.38	361
India Street/SASB	**A**	**7.4**		
India WB left | left	D	37.9	0.42	94
India WB thru	D	37.3	0.33	82
SASB SB thru | thru | thru/right	A	0.9	0.34	18
Milk Street/Atlantic Avenue	**C**	**20.3**		
Milk EB left | left	C	32.7	0.18	41
Milk EB thru	D	52.6	0.68	158
Milk WB right	A	0.1	0.03	0
Atlantic NB thru | thru/right	A	9.2	0.47	70
Milk Street/SASB	**A**	**5.8**		
Milk EB thru | thru/right	C	28.7	0.31	60
SASB SB left/thru | thru | thru	A	3.3	0.50	34

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Atlantic Avenue	**A**	**3.6**		
State WB thru/right	C	25.1	0.28	40
Atlantic NB left/thru | thru | thru/right	A	1.6	0.25	10
State Street/SASB	**B**	**10.4**		
State WB left	C	30.1	0.30	43
State WB thru | thru	C	32.3	0.50	80
SASB SB thru | thru | thru/right	A	7.4	0.72	244
Mercantile Street/Atlantic Avenue/Cross Street	**B**	**19.5**		
Mercantile EB left/thru | thru	C	27.1	0.37	76
Atlantic WB thru | thru/right	D	41.9	0.56	134
Atlantic NB left/thru | thru	A	5.8	0.17	28
Atlantic NB right	A	1.5	0.27	0
Mercantile Street/SASB	**A**	**5.4**		
Mercantile WB left | left	C	25.3	0.66	141
SASB SB left/thru | thru | thru	A	1.9	0.54	m16
Commercial Street/Cross Street	**A**	**1.5**		
Commercial WB right	A	0.6	0.13	0
Cross NB thru | thru	A	1.6	0.16	9
Clinton Street/SASB	**D**	**45.0**		
I-93 WB left	D	54.1	0.93	#571
I-93 WB left/thru	D	54.8	0.95	#624
SASB SB thru | thru | thru/right	D	35.3	0.88	#331
Kneeland Street/SASB	**C**	**22.4**		
Kneeland EB thru | thru	C	29.2	0.43	132
Kneeland EB right	A	5.7	0.31	43
Kneeland WB left	C	24.6	0.41	m68
Kneeland WB thru | thru	D	35.2	0.72	m213
SASB SB left/thru | thru | thru/right	A	6.7	0.45	57
Beach Street/SASB	**A**	**3.8**		
Beach WB left	C	31.1	0.37	m55
SASB SB thru | thru | thru	A	1.5	0.28	20
Essex Street/Lincoln Street/SASB	**C**	**34.2**		
Essex EB left/thru | thru	C	39.0	0.76	256
Essex EB right/hard right	C	33.6	0.42	117
SASB SB left/thru | thru | thru/right	C	23.4	0.52	215
I-93 Ramp NWB left/thru | thru | thru/right	D	41.5	0.78	214
Essex Street/South Street	**A**	**5.2**		
Essex EB thru | thru/right	A	2.9	0.29	24
South WB left | left	C	22.2	0.18	m13
Summer Street/Purchase Street/SASB	**D**	**45.7**		
Summer EB thru	E	64.1	0.40	96
Summer EB right	D	38.6	0.24	42
Summer WB left	D	36.7	0.69	m198
Summer WB left/thru | thru	D	41.3	0.79	m230
Purchase SB left/thru | thru/right	D	52.6	0.95	#281
I-90 off-ramp SWB left/thru | thru/right	D	46.6	0.79	#304

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**B**	**17.7**		
Congress EB thru | thru | thru/right	A	9.6	0.40	91
Congress EB right	B	11.9	0.33	102
Purchase SB hard left	C	25.6	0.75	314
Purchase SB left/thru | thru	C	21.5	0.76	271
Kneeland Street/Lincoln Street	**C**	**31.0**		
Kneeland EB left/thru | thru/right	C	26.9	0.74	115
Kneeland WB left/thru | thru | thru/right	D	53.0	0.86	m211
Lincoln NB left/thru | thru	C	20.8	0.60	#393
Lincoln NB right	A	3.0	0.33	38
North Street/SASB	**B**	**13.8**		
North Street EB right	A	0.5	0.05	m3
I-93 WB left/thru | thru	A	9.2	0.57	287
SASB SB thru | thru/right	C	27.0	0.75	192
North Street/Cross Street	**C**	**25.2**		
I-93 EB left	B	16.2	0.39	202
I-93 EB left/thru	B	16.5	0.42	204
Cross NB thru | thru/right	D	36.8	0.79	190
Hanover Street/SASB	**B**	**17.4**		
Hanover EB thru | thru/right	C	20.8	0.03	6
Hanover WB left	A	9.4	0.12	38
Hanover WB thru	B	11.0	0.21	91
SASB SB left/thru | thru/right	C	21.1	0.44	85
Hanover Street/Cross Street	**A**	**7.1**		
Hanover EB left	D	45.7	0.13	15
Hanover EB thru	D	45.1	0.10	m28
Hanover WB thru/right	C	30.3	0.61	79
Cross NB left/thru | thru/right	A	1.8	0.42	15
New Sudbury Street/SASB	**C**	**21.5**		
New Sudbury EB thru | thru	C	28.6	0.26	m64
New Sudbury EB right	A	8.8	0.34	m26
SASB SB left/thru | thru	B	11.1	0.30	58
Haymarket Station SEB right	E	65.7	0.72	25
New Sudbury Street/Cross Street	**B**	**14.5**		
New Sudbury EB left | left	A	2.2	0.17	5
Cross NB left/thru | thru	B	19.4	0.75	222
New Chardon Street/SASB	**D**	**37.0**		
New Chardon EB bear right | bear right	C	26.2	0.48	132
New Chardon EB right	B	23.3	0.21	45
SASB SB left	E	47.6	0.83	381
SASB SB left/thru | thru/right	D	35.7	0.82	361
SASB SB right	E	53.1	0.85	#440
I-93 NWB left | left	C	28.8	0.54	193

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**B**	**11.3**		
Cooper Street WB right	A	1.0	0.16	0
I-93 NB thru | thru	D	47.8	0.56	83
Cross NWB bear right | bear right	A	1.8	0.43	25
North Washington Street/Beverly Street	**A**	**6.8**		
N. Washington SB thru | thru | thru	A	7.5	0.52	117
Beverly SEB right | right | right	A	3.5	0.18	m9
Valenti Way/Beverly Street				
Valenti WB left	A	0.5	0.19	17
Valenti Way/North Washington Street	**B**	**18.6**		
N. Washington NB left (de facto)	E	56.5	0.83	217
N. Washington NB thru/right	B	14.8	0.74	595
N. Washington SB left/thru | thru | thru/right	B	12.4	0.65	266
Congress Street/Atlantic Avenue	**C**	**21.5**		
Congress EB left | left	D	45.8	0.65	m126
Congress EB thru | thru	B	16.3	0.31	160
Congress WB right | right	A	4.9	0.31	m24
Atlantic NB thru | thru | thru/right	C	20.9	0.78	m125
Summer Street/Atlantic Avenue	**D**	**39.8**		
Summer EB left/thru | thru	D	36.6	0.70	m175
Summer WB thru | thru | thru/right	E	63.3	0.69	m144
Atlantic NB left/thru | thru | thru	C	29.3	0.90	m151
Atlantic NB right	D	50.0	0.96	m166
Essex Street/Atlantic Avenue	**D**	**45.1**		
Essex EB left | left	B	16.1	0.37	56
Atlantic NB left/thru | thru | thru	D	50.1	1.00	#510
Beach Street/Atlantic Avenue	**A**	**7.3**		
Atlantic NB left/thru | thru | thru	A	7.3	0.57	m140
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**D**	**50.0**		
Kneeland EB left	E	76.0	0.89	m#258
Kneeland EB left/thru	E	63.4	0.81	m#238
MBTA Drive WB thru/right	D	39.0	0.05	18
Frontage NB left	D	42.5	0.55	#262
Frontage NB left/thru	D	47.9	0.70	#385
I-90 WB Off-Ramp NWB left	D	53.3	0.91	#497
I-90 WB Off-Ramp NWB thru	D	41.4	0.97	#969
North Street/Clinton Street	**B**	**19.0**		
North EB thru	C	25.5	0.15	61
North WB thru | thru	B	10.6	0.50	95
Clinton NB left | left/right	C	34.7	0.77	m103
Purchase Street/Fire Station				
Fire Station EB right	A	9.3	0.04	3
Purchase SB thru | thru | thru/right	A	0.0	0.29	0

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**C**	**27.4**		
State WB left/thru | thru/right	D	40.9	0.85	268
Congress NB thru | thru	B	12.6	0.21	41
Congress SB thru | thru/bear right	B	19.0	0.83	273
Congress SB right	C	26.5	0.81	#412
North Street/Congress Street	**D**	**51.7**		
North WB left | left/right	E	66.1	1.09	m#511
Congress NB thru| thru | thru/right	A	3.9	0.39	m4
Congress SB left/thru | thru | thru	D	53.5	0.95	#154
North Street/Union Street	**C**	**30.5**		
North EB left/thru | thru	A	0.5	0.05	m0
North WB thru | thru/right	C	33.1	0.87	#433
Hanover Street/Congress Street	**A**	**3.7**		
Hanover WB left	B	14.9	0.66	52
Congress NB thru | thru | thru/right	A	0.3	0.26	m0
Congress SB thru | thru | thru	A	1.9	0.23	13
New Sudbury Street/Congress Street/Merrimac Street	**C**	**31.5**		
New Sudbury EB left	D	50.5	0.67	161
New Sudbury EB thru | thru	D	37.7	0.41	103
New Sudbury EB right	A	9.5	0.43	52
Congress NB thru | thru | thru/right	C	33.2	0.81	281
Merrimac SB left	D	48.5	0.69	m60
Merrimac SB thru | thru | thru	C	20.1	0.23	m65
New Chardon Street/Merrimac Street	**F**	**102.5**		
New Chardon EB left/thru | thru/right	A	6.7	0.40	5
New Chardon WB hard left/left	F	513.5	2.05	#403
New Chardon WB thru | thru/right	C	25.3	0.47	194
Merrimac NB hard left/left	F	92.8	1.12	m#543
Merrimac NB thru | thru/right	B	18.3	0.70	83
Merrimac SB left/thru | thru | thru/right	D	46.8	0.76	102
Summer Street/Dorchester Avenue	**E**	**67.2**		
Summer EB left/thru | thru/right	E	64.7	1.02	m#465
Summer WB left/thru | thru/right	B	16.3	0.69	142
Dorchester NB left/thru/right	C	29.7	0.39	66
Dorchester SB left	F	229.6	1.38	#448
Dorchester SB thru/right	B	19.4	0.26	37
Summer Street/Melcher Street	**B**	**16.2**		
Summer EB thru | thru/right	A	6.1	0.63	m130
Summer WB left/thru | thru	C	25.6	0.59	235
Melcher NB left/right	D	54.2	0.68	160
Summer Street/Pump House Road	**A**	**9.3**		
Summer EB left/thru | thru	A	6.5	0.29	121
Summer WB thru | thru | thru/right	A	8.7	0.37	187
Driveway NB left/thru/right	A	0.0	0.0	0
Pump House SB left	D	37.8	0.27	41
Pump House SB left/right	C	25.3	0.28	34

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Massport Haul Road/Pump Station Connector	**C**	**22.2**		
Haul EB thru	B	16.0	0.11	78
Haul EB right	A	5.3	0.12	28
Haul WB left	B	10.3	0.03	16
Haul WB thru	A	9.8	0.08	32
Pump Station NB left | left/right	C	31.8	0.57	48
Summer Street/D Street	**C**	**28.8**		
Summer EB left	C	25.4	0.35	97
Summer EB thru | thru/right	C	19.5	0.33	140
Summer WB left/thru | thru	D	32.5	0.69	#85
Summer WB right	A	8.9	0.44	32
D Street NB left	D	38.2	0.36	84
D Street NB thru | thru/right	C	31.2	0.33	81
D Street SB left	C	29.9	0.57	120
D Street SB thru | thru/right	B	16.7	0.47	95
Ramp DB (I-90 WB On Ramp)/D Street	**B**	**12.4**		
D Street NB left	D	51.3	0.67	176
D Street NB thru | thru	A	1.2	0.18	71
D Street SB thru | thru/right	A	8.5	0.27	154
Transitway/D Street	**B**	**10.0**		
Transitway EB thru	D	51.7	0.39	44
Transitway WB thru	D	49.8	0.35	47
D Street NB thru | thru | thru/right	B	10.8	0.22	60
D Street SB thru | thru	A	3.7	0.23	107
Congress Street/D Street	**C**	**31.8**		
Congress EB left/thru | thru/right	C	30.4	0.44	m183
Congress EB right	B	14.5	0.51	m154
Congress WB left/thru | thru/right	D	36.7	0.44	37
D Street NB left	D	44.8	0.74	205
D Street NB left/thru | thru/right	C	33.1	0.66	34
D Street SB left/thru | thru/right	D	42.5	0.56	96
Congress Street/B Street/Ramps D&F	**D**	**36.8**		
Congress EB left/thru | thru	D	51.8	0.88	m#278
Congress EB right	B	12.4	0.12	m7
Congress WB left	D	35.5	0.41	m159
Congress WB left/thru | thru/right	C	31.7	0.40	127
Ramp NB left	E	69.5	0.90	#329
Ramp NB thru	C	29.0	0.54	206
Ramp NB right	A	5.4	0.56	61
B Street SB thru | thru	D	39.1	0.16	13
B Street SB right	B	19.8	0.12	m7

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**C**	**30.6**		
Congress EB left	C	22.2	0.18	28
Congress EB thru | thru	B	17.9	0.16	52
Congress WB thru | thru	C	27.6	0.30	m111
Congress WB right	B	17.5	0.14	m33
Ramp I NB left/thru | thru	D	41.6	0.67	168
Ramp I NB right	A	8.2	0.54	43
Ramp C NEB thru | thru/right	D	36.9	0.83	292
Congress Street/Boston Wharf Road	**C**	**22.5**		
Congress EB left/thru	C	23.6	0.50	m203
Congress EB right	A	6.5	0.09	m8
Congress WB left	B	13.6	0.06	m10
Congress WB thru | thru/right	B	13.1	0.30	M90
Boston Wharf NB left	D	46.1	0.60	156
Boston Wharf NB thru/right	C	29.9	0.23	49
Boston Wharf SB left/thru	D	46.4	0.49	47
Boston Wharf SB right	B	11.4	0.36	27
Seaport Boulevard (Northern Avenue)/ B Street	**C**	**21.9**		
Seaport EB thru | thru/right	B	13.1	0.66	136
Seaport WB left/thru | thru	B	16.2	0.43	146
B Street NB left | left	E	59.6	0.71	m119
B Street NB right	B	19.6	0.49	m53
Seaport Boulevard/Northern Avenue/East Service Road	**B**	**15.6**		
Seaport EB left	A	9.0	0.21	6
Seaport EB thru | thru	A	9.2	0.46	36
Seaport WB thru | thru/right	B	6.9	0.60	257
East Service NB left	C	30.4	0.53	m152
East Service NB thru	D	35.1	0.70	m192
East Service NB right	B	12.0	0.57	m105
Northern SB left	D	45.2	0.26	38
Northern SB left/right	C	29.9	0.24	41
Seaport Boulevard/Sleeper Street	**B**	**18.2**		
Seaport EB left/thru | thru	C	26.6	3.75dl	m#471
Seaport EB right	A	0.2	0.16	m0
Seaport WB left	A	1.7	0.08	m4
Seaport WB thru | thru/right	A	2.5	0.28	37
Sleeper NB left/thru/right	D	43.4	0.66	75
Sleeper SB left/thru	D	36.8	0.21	26
Sleeper SB right	B	12.6	0.17	22
Congress Street/Dorchester Avenue	**B**	**17.6**		
Congress EB thru	B	16.6	0.46	m169
Congress EB right	A	7.0	0.49	m67
Congress WB left/thru	C	23.3	0.38	m150
Dorchester NB left/right	C	27.5	0.78	m197

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**D**	**45.4**		
Congress EB left/thru | thru	E	60.2	0.89	m#347
Congress EB right	A	5.0	0.19	m49
Congress WB left	D	46.8	0.87	#379
Congress WB thru/right	B	19.2	0.25	196
A Street NB left/thru/right	E	71.4	0.93	109
Thompson SB left/thru/right	C	29.9	0.15	5
Summer Street/West Side Drive	**A**	**5.6**		
Summer EB thru | thru/right	A	1.7	0.35	78
Summer WB left	B	10.7	0.09	14
Summer WB thru | thru	B	9.3	0.24	87
West Side NB left	D	40.2	0.02	13
West Side NB right	C	23.2	0.05	6
Summer Street/WTC Avenue	**B**	**11.3**		
Summer EB left	A	6.6	0.04	5
Summer EB thru | thru	A	7.9	0.31	42
Summer EB right	A	1.2	0.08	3
Summer WB left	A	9.4	0.15	m25
Summer WB thru | thru/right	B	12.6	0.31	m103
WTC NB left	D	43.4	0.18	40
WTC NB thru/right	B	17.7	0.19	9
WTC SB left	D	45.2	0.22	36
WTC SB thru/right	A	0.0	0.02	0
Seaport Boulevard/Boston Wharf Road	**A**	**7.5**		
Seaport EB thru | thru/right	A	4.6	0.50	m105
Seaport WB left	A	7.8	0.14	m29
Seaport WB thru| thru	A	6.0	0.26	165
Boston Wharf NB left | left/right	D	51.1	0.30	33
SSCONN/Albany Street	**A**	**8.7**		
SSCONN WB left | left	E	46.2	0.34	38
Albany SB left/thru | thru | thru	A	3.9	0.20	84
Broadway Bridge/Frontage Road	**E**	**62.9**		
Traveler EB hard left	D	41.2	0.15	m47
Traveler EB left	F	93.7	0.60	140
Traveler EB thru | thru	A	8.1	0.31	42
Broadway WB right	C	32.9	0.65	323
Broadway WB hard right (de facto)	F	133.5	1.19	#853
Frontage NB thru | thru	C	35.0	0.26	m110
Frontage NB right | right | right/hard right	E	56.0	0.94	#254
Bennington Street/Neptune Road	**E**	**57.5**		
Bennington EB left/thru | thru/right	E	60.5	0.70	102
Bennington WB left/thru | thru/right	E	72.0	0.89	m#95
Neptune NB left/thru | thru/right	D	50.8	0.91	#264
Neptune SB left (de facto)	F	85.0	1.10	#899
Neptune SB thru/right	B	14.6	0.53	445

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**10.1**		
SSCONN EB left/thru	E	57.6	0.32	42
SSCONN EB right	C	21.0	0.10	8
SSCONN WB left	D	50.5	0.28	33
SSCONN WB thru/right	C	30.0	0.39	36
Ramp NB left/thru | thru/right	A	7.1	0.45	265
Ramp SB left	A	6.2	0.06	m4
Ramp SB left/thru | thru/right	A	2.8	0.04	m5
East Berkeley Street/Albany Street	**D**	**36.2**		
East Berkeley WB left/thru | thru | thru	D	44.5	0.65	209
Albany SB thru | thru | thru/right	C	20.6	0.47	70
West 4th Street/Frontage Road	**C**	**32.7**		
West 4th WB thru | thru | thru/right	D	52.0	0.87	355
Frontage NB left	C	22.0	0.64	#646
Frontage NB thru | thru/right	B	17.4	0.64	#534
Traveler Street/Albany Street	**B**	**14.2**		
Traveler EB thru/right	E	58.3	0.69	188
Albany SB left	B	10.6	0.51	383
Albany SB left/thru | thru/right	A	8.7	0.51	372
Herald Street/Albany Street	**C**	**22.7**		
Herald EB right | right | right	B	13.6	0.53	184
Albany SB thru | thru | thru	C	29.2	0.83	224
MBTA Bus Lot (near Randolph)/Albany Street	**D**	**37.6**		
MBTA EB thru/right	D	39.4	0.06	12
Albany SB left	C	26.6	0.19	m101
Albany SB left/bear left | bear left	C	24.0	0.19	87
Albany SB thru/right	A	4.1	0.53	112
Albany NB right | right	F	80.6	0.62	255
Ramp A2/Ramp I/Frontage Road	**C**	**27.1**		
Frontage SB thru	C	34.3	0.53	211
Frontage SB right	C	28.1	0.13	60
Ramp SWB left/thru | thru	C	25.9	0.91	470
Nashua Street/Martha Road	**A**	**8.8**		
Nashua WB left | left	A	8.6	0.43	54
Martha SB thru | thru	A	8.9	0.48	105
Chelsea Street/Rutherford Avenue/N. Washington Street	**C**	**34.4**		
Chelsea WB left	F	140.3	1.20	#683
Chelsea WB thru	D	35.2	0.69	319
Chelsea WB right	A	5.0	0.31	33
N. Washington NB thru | thru | thru	C	30.0	0.33	90
N. Washington NB right	A	9.0	0.73	104
Rutherford SB left	E	71.4	0.94	m#353
Rutherford SB thru | thru | thru	A	4.5	0.55	80
Rutherford SB right	A	4.4	0.64	m62

Table 8. (cont.) Phase 1 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**C**	**28.5**		
Ramp EB left | left	D	35.2	0.59	174
Ramp EB right | right	D	47.8	0.84	239
Rutherford NB left	C	31.5	0.73	m#236
Rutherford NB thru | thru | thru | thru	A	4.6	0.11	m22
Rutherford SB thru | thru | thru | thru	C	29.4	0.77	348
Rutherford SB right	A	6.1	0.26	91
Albany Street/Frontage Road	**C**	**22.8**		
Albany EB left | left	C	26.7	0.73	90
Albany EB thru	B	18.1	0.07	m13
Albany WB right	C	23.5	0.48	46
Frontage NB thru | thru | thru/right	C	21.0	0.56	341
Neptune Road/Route 1A Off-ramp	**D**	**35.3**		
Neptune EB left/thru | thru	A	4.4	0.06	m11
Neptune WB thru | thru/right	B	13.3	0.24	47
Off-Ramp NB left	E	65.9	0.87	259
Off-Ramp NB thru/right	C	33.2	0.36	99

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

Table 9. Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**6.4**		
Atlantic WB left/thru | thru | thru	A	6.4	0.37	103
Pearl Street/Purchase Street	**A**	**8.8**		
Pearl WB left	D	44.3	0.26	60
Pearl WB left/thru | thru	D	44.0	0.35	58
Purchase SB thru | thru | thru/right	A	4.2	0.42	71
Seaport Boulevard/Atlantic Avenue	**C**	**24.1**		
Seaport EB left/thru | thru	C	20.6	0.62	58
Seaport WB thru/bear right	E	58.7	0.76	196
Seaport WB bear right/right	E	56.8	0.72	145
Seaport WB right	B	17.6	0.54	54
Atlantic NB left/bear left	B	19.7	0.66	#394
Atlantic NB left/thru | thru/right	B	14.1	0.66	#330
Oliver Street/Purchase Street	**C**	**27.0**		
Oliver WB left/thru | thru	D	42.3	0.73	m128
Purchase SB thru | thru | thru/right	C	26.6	0.80	231
I-93 SWB left	B	12.3	0.45	197
I-93 SWB thru | right	C	34.9	0.54	184
High Street/Atlantic Avenue	**B**	**16.6**		
High EB left | left	D	43.2	0.39	55
Atlantic NB thru | thru	A	9.3	0.38	114
High Street/Purchase Street	**A**	**8.6**		
High EB thru | thru/right	C	23.6	0.41	43
Purchase SB left/thru | thru | thru	A	4.4	0.36	21
Broad Street/Purchase Street	**A**	**3.5**		
Broad EB right	A	1.2	0.28	0
Purchase SB thru | thru | thru/right	A	4.0	0.29	33
East India Row/Atlantic Avenue	**A**	**6.4**		
East India WB thru/right	B	19.5	0.25	35
Atlantic NB left/thru | thru/right	A	5.4	0.30	63
India Street/SASB	**A**	**6.5**		
India WB left | left	C	28.1	0.24	48
India WB thru	C	28.1	0.21	62
SASB SB thru | thru | thru/right	A	1.7	0.23	32
Milk Street/Atlantic Avenue	**B**	**13.7**		
Milk EB left | left	C	30.3	0.33	53
Milk EB thru	D	38.5	0.42	87
Milk WB right	A	0.1	0.04	0
Atlantic NB thru | thru/right	A	7.5	0.47	11
Milk Street/SASB	**A**	**7.0**		
Milk EB thru | thru/right	B	19.9	0.36	46
SASB SB left/thru | thru | thru	A	3.5	0.32	31

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Atlantic Avenue	**A**	**3.4**		
State WB thru/right	C	22.1	0.23	47
Atlantic NB left/thru | thru | thru/right	A	1.6	0.32	20
State Street/SASB	**A**	**9.6**		
State WB left	C	28.8	0.31	51
State WB thru | thru	C	27.8	0.40	67
SASB SB thru | thru | thru/right	A	5.0	0.43	108
Mercantile Street/Atlantic Avenue/Cross Street	**B**	**16.1**		
Mercantile EB left/thru | thru	C	32.6	0.34	80
Atlantic WB thru | thru/right	C	31.0	0.43	91
Atlantic NB left/thru | thru	A	6.1	0.23	43
Atlantic NB right	A	4.0	0.35	0
Mercantile Street/SASB	**A**	**3.4**		
Mercantile WB left | left	B	15.9	0.49	18
SASB SB left/thru | thru | thru	A	0.5	0.28	0
Commercial Street/Cross Street	**A**	**3.6**		
Commercial WB right	A	0.4	0.09	0
Cross NB thru | thru	A	3.9	0.16	35
Clinton Street/SASB	**C**	**25.3**		
I-93 WB left	D	42.3	0.69	167
I-93 WB left/thru	D	41.9	0.70	203
SASB SB thru | thru | thru/right	B	12.9	0.56	124
Kneeland Street/SASB	**C**	**23.3**		
Kneeland EB thru | thru	D	43.4	0.79	180
Kneeland EB right	A	7.8	0.46	51
Kneeland WB left	C	33.9	0.47	m78
Kneeland WB thru | thru	D	35.3	0.56	195
SASB SB left/thru | thru | thru/right	A	8.2	0.49	19
Beach Street/SASB	**A**	**8.1**		
Beach WB left	D	49.7	0.55	89
SASB SB thru | thru | thru	A	2.1	0.29	36
Essex Street/Lincoln Street/SASB	**C**	**23.7**		
Essex EB left/thru | thru	C	28.4	0.75	96
Essex EB right/hard right	C	21.9	0.71	50
SASB SB left/thru | thru | thru/right	B	15.4	0.49	142
I-93 Ramp NWB left/thru | thru | thru/right	C	33.8	0.58	112
Essex Street/South Street	**A**	**5.2**		
Essex EB thru | thru/right	A	4.1	0.28	21
South WB left | left	B	14.7	0.13	m17
Summer Street/Purchase Street/SASB	**D**	**39.9**		
Summer EB thru	D	51.0	0.28	85
Summer EB right	C	34.8	0.24	21
Summer WB left	C	32.8	0.71	m81
Summer WB left/thru | thru	C	24.7	0.71	m78
Purchase SB left/thru | thru/right	D	53.8	0.84	#260
I-90 off-ramp SWB left/thru | thru/right	C	31.4	0.39	112

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**B**	**15.8**		
Congress EB thru | thru | thru/right	B	16.3	0.41	146
Congress EB right	B	19.9	0.41	168
Purchase SB hard left	B	13.3	0.55	49
Purchase SB left/thru | thru	B	15.5	0.77	58
Kneeland Street/Lincoln Street	**C**	**23.9**		
Kneeland EB left/thru | thru/right	C	26.2	0.77	m118
Kneeland WB left/thru | thru | thru/right	C	25.5	0.66	132
Lincoln NB left/thru | thru	C	23.9	0.36	194
Lincoln NB right	B	11.0	0.25	96
North Street/SASB	**B**	**12.1**		
North Street EB right	A	1.6	0.20	1
I-93 WB left/thru | thru	A	5.3	0.29	97
SASB SB thru | thru/right	C	29.9	0.63	154
North Street/Cross Street	**C**	**24.1**		
I-93 EB left	B	14.5	0.26	118
I-93 EB left/thru	B	14.6	0.27	87
Cross NB thru | thru/right	C	32.0	0.80	172
Hanover Street/SASB	**A**	**9.1**		
Hanover EB thru | thru/right	B	18.1	0.08	12
Hanover WB left	B	15.5	0.18	m40
Hanover WB thru	B	15.9	0.22	64
SASB SB left/thru | thru/right	A	5.0	0.27	35
Hanover Street/Cross Street	**A**	**8.5**		
Hanover EB left	C	27.0	0.17	22
Hanover EB thru	C	28.0	0.24	30
Hanover WB thru/right	C	29.7	0.63	113
Cross NB left/thru | thru/right	A	1.6	0.37	7
New Sudbury Street/SASB	**C**	**23.2**		
New Sudbury EB thru | thru	B	12.0	0.15	76
New Sudbury EB right	A	5.9	0.31	54
SASB SB left/thru | thru	D	36.9	0.70	155
Haymarket Station SEB right	D	50.9	0.43	13
New Sudbury Street/Cross Street	**A**	**10.0**		
New Sudbury EB left | left	A	6.0	0.16	50
Cross NB left/thru | thru	B	12.5	0.67	130
New Chardon Street/SASB	**C**	**24.8**		
New Chardon EB bear right | bear right	C	22.1	0.47	184
New Chardon EB right	B	18.5	0.16	59
SASB SB left	C	29.9	0.64	238
SASB SB left/thru | thru/right	C	26.3	0.64	209
SASB SB right	C	31.0	0.65	235
I-93 NWB left | left	B	19.0	0.26	91

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**A**	**9.7**		
Cooper Street WB right	A	0.9	0.18	0
I-93 NB thru | thru	D	40.9	0.41	51
Cross NWB bear right | bear right	A	3.9	0.40	31
North Washington Street/Beverly Street	**C**	**25.2**		
N. Washington SB thru | thru | thru	C	29.6	0.35	180
Beverly SEB right | right | right	B	13.2	0.16	m49
Valenti Way/Beverly Street	**A**	**7.8**		
Valenti WB left	A	0.5	0.18	16
Valenti Way/North Washington Street	**A**	**7.8**		
N. Washington NB left/thru | thru/right	A	2.1	0.54	0
N. Washington SB left/thru | thru | thru/right	B	13.1	0.71	212
Congress Street/Atlantic Avenue	**B**	**20.4**		
Congress EB left | left	D	52.3	0.68	135
Congress EB thru | thru	A	9.3	0.21	54
Congress WB right | right	A	0.6	0.24	m0
Atlantic NB thru | thru | thru/right	B	18.5	0.68	49
Summer Street/Atlantic Avenue	**C**	**23.1**		
Summer EB left/thru | thru	D	35.2	0.37	m115
Summer WB thru | thru | thru/right	C	20.4	0.49	87
Atlantic NB left/thru | thru | thru	B	19.8	0.72	107
Atlantic NB right	C	26.2	0.68	#119
Essex Street/Atlantic Avenue	**C**	**21.4**		
Essex EB left | left	C	14.5	0.29	52
Atlantic NB left/thru | thru | thru	B	23.3	0.60	234
Beach Street/Atlantic Avenue	**B**	**10.4**		
Atlantic NB left/thru | thru | thru	B	10.4	0.33	125
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**C**	**31.9**		
Kneeland EB left	D	39.9	0.80	m167
Kneeland EB left/thru	C	33.0	0.73	m160
MBTA Drive WB thru/right	C	33.0	0.02	6
Frontage NB left	C	26.6	0.32	167
Frontage NB left/thru	C	27.3	0.36	182
I-90 WB Off-Ramp NWB left	E	56.8	0.82	168
I-90 WB Off-Ramp NWB thru	B	12.6	0.36	187
North Street/Clinton Street	**B**	**19.5**		
North EB thru	C	22.2	0.20	117
North WB thru | thru	B	11.5	0.37	89
Clinton NB left | left/right	C	32.8	0.69	110
Purchase Street/Fire Station	**A**	**0.5**		
Fire Station EB right	A	9.4	0.06	5
Purchase SB thru | thru | thru/right	A	0.0	0.23	0

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**B**	**19.1**		
State WB left/thru | thru/right	C	25.4	0.58	167
Congress NB thru | thru	C	22.8	0.25	80
Congress SB thru | thru/bear right	B	12.3	0.59	136
Congress SB right	B	15.3	0.57	143
North Street/Congress Street	**C**	**20.7**		
North WB left | left/right	C	21.0	0.82	137
Congress NB thru| thru | thru/right	A	2.7	0.38	4
Congress SB left/thru | thru | thru	D	35.7	0.75	100
North Street/Union Street	**B**	**12.1**		
North EB left/thru | thru	A	6.8	0.10	18
North WB thru | thru/right	B	13.4	0.57	103
Hanover Street/Congress Street	**A**	**1.4**		
Hanover WB left	A	2.2	0.33	5
Congress NB thru | thru | thru/right	A	0.3	0.21	m0
Congress SB thru | thru | thru	A	2.4	0.18	11
New Sudbury Street/Congress Street/Merrimac Street	**C**	**32.4**		
New Sudbury EB left	D	42.4	0.62	151
New Sudbury EB thru | thru	C	32.3	0.37	90
New Sudbury EB right	A	8.3	0.48	49
Congress NB thru | thru | thru/right	D	40.9	0.68	213
Merrimac SB left	E	55.3	0.55	m61
Merrimac SB thru | thru | thru	B	13.9	0.17	m45
New Chardon Street/Merrimac Street	**C**	**31.2**		
New Chardon EB left/thru | thru/right	A	4.5	0.37	6
New Chardon WB hard left/left	F	96.1	0.97	#118
New Chardon WB thru | thru/right	C	22.7	0.27	117
Merrimac NB hard left/left	D	51.6	0.97	#360
Merrimac NB thru | thru/right	B	12.8	0.57	58
Merrimac SB left/thru | thru | thru/right	C	32.1	0.58	94
Summer Street/Dorchester Avenue	**C**	**21.6**		
Summer EB left/thru | thru/right	B	18.3	0.65	#373
Summer WB left/thru | thru/right	B	10.1	0.48	122
Dorchester NB left/thru/right	C	28.1	0.46	83
Dorchester SB left	E	62.8	0.94	#217
Dorchester SB thru/right	A	4.8	0.31	9
Summer Street/Melcher Street	**B**	**15.4**		
Summer EB thru | thru/right	B	10.2	0.49	m169
Summer WB left/thru | thru	B	15.8	0.48	198
Melcher NB left/right	D	42.5	0.67	139
Summer Street/Pump House Road	**A**	**9.6**		
Summer EB left/thru | thru	A	6.8	0.27	122
Summer WB thru | thru | thru/right	A	8.8	0.23	97
Driveway NB left/thru/right	A	0.0	0.00	0
Pump House SB left	C	35.0	0.32	38
Pump House SB left/right	B	19.8	0.34	36

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Massport Haul Road/Pump Station Connector	**B**	**12.1**		
Haul EB thru	B	13.7	0.08	51
Haul EB right	A	5.3	0.11	29
Haul WB left	A	7.6	0.06	14
Haul WB thru	A	7.5	0.07	38
Pump Station NB left | left/right	B	19.1	0.24	13
Summer Street/D Street	**C**	**23.1**		
Summer EB left	B	18.3	0.36	45
Summer EB thru | thru/right	B	13.0	0.28	45
Summer WB left/thru | thru	D	41.6	0.52	102
Summer WB right	B	12.5	0.31	65
D Street NB left	C	30.1	0.23	68
D Street NB thru | thru/right	B	17.1	0.25	51
D Street SB left	D	38.1	0.43	83
D Street SB thru | thru/right	C	24.7	0.43	63
Ramp DB (I-90 WB On Ramp)/D Street	**B**	**10.9**		
D Street NB left	D	37.2	0.54	141
D Street NB thru | thru	A	1.1	0.12	23
D Street SB thru | thru/right	A	8.8	0.25	124
Transitway/D Street	**A**	**6.7**		
Transitway EB thru	D	41.7	0.21	25
Transitway WB thru	D	40.4	0.21	29
D Street NB thru | thru | thru/right	A	7.9	0.13	38
D Street SB thru | thru	A	3.1	0.18	60
Congress Street/D Street	**C**	**20.9**		
Congress EB left/thru | thru/right	A	7.3	0.27	65
Congress EB right	A	3.1	0.32	91
Congress WB left/thru | thru/right	D	37.4	0.51	45
D Street NB left	C	30.7	0.60	65
D Street NB left/thru | thru/right	C	20.1	0.54	50
D Street SB left/thru | thru/right	D	36.4	0.51	84
Congress Street/B Street/Ramps D&F	**C**	**30.0**		
Congress EB left/thru | thru	D	40.2	0.57	120
Congress EB right	B	13.2	0.30	4
Congress WB left	C	34.4	0.23	m135
Congress WB left/thru | thru/right	C	31.6	0.22	86
Ramp NB left	D	47.0	0.49	93
Ramp NB thru	C	26.4	0.17	59
Ramp NB right	A	7.3	0.47	55
B Street SB thru | thru	D	54.2	0.21	m32
B Street SB right	C	34.6	0.19	m22

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**B**	**18.9**		
Congress EB left	A	5.1	0.04	7
Congress EB thru | thru	A	5.0	0.08	23
Congress WB thru | thru	B	10.9	0.09	45
Congress WB right	A	7.7	0.02	m5
Ramp I NB left/thru | thru	D	37.8	0.29	47
Ramp I NB right	B	12.5	0.45	23
Ramp C NEB thru | thru/right	D	37.5	0.35	60
Congress Street/Boston Wharf Road	**B**	**16.3**		
Congress EB left/thru	A	9.6	0.24	m59
Congress EB right	A	2.8	0.13	m8
Congress WB left	A	7.0	0.08	12
Congress WB thru | thru/right	A	5.2	0.12	25
Boston Wharf NB left	C	32.8	0.15	47
Boston Wharf NB thru/right	C	22.8	0.16	21
Boston Wharf SB left/thru	D	51.8	0.54	67
Boston Wharf SB right	C	21.6	0.30	43
Seaport Boulevard (Northern Avenue)/ B Street	**B**	**17.2**		
Seaport EB thru | thru/right	A	9.8	0.63	m131
Seaport WB left	C	27.2	0.51	55
Seaport WB thru	B	19.0	0.59	250
B Street NB left | left	D	45.5	0.52	84
B Street NB right	B	16.5	0.57	39
Seaport Boulevard/Northern Avenue/East Service Road	**C**	**26.6**		
Seaport EB left	C	23.6	0.51	#79
Seaport EB thru | thru	B	18.7	0.58	158
Seaport WB thru | thru/right	C	33.7	0.87	#321
East Service NB left	D	40.1	0.57	152
East Service NB thru	D	37.4	0.49	130
East Service NB right	B	11.9	0.59	44
Northern SB left	D	40.8	0.51	100
Northern SB left/right	B	15.7	0.44	75
Seaport Boulevard/Sleeper Street	**A**	**7.4**		
Seaport EB left/thru | thru	A	6.4	1.20dl	145
Seaport EB right	A	0.6	0.07	m1
Seaport WB left	A	2.7	0.08	7
Seaport WB thru | thru/right	A	3.1	0.22	33
Sleeper NB left/thru/right	C	31.7	0.42	16
Sleeper SB left/thru	D	38.1	0.22	31
Sleeper SB right	B	12.8	0.40	18
Congress Street/Dorchester Avenue	**B**	**14.0**		
Congress EB thru	A	6.4	0.30	65
Congress EB right	A	1.5	0.34	0
Congress WB left/thru	B	17.2	0.36	m196
Dorchester NB left/right	D	40.0	0.74	42

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**C**	**32.3**		
Congress EB left/thru | thru	E	69.0	0.92	#290
Congress EB right	A	4.9	0.17	m46
Congress WB left	B	16.3	0.46	81
Congress WB thru/right	A	9.3	0.16	69
A Street NB left/thru/right	D	38.0	0.76	23
Thompson SB left/thru/right	C	25.6	0.13	23
Summer Street/West Side Drive	**A**	**6.8**		
Summer EB thru | thru/right	A	6.5	0.26	99
Summer WB left	A	5.3	0.04	4
Summer WB thru | thru	A	4.0	0.13	23
West Side NB left	D	37.0	0.11	19
West Side NB right	B	14.0	0.23	6
Summer Street/WTC Avenue	**B**	**12.1**		
Summer EB left	A	6.7	0.06	12
Summer EB thru | thru	A	7.9	0.23	51
Summer EB right	A	1.9	0.06	5
Summer WB left	B	14.5	0.10	m35
Summer WB thru | thru/right	B	17.9	0.15	105
WTC NB left	D	41.4	0.25	23
WTC NB thru/right	A	0.1	0.06	0
WTC SB left	D	39.7	0.16	30
WTC SB thru/right	A	0.1	0.03	0
Seaport Boulevard/Boston Wharf Road	**A**	**7.6**		
Seaport EB thru | thru/right	A	8.0	0.37	138
Seaport WB left	A	4.8	0.22	25
Seaport WB thru| thru	A	3.9	0.14	m43
Boston Wharf NB left | left/right	C	20.9	0.35	29
SSCONN/Albany Street	**A**	**7.2**		
SSCONN WB left | left	D	47.0	0.25	m42
Albany SB left/thru | thru | thru	A	3.6	0.23	84
Broadway Bridge/Frontage Road	**D**	**36.6**		
Traveler EB hard left	D	41.9	0.16	m53
Traveler EB left	E	60.7	0.67	188
Traveler EB thru | thru	B	15.0	0.27	32
Broadway WB right	C	31.3	0.33	106
Broadway WB hard right (de facto)	E	79.3	0.99	#415
Frontage NB thru | thru	B	17.9	0.14	m43
Frontage NB right | right | right/hard right	C	21.9	0.56	m121
Bennington Street/Neptune Road	**C**	**26.4**		
Bennington EB left/thru | thru/right	D	39.2	0.41	55
Bennington WB left/thru | thru/right	C	28.8	0.76	m77
Neptune NB left/thru | thru/right	C	29.4	0.60	#288
Neptune SB left/thru | thru/right	B	19.3	0.58	#296

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**10.8**		
SSCONN EB left/thru	D	40.7	0.12	15
SSCONN EB right	C	33.3	0.12	23
SSCONN WB left	D	42.8	0.25	26
SSCONN WB thru/right	C	24.1	0.52	23
Ramp NB left/thru | thru/right	A	7.3	0.38	143
Ramp SB left	B	17.5	0.04	m6
Ramp SB left/thru | thru/right	B	11.1	0.04	m20
East Berkeley Street/Albany Street	**B**	**17.5**		
East Berkeley WB left/thru | thru | thru	B	14.5	0.35	m57
Albany SB thru | thru | thru/right	C	21.2	0.35	134
West 4th Street/Frontage Road	**C**	**33.4**		
West 4th WB thru | thru | thru/right	E	62.9	0.99	#356
Frontage NB left	B	13.9	0.62	#580
Frontage NB thru | thru/right	B	11.5	0.62	#476
Traveler Street/Albany Street	**B**	**11.6**		
Traveler EB thru/right	D	42.0	0.61	118
Albany SB left	A	8.4	0.37	250
Albany SB left/thru | thru/right	A	7.0	0.37	214
Herald Street/Albany Street	**C**	**21.3**		
Herald EB right | right | right	B	14.4	0.52	192
Albany SB thru | thru | thru	C	26.3	0.82	272
MBTA Bus Lot (near Randolph)/Albany Street	**D**	**42.7**		
MBTA EB thru/right	C	32.7	0.06	4
Albany SB left	C	26.1	0.25	81
Albany SB left/bear left | bear left	C	22.1	0.25	96
Albany SB thru/right	A	3.9	0.38	64
Albany NB right | right	F	95.0	0.53	172
Ramp A2/Ramp I/Frontage Road	**C**	**25.4**		
Frontage SB thru	C	32.2	0.55	191
Frontage SB right	C	25.7	0.13	54
Ramp SWB left/thru | thru	C	24.2	0.91	449
Nashua Street/Martha Road	A	4.5		
Nashua WB left | left	A	0.4	0.23	0
Martha SB thru | thru	A	7.3	0.28	56
Chelsea Street/Rutherford Avenue/N. Washington Street	**B**	**16.3**		
Chelsea WB left	D	49.7	0.76	201
Chelsea WB thru	D	43.3	0.66	177
Chelsea WB right	A	6.9	0.37	43
N. Washington NB thru | thru | thru	B	17.8	0.20	92
N. Washington NB right	A	4.7	0.38	58
Rutherford SB left	E	65.0	0.66	m115
Rutherford SB thru | thru | thru	A	1.1	0.23	m14
Rutherford SB right	A	2.2	0.49	m41

Table 9. (cont.) Phase 1 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**C**	**25.2**		
Ramp EB left | left	D	38.7	0.41	88
Ramp EB right | right	A	6.8	0.33	23
Rutherford NB left	D	53.8	0.92	#355
Rutherford NB thru | thru | thru | thru	A	3.5	0.13	28
Rutherford SB thru | thru | thru | thru	C	31.2	0.82	329
Rutherford SB right	A	6.4	0.47	96
Albany Street/Frontage Road	**C**	**25.9**		
Albany EB left | left	C	23.2	0.53	148
Albany EB thru	B	19.8	0.05	m15
Albany WB right	C	20.4	0.43	44
Frontage NB thru | thru | thru/right	C	27.8	0.71	335
Neptune Road/Route 1A Off-ramp	**C**	**32.3**		
Neptune EB left/thru | thru	A	4.0	0.08	m20
Neptune WB thru | thru/right	C	21.6	0.53	86
Off-Ramp NB left	E	59.4	0.86	249
Off-Ramp NB thru/right	C	33.3	0.45	99

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

Table 10. Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Pearl Street/Atlantic Avenue	**A**	**1.2**		
Atlantic WB left/thru | thru | thru	A	1.2	0.48	14
Pearl Street/Purchase Street	**A**	**9.8**		
Pearl WB left	D	47.7	0.32	43
Pearl WB left/thru | thru	D	48.5	0.47	53
Purchase SB thru | thru | thru/right	A	5.4	0.61	109
Seaport Boulevard/Atlantic Avenue	**E**	**74.2**		
Seaport EB left/thru | thru	D	50.4	0.66	206
Seaport WB thru/bear right	F	114.5	1.11	#510
Seaport WB bear right/right	F	85.3	1.01	#426
Seaport WB right	B	12.6	0.44	m106
Atlantic NB left/bear left	F	85.8	1.06	#681
Atlantic NB left/thru | thru/right	E	72.6	1.05	#570
Oliver Street/Purchase Street	**C**	**26.1**		
Oliver WB left/thru | thru	D	52.7	0.82	m80
Purchase SB thru | thru | thru/right	C	23.6	0.82	168
I-93 SWB left	B	10.4	0.46	205
I-93 SWB thru | right	D	37.0	0.55	206
High Street/Atlantic Avenue	**B**	**10.6**		
High EB left | left	D	35.6	0.47	72
Atlantic NB thru | thru	A	4.7	0.44	m62
High Street/Purchase Street	**A**	**6.6**		
High EB thru | thru/right	B	15.6	0.55	68
Purchase SB left/thru | thru | thru	A	3.9	0.43	41
Broad Street/Purchase Street	**A**	**4.8**		
Broad EB right	A	1.7	0.34	0
Purchase SB thru | thru | thru/right	A	5.4	0.30	42
East India Row/Atlantic Avenue	**A**	**9.8**		
East India WB thru/right	C	21.8	0.18	26
Atlantic NB left/thru | thru/right	A	9.4	0.46	458
India Street/SASB	**A**	**8.5**		
India WB left | left	C	30.8	0.35	56
India WB thru	C	31.7	0.26	49
SASB SB thru | thru | thru/right	A	2.9	0.24	59
Milk Street/Atlantic Avenue	**C**	**28.3**		
Milk EB left | left	D	44.4	0.67	54
Milk EB thru	D	38.6	0.34	31
Milk WB right	A	1.7	0.29	0
Atlantic NB thru | thru/right	C	27.5	0.62	370
Milk Street/SASB	**B**	**11.8**		
Milk EB thru | thru/right	D	37.0	0.51	107
SASB SB left/thru | thru | thru	A	3.8	0.30	42

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Atlantic Avenue	**A**	**2.7**		
State WB thru/right	C	24.6	0.33	75
Atlantic NB left/thru | thru | thru/right	A	0.8	0.35	8
State Street/SASB	**B**	**10.7**		
State WB left	D	46.4	0.42	106
State WB thru | thru	D	44.1	0.43	84
SASB SB thru | thru | thru/right	A	1.0	0.37	4
Mercantile Street/Atlantic Avenue/Cross Street	**B**	**19.4**		
Mercantile EB left/thru | thru	D	51.7	0.55	77
Atlantic WB thru | thru/right	D	36.0	0.47	101
Atlantic NB left/thru | thru	A	7.9	0.34	83
Atlantic NB right	A	4.1	0.48	55
Mercantile Street/SASB	**C**	**22.0**		
Mercantile WB left | left	E	73.9	0.67	95
SASB SB left/thru | thru | thru	A	8.2	0.31	75
Commercial Street/Cross Street	**A**	**0.8**		
Commercial WB right	A	1.4	0.20	0
Cross NB thru | thru	A	0.7	0.27	4
Clinton Street/SASB	**C**	**24.5**		
I-93 WB left	D	48.5	0.70	215
I-93 WB left/thru	D	47.9	0.71	184
SASB SB thru | thru | thru/right	A	8.1	0.33	57
Kneeland Street/SASB	**C**	**27.6**		
Kneeland EB thru | thru	D	47.0	0.79	210
Kneeland EB right	B	16.0	0.78	113
Kneeland WB left	D	52.5	0.75	m133
Kneeland WB thru | thru	D	40.8	0.46	m18
SASB SB left/thru | thru | thru/right	B	17.2	0.79	#402
Beach Street/SASB	**A**	**7.8**		
Beach WB left	D	45.0	0.63	92
SASB SB thru | thru | thru	A	3.7	0.44	75
Essex Street/Lincoln Street/SASB	**C**	**33.6**		
Essex EB left/thru | thru	D	48.6	0.85	212
Essex EB right/hard right	C	27.3	0.46	m109
SASB SB left/thru | thru | thru/right	D	42.6	0.79	164
I-93 Ramp NWB left/thru | thru | thru/right	C	24.9	0.68	280
Essex Street/South Street	**B**	**12.9**		
Essex EB thru | thru/right	A	6.3	0.25	29
South WB left | left	C	34.4	0.33	56
Summer Street/Purchase Street/SASB	**D**	**44.0**		
Summer EB thru	F	110.9	0.69	166
Summer EB right	C	24.5	0.35	48
Summer WB left	D	47.8	0.77	m#260
Summer WB left/thru | thru	C	33.7	0.77	m215
Purchase SB left/thru | thru/right	D	43.1	0.82	#211
I-90 off-ramp SWB left/thru | thru/right	D	36.6	0.66	246

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/Purchase Street	**F**	**85.4**		
Congress EB thru | thru	B	10.3	0.66	36
Congress EB bear right (de facto)	F	206.3	1.40	#793
Congress EB right	A	8.6	0.34	m20
Purchase SB hard left	B	14.2	0.62	59
Purchase SB bear left (de facto)	F	129.5	1.22	#862
Purchase SB thru	B	11.9	0.50	49
Kneeland Street/Lincoln Street	**C**	**25.5**		
Kneeland EB left/thru | thru/right	C	26.3	0.75	114
Kneeland WB left/thru | thru | thru/right	D	36.7	0.81	182
Lincoln NB left/thru | thru	B	16.6	0.37	201
Lincoln NB right	A	4.3	0.19	17
North Street/SASB	**B**	**17.8**		
North Street EB right	A	4.0	0.17	16
I-93 WB left/thru | thru	A	5.3	0.21	77
SASB SB thru | thru/right	C	34.1	0.78	75
North Street/Cross Street	**C**	**26.9**		
I-93 EB left	C	27.6	0.51	248
I-93 EB left/thru	C	28.8	0.56	218
Cross NB thru | thru/right	C	26.1	0.82	175
Hanover Street/SASB	**B**	**13.5**		
Hanover EB thru | thru/right	C	20.6	0.15	30
Hanover WB left	B	17.3	0.26	m69
Hanover WB thru	B	16.7	0.19	m77
SASB SB left/thru | thru/right	B	10.5	0.29	m117
Hanover Street/Cross Street	**B**	**12.6**		
Hanover EB left	D	39.5	0.36	43
Hanover EB thru	C	34.5	0.31	70
Hanover WB thru/right	D	53.1	0.81	184
Cross NB left/thru | thru/right	A	3.0	0.62	104
New Sudbury Street/SASB	**C**	**28.9**		
New Sudbury EB thru | thru	B	16.2	0.45	m128
New Sudbury EB right	A	4.4	0.36	m22
SASB SB left/thru | thru	C	30.7	0.63	m104
Haymarket Station SEB right	F	138.2	1.06	38
New Sudbury Street/Cross Street	**B**	**11.2**		
New Sudbury EB left | left	B	10.9	0.54	64
Cross NB left/thru | thru	B	11.5	0.74	304
New Chardon Street/SASB	**D**	**37.4**		
New Chardon EB bear right | bear right	D	44.1	0.95	#515
New Chardon EB right	B	16.2	0.20	46
SASB SB left	C	33.8	0.91	#351
SASB SB left/thru | thru/right	D	44.2	0.90	#324
SASB SB right	D	43.8	0.90	#288
I-93 NWB left | left	C	21.0	0.42	122

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
North Washington Street/Cross Street	**B**	**13.7**		
Cooper Street WB right	A	1.0	0.16	0
I-93 NB thru | thru	D	47.8	0.56	83
Cross NWB bear right | bear right	A	5.1	0.43	146
North Washington Street/Beverly Street	**B**	**14.7**		
N. Washington SB thru | thru | thru	B	15.3	0.64	144
Beverly SEB right | right | right	B	12.6	0.25	m94
Valenti Way/Beverly Street				
Valenti WB left	A	0.6	0.21	20
Valenti Way/North Washington Street	**D**	**46.4**		
N. Washington NB left (de facto)	F	131.9	1.07	#352
N. Washington NB thru/right	E	58.1	0.85	#705
N. Washington SB left/thru | thru | thru/right	B	17.9	0.85	434
Congress Street/Atlantic Avenue	**B**	**13.2**		
Congress EB left | left	C	29.3	0.74	177
Congress EB thru | thru	A	2.2	0.32	22
Congress WB right | right	A	3.5	0.45	m8
Atlantic NB thru | thru | thru/right	B	15.7	0.75	100
Summer Street/Atlantic Avenue	**C**	**23.2**		
Summer EB left/thru | thru	C	35.0	0.67	m192
Summer WB thru | thru | thru/right	B	16.4	0.54	105
Atlantic NB left/thru | thru | thru	C	23.8	0.76	96
Atlantic NB right	C	24.7	0.69	156
Essex Street/Atlantic Avenue	**B**	**18.8**		
Essex EB left | left	C	26.7	0.47	145
Atlantic NB left/thru | thru | thru	B	15.8	0.55	103
Beach Street/Atlantic Avenue	**A**	**7.2**		
Atlantic NB left/thru | thru | thru	A	7.2	0.57	134
Kneeland Street/Atlantic Avenue/I-90 WB Off-Ramps	**C**	**31.4**		
Kneeland EB left	D	41.5	0.76	m180
Kneeland EB left/thru	D	35.7	0.69	m172
MBTA Drive WB thru/right	D	40.0	0.10	8
Frontage NB left	C	26.3	0.33	153
Frontage NB left/thru	C	28.2	0.45	205
I-90 WB Off-Ramp NWB left	E	59.0	0.79	#216
I-90 WB Off-Ramp NWB thru	B	13.2	0.41	220
North Street/Clinton Street	**C**	**22.9**		
North EB thru	C	23.9	0.17	54
North WB thru | thru	C	21.2	0.55	239
Clinton NB left | left/right	C	26.2	0.59	73
Purchase Street/Fire Station				
Fire Station EB right	B	10.8	0.26	26
Purchase SB thru | thru | thru/right	A	0.0	0.33	0

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
State Street/Congress Street	**C**	**22.8**		
State WB left/thru | thru/right	C	33.0	0.67	213
Congress NB thru | thru	C	22..5	0.48	114
Congress SB thru | thru/bear right	C	15.5	0.62	171
Congress SB right	C	18.5	0.60	191
North Street/Congress Street	**C**	**26.3**		
North WB left | left/right	E	55.1	0.77	223
Congress NB thru| thru | thru/right	A	6.2	0.53	20
Congress SB left/thru | thru | thru	B	19.9	0.72	69
North Street/Union Street	**A**	**4.4**		
North EB left/thru | thru	A	4.4	0.06	m12
North WB thru | thru/right	A	4.4	0.38	32
Hanover Street/Congress Street	**A**	**2.6**		
Hanover WB left	B	17.2	0.28	71
Congress NB thru | thru | thru/right	A	0.3	0.27	3
Congress SB thru | thru | thru	A	2.4	0.21	36
New Sudbury Street/Congress Street/Merrimac Street	**D**	**50.8**		
New Sudbury EB left	E	77.7	0.96	#337
New Sudbury EB thru | thru	D	38.5	0.63	191
New Sudbury EB right	A	7.8	0.48	32
Congress NB thru | thru	D	51.2	0.72	285
Congress NB right (de facto)	F	83.3	0.95	#351
Merrimac SB left	F	82.2	0.97	m#97
Merrimac SB thru | thru | thru	C	28.8	0.22	m69
New Chardon Street/Merrimac Street	**E**	**58.6**		
New Chardon EB left/thru | thru/right	A	7.0	0.62	11
New Chardon WB hard left/left	F	234.2	1.37	55
New Chardon WB thru | thru/right	A	8.6	0.31	67
Merrimac NB hard left/left	E	62.7	0.96	m#318
Merrimac NB thru	D	43.0	0.81	m#209
Merrimac NB right (de facto)	B	13.1	0.67	m111
Merrimac SB left (de facto)	F	151.9	1.18	#337
Merrimac SB thru | thru/right	A	36.1	0.58	114
Summer Street/Dorchester Avenue	**C**	**28.1**		
Summer EB left/thru | thru/right	C	34.6	0.69	#193
Summer WB left/thru | thru/right	B	17.5	0.69	225
Dorchester NB left/thru/right	B	18.2	0.33	39
Dorchester SB left	E	58.0	0.91	#332
Dorchester SB thru/right	A	2.9	0.28	27
Summer Street/Melcher Street	**C**	**20.4**		
Summer EB thru | thru/right	B	10.7	0.51	m198
Summer WB left/thru | thru	B	17.1	0.40	216
Melcher NB left/right	D	51.1	0.81	238

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Summer Street/Pump House Road	**B**	**15.2**		
Summer EB left/thru | thru	A	5.9	0.39	130
Summer WB thru | thru | thru/right	A	9.9	0.28	136
Driveway NB left/thru/right	A	0.0	0.00	0
Pump House SB left	D	50.0	0.69	145
Pump House SB left/right	D	39.9	0.64	131
Massport Haul Road/Pump Station Connector	**B**	**12.7**		
Haul EB thru	B	13.4	0.06	29
Haul EB right	A	3.2	0.25	48
Haul WB left	A	6.6	0.11	47
Haul WB thru	A	6.6	0.16	90
Pump Station NB left | left/right	C	29.1	0.45	41
Summer Street/D Street	**C**	**23.9**		
Summer EB left	D	31.2	0.69	238
Summer EB thru | thru/right	C	20.5	0.45	223
Summer WB left/thru | thru	C	27.8	0.60	51
Summer WB right	A	8.1	0.25	33
D Street NB left	D	37.6	0.36	85
D Street NB thru | thru/right	C	34.2	0.34	98
D Street SB left	C	30.9	0.68	m192
D Street SB thru | thru/right	B	17.0	0.67	135
Ramp DB (I-90 WB On Ramp)/D Street	**B**	**14.4**		
D Street NB left	D	50.3	0.72	237
D Street NB thru | thru	A	0.8	0.16	49
D Street SB thru | thru/right	B	10.9	0.52	216
Transitway/D Street	**A**	**7.9**		
Transitway EB thru	D	50.0	0.38	43
Transitway WB thru	D	51.7	0.43	51
D Street NB thru | thru | thru/right	B	10.5	0.19	63
D Street SB thru | thru	A	2.9	0.38	68
Congress Street/D Street	**D**	**38.9**		
Congress EB left/thru | thru/right	C	29.7	0.47	95
Congress EB right	B	19.0	0.53	m194
Congress WB left/thru | thru/right	D	50.3	0.76	102
D Street NB left	D	50.6	0.75	197
D Street NB left/thru | thru/right	C	36.5	0.63	125
D Street SB left/thru | thru/right	D	47.7	0.82	244
Congress Street/B Street/Ramps D&F	**C**	**29.5**		
Congress EB left/thru | thru	D	43.2	0.73	193
Congress EB right	B	11.0	0.46	m31
Congress WB left	C	29.0	0.60	218
Congress WB left/thru | thru/right	C	23.3	0.51	170
Ramp NB left	E	68.5	0.76	#161
Ramp NB thru	C	25.4	0.19	65
Ramp NB right	A	5.5	0.46	31
B Street SB thru | thru	D	41.7	0.60	135
B Street SB right	C	21.8	0.25	50

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/East Service Road/Ramps I&C	**C**	**22.8**		
Congress EB left	A	5.9	0.07	m9
Congress EB thru | thru	A	6.0	0.19	M46
Congress WB thru | thru	B	13.4	0.17	m94
Congress WB right	A	8.2	0.04	m8
Ramp I NB left/thru | thru	D	44.0	0.33	51
Ramp I NB right	B	13.8	0.49	35
Ramp C NEB thru | thru/right	D	44.9	0.70	117
Congress Street/Boston Wharf Road	**C**	**22.1**		
Congress EB left/thru	C	20.4	0.42	m152
Congress EB right	A	4.9	0.35	m45
Congress WB left	B	10.5	0.31	19
Congress WB thru | thru/right	A	6.0	0.20	m28
Boston Wharf NB left	D	46.8	0.29	56
Boston Wharf NB thru/right	C	28.5	0.19	14
Boston Wharf SB left/thru	D	52.7	0.88	257
Boston Wharf SB right	A	4.6	0.20	16
Seaport Boulevard (Northern Avenue)/ B Street	**C**	**20.9**		
Seaport EB thru | thru/right	B	13.9	0.63	152
Seaport WB left/thru | thru	B	19.0	0.57	179
B Street NB left | left	D	49.3	0.73	129
B Street NB right	B	12.1	0.46	m49
Seaport Boulevard/Northern Avenue/East Service Road	**C**	**26.3**		
Seaport EB left	B	16.6	0.27	38
Seaport EB thru | thru	B	15.7	0.50	178
Seaport WB thru | thru/right	C	22.7	0.70	#405
East Service NB left	E	55.7	0.67	143
East Service NB thru	D	38.1	0.11	m15
East Service NB right	C	21.8	0.59	33
Northern SB left	D	49.1	0.63	158
Northern SB left/right	D	36.6	0.57	142
Seaport Boulevard/Sleeper Street	**B**	**19.3**		
Seaport EB left/thru | thru	C	23.0	0.46	m176
Seaport EB right	B	11.1	0.11	m39
Seaport WB left	A	7.6	0.01	m4
Seaport WB thru | thru/right	A	11.2	0.36	236
Sleeper NB left/thru/right	D	54.5	0.76	94
Sleeper SB left/thru	C	34.3	0.31	55
Sleeper SB right	B	12.8	0.56	73
Congress Street/Dorchester Avenue	**C**	**26.1**		
Congress EB thru	C	22.0	0.39	159
Congress EB right	A	7.5	0.44	m88
Congress WB left/thru	C	27.6	0.62	201
Dorchester NB left/right	D	52.2	0.89	#292

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Congress Street/A Street	**D**	**42.7**		
Congress EB left/thru | thru	D	51.8	0.85	m#356
Congress EB right	A	5.0	0.26	m47
Congress WB left	D	48.4	0.86	#286
Congress WB thru/right	B	13.8	0.28	112
A Street NB left/thru/right	E	64.9	0.95	83
Thompson SB left/thru/right	C	30.3	0.23	32
Summer Street/West Side Drive	**A**	**6.1**		
Summer EB thru | thru/right	A	6.1	0.41	32
Summer WB left	A	5.1	0.09	4
Summer WB thru | thru	A	3.5	0.20	34
West Side NB left	D	41.8	0.11	30
West Side NB right	B	15.4	0.24	11
Summer Street/WTC Avenue	**A**	**7.6**		
Summer EB left	A	2.5	0.06	4
Summer EB thru | thru	A	2.9	0.34	36
Summer EB right	A	0.4	0.16	0
Summer WB left	A	6.8	0.24	m26
Summer WB thru | thru/right	A	10.5	0.21	130
WTC NB left	D	46.5	0.31	49
WTC NB thru/right	A	0.3	0.10	0
WTC SB left	D	46.9	0.30	43
WTC SB thru/right	B	19.6	0.14	0
Seaport Boulevard/Boston Wharf Road	**B**	**14.7**		
Seaport EB thru | thru/right	B	19.4	0.36	182
Seaport WB left	A	5.5	0.19	m29
Seaport WB thru| thru	A	5.1	0.37	95
Boston Wharf NB left | left/right	D	44.4	0.53	88
SSCONN/Albany Street	**A**	**7.4**		
SSCONN WB left | left	E	57.4	0.46	52
Albany SB left/thru | thru | thru	A	3.0	0.44	92
Broadway Bridge/Frontage Road	**D**	**42.6**		
Traveler EB hard left	D	51.7	0.34	54
Traveler EB left	F	92.6	0.48	m144
Traveler EB thru | thru	A	9.7	0.38	72
Broadway WB right	C	21.2	0.08	43
Broadway WB hard right (de facto)	E	75.1	1.01	#578
Frontage NB thru | thru	C	25.3	0.04	m11
Frontage NB right | right | right/hard right	D	40.3	0.84	217
Bennington Street/Neptune Road	**D**	**35.9**		
Bennington EB left/thru | thru/right	D	39.5	0.19	56
Bennington WB left/thru | thru/right	C	31.9	0.83	m80
Neptune NB left/thru | thru/right	D	53.2	0.91	#466
Neptune SB left/thru | thru/right	B	19.7	0.55	237

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
SSCONN/Ramps K&X	**B**	**14.3**		
SSCONN EB left/thru	D	50.5	0.25	32
SSCONN EB right	B	18.6	0.55	119
SSCONN WB left	E	60.9	0.49	36
SSCONN WB thru/right	C	30.4	0.54	55
Ramp NB left/thru | thru/right	A	8.5	0.24	119
Ramp SB left	A	1.6	0.02	m1
Ramp SB left/thru | thru/right	A	0.7	0.10	m4
East Berkeley Street/Albany Street	**B**	**17.8**		
East Berkeley WB left/thru | thru | thru	B	14.0	0.46	m86
Albany SB thru | thru | thru/right	C	22.7	0.52	214
West 4th Street/Frontage Road	**C**	**32.3**		
West 4th WB thru | thru | thru/right	D	52.3	0.92	#363
Frontage NB left	B	19.6	0.62	#548
Frontage NB thru | thru/right	B	17.3	0.62	356
Traveler Street/Albany Street	**B**	**16.1**		
Traveler EB thru/right	D	52.3	0.78	241
Albany SB left	A	4.9	0.58	149
Albany SB left/thru | thru/right	B	11.8	0.48	292
Herald Street/Albany Street	**C**	**22.7**		
Herald EB right | right | right	B	13.6	0.53	184
Albany SB thru | thru | thru	C	29.2	0.83	224
MBTA Bus Lot (near Randolph)/Albany Street	**F**	**99.4**		
MBTA EB thru/right	D	38.6	0.09	12
Albany SB left	B	14.2	0.37	73
Albany SB left/bear left | bear left	C	31.4	0.36	158
Albany SB thru/right	A	7.9	0.39	262
Albany NB right | right	F	197.8	0.92	380
Ramp A2/Ramp I/Frontage Road	**C**	**29.3**		
Frontage SB thru	C	33.1	0.51	211
Frontage SB right	C	27.5	0.12	60
Ramp SWB left/thru | thru	C	28.7	0.93	470
Nashua Street/Martha Road	**A**	**8.8**		
Nashua WB left | left	A	8.6	0.43	54
Martha SB thru | thru	A	8.9	0.48	105
Chelsea Street/Rutherford Avenue/N. Washington Street	**C**	**25.5**		
Chelsea WB left	E	65.0	0.98	#692
Chelsea WB thru	C	29.3	0.56	322
Chelsea WB right	A	4.0	0.27	30
N. Washington NB thru | thru | thru	D	42.5	0.42	115
N. Washington NB right	B	11.8	0.77	126
Rutherford SB left	E	66.8	0.95	#386
Rutherford SB thru | thru | thru	A	6.4	0.62	89
Rutherford SB right	A	5.3	0.67	m34

Table 10. (cont.) Phase 1 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
LT-TL/Rutherford Avenue	**C**	**32.9**		
Ramp EB left | left	D	41.0	0.58	198
Ramp EB right | right	D	53.5	0.83	#272
Rutherford NB left	D	37.2	0.70	m118
Rutherford NB thru | thru | thru | thru	A	6.0	0.11	m23
Rutherford SB thru | thru | thru | thru	C	34.0	0.76	429
Rutherford SB right	A	7.3	0.26	112
Albany Street/Frontage Road	**C**	**23.1**		
Albany EB left | left	C	20.6	0.62	m55
Albany EB thru	B	11.5	0.06	m7
Albany WB right	B	17.7	0.45	35
Frontage NB thru | thru | thru/right	C	25.0	0.63	361
Neptune Road/Route 1A Off-ramp	**D**	**37.3**		
Neptune EB left/thru | thru	A	4.9	0.04	m8
Neptune WB thru | thru/right	B	16.2	0.63	123
Off-Ramp NB left	E	65.8	0.92	456
Off-Ramp NB thru/right	D	43.3	0.69	328

# = 95th percentile volume exceeds capacity. Queue may be longer. Queue shown is the maximum after two cycles.
m = 95th percentile queue is metered by upstream traffic signal.
* 25-foot left-turn pocket added during calibration process.

During the morning peak period, 33 of the 81 intersections have an improved overall LOS under Phase 1 conditions. Some of the intersections have an LOS that is worse than the Existing conditions due to the increase in vehicle and pedestrian clearance times. Of the 8 locations that are expected to get worse, only 1 has a failing LOS.

Under mid-day Phase 1 conditions, 25 of the 81 intersections have an improved LOS. 7 intersections get worse; however, none of these locations are failing.

During the evening peak hour, 21 intersections show an improvement in LOS. 7 intersections get worse; however, none of these locations are failing.

Phase 2 Improvements

Improvements identified in Phase 2 consisted of those that had to be made at the controller and any changes that may affect the approach geometry. These include changes to ***pavement markings and signage, pedestrian phases, protected turn phases,*** and ***parking regulations.***

Pavement Marking & Signage Improvements

HSH recommends updating some of the existing signage and pavement markings at some of the study area locations. These improvements will help clarify restrictions as well as provide advanced warning of lane usage.

Seaport Boulevard/Atlantic Avenue

On the northbound Atlantic Avenue approach at Seaport Boulevard/Atlantic Avenue, there are three travel lanes with 4 different directions in which to proceed: left onto Oliver Street, bear left onto I-93 NB, through to continue onto Atlantic Avenue, and right onto Seaport Boulevard. For this approach, there is much driver confusion regarding which lane to use for their specific destination. After doing field observations, the lanes normally act as a shared left/bear left lane, a shared bear left/through lane, and a shared through/right-turn lane. HSH recommends striping the northbound lanes with arrow markings as well as dashed guide lines. A lane use sign is also suggested to give drivers advanced warning.

Photo 1. Atlantic Avenue looking north at Seaport Boulevard/Atlantic Avenue

Essex Street/Lincoln Street/SASB

There are three approaches to the intersection Essex Street/Lincoln Street/Surface Artery Southbound (SASB), and three departure legs, making this intersection geometry confusing for drivers. The eastbound Essex Street approach also lacks clear and accurate pavement markings and signage: the existing overhead guide sign directs drivers heading to Interstate 93 South to use the right lane, but channelized pavement markings seemingly direct traffic in the right lane onto SASB instead. Based upon traffic volume data collected, HSH recommends updating the guide sign on the eastbound approach to direct drivers in the left lane to Interstate 93 North and Lincoln Street, drivers in the center lane to Essex Street, South Station, and Interstate 93 South, and drivers in the right lane to SASB and Interstate 90. Pavement markings directing vehicles to the interstate highway system could also be added to further guide drivers.

Photo 2. Essex Street looking east at Essex Street/Lincoln Street/SASB

A No Left Turn sign is located at the stop line on Essex Street that presumably is there to stop vehicles from turning onto SASB, heading the wrong-way on a one-way street, but also legally prohibits vehicles from turning left onto Lincoln Street. A concurrent pedestrian phase across the northern leg of Lincoln Street also exists during the Essex Street phase. Over 70 vehicles per hour still make this safe, but illegal, turn during both the morning and mid-day peak hours. HSH recommends removing the No Left Turn sign on this approach and relocating the Do Not Enter sign on the north side of SASB from the existing street light to the existing signal post, where it will be closer to the intersection and more visible to approaching vehicles. In order to increase pedestrian safety, the concurrent pedestrian phase across Lincoln Street could also be moved so that it operates concurrently with SASB where fewer vehicle and pedestrian conflicts would exist.

Congress Street/Purchase Street

After field observations, HSH noticed driver confusion when traveling along Purchase Street toward this intersection. On the southbound approach at Congress Street/Purchase Street, the lanes are supposed to be an exclusive hard-left lane, a shared bear left/through lane, and a through lane. Currently some vehicles in the left-most lane try to bear left onto I-93 along with those in the middle lane. However, the I-93 ramp only has 1 receiving lane causing dangerous merging situations for vehicles. In order to prevent this situation, HSH recommends adding signage with lane use diagrams prior to this approach. Pavement marking arrows and I-93 text are also suggested for the middle lane.

Photo 3. Purchase Street looking south at Congress Street/Purchase Street

Additionally, the eastbound Congress Street approach to this intersection could benefit from new pavement markings that instruct drivers in the right-most lane to only turn onto Purchase Street and drivers looking to turn onto I-93 South use the second lane from the right.

Photo 4. Congress Street looking east at Congress Street/Purchase Street

Valenti Way/North Washington Street

The northbound North Washington Street approach currently consists of a shared left-turn/through lane and a shared through/right-turn lane. During the morning and evening peak hours, the left-most lane at this approach acts as a de facto left-turn lane due the high volumes turning left onto Valenti Way from North Washington Street. Since the existing cross-section is wide enough to accommodate an additional lane without dropping the parking lane or a southbound lane, HSH recommends that this approach be re-striped to consist of an exclusive left-turn lane, a through lane, and a shared through/right-turn lane.

Photo 5. North Washington Street looking north at Valenti Way/North Washington Street

Seaport Boulevard/B Street

At Seaport Boulevard/B Street, the eastbound approach is currently striped as a through lane and an exclusive right-turn lane. The right turn lane has a protected turn overlap during the northbound phase. Currently, vehicles traveling eastbound use both travel lanes to continue straight on Seaport Boulevard since there are two receiving lanes on the opposite side of the intersection. HSH recommends re-striping the eastbound approach as a through lane and a shared through/right-turn lane. The right-turn overlap phase and the no turn on red sign should be removed from the eastbound approach.

Photo 6. Seaport Boulevard looking east at Seaport Boulevard/B Street

Protected Turn Phases to be Removed

Using the BTD guidelines, Protected/Permissive or Split phasing is not required at some of the locations.

Congress Street/A Street

At Congress Street/A Street, the northbound and southbound approaches have split phases. Turning volumes are generally low at this intersection. However, due to the skewed geometry, HSH recommends keeping the split phasing at this location.

Summer Street/West Side Drive

At Summer Street/West Side Drive, the westbound Summer Street approach has a permissive phase and a protected phase. Left turn volumes are very low at this intersection and do not require a protected phase. HSH suggests removing the protected phase at this location. Removing the extra phase will decrease the delay for the northbound approach as well as pedestrians. It will also allow for improvement in the progression along Summer Street.

Summer Street/World Trade Center Avenue

Currently, the eastbound and westbound Summer Street approaches have leading left-turn phases at Summer Street/World Trade Center Avenue. The left-turning volumes at this location are relatively low and do not require a protected phase. Removing a phase will decrease delay and allow for improved progression along Summer Street. HSH recommends working with the Convention Center on this issue.

Seaport Boulevard/Boston Wharf Road

At Seaport Boulevard/Boston Wharf Road, the westbound Seaport Boulevard approach has a permissive phase and a protected phase. Left turn volumes are very low at this intersection and do not require a protected phase. HSH suggests removing the protected phase at this location. Removing the extra phase will decrease the delay for pedestrians and allow for improved progression along Seaport Boulevard.

Phasing Sequence Changes

New Chardon Street/Merrimac Street

At New Chardon Street/Merrimac Street, the LOS is at an E or F during the morning and evening peak hours under Existing and Phase 1 Conditions. Due to the geometry of this location and the heavy left-turn movements in the northbound and westbound directions, the intersection currently operates with 5 phases.

HSH has considered different options for improving operations at this intersection. While the volumes are low enough in the east and westbound directions to allow a protected/permissive movement, the geometry of the intersection as well as the placement of the crosswalks make it unsafe. The phasing is such that the eastbound traffic runs concurrent with the crossing of Merrimack on the south side of the intersection. This crossing is skewed to the eastbound left turns and set back far enough where pedestrians may not be seen easily if this phase were to run permissive. More importantly, although the entrance into the garage is supposed to happen from the westbound through lane, many vehicles use the protected left lane to get ahead of the eastbound traffic. Should this continue to occur during the permissive phase, this would lead to a head-on conflict.

To accommodate the heavy westbound left turn movement, allowing left turns from the middle lane is recommended to increase capacity. The lanes should be re-striped to have an exclusive left-turn lane, a shared left-turn/bear left/through lane, and a shared through/right-turn lane. To lower the number of phases at New Chardon Street/Merrimac Street, HSH suggests that all approaches operate with split phasing. The first phase will be for the northbound approach, with a concurrent crossing for the eastern crosswalk from the island to the opposite side of New Chardon Street. The second phase will be for the westbound approach, with an overlap for the northbound right turns. The third phase is for the eastbound approach, with concurrent crossings for the northern and southern crosswalks. The fourth phase is the southbound approach along with the garage exit. The southern pedestrian crossing will run concurrent with this last phase. Since the westbound phase is no longer followed by the garage movement, the 7-second clearance interval to clear the vehicles past the garage exit is not needed. However, there should be a setting into the controller to call the third phase before allowing Phase 4.

Coordinated Phase Changes

HSH examined changing the coordinated phase at locations where the side street is currently set as the coordinated phase. However, the intersections seem to benefit very little or worsened when changing the coordination. At this time, HSH does not recommend changing the coordinated phase at any of the locations.

Parking Regulations

At this time, HSH is proposing no changes to existing parking regulations within the study area.

See **Figure 2** to **Figure 4** for Existing On-street parking in the study area.

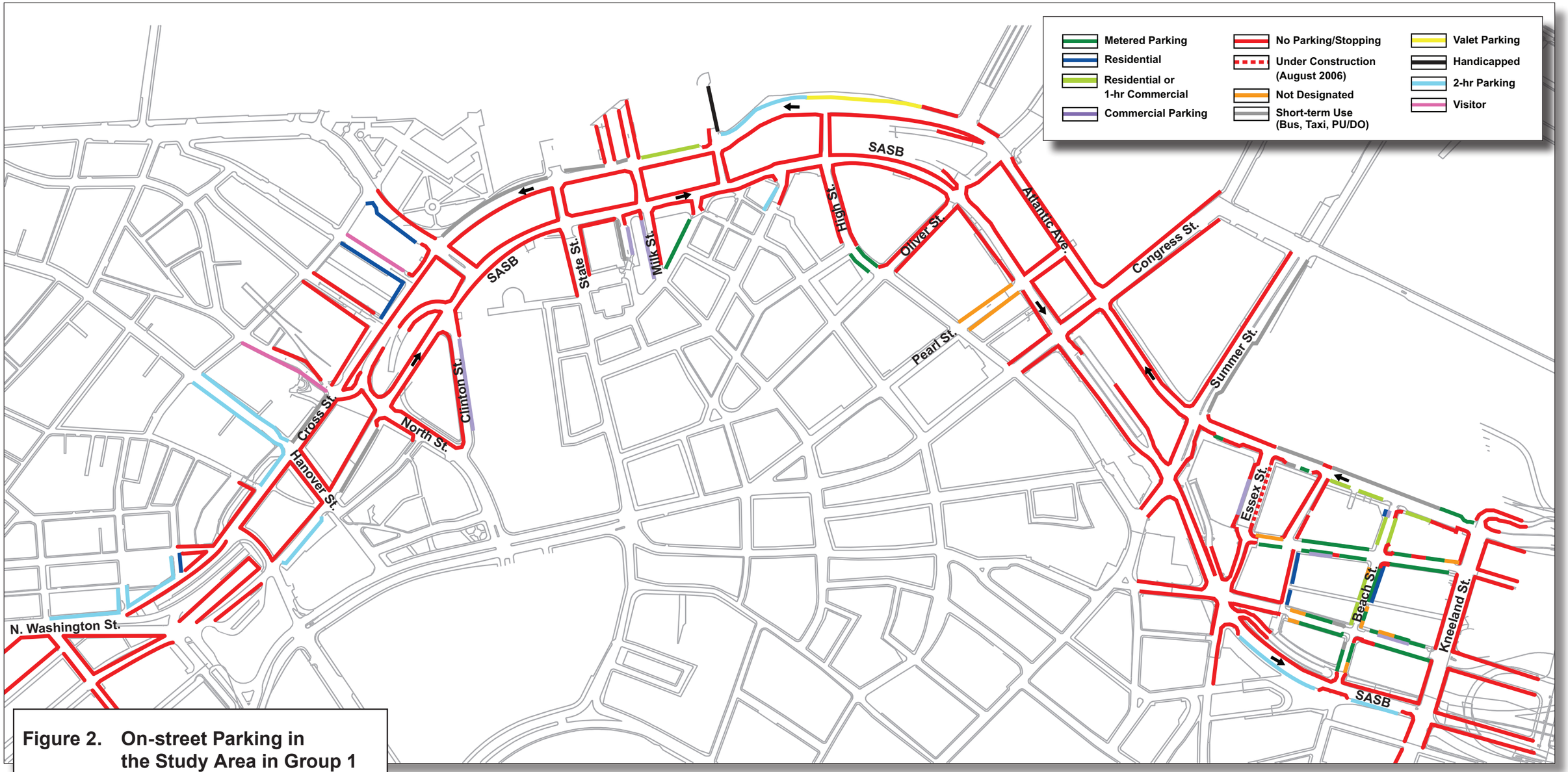
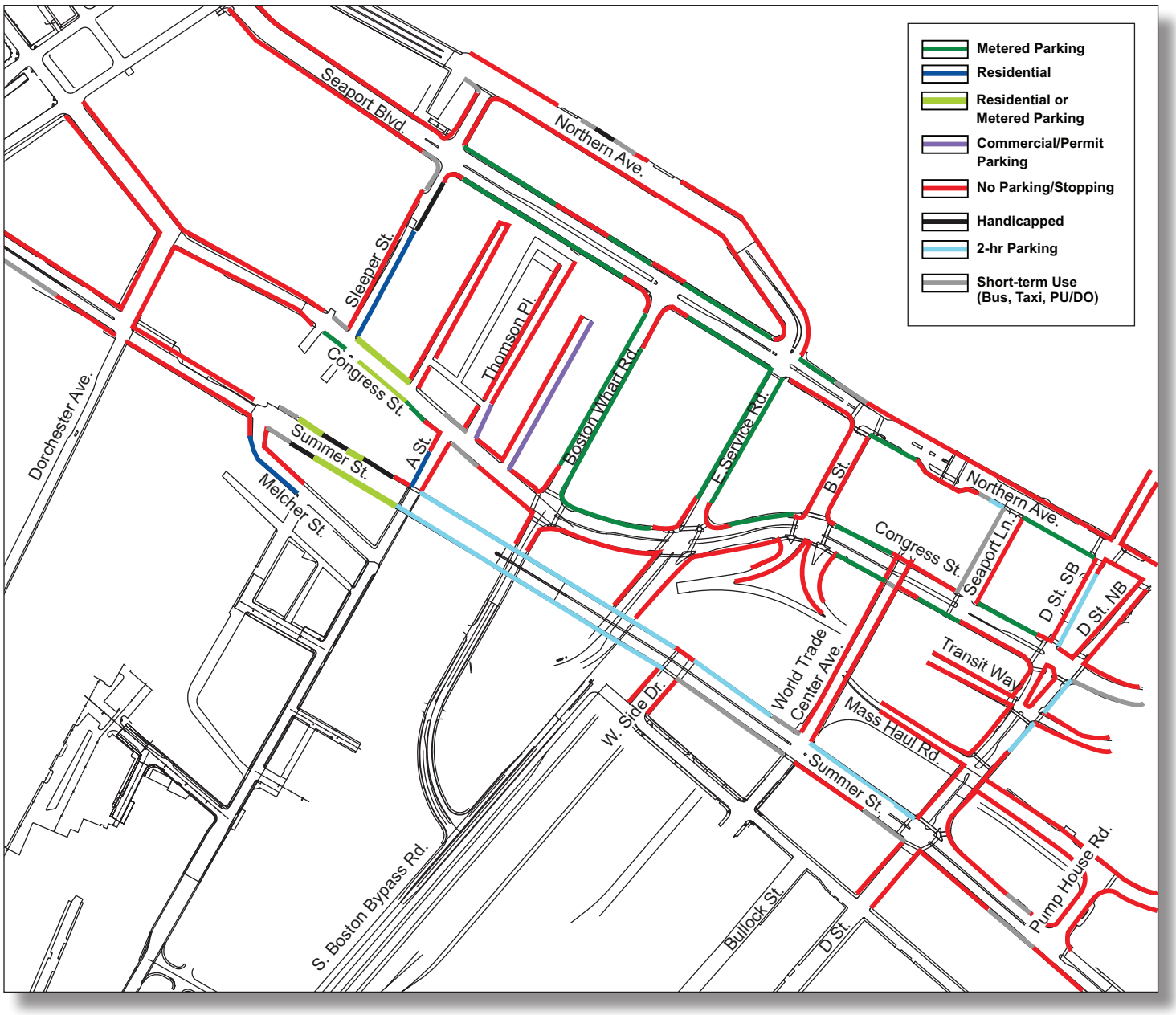


Figure 2. On-street Parking in the Study Area in Group 1

HOWARD/STEIN-HUDSON. ASSOCIATES

Not to scale.

Figure 3. On-Street Parking in the Study Area in Group 2



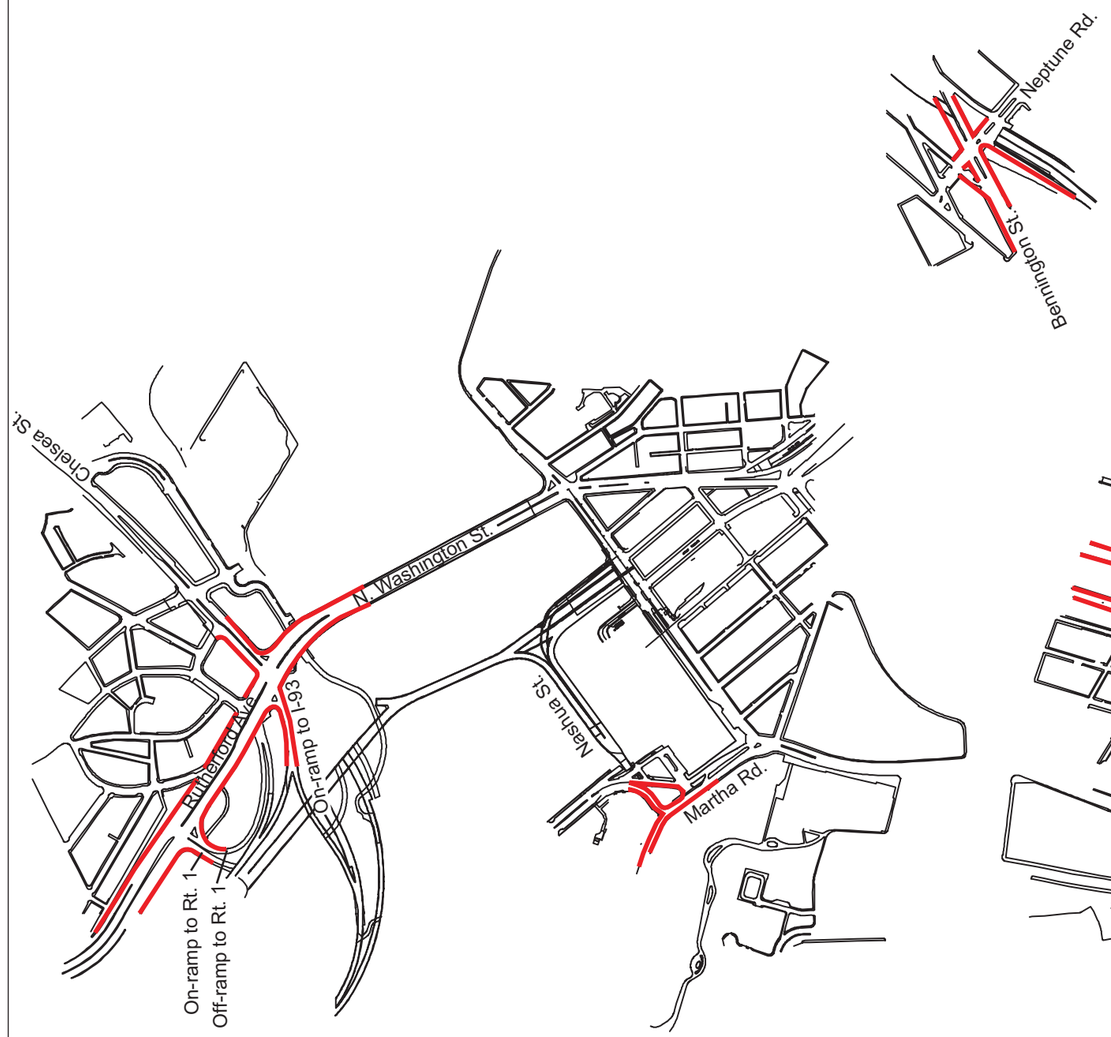
Not to scale.

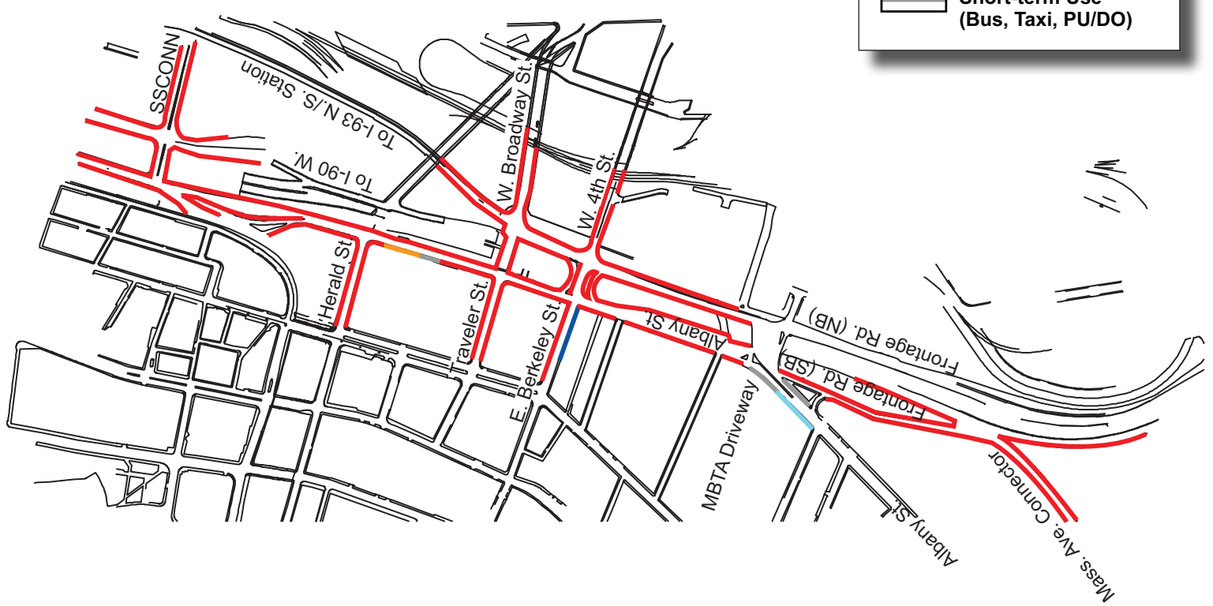
Figure 4. On-Street Parking in the Study Area in Group 3

HOWARD/STEIN-HUDSON. ASSOCIATES

Not to scale.

- Residential
- No Parking/Stopping
- Not Designated
- 2-hr Parking
- Short-term Use (Bus, Taxi, PU/DO)





Phase 2 Synchro Analysis

Table 11 through **Table 13** show the results of the Phase 2 Synchro analysis.

Table 11. Phase 2 Intersection Operations, a.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Valenti Way/North Washington Street	**B**	**15.7**		
N. Washington NB left	E	58.3	0.83	217
N. Washington NB thru | thru/right	A	5.9	0.39	96
N. Washington SB left/thru | thru | thru/right	B	11.9	0.62	256
Summer Street/West Side Drive	**A**	**4.7**		
Summer EB thru | thru/right	A	0.3	0.28	3
Summer WB left	B	11.2	0.10	15
Summer WB thru | thru	A	8.9	0.24	86
West Side NB left	D	40.2	0.02	13
West Side NB right	C	23.2	0.05	6
Summer Street/WTC Avenue	**A**	**7.6**		
Summer EB left	A	3.4	0.05	2
Summer EB thru | thru	A	3.0	0.27	19
Summer EB right	A	0.4	0.07	0
Summer WB left	A	9.3	0.15	m26
Summer WB thru | thru/right	A	8.1	0.26	78
WTC NB left	D	43.6	0.18	40
WTC NB thru/right	B	17.8	0.19	9
WTC SB left	D	45.4	0.22	37
WTC SB thru/right	A	0.0	0.02	0
Seaport Boulevard/Boston Wharf Road	**A**	**5.9**		
Seaport EB thru | thru/right	A	2.0	0.35	m57
Seaport WB left	B	10.3	0.17	m34
Seaport WB thru| thru	A	6.1	0.26	171
Boston Wharf NB left | left/right	D	46.1	0.30	33
New Chardon Street/Merrimac Street	**E**	**65.9**		
New Chardon EB left/thru | thru/right	A	6.4	0.41	6
New Chardon WB hard left	F	115.6	1.08	#321
New Chardon WB left/thru | thru/right	F	122.1	1.08	#329
Merrimac NB hard left/left	F	85.3	1.09	m#576
Merrimac NB thru | thru	C	20.0	0.46	m81
Merrimac NB right	A	4.0	0.21	m26
Merrimac SB left/thru | thru | thru/right	D	41.9	0.72	98

Table 12. Phase 2 Intersection Operations, Mid-day Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Valenti Way/North Washington Street	**B**	**12.5**		
N. Washington NB left	C	25.7	0.26	68
N. Washington NB thru | thru/right	B	10.4	0.35	142
N. Washington SB left/thru | thru | thru/right	B	12.8	0.70	208
Summer Street/West Side Drive	**A**	**8.6**		
Summer EB thru | thru/right	B	10.5	0.20	178
Summer WB left	A	4.5	0.04	6
Summer WB thru | thru	A	3.3	0.13	34
West Side NB left	D	37.0	0.11	19
West Side NB right	B	14.0	0.23	6
Summer Street/WTC Avenue	**A**	**4.7**		
Summer EB left	A	1.4	0.05	3
Summer EB thru | thru	A	1.3	0.20	8
Summer EB right	A	0.1	0.06	0
Summer WB left	A	6.6	0.09	m24
Summer WB thru | thru/right	A	4.9	0.13	54
WTC NB left	D	41.6	0.25	23
WTC NB thru/right	A	0.2	0.07	0
WTC SB left	D	39.8	0.16	31
WTC SB thru/right	A	0.1	0.03	0
Seaport Boulevard/Boston Wharf Road	**A**	**5.5**		
Seaport EB thru | thru/right	A	5.0	0.23	91
Seaport WB left	A	3.5	0.24	22
Seaport WB thru| thru	A	2.2	0.14	m34
Boston Wharf NB left | left/right	C	20.2	0.34	29
New Chardon Street/Merrimac Street	**C**	**29.3**		
New Chardon EB left/thru | thru/right	A	7.4	0.51	11
New Chardon WB hard left	F	81.9	0.90	#186
New Chardon WB left/thru | thru/right	D	46.0	0.87	#104
Merrimac NB hard left/left	C	31.2	0.80	#374
Merrimac NB thru | thru	B	15.9	0.30	66
Merrimac NB right	A	5.3	0.18	26
Merrimac SB left/thru | thru | thru/right	C	33.8	0.64	90

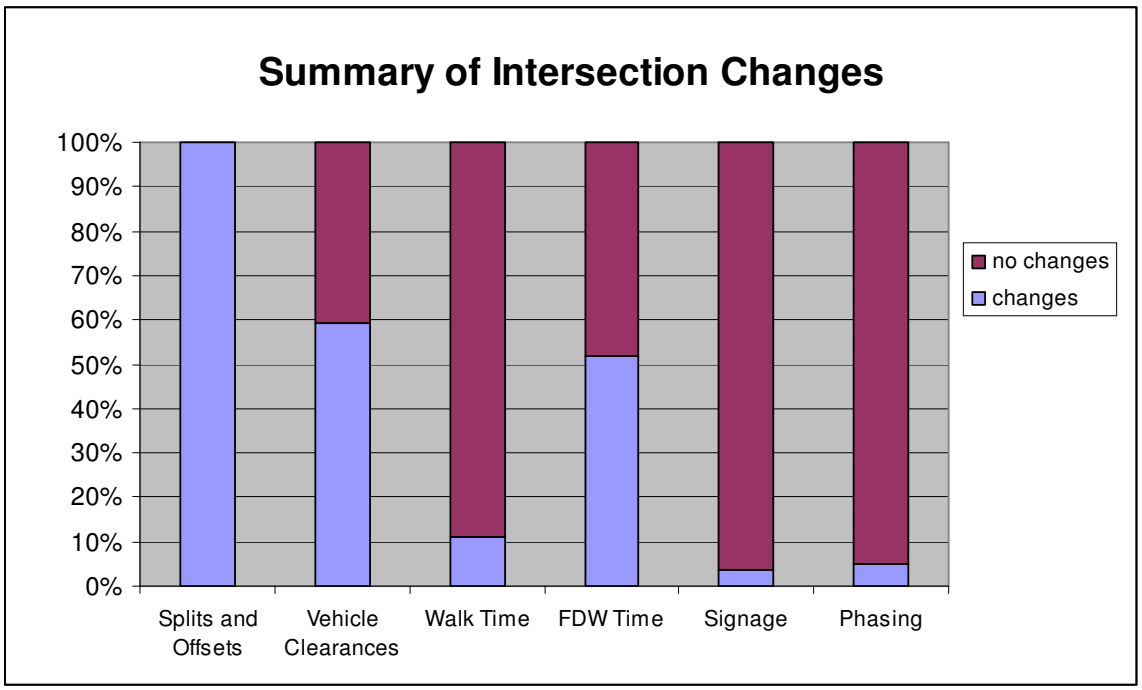
Table 13. Phase 2 Intersection Operations, p.m. Peak Hour

Intersection Approach	LOS	Delay (sec./veh.)	v/c Ratio	95% Queue Length (feet)
Valenti Way/North Washington Street	**C**	**27.5**		
N. Washington NB left	F	132.0	1.07	#353
N. Washington NB thru | thru/right	B	10.4	0.45	186
N. Washington SB left/thru | thru | thru/right	B	13.7	0.78	363
Summer Street/West Side Drive	**A**	**8.0**		
Summer EB thru | thru/right	A	8.9	0.34	291
Summer WB left	A	5.8	0.10	4
Summer WB thru | thru	A	4.0	0.20	44
West Side NB left	D	41.8	0.11	30
West Side NB right	B	15.4	0.24	11
Summer Street/WTC Avenue	**A**	**5.6**		
Summer EB left	A	1.2	0.06	2
Summer EB thru | thru	A	1.1	0.30	11
Summer EB right	A	0.3	0.14	0
Summer WB left	A	8.6	0.24	m54
Summer WB thru | thru/right	A	5.5	0.18	85
WTC NB left	D	46.6	0.31	49
WTC NB thru/right	A	0.4	0.12	0
WTC SB left	D	47.0	0.30	43
WTC SB thru/right	B	19.	0.14	0
Seaport Boulevard/Boston Wharf Road	**B**	**10.9**		
Seaport EB thru | thru/right	A	7.3	0.21	79
Seaport WB left	A	5.0	0.21	m27
Seaport WB thru| thru	A	4.0	0.37	80
Boston Wharf NB left | left/right	D	46.7	0.54	87
New Chardon Street/Merrimac Street	**E**	**60.2**		
New Chardon EB left/thru | thru/right	A	6.9	0.65	8
New Chardon WB hard left	E	67.6	0.89	#260
New Chardon WB left/thru | thru/right	D	53.6	0.90	#123
Merrimac NB hard left/left	D	50.0	0.94	m#335
Merrimac NB thru | thru	B	16.9	0.42	m72
Merrimac NB right	E	63.1	0.60	m319
Merrimac SB left (de facto)	F	209.4	0.98	#298
Merrimac SB thru | thru/right	C	30.3	0.49	107

Summary of Intersection Improvements

Of the 81 study area locations, changes have been made to all of them to improve operations. **Figure 5** shows a summary of all the changes made to improve the network.

Figure 5. Intersection Improvements



As shown in the above figure, splits and offsets were adjusted for all of the intersections. Vehicle clearances were adjusted for about 60%, walk times for 11%, FDW times for 52%, signage for 4% and phasing for 6% of the locations. A list showing the signal changes made at each intersection can be found in **Appendix E.**

Corridor Measures of Effectiveness

Synchro allows for the output of delay, fuel consumption, emissions, and other details for multiple intersections located within the same corridor. The formulas used to calculate fuel consumption are the same as the default formulas in TRANSYT-7F and the emissions formulas are based on fuel consumption rates determined by the Oak Ridge National Laboratory. Corridor Measures of Effectiveness comparisons between Existing Conditions and Phase 1 Improvements can be seen in **Table 14** through **Table 25.**

Table 14. Synchro Detailed Measures of Effectiveness Comparison Atlantic Avenue/Cross Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	127	87	-47.2%
Stops/vehicle	0.52	0.41	-21.2%
Average Speed (mph)	7	11	+57.1%
Fuel Consumed (gal.)	192	136	-29.2%
Fuel Economy (mpg)	6.4	8.9	+39.1%
CO Emissions (kg)	13.40	9.5	-29.1%
NOx Emissions (kg)	2.61	1.85	-29.1%
VOC Emissions (kg)	3.10	2.20	-29.0%
Mid-day Peak Hour			
Total Delay (hr.)	51	38	-25.5%
Stops/vehicle	0.50	0.49	-2.0%
Average Speed (mph)	11	13	+18.2%
Fuel Consumed (gal.)	104	98	-5.7%
Fuel Economy (mpg)	8.2	9.1	+11.0%
CO Emissions (kg)	7.29	6.83	-6.3%
NOx Emissions (kg)	1.42	1.33	-6.3%
VOC Emissions (kg)	1.69	1.58	-5.3%
p.m. Peak Hour			
Total Delay (hr.)	60	67	+11.7%
Stops/vehicle	0.38	0.41	+7.9%
Average Speed (mph)	12	11	-8.3%
Fuel Consumed (gal.)	131	136	+3.8%
Fuel Economy (mpg)	9.5	8.9	-6.3%
CO Emissions (kg)	9.17	9.50	+3.6%
NOx Emissions (kg)	1.78	1.84	+3.4%
VOC Emissions (kg)	2.12	2.19	+3.3%

The Phase 1 Improvements are expected to decrease delays along Atlantic Avenue/Cross Street during the morning and mid-day peak by 47.2% and 25.5%, respectively. An increase of 11.7% during the evening peak hour expected. Generally, Atlantic Avenue operates pretty well during the even peak hour. Favor in progression was given to the Purchase Street corridor in the afternoon causing a slight increase in delay on Atlantic Avenue.

Yearly savings over the Phase 1 Improvements are expected to be a decrease of 47,800 hours of delay and save over 28,900 gallons of fuel. This will also prevent over 2 tons of CO from being emitted per year.

Table 15. Synchro Detailed Measures of Effectiveness Comparison Surface Road/Purchase Street/SASB

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	168	107	-36.3%
Stops/vehicle	0.48	0.47	-2.1%
Average Speed (mph)	6	9	+50.0%
Fuel Consumed (gal.)	230	190	-17.4%
Fuel Economy (mpg)	5.2	6.8	+30.8%
CO Emissions (kg)	16.05	13.28	-17.3%
NOx Emissions (kg)	3.12	2.58	-17.3%
VOC Emissions (kg)	3.72	3.08	-17.2%
Mid-day Peak Hour			
Total Delay (hr.)	79	56	-29.1%
Stops/vehicle	0.53	0.41	-22.6%
Average Speed (mph)	9	12	+33.3%
Fuel Consumed (gal.)	145	122	-15.9%
Fuel Economy (mpg)	6.6	8.6	+30.3%
CO Emissions (kg)	10.14	8.87	-12.5%
NOx Emissions (kg)	1.97	1.73	-12.2%
VOC Emissions (kg)	2.35	2.06	-12.3%
p.m. Peak Hour			
Total Delay (hr.)	113	106	-6.2%
Stops/vehicle	0.48	0.47	-2.1%
Average Speed (mph)	8	9	+12.5%
Fuel Consumed (gal.)	198	190	-4.0%
Fuel Economy (mpg)	6.7	6.8	+1.5%
CO Emissions (kg)	13.81	13.25	-4.1%
NOx Emissions (kg)	2.69	2.58	-4.1%
VOC Emissions (kg)	3.20	3.07	-4.1%

The Phase 1 Improvements are expected to decrease by over delays along Surface Road/Purchase Street/SASB by 30% during the morning and mid-day peak hours. Phase 1 improvements are also expected to slightly decrease delay during the evening peak hour.

Phase 1 Improvements are expected to save 77,500 hours of delay yearly and save over 72,000 gallons of fuel. This will also prevent 4.5 tons of CO from being emitted per year.

Table 16. Synchro Detailed Measures of Effectiveness Comparison Kneeland Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	51	29	-43.1%
Stops/vehicle	0.88	0.73	-17.0%
Average Speed (mph)	4	6	+50%
Fuel Consumed (gal.)	60	41	-3.7%
Fuel Economy (mpg)	3.4	4.8	+41.2%
CO Emissions (kg)	4.22	2.84	-32.7%
NOx Emissions (kg)	0.82	0.55	-33.0%
VOC Emissions (kg)	0.97	0.66	-32.0%
Mid-day Peak Hour			
Total Delay (hr.)	47	23	-51.0%
Stops/vehicle	0.77	0.75	-2.6%
Average Speed (mph)	3	6	+100.0%
Fuel Consumed (gal.)	53	35	-34.0%
Fuel Economy (mpg)	3.3	5.0	+51.5%
CO Emissions (kg)	3.70	2.46	-33.5%
NOx Emissions (kg)	0.72	0.48	-33.3%
VOC Emissions (kg)	0.86	0.57	-33.7%
p.m. Peak Hour			
Total Delay (hr.)	45	29	-35.6%
Stops/vehicle	0.74	0.73	-1.4%
Average Speed (mph)	4	6	+50.0%
Fuel Consumed (gal.)	53	41	-22.6%
Fuel Economy (mpg)	3.7	4.8	+29.7%
CO Emissions (kg)	3.72	2.84	-23.7%
NOx Emissions (kg)	0.72	0.55	-23.6%
VOC Emissions (kg)	0.86	0.66	-23.3%

The Phase 1 Improvements are expected to decrease delays by over 30% along Kneeland Street during all peak hours.

Yearly savings over the Phase 1 Improvements are expected to be over 72,000 hours of delay and 54,800 gallons of fuel. This will also prevent over 4 tons of CO from being emitted per year.

Table 17. Synchro Detailed Measures of Effectiveness Comparison Congress Street/Merrimac Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	70	59	-15.7%
Stops/vehicle	0.61	0.51	-16.4%
Average Speed (mph)	6	7	+16.7%
Fuel Consumed (gal.)	98	85	-7.1%
Fuel Economy (mpg)	5.2	6.0	+15.4%
CO Emissions (kg)	6.84	5.97	-16.1%
NOx Emissions (kg)	1.33	1.16	-12.8%
VOC Emissions (kg)	1.59	1.38	-13.2%
Mid-day Peak Hour			
Total Delay (hr.)	41	33	-19.5%
Stops/vehicle	0.62	0.48	-22.6%
Average Speed (mph)	7	9	+28.6%
Fuel Consumed (gal.)	66	56	-15.2%
Fuel Economy (mpg)	6.0	7.0	+16.7%
CO Emissions (kg)	4.65	3.90	-16.1%
NOx Emissions (kg)	0.89	0.76	-14.6%
VOC Emissions (kg)	1.07	0.90	-15.9%
p.m. Peak Hour			
Total Delay (hr.)	48	59	+23.0%
Stops/vehicle	0.48	0.54	+12.5%
Average Speed (mph)	8	7	-12.5%
Fuel Consumed (gal.)	77	88	+14.3%
Fuel Economy (mpg)	6.8	5.9	-13.2%
CO Emissions (kg)	5.41	6.15	+13.7%
NOx Emissions (kg)	1.05	1.20	+14.3%
VOC Emissions (kg)	1.25	1.42	+13.6%

The Phase 1 Improvements are expected to decrease delay along the downtown section of Congress Street/Merrimac Street during the morning and mid-day peak hour. Delay is expected to increase by 23% during the evening peak hour.

Phase 1 Improvements are expected to save 20,800 hours of delay and over 26,000 gallons of fuel yearly. This will also prevent over 2 tons of CO from being emitted per year.

Table 18. Synchro Detailed Measures of Effectiveness Comparison North Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	21	32	+52.4%
Stops/vehicle	0.69	0.68	-1.5%
Average Speed (mph)	5	4	-20.0%
Fuel Consumed (gal.)	32	40	+25.0%
Fuel Economy (mpg)	4.0	3.2	-20.0%
CO Emissions (kg)	2.22	2.76	+23.9%
NOx Emissions (kg)	0.43	0.54	+25.6%
VOC Emissions (kg)	0.51	0.64	+25.5%
Mid-day Peak Hour			
Total Delay (hr.)	18	9	-50.0%
Stops/vehicle	0.78	0.62	-20.5%
Average Speed (mph)	4	8	+50.0%
Fuel Consumed (gal.)	26	17	-34.6%
Fuel Economy (mpg)	3.5	5.3	+51.4%
CO Emissions (kg)	1.82	1.21	-33.5%
NOx Emissions (kg)	0.35	0.24	-31.4%
VOC Emissions (kg)	0.42	0.28	-33.3%
p.m. Peak Hour			
Total Delay (hr.)	12	12	No Change
Stops/vehicle	0.69	0.46	-33.3%
Average Speed (mph)	6	6	No Change
Fuel Consumed (gal.)	21	18	-14.3%
Fuel Economy (mpg)	4.5	5.2	+15.6%
CO Emissions (kg)	1.43	1.26	-11.9%
NOx Emissions (kg)	0.28	0.24	-14.3%
VOC Emissions (kg)	0.33	0.29	-12.1%

The Phase 1 Improvements are expected to increase delays along North Street the morning peak hour, decrease during the mid-day peak hour, and have no change in the evening peak.

Yearly savings over the Phase 1 Improvements are expected to save 20,500 hours of delay and 22,000 gallons of fuel. This will also prevent over 1 ton of CO from being emitted per year.

Table 19. Synchro Detailed Measures of Effectiveness Comparison Summer Street (South Boston)

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	41	38	-7.3%
Stops/vehicle	0.55	0.46	-16.4%
Average Speed (mph)	14	14	No Change
Fuel Consumed (gal.)	96	90	-6.3%
Fuel Economy (mpg)	10.8	11.6	+7.4%
CO Emissions (kg)	6.72	6.33	-5.4%
NOx Emissions (kg)	1.31	1.22	-6.7%
VOC Emissions (kg)	1.56	1.46	-6.4%
Mid-day Peak Hour			
Total Delay (hr.)	25	19	-24.0%
Stops/vehicle	0.49	0.46	-6.1%
Average Speed (mph)	16	18	+12.5%
Fuel Consumed (gal.)	68	62	-8.8%
Fuel Economy (mpg)	12.1	13.2	+9.1%
CO Emissions (kg)	4.76	4.36	-8.4%
NOx Emissions (kg)	0.93	0.85	-8.6%
VOC Emissions (kg)	1.10	1.01	-8.2%
p.m. Peak Hour			
Total Delay (hr.)	30	27	-10.0%
Stops/vehicle	0.54	0.49	-9.3%
Average Speed (mph)	16	17	+6.3%
Fuel Consumed (gal.)	85	80	-5.9%
Fuel Economy (mpg)	11.9	12.6	+5.9%
CO Emissions (kg)	5.92	5.61	-5.2%
NOx Emissions (kg)	1.15	1.09	-5.2%
VOC Emissions (kg)	1.37	1.30	-5.1%

The Phase 1 Improvements are expected to decrease delays along Summer Street in South Boston during all peak hours.

Phase 1 Improvements are expected to save 17,000 hours of delay and nearly 18,500 gallons of fuel annually. This will also prevent over 1 ton of CO from being emitted per year.

Table 20. Synchro Detailed Measures of Effectiveness Comparison Congress Street (South Boston)

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	15	36	+140.0%
Stops/vehicle	0.49	0.71	+44.9%
Average Speed (mph)	15	11	-26.7%
Fuel Consumed (gal.)	38	69	+81.6%
Fuel Economy (mpg)	11.4	8.7	-23.7%
CO Emissions (kg)	2.67	4.84	+81.3%
NOx Emissions (kg)	0.52	0.94	+80.8%
VOC Emissions (kg)	0.62	1.12	+80.6%
Mid-day Peak Hour			
Total Delay (hr.)	9	16	+77.8%
Stops/vehicle	0.48	0.51	+6.3%
Average Speed (mph)	17	14	-17.6%
Fuel Consumed (gal.)	26	38	+46.1%
Fuel Economy (mpg)	12.6	11.4	-9.5%
CO Emissions (kg)	1.83	2.68	+46.4%
NOx Emissions (kg)	0.36	0.52	+44.4%
VOC Emissions (kg)	0.42	0.62	+47.6%
p.m. Peak Hour			
Total Delay (hr.)	25	27	+8.0%
Stops/vehicle	0.61	0.53	-13.1%
Average Speed (mph)	13	12	-7.7%
Fuel Consumed (gal.)	55	55	No Change
Fuel Economy (mpg)	10.1	10.1	No Change
CO Emissions (kg)	3.82	3.83	+2.6%
NOx Emissions (kg)	0.75	0.75	No Change
VOC Emissions (kg)	0.89	0.89	No Change

The Phase 1 Improvements are expected to increase delays greatly along Congress Street in the South Boston Waterfront neighborhood during the morning and mid-day peak, and increase slightly during the evening peak hour.

Table 21. Synchro Detailed Measures of Effectiveness Comparison D Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	22	17	-22.7%
Stops/vehicle	0.47	0.51	+8.5%
Average Speed (mph)	7	9	+28.6%
Fuel Consumed (gal.)	34	31	-8.8%
Fuel Economy (mpg)	6.4	6.9	+7.8%
CO Emissions (kg)	2.38	2.19	-8.0%
NOx Emissions (kg)	0.46	0.43	-6.5%
VOC Emissions (kg)	0.55	0.51	-7.3%
Mid-day Peak Hour			
Total Delay (hr.)	11	12	+9.1%
Stops/vehicle	0.43	0.49	+14.0%
Average Speed (mph)	10	10	No Change
Fuel Consumed (gal.)	21	22	+4.7%
Fuel Economy (mpg)	7.8	7.4	-5.1%
CO Emissions (kg)	1.49	1.56	+4.7%
NOx Emissions (kg)	0.29	0.30	+3.4%
VOC Emissions (kg)	0.35	0.36	+2.8%
p.m. Peak Hour			
Total Delay (hr.)	31	27	-12.9%
Stops/vehicle	0.58	0.50	-13.8%
Average Speed (mph)	7	8	+14.2%
Fuel Consumed (gal.)	51	46	-9.8%
Fuel Economy (mpg)	6.0	6.7	+11.7%
CO Emissions (kg)	3.57	3.20	-10.3%
NOx Emissions (kg)	0.70	0.62	-11.4%
VOC Emissions (kg)	0.83	0.74	-10.8%

The Phase 1 Improvements are expected to decrease delays slightly along D Street during the morning and evening peak, while increasing slighting during the mid-day peak.

Table 22. Synchro Detailed Measures of Effectiveness Comparison Seaport Boulevard

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	31	23	-25.8%
Stops/vehicle	0.55	0.50	-9.1%
Average Speed (mph)	13	15	+15.4%
Fuel Consumed (gal.)	68	59	-13.2%
Fuel Economy (mpg)	10.2	11.2	+9.8%
CO Emissions (kg)	4.75	4.12	-13.3%
NOx Emissions (kg)	0.92	0.80	-13.0%
VOC Emissions (kg)	1.10	0.95	-13.6%
Mid-day Peak Hour			
Total Delay (hr.)	17	22	+29.4%
Stops/vehicle	0.57	0.52	-8.8%
Average Speed (mph)	14	13	-7.1%
Fuel Consumed (gal.)	46	47	+2.2%
Fuel Economy (mpg)	10.4	10.0	-3.8%
CO Emissions (kg)	3.18	3.31	+4.1%
NOx Emissions (kg)	0.62	0.64	+3.2%
VOC Emissions (kg)	0.74	0.77	+4.1%
p.m. Peak Hour			
Total Delay (hr.)	23	27	+17.4%
Stops/vehicle	0.62	0.49	-20.9%
Average Speed (mph)	13	17	+30.7%
Fuel Consumed (gal.)	56	80	+42.9%
Fuel Economy (mpg)	9.7	12.6	+29.9%
CO Emissions (kg)	3.92	5.61	+43.1%
NOx Emissions (kg)	0.76	1.09	+43.4%
VOC Emissions (kg)	0.91	1.30	+42.9%

The Phase 1 Improvements are expected to decrease delays along Seaport Boulevard during the morning peak, and increase during the mid-day and evening peak hour.

With the implementation of Phase 2 improvements, Seaport Boulevard is expected to have more significant improvements in delay.

Table 23. Synchro Detailed Measures of Effectiveness Comparison Albany Street

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	23	22	-4.3%
Stops/vehicle	0.57	0.52	-8.8%
Average Speed (mph)	16	16	No Change
Fuel Consumed (gal.)	62	60	-3.2%
Fuel Economy (mpg)	11.8	12.1	+2.5%
CO Emissions (kg)	4.31	4.20	-2.6%
NOx Emissions (kg)	0.84	0.82	-2.4%
VOC Emissions (kg)	1.00	0.97	-3.0%
Mid-day Peak Hour			
Total Delay (hr.)	17	20	+17.6%
Stops/vehicle	0.52	0.57	+9.6%
Average Speed (mph)	16	15	-6.3%
Fuel Consumed (gal.)	48	55	+14.6%
Fuel Economy (mpg)	12.5	11.8	-5.6%
CO Emissions (kg)	3.38	3.82	+13.0%
NOx Emissions (kg)	0.66	0.74	+12.1%
VOC Emissions (kg)	0.78	0.88	+12.8%
p.m. Peak Hour			
Total Delay (hr.)	24	27	+4.2%
Stops/vehicle	0.51	0.56	+7.8%
Average Speed (mph)	16	15	-6.3%
Fuel Consumed (gal.)	64	69	+7.8%
Fuel Economy (mpg)	11.9	11.5	-3.4%
CO Emissions (kg)	4.51	4.86	+7.8%
NOx Emissions (kg)	0.88	0.94	+6.8%
VOC Emissions (kg)	1.02	1.13	+10.8%

The Phase 1 Improvements are expected to decrease delays slightly along Albany Street during the morning peak hour, but will increase slightly during the mid-day and evening peak hours.

Delays are expected to increase on southbound Albany Street in order to decrease delays on the side streets, including the Broadway Bridge, East Berkeley Street, and West Fourth Street. Increasing clearance times in order to improve safety is also expected to add to overall delays.

Table 24. Synchro Detailed Measures of Effectiveness Comparison Frontage Road

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	16	25	+56.3%
Stops/vehicle	0.59	0.67	+13.6%
Average Speed (mph)	14	11	-21.4%
Fuel Consumed (gal.)	40	48	+20.0%
Fuel Economy (mpg)	10.4	8.7	-16.3%
CO Emissions (kg)	2.79	3.34	+19.7%
NOx Emissions (kg)	0.54	0.65	+20.4%
VOC Emissions (kg)	0.65	0.77	+18.5%
Mid-day Peak Hour			
Total Delay (hr.)	12	14	+16.7%
Stops/vehicle	0.62	0.58	-6.5%
Average Speed (mph)	15	14	-6.7%
Fuel Consumed (gal.)	31	33	+6.5%
Fuel Economy (mpg)	10.7	10.7	No Change
CO Emissions (kg)	2.14	2.33	+8.9%
NOx Emissions (kg)	0.42	0.45	+7.1%
VOC Emissions (kg)	0.50	0.54	+7.4%
p.m. Peak Hour			
Total Delay (hr.)	15	23	+43.7%
Stops/vehicle	0.60	0.66	+10.0%
Average Speed (mph)	14	11	-21.4%
Fuel Consumed (gal.)	35	45	+28.6%
Fuel Economy (mpg)	10.5	8.9	-15.2%
CO Emissions (kg)	2.47	3.15	+27.5%
NOx Emissions (kg)	0.48	0.61	+27.1%
VOC Emissions (kg)	0.57	0.73	+28.1%

The Phase 1 Improvements are expected to increase delays along Frontage Road during all peak hours.

Delays are expected to increase on northbound Frontage Road in order to decrease delays on the side streets, including the Broadway Bridge, East Berkeley Street, and West Fourth Street. Increasing clearance times in order to improve safety is also expected to add to overall delays.

Table 25. Synchro Detailed Measures of Effectiveness Comparison North Washington Street/Rutherford Avenue

	Existing	Phase 1	
			% Change from Existing
a.m. Peak Hour			
Total Delay (hr.)	32	29	-9.4%
Stops/vehicle	0.45	0.47	+4.4%
Average Speed (mph)	14	14	No Change
Fuel Consumed (gal.)	70	68	-2.9%
Fuel Economy (mpg)	11.2	11.4	+1.8%
CO Emissions (kg)	4.87	4.78	-1.8%
NOx Emissions (kg)	0.95	0.93	-2.1%
VOC Emissions (kg)	1.13	1.11	-1.8%
Mid-day Peak Hour			
Total Delay (hr.)	34	24	-29.4%
Stops/vehicle	0.48	0.48	No Change
Average Speed (mph)	12	14	+14.3%
Fuel Consumed (gal.)	63	56	-11.1%
Fuel Economy (mpg)	10.0	11.2	+12.0%
CO Emissions (kg)	4.43	3.94	-11.1%
NOx Emissions (kg)	0.86	0.77	-10.4%
VOC Emissions (kg)	1.03	0.91	-11.7%
p.m. Peak Hour			
Total Delay (hr.)	51	34	-33.3%
Stops/vehicle	0.54	0.50	-7.4%
Average Speed (mph)	11	13	+18.2%
Fuel Consumed (gal.)	94	73	-22.3%
Fuel Economy (mpg)	9.5	10.7	+12.6%
CO Emissions (kg)	6.57	5.10	-22.4%
NOx Emissions (kg)	1.28	0.99	-22.7%
VOC Emissions (kg)	1.52	1.18	-22.4%

The Phase 1 Improvements are expected to decrease delays along North Washington Street/Rutherford Avenue during all peak hours.

Yearly savings over the Phase 1 Improvements are expected to decrease by almost 32,000 hours of delay and 25,000 gallons of fuel. This will also prevent over 2 tons of CO from being emitted per year.