BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

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TECHNICAL MEMORANDUM

DATE: **May 6, 2021**

TO: **Chris Cassani, Director of Traffic, Parking, Alarm and Lighting, City of Quincy**

FROM: **Chen-Yuan Wang and Mark Abbott, Boston Region Metropolitan Planning Organization Staff**

RE: **Safety and Operations Analyses at Selected Intersections, FFY 2020—Adams Street at Furnace Brook Parkway and Common Street in Quincy**

This memorandum summarizes safety and operations analyses for the intersections of Adams Street at Furnace Brook Parkway and at Common Street in Quincy and proposes improvement strategies for this location. The two intersections were selected for this federal fiscal year 2020 study through a comprehensive review of 30 potential locations in the region.[1]

The memorandum contains the following sections:

1. Study Background
2. Existing Intersection Conditions
3. Issues and Concerns
4. Crash Data Analysis
5. Existing Conditions Analysis
6. Proposed Short-Term Improvements
7. Long-Term Improvement Alternatives
8. Recommendations

In addition, the memorandum includes technical appendices that contain supporting data and methods applied in the study.

1 STUDY BACKGROUND

The purpose of the "Safety and Operations Analyses at Selected Intersections" study is to examine safety, operations, and mobility issues at major intersections

[1] Details of the selection process and criteria may be found in the Central Transportation Planning Staff's (CTPS) technical memorandum, "Safety and Operation at Selected Intersections: Federal Fiscal Year 2020," Chen-Yuan Wang November 7, 2019.

Civil Rights, nondiscrimination, and accessibility information is on the last page.

in the Boston Region Metropolitan Planning Organization's (MPO) planning area, particularly on arterial highways where many crashes occur, congestion during peak traffic periods may be heavy, or improvements for bus, bicycle, and pedestrian travel are needed.

For more than 10 years, the MPO has been conducting these planning studies with municipalities in the region. The communities find the studies beneficial, as they provide an opportunity to begin looking at the needs of problematic locations at the conceptual level before municipalities commit funds for design and engineering. Eventually, if the project qualifies for federal funds, the study's documentation will also be useful to the Massachusetts Department of Transportation (MassDOT) and its project-development process.

These studies support the MPO's visions and goals, which include increasing transportation safety, maintaining the transportation system, advancing mobility, and reducing congestion.

2 EXISTING CONDITIONS

The study location is in West Quincy, about one mile from the city center. The two intersections, Adams Street at Furnace Brook Parkway and at Common Street, are located closely within 150 feet. The intersection of Adams Street and Furnace Brook Parkway was first identified as a high crash location with pedestrian safety concerns. Further review indicates that the intersection of Adams Street and Common Street also has a high crash rate. The safety and operations of the two intersections are highly correlated and must be analyzed together.

The adjacent land uses are primarily residential with commercial developments concentrated on the south side of Adams Street west of Furnace Brook Parkway. The residential developments are mostly single family homes, with a number of multi-family condos and apartments located near the two intersections. The commercial developments include Walgreens, In Sync Center of the Arts, Unchained Pizza, and Dunkin' Donuts in Adams Plaza, and TD Bank and Enterprise Rent-A-Car on the street front. A primary school, Charles A. Bernazzani Elementary School, is located on Furnace Brook Parkway about 500 feet east of Adams Street. Figure 1 shows the location of the intersection, existing street layouts, and major developments in the study area.

Adams Street is a principal arterial under the city's jurisdiction. From Quincy Center, it heads northwest through West Quincy, across Interstate 93, through East Milton, and connects Dorchester Avenue in the Dorchester neighborhood of Boston. It is a two-lane roadway (one lane in each direction) that carries local

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Figure 1
Study Area Map
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis
at Selected MPO Intersections

and regional traffic. Traffic is busy during the AM and PM peak periods. The section of Adams Street in the study area has a speed limit of 30 miles per hour (mph) in both directions.

Furnace Brook Parkway is a historical parkway owned and maintained by the Massachusetts Department of Conservation and Recreation (DCR). The parkway was built to connect Blue Hill Reservation and Quincy Shore Reservation as part of the parks network in the areas surrounding Boston in early 1990s. Following the courses of Furnace Brook and Blacks Creek, it meanders through the city from southwest to northeast. Today it also serves the homes and local businesses in the adjacent areas and is classified as an urban minor arterial.

Similar to Adams Street, the two-lane parkway carries busy local and regional traffic during the AM and PM peak periods. Trucks are prohibited on the parkway. Based on observations, most sections of Furnace Brook Parkway in the vicinity have a 30 mph speed limit, except the section from Brae Road to Bernazani Primary School (20 mph speed limit) and the winding section east of the school (25 mph speed limit).

The intersection of Adams Street at Furnace Brook Parkway is signalized. The signal operates in a simple three-phase mode—one for Adams Street traffic, one for Furnace Brook Parkway traffic, and one exclusively for pedestrian crossings. Both Adams Street approaches widen to accommodate turning movements. The westbound approach expands from a single lane to include an exclusive left-turn lane and two through lanes (one is a short section between the right-turn channel of the approach and the stop line). The eastbound approach expands to two lanes, one for left-turn and through movements and one for through and right-turn movements. On Furnace Brook Parkway, the southbound approach maintains a single lane for all movements, and the northbound approach flares slightly to allow traffic forming two lanes near the stop line, one for left-turn and one for through and right-turn movements.

All the right turns at the intersection are channelized, except the southbound approach. Right turns from Adams Street westbound are under a traffic signal control that is synchronized with the east-west signal phase. Both the right turns from Adams Street are under No Turn on Red (NTOR) regulation during 7:00–8:00 AM, 11:00 AM–12:00 PM, and 2:00–3:00 PM on school days. On Furnace Brook Parkway, right turns are under Yield control for the northbound approach and no separate control for the southbound approach, with right turns on red are allowed.

Crosswalks exist on all approaches of the intersection, next to the stop lines and across the right-turn channels. Pedestrian signals and push buttons are located

near the intersection on the three channelized islands and at the northeast street corner. The signals display the conventional walking person (symbolizing walk) and upraised hand (symbolizing stop), with no count-down or accessible (audible) functions. During the primary school opening and closing hours, there is a school crossing guard to actuate pedestrian signals and assist students crossing the intersection.

Common Street is owned by the city and classified as a major connector. The two-lane roadway is about a mile long, running parallel to Furnace Brook Parkway from Central Street (near Interstate 93) northerly to end at Adams Street. People often use it as a short cut to bypass Furnace Brook Parkway, especially during the AM and PM peak periods when the parkway is congested.

The intersection of Adams Street at Common Street is unsignalized, with the Common Street approach under stop control. In addition to right- and left-turns to Adams Street, through movements from Common Street are allowed to cross Adams Street and continue on the parkway northbound via the channelized right-turn lane on Adams Street. At the intersection, Common Street maintains a single lane for all movements. During the peak hours when the Adams Street traffic is busy, there are usually 10 to 20 vehicles queuing on Common Street. In this situation, drivers scramble to find gaps in traffic on Adams Street and tend to drive aggressively.

On Adams Street, the westbound approach widens to include an exclusive left-turn lane and a through and right-turn shared lane. The eastbound approach has two lanes continuing from Furnace Brook Parkway to this intersection. After the intersection, it gradually tapers down to one lane.

There is a crosswalk on Common Street and no crosswalks on Adams Street. Adams Street at this intersection is wide and difficult for pedestrians to cross. In principal, pedestrians are encouraged to use crosswalks at the Furnace Brook Parkway intersection.

The most congested part of this study location is the short section of Adams Street westbound between Common Street and Furnace Brook Parkway. During peak hours, heavy traffic from Adams Street westbound and the northbound through traffic from Common Street frequently jams in this section, which is less than 100 feet long. A “Do Not Block” hatched box pavement marking exists on Adams Street westbound at the Common Street intersection. It appears to have little effect to prevent blockage by drivers who jockey for position to pass the parkway intersection.

On-street parking is allowed on both sides of Adams Street east of Common Street. The section of Adams Street remains relatively wide with a 13-foot travel lane in each direction and ten-foot shoulders on both sides. No specific parking prohibition signs are posted, except the prohibition of parking during snow emergencies (Adams Street is a designated emergency arterial). Field observations indicate that one or two vehicles occasionally park very close to the Common Street intersection, which impedes the intersection operations, especially during the peak hours.

Massachusetts Bay Transportation Authority (MBTA) local bus Route 245 (Quincy Center Station—Mattapan Station) runs along Adams Street and Common Street. It serves the area, with stops at Adams Plaza and adjacent neighborhoods. There are no stops at the two intersections. The nearest bus stop is located on Common Street about 200 feet south of Adams Street at the corner of Hilltop Street.

Sidewalks exist on both sides of all the roadways approaching the two intersections, except a short section of about 200 feet on the west side of Furnace Brook Parkway (from the Enterprise Rent-A-Car driveway to the adjacent apartment). With the dense residential and commercial developments and the nearby primary school, there are intensive pedestrian activities when traffic conditions are busy, especially during the AM and PM peak periods.

No dedicated bicycle accommodations exist on the roadways approaching the intersections. Five-foot or more shoulders exist in limited sections of Adams Street but they are frequently disrupted by on-street parking. Five-foot shoulders exist in some sections of Furnace Brook Parkway. With trucks prohibited, the parkway is popular with commuter and recreational cyclists.

3 ISSUES AND CONCERNS

Based on MPO staff's field observations, discussions with the city officers, and analyses of crash data and existing operations, major issues and concerns at the intersection include the following:

- High crash location
  The intersection of Adams Street at Furnace Brook Parkway is a HSIP-eligible high crash location.[2] The intersection had 47 crashes in a recent

[2] Locations eligible for Highway Safety Improvement Program (HSIP) funding are defined by MassDOT as crash clusters that rank within the top five percent of crash clusters for each regional planning agency, based on the Equivalent Property Damage Only (EPDO) index. In the EPDO index, crashes resulting in property damage only and crashes in which the severity is unknown are awarded one point each, fatal crashes and crashes involving injuries are given 21 points each. In the Boston Region MPO area, 421 intersections are identified from

five-year period. The adjacent intersection of Adams Street at Common Street had 25 crashes in the same period. The total 72 crashes include two that involved a person who was walking.

- Traffic congestion during peak hours
  The intersection of Adams Street at Furnace Brook Parkway carries high traffic volumes during AM and PM peak hours on weekdays. Also, it has a significant number of pedestrian crossings during the peak traffic hours.
- Wide roadway and large intersection layouts
  Adams Street has a wide cross-section at the study location, especially the section east of Furnace Brook Parkway. In addition, right-turn channels exist at three corners of the intersection at Furnace Brook Parkway. These channels create large layouts at both intersections and cause accessibility and safety concerns for people who walk and bike.
- Lack of turning lanes
  The crash data shows a large number of left-turn crashes occurring at the intersection.[3] Currently the intersection carries high left-turn volumes on all approaches and contains no dedicated left-turn lanes except on the eastbound approach. Left turns frequently impede through movements, block the intersection, and obstruct drivers' view. Meanwhile, the southbound approach carries a high right-turn volume. Dedicated turning lanes on critical approaches would significantly relieve congestion and improve safety at the intersection, especially during the peak hours.
- Inadequate signal displays
  All approaches of the intersection currently use the basic three-section signals, with no backplates and no retroreflective borders. They are all post-mounted. On Adams Street, the signals appear low and are not easy to identify from a distance. On the parkway, they appear to blend into thick vegetation. Meanwhile, drivers on Adams Street frequently encounter sun glare in the AM or PM peak hours.
- Pedestrian accessibility and safety concerns
  Push buttons to activate pedestrian signal phases are located on the right-turn channel islands of the intersection (except the northwest corner). To cross the intersection, pedestrians usually have to cross one or two of the right-turn channel lanes in addition to a relatively long crosswalk.[4] The

MassDOT 2014–16 crash data as the top five percent crash clusters with a minimum EPDO value of 115.

[3] "Left-turn crash" refers to a crash that involves at least one left-turning vehicle.

[4] The crosswalks on Adams Street are about 75 to 80 feet long and the crosswalks on Furnace Brook Parkway are about 50 to 55 feet long.

pedestrian signals do not have the count-down function and are not fully accessible.

- Lack of bicycle accommodation
  There are no dedicated lanes or wide shoulders to accommodate bicycle travel on Adams Street and Furnace Brook Parkway and no bicycle detection at the intersection. However, turning movement counts collected for this study indicate that there were a significant number of bicycles (five to 10 per AM or PM peak hour) traveling through the intersection in fair weather autumn days.

- Cut-through traffic on Common Street
  Common Street carries a high proportion of cut-through traffic, especially during AM and PM peak hours. The counts collected for the street indicate a high proportion of truck traffic, approximately four to five percent in the AM peak hour and two to three percent in the PM peak hour.

- Gridlocked traffic at the Common Street intersection
  During peak hours (especially in the morning), heavy traffic on Adams Street westbound and from Common Street frequently blocks the intersection and creates gridlock conditions at the Common Street intersection. The “Do Not Block” hatched box has little effect in preventing blockage at the intersection.

- Parking on Adams Street
  On-street parking is allowed on Adams Street east of Common Street. Vehicles from time to time are parked on Common Street westbound very close to the right-turn channel, which impedes the intersection operations and causes safety concerns. Crash data collected for this study indicate that two sideswipe crashes with parked vehicles occurred in this section in recent years.

4 CRASH DATA ANALYSIS

Crash data analysis is essential to identify safety and operational problems at an intersection. Analyzing data on the frequency of crashes, types and patterns of collisions, and the circumstances under which crashes occur, such as the time of day and roadway surface conditions, also helps to develop improvement strategies.

4.1 Crash Statistics

MPO staff used the most recent five-year crash reports (January 2015–November 2019) from the Quincy Police Department for this study. To account for crashes that intersection operations may have contributed to, staff examined

the crashes in the section of Adams Street between Adams Plaza and Brae Road. The section covers the two intersections (the study location) and 500 feet beyond in the both directions of Adams Street.

In total, there were 98 crashes in the recent five-year period in the section. They can be classified in three categories:

1) 72 crashes at the study location (the vicinity of two adjacent intersections)
2) 24 crashes in the commercial section of Adams Street (west of the study location)
3) two individual crashes at remote locations, one in the Adams Plaza parking lot and one crash with parked cars near Brae Road

At the study location, the predominant crash type was the angle collision involving a left-turning vehicle and a through vehicle (known as left-turn crashes). Thirty-eight such crashes (53 percent of the total) occurred at the two intersections. Additionally, 11 crashes (15 percent of the total) were identified as right-angle collisions that involved two vehicles from two different approaches running into each other. In sum, 49 crashes (68 percent of the total 72 crashes) were identified as angle collisions. This result is alarming because angle collisions usually cause more severe personal injuries and property damage than rear-end collisions at an intersection.

Table 1 summarizes the 72 crashes in terms of severity, collision type, pedestrian or bicycle involvement, time of the day, and weather and pavement conditions. Fifteen of the crashes (21 percent) caused personal injuries with no fatalities. The collision types included 49 angle collisions (68 percent), eight rear-end collisions (11 percent), eight same direction sideswipe collisions (11 percent), and three single vehicle crashes.

Noticeably, about 40 percent of the crashes occurred during peak traffic periods (7:00–10:00 AM and 3:30–6:30 PM), which reflects the study location’s recurrent congested conditions during peak AM and PM periods. Meanwhile, nearly 30 percent of the crashes occurred during darkness. The two adjacent intersections have a fairly large layout and the lighting may not be sufficient to cover the entire area.

In the commercial section of Adams Street, 24 crashes occurred in the recent five years. Table 2 summarizes those crashes in terms of the severity, collision type, pedestrian or bicycle involvement, time of the day, and weather and pavement conditions. Eight of the crashes caused personal injuries with no fatalities. Eighteen crashes (75 percent) were angle collisions. Noticeably, 15 crashes (63 percent) occurred during peak traffic periods, mostly in the evening.

Table 1
Crash Data Summary
Adams Street at Furnace Brook Parkway and Common Street
Quincy Police Crash Reports, January 2015–November 2019

Statistics Period	2015	2016	2017	2018	2019	5-Year Total	Average
Total number of crashes	21	12	18	14	7	72	14.4
Severity: Property damage only	16	10	15	13	3	57	11.4
Severity: Non-fatal injury	5	2	3	1	4	15	3.0
Severity: Fatality	0	0	0	0	0	0	0.0
Severity: Not reported/unknown	0	0	0	0	0	0	0.0
Collision type: Single vehicle	1	1	1	0	0	3	0.6
Collision type: Rear-end	3	2	2	0	1	8	1.6
Collision type: Angle	12	7	14	11	5	49	9.8
Collision type: Sideswipe, same direction	3	2	1	2	0	8	1.6
Collision type: Sideswipe, opposite direction	0	0	0	0	1	1	0.2
Collision type: Head-on	1	0	0	1	0	2	0.4
Collision type: Not reported/unknown	1	0	0	0	0	1	0.2
Involved pedestrian(s)	2	0	0	0	0	2	0.4
Involved bicyclist(s)	0	0	0	0	0	0	0.0
Occurred during weekday peak periods*	8	6	11	3	1	29	5.8
Wet or icy pavement conditions	6	1	1	8	2	18	3.6
Dark conditions (lit or unlit)	6	2	8	3	2	21	4.2

* Peak periods are defined as weekdays 7:00–10:00 AM and 3:30–6:30 PM.

Table 2
Crash Data Summary
Adams Street in the Adams Plaza Vicinity
Quincy Police Crash Reports, January 2015–November 2019

Statistics Period	2015	2016	2017	2018	2019	5-Year Total	Average
Total number of crashes	4	5	6	5	4	24	4.8
Severity: Property damage only	0	2	5	5	4	16	3.2
Severity: Non-fatal injury	4	3	1	0	0	8	1.6
Severity: Fatality	0	0	0	0	0	0	0.0
Severity: Not reported/unknown	0	0	0	0	0	0	0.0
Collision type: Single vehicle	0	0	0	0	0	0	0.0
Collision type: Rear-end	0	1	1	0	1	3	0.6
Collision type: Angle	4	2	4	5	3	18	3.6
Collision type: Sideswipe, same direction	0	1	1	0	0	2	0.4
Collision type: Sideswipe, opposite direction	0	1	0	0	0	1	0.2
Collision type: Not reported/unknown	0	0	0	0	0	0	0.0
Involved pedestrian(s)	0	0	0	0	0	0	0.0
Involved bicyclist(s)	0	0	1	0	0	1	0.2
Occurred during weekday peak periods*	3	1	5	3	3	15	3.0
Wet or icy pavement conditions	1	1	2	1	2	7	1.4
Dark conditions (lit or unlit)	1	0	3	2	1	7	1.4

* Peak periods are defined as weekday 7:00–10:00 AM and 3:30–6:30 PM.

4.2 Collision Diagram and Crash Pattern Analysis

Based on the police reports, staff constructed a collision diagram (Figure 2) that shows the locations and patterns of all the crashes on Adams Street between Adams Plaza and Brae Road (each indexed by chronicled order of occurrence). The information of each crash, including date, time, severity, collision type, most harmful event, weather conditions, and driver contributing code are summarized in Appendix A.

At the study location, 47 crashes occurred at the intersection of Adams Street and Furnace Brook Parkway. The noticeable crash patterns were as follows:

- 13 crashes involving a westbound left-turn vehicle and an eastbound through vehicle on Adams Street
- six crashes involving an eastbound left-turn vehicle and a westbound through vehicle on Adams Street
- three crashes involving a northbound left-turn vehicle and a southbound through vehicle on Furnace Brook Parkway
- three right-angle crashes involving an eastbound through vehicle and a northbound through vehicle
- two right-angle crashes involving an eastbound through vehicle and a northbound vehicle
- seven rear-end crashes including five on Adams Street eastbound and two on Furnace Brook Parkway northbound
- one pedestrian crash near the crosswalk on Adams Street westbound

The prevailing left-turn crashes were mainly caused by the lack of left-turn lanes and signal phases at the intersection. Drivers have difficulty making left turns during the peak traffic periods with continuous traffic flow.

On Adams Street, the multiple-lane setting and the offset alignment of left-turn lanes on both sides of the intersection create difficulties for left-turning drivers trying see the opposing through traffic, especially when their view is blocked by a left-turning vehicle on the opposite side. On the eastbound approach, the inside lane is shared by vehicles making left-turns and through movements. Oftentimes, vehiclesattempt to maneuver around the stopped left-turn vehicles and collide with vehicles in the adjacent lane or cause rear-end crashes.

The intersection has a fairly large layout with medians, traffic islands, and a lot of signage. Drivers have too many things to observe during the peak traffic period when pedestrians and bicyclists are usually active in the intersection. According to the school crossing guard, drivers on the right-turn channelized lane often do

not observe the NTOR regulation during the school hours. Fortunately, no crashes were identified to be caused by such violations.

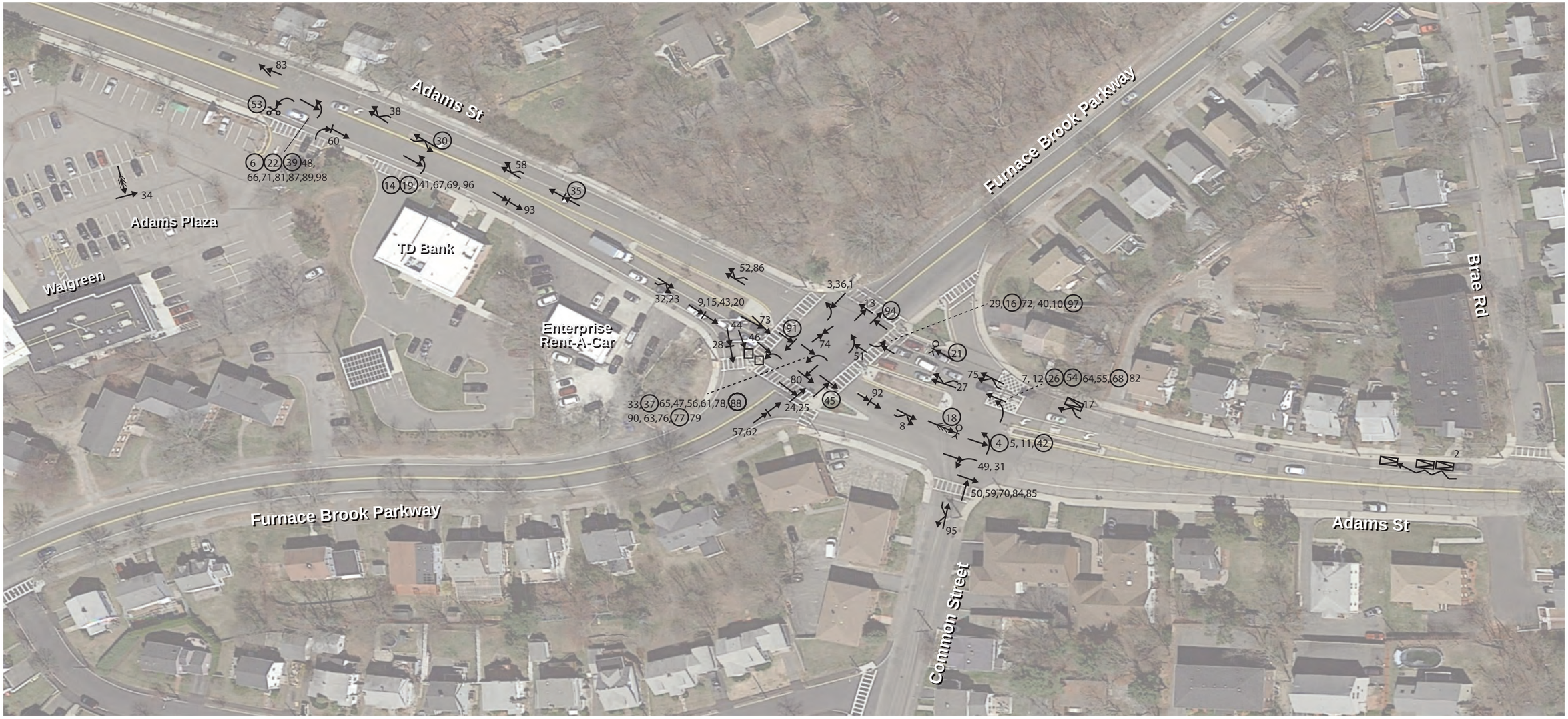
The collision diagram depicts 25 crashes at the intersection of Adams Street at Common Street. The majority of the crashes were caused by vehicles entering the intersection from the stop-controlled approach (Common Street) and colliding with vehicles traveling along Adams Street. There were 17 such occurrences, and five resulted in personal injuries. The noticeable crash patterns include the following:

- eight angle collisions involving a left-turn vehicle from Common Street and a vehicle traveling on Adams Street westbound
- four angle collisions involving a left-turn vehicle from Common Street and a vehicle traveling on Adams Street eastbound
- five angle collisions involving a vehicle just entering the intersection from Common Street and bumping into a vehicle traveling on Adams Street eastbound

Additionally, there were four noticeable crashes at the intersection:

- two angle collisions involving a westbound left-turning vehicle and an eastbound through vehicle on Adams Street
- one pedestrian crash involving a vehicle traveling from Common Street that turned left into wrong lanes and backed into the pedestrian
- one sideswipe crash involving a vehicle parked too close to the intersection and a moving vehicle on Adams Street westbound

During the AM and PM peak periods, traffic on Adams Street flows continuously. Drivers from Common Street struggle to find gaps and often act aggressively to enter the intersection. The high number of angle collisions may also be attributed to the width of Adams Street at this intersection. Left-turning vehicles must cross two eastbound travel lanes, the median, and a westbound left-turn lane to proceed as through traffic on Adams Street westbound. Meanwhile, Adams Street between the two intersections is very short and creates grid-lock traffic congestion at the middle of this intersection. This situation also contributes to the overall high crash rate at the intersection.



SYMBOLS

- Moving Vehicle
- Backing Vehicle
- Non-Involved Vehicle
- Pedestrian
- Parked Vehicle
- Fixed Object
- Bicycle

TYPES OF CRASH

- Head On
- Angle
- Rear End
- Sideswipe
- Out of Control

SEVERITY

- # — Property Damage Only Crash
- (#) — Non-Fatal Injury Crash

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Figure 2
Collision Diagram: Adams Street at Furnace Brook Parkway and Common Sreet
Quincy Police Report: January 2015–November 2019

Safety and Operations Analysis at Selected MPO Intersections

Drivers traveling from Common Street and intending to continue onto Furnace Brook Parkway northbound must cross two eastbound lanes, a traffic median, and three westbound lanes to reach the channelized right-turn lane at the intersection. To get there, some vehicles often zigzag through the congested traffic during peak hours.

In the commercial section of Adams Street, there were 24 crashes in the recent five years. Almost all of them were related to access and egress from the commercial establishments. The noticeable crash patterns in the section include the following:

- 10 angle collisions involving a left-turning vehicle exiting from Adams Plaza driveway and a vehicle traveling on Adams Street eastbound
- six angle collisions involving a left-turning vehicle exiting the TD Bank driveway and a vehicle traveling on Adams Street eastbound
- three sideswipe collisions and one rear-end crash involving vehicles traveling in or near the left-turn lane (for access to the adjacent businesses) on Adams Street westbound
- one crash involving a bicycle traveling on Adams Street eastbound colliding with a vehicle turning into Adams Plaza

Both driveways for Adams Plaza and TD Bank are under stop control with clear signage. During PM peak periods when traffic on Adams Street flows continuously, customers scramble to find gaps and tend to drive aggressively. Meanwhile, drivers on Adams Street and those exiting from the commercial driveways are potentially affected by solar glare, mainly in the afternoon, due to the east-west position of Adams Street.

5 EXISTING CONDITIONS ANALYSIS

To examine the existing conditions, MPO staff requested MassDOT's assistance in collecting Automatic Traffic Recorder (ATR) counts on the approaching roadways and intersection turning movement counts (TMCs) for this study. The ATR counts include daily traffic volumes and travel speed counts and the TMCs include pedestrian and bicycle counts at the intersections. Appendix B contains details of the locations and specifications for these counts.

The data collection was delayed by a snowstorm in late November 2019 and periodic snows in the following months. The ATR counts were performed during the last week of February 2020. In March, just as MassDOT scheduled the collection of the TMCs for this study, the state's traffic data collection operations were suspended because of the COVID-19 pandemic. In September, MassDOT

resumed the traffic count programs and collected TMCs for this study on October 1 (Thursday) and October 3, 2020 (Saturday).

5.1 Daily Traffic Volumes

The February ATR counts can be regarded as representing normal traffic conditions, as they were collected at least two weeks before the state's announcement of the COVID-19 State of Emergency.[5] Based on the data, staff estimated the average weekday traffic volumes at in roadway sections near the study intersections as follows:

- Adams Street west of Furnace Brook Parkway—16,800 vehicles, with a split of 8,500 (51 percent) westbound vehicles and 8,300 (49 percent) eastbound vehicles
- Adams Street east of Common Street—10,600 vehicles, with a split of 5,400 eastbound vehicles (51 percent) and 5,200 (49 percent) westbound vehicles
- Furnace Brook Parkway north of Adams Street—11,400 vehicles, with a split of 6,000 (53 percent) southbound vehicles and 5,400 (47 percent) eastbound vehicles
- Furnace Brook Parkway south of Adams Street—10,800 vehicles, with a split of 5,600 (52 percent) northbound vehicles and 5,200 (48 percent) southbound vehicles
- Common Street south of Adams Street—6,300 vehicles, with a split of 3,200 (51 percent) northbound vehicles and 3,100 (49 percent) southbound vehicles

As the ATR counts were collected during different time periods in the last week of February, the data collected on Thursday, February 27, 2020, was used for this estimation. Appendix C contains the 24-hour counts, summarized in hours and by vehicle classes, for the available count locations.[6] Annual seasonal adjustment factors, 1.02 for Adams Street (U3: Urban Principal Arterial) and 1.01 for Furnace Brook Parkway (U4: Urban Minor Arterial) and Common Street (U5: Urban Collector), were used to adjust the February counts. The factors were developed from the average of 2016–19 MassDOT Weekday Seasonal Correction Factors (Appendix D).

[5] Governor Baker's COVID-19 Order #5, which prohibited gatherings of more than 25 people, was issued on March 15, 2020.

[6] The entire ATR data set for this study can be obtained from the MassDOT Interactive Traffic Volume and Classification Map (also known as Transportation Data Management System) at Massachusetts government webpage https://www.mass.gov/traffic-volume-and-classification.

5.2 Turning Movement Counts

MassDOT collected turning movement counts at the study intersections on Thursday October 1, 2020, during the morning peak period (6:00–10:00 AM) and the evening peak period (2:00–6:00 PM), and on Saturday October 3, 2020, during the midday peak period (10:00 AM–2:00 PM).

In addition to traffic volumes, the counts include pedestrian crossings and bicycle turning movements at the two study intersections. Appendices E and F contain all the data by 15-minute interval in the peak periods and in the peak hours for the intersections of Adams Street at Furnace Brook Parkway and at Common Street.

Staff recognized that the traffic volumes of these TMCs could be lower than those in normal traffic conditions, as many people still worked from home even though most schools were open in early October. Based on the February ATR counts, staff estimated that the weekday AM and PM peak-hour traffic counts must increase by 45 percent and 15 percent respectively in order to represent the normal traffic conditions.

Figure 3 summarizes the estimated 2020 AM and PM peak-hour traffic turning volumes and pedestrian crossing volumes by approaches at the two study intersections. The estimation represents normal traffic conditions in 2020, not the conditions during the COVID-19 crisis.

The intersection of Adams Street at Furnace Brook Parkway is estimated to carry approximately 2,000 to 2,200 entry vehicles per peak hour under the normal traffic conditions. In general, traffic is more prevailing in the directions toward Interstate 93 in the morning and toward Quincy Center in the evening. Each of the approaches carries about 400 to 600 vehicles per peak hour, except the Adams Street eastbound that could carry over 750 vehicles in the PM peak hour. All approaches have a high proportion of left-turning traffic, especially the parkway northbound and Adams Street eastbound. Each could carry about 150 left-turn vehicles per peak hour. Meanwhile, the parkway southbound could carry nearly 200 right-turning vehicles in the AM peak hour and Adams Street generally has about 120 right-turning vehicles per peak hour.

The intersection of Adams Street at Common Street is estimated to carry approximately 1,200 to 1,400 entry vehicles per peak hour under normal traffic conditions. The estimation indicates that Common Street carries about 300 vehicles per peak hour in the morning and about 250 vehicles per peak hour in the evening.

5.3 Pedestrian and Bicycle Volumes

The intersection turning movement counts, conducted in the extended four-hour peak periods in the weekday morning and evening and Saturday midday, provide three different sets of pedestrian and bicycle counts:

- Pedestrian crossing counts at crosswalks (by crossing approaches)
- Bicycle crossing counts at crosswalks (bicyclists who walk or ride a bike on crosswalks)
- On-road bicycle counts (by turning movements on each approach, similar to vehicle counts)

The data indicate that the intersection of Adams Street at Furnace Brook Parkway carried significant pedestrian volumes during the weekday AM and PM peak hours on a fair weather autumn day. In the AM peak hour (7:30–8:30 AM), there were a total of 25 pedestrian crossings and three bicycle crossings. In the PM peak hour (4:45–5:45 PM), there were a total of 76 pedestrian crossings and five bicycle crossings. The counts by approaches indicate that all the four crosswalks at the intersection were fairly utilized.

In the AM peak period (6:00–10:00 AM), there were 73 pedestrian crossings and three bicycle crossings in the intersection. In the PM peak period (2:00–6:00 PM), there were 132 pedestrian crossings and 27 bicycle crossings. During the peak period (10:00 AM–2:00 PM) on Saturday (October 3, 2020), there were 56 pedestrian crossings and 16 bicycle crossings.

There were a smaller number of pedestrian and bicycle crossings at the intersection of Adams and Common Streets. In the AM peak hour (7:30–8:30 AM), there were a total of 16 pedestrian crossings and one bicycle crossing. In the PM peak hour (4:45–5:45 PM), there were a total of 29 pedestrian crossings and no bicycle crossings. Most people crossed the intersection at the crosswalk on Common Street and some crossed the right-turn channel on Adams Street westbound. During peak AM and PM hours, there were one and three persons crossing Adams Street where no crosswalks exist. Though Adams Street is wide, the traffic medians provide a refuge for these crossings.

The counts also show that a significant number of people bicycled through the intersection of Adams Street at Furnace Brook Parkway. In the AM peak hour (7:30–8:30 AM), two bicyclists went through the intersection and one turned right on the parkway southbound. In the PM peak hour (4:45–5:45 PM), there were two right-turning bicyclists and one who traveled through on Adams Street eastbound and four right-turning bicyclists on Furnace Brook Parkway southbound.

BOSTON REGION MPO

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Figure 3
Estimated 2020 Weekday Traffic Volumes
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis at Selected MPO Intersections

The counts confirm that Furnace Brook Parkway is a popular bike route. In the AM peak period (6:00–10:00 AM), the parkway carried 10 and Adams Street carried four bicycles. In the PM peak period (2:00–6:00 PM), the parkway carried 26 and Adams Street carried 19 bicycles. In the Saturday (October 9, 2020) peak period (10:00 AM–2:00 PM), the parkway carried 36 and Adams Street carried 16 bicycles. On the parkway the directional split was fairly even, but it appears that there were more bicycles traveling on Adams Street eastbound in all the peak periods.

Common Street generally carries a smaller number of on-road bicycles. At the intersection, the northbound approach carried five bicycles toward the intersection in the AM peak period, no bicycles in the PM peak period, and 11 bicycles in the Saturday peak period.

5.4 Roadway Travel Speeds

Traffic studies usually apply the observed or estimated 85th percentile speeds to assess how fast vehicles are traveling at a specific location on a roadway. The 85th percentile speed is the speed at or below which 85 percent of vehicles passing a given point are traveling, and it is the principal value used to establish speed controls by the state. It can be regarded as the prevailing vehicle speed on the roadway adjacent to the study location.

The ATR counts that staff requested for this study include spot speed estimates at the count locations. Based on the counts, MassDOT estimated the 85th percentile speeds at the following three locations:

- Adams Street west of the intersection, between Adams Plaza and Alrick Road (30 mph speed limit in both directions)—36 mph in the eastbound direction and 38 mph in the westbound direction
- Furnace Brook Parkway north of the intersection, between Adams Street and Brae Road (30 mph speed limit in both directions)—38 mph in the northbound direction and 38 mph in the southbound direction
- Common Street south of the intersection, between Adams Street and Hilltop Street (20 mph speed limit in both directions)—27 mph in the northbound direction and 24 mph in the southbound direction

The data indicate that people generally traveled much faster than the posted speed limits in the vicinity of the study intersections, probably due to the wide travel lanes. Appendix G summarizes the percentages of the travel speed ranges by five mph increments at the three locations. Note that the 85th percentile

speeds estimated from the ATR counts cannot be directly used for modification of the existing speed regulation.[7]

5.5 Intersection Capacity Analysis

Based on the estimated 2020 AM and PM peak-hour turning movements, staff conducted the intersection capacity analysis for the two study intersections by using the Synchro traffic analysis and simulation program.[8]

Staff conducted traffic operations analyses consistent with the Highway Capacity Manual (HCM) methodologies (included in Appendix C). HCM methodology demonstrates driving conditions at signalized and unsignalized intersections in terms of level-of- service (LOS) ratings from A through F. LOS A represents the best operating conditions (little to no delay), while LOS F represents the worst operating conditions (very long delay). LOS E represents operating conditions at capacity (limit of acceptable delay). Table 3 presents the control delays associated with each LOS for signalized and unsignalized intersections.

Table 3
Intersection Level of Service Criteria

Level of Service	Signalized Intersection Control Delay (Seconds per Vehicle)	Unsignalized Intersection Control Delay (Seconds per Vehicle)
A	0–10	0–10
B	> 10–20	> 10–15
C	> 20–35	> 15–25
D	> 35–55	> 25–35
E	> 55–80	> 35–50
F	> 80	> 50

Source: Highway Capacity Manual 2010.

Table 4 summarizes the estimated LOS, average delay, and volume to capacity ratio (V/C) for all the approaches at the intersection in the AM and PM peak hours. The estimation was based on an observed cycle length of 129 seconds that consists of 46 seconds (40-second green, plus six-second yellow, and all-red clearance time) for Adams Street approaches, 56 seconds (50-second green, plus six-second yellow, and all-red clearance time) for Furnace Brook Parkway approaches, and 27 seconds for the exclusive pedestrian signal phase.

[7] To establish or modify speed controls, MassDOT requires the collection of speed data by radar gun or laser gun at critical locations at intervals not to exceed 0.25 miles, in addition to vehicle trial runs in the study area.

[8] Staff used Synchro Version 10.3, developed and distributed by Trafficware Ltd. It can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections in a roadway network.

The evaluation revealed that intersection of Adams Street at Furnace Brook Parkway operated at acceptable LOS overall.[9] However, some individual approaches operated at an undesirable LOS. The parkway southbound was estimated to operate at LOS F with average delay of nearly one and half minutes in the AM peak hour and the Adams Street eastbound was estimated to operate at LOS E with average delay of about one minute in the PM peak hour.

At the unsignalized intersection, the stop-controlled Common Street approach operated at LOS F with average delay of about one minute in both the AM and PM peak hours.

Appendix H contains detailed Synchro reports of the AM and PM intersection capacity analysis for the two intersections. Note that the analysis does not completely reflect some congested conditions, such as left-turn blockages on Furnace Brook Parkway and the usually congested short section of Adams Street westbound between Furnace Brook Parkway and Common Street during the peak hours. However, the conditions were present in the traffic simulations of the Synchro models.

[9] For the intersections in a metropolitan urban area, LOS A, B, and C are considered desirable; LOS D and E are considered acceptable; and LOS F is considered undesirable.

Table 4
Summary of Intersection Capacity Analyses
Estimated 2020 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L/T/R	D	38	0.68	320	E	63	0.98	#552
Adams Street WB	L	D	37	0.36	99	D	40	0.31	61
Adams Street WB	T/R	C	30	0.35	203	C	30	0.38	214
Furnace Brook Parkway NB	L/T	D	43	0.78	#451	D	41	0.78	#534
Furnace Brook Parkway NB	R	A	8	0.11	38	A	9	0.13	50
Furnace Brook Parkway SB	L/T/R	F	84	1.07	#771	D	39	0.81	#661
Intersection (1) Average	-	D	52	-	-	D	45	-	-
Adams Street EB	T/R	A	0	0.18	-	A	0	0.26	-
Adams Street WB	L	A	9	0.05	4	A	8	0.05	4
Adams Street WB	T/R	A	0	0.15	-	A	0	0.15	-
Common Street NB	L/T/R	F	69	0.95	263	F	51	0.86	203
Intersection (2) Average	-	C	19	-	-	B	11	-	-

Notes:

Intersection (1) is Adams Street at Furnace Brook Parkway. Intersection (2) is Adams Street at Common Street.

The figures for AM and PM delay represent the average seconds of delay per vehicle.

Locations where the 95th percentile volume exceeded capacity are indicated by the number sign (#). The queue shown is the maximum after two cycles,

EB = eastbound. L = left turn. LOS = level of service. NB = northbound. SB = southbound. R = right turn. T = through movement. V/C = volume-to-capacity ratio. WB = westbound.

Source: Central Transportation Planning Staff.

6 PROPOSED SHORT-TERM IMPROVEMENTS

Based on the above analyses, MPO staff developed a series of short- and long-term improvements to address safety and operational problems at the intersections. The proposed short-term improvements generally can be implemented within two years at a relatively low cost (usually under $30,000). The proposed long-term improvements are more complicated and cover larger areas, thus require intensive planning and design, and significant funding. These improvements are analyzed in the next section. The proposed short-term improvements are summarized below, from the lowest to the highest cost:

- Enforce the NTOR regulation at the right-turn channels of the parkway intersection during these time periods: 7:00–8:00 AM, 11:00 AM–12:00 PM, and 2:00–3:00 PM on school days.
- Enforce speed regulations on the roadways approaching the intersections, especially on Adams Street.
- Enlarge the Do Not Block hatched box (see Figure 4 in the next section) and install *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* Do Not Block Intersection regulatory sign (R10-7) on the roadside adjacent to the box.
- Retime the traffic signal at the parkway intersection based on the existing phasing sequence.[10]
- Consider restriping all travel lanes from existing12-foot wide lanes to 11-foot wide lanes approaching the intersection and striping five-foot shoulders for temporary bicycle accommodation.
- Examine the feasibility of installing backplates with retroreflective borders on the existing signal heads.[11]
- Double stop signs at the Common Street approach.
- Clearly define on-street parking spaces on Adams Street westbound near Common Street and prohibit parking near the intersection.

7 LONG-TERM IMPROVEMENT ALTERNATIVES

The proposed long-term improvements would require intensive planning, design, and funding. Staff developed four improvement alternatives for the two intersections and the immediate area around them, based on the goals of maximizing safety and operational benefits for all transportation modes and minimizing land-taking and construction impacts.

Staff also analyzed traffic operations for the alternatives and the base case (no-build scenario) under the projected 2030 traffic conditions. For comparison purposes, the analysis included a future year no-build scenario that contained only improvements involving signal retiming with no geometry modifications and no upgrade to the signal system.

[10] Appendix I contains the intersection capacity analyses based on the estimated 2020 normal traffic volumes. The analyses indicate that an adjustment to the signal timing for both roadway approaches by slightly increasing the cycle length by six seconds would notably reduce delays and traffic queue lengths at the intersection, especially in the AM peak hour.

[11] The backplates and retroreflective borders would be effective by increasing drivers' awareness of the signal presence and by reducing solar glare. However, the existing signal post foundations may not be strong enough to support the additional weight. Their positions and effectiveness need to be further examined.

Key elements of the no-build scenario and the four alternatives are summarized as below.

No-Build Scenario

The no-build alternative assumes that the intersection would remain the same as the existing conditions with no intersection layout modifications and no upgrade to the signal system. The only improvement included was the retiming of the signal with the existing signal phasing sequence and a slight increase of overall cycle length.

Alternative One

Alternative 1 proposes to reconstruct both intersections, and upgrade signals at the parkway intersection. Figure 4 shows the conceptual plan of the alternative. Key elements of the alternative include

- removing Furnace Brook Parkway's northbound right-turn channel lane and reducing the width of Adams Street east of the parkway;[12]
- adding a left-turn exclusive lane on Adams Street eastbound;[13]
- narrowing traffic median and realigning the left-turn exclusive lane on Adams Street westbound;
- adding a right-turn and left-turn exclusive lanes on Furnace Brook Parkway southbound;[14]
- adding a left-turn exclusive lane on Furnace Brook Parkway northbound;[15]
- reducing all travel lanes from the existing width of 12 feet to 11 feet approaching both intersections;
- realigning crosswalks on Adams Street to reduce crossing distance;
- installing five-foot sidewalks on the east side of Furnace Brook Parkway from Adams Street to the driveway of Meadowbrook Apartment;
- reconstructing sidewalks adjacent to Common Street and installing a new crosswalk with Americans with Disabilities Act (ADA) compliant wheelchair ramps;

[12] The right-turn channel carries a relatively low volume, allows fast right-turn movements, and inconveniences pedestrians when crossing.

[13] The space for adding the left-turn lane can be obtained by reducing the width of the traffic median on Adams Street. The intersection capacity analysis with the 2030 traffic projections indicate that it would require a storage length of at least 100 feet.

[14] The intersection capacity analysis indicates that the right-turn lane would require a storage length of about 150 feet and the left-turn lane would require a storage length of 50 to 75 feet.

[15] The left-turn lane should have a storage length of about 150 feet.

- installing five-foot bike lanes with two-foot street buffers on both sides of Adams Street and Furnace Brook Parkway;
- designating parking spaces on Adams Street further east of Common Street;
- enlarging and repainting the Do Not Block box on Adams Street westbound; and
- updating the signal system to include accessible count-down pedestrian signals, bicycle detection, and new signal indications.[16]

Alternative Two

Alternative 2 proposes to reconstruct both intersections, upgrade signals at the parkway intersection, and signalize the Common Street intersection under the same controller. The alternative would require a similar layout to Alternative 1 (see Figure 5 for the conceptual plan). Key elements of the alternative include

- removing Furnace Brook Parkway's northbound right-turn channel lane and reducing the width of Adams Street east of the parkway;
- adding a left-turn exclusive lane on Adams Street eastbound;[17]
- narrowing the traffic median and realigning the left-turn exclusive lane on Adams Street westbound;
- adding a right-turn exclusive lane and a left-turn exclusive lane on Furnace Brook Parkway southbound;[18]
- adding a left-turn exclusive lane on Furnace Brook Parkway northbound;[19]
- reducing all travel lanes from the existing width of 12 feet to 11 feet approaching both intersections;
- realigning crosswalks on Adams Street to reduce crossing distance;
- installing five-foot sidewalks on the east side of Furnace Brook Parkway from Adams Street to the driveway of Meadowbrook Apartments;
- reconstructing sidewalks adjacent to Common Street and installing a new crosswalk with ADA compliant wheelchair ramps;
- installing five-foot bike lanes with two-foot street buffers on both sides of Adams Street and Furnace Brook Parkway; and

[16] The existing signals are post-mounted. The posts should be replaced by mast arms. The signal heads should be designed and positioned according to traffic operations and the intersection layout and equipped with backplates and retroreflective borders.

[17] The intersection capacity analysis indicates that it would require a storage length of about 100 feet.

[18] The right-turn lane would require a storage length of about 150 feet and the left-turn would require a storage length of 50 to 75 feet.

[19] The left-turn lane should have a storage length of about 150 feet.

- installing a new signal system to control both intersections, equipped with accessible count-down pedestrian signals, bicycle detection, and new signal indications.[20]

Alternative Three

Alternative 3 proposes to reconstruct both intersections, upgrade signals at the parkway intersection, and prohibit traffic from Common Street crossing Adams Street in both directions. Figure 6 shows the conceptual plan for the alternative. Key elements of the alternative include

- removing Furnace Brook Parkway's northbound right-turn channel lane and reducing the width of Adams Street east of the parkway;
- adding a left-turn exclusive lane on Adams Street eastbound;[21]
- narrowing the traffic median and realigning the left-turn exclusive lane on Adams Street westbound;
- adding a right-turn exclusive lane and a left-turn exclusive lane on Furnace Brook Parkway southbound;[22]
- adding a left-turn exclusive lane on Furnace Brook Parkway northbound;[23]
- extending the traffic median on Adams Street westbound from the parkway to about 100 feet east of Common Street in order to prohibit traffic crossing to and from Common Street;
- removing the existing Adams Street westbound right-turn channel (and the existing crosswalk) and reconstructing sidewalks in the area;[24]
- reducing all travel lanes from 12 to 11 feet at both intersections;
- realigning crosswalks on Adams Street to reduce crossing distance;
- installing five-foot sidewalks on the east side of Furnace Brook Parkway from Adams Street to the driveway of Meadowbrook Apartment;
- installing five-foot bike lanes with two-foot street buffers on both sides of Adams Street and Furnace Brook Parkway;

[20] In this alternative, traffic signals would operate with protected left turns and pedestrian signals would operate in concurrent phases with through traffic movements.

[21] The left-turn should have a storage length of about 100 feet.

[22] The right-turn lane should have a storage length of about 150 feet and the left-turn should have a storage length of 50 to 75 feet.

[23] The intersection capacity analysis indicates that the left-turn lane would require a storage length of about 200 feet.

[24] The right-turn channel mainly serves traffic from Common Street and carries only about five to 10 vehicles per hour from Adams Street. The removal would provide more comfortable access and crossing at the intersection for people who walk and bike.

- reconstructing sidewalks adjacent to Common Street and installing a new crosswalk with ADA compliant wheelchair ramps; and
- updating the signal system to include accessible count-down pedestrian signals, bicycle detection, and new signal indications.

Alternative Four

Alternative 4 proposes to convert the two intersections into a double-lane modern roundabout. Figure 7 shows the conceptual plan of the alternative. Key elements of the alternative include

- designing and constructing a double-lane modern roundabout with an inscribed circle of at least 165 feet in diameter;[25]
- installing a separated right-turn lane for the movements from Common Street to Adams Street eastbound;[26]
- installing 10-foot shared-use paths encircling the roundabout with ADA-compliant wheelchair ramps connected to the crosswalks;[27]
- installing crosswalks on all the roadways connecting to the roundabout;
- installing five-foot sidewalks on the west side of Furnace Brook Parkway from Adams Street to the driveway of Meadowbrook Apartments;
- installing five-foot bike lanes with two-foot street buffers on both sides of Adams Street and Furnace Brook Parkway; and
- installing sharrow makings in the circulatory roadway for bicycle travel.

[25] The Synchro HCM 6th roundabout analysis indicates that a single-lane roundabout would not be feasible under the projected 2030 traffic conditions.

[26] The right turns at the roundabout would not be feasible because of the entry angle of the Common Street approach.

[27] According to the MassDOT Guidelines for Planning and Design of Roundabouts (published September 2020), bicyclists are always offered the option of traveling through a roundabout as a vehicle. However, at locations with planned or existing bicycle facilities on the roundabout approaches, bicyclists are provided with additional options for navigating the roundabout, such as by continuing biking on a share-use path (10 feet minimal) or walking their bike as a pedestrian on a sidewalk (at constrained locations less than 10 feet wide).

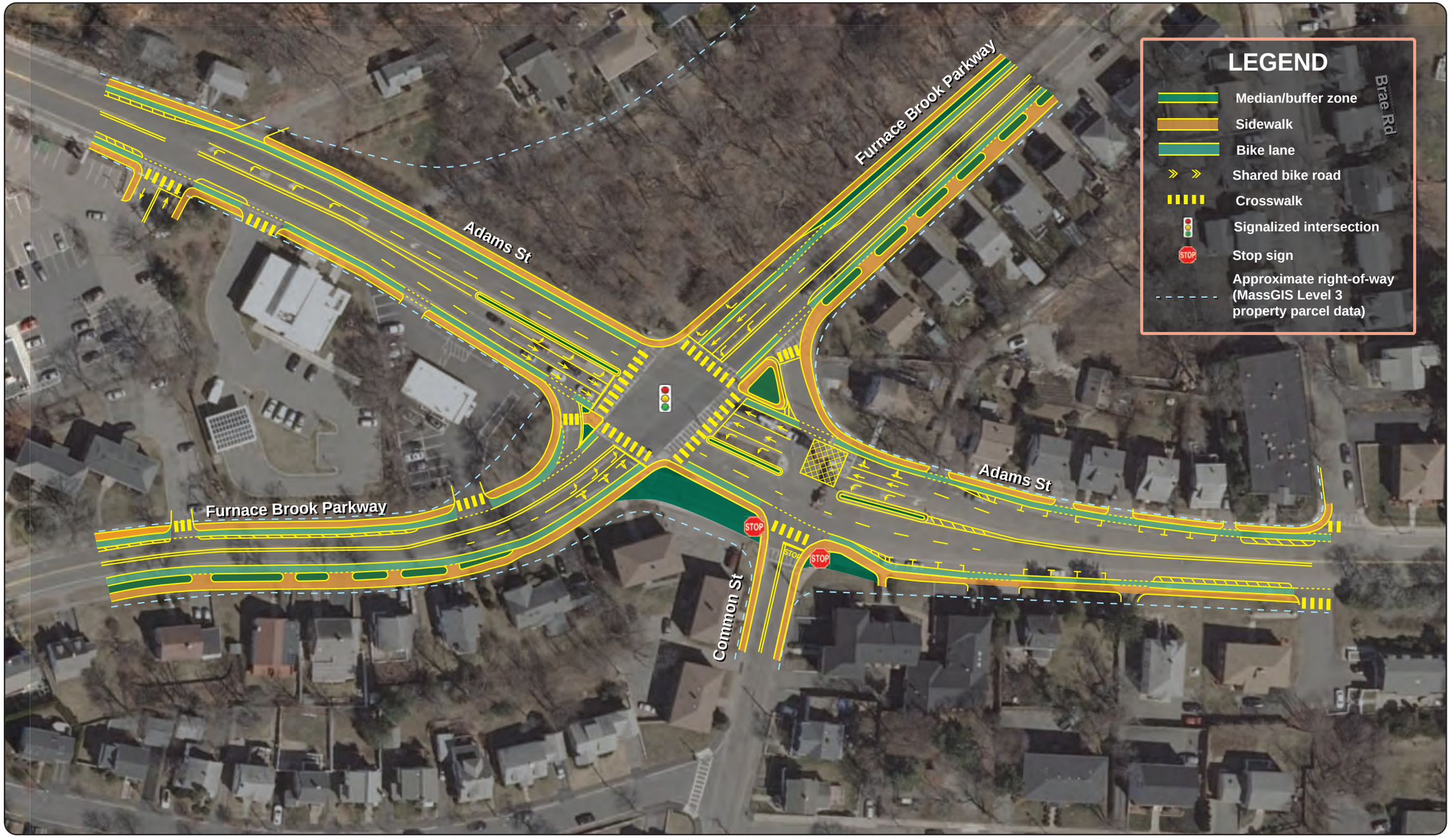

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Figure 4
Conceptual Plan: Proposed Long-Term Improvement Alternative 1
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis
at Selected MPO Intersections

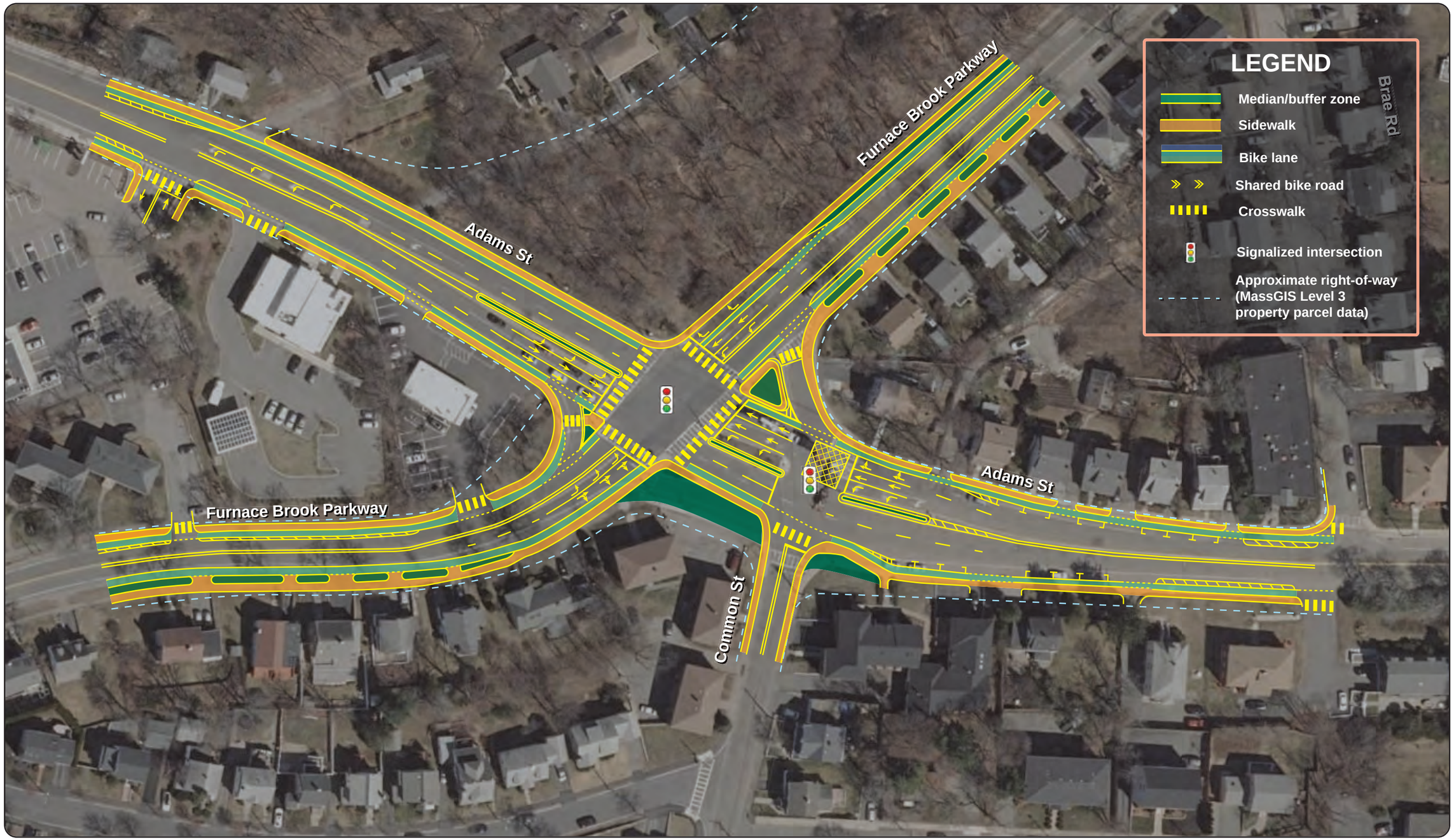

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Figure 5
Conceptual Plan: Proposed Long-Term Improvement Alternative 2
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis at Selected MPO Intersections

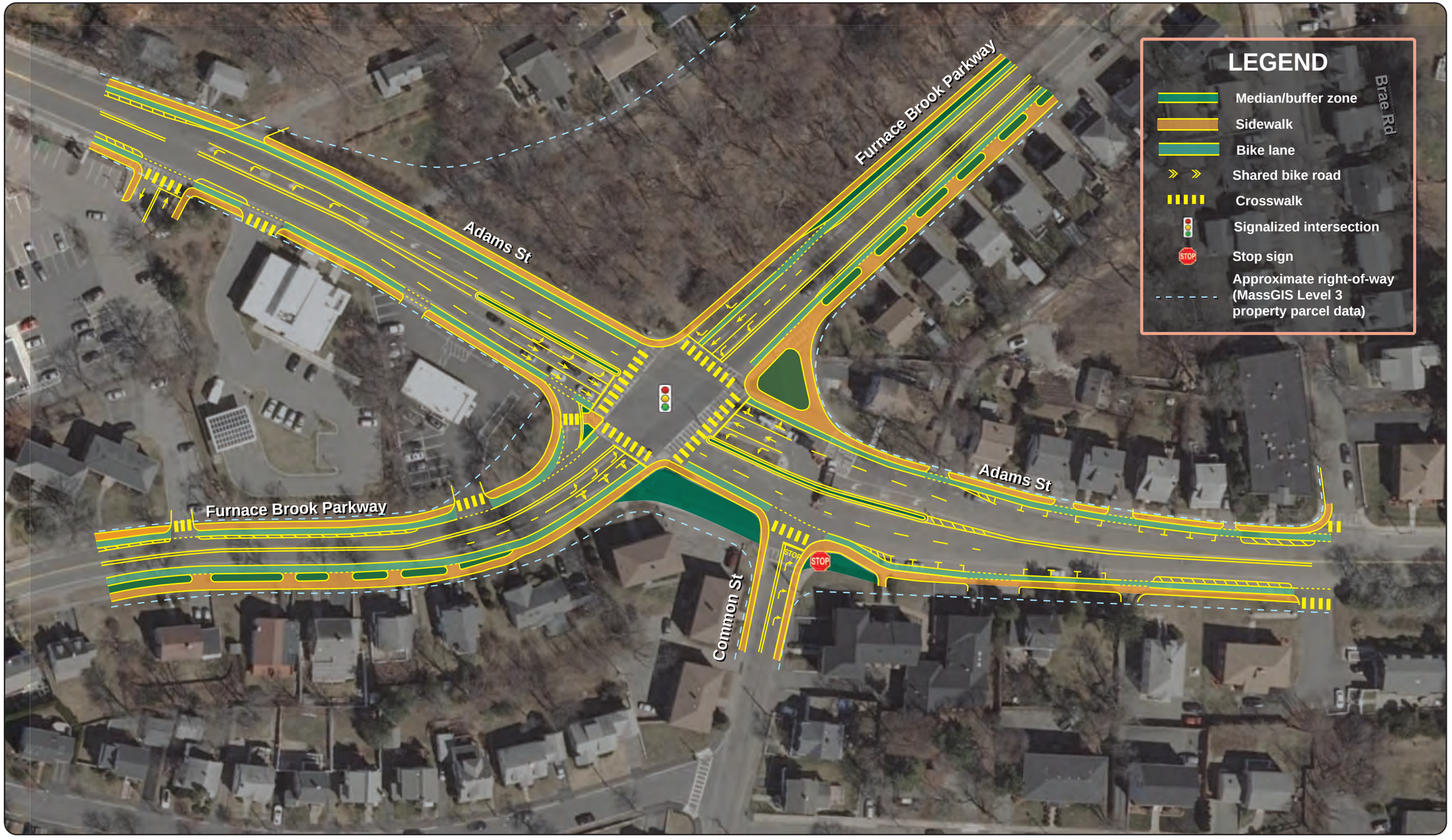

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Figure 6
Conceptual Plan: Proposed Long-Term Improvement Alternative 3
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis
at Selected MPO Intersections

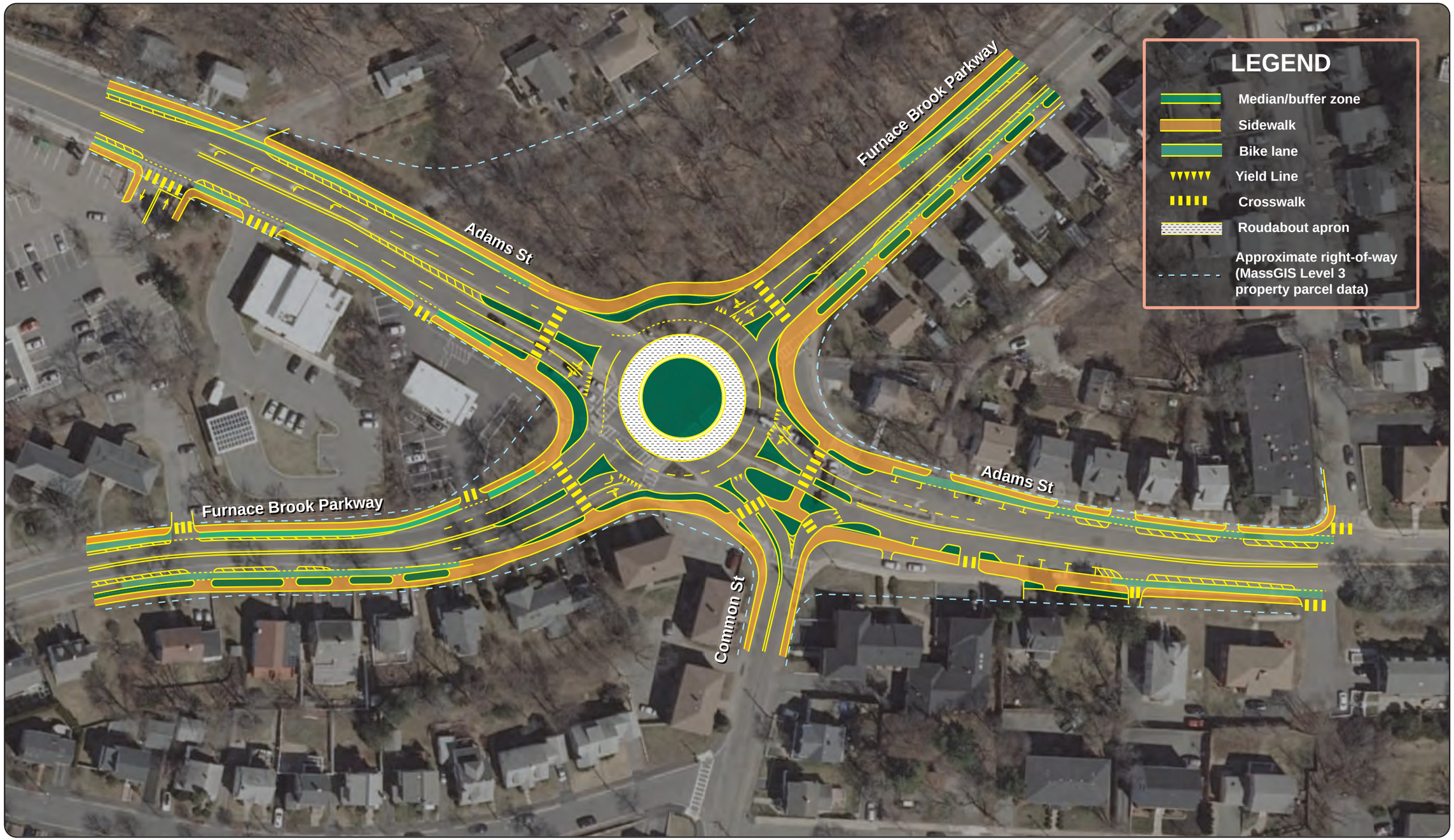

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Figure 7
Conceptual Plan: Proposed Long-Term Improvement Alternative 4
Adams Street at Furnace Brook Parkway and Common Street, Quincy

Safety and Operations Analysis at Selected MPO Intersections

Staff conducted the intersection capacity analyses for the no-build scenario and the four alternatives under the forecasted 2030 AM and PM peak-hour traffic conditions.[28] Appendix J contains a series of tables that summarize the capacity analysis results and Synchro reports that include input volumes, lane configurations, signal-timing settings, estimated delays and 95th percentile queue lengths by approaches for the no-build scenario and the four alternatives.

The analyses indicate that all the four alternatives would operate at acceptable levels of services in both the AM and PM peak hours. They would improve traffic operations over the no-build scenario and improve safety for all the users of the intersections.

Note that the capacity analyses do not explicitly indicate the safety benefits of the four alternatives. The addition of left-turn lanes in Alternatives 1, 2, and 3 would reduce left-turn crashes and reduce the severity of crashes. In addition, these alternatives would improve safety for pedestrians and bicyclists by shortening crossing distance and adding sidewalks and bicycle accommodation and detection. Among them, Alternative 3 would change the traffic patterns in the area and have significant impacts to the neighborhoods on Common Street and Furnace Brook Parkway.[29] This alternative and these issues should be further discussed and examined at the functional design stage.

Alternative 4 (modern roundabout conversion) would significantly slow down the traffic at the intersection and reduce the severity of crashes. It would require two circulatory lanes and a much larger footprint than Alternatives 1, 2, and 3.[30] Meanwhile, pedestrians and bicyclists would need to take longer and indirect paths to cross the roundabout. Due to the high traffic volumes and the significant number of pedestrian and bicyclist crossings, further examination should be done to determine if traffic signals are required at the crosswalk locations.

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[28] Staff estimated that the intersection would have about five percent traffic growth (about 0.5 percent per year) in the AM peak hour and six percent traffic growth (about 0.6 percent per year) in the PM peak hour from 2020 to 2030, based on analysis of the historical counts and consideration of traffic growth at Quincy Center.

[29] Presumably, most of the traffic using Common Street as a cut-through route would switch back to Furnace Brook Parkway. Common Street neighborhoods would benefit from reduced traffic, although the residents may also need to take a longer path to reach the north and west of the intersection. In the capacity analysis of Alternative 3, this study assumed that all the northbound through and left-turn movements on Common Street would divert to the Furnace Brook Parkway northbound approach. The analysis indicates that the northbound approach would have longer traffic queues and require about 50 feet more left-turn storage than Alternatives 1 and 2.

[30] As shown in Figure 7, MassGIS Level 3 standardized assessors' parcel data indicate that the roundabout could potentially be constructed without taking lands from adjacent private properties.

8 RECOMMENDATIONS

This study performed a series of safety and operations analyses, identified issues and concerns, and proposed short- and long-term improvements at the intersection. The proposed short-term improvements would enhance safety and operations for the intersection under the existing conditions. With a relatively high benefit/cost ratio, these improvements should be implemented as soon as resources are available from highway maintenance or local Chapter 90 funding.

The proposed long-term improvements—such as reconstructing the two intersections by adding necessary turning lanes, installing sidewalks, crosswalks and bicycle accommodations, and renovating the signal system to include count-down pedestrian assessable signals and bicycle detection—would significantly address the safety and operational problems at both intersections. At this preliminary planning stage, staff consider all alternatives feasible.

Staff presented the study findings and proposed improvement alternatives to the City of Quincy and MassDOT on February 11, 2021, via ZOOM video conference. The City considered the long-term improvement Alternatives 2 and 4 more favorable than the other alternatives and suggested that variations of the modern roundabouts (Alternative 4), such as an ellipse or a “peanut” shape roundabout, should be further examined at the design stage. (See Appendix K for the comments from the City.)

DCR has jurisdiction of the intersection of Adams Street at Furnace Brook Parkway and the City of Quincy has jurisdiction of the intersection of Adams Street at Common Street. This study gives the City an opportunity to address the needs of both intersections and plan for design and engineering.

The next steps would be to advance the project through the planning process to the functional design stage and select the preferred alternative that meets the goals and needs of all stakeholders, including residents and business owners. These steps will depend upon cooperation between the City, DCR, and MassDOT, which can begin the project notification and review process and complete the project initiation form. After completing a preliminary design, preferably an approved 25-percent functional design, the City can submit the project for inclusion in the Boston Region MPO’s Transportation Improvement Program. Project development is a complicated process that takes transportation improvements from concept to construction and is influenced by factors such as financial limitations and agency programmatic commitments. (See Appendix L for an overview of this process.)

This study supports the MPO's visions and goals, which include increasing transportation safety, maintaining the transportation system, advancing mobility and access, reducing congestion, and expanding the opportunities for walking and bicycling, while making these activities safer. If implemented, the improvements proposed in this report would modernize the roadway and significantly improve safety and mobility of all users. As with all conceptual level studies and recommendations, a further more detailed engineering examination should be conducted before implementing any of this study's recommendations.

cc: Allison Ruel, City of Quincy
Makaela Niles, MassDOT Office of Transportation Planning

Appendices

The Boston Region Metropolitan Planning Organization (MPO) operates its programs, services, and activities in compliance with federal nondiscrimination laws including Title VI of the Civil Rights Act of 1964 (Title VI), the Civil Rights Restoration Act of 1987, and related statutes and regulations. Title VI prohibits discrimination in federally assisted programs and requires that no person in the United States of America shall, on the grounds of race, color, or national origin (including limited English proficiency), be excluded from participation in, denied the benefits of, or be otherwise subjected to discrimination under any program or activity that receives federal assistance. Related federal nondiscrimination laws administered by the Federal Highway Administration, Federal Transit Administration, or both, prohibit discrimination on the basis of age, sex, and disability. The Boston Region MPO considers these protected populations in its Title VI Programs, consistent with federal interpretation and administration. In addition, the Boston Region MPO provides meaningful access to its programs, services, and activities to individuals with limited English proficiency, in compliance with U.S. Department of Transportation policy and guidance on federal Executive Order 13166.

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Title VI Specialist
Boston Region MPO
10 Park Plaza, Suite 2150
Boston, MA 02116
civilrights@ctps.org
857.702.3700 (voice)
617.570.9193 (TTY)

APPENDIX A

Crash Data Summary
Quincy Police Crash Reports
January 2015–November 2019

Summary of Crash Data
Quincy Police Crash Reports January 2015–November 2019

Index	Crash Date	Day	Time	Crash Severity	Manner of Collision	Road Conditions	Ambien Light Conditions	Weather Conditions	Vehicel Action Veh #1	Vehicel Action Veh #2	Most Harmful Event	Driver Contributing Code
1	1/9/2015	Friday	14:02	PDO	Angle	Wet	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
2	1/10/2015	Saturday	23:16	PDO	Sideswipe,same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Parked	Collision with motor vehicle in traffic	Unknown
3	1/29/2015	Thursday	15:37	PDO	Angle	Wet	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
4	4/5/2015	Sunday	19:30	Non-fatal-injury	Angle	Dry	Dusk	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Other improper action
5	4/9/2015	Thursday	8:57	PDO	Angle	Wet	Daylight	Rain	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
6	4/18/2015	Saturday	12:06	Non-fatal-injury	Angle	Dry	Daylight	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	No improper driving
7	4/23/2015	Thursday	8:31	PDO	Angle	Dry	Daylight	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Distracted
8	5/4/2015	Monday	14:55	PDO	Sideswipe,same direction	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Made an improper turn
9	5/27/2015	Wednesday	11:03	PDO	Rear-end	Dry	Daylight	Clear	Turning right	Turning right	Collision with motor vehicle in traffic	Operating defective equipment
10	5/31/2015	Sunday	13:09	PDO	Head on	Dry	Daylight	Cloudy	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
11	6/8/2015	Monday	17:54	PDO	Angle	Dry	Daylight	Cloudy	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Failed to yield right of way
12	6/17/2015	Wednesday	7:26	PDO	Angle	Dry	Daylight	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
13	6/27/2015	Saturday	21:21	PDO	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	No improper driving
14	7/21/2015	Tuesday	16:00	Non-fatal-injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Unknown
15	8/10/2015	Monday	14:48	PDO	Rear-end	Dry	Daylight	Clear	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
16	8/27/2015	Thursday	18:40	Non-fatal-injury	Angle	Dry	Dusk	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
17	9/17/2015	Thursday	21:26	PDO	Sideswipe,same direction	Dry	Dark - lighted roadway	Clear	Parked		Collision with parked motor vehicle	
18	9/18/2015	Friday	14:22	Non-fatal-injury	Unknown	Dry	Daylight	Clear	Backing		Collision with pedestrian	Unknown
19	10/7/2015	Wednesday	17:20	Non-fatal-injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Inattention
20	10/18/2015	Sunday	17:48	PDO	Rear-end	Dry	Dusk	Clear	Slowing or stopped	Slowing or stopped	Collision with motor vehicle in traffic	Followed too closely
21	10/29/2015	Thursday	15:53	Non-fatal-injury	Single vehicle crash	Dry	Daylight	Clear	Slowing or stopped		Collision with pedestrian	Unknown
22	11/12/2015	Thursday	16:37	Non-fatal-injury	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
23	11/30/2015	Monday	17:23	PDO	Sideswipe,same direction	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
24	12/8/2015	Tuesday	16:35	PDO	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
25	12/20/2015	Sunday	12:12	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Disregarded traffic signs, signals, road markings
26	12/22/2015	Tuesday	19:24	Non-fatal-injury	Angle	Wet	Dark - lighted roadway	Rain	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
27	1/15/2016	Friday	8:01	PDO	Sideswipe,same direction	Dry	Daylight	Clear	Travelling straight ahead	Changing lanes	Collision with motor vehicle in traffic	Inattention
28	2/25/2016	Thursday	7:08	PDO	Rear-end	Wet	Daylight	Rain	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
29	3/9/2016	Wednesday	13:34	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
30	3/12/2016	Saturday	16:04	Non-fatal-injury	Sideswipe,opposit direction	Dry	Daylight	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
31	3/22/2016	Tuesday	7:56	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	No improper driving
32	5/15/2016	Sunday	17:44	PDO	Sideswipe,same direction	Dry	Daylight	Cloudy	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	
33	5/20/2016	Friday	18:55	PDO	Angle	Dry	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
34	5/28/2016	Saturday	18:32	PDO	Angle	Dry	Daylight	Clear	Backing	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
35	7/17/2016	Sunday	19:06	Non-fatal-injury	Rear-end	Dry	Dusk	Clear	Travelling straight ahead	Slowing or stopped	Collision with motor vehicle in traffic	Glare
36	7/18/2016	Monday	14:33	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Made an improper turn
37	7/27/2016	Wednesday	21:25	Non-fatal-injury	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
38	8/3/2016	Wednesday	11:20	PDO	Sideswipe,same direction	Dry	Daylight	Clear	Changing lanes	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
39	9/8/2016	Thursday	16:24	Non-fatal-injury	Angle	Dry	Daylight	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Failure to keep in proper lane or running off road
40	9/9/2016	Friday	18:13	PDO	Angle	Dry	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
41	10/1/2016	Saturday	12:21	PDO	Angle	Wet	Daylight	Rain	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Visibility obstructed
42	11/7/2016	Monday	11:26	Non-fatal-injury	Angle	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Failed to yield right of way
43	11/11/2016	Friday	17:45	PDO	Rear-end	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Slowing or stopped	Collision with motor vehicle in traffic	Inattention
44	11/18/2016	Friday	8:28	PDO	Single vehicle crash	Dry	Daylight	Clear	Travelling straight ahead		Collision with curb	No improper driving
45	1/6/2017	Friday	18:14	Non-fatal-injury	Angle	Dry	Dark - lighted roadway	Cloudy	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Operating vehicle in erratic, rackless, careless, negligent or aggressive manner
46	1/19/2017	Thursday	17:18	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Made an improper turn
47	1/26/2017	Thursday	16:03	PDO	Angle	Wet	Daylight	Rain	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
48	1/27/2017	Friday	17:52	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
49	2/16/2017	Thursday	17:04	PDO	Angle	Dry	Daylight	Clear	Turning right	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
50	3/6/2017	Monday	8:16	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Failed to yield right of way
51	4/27/2017	Thursday	17:16	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Inattention
52	5/13/2017	Saturday	22:24	PDO	Sideswipe,same direction	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
53	5/16/2017	Tuesday	19:10	Non-fatal-injury	Angle	Dry	Dusk	Clear	Turning left		Collision with cyclist	No improper driving
54	6/18/2017	Sunday	14:41	Non-fatal-injury	Angle	Dry	Daylight	Cloudy	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
55	7/27/2017	Thursday	18:25	PDO	Angle	Wet	Daylight	Cloudy	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
56	7/27/2017	Thursday	20:53	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Made an improper turn
57	7/27/2017	Thursday	21:02	PDO	Rear-end	Dry	Dark - lighted roadway	Clear	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	Other improper action

Summary of Crash Data
Quincy Police Crash Reports January 2015–November 2019

Index	Crash Date	Day	Time	Crash Severity	Manner of Collision	Road Conditions	Ambien Light Conditions	Weather Conditions	Vehicel Action Veh #1	Vehicel Action Veh #2	Most Harmful Event	Driver Contributing Code
58	9/1/2017	Friday	15:47	PDO	Sideswipe,same direction	Dry	Daylight	Clear	Entering traffic lane	Entering traffic lane	Collision with motor vehicle in traffic	Unknown
59	9/7/2017	Thursday	17:29	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
60	10/18/2017	Wednesday	18:03	PDO	Rear-end	Wet	Dusk	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Failed to yield right of way
61	10/20/2017	Friday	20:25	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
62	11/3/2017	Friday	17:55	PDO	Rear-end	Dry	Dark - lighted roadway	Cloudy	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	No improper driving
63	11/9/2017	Thursday	9:35	PDO	Head on	Dry	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
64	11/18/2017	Saturday	14:40	PDO	Angle	Dry	Daylight	Cloudy	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
65	12/1/2017	Friday	10:31	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
66	12/1/2017	Friday	17:35	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
67	12/12/2017	Tuesday	17:58	PDO	Angle	Wet	Dark - lighted roadway	Cloudy	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
68	12/20/2017	Wednesday	17:28	Non-fatal-injury	Angle	Dry	Dark - lighted roadway	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
69	1/3/2018	Wednesday	18:02	PDO	Angle	Dry	Dark - lighted roadway	Clear	Entering traffic lane	Travelling straight ahead	Collision with motor vehicle in traffic	No improper driving
70	1/12/2018	Friday	15:11	PDO	Angle	Wet	Daylight	Rain	Travelling straight ahead	Turning right	Collision with motor vehicle in traffic	Inattention
71	2/3/2018	Saturday	12:32	PDO	Angle	Wet	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
72	2/8/2018	Thursday	13:45	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
73	4/4/2018	Wednesday	19:41	PDO	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Followed too closely
74	4/6/2018	Friday	7:29	PDO	Head on	Dry	Daylight	Clear	Slowing or stopped	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
75	4/7/2018	Saturday	12:56	PDO	Sideswipe,same direction	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	No improper driving
76	4/27/2018	Friday	13:10	PDO	Angle	Wet	Daylight	Rain	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
77	6/4/2018	Monday	12:21	Non-fatal-injury	Angle	Wet	Daylight	Rain	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
78	6/21/2018	Thursday	7:38	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
79	7/27/2018	Friday	12:57	PDO	Angle	Dry	Daylight	Clear	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Failed to yield right of way
80	8/8/2018	Wednesday	19:25	PDO	Angle	Wet	Dusk	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
81	8/27/2018	Monday	8:46	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Unknown
82	9/6/2018	Thursday	17:25	PDO	Angle	Wet	Daylight	Rain	Entering traffic lane	Overtaking/passing	Collision with motor vehicle in traffic	Failure to keep in proper lane or running off road
83	10/9/2018	Tuesday	17:11	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Overtaking/passing	Collision with motor vehicle in traffic	Disregarded traffic signs, signals, road markings
84	10/16/2018	Tuesday	12:32	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Entering traffic lane	Collision with motor vehicle in traffic	Failed to yield right of way
85	10/23/2018	Tuesday	18:31	PDO	Angle	Wet	Dark - lighted roadway	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
86	12/18/2018	Tuesday	6:07	PDO	Sideswipe,same direction	Ice	Dark - lighted roadway	Blowing Sand, sno	Travelling straight ahead		Collision with motor vehicle in traffic	No improper driving
87	12/19/2018	Wednesday	18:52	PDO	Angle	Dry	Dark - lighted roadway	Clear	Turning left	Slowing or stopped	Collision with motor vehicle in traffic	Made an improper turn
88	1/7/2019	Monday	18:38	Non-fatal-injury	Angle	Dry	Dark - lighted roadway	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
89	1/8/2019	Tuesday	16:55	PDO	Angle	Wet	Dark - lighted roadway	Rain	Turning left	Travelling straight ahead	Collision with motor vehicle in traffic	Disregarded traffic signs, signals, road markings
90	1/24/2019	Thursday	11:53	PDO	Angle	Wet	Daylight	Rain	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
91	2/13/2019	Wednesday	6:15	Non-fatal-injury	Angle	Slush	Dawn	Rain	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Unknown
92	3/12/2019	Tuesday	18:01	PDO	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
93	3/28/2019	Thursday	18:07	PDO	Rear-end	Dry	Daylight	Clear	Travelling straight ahead	Slowing or stopped	Collision with motor vehicle in traffic	Followed too closely
94	4/3/2019	Wednesday	20:32	Non-fatal-injury	Angle	Wet	Dark - lighted roadway	Cloudy	Travelling straight ahead	Travelling straight ahead	Collision with motor vehicle in traffic	Inattention
95	4/14/2019	Sunday	12:20	PDO	Sideswipe,opposit direction	Dry	Daylight	Cloudy	Slowing or stopped	Turning right	Collision with motor vehicle in traffic	Made an improper turn
96	8/26/2019	Monday	17:13	PDO	Angle	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Made an improper turn
97	9/23/2019	Monday	12:49	Non-fatal-injury	Head on	Dry	Daylight	Clear	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Failed to yield right of way
98	10/9/2019	Wednesday	12:22	PDO	Angle	Wet	Daylight	Rain	Travelling straight ahead	Turning left	Collision with motor vehicle in traffic	Made an improper turn

APPENDIX B

Quincy Intersection Study Count Request
November 2019

Commonwealth of Massachusetts
DEPARTMENT OF TRANSPORTATION
Office of Transportation Planning

MEMORANDUM

TO:	Bonnie Polin, Manager Highway Safety Programs, Traffic Operations
THROUGH:	David Mohler, Executive Director
FROM:	Ethan Britland, Manager Multi-Modal Planning
DATE:	November 7, 2019
RE:	Traffic Count Request: Adams Street at Furnace Brook Parkway in Quincy

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The Office of Transportation Planning requests that the Highway Division collect the following data in the vicinity of Adams Street at Furnace Brook Parkway in Quincy:

- Turning movement counts (TMC) at three locations
- Spot speed study/automatic traffic recorder (ATR) counts at four locations

Descriptions of the sites along with a map showing count locations are attached. These counts are needed for the Safety and Operations Analysis at Selected Intersections Study recently begun by Central Transportation Planning Staff (CTPS) on behalf of MassDOT through funding from the Boston Region Metropolitan Planning Organization. These data should be collected in November before the Thanksgiving week (November 24) holidays or December before the Christmas week (December 22).

The TMC should be performed for the following periods on a mid-week day (Tuesday, Wednesday, or Thursday) and a Saturday:

- Weekday AM peak period (6:00 AM to 10:00 AM)
- Weekday PM peak period (2:00 PM to 6:00 PM)
- Saturday midday peak period (10:00 AM to 2:00 PM)

Please record the TMC data for **passenger cars, trucks and buses, pedestrians, and bicycles** separately.

For the spot speed study/ATR counts, a consecutive five-day (Tuesday through Saturday) count should be completed for each location. When the job is complete, please provide us with data sets in 15-minute intervals (TMC) and hourly intervals (spot speed study/ATR counts). If you have questions about this request, please contact me at (857) 368-8840.

Attachments: 1. List of TMC and spot speed study/ATR locations
2. Count locations graphic

cc: J. Amato, MassDOT – Traffic Data Collection
M. Niles, MassDOT– OTP
S. Peterson, CTPS

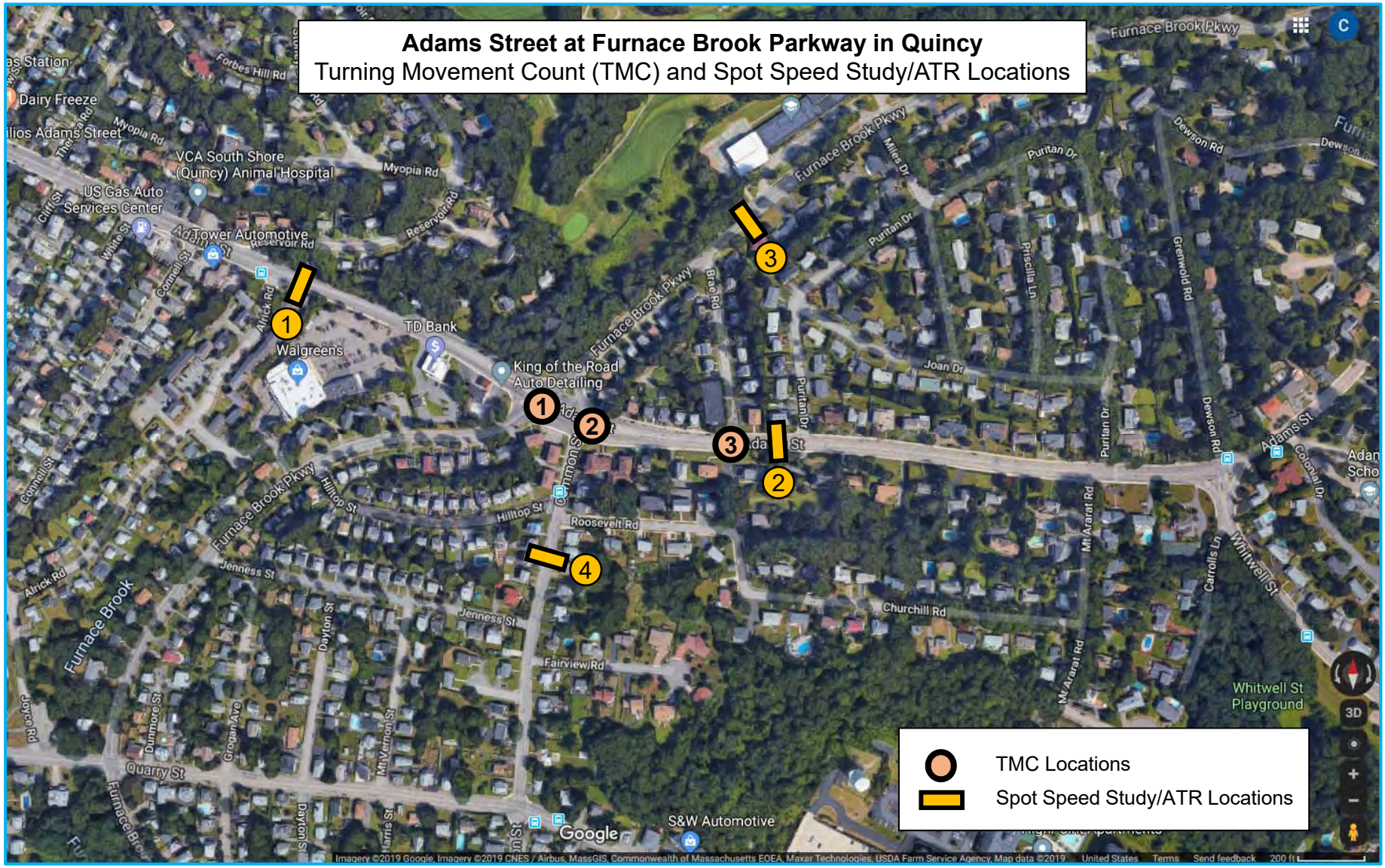
M. Abbott, CTPS
C. Wang, CTPS

List of Turning Movement Counts (TMC) Needed, by Location

1. Adams Street at Furnace Brook Parkway
2. Adams Street at Common Street
3. Adams Street at Brae Road (including the driveway on the south side of Adams Street)

List of Spot Speed Study/ATR Counts Needed, by Location

1. Adams Street east of Alrick Road
2. Adams Street east of Brae Road
3. Furnace Brook Parkway north Brae Road (near Bernazzani Elementary School)
4. Common Street south of Roosevelt Road


Adams Street at Furnace Brook Parkway in Quincy
Turning Movement Count (TMC) and Spot Speed Study/ATR Locations
TMC Locations
Spot Speed Study/ATR Locations
Furnace Brook Pkwy
Forbes Hill Rd
Myopia Rd
VCA South Shore (Quincy) Animal Hospital
US Gas Auto Services Center
Tower Automotive
Reservoir Rd
Alrick Rd
TD Bank
Walgreens
King of the Road Auto Detailing
Brae Rd
Miles Dr
Puritan Dr
Priscilla Ln
Grenwold Rd
Dewson Rd
Joan Dr
Adams St
Colonial Dr
Mt Ararat Rd
Carrolls Ln
Whitwell St
Whitwell St Playground
Churchill Rd
Roosevelt Rd
Hilltop St
Jenness St
Fairview Rd
Furnace Brook
Dayton St
Dunmore St
Grogan Ave
Mt Vernon St
Quarry St
Harris St
Joyce Rd
Connell St
Cliff St
White St
Common St
S&W Automotive
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Commonwealth of Massachusetts
DEPARTMENT OF TRANSPORTATION
Office of Transportation Planning

MEMORANDUM

TO:	Carrie McInerney, Manager of Advanced Transportation Technologies
THROUGH:	David Mohler, Executive Director
FROM:	Ethan Britland, Manager Multi-Modal Planning
DATE:	September 11, 2020
RE:	Traffic Count Request: Adams Street at Furnace Brook Parkway in Quincy

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The Office of Transportation Planning requests that the Highway Division collect the following data in the vicinity of Adams Street at Furnace Brook Parkway in Quincy:

- Turning movement counts (TMC) at Adams Street and Furnace Brook Parkway
- TMC at Adams Street and Common Street

Descriptions of the sites with a map showing count locations is attached. These counts are needed for the Safety and Operations Analysis at Selected Intersections Study recently begun by Central Transportation Planning Staff (CTPS) on behalf of MassDOT through funding from the Boston Region Metropolitan Planning Organization. These data should be collected before October 11, 2020.

The TMC should be performed for the following periods on a mid-week day (Tuesday, Wednesday, or Thursday) and a Saturday:

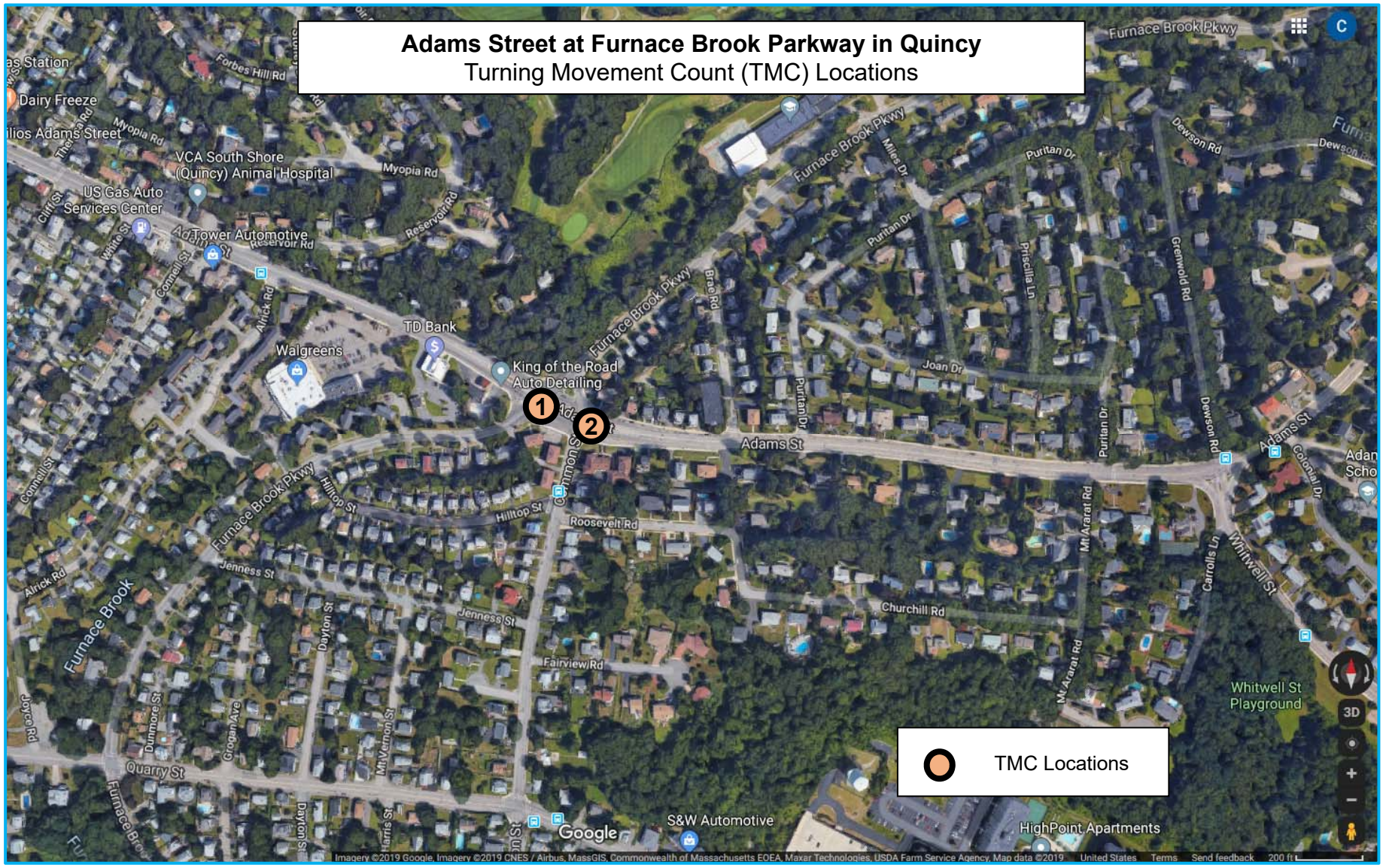
- Weekday AM peak period (6:00 AM to 10:00 AM)
- Weekday PM peak period (2:00 PM to 6:00 PM)
- Saturday midday peak period (10:00 AM to 2:00 PM)

Please record the TMC data for **passenger cars, trucks and buses, pedestrians, and bicycles** separately.

If you have questions about this request, please contact me at (857) 368-8840.

Attachments: Count locations graphic

cc: J. Amato, MassDOT – Traffic Data Collection
M. Niles, MassDOT– OTP
S. Peterson, CTPS
M. Abbott, CTPS
C. Wang, CTPS


Adams Street at Furnace Brook Parkway in Quincy
Turning Movement Count (TMC) Locations
Furnace Brook Pkwy
Forbes Hill Rd
Dairy Freeze
Myopia Rd
VCA South Shore (Quincy) Animal Hospital
US Gas Auto Services Center
Tower Automotive
Reservoir Rd
Cliff St
White St
Connell St
Alrick Rd
TD Bank
Walgreens
King of the Road Auto Detailing
Brae Rd
Miles Dr
Puritan Dr
Priscilla Ln
Grenwold Rd
Dewson Rd
Joan Dr
Adams St
Colonial Dr
Hilltop St
Roosevelt Rd
Mt Ararat Rd
Carrolls Ln
Whitwell St
Churchill Rd
Jenness St
Furnace Brook
Dayton St
Fairview Rd
Whitwell St Playground
Joyce Rd
Dunmore St
Grogan Ave
Mt Vernon St
Quarry St
Harris St
S&W Automotive
HighPoint Apartments
Google
TMC Locations
1
2
3D
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APPENDIX C

Automatic Traffic Count Data
February 2020

Location ID	S20-005-243-01_EB	Located On	ADAMS STREET	Community	Quincy
Counted By		Between	ALRICK ROAD	County	Norfolk
Start Date	2/27/2020	And	FURNACE BROOK PARKWAY	Module	
Start Time	11:00:00 AM	Direction	EB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	34	2	0	0	0	0	0	0	0	0	0	0	0	0	36
1:00 AM	0	19	2	0	1	0	0	0	0	0	0	0	0	0	0	22
2:00 AM	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	13
3:00 AM	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	18
4:00 AM	0	26	8	0	0	1	0	0	0	0	0	0	0	0	0	35
5:00 AM	0	68	8	0	0	0	0	0	0	0	0	0	0	0	0	76
6:00 AM	0	212	49	0	2	1	0	0	0	0	0	0	0	0	0	264
7:00 AM	0	469	52	0	1	2	0	1	0	0	0	0	0	0	0	525
8:00 AM	0	430	40	1	4	2	0	0	0	0	0	1	0	0	0	478
9:00 AM	1	377	50	1	4	1	0	1	0	0	0	0	0	0	0	435
10:00 AM	0	423	80	0	6	1	0	1	0	0	0	0	0	0	0	511
11:00 AM	3	367	40	0	6	1	0	0	0	0	0	0	0	0	0	417
12:00 PM	2	390	83	0	3	0	0	0	1	0	0	0	0	0	0	479
1:00 PM	1	421	69	1	5	0	0	2	1	0	0	0	0	0	0	500
2:00 PM	2	502	84	1	5	1	0	0	0	0	0	0	0	0	0	595
3:00 PM	3	555	80	0	6	0	0	1	0	0	0	0	0	0	0	645
4:00 PM	2	620	66	0	3	1	0	0	0	0	0	0	0	0	0	692
5:00 PM	2	699	68	2	0	0	0	0	0	0	0	0	0	0	0	771
6:00 PM	0	504	39	0	1	0	0	0	0	0	0	1	0	0	0	545
7:00 PM	0	303	34	0	1	0	0	0	0	0	0	0	0	0	0	338
8:00 PM	1	285	16	0	2	0	0	0	0	0	0	0	0	0	0	304
9:00 PM	0	184	14	0	0	0	0	0	0	0	0	0	0	0	0	198
10:00 PM	0	121	7	0	0	0	0	0	0	0	0	0	0	0	0	128
11:00 PM	0	66	9	0	0	0	0	0	0	0	0	0	0	0	0	75
TOTAL	17	7103	903	6	50	11	0	6	2	0	0	2	0	0	0	8100

Location ID	S20-005-243-01_WB	Located On	ADAMS STREET	Community	Quincy
Counted By		Between	ALRICK ROAD	County	Norfolk
Start Date	2/27/2020	And	S	Module	
Start Time	11:00:00 AM	Direction	WB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	32	3	0	0	0	0	0	0	0	0	0	0	0	0	35
1:00 AM	0	17	0	0	1	0	0	0	0	0	0	0	0	0	0	18
2:00 AM	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	12
3:00 AM	0	11	3	0	1	0	0	0	0	0	0	0	0	0	0	15
4:00 AM	0	17	4	0	2	1	0	0	0	0	0	0	0	0	0	24
5:00 AM	0	129	27	0	2	0	0	0	0	0	0	0	0	0	0	158
6:00 AM	0	427	81	2	5	1	0	1	0	0	0	1	0	0	0	518
7:00 AM	1	713	103	2	6	1	0	0	1	0	2	1	0	0	0	830
8:00 AM	0	573	83	1	3	0	0	2	0	0	0	0	0	0	0	662
9:00 AM	0	390	67	1	8	1	0	0	0	0	0	1	0	0	0	468
10:00 AM	0	382	69	0	4	1	1	0	1	0	0	0	0	0	0	458
11:00 AM	0	370	53	0	6	3	0	0	0	0	0	0	0	0	0	432
12:00 PM	1	403	61	3	7	1	0	0	1	0	1	0	0	0	0	478
1:00 PM	0	381	57	1	4	0	0	1	0	0	0	4	0	0	0	448
2:00 PM	0	525	63	2	2	1	0	1	0	0	0	0	0	0	0	594
3:00 PM	0	440	72	1	5	0	0	0	0	0	0	0	0	0	0	518
4:00 PM	1	475	63	2	4	0	0	0	1	0	0	0	0	0	0	546
5:00 PM	0	550	56	0	6	0	0	2	0	0	1	0	0	0	0	615
6:00 PM	1	467	33	1	1	0	0	0	0	0	0	0	0	0	0	503
7:00 PM	0	333	38	0	0	0	0	0	0	0	0	0	0	0	0	371
8:00 PM	0	232	17	1	0	0	1	0	0	0	0	0	1	0	0	252
9:00 PM	0	168	13	0	0	0	0	0	0	0	0	0	0	0	0	181
10:00 PM	0	80	8	0	0	0	0	0	0	0	0	0	0	0	0	88
11:00 PM	0	35	6	0	1	0	0	0	0	0	0	0	0	0	0	42
TOTAL	4	7160	982	17	68	10	2	7	4	0	4	7	1	0	0	8266

Location ID	S20-005-243-02_EB	Located On	ADAMS STREET	Community	Quincy
Counted By		Between	COMMON STREET	County	Norfolk
Start Date	2/27/2020	And	BRAE ROAD	Module	
Start Time	11:00:00 AM	Direction	EB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	23	1	0	0	0	0	0	0	0	0	0	0	0	0	24
1:00 AM	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	15
2:00 AM	0	6	1	0	1	0	0	0	0	0	0	0	0	0	0	8
3:00 AM	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4
4:00 AM	0	20	2	0	0	0	0	0	0	0	0	0	0	0	0	22
5:00 AM	0	57	4	0	0	0	0	0	0	0	0	0	0	0	0	61
6:00 AM	0	131	20	0	1	1	0	1	0	0	0	0	0	0	0	154
7:00 AM	1	339	63	1	5	0	0	2	0	0	0	2	0	0	0	413
8:00 AM	0	302	48	1	9	3	0	0	0	0	0	0	0	0	0	363
9:00 AM	2	260	53	1	5	1	0	1	0	0	0	0	0	0	0	323
10:00 AM	0	245	36	0	6	0	0	1	0	0	0	0	0	0	0	288
11:00 AM	0	241	42	0	4	0	0	0	0	0	0	0	0	0	0	287
12:00 PM	2	235	51	0	7	2	0	2	0	0	0	0	0	0	0	299
1:00 PM	1	281	66	1	1	2	0	0	0	0	0	0	0	0	0	352
2:00 PM	1	286	71	1	4	3	0	1	0	0	0	0	1	0	0	368
3:00 PM	0	306	55	2	1	0	0	0	0	0	0	0	0	0	0	364
4:00 PM	0	386	69	1	2	1	0	1	0	0	0	0	0	0	0	460
5:00 PM	0	413	69	0	4	0	0	0	0	0	1	0	1	0	0	488
6:00 PM	2	326	38	0	3	0	0	1	1	0	1	0	0	0	0	372
7:00 PM	0	203	32	0	0	0	1	0	0	0	0	0	0	0	0	236
8:00 PM	1	185	20	1	0	0	0	0	0	0	0	0	0	0	0	207
9:00 PM	0	111	16	0	0	0	1	0	0	0	0	0	0	0	0	128
10:00 PM	0	76	12	0	0	0	0	0	0	0	0	0	0	0	0	88
11:00 PM	0	42	2	0	0	0	0	0	0	0	0	0	0	0	0	44
TOTAL	10	4493	771	9	53	13	2	10	1	0	2	2	2	0	0	5368

Location ID	S20-005-243-02_WB	Located On	ADAMS STREET	Community	Quincy
Counted By		Between	COMMON STREET	County	Norfolk
Start Date	2/27/2020	And	BRAE ROAD	Module	
Start Time	11:00:00 AM	Direction	WB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	24	2	0	0	0	0	0	0	0	0	0	0	0	0	26
1:00 AM	0	12	1	0	0	0	0	0	0	0	0	0	0	0	0	13
2:00 AM	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0	10
3:00 AM	0	9	2	0	0	0	0	0	0	0	0	0	0	0	0	11
4:00 AM	0	16	1	0	1	1	1	1	0	0	0	0	0	0	0	21
5:00 AM	0	80	9	0	1	0	0	0	0	0	0	0	0	0	0	90
6:00 AM	1	227	32	0	4	0	0	1	1	0	1	0	0	0	0	267
7:00 AM	2	397	39	2	6	1	0	1	0	0	1	1	0	0	0	450
8:00 AM	1	332	38	1	3	1	0	3	0	0	0	0	0	0	0	379
9:00 AM	0	235	34	1	4	1	1	1	0	0	0	0	1	0	0	278
10:00 AM	0	252	28	0	2	1	0	0	0	0	0	0	0	0	0	283
11:00 AM	1	269	23	1	1	3	0	0	0	0	0	0	0	0	0	298
12:00 PM	2	274	24	1	4	0	0	0	1	0	0	0	0	0	0	306
1:00 PM	0	280	34	0	2	0	2	1	0	0	0	0	0	0	0	319
2:00 PM	2	302	25	0	1	1	1	0	0	0	0	0	0	0	0	332
3:00 PM	0	280	30	0	3	0	1	0	0	0	0	0	0	0	0	314
4:00 PM	1	337	23	0	3	0	1	0	1	0	0	0	0	0	0	366
5:00 PM	0	366	26	0	2	0	1	0	0	0	0	0	0	0	0	395
6:00 PM	1	294	16	0	2	0	0	0	0	0	0	0	0	0	0	313
7:00 PM	0	213	12	0	0	0	0	0	0	0	0	0	0	0	0	225
8:00 PM	0	169	7	0	1	0	0	0	0	0	0	0	0	0	0	177
9:00 PM	0	127	5	0	0	0	0	0	0	0	0	0	0	0	0	132
10:00 PM	0	68	7	0	0	0	0	0	0	0	0	0	0	0	0	75
11:00 PM	0	33	4	0	0	0	0	0	0	0	0	0	0	0	0	37
TOTAL	11	4604	424	6	40	9	8	8	3	0	2	1	1	0	0	5117

Location ID	S20-005-243-03_NB	Located On	FURNACE BROOK PARKWAY	Community	Quincy
Counted By		Between	ADAMS STREET	County	Norfolk
Start Date	2/27/2020	And	BRAE ROAD	Module	
Start Time	10:00:00 AM	Direction	NB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	31	3	0	0	0	0	0	0	0	0	0	0	0	0	34
1:00 AM	0	14	1	0	0	0	0	0	0	0	0	0	0	0	0	15
2:00 AM	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	6
3:00 AM	0	7	2	0	0	0	0	0	0	0	0	0	0	0	0	9
4:00 AM	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	11
5:00 AM	0	50	7	0	0	0	0	0	0	0	0	0	0	0	0	57
6:00 AM	0	151	26	0	0	0	0	0	0	0	0	0	0	0	0	177
7:00 AM	3	400	35	1	1	0	1	3	0	0	1	0	0	0	0	445
8:00 AM	5	299	40	0	1	0	0	2	0	0	0	0	1	0	0	348
9:00 AM	2	288	47	0	4	0	0	2	1	0	0	0	0	0	0	344
10:00 AM	7	330	35	1	0	0	1	0	0	0	0	0	0	0	0	374
11:00 AM	0	231	31	0	2	0	0	0	0	0	0	0	0	0	0	264
12:00 PM	0	234	28	0	1	0	0	0	0	0	0	0	0	0	0	263
1:00 PM	1	282	40	0	1	0	0	0	0	0	0	1	0	0	0	325
2:00 PM	0	296	39	1	1	0	0	0	0	0	0	0	0	0	0	337
3:00 PM	0	337	53	0	0	0	0	0	0	0	0	0	0	0	0	390
4:00 PM	0	364	39	0	1	0	0	0	0	0	0	0	0	0	0	404
5:00 PM	0	412	34	0	0	0	0	0	0	0	0	0	0	0	0	446
6:00 PM	1	343	28	0	1	0	0	0	0	0	0	0	0	0	0	373
7:00 PM	0	224	19	0	0	0	0	0	0	0	0	0	0	0	0	243
8:00 PM	0	201	12	0	0	0	0	0	0	0	0	0	0	0	0	213
9:00 PM	0	129	9	0	0	0	0	0	0	0	0	0	0	0	0	138
10:00 PM	0	77	9	0	0	0	0	0	0	0	0	0	0	0	0	86
11:00 PM	0	48	3	1	0	0	0	0	0	0	0	0	0	0	0	52
TOTAL	20	4764	540	4	13	0	2	7	1	0	1	1	1	0	0	5354

Location ID	S20-005-243-03_SB	Located On	FURNACE BROOK PARKWAY	Community	Quincy
Counted By		Between	ADAMS STREET	County	Norfolk
Start Date	2/27/2020	And	BRAE ROAD	Module	
Start Time	10:00:00 AM	Direction	SB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	26	3	0	0	0	0	0	0	0	0	0	0	0	0	29
1:00 AM	0	15	2	0	1	0	0	0	0	0	0	0	0	0	0	18
2:00 AM	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
3:00 AM	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	4
4:00 AM	0	15	3	0	0	0	0	0	0	0	0	0	0	0	0	18
5:00 AM	0	61	13	0	0	0	0	0	0	0	0	0	0	0	0	74
6:00 AM	0	188	29	0	2	0	0	0	0	0	0	0	0	0	0	219
7:00 AM	6	495	59	2	1	0	0	3	0	0	1	0	0	0	0	567
8:00 AM	1	381	34	1	1	0	2	0	0	0	0	0	0	0	0	420
9:00 AM	7	317	33	0	3	2	0	2	0	0	1	1	0	0	0	366
10:00 AM	7	326	45	0	2	0	0	3	0	0	0	0	0	0	0	383
11:00 AM	1	212	36	0	2	0	0	0	0	0	0	0	0	0	0	251
12:00 PM	1	263	37	0	1	1	0	0	0	0	0	0	0	0	0	303
1:00 PM	2	272	50	0	4	0	0	0	0	0	0	0	0	0	0	328
2:00 PM	0	378	58	1	1	0	0	0	2	0	0	0	0	0	0	440
3:00 PM	1	346	49	0	1	0	0	2	0	0	0	0	0	0	0	399
4:00 PM	2	452	49	0	2	0	0	2	0	0	0	1	0	0	0	508
5:00 PM	3	507	38	0	2	0	0	2	0	0	0	0	0	0	0	552
6:00 PM	0	328	26	0	1	0	0	0	0	0	0	0	0	0	0	355
7:00 PM	0	222	22	0	0	0	0	0	0	0	0	0	0	0	0	244
8:00 PM	0	163	12	0	0	0	0	0	0	0	0	0	0	0	0	175
9:00 PM	0	129	2	0	0	0	0	0	0	0	0	0	0	0	0	131
10:00 PM	0	67	6	0	0	0	0	0	0	0	0	0	0	0	0	73
11:00 PM	1	43	4	1	0	0	0	0	0	0	0	0	0	0	0	49
TOTAL	32	5217	612	5	24	3	2	14	2	0	2	2	0	0	0	5915

Location ID	S20-005-243-04_NB	Located On	COMMON STREET	Community	Quincy
Counted By		Between	ROOSEVELT ROAD	County	Norfolk
Start Date	2/27/2020	And	JENNESS STREET	Module	
Start Time	11:00:00 AM	Direction	NB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	16	3	0	0	0	0	0	0	0	0	0	0	0	0	19
1:00 AM	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	6
2:00 AM	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3
3:00 AM	0	8	1	0	0	0	0	0	0	0	0	0	0	0	0	9
4:00 AM	0	12	2	0	1	0	0	0	0	0	0	0	0	0	0	15
5:00 AM	0	52	12	0	1	0	0	0	0	0	0	0	0	0	0	65
6:00 AM	0	148	16	1	4	1	0	0	0	0	0	0	0	0	0	170
7:00 AM	1	283	26	1	4	0	1	3	1	0	0	0	0	0	0	320
8:00 AM	0	248	21	4	2	1	0	8	0	0	0	0	0	0	0	284
9:00 AM	0	132	29	0	4	2	0	2	0	0	0	1	0	0	0	170
10:00 AM	1	129	22	1	4	2	0	2	0	0	1	0	0	0	0	162
11:00 AM	0	111	19	0	6	0	0	0	0	0	0	0	0	0	0	136
12:00 PM	0	105	24	0	5	0	0	1	0	0	0	0	0	0	0	135
1:00 PM	0	157	16	1	4	0	0	0	0	0	0	0	0	0	0	178
2:00 PM	2	173	36	1	2	1	0	1	0	0	0	0	0	0	0	216
3:00 PM	0	154	30	2	3	0	0	1	0	0	0	0	0	0	0	190
4:00 PM	0	172	41	3	3	0	0	1	0	0	0	0	0	0	0	220
5:00 PM	0	235	20	2	2	0	0	2	0	0	0	0	0	0	0	261
6:00 PM	0	152	23	3	1	0	0	0	0	0	0	0	0	0	0	179
7:00 PM	0	106	27	1	3	0	0	0	0	0	0	0	0	0	0	137
8:00 PM	0	82	17	1	1	0	0	0	0	0	0	0	0	0	0	101
9:00 PM	0	59	11	0	1	0	0	0	0	0	0	0	0	0	0	71
10:00 PM	0	24	10	0	1	0	0	0	0	0	0	0	0	0	0	35
11:00 PM	0	21	14	0	3	0	0	0	0	0	0	0	0	0	0	38
TOTAL	4	2584	424	21	55	7	1	21	1	0	1	1	0	0	0	3120

Location ID	S20-005-243-04_SB	Located On	COMMON STREET	Community	Quincy
Counted By		Between	ROOSEVELT ROAD	County	Norfolk
Start Date	2/27/2020	And	JENNESS STREET	Module	
Start Time	11:00:00 AM	Direction	SB	Agency	MHD
		Source		Owner ID	mhdds

FHWA-Scheme F Classification

Start Time	Motor cycle	Car	Light Truck	Bus	2A SU	3A SU	>3A SU	<5A 2U	5A 2U	>5A 2U	<6A >2U	6A >2U	>6A >2U	14	15	Total
12:00 AM	0	10	2	0	0	0	0	0	0	0	0	0	0	0	0	12
1:00 AM	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	7
2:00 AM	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
3:00 AM	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	7
4:00 AM	0	5	3	0	0	0	0	0	0	0	0	0	0	0	0	8
5:00 AM	0	29	3	0	0	0	0	0	0	0	0	0	0	0	0	32
6:00 AM	0	71	14	0	2	0	0	0	0	0	0	0	0	0	0	87
7:00 AM	0	158	20	2	2	1	0	1	0	0	0	0	0	0	0	184
8:00 AM	0	145	20	1	6	1	0	0	0	0	0	0	0	0	0	173
9:00 AM	0	107	23	0	3	3	0	1	0	0	0	0	0	0	0	137
10:00 AM	0	135	28	1	3	1	0	0	0	0	0	0	0	0	0	168
11:00 AM	0	104	20	1	4	1	0	0	0	0	0	0	0	0	0	130
12:00 PM	1	111	24	1	2	0	0	0	0	0	0	0	0	0	0	139
1:00 PM	0	117	25	1	2	0	0	0	0	0	0	0	0	0	0	145
2:00 PM	1	180	42	1	1	2	0	0	0	0	0	0	0	0	0	227
3:00 PM	0	215	52	0	1	0	0	0	0	0	0	0	0	0	0	268
4:00 PM	0	256	55	2	5	0	0	1	1	0	0	0	0	0	0	320
5:00 PM	0	296	43	6	4	0	0	1	0	0	0	0	0	0	0	350
6:00 PM	0	196	21	1	3	0	0	0	0	0	0	0	0	0	0	221
7:00 PM	0	122	19	1	0	0	0	0	0	0	0	0	0	0	0	142
8:00 PM	0	103	6	1	1	0	0	0	0	0	0	0	0	0	0	111
9:00 PM	0	67	3	0	0	0	0	0	0	0	0	0	0	0	0	70
10:00 PM	0	38	5	0	0	0	0	0	0	0	0	0	0	0	0	43
11:00 PM	0	37	7	0	1	0	0	0	0	0	0	0	0	0	0	45
TOTAL	2	2518	436	19	40	9	0	4	1	0	0	0	0	0	0	3029

APPENDIX D

MassDOT Weekday Seasonal and Axle Correction Factors 2016–19

Massachusetts Highway Department
Statewide Traffic Data Collection
2016 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.21	1.17	1.10	1.04	0.97	0.92	0.90	0.88	0.97	0.93	0.97	1.05	0.88
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.03	1.02	0.99	0.92	0.91	0.91	0.90	0.94	0.93	0.99	1.02	0.97
R4-R7	1.09	1.13	1.06	1.05	0.95	0.90	0.88	0.91	0.95	0.95	1.04	1.07	0.95
U1-Boston	1.03	1.04	0.99	0.96	0.94	0.91	0.93	0.91	0.95	0.93	0.98	0.98	0.93
U1-Essex	1.06	1.08	1.04	1.01	0.95	0.89	0.88	0.86	0.94	0.94	1.01	1.05	0.91
U1-Southeast	1.07	1.12	1.05	1.01	0.95	0.89	0.87	0.86	0.94	0.95	0.99	1.01	0.94
U1-West	0.97	0.97	0.91	0.95	0.92	0.90	0.94	0.92	0.92	0.90	0.93	0.94	0.94
U1-Worcester	1.10	1.14	1.03	1.00	0.94	0.91	0.92	0.90	0.94	0.93	0.97	1.04	0.92
U2	1.02	1.00	0.97	0.96	0.93	0.90	0.93	0.91	0.94	0.93	0.96	0.99	0.95
U3	1.00	1.00	0.96	0.95	0.92	0.89	0.94	0.92	0.94	0.93	0.96	0.97	0.96
U4-U7	1.02	1.03	0.97	0.96	0.92	0.89	0.93	0.92	0.94	0.95	0.98	0.96	0.93
Rec - East	1.18	1.17	1.13	1.05	0.93	0.84	0.79	0.80	0.93	1.00	1.09	1.13	0.99
Rec - West	1.20	1.24	1.29	1.18	1.03	0.85	0.70	0.81	0.92	0.95	1.11	1.15	0.98

Round off:
0-999 = 10
>1000 = 100

U = Urban
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Recreational - East Group - Cape Cod (all towns) including the town of Plymouth south of Route 3A (stations 7014,7079,7080,7090,7091,7092,7093,7094,7095,7096,7097,7108 and 7178), Martha's Vineyard and Nantucket.

Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114,1116,2196,2197 and 2198.

10/14/2020

Massachusetts Highway Department
Statewide Traffic Data Collection
2017 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.30	1.23	1.21	1.04	0.98	0.92	0.86	0.81	0.95	0.99	1.03	1.10	0.80
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.05	1.01	1.04	0.99	0.94	0.93	0.91	0.92	0.96	0.94	1.01	1.03	0.97
R4-R7	1.10	1.07	1.09	1.00	0.95	0.89	0.88	0.87	0.92	0.95	1.04	1.09	0.93
U1-Boston	1.01	1.04	0.99	0.94	0.93	0.92	0.96	0.93	0.94	0.93	0.95	0.98	0.95
U1-Essex	1.04	1.05	1.00	0.96	0.93	0.89	0.90	0.90	0.93	0.93	0.98	1.03	0.90
U1-Southeast	1.07	1.05	1.02	0.97	0.95	0.90	0.89	0.88	0.92	0.94	0.98	1.01	0.97
U1-West	1.00	0.96	0.94	0.92	0.93	0.92	0.95	0.93	0.92	0.92	0.97	0.97	0.89
U1-Worcester	1.10	1.10	1.04	0.97	0.95	0.94	0.93	0.91	0.95	0.96	0.98	1.04	0.89
U2	1.01	1.03	0.98	0.95	0.93	0.91	0.94	0.92	0.95	0.95	0.95	0.97	0.98
U3	1.03	1.05	1.01	0.95	0.92	0.90	0.94	0.93	0.93	0.92	0.96	0.99	0.96
U4-U7	1.06	1.05	1.02	0.96	0.92	0.89	0.95	0.95	0.92	0.92	0.98	1.03	0.98
Rec - East	1.18	1.17	1.08	1.03	0.95	0.87	0.83	0.83	0.97	0.98	1.19	1.19	0.98
Rec - West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.95

Round off:
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Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114,1116,2196,2197 and 2198.

10/14/2020

Massachusetts Highway Department
Statewide Traffic Data Collection
2018 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.37	1.26	1.30	1.08	0.97	0.93	0.87	0.83	0.96	0.98	1.05	1.13	0.78
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.06	1.07	1.00	0.89	0.88	0.89	0.89	0.95	0.92	1.02	1.01	0.98
R4-R7	1.10	1.07	1.03	1.00	0.90	0.92	0.94	0.94	0.96	0.94	1.03	1.02	0.93
U1-Boston	1.05	0.98	1.01	0.93	0.92	0.91	0.95	0.93	0.94	0.92	0.96	0.99	0.96
U1-Essex	1.05	1.01	1.04	0.93	0.92	0.89	0.90	0.90	0.94	0.93	0.98	1.01	0.91
U1-Southeast	1.11	1.05	1.07	0.99	0.93	0.89	0.88	0.87	0.93	0.95	1.01	1.05	0.98
U1-West	1.15	1.08	1.07	0.98	0.94	0.92	0.92	0.88	0.92	0.91	1.00	1.06	0.83
U1-Worcester	1.18	1.11	1.09	0.99	0.95	0.94	0.95	0.91	0.97	0.97	1.01	1.05	0.87
U2	1.04	0.99	0.99	0.94	0.92	0.90	0.93	0.91	0.94	0.92	0.96	0.98	0.99
U3	0.99	1.00	1.02	0.96	0.91	0.89	0.92	0.90	0.95	0.92	1.01	0.97	0.97
U4-U7	1.03	1.02	0.97	0.95	0.88	0.89	0.96	0.93	0.94	0.93	1.00	1.00	0.99
Rec - East	1.22	1.15	1.09	1.12	0.90	0.89	0.82	0.83	0.92	0.98	1.06	1.08	0.99
Rec - West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.97

Round off:
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Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114,1116,2196,2197 and 2198.

10/14/2020

Massachusetts Highway Department
Statewide Traffic Data Collection
2019 Weekday Seasonal Factors

Factor Group	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Axle Factor
R1	1.22	1.14	1.12	1.06	1.00	0.96	0.87	0.85	0.96	0.99	1.04	1.12	0.85
R2	0.95	0.96	0.98	0.97	0.97	0.93	0.97	0.94	0.96	0.90	0.92	0.93	0.96
R3	1.15	1.06	1.07	1.00	0.89	0.88	0.89	0.89	0.95	0.92	1.02	1.01	0.97
R4-R7	1.09	1.09	1.11	1.02	0.96	0.92	0.89	0.89	0.99	0.98	1.09	1.13	0.98
U1-Boston	1.03	1.01	0.98	0.94	0.94	0.92	0.95	0.93	0.94	0.94	0.97	1.04	0.96
U1-Essex	1.09	1.06	1.03	0.99	0.94	0.90	0.88	0.86	0.93	0.94	0.99	1.06	0.93
U1-Southeast	1.06	1.05	1.01	0.97	0.95	0.93	0.93	0.90	0.94	0.94	0.98	1.04	0.98
U1-West	1.19	1.14	1.09	0.95	0.92	0.89	0.89	0.86	0.91	0.95	0.97	1.07	0.84
U1-Worcester	1.02	1.04	0.97	0.94	0.93	0.91	0.95	0.91	0.93	0.92	0.95	1.10	0.88
U2	1.01	1.00	0.94	0.93	0.91	0.89	0.93	0.90	0.90	0.91	0.94	1.02	0.99
U3	1.06	1.03	0.98	0.94	0.93	0.91	0.95	0.91	0.92	0.93	0.97	1.00	0.98
U4-U7	1.01	1.00	0.95	0.92	0.88	0.86	0.92	0.91	0.92	0.94	0.99	1.04	0.99
Rec - East	1.04	1.16	1.12	0.98	0.92	0.88	0.77	0.81	0.94	1.02	1.08	1.12	0.99
Rec - West	1.30	1.23	1.32	1.18	0.95	0.82	0.70	0.69	0.97	0.96	1.16	1.15	0.98

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0-999 = 10
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Recreational - West Group - Continuous Stations 2 and 189 including stations 1066,1067,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1113,1114,1116,2196,2197 and 2198.

10/14/2020

APPENDIX E

Turning Movement Count Data
Adams Street at Furnace Brook Parkway
October 2020

207487-A Furnace Brook Parkway @ Adams Stree... - TMC
Thu Oct 1, 2020
Full Length (6 AM-10 AM, 2 PM-6 PM, 10 AM-2 PM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786554, Location: 42.253518, -71.025273

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Adams Street						Adams Street						Furnace Brook Parkway						Furnace Brook Parkway						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2020-10-01 6:00AM	3	14	12	0	**29**	0	1	35	0	0	**36**	1	9	9	1	0	**19**	0	2	11	11	0	**24**	0	**108**
6:15AM	1	18	14	0	**33**	0	3	41	0	0	**44**	0	8	10	2	0	**20**	0	1	22	9	0	**32**	0	**129**
6:30AM	4	29	12	0	**45**	2	5	57	0	0	**62**	0	21	18	6	0	**45**	2	1	26	14	0	**41**	2	**193**
6:45AM	7	44	16	0	**67**	0	4	69	0	0	**73**	0	10	28	5	0	**43**	2	5	40	17	0	**62**	1	**245**
Hourly Total	15	105	54	0	**174**	2	13	202	0	0	**215**	1	48	65	14	0	**127**	4	9	99	51	0	**159**	3	**675**
7:00AM	12	45	21	0	**78**	0	8	60	0	0	**68**	0	19	23	9	0	**51**	1	4	35	14	0	**53**	1	**250**
7:15AM	12	51	22	0	**85**	1	18	61	0	0	**79**	3	12	28	13	0	**53**	0	3	43	18	0	**64**	4	**281**
7:30AM	19	60	21	0	**100**	4	8	83	0	0	**91**	3	15	44	15	0	**74**	5	9	48	29	0	**86**	1	**351**
7:45AM	24	72	28	0	**124**	2	12	70	0	0	**82**	3	22	35	13	0	**70**	2	18	73	45	0	**136**	0	**412**
Hourly Total	67	228	92	0	**387**	7	46	274	0	0	**320**	9	68	130	50	0	**248**	8	34	199	106	0	**339**	6	**1294**
8:00AM	15	83	29	0	**127**	0	12	79	0	0	**91**	0	24	37	12	0	**73**	4	7	47	32	0	**86**	1	**377**
8:15AM	12	69	23	0	**104**	0	15	66	0	0	**81**	3	22	30	13	0	**65**	0	13	45	21	0	**79**	0	**329**
8:30AM	7	59	29	0	**95**	1	9	60	0	0	**69**	3	30	46	11	0	**87**	2	4	38	26	0	**68**	0	**319**
8:45AM	14	61	24	0	**99**	0	11	76	0	0	**87**	1	30	30	15	0	**75**	3	4	42	28	0	**74**	3	**335**
Hourly Total	48	272	105	0	**425**	1	47	281	0	0	**328**	7	106	143	51	0	**300**	9	28	172	107	0	**307**	4	**1360**
9:00AM	12	47	21	0	**80**	1	9	74	0	0	**83**	0	25	38	13	0	**76**	3	4	42	14	0	**60**	0	**299**
9:15AM	23	71	29	0	**123**	2	5	47	0	0	**52**	0	26	29	8	0	**63**	2	5	35	21	0	**61**	0	**299**
9:30AM	12	70	22	0	**104**	2	3	74	0	0	**77**	0	21	50	16	0	**87**	3	5	33	29	0	**67**	0	**335**
9:45AM	16	61	21	0	**98**	0	12	72	0	0	**84**	1	26	42	14	0	**82**	0	10	28	16	0	**54**	1	**318**
Hourly Total	63	249	93	0	**405**	5	29	267	0	0	**296**	1	98	159	51	0	**308**	8	24	138	80	0	**242**	1	**1251**
2:00PM	15	78	25	0	**118**	2	9	65	0	0	**74**	1	25	48	22	0	**95**	1	18	67	38	0	**123**	0	**410**
2:15PM	15	89	30	0	**134**	2	9	75	0	0	**84**	0	29	45	12	0	**86**	0	15	63	19	0	**97**	1	**401**
2:30PM	20	86	34	0	**140**	2	12	87	0	0	**99**	4	33	55	16	0	**104**	3	11	50	19	0	**80**	1	**423**
2:45PM	13	95	25	0	**133**	2	10	82	0	0	**92**	3	31	71	26	0	**128**	0	14	65	43	0	**122**	1	**475**
Hourly Total	63	348	114	0	**525**	8	40	309	0	0	**349**	8	118	219	76	0	**413**	4	58	245	119	0	**422**	3	**1709**
3:00PM	24	106	32	1	**163**	0	18	90	0	0	**108**	0	28	49	15	0	**92**	4	13	58	25	0	**96**	0	**459**
3:15PM	21	112	21	0	**154**	2	17	80	0	0	**97**	0	35	48	17	0	**100**	1	16	57	32	0	**105**	1	**456**
3:30PM	30	96	34	0	**160**	0	10	61	0	0	**71**	1	24	48	15	0	**87**	1	9	55	24	0	**88**	0	**406**
3:45PM	28	109	24	0	**161**	0	2	76	0	0	**78**	3	23	60	16	0	**99**	2	16	63	28	0	**107**	2	**445**
Hourly Total	103	423	111	1	**638**	2	47	307	0	0	**354**	4	110	205	63	0	**378**	8	54	233	109	0	**396**	3	**1766**
4:00PM	30	125	26	0	**181**	0	5	86	0	0	**91**	0	29	49	16	0	**94**	0	17	65	30	0	**112**	0	**478**
4:15PM	19	108	14	0	**141**	8	9	76	0	0	**85**	2	18	47	18	0	**83**	3	18	58	18	0	**94**	7	**403**
4:30PM	22	104	25	0	**151**	5	12	84	0	0	**96**	0	29	59	16	0	**104**	3	12	80	23	0	**115**	3	**466**
4:45PM	31	128	26	0	**185**	5	10	81	0	0	**91**	4	27	57	21	0	**105**	1	15	62	23	0	**100**	8	**481**
Hourly Total	102	465	91	0	**658**	18	36	327	0	0	**363**	6	103	212	71	0	**386**	7	62	265	94	0	**421**	18	**1828**
5:00PM	37	101	21	0	**159**	0	9	100	0	0	**109**	3	33	56	20	0	**109**	5	13	58	31	0	**102**	5	**479**
5:15PM	30	99	31	0	**160**	9	2	73	0	0	**75**	5	28	66	17	0	**111**	9	16	66	32	0	**114**	6	**460**
5:30PM	26	119	24	2	**171**	9	7	97	0	0	**104**	2	43	52	22	0	**117**	2	11	57	28	0	**96**	8	**488**
5:45PM	18	86	33	0	**137**	1	16	82	0	0	**98**	0	31	60	24	0	**115**	3	11	53	24	0	**88**	3	**438**
Hourly Total	111	405	109	2	**627**	19	34	352	0	0	**386**	10	135	234	83	0	**452**	19	51	234	115	0	**400**	22	**1865**
2020-10-03 10:00AM	20	75	35	0	**130**	4	13	64	0	0	**77**	0	22	35	9	0	**66**	3	8	53	45	0	**106**	0	**379**
10:15AM	23	85	27	0	**135**	0	14	81	0	0	**95**	0	26	63	8	0	**97**	1	10	63	14	0	**87**	4	**414**
10:30AM	18	73	34	0	**125**	4	12	66	1	1	**80**	1	23	55	11	0	**89**	1	9	54	26	0	**89**	0	**383**
10:45AM	20	66	45	1	**132**	5	9	84	0	0	**93**	0	28	43	6	0	**77**	2	9	63	33	0	**105**	0	**407**
Hourly Total	81	299	141	1	**522**	13	48	295	1	1	**345**	1	99	196	34	0	**329**	7	36	233	118	0	**387**	4	**1583**
11:00AM	14	81	43	0	**138**	4	8	75	0	0	**83**	0	26	58	15	0	**99**	0	19	56	26	0	**101**	0	**421**
11:15AM	15	77	32	0	**124**	2	12	79	0	0	**91**	0	24	54	9	0	**87**	1	15	54	33	0	**102**	2	**404**
11:30AM	32	85	37	0	**154**	3	10	73	0	0	**83**	1	32	62	18	0	**112**	2	14	65	27	0	**106**	2	**455**
11:45AM	19	71	43	0	**133**	0	8	70	0	0	**78**	1	34	68	15	0	**117**	1	9	65	32	0	**106**	0	**434**
Hourly Total	80	314	155	0	**549**	9	38	297	0	0	**335**	2	116	242	57	0	**415**	4	57	240	118	0	**415**	4	**1714**
12:00PM	13	100	30	0	**143**	3	11	69	0	0	**80**	3	30	52	8	0	**90**	0	8	69	20	0	**97**	0	**410**
12:15PM	19	73	28	0	**120**	0	13	73	0	0	**86**	0	28	63	13	0	**104**	2	14	68	21	0	**103**	0	**413**
12:30PM	20	83	48	0	**151**	2	13	75	0	0	**88**	0	41	63	16	0	**120**	1	6	71	28	0	**105**	0	**464**
12:45PM	20	74	47	0	**141**	3	10	72	0	0	**82**	1	35	62	14	0	**111**	0	9	72	28	0	**109**	2	**443**
Hourly Total	72	330	153	0	**555**	8	47	289	0	0	**336**	4	134	240	51	0	**425**	3	37	280	97	0	**414**	2	**1730**
1:00PM	17	81	21	0	**119**	0	10	58	0	0	**68**	2	36	63	17	0	**116**	1	11	72	22	0	**105**	0	**408**
1:15PM	29	74	24	0	**127**	0	7	84	0	0	**91**	0	28	70	33	0	**131**	0	9	62	24	0	**95**	2	**444**
1:30PM	30	88	30	0	**148**	0	8	75	0	0	**83**	0	43	47	15	0	**105**	2	11	53	26	0	**90**	1	**426**
1:45PM	16	89	28	0	**133**	0	8	78	0	0	**86**	1	30	85	11	0	**126**	2	9	68	19	0	**96**	0	**441**
Hourly Total	92	332	103	0	**527**	0	33	295	0	0	**328**	3	137	265	76	0	**478**	5	40	255	91	0	**386**	3	**1719**
Total	897	3770	1321	4	**5992**	92	458	3495	1	1	**3955**	56	1272	2310	677	0	**4259**	86	490	2593	1205	0	**4288**	73	**18494**
% Approach	15.0%	62.9%	22.0%	0.1%	-	-	11.6%	88.4%	0%	0%	-	-	29.9%	54.2%	15.9%	0%	-	-	11.4%	60.5%	28.1%	0%	-	-	-
% Total	4.9%	20.4%	7.1%	0%	**32.4%**	-	2.5%	18.9%	0%	0%	**21.4%**	-	6.9%	12.5%	3.7%	0%	**23.0%**	-	2.6%	14.0%	6.5%	0%	**23.2%**	-	-
Lights	886	3677	1297	4	**5864**	-	452	3410	1	1	**3864**	-	1256	2279	658	0	**4193**	-	485	2555	1169	0	**4209**	-	18130
% Lights	98.8%	97.5%	98.2%	100%	**97.9%**	-	98.7%	97.6%	100%	100%	**97.7%**	-	98.7%	98.7%	97.2%	0%	**98.5%**	-	99.0%	98.5%	97.0%	0%	**98.2%**	-	98.0%
Single-Unit Trucks	7	61	12	0	**80**	-	4	61	0	0	**65**	-	9	15	15	0	**39**	-	2	22	13	0	**37**	-	221
% Single-Unit Trucks	0.8%	1.6%	0.9%	0%	**1.3%**	-	0.9%	1.7%	0%	0%	**1.6%**	-	0.7%	0.6%	2.2%	0%	**0.9%**	-	0.4%	0.8%	1.1%	0%	**0.9%**	-	1.2%
Articulated Trucks	0	8	1	0	**9**	-	0	10	0	0	**10**	-	1	1	1	0	**3**	-	0	1	1	0	**2**	-	24
% Articulated Trucks	0%	0.2%	0.1%	0%	**0.2%**	-	0%	0.3%	0%	0%	**0.3%**	-	0.1%	0%	0.1%	0%	**0.1%**	-	0%	0%	0.1%	0%	**0%**	-	0.1%
Buses	2	15	6	0	**23**	-	0	11	0	0	**11**	-	6	0	2	0	**8**	-	2	4	6	0	**12**	-	54
% Buses	0.2%	0.4%	0.5%	0%	**0.4%**	-	0%	0.3%	0%	0%	**0.3%**	-	0.5%	0%	0.3%	0%	**0.2%**	-	0.4%	0.2%	0.5%	0%	**0.3%**	-	0.3%
Bicycles on Road	2	9	5	0	**16**	-	2	3	0	0	**5**	-	0	15	1	0	**16**	-	1	11	16	0	**28**	-	65

Leg	Adams Street						Adams Street						Furnace Brook Parkway						Furnace Brook Parkway						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	**Int**
% Bicycles on Road	0.2%	0.2%	0.4%	0%	**0.3%**	-	0.4%	0.1%	0%	0%	**0.1%**	-	0%	0.6%	0.1%	0%	**0.4%**	-	0.2%	0.4%	1.3%	0%	**0.7%**	-	0.4%
Pedestrians	-	-	-	-	-	74	-	-	-	-	-	46	-	-	-	-	-	76	-	-	-	-	-	65	
% Pedestrians	-	-	-	-	-	80.4%	-	-	-	-	-	82.1%	-	-	-	-	-	88.4%	-	-	-	-	-	89.0%	-
Bicycles on Crosswalk	-	-	-	-	-	18	-	-	-	-	-	10	-	-	-	-	-	10	-	-	-	-	-	8	
% Bicycles on Crosswalk	-	-	-	-	-	19.6%	-	-	-	-	-	17.9%	-	-	-	-	-	11.6%	-	-	-	-	-	11.0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-A Furnace Brook Parkway @ Adams Stree... - TMC
Thu Oct 1, 2020
AM Peak (Oct 01 2020 7:30AM - 8:30 AM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786554, Location: 42.253518, -71.025273

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

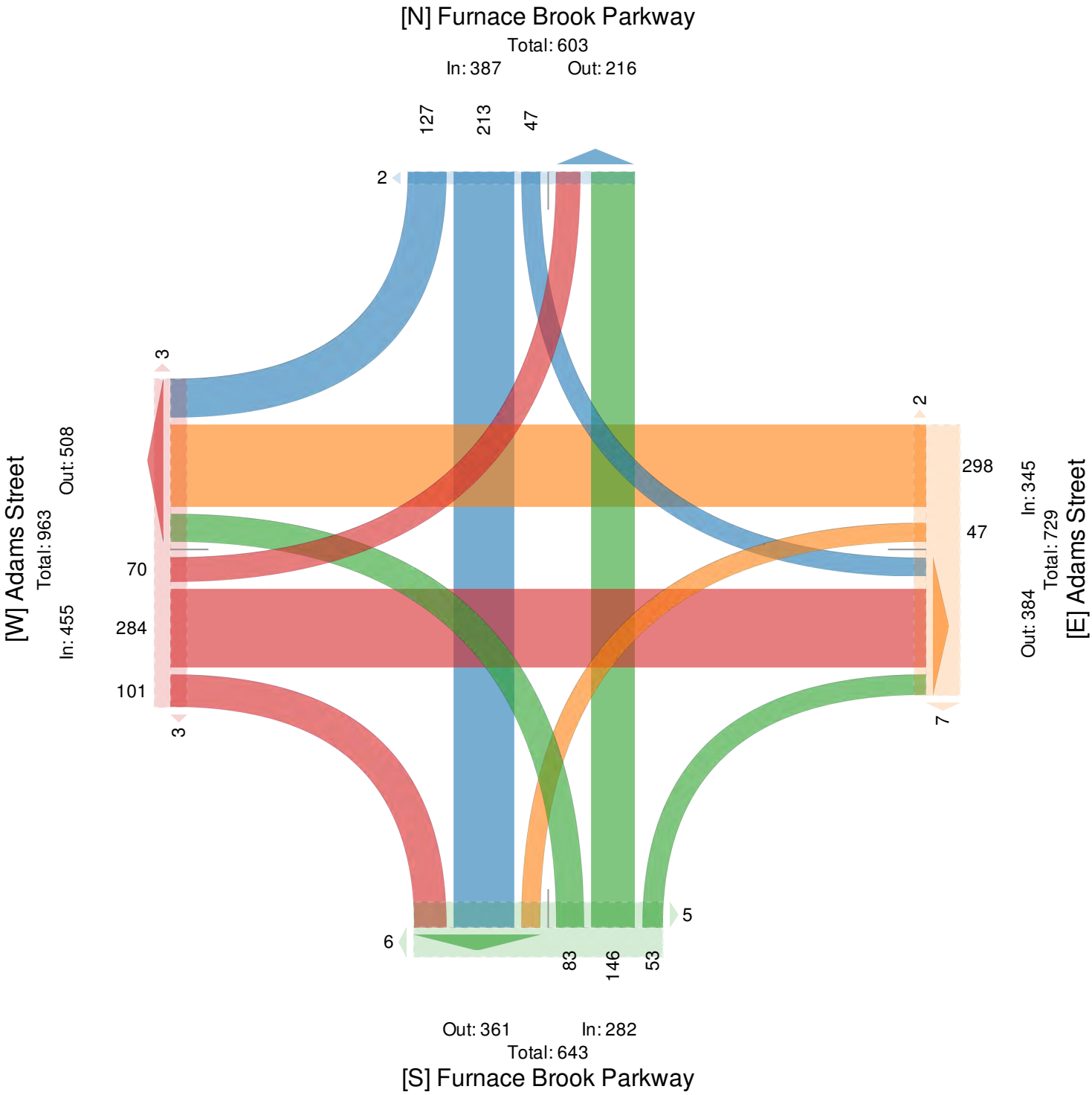
Leg	Adams Street						Adams Street						Furnace Brook Parkway						Furnace Brook Parkway						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2020-10-01 7:30AM	19	60	21	0	**100**	4	8	83	0	0	**91**	3	15	44	15	0	**74**	5	9	48	29	0	**86**	1	**351**
7:45AM	24	72	28	0	**124**	2	12	70	0	0	**82**	3	22	35	13	0	**70**	2	18	73	45	0	**136**	0	**412**
8:00AM	15	83	29	0	**127**	0	12	79	0	0	**91**	0	24	37	12	0	**73**	4	7	47	32	0	**86**	1	**377**
8:15AM	12	69	23	0	**104**	0	15	66	0	0	**81**	3	22	30	13	0	**65**	0	13	45	21	0	**79**	0	**329**
Total	70	284	101	0	**455**	6	47	298	0	0	**345**	9	83	146	53	0	**282**	11	47	213	127	0	**387**	2	**1469**
% Approach	15.4%	62.4%	22.2%	0%	-	-	13.6%	86.4%	0%	0%	-	-	29.4%	51.8%	18.8%	0%	-	-	12.1%	55.0%	32.8%	0%	-	-	-
% Total	4.8%	19.3%	6.9%	0%	**31.0%**	-	3.2%	20.3%	0%	0%	**23.5%**	-	5.7%	9.9%	3.6%	0%	**19.2%**	-	3.2%	14.5%	8.6%	0%	**26.3%**	-	-
PHF	0.729	0.855	0.871	-	**0.896**	-	0.783	0.898	-	-	**0.948**	-	0.865	0.830	0.883	-	**0.953**	-	0.653	0.723	0.700	-	**0.706**	-	0.890
Lights	69	275	100	0	**444**	-	47	285	0	0	**332**	-	82	143	49	0	**274**	-	47	210	121	0	**378**	-	1428
% Lights	98.6%	96.8%	99.0%	0%	**97.6%**	-	100%	95.6%	0%	0%	**96.2%**	-	98.8%	97.9%	92.5%	0%	**97.2%**	-	100%	98.6%	95.3%	0%	**97.7%**	-	97.2%
Single-Unit Trucks	1	5	0	0	**6**	-	0	9	0	0	**9**	-	0	2	3	0	**5**	-	0	0	4	0	**4**	-	24
% Single-Unit Trucks	1.4%	1.8%	0%	0%	**1.3%**	-	0%	3.0%	0%	0%	**2.6%**	-	0%	1.4%	5.7%	0%	**1.8%**	-	0%	0%	3.1%	0%	**1.0%**	-	1.6%
Articulated Trucks	0	1	0	0	**1**	-	0	2	0	0	**2**	-	0	1	0	0	**1**	-	0	1	0	0	**1**	-	5
% Articulated Trucks	0%	0.4%	0%	0%	**0.2%**	-	0%	0.7%	0%	0%	**0.6%**	-	0%	0.7%	0%	0%	**0.4%**	-	0%	0.5%	0%	0%	**0.3%**	-	0.3%
Buses	0	3	1	0	**4**	-	0	2	0	0	**2**	-	1	0	1	0	**2**	-	0	0	1	0	**1**	-	9
% Buses	0%	1.1%	1.0%	0%	**0.9%**	-	0%	0.7%	0%	0%	**0.6%**	-	1.2%	0%	1.9%	0%	**0.7%**	-	0%	0%	0.8%	0%	**0.3%**	-	0.6%
Bicycles on Road	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	2	1	0	**3**	-	3
% Bicycles on Road	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0.9%	0.8%	0%	**0.8%**	-	0.2%
Pedestrians	-	-	-	-	-	6	-	-	-	-	-	8	-	-	-	-	-	10	-	-	-	-	-	1	
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	88.9%	-	-	-	-	-	90.9%	-	-	-	-	-	50.0%	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	11.1%	-	-	-	-	-	9.1%	-	-	-	-	-	50.0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-A Furnace Brook Parkway @ Adams Stree... - TMC

Thu Oct 1, 2020
AM Peak (Oct 01 2020 7:30AM - 8:30 AM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786554, Location: 42.253518, -71.025273

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



207487-A Furnace Brook Parkway @ Adams Stree... - TMC
Thu Oct 1, 2020
PM Peak (Oct 01 2020 4:45PM - 5:45 PM) - Overall Peak Hour
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786554, Location: 42.253518, -71.025273

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Adams Street						Adams Street						Furnace Brook Parkway						Furnace Brook Parkway						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2020-10-01 4:45PM	31	128	26	0	**185**	5	10	81	0	0	**91**	4	27	57	21	0	**105**	1	15	62	23	0	**100**	8	**481**
5:00PM	37	101	21	0	**159**	0	9	100	0	0	**109**	3	33	56	20	0	**109**	5	13	58	31	0	**102**	5	**479**
5:15PM	30	99	31	0	**160**	9	2	73	0	0	**75**	5	28	66	17	0	**111**	9	16	66	32	0	**114**	6	**460**
5:30PM	26	119	24	2	**171**	9	7	97	0	0	**104**	2	43	52	22	0	**117**	2	11	57	28	0	**96**	8	**488**
Total	124	447	102	2	**675**	23	28	351	0	0	**379**	14	131	231	80	0	**442**	17	55	243	114	0	**412**	27	**1908**
% Approach	18.4%	66.2%	15.1%	0.3%	**-**	-	7.4%	92.6%	0%	0%	**-**	-	29.6%	52.3%	18.1%	0%	**-**	-	13.3%	59.0%	27.7%	0%	**-**	-	-
% Total	6.5%	23.4%	5.3%	0.1%	**35.4%**	-	1.5%	18.4%	0%	0%	**19.9%**	-	6.9%	12.1%	4.2%	0%	**23.2%**	-	2.9%	12.7%	6.0%	0%	**21.6%**	-	-
PHF	0.838	0.871	0.833	0.250	**0.908**	-	0.700	0.878	-	-	**0.869**	-	0.762	0.875	0.909	-	**0.944**	-	0.859	0.920	0.917	-	**0.911**	-	0.978
Lights	122	443	99	2	**666**	-	28	345	0	0	**373**	-	131	230	78	0	**439**	-	54	243	110	0	**407**	-	1885
% Lights	98.4%	99.1%	97.1%	100%	**98.7%**	-	100%	98.3%	0%	0%	**98.4%**	-	100%	99.6%	97.5%	0%	**99.3%**	-	98.2%	100%	96.5%	0%	**98.8%**	-	98.8%
Single-Unit Trucks	2	2	1	0	**5**	-	0	5	0	0	**5**	-	0	1	2	0	**3**	-	1	0	0	0	**1**	-	14
% Single-Unit Trucks	1.6%	0.4%	1.0%	0%	**0.7%**	-	0%	1.4%	0%	0%	**1.3%**	-	0%	0.4%	2.5%	0%	**0.7%**	-	1.8%	0%	0%	0%	**0.2%**	-	0.7%
Articulated Trucks	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Articulated Trucks	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%
Buses	0	1	0	0	**1**	-	0	1	0	0	**1**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	2
% Buses	0%	0.2%	0%	0%	**0.1%**	-	0%	0.3%	0%	0%	**0.3%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0.1%
Bicycles on Road	0	1	2	0	**3**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	4	0	**4**	-	7
% Bicycles on Road	0%	0.2%	2.0%	0%	**0.4%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	3.5%	0%	**1.0%**	-	0.4%
Pedestrians	-	-	-	-	-	20	-	-	-	-	-	13	-	-	-	-	-	16	-	-	-	-	-	27	
% Pedestrians	-	-	-	-	-	87.0%	-	-	-	-	-	92.9%	-	-	-	-	-	94.1%	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	13.0%	-	-	-	-	-	7.1%	-	-	-	-	-	5.9%	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-A Furnace Brook Parkway @ Adams Stree... - TMC

Thu Oct 1, 2020

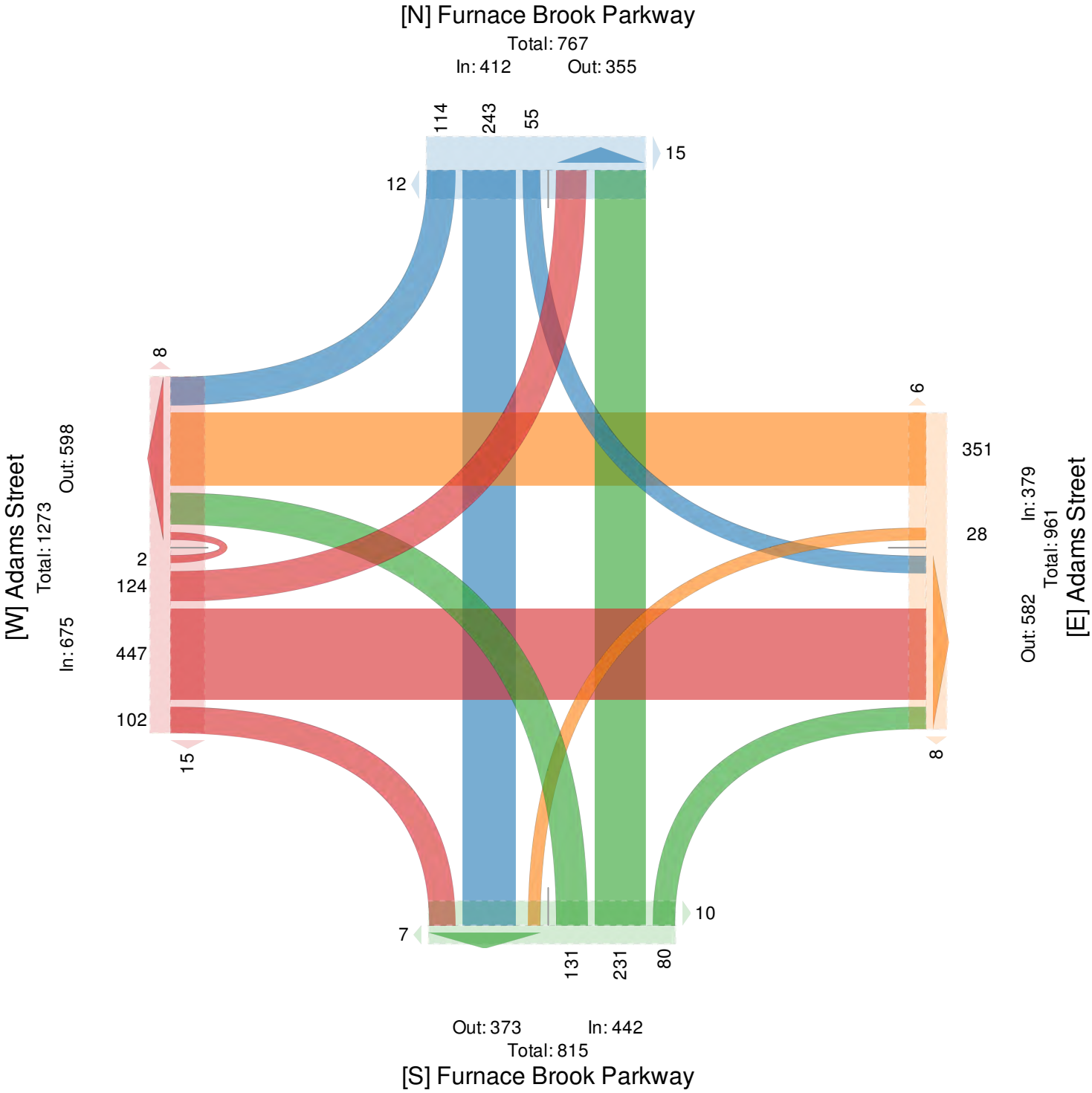
PM Peak (Oct 01 2020 4:45PM - 5:45 PM) - Overall Peak Hour

All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 786554, Location: 42.253518, -71.025273

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



APPENDIX F

Turning Movement Count Data
Adams Street at Common Street
October 2020

207487-B Adams Street @ Furnace Brook Parkwa... - TMC
Thu Oct 1, 2020
Full Length (6 AM-10 AM, 2 PM-6 PM, 10 AM-2 PM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786555, Location: 42.253305, -71.024814

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Adams Street						Adams Street						Common Street						Furnace Brook Parkway Ramp						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	L	T	R	U	App	Ped*	Int
2020-10-01 6:00AM	0	14	4	0	**18**	0	2	29	0	0	**31**	0	10	7	2	0	**19**	0	0	0	0	0	**0**	0	**68**
6:15AM	0	14	7	0	**21**	0	2	28	0	0	**30**	0	15	3	0	0	**18**	0	0	0	0	0	**0**	0	**69**
6:30AM	0	23	14	1	**38**	1	4	42	0	0	**46**	1	18	7	4	0	**29**	3	0	0	0	0	**0**	1	**113**
6:45AM	0	36	19	0	**55**	0	7	45	2	0	**54**	0	28	7	4	0	**39**	0	0	0	0	0	**0**	2	**148**
Hourly Total	0	87	44	1	**132**	1	15	144	2	0	**161**	1	71	24	10	0	**105**	3	0	0	0	0	**0**	3	**398**
7:00AM	0	35	23	0	**58**	0	2	48	0	0	**50**	2	19	7	6	0	**32**	2	0	0	0	0	**0**	2	**140**
7:15AM	0	50	17	0	**67**	0	7	67	1	0	**75**	1	14	17	7	0	**38**	3	0	0	0	0	**0**	2	**180**
7:30AM	1	59	26	0	**86**	0	6	67	5	0	**78**	0	23	12	17	0	**52**	4	0	0	0	0	**0**	0	**216**
7:45AM	2	58	39	0	**99**	1	8	55	2	1	**66**	0	27	10	6	0	**43**	3	0	0	0	0	**0**	1	**208**
Hourly Total	3	202	105	0	**310**	1	23	237	8	1	**269**	3	83	46	36	0	**165**	12	0	0	0	0	**0**	5	**744**
8:00AM	0	70	35	0	**105**	0	12	73	1	0	**86**	0	18	11	13	0	**42**	6	0	0	0	0	**0**	0	**233**
8:15AM	0	57	39	0	**96**	0	9	57	0	0	**66**	1	24	6	7	0	**37**	2	0	0	0	0	**0**	0	**199**
8:30AM	0	58	17	0	**75**	0	12	56	6	0	**74**	1	13	11	9	0	**33**	2	0	0	0	0	**0**	0	**182**
8:45AM	0	61	22	0	**83**	0	5	60	2	0	**67**	1	28	10	9	0	**47**	2	0	0	0	0	**0**	2	**197**
Hourly Total	0	246	113	0	**359**	0	38	246	9	0	**293**	3	83	38	38	0	**159**	12	0	0	0	0	**0**	2	**811**
9:00AM	0	49	15	0	**64**	0	10	58	0	0	**68**	0	21	9	9	0	**39**	1	0	0	0	0	**0**	0	**171**
9:15AM	0	51	31	1	**83**	0	4	32	3	0	**39**	0	20	8	4	0	**32**	3	0	0	0	0	**0**	0	**154**
9:30AM	0	61	31	0	**92**	0	3	57	1	0	**61**	0	19	9	10	0	**38**	6	0	0	0	0	**0**	0	**191**
9:45AM	0	48	37	0	**85**	0	6	65	2	0	**73**	0	24	8	4	0	**36**	1	0	0	0	0	**0**	1	**194**
Hourly Total	0	209	114	1	**324**	0	23	212	6	0	**241**	0	84	34	27	0	**145**	11	0	0	0	0	**0**	1	**710**
2:00PM	0	83	36	0	**119**	0	6	46	2	0	**54**	0	26	20	7	0	**53**	1	0	0	0	0	**0**	0	**226**
2:15PM	0	79	37	0	**116**	0	8	67	1	0	**76**	0	18	15	5	0	**38**	1	0	0	0	0	**0**	1	**230**
2:30PM	0	83	30	0	**113**	1	9	71	0	0	**80**	0	34	17	5	0	**56**	3	0	0	0	0	**0**	3	**249**
2:45PM	0	87	48	0	**135**	0	11	71	0	1	**83**	0	22	18	13	0	**53**	1	0	0	0	0	**0**	2	**271**
Hourly Total	0	332	151	0	**483**	1	34	255	3	1	**293**	0	100	70	30	0	**200**	6	0	0	0	0	**0**	6	**976**
3:00PM	0	80	52	0	**132**	0	11	80	1	0	**92**	0	20	20	8	0	**48**	5	0	0	0	0	**0**	0	**272**
3:15PM	0	86	63	0	**149**	0	7	75	1	0	**83**	0	24	17	9	0	**50**	2	0	0	0	0	**0**	1	**282**
3:30PM	0	81	42	0	**123**	0	3	46	0	0	**49**	0	21	9	13	0	**43**	1	0	0	0	0	**0**	0	**215**
3:45PM	0	82	58	0	**140**	0	6	56	1	0	**63**	0	24	11	5	0	**40**	2	0	0	0	0	**0**	0	**243**
Hourly Total	0	329	215	0	**544**	0	27	257	3	0	**287**	0	89	57	35	0	**181**	10	0	0	0	0	**0**	1	**1012**
4:00PM	0	89	71	0	**160**	0	5	73	1	0	**79**	1	18	10	5	0	**33**	2	0	0	0	0	**0**	0	**272**
4:15PM	0	80	63	0	**143**	0	9	64	0	0	**73**	0	23	15	6	0	**44**	1	0	0	0	1	**1**	1	**261**
4:30PM	0	92	38	0	**130**	1	11	76	1	0	**88**	0	22	9	7	0	**38**	2	0	0	0	0	**0**	3	**256**
4:45PM	0	98	70	0	**168**	0	4	61	2	1	**68**	0	28	11	12	0	**51**	1	0	0	0	0	**0**	0	**287**
Hourly Total	0	359	242	0	**601**	1	29	274	4	1	**308**	1	91	45	30	0	**166**	6	0	0	0	1	**1**	4	**1076**
5:00PM	0	85	45	1	**131**	0	14	70	0	0	**84**	1	34	25	8	0	**67**	3	0	0	0	0	**0**	0	**282**
5:15PM	0	83	51	0	**134**	0	10	58	1	0	**69**	2	24	17	7	0	**48**	2	0	0	0	0	**0**	3	**251**
5:30PM	0	103	56	0	**159**	2	7	81	3	0	**91**	0	21	16	10	0	**47**	5	0	0	0	0	**0**	10	**297**
5:45PM	0	79	41	0	**120**	0	7	62	3	0	**72**	0	33	14	7	0	**54**	2	0	0	0	0	**0**	4	**246**
Hourly Total	0	350	193	1	**544**	2	38	271	7	0	**316**	3	112	72	32	0	**216**	12	0	0	0	0	**0**	17	**1076**
2020-10-03 10:00AM	0	56	36	0	**92**	0	5	60	2	0	**67**	1	12	13	4	0	**29**	8	0	0	0	0	**0**	0	**188**
10:15AM	0	71	30	0	**101**	0	8	82	0	0	**90**	0	16	19	4	0	**39**	3	0	0	0	0	**0**	3	**230**
10:30AM	0	56	38	0	**94**	0	5	66	3	0	**74**	0	16	6	7	0	**29**	1	0	0	0	0	**0**	0	**197**
10:45AM	0	56	30	0	**86**	0	7	71	0	0	**78**	0	18	13	5	0	**36**	1	0	0	0	0	**0**	0	**200**
Hourly Total	0	239	134	0	**373**	0	25	279	5	0	**309**	1	62	51	20	0	**133**	13	0	0	0	0	**0**	3	**815**
11:00AM	0	69	45	0	**114**	0	8	64	3	0	**75**	2	21	6	8	0	**35**	3	0	0	0	0	**0**	0	**224**
11:15AM	0	58	40	0	**98**	0	5	77	1	0	**83**	0	20	15	7	0	**42**	1	0	0	0	0	**0**	2	**223**
11:30AM	0	69	45	0	**114**	0	11	45	2	2	**60**	2	31	11	4	0	**46**	1	0	0	0	0	**0**	1	**220**
11:45AM	0	62	37	0	**99**	0	6	62	3	0	**71**	0	21	11	14	0	**46**	2	0	0	0	0	**0**	0	**216**
Hourly Total	0	258	167	0	**425**	0	30	248	9	2	**289**	4	93	43	33	0	**169**	7	0	0	0	0	**0**	3	**883**
12:00PM	0	75	44	0	**119**	0	8	47	2	0	**57**	0	28	15	8	0	**51**	4	0	0	1	0	**1**	2	**228**
12:15PM	0	57	43	0	**100**	0	12	63	2	0	**77**	0	23	19	3	0	**45**	2	0	0	0	0	**0**	0	**222**
12:30PM	0	74	31	0	**105**	0	8	68	3	0	**79**	0	23	8	3	0	**34**	5	0	0	0	0	**0**	0	**218**
12:45PM	1	62	36	0	**99**	0	9	58	2	0	**69**	0	20	11	9	0	**40**	1	0	0	0	0	**0**	2	**208**
Hourly Total	1	268	154	0	**423**	0	37	236	9	0	**282**	0	94	53	23	0	**170**	12	0	0	1	0	**1**	4	**876**
1:00PM	0	71	38	0	**109**	0	2	48	1	0	**51**	0	19	9	9	0	**37**	3	0	0	0	0	**0**	0	**197**
1:15PM	0	86	31	0	**117**	0	13	74	4	0	**91**	0	19	15	9	0	**43**	3	0	0	0	0	**0**	0	**251**
1:30PM	0	75	41	0	**116**	0	5	54	3	0	**62**	0	27	16	4	0	**47**	4	0	0	0	0	**0**	1	**225**
1:45PM	0	76	34	0	**110**	0	4	65	3	0	**72**	0	25	17	7	0	**49**	2	0	0	0	0	**0**	1	**231**
Hourly Total	0	308	144	0	**452**	0	24	241	11	0	**276**	0	90	57	29	0	**176**	12	0	0	0	0	**0**	2	**904**
Total	4	3187	1776	3	**4970**	6	343	2900	76	5	**3324**	16	1052	590	343	0	**1985**	116	0	0	1	1	**2**	51	**10281**
% Approach	0.1%	64.1%	35.7%	0.1%	-	-	10.3%	87.2%	2.3%	0.2%	-	-	53.0%	29.7%	17.3%	0%	-	-	0%	0%	50.0%	50.0%	-	-	-
% Total	0%	31.0%	17.3%	0%	**48.3%**	-	3.3%	28.2%	0.7%	0%	**32.3%**	-	10.2%	5.7%	3.3%	0%	**19.3%**	-	0%	0%	0%	0%	**0%**	-	-
Lights	4	3100	1740	3	**4847**	-	333	2836	73	5	**3247**	-	1024	581	323	0	**1928**	-	0	0	0	1	**1**	-	10023
% Lights	100%	97.3%	98.0%	100%	**97.5%**	-	97.1%	97.8%	96.1%	100%	**97.7%**	-	97.3%	98.5%	94.2%	0%	**97.1%**	-	0%	0%	0%	100%	**50.0%**	-	97.5%
Single-Unit Trucks	0	58	22	0	**80**	-	3	47	1	0	**51**	-	14	3	11	0	**28**	-	0	0	0	0	**0**	-	159
% Single-Unit Trucks	0%	1.8%	1.2%	0%	**1.6%**	-	0.9%	1.6%	1.3%	0%	**1.5%**	-	1.3%	0.5%	3.2%	0%	**1.4%**	-	0%	0%	0%	0%	**0%**	-	1.5%
Articulated Trucks	0	9	3	0	**12**	-	2	7	0	0	**9**	-	5	2	3	0	**10**	-	0	0	0	0	**0**	-	31
% Articulated Trucks	0%	0.3%	0.2%	0%	**0.2%**	-	0.6%	0.2%	0%	0%	**0.3%**	-	0.5%	0.3%	0.9%	0%	**0.5%**	-	0%	0%	0%	0%	**0%**	-	0.3%
Buses	0	10	9	0	**19**	-	0	4	0	0	**4**	-	9	2	0	0	**11**	-	0	0	0	0	**0**	-	34

Leg	Adams Street						Adams Street						Common Street						Furnace Brook Parkway Ramp						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	**Int**
% Buses	0%	0.3%	0.5%	0%	**0.4%**	-	0%	0.1%	0%	0%	**0.1%**	-	0.9%	0.3%	0%	0%	**0.6%**	-	0%	0%	0%	0%	**0%**	-	0.3%
Bicycles on Road	0	10	2	0	**12**	-	5	6	2	0	**13**	-	0	2	6	0	**8**	-	0	0	1	0	**1**	-	34
% Bicycles on Road	0%	0.3%	0.1%	0%	**0.2%**	-	1.5%	0.2%	2.6%	0%	**0.4%**	-	0%	0.3%	1.7%	0%	**0.4%**	-	0%	0%	100%	0%	**50.0%**	-	0.3%
Pedestrians	-	-	-	-	-	6	-	-	-	-	-	15	-	-	-	-	-	107	-	-	-	-	-	47	
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	93.8%	-	-	-	-	-	92.2%	-	-	-	-	-	92.2%	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	9	-	-	-	-	-	4	
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	6.3%	-	-	-	-	-	7.8%	-	-	-	-	-	7.8%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-B Adams Street @ Furnace Brook Parkwa... - TMC

Thu Oct 1, 2020
AM Peak (Oct 01 2020 7:30AM - 8:30 AM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786555, Location: 42.253305, -71.024814

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

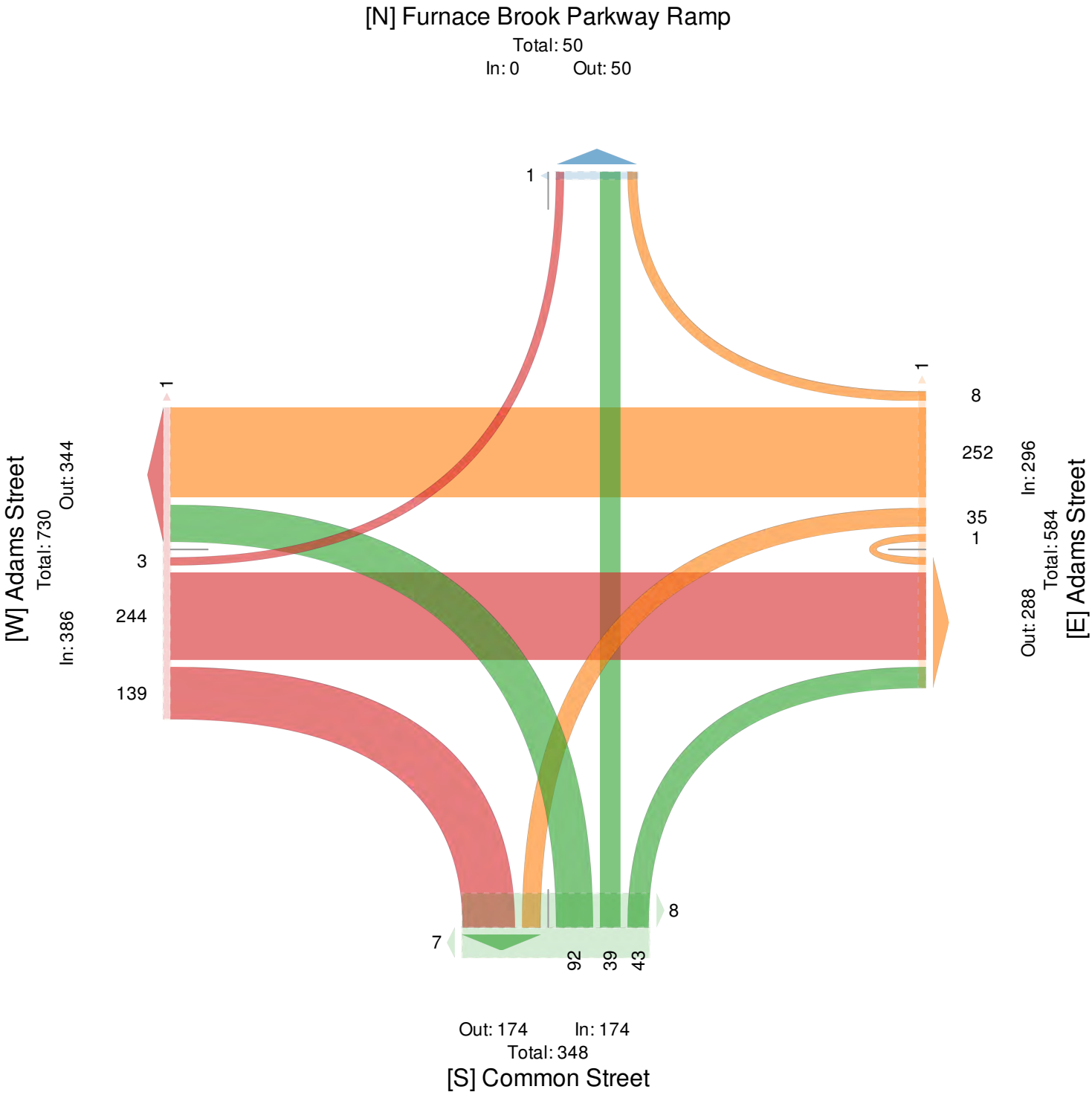
Leg	Adams Street						Adams Street						Common Street						Furnace Brook Parkway Ramp						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	**Int**
2020-10-01 7:30AM	1	59	26	0	**86**	0	6	67	5	0	**78**	0	23	12	17	0	**52**	4	0	0	0	0	**0**	0	**216**
7:45AM	2	58	39	0	**99**	1	8	55	2	1	**66**	0	27	10	6	0	**43**	3	0	0	0	0	**0**	1	**208**
8:00AM	0	70	35	0	**105**	0	12	73	1	0	**86**	0	18	11	13	0	**42**	6	0	0	0	0	**0**	0	**233**
8:15AM	0	57	39	0	**96**	0	9	57	0	0	**66**	1	24	6	7	0	**37**	2	0	0	0	0	**0**	0	**199**
Total	3	244	139	0	**386**	1	35	252	8	1	**296**	1	92	39	43	0	**174**	15	0	0	0	0	**0**	1	**856**
% Approach	0.8%	63.2%	36.0%	0%	**-**	-	11.8%	85.1%	2.7%	0.3%	**-**	-	52.9%	22.4%	24.7%	0%	**-**	-	0%	0%	0%	0%	**-**	-	-
% Total	0.4%	28.5%	16.2%	0%	**45.1%**	-	4.1%	29.4%	0.9%	0.1%	**34.6%**	-	10.7%	4.6%	5.0%	0%	**20.3%**	-	0%	0%	0%	0%	**0%**	-	-
PHF	0.375	0.868	0.891	-	**0.917**	-	0.729	0.863	0.400	0.250	**0.860**	-	0.852	0.792	0.574	-	**0.813**	-	-	-	-	-	**-**	-	0.928
Lights	3	234	135	0	**372**	-	35	243	8	1	**287**	-	89	37	35	0	**161**	-	0	0	0	0	**0**	-	820
% Lights	100%	95.9%	97.1%	0%	**96.4%**	-	100%	96.4%	100%	100%	**97.0%**	-	96.7%	94.9%	81.4%	0%	**92.5%**	-	0%	0%	0%	0%	**-**	-	95.8%
Single-Unit Trucks	0	5	3	0	**8**	-	0	7	0	0	**7**	-	1	1	2	0	**4**	-	0	0	0	0	**0**	-	19
% Single-Unit Trucks	0%	2.0%	2.2%	0%	**2.1%**	-	0%	2.8%	0%	0%	**2.4%**	-	1.1%	2.6%	4.7%	0%	**2.3%**	-	0%	0%	0%	0%	**-**	-	2.2%
Articulated Trucks	0	1	0	0	**1**	-	0	1	0	0	**1**	-	1	0	2	0	**3**	-	0	0	0	0	**0**	-	5
% Articulated Trucks	0%	0.4%	0%	0%	**0.3%**	-	0%	0.4%	0%	0%	**0.3%**	-	1.1%	0%	4.7%	0%	**1.7%**	-	0%	0%	0%	0%	**-**	-	0.6%
Buses	0	3	1	0	**4**	-	0	1	0	0	**1**	-	1	0	0	0	**1**	-	0	0	0	0	**0**	-	6
% Buses	0%	1.2%	0.7%	0%	**1.0%**	-	0%	0.4%	0%	0%	**0.3%**	-	1.1%	0%	0%	0%	**0.6%**	-	0%	0%	0%	0%	**-**	-	0.7%
Bicycles on Road	0	1	0	0	**1**	-	0	0	0	0	**0**	-	0	1	4	0	**5**	-	0	0	0	0	**0**	-	6
% Bicycles on Road	0%	0.4%	0%	0%	**0.3%**	-	0%	0%	0%	0%	**0%**	-	0%	2.6%	9.3%	0%	**2.9%**	-	0%	0%	0%	0%	**-**	-	0.7%
Pedestrians	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	14	-	-	-	-	-	1	
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	0%	-	-	-	-	-	93.3%	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	100%	-	-	-	-	-	6.7%	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-B Adams Street @ Furnace Brook Parkwa... - TMC

Thu Oct 1, 2020
AM Peak (Oct 01 2020 7:30AM - 8:30 AM)
All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)
All Movements
ID: 786555, Location: 42.253305, -71.024814

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



207487-B Adams Street @ Furnace Brook Parkwa... - TMC

Thu Oct 1, 2020

PM Peak (Oct 01 2020 4:45PM - 5:45 PM) - Overall Peak Hour

All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 786555, Location: 42.253305, -71.024814

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US

Leg	Adams Street						Adams Street						Common Street						Furnace Brook Parkway Ramp						
Direction	Eastbound						Westbound						Northbound						Southbound						
Time	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	L	T	R	U	**App**	Ped*	**Int**
2020-10-01 4:45PM	0	98	70	0	**168**	0	4	61	2	1	**68**	0	28	11	12	0	**51**	1	0	0	0	0	**0**	0	**287**
5:00PM	0	85	45	1	**131**	0	14	70	0	0	**84**	1	34	25	8	0	**67**	3	0	0	0	0	**0**	0	**282**
5:15PM	0	83	51	0	**134**	0	10	58	1	0	**69**	2	24	17	7	0	**48**	2	0	0	0	0	**0**	3	**251**
5:30PM	0	103	56	0	**159**	2	7	81	3	0	**91**	0	21	16	10	0	**47**	5	0	0	0	0	**0**	10	**297**
Total	0	369	222	1	**592**	2	35	270	6	1	**312**	3	107	69	37	0	**213**	11	0	0	0	0	**0**	13	**1117**
% Approach	0%	62.3%	37.5%	0.2%	**-**	-	11.2%	86.5%	1.9%	0.3%	**-**	-	50.2%	32.4%	17.4%	0%	**-**	-	0%	0%	0%	0%	**-**	-	-
% Total	0%	33.0%	19.9%	0.1%	**53.0%**	-	3.1%	24.2%	0.5%	0.1%	**27.9%**	-	9.6%	6.2%	3.3%	0%	**19.1%**	-	0%	0%	0%	0%	**0%**	-	-
PHF	-	0.896	0.797	0.250	**0.883**	-	0.625	0.833	0.625	0.250	**0.864**	-	0.787	0.690	0.771	-	**0.795**	-	-	-	-	-	**-**	-	0.941
Lights	0	365	218	1	**584**	-	35	267	5	1	**308**	-	104	68	35	0	**207**	-	0	0	0	0	**0**	-	1099
% Lights	0%	98.9%	98.2%	100%	**98.6%**	-	100%	98.9%	83.3%	100%	**98.7%**	-	97.2%	98.6%	94.6%	0%	**97.2%**	-	0%	0%	0%	0%	**-**	-	98.4%
Single-Unit Trucks	0	4	1	0	**5**	-	0	3	0	0	**3**	-	2	1	2	0	**5**	-	0	0	0	0	**0**	-	13
% Single-Unit Trucks	0%	1.1%	0.5%	0%	**0.8%**	-	0%	1.1%	0%	0%	**1.0%**	-	1.9%	1.4%	5.4%	0%	**2.3%**	-	0%	0%	0%	0%	**-**	-	1.2%
Articulated Trucks	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	0
% Articulated Trucks	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0%
Buses	0	0	1	0	**1**	-	0	0	0	0	**0**	-	1	0	0	0	**1**	-	0	0	0	0	**0**	-	2
% Buses	0%	0%	0.5%	0%	**0.2%**	-	0%	0%	0%	0%	**0%**	-	0.9%	0%	0%	0%	**0.5%**	-	0%	0%	0%	0%	**-**	-	0.2%
Bicycles on Road	0	0	2	0	**2**	-	0	0	1	0	**1**	-	0	0	0	0	**0**	-	0	0	0	0	**0**	-	3
% Bicycles on Road	0%	0%	0.9%	0%	**0.3%**	-	0%	0%	16.7%	0%	**0.3%**	-	0%	0%	0%	0%	**0%**	-	0%	0%	0%	0%	**-**	-	0.3%
Pedestrians	-	-	-	-	-	2	-	-	-	-	-	3	-	-	-	-	-	11	-	-	-	-	-	13	
% Pedestrians	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	100%	-
Bicycles on Crosswalk	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	0	
% Bicycles on Crosswalk	-	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	0%	-	-	-	-	-	0%	-

*Pedestrians and Bicycles on Crosswalk. L: Left, R: Right, T: Thru, U: U-Turn

207487-B Adams Street @ Furnace Brook Parkwa... - TMC

Thu Oct 1, 2020

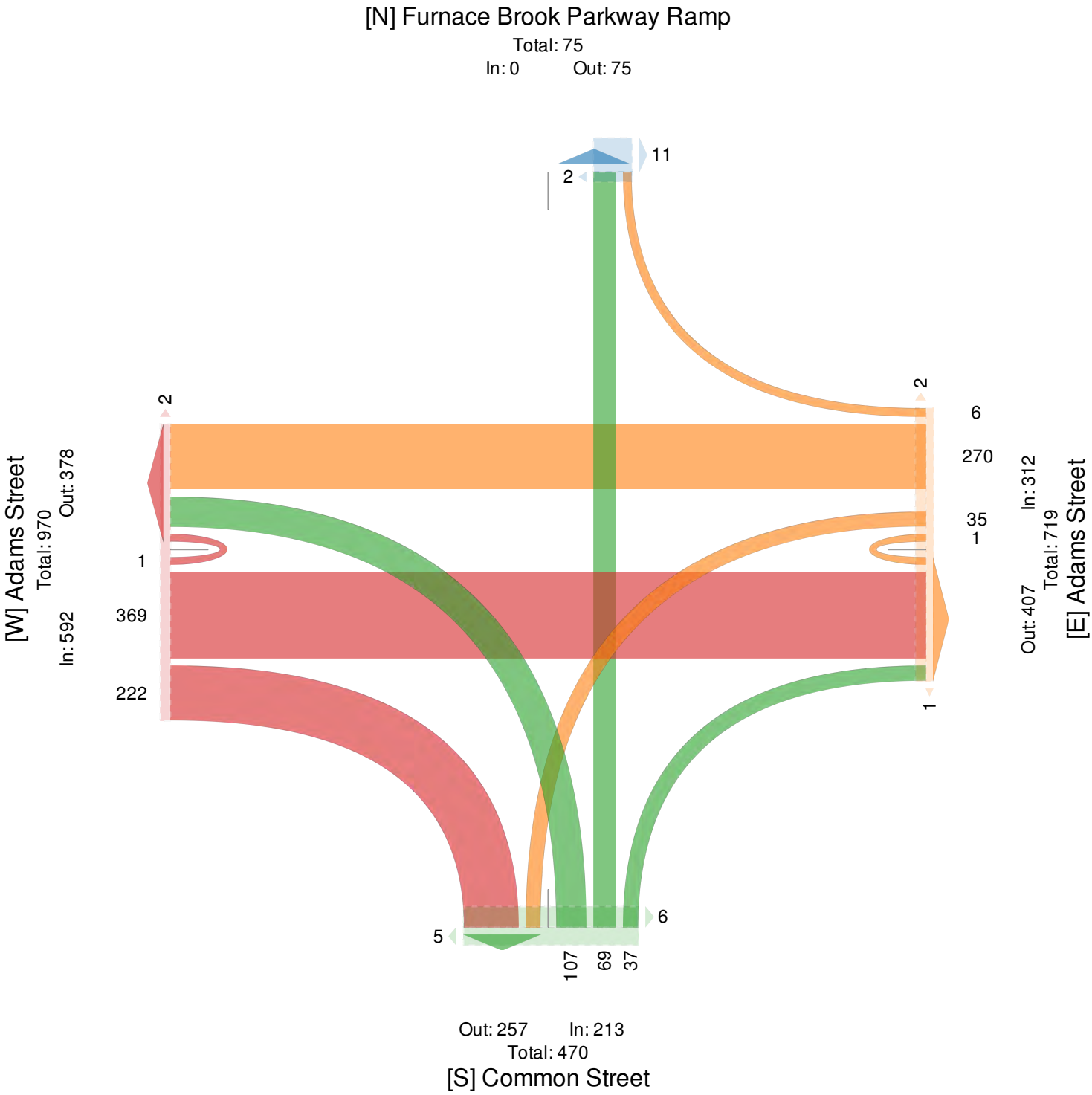
PM Peak (Oct 01 2020 4:45PM - 5:45 PM) - Overall Peak Hour

All Classes (Lights, Single-Unit Trucks, Articulated Trucks, Buses, Pedestrians, Bicycles on Road, Bicycles on Crosswalk)

All Movements

ID: 786555, Location: 42.253305, -71.024814

Provided by: Precision Data Industries, LLC (PDI)
46 Morton Street,
Framingham, MA, MA, 01702, US



APPENDIX G

Spot Speed Count Data
February 2020

Massachusetts Highway Department

S20-005-243-01: February 2020 speed Report

Location ID:	**S20-005-243-01**	**Functional Class:**	**3**
County:	**Norfolk**	**Axle Factor Group:**	**U3**
Community	**Quincy**		
Description:	**On ADAMS STREET at ALRICK RD.**		

DATE	DIR/LANE	0 - 10 MPH	10 - 15 MPH	15 - 20 MPH	20 - 25 MPH	25 - 30 MPH	30 - 35 MPH	35 - 40 MPH	40 - 45 MPH	45 - 50 MPH	50 - 55 MPH	55 - 60 MPH	60 - 65 MPH	65 - 70 MPH	70 - 250	250+ MPH	TOTAL
Mon 24	EB	31	65	223	461	2551	3595	1078	107	11	1	3	2	4	26	0	8158
Mon 24	WB	78	74	201	618	1886	2975	2344	702	100	17	1	0	0	1	0	8997
Tue 25	EB	17	39	165	359	2545	3643	1086	87	6	0	0	2	10	18	0	7977
Tue 25	WB	149	130	181	578	1833	2846	2265	626	99	13	3	3	0	1	0	8727
Wed 26	EB	22	30	146	324	2617	3617	1196	123	5	1	4	7	7	55	0	8154
Wed 26	WB	322	222	385	771	1956	2904	2127	612	85	13	3	0	0	1	0	9401
Thu 27	EB	25	32	148	252	2069	3771	1588	163	13	3	0	3	8	25	0	8100
Thu 27	WB	37	52	120	342	1580	2842	2451	731	89	16	3	1	0	2	0	8266
Fri 28	EB	30	20	164	339	2333	3813	1426	126	16	4	0	1	3	24	0	8299
Fri 28	WB	24	42	93	336	1335	2530	2152	691	94	17	7	1	0	0	0	7322
Percentages		**.81%**	**.80%**	**2.11%**	**4.95%**	**24.09%**	**39.38%**	**21.87%**	**4.95%**	**.64%**	**.11%**	**.03%**	**.02%**	**.04%**	**.19%**	**0%**	**100%**
Totals		**780**	**775**	**2032**	**4771**	**23207**	**37949**	**21077**	**4769**	**617**	**104**	**31**	**22**	**35**	**185**	**0**	**96354**

Massachusetts Highway Department
S20-005-243-03: February 2020 speed Report

Location ID:	**S20-005-243-03**	**Functional Class:**	**4**
County:	**Norfolk**	**Axle Factor Group:**	**U4-7**
Community	**Quincy**		
Description:	**On FURNACE BROOK PARKWAY at BRAE RD. AT 856 FURNACE BROOK PWY**		

DATE	DIR/LANE	0 - 10 MPH	10 - 15 MPH	15 - 20 MPH	20 - 25 MPH	25 - 30 MPH	30 - 35 MPH	35 - 40 MPH	40 - 45 MPH	45 - 50 MPH	50 - 55 MPH	55 - 60 MPH	60 - 65 MPH	65 - 70 MPH	70 - 250	250+ MPH	TOTAL
Thu 27	NB	96	29	57	167	881	2096	1703	300	18	2	2	0	0	3	0	5354
Thu 27	SB	158	108	206	470	1178	1682	1569	438	83	14	6	1	0	2	0	5915
Percentages		**11.92%**	**1.30%**	**2.48%**	**5.17%**	**15.96%**	**30.39%**	**25.46%**	**6.19%**	**.87%**	**.13%**	**.04%**	**.02%**	**0%**	**.06%**	**0%**	**100%**
Totals		**9722**	**1058**	**2019**	**4215**	**13020**	**24793**	**20769**	**5052**	**713**	**103**	**36**	**19**	**4**	**48**	**0**	**81571**

Massachusetts Highway Department
S20-005-243-04: February 2020 speed Report

Location ID: S20-005-243-04
County: Norfolk
Community Quincy
Description: On COMMON STREET at HILLTOP ST./ROOSEVELT RD.

Functional Class: 5
Axle Factor Group: U4-7

DATE	DIR/LANE	0 - 10 MPH	10 - 15 MPH	15 - 20 MPH	20 - 25 MPH	25 - 30 MPH	30 - 35 MPH	35 - 40 MPH	40 - 45 MPH	45 - 50 MPH	50 - 55 MPH	55 - 60 MPH	60 - 65 MPH	65 - 70 MPH	70 - 250	250+ MPH	TOTAL
Mon 24	NB	369	254	976	1464	340	123	38	10	1	1	1	0	0	1	0	3578
Mon 24	SB	36	73	374	1479	969	117	6	1	1	0	0	0	0	0	0	3056
Tue 25	NB	289	282	957	1370	304	85	40	8	1	0	0	0	0	0	0	3336
Tue 25	SB	22	62	404	1475	908	78	9	0	0	0	0	0	0	1	0	2959
Wed 26	NB	658	336	903	1381	310	81	25	18	3	0	0	0	0	0	0	3715
Wed 26	SB	34	65	379	1492	884	116	10	0	0	0	0	0	0	0	0	2980
Thu 27	NB	140	202	915	1406	322	88	37	10	0	0	0	0	0	0	0	3120
Thu 27	SB	25	69	389	1465	963	115	2	0	1	0	0	0	0	0	0	3029
Fri 28	NB	65	114	778	1338	332	91	53	16	3	0	0	0	0	0	0	2790
Fri 28	SB	15	40	315	1477	1010	122	6	0	0	0	0	0	0	0	0	2985
Sat 29	NB	16	70	618	1109	287	93	45	7	0	0	0	0	0	3	0	2248
Sat 29	SB	18	22	239	1072	766	92	7	0	0	0	0	0	0	0	0	2216
Percentages		**4.68%**	**4.41%**	**20.12%**	**45.90%**	**20.53%**	**3.33%**	**.77%**	**.19%**	**.03%**	**0%**	**0%**	**0%**	**0%**	**.01%**	**0%**	**100%**
Totals		**1687**	**1589**	**7247**	**16528**	**7395**	**1201**	**278**	**70**	**10**	**1**	**1**	**0**	**0**	**5**	**0**	**36012**

APPENDIX H

Intersection Capacity Analyses
Estimated 2020 Existing Conditions

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Future Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	16	12	12	16	12
Storage Length (ft)	0		0	0		0	0		50	0		0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		329			132			636			144	
Travel Time (s)		7.5			3.0			14.5			3.3	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	609	0	73	441	0	0	338	78	0	777	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	46.0	46.0		46.0	46.0		56.0	56.0	56.0	56.0	56.0	
Total Split (%)	35.7%	35.7%		35.7%	35.7%		43.4%	43.4%	43.4%	43.4%	43.4%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		40.5		40.5	40.5			50.7	50.7		50.7	
Actuated g/C Ratio		0.36		0.36	0.36			0.45	0.45		0.45	
v/c Ratio		0.68		0.36	0.35			0.78	0.11		1.07	
Control Delay		37.5		37.2	29.5			43.2	7.6		84.4	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		37.5		37.2	29.5			43.2	7.6		84.4	
LOS		D		D	C			D	A		F	
Approach Delay		37.5			30.6			36.6			84.4	
Approach LOS		D			C			D			F	
Queue Length 50th (ft)		165		33	103			166	3		470	
Queue Length 95th (ft)		320		99	203			#451	38		#771	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		896		204	1247			436	728		727	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	21%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.68		0.36	0.35			0.78	0.11		1.07	

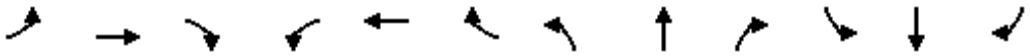
Intersection Summary			
Area Type:	Other		
Cycle Length: 129			
Actuated Cycle Length: 112.8			
Natural Cycle: 145			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.07			
Intersection Signal Delay: 51.5		Intersection LOS: D	
Intersection Capacity Utilization 97.5%		ICU Level of Service F	
Analysis Period (min) 15			

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:

HCM Unsignalized Intersection Capacity Analysis
Adams Street at Common Street

01/12/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Future Volume (Veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.86	0.86	0.86	0.82	0.82	0.82	0.92	0.92	0.92
Hourly flow rate (vph)	0	336	191	56	392	13	189	80	88	0	0	0
Pedestrians		1			1			15			1	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.93			0.93	0.93	0.93	0.93	0.93	
vC, conflicting volume	406			542			756	964	280	808	1054	204
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	406			349			579	805	66	636	901	204
tC, single (s)	4.2			4.2			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			44	70	90	100	100	100
cM capacity (veh/h)	1142			1096			340	268	890	222	240	801

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	224	303	56	261	144	357
Volume Left	0	0	56	0	0	189
Volume Right	0	191	0	0	13	88
cSH	1700	1700	1096	1700	1700	375
Volume to Capacity	0.13	0.18	0.05	0.15	0.08	0.95
Queue Length 95th (ft)	0	0	4	0	0	263
Control Delay (s)	0.0	0.0	8.5	0.0	0.0	69.1
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			69.1
Approach LOS						F

Intersection Summary				
Average Delay	18.7			
Intersection Capacity Utilization	47.9%	ICU Level of Service		A
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Future Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	829	0	39	485	0	0	421	94	0	553	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	46.0	46.0		46.0	46.0		56.0	56.0	56.0	56.0	56.0	
Total Split (%)	35.7%	35.7%		35.7%	35.7%		43.4%	43.4%	43.4%	43.4%	43.4%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		40.5		40.5	40.5			50.7	50.7		50.7	
Actuated g/C Ratio		0.36		0.36	0.36			0.45	0.45		0.45	
v/c Ratio		0.98		0.31	0.38			0.78	0.13		0.81	
Control Delay		62.8		39.7	29.9			41.3	9.2		39.3	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		62.8		39.7	29.9			41.3	9.2		39.3	
LOS		E		D	C			D	A		D	
Approach Delay		62.8			30.6			35.4			39.3	
Approach LOS		E			C			D			D	
Queue Length 50th (ft)		261		17	115			208	9		270	
Queue Length 95th (ft)		#552		61	214			#534	50		#661	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		849		124	1271			537	739		684	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.98		0.31	0.38			0.78	0.13		0.81	

Intersection Summary
Cycle Length: 129
Actuated Cycle Length: 112.8
Natural Cycle: 135
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.98

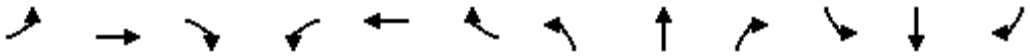
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	21%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Intersection Signal Delay: 44.6	Intersection LOS: D
Intersection Capacity Utilization 103.1%	ICU Level of Service G
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Future Volume (Veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.86	0.86	0.86	0.80	0.80	0.80	0.92	0.92	0.92
Hourly flow rate (vph)	0	469	282	50	378	8	163	105	56	0	0	0
Pedestrians		2			3			11			13	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.81			0.81	0.81	0.81	0.81	0.81	
vC, conflicting volume	399			762			912	1120	390	841	1257	208
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	399			242			427	683	0	340	852	208
tC, single (s)	4.1			4.1			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			58	63	94	100	100	100
cM capacity (veh/h)	1156			1067			390	282	865	304	226	796

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	313	438	50	252	134	324
Volume Left	0	0	50	0	0	163
Volume Right	0	282	0	0	8	56
cSH	1700	1700	1067	1700	1700	379
Volume to Capacity	0.18	0.26	0.05	0.15	0.08	0.86
Queue Length 95th (ft)	0	0	4	0	0	203
Control Delay (s)	0.0	0.0	8.5	0.0	0.0	50.6
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			50.6
Approach LOS						F

Intersection Summary				
Average Delay	11.1			
Intersection Capacity Utilization	51.3%	ICU Level of Service		A
Analysis Period (min)	15			

APPENDIX I

Intersection Capacity Analyses
2020 Signal Retiming Scenario

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Future Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	16	12	12	16	12
Storage Length (ft)	0		0	0		0	0		50	0		0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		329			132			636			144	
Travel Time (s)		7.5			3.0			14.5			3.3	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	609	0	73	441	0	0	338	78	0	777	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	42.0	42.0		42.0	42.0		66.0	66.0	66.0	66.0	66.0	
Total Split (%)	31.1%	31.1%		31.1%	31.1%		48.9%	48.9%	48.9%	48.9%	48.9%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		36.4		36.4	36.4			60.7	60.7		60.7	
Actuated g/C Ratio		0.31		0.31	0.31			0.51	0.51		0.51	
v/c Ratio		0.82		0.47	0.41			0.62	0.10		0.89	
Control Delay		50.1		50.0	36.1			30.2	6.8		40.9	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		50.1		50.0	36.1			30.2	6.8		40.9	
LOS		D		D	D			C	A		D	
Approach Delay		50.1			38.0			25.8			40.9	
Approach LOS		D			D			C			D	
Queue Length 50th (ft)		196		39	121			145	4		405	
Queue Length 95th (ft)		#396		114	225			367	37		641	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		743		154	1064			543	818		876	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	20%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.82		0.47	0.41			0.62	0.10		0.89	

Intersection Summary			
Area Type:	Other		
Cycle Length: 135			
Actuated Cycle Length: 118.8			
Natural Cycle: 145			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.89			
Intersection Signal Delay: 40.0		Intersection LOS: D	
Intersection Capacity Utilization 97.5%		ICU Level of Service F	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Future Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	829	0	39	485	0	0	421	94	0	553	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	51.0	51.0		51.0	51.0		57.0	57.0	57.0	57.0	57.0	
Total Split (%)	37.8%	37.8%		37.8%	37.8%		42.2%	42.2%	42.2%	42.2%	42.2%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		45.5		45.5	45.5			51.6	51.6		51.6	
Actuated g/C Ratio		0.38		0.38	0.38			0.43	0.43		0.43	
v/c Ratio		0.91		0.27	0.36			0.83	0.13		0.87	
Control Delay		51.1		36.6	29.0			47.5	10.2		47.5	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		51.1		36.6	29.0			47.5	10.2		47.5	
LOS		D		D	C			D	B		D	
Approach Delay		51.1			29.6			40.7			47.5	
Approach LOS		D			C			D			D	
Queue Length 50th (ft)		264		17	117			233	11		307	
Queue Length 95th (ft)		#546		59	215			#573	54		#723	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		912		143	1356			509	715		635	
Starvation Cap Reductn		0		0	0			0	0		0	
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.91		0.27	0.36			0.83	0.13		0.87	

Intersection Summary
Cycle Length: 135
Actuated Cycle Length: 118.8
Natural Cycle: 135
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.91

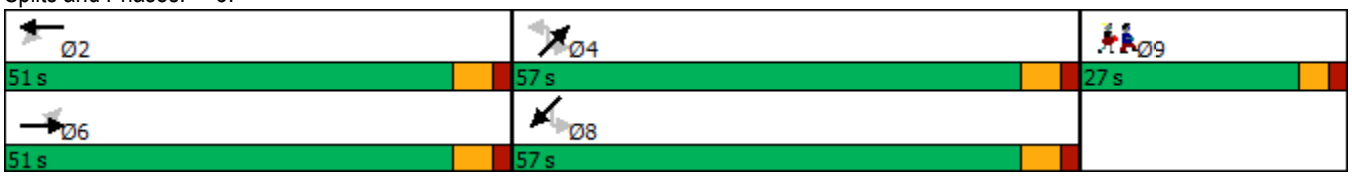
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	20%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	

Intersection Summary

Intersection Signal Delay: 43.4	Intersection LOS: D
Intersection Capacity Utilization 103.1%	ICU Level of Service G
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:



APPENDIX J

Intersection Capacity Analyses
No-Build and Proposed Alternatives
2030 Projected Traffic Conditions

Table I-1
Intersection Capacity Analysis
No-Build Scenario under Projected 2030 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L/T/R	D	47	0.82	#398	E	74	1.03	#596
Adams Street WB	L	D	47	0.48	114	D	42	0.36	61
Adams Street WB	T/R	C	33	0.41	223	C	30	0.39	224
Furnace Brook Parkway NB	L/T	D	38	0.74	#451	D	44	0.78	#606
Furnace Brook Parkway NB	R	A	7	0.10	39	A	10	0.14	54
Furnace Brook Parkway SB	L/T/R	E	69	1.03	#777	E	56	0.94	#771
Intersection (1) Average	-	D	49	-	-	D	54	-	-
Adams Street EB	T/R	A	0	0.19	-	A	0	0.27	-
Adams Street WB	L	A	8	0.05	4	A	9	0.05	4
Adams Street WB	T/R	A	0	0.16	-	A	0	0.16	-
Common Street NB	L/T/R	F	76	0.98	263	F	74	0.96	264
Intersection (2) Average	-	C	21	-	-	C	16	-	-

Notes:
• Intersection: (1) Adams Street at Furnace Brook Parkway, (2) Adams Street at Common Street
• Approach: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound
• Turning movement: L = Left turn, T = Through movement, R = Right turn
• LOS = Lever of Service
• Delay (seconds) = Average delay per vehicle
• V/C = Volume to capacity ratio
• #: 95th percentile volume exceeds capacity. The queue shown is maximum after two cycles.
• #: 95th percentile volume exceeds capacity. Queue shown is maximum afer two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Future Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	16	12	12	16	12
Storage Length (ft)	0		0	0		0	0		50	0		0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		329			132			636			144	
Travel Time (s)		7.5			3.0			14.5			3.3	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Growth Factor	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	639	0	76	463	0	0	355	82	0	814	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	42.0	42.0		42.0	42.0		60.0	60.0	60.0	60.0	60.0	
Total Split (%)	32.6%	32.6%		32.6%	32.6%		46.5%	46.5%	46.5%	46.5%	46.5%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		36.5		36.5	36.5			54.7	54.7		54.7	
Actuated g/C Ratio		0.32		0.32	0.32			0.48	0.48		0.48	
v/c Ratio		0.82		0.48	0.41			0.74	0.10		1.03	
Control Delay		46.9		47.0	33.1			37.6	7.2		68.5	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		46.9		47.0	33.1			37.6	7.2		68.5	
LOS		D		D	C			D	A		E	
Approach Delay		46.9			35.1			31.9			68.5	
Approach LOS		D			D			C			E	
Queue Length 50th (ft)		190		37	117			161	4		464	
Queue Length 95th (ft)		#398		114	223			#451	39		#777	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		780		159	1122			480	781		794	
Starvation Cap Reductn		0		0	0			0	0		0	

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	21%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	

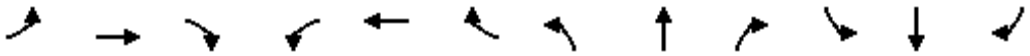
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		0.82		0.48	0.41			0.74	0.10		1.03	

Intersection Summary			
Area Type:	Other		
Cycle Length: 129			
Actuated Cycle Length: 112.8			
Natural Cycle: 145			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.03			
Intersection Signal Delay: 48.8		Intersection LOS: D	
Intersection Capacity Utilization 101.3%		ICU Level of Service G	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 3:

HCM Unsignalized Intersection Capacity Analysis
Adams Street at Common Street

01/18/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Future Volume (Veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.86	0.86	0.86	0.82	0.82	0.82	0.92	0.92	0.92
Hourly flow rate (vph)	0	353	201	59	411	13	198	85	92	0	0	0
Pedestrians		1			1			15			1	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.90			0.90	0.90	0.90	0.90	0.90	
vC, conflicting volume	425			569			793	1012	293	848	1106	214
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	425			295			544	787	0	606	892	214
tC, single (s)	4.2			4.2			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			43	68	90	100	100	100
cM capacity (veh/h)	1124			1113			349	265	951	221	235	790

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	235	319	59	274	150	375
Volume Left	0	0	59	0	0	198
Volume Right	0	201	0	0	13	92
cSH	1700	1700	1113	1700	1700	381
Volume to Capacity	0.14	0.19	0.05	0.16	0.09	0.98
Queue Length 95th (ft)	0	0	4	0	0	287
Control Delay (s)	0.0	0.0	8.4	0.0	0.0	75.7
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			75.7
Approach LOS						F

Intersection Summary				
Average Delay	20.5			
Intersection Capacity Utilization	49.6%	ICU Level of Service		A
Analysis Period (min)	15			

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Future Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	16	12	12	16	12
Storage Length (ft)	0		0	0		0	0		50	0		0
Storage Lanes	0		0	1		0	0		1	0		0
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		329			132			636			144	
Travel Time (s)		7.5			3.0			14.5			3.3	
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Growth Factor	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	879	0	41	514	0	0	446	99	0	586	0
Turn Type	Perm	NA		Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		6			2			4			8	
Permitted Phases	6			2			4		4	8		
Detector Phase	6	6		2	2		4	4	4	8	8	
Switch Phase												
Minimum Initial (s)	5.0	5.0		5.0	5.0		5.0	5.0	5.0	1.0	1.0	
Minimum Split (s)	27.0	27.0		27.0	27.0		27.0	27.0	27.0	27.0	27.0	
Total Split (s)	47.0	47.0		47.0	47.0		55.0	55.0	55.0	55.0	55.0	
Total Split (%)	36.4%	36.4%		36.4%	36.4%		42.6%	42.6%	42.6%	42.6%	42.6%	
Yellow Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Lost Time Adjust (s)		0.0		0.0	0.0			0.0	0.0		0.0	
Total Lost Time (s)		6.0		6.0	6.0			6.0	6.0		6.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	Max	Max		Max	Max		None	None	None	None	None	
Act Effct Green (s)		41.5		41.5	41.5			49.7	49.7		49.7	
Actuated g/C Ratio		0.37		0.37	0.37			0.44	0.44		0.44	
v/c Ratio		1.03		0.36	0.39			0.88	0.14		0.94	
Control Delay		74.0		42.1	29.4			51.9	9.8		56.3	
Queue Delay		0.0		0.0	0.0			0.0	0.0		0.0	
Total Delay		74.0		42.1	29.4			51.9	9.8		56.3	
LOS		E		D	C			D	A		E	
Approach Delay		74.0			30.3			44.3			56.3	
Approach LOS		E			C			D			E	
Queue Length 50th (ft)		284		18	121			238	10		320	
Queue Length 95th (ft)		#596		65	224			#606	54		#771	
Internal Link Dist (ft)		249			52			556			64	
Turn Bay Length (ft)									50			
Base Capacity (vph)		857		115	1303			505	725		622	
Starvation Cap Reductn		0		0	0			0	0		0	

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Lane Width (ft)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	21%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	

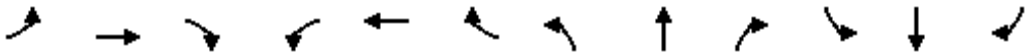
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Spillback Cap Reductn		0		0	0			0	0		0	
Storage Cap Reductn		0		0	0			0	0		0	
Reduced v/c Ratio		1.03		0.36	0.39			0.88	0.14		0.94	

Intersection Summary			
Area Type:	Other		
Cycle Length: 129			
Actuated Cycle Length: 112.8			
Natural Cycle: 135			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.03			
Intersection Signal Delay: 54.2		Intersection LOS: D	
Intersection Capacity Utilization 108.0%		ICU Level of Service G	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 3:

HCM Unsignalized Intersection Capacity Analysis
Adams Street at Common Street

01/18/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Future Volume (Veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.86	0.86	0.86	0.80	0.80	0.80	0.92	0.92	0.92
Hourly flow rate (vph)	0	497	299	53	401	9	172	111	60	0	0	0
Pedestrians		2			3			11			13	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.80			0.80	0.80	0.80	0.80	0.80	
vC, conflicting volume	423			807			966	1186	412	892	1332	220
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	423			250			450	726	0	356	908	220
tC, single (s)	4.1			4.1			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			53	57	93	100	100	100
cM capacity (veh/h)	1133			1041			368	260	850	271	205	782

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	331	465	53	267	143	343
Volume Left	0	0	53	0	0	172
Volume Right	0	299	0	0	9	60
cSH	1700	1700	1041	1700	1700	356
Volume to Capacity	0.19	0.27	0.05	0.16	0.08	0.96
Queue Length 95th (ft)	0	0	4	0	0	264
Control Delay (s)	0.0	0.0	8.6	0.0	0.0	73.7
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			73.7
Approach LOS						F

Intersection Summary				
Average Delay	16.1			
Intersection Capacity Utilization	53.5%	ICU Level of Service		A
Analysis Period (min)	15			

Table I-2
Intersection Capacity Analysis
Alternative 1 under Projected 2030 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L	C	26	0.37	82	C	33	0.57	#165
Adams Street EB	T/R	C	32	0.64	#242	C	31	0.64	#340
Adams Street WB	L	C	26	0.33	67	C	22	0.19	40
Adams Street WB	T/R	C	29	0.53	189	C	29	0.51	196
Furnace Brook Parkway NB	L	E	58	0.77	#168	D	40	0.67	#171
Furnace Brook Parkway NB	T/R	D	36	0.64	#333	D	42	0.77	#412
Furnace Brook Parkway SB	L	C	26	0.34	68	C	26	0.36	67
Furnace Brook Parkway SB	T	E	64	0.95	#394	D	39	0.73	#345
Furnace Brook Parkway SB	R	D	40	0.68	#215	C	31	0.42	149
Intersection (1) Average	-	D	39	-	-	C	34	-	-
Adams Street EB	T/R	A	0	0.19	-	A	0	0.27	-
Adams Street WB	L	A	8	0.05	4	A	9	0.05	4
Adams Street WB	T/R	A	0	0.16	-	A	0	0.16	-
Common Street NB	L/T/R	F	63	0.94	259	F	101	1.05	312
Intersection (2) Average	-	C	17	-	-	C	22	-	-

Notes:
• Intersection: (1) Adams Street at Furnace Brook Parkway, (2) Adams Street at Common Street
• Approach: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound
• Turning movement: L = Left turn, T = Through movement, R = Right turn
• LOS = Lever of Service
• Delay (seconds) = Average delay per vehicle
• V/C = Volume to capacity ratio
• #: 95th percentile volume exceeds capacity. The queue shown is maximum after two cycles.
• #: 95th percentile volume exceeds capacity. Queue shown is maximum afer two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Future Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	125		0	75		0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		426			132			636			144	
Travel Time (s)		9.7			3.0			14.5			3.3	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Growth Factor	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	541	0	76	463	0	128	309	0	99	448	267
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6			2			4			8		8
Detector Phase	1	6		5	2		7	4		3	8	8
Switch Phase												
Minimum Initial (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	5.0	5.0
Minimum Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (%)	7.4%	28.4%		7.4%	28.4%		7.4%	28.4%		7.4%	28.4%	28.4%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None		None	None	None
Act Effct Green (s)	26.1	21.7		26.1	21.7		27.9	23.5		26.9	21.7	21.7
Actuated g/C Ratio	0.34	0.28		0.34	0.28		0.36	0.30		0.35	0.28	0.28
v/c Ratio	0.37	0.64		0.33	0.53		0.77	0.64		0.34	0.95	0.68
Control Delay	26.3	31.7		25.9	29.2		57.8	36.4		25.6	64.3	39.8
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	26.3	31.7		25.9	29.2		57.8	36.4		25.6	64.3	39.8
LOS	C	C		C	C		E	D		C	E	D
Approach Delay		30.9			28.7			42.6			51.6	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	23	98		18	81		31	109		24	174	94
Queue Length 95th (ft)	82	#242		67	189		#168	#333		68	#394	#215
Internal Link Dist (ft)		346			52			556			64	
Turn Bay Length (ft)	200						125			75		
Base Capacity (vph)	267	849		227	877		166	481		288	470	392
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0

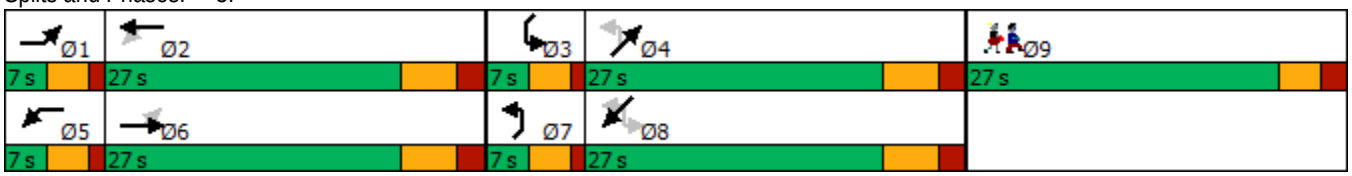
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	28%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

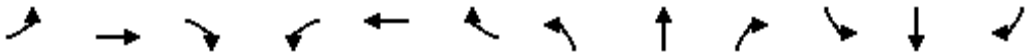
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.37	0.64		0.33	0.53		0.77	0.64		0.34	0.95	0.68

Intersection Summary			
Area Type:	CBD		
Cycle Length: 95			
Actuated Cycle Length: 77.4			
Natural Cycle: 95			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.95			
Intersection Signal Delay: 39.4		Intersection LOS: D	
Intersection Capacity Utilization 64.1%		ICU Level of Service C	
Analysis Period (min) 15			

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Future Volume (Veh/h)	0	309	176	48	337	11	155	66	72	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.86	0.86	0.86	0.82	0.82	0.82	0.92	0.92	0.92
Hourly flow rate (vph)	0	353	201	59	411	13	198	85	92	0	0	0
Pedestrians		1			1			15			1	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.88			0.88	0.88	0.88	0.88	0.88	
vC, conflicting volume	425			569			793	1012	293	848	1106	214
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	425			237			492	740	0	555	847	214
tC, single (s)	4.2			4.2			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			47	69	90	100	100	100
cM capacity (veh/h)	1124			1145			373	277	931	239	245	790

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	235	319	59	274	150	375
Volume Left	0	0	59	0	0	198
Volume Right	0	201	0	0	13	92
cSH	1700	1700	1145	1700	1700	401
Volume to Capacity	0.14	0.19	0.05	0.16	0.09	0.94
Queue Length 95th (ft)	0	0	4	0	0	259
Control Delay (s)	0.0	0.0	8.3	0.0	0.0	62.7
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			62.7
Approach LOS						F

Intersection Summary				
Average Delay	17.0			
Intersection Capacity Utilization	49.6%	ICU Level of Service		A
Analysis Period (min)	15			

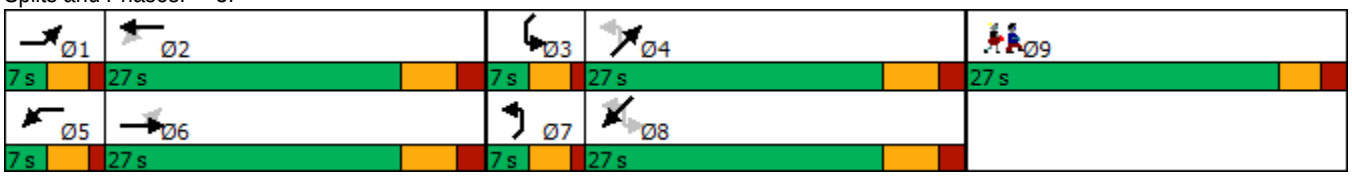
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Future Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	125		0	100		0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		438			132			636			144	
Travel Time (s)		10.0			3.0			14.5			3.3	
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Growth Factor	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	164	715	0	41	514	0	161	384	0	78	346	162
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6			2			4			8		8
Detector Phase	1	6		5	2		7	4		3	8	8
Switch Phase												
Minimum Initial (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	1.0	1.0
Minimum Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (%)	7.4%	28.4%		7.4%	28.4%		7.4%	28.4%		7.4%	28.4%	28.4%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None		None	None	None
Act Effct Green (s)	28.9	25.2		27.0	21.8		25.8	21.4		24.8	19.6	19.6
Actuated g/C Ratio	0.37	0.33		0.35	0.28		0.33	0.28		0.32	0.25	0.25
v/c Ratio	0.57	0.64		0.19	0.51		0.67	0.77		0.36	0.73	0.42
Control Delay	33.3	30.5		22.2	28.5		40.4	41.9		26.2	39.2	30.9
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	33.3	30.5		22.2	28.5		40.4	41.9		26.2	39.2	30.9
LOS	C	C		C	C		D	D		C	D	C
Approach Delay		31.0			28.0			41.5			35.1	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	40	135		9	90		39	139		18	121	52
Queue Length 95th (ft)	#165	#340		40	196		#171	#412		67	#345	149
Internal Link Dist (ft)		358			52			556			64	
Turn Bay Length (ft)	200						125			100		
Base Capacity (vph)	288	1111		216	999		239	506		218	530	432
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0

Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	28%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.57	0.64		0.19	0.51		0.67	0.76		0.36	0.65	0.38

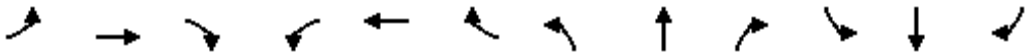
Intersection Summary			
Area Type:	Other		
Cycle Length: 95			
Actuated Cycle Length: 77.1			
Natural Cycle: 95			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.77			
Intersection Signal Delay: 33.5		Intersection LOS: C	
Intersection Capacity Utilization 63.8%		ICU Level of Service B	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			

Splits and Phases: 3:



HCM Unsignalized Intersection Capcity Analysis
Adams Street at Common Street

01/12/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Future Volume (Veh/h)	0	413	248	43	325	7	130	84	45	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.88	0.88	0.88	0.86	0.86	0.86	0.80	0.80	0.80	0.92	0.92	0.92
Hourly flow rate (vph)	0	497	299	53	401	9	172	111	60	0	0	0
Pedestrians		2			3			11			13	
Lane Width (ft)		12.0			14.0			12.0			0.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		0			0			1			0	
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		132										
pX, platoon unblocked				0.83			0.83	0.83	0.83	0.83	0.83	
vC, conflicting volume	423			807			966	1186	412	892	1332	220
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	423			350			542	808	0	452	984	220
tC, single (s)	4.1			4.1			7.6	6.6	7.0	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			48	54	93	100	100	100
cM capacity (veh/h)	1133			993			328	241	882	231	192	782

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	WB 3	NB 1
Volume Total	331	465	53	267	143	343
Volume Left	0	0	53	0	0	172
Volume Right	0	299	0	0	9	60
cSH	1700	1700	993	1700	1700	326
Volume to Capacity	0.19	0.27	0.05	0.16	0.08	1.05
Queue Length 95th (ft)	0	0	4	0	0	312
Control Delay (s)	0.0	0.0	8.8	0.0	0.0	101.3
Lane LOS			A			F
Approach Delay (s)	0.0		1.0			101.3
Approach LOS						F

Intersection Summary				
Average Delay	22.0			
Intersection Capacity Utilization	53.5%	ICU Level of Service		A
Analysis Period (min)	15			

Table I-3
Intersection Capacity Analysis
Alternative 2 under Projected 2030 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L	D	41	0.41	108	D	44	0.64	154
Adams Street EB	T/R	E	63	0.86	#324	D	52	0.83	#380
Adams Street WB	L	D	40	0.67	m#46	B	19	0.36	m25
Adams Street WB	T/R	B	17	0.41	m171	B	11	0.39	m173
Furnace Brook Parkway NB	L	E	76	0.73	#181	E	76	0.78	#220
Furnace Brook Parkway NB	T/R	D	48	0.66	322	D	55	0.79	#453
Furnace Brook Parkway SB	L	E	68	0.61	108	E	75	0.61	#121
Furnace Brook Parkway SB	T	E	72	0.93	#397	E	71	0.88	#443
Furnace Brook Parkway SB	R	C	21	0.50	94	C	21	0.37	96
Intersection (1) Average	-	D	49	-	-	D	46	-	-
Adams Street EB	T/R	A	2	0.24	m0	A	2	0.24	0
Adams Street WB	L	D	45	0.34	77	D	39	0.34	68
Adams Street WB	T/R	D	43	0.47	190	C	34	0.47	166
Common Street NB	L/T/R	E	67	0.89	#379	E	78	0.93	#354
Intersection (2) Average	-	C	33	-	-	C	27	-	-

Notes:
• Intersection: (1) Adams Street at Furnace Brook Parkway, (2) Adams Street at Common Street
• Approach: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound
• Turning movement: L = Left turn, T = Through movement, R = Right turn
• LOS = Lever of Service
• Delay (seconds) = Average delay per vehicle
• V/C = Volume to capacity ratio
• 95th Queue (feet) = the maximun back of queue with 95th percentile traffic volumes.
• #: 95th percentile volume exceeds capacity. The queue shown is maximum after two cycles.
• m: Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Future Volume (vph)	84	342	122	69	419	0	116	205	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	125		50	75		0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		404			132			636			144	
Travel Time (s)		9.2			3.0			14.5			3.3	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Growth Factor	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	541	0	76	463	0	128	309	0	99	448	267
Turn Type	pm+pt	NA		custom	NA		Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6 10		3	8		7	4	4 5
Permitted Phases	2			6								
Detector Phase	5	2		1	6 10		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	3.0	1.0		3.0			3.0	5.0		5.0	3.0	
Minimum Split (s)	7.0	8.0		7.0			7.0	30.0		9.5	30.0	
Total Split (s)	16.0	27.0		7.0			17.0	36.0		17.0	36.0	
Total Split (%)	13.3%	22.5%		5.8%			14.2%	30.0%		14.2%	30.0%	
Yellow Time (s)	3.0	4.0		3.0			3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0			1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0			4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead			Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes	Yes	
Recall Mode	None	None		None			None	Max		None	None	
Act Effct Green (s)	30.0	22.4		17.5	39.5		12.0	31.9		11.1	31.0	40.4
Actuated g/C Ratio	0.25	0.19		0.15	0.33		0.10	0.27		0.09	0.26	0.34
v/c Ratio	0.41	0.86		0.67	0.41		0.73	0.66		0.61	0.93	0.50
Control Delay	41.4	62.9		40.1	13.3		76.2	47.8		67.8	71.7	20.6
Queue Delay	0.0	0.0		0.3	4.1		0.0	0.0		0.0	0.0	0.0
Total Delay	41.4	62.9		40.4	17.4		76.2	47.8		67.8	71.7	20.6
LOS	D	E		D	B		E	D		E	E	C
Approach Delay		59.6			20.7			56.1			54.5	
Approach LOS		E			C			E			D	
Queue Length 50th (ft)	61	219		31	128		97	216		74	344	78
Queue Length 95th (ft)	108	#324		m#46	m171		#181	322		108	#397	94
Internal Link Dist (ft)		324			52			556			64	
Turn Bay Length (ft)	200						125			75		
Base Capacity (vph)	244	626		114	1143		189	467		191	480	540
Starvation Cap Reductn	0	0		1	585		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0

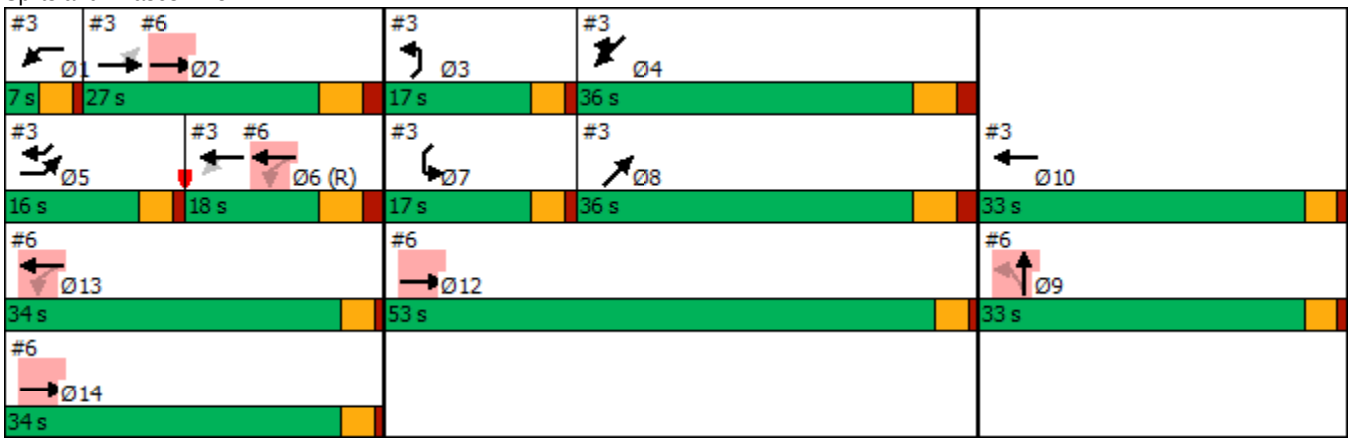
Lane Group	Ø6	Ø9	Ø10	Ø12	Ø13	Ø14
Lane Configurations						
Traffic Volume (vph)						
Future Volume (vph)						
Ideal Flow (vphpl)						
Storage Length (ft)						
Storage Lanes						
Taper Length (ft)						
Right Turn on Red						
Link Speed (mph)						
Link Distance (ft)						
Travel Time (s)						
Confl. Peds. (#/hr)						
Peak Hour Factor						
Growth Factor						
Heavy Vehicles (%)						
Shared Lane Traffic (%)						
Lane Group Flow (vph)						
Turn Type						
Protected Phases	6	9	10	12	13	14
Permitted Phases						
Detector Phase						
Switch Phase						
Minimum Initial (s)	2.5	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	8.5	27.0	28.0	22.5	22.0	22.5
Total Split (s)	18.0	33.0	33.0	53.0	34.0	34.0
Total Split (%)	15%	28%	28%	44%	28%	28%
Yellow Time (s)	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)						
Total Lost Time (s)						
Lead/Lag	Lag					
Lead-Lag Optimize?	Yes					
Recall Mode	C-Max	Max	None	None	None	None
Act Effct Green (s)						
Actuated g/C Ratio						
v/c Ratio						
Control Delay						
Queue Delay						
Total Delay						
LOS						
Approach Delay						
Approach LOS						
Queue Length 50th (ft)						
Queue Length 95th (ft)						
Internal Link Dist (ft)						
Turn Bay Length (ft)						
Base Capacity (vph)						
Starvation Cap Reductn						
Spillback Cap Reductn						

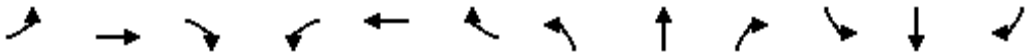
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.40	0.86		0.67	0.83		0.68	0.66		0.52	0.93	0.49

Intersection Summary	
Area Type:	Other
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 6:WBTL, Start of Green	
Natural Cycle: 90	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.93	
Intersection Signal Delay: 48.6	Intersection LOS: D
Intersection Capacity Utilization 59.8%	ICU Level of Service B
Analysis Period (min) 15	

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3:





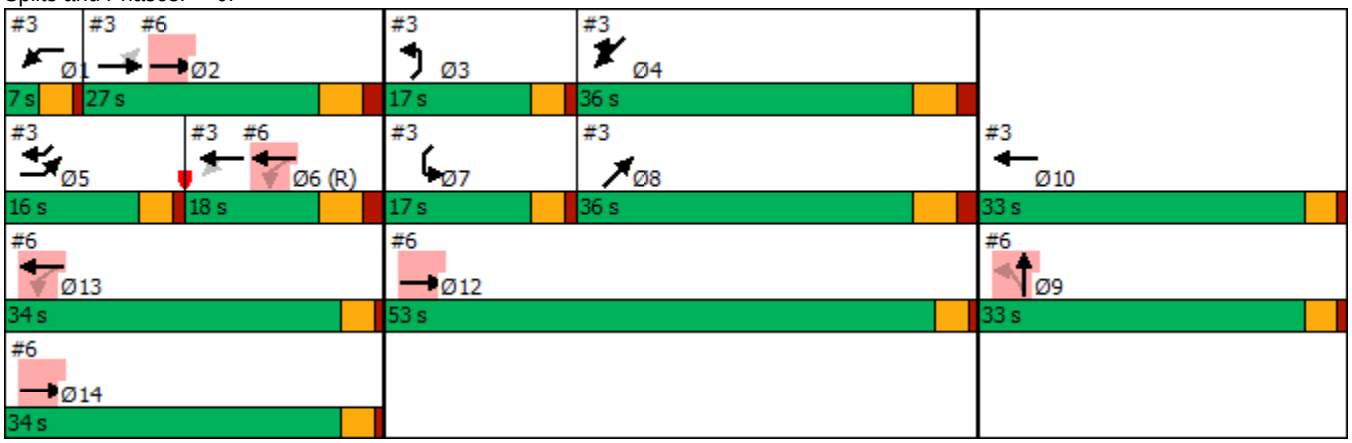
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	309	176	48	337	11	155	66	72	0	0	0
Future Volume (vph)	0	309	176	48	337	11	155	66	72	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	15	12	12	12	12	12	12	12
Storage Length (ft)	0		0	150		0	0		50	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		132			254			588			156	
Travel Time (s)		3.0			5.8			13.4			3.5	
Confl. Peds. (#/hr)	1		15	15		1	1		1			
Peak Hour Factor	0.92	0.92	0.92	0.86	0.86	0.86	0.82	0.82	0.82	0.92	0.92	0.92
Growth Factor	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	5%	5%	5%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	554	0	59	424	0	0	375	0	0	0	0
Turn Type		NA		Perm	NA		Perm	NA				
Protected Phases		2 12 14			6 13			9				
Permitted Phases				6 13			9					
Detector Phase		2 12 14		6 13	6 13		9	9				
Switch Phase												
Minimum Initial (s)							5.0	5.0				
Minimum Split (s)							27.0	27.0				
Total Split (s)							33.0	33.0				
Total Split (%)							27.5%	27.5%				
Yellow Time (s)							3.0	3.0				
All-Red Time (s)							1.0	1.0				
Lost Time Adjust (s)								0.0				
Total Lost Time (s)								4.0				
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode							Max	Max				
Act Effct Green (s)		81.0		28.0	28.0			29.0				
Actuated g/C Ratio		0.68		0.23	0.23			0.24				
v/c Ratio		0.24		0.34	0.47			0.89				
Control Delay		0.2		44.7	41.5			67.0				
Queue Delay		1.4		0.0	1.3			0.0				
Total Delay		1.6		44.7	42.8			67.0				
LOS		A		D	D			E				
Approach Delay		1.6			43.0			67.0				
Approach LOS		A			D			E				
Queue Length 50th (ft)		0		38	148			273				
Queue Length 95th (ft)		m0		77	190			#379				
Internal Link Dist (ft)		52			174			508			76	
Turn Bay Length (ft)				150								
Base Capacity (vph)		2277		176	895			420				
Starvation Cap Reductn		1479		0	0			0				

Lane Group	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	Ø10	Ø12	Ø13	Ø14
Lane Configurations												
Traffic Volume (vph)												
Future Volume (vph)												
Ideal Flow (vphpl)												
Lane Width (ft)												
Storage Length (ft)												
Storage Lanes												
Taper Length (ft)												
Right Turn on Red												
Link Speed (mph)												
Link Distance (ft)												
Travel Time (s)												
Confl. Peds. (#/hr)												
Peak Hour Factor												
Growth Factor												
Heavy Vehicles (%)												
Shared Lane Traffic (%)												
Lane Group Flow (vph)												
Turn Type												
Protected Phases	1	2	3	4	5	6	7	8	10	12	13	14
Permitted Phases												
Detector Phase												
Switch Phase												
Minimum Initial (s)	3.0	1.0	3.0	3.0	3.0	2.5	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	7.0	8.0	7.0	30.0	7.0	8.5	9.5	30.0	28.0	22.5	22.0	22.5
Total Split (s)	7.0	27.0	17.0	36.0	16.0	18.0	17.0	36.0	33.0	53.0	34.0	34.0
Total Split (%)	6%	23%	14%	30%	13%	15%	14%	30%	28%	44%	28%	28%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)												
Total Lost Time (s)												
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Recall Mode	None	None	None	None	None	C-Max	None	Max	None	None	None	None
Act Effct Green (s)												
Actuated g/C Ratio												
v/c Ratio												
Control Delay												
Queue Delay												
Total Delay												
LOS												
Approach Delay												
Approach LOS												
Queue Length 50th (ft)												
Queue Length 95th (ft)												
Internal Link Dist (ft)												
Turn Bay Length (ft)												
Base Capacity (vph)												
Starvation Cap Reductn												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Spillback Cap Reductn		0		0	272			0				
Storage Cap Reductn		0		0	0			0				
Reduced v/c Ratio		0.69		0.34	0.68			0.89				

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 6:WBTL, Start of Green			
Natural Cycle: 90			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.93			
Intersection Signal Delay: 33.2		Intersection LOS: C	
Intersection Capacity Utilization 49.4%		ICU Level of Service A	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 6:



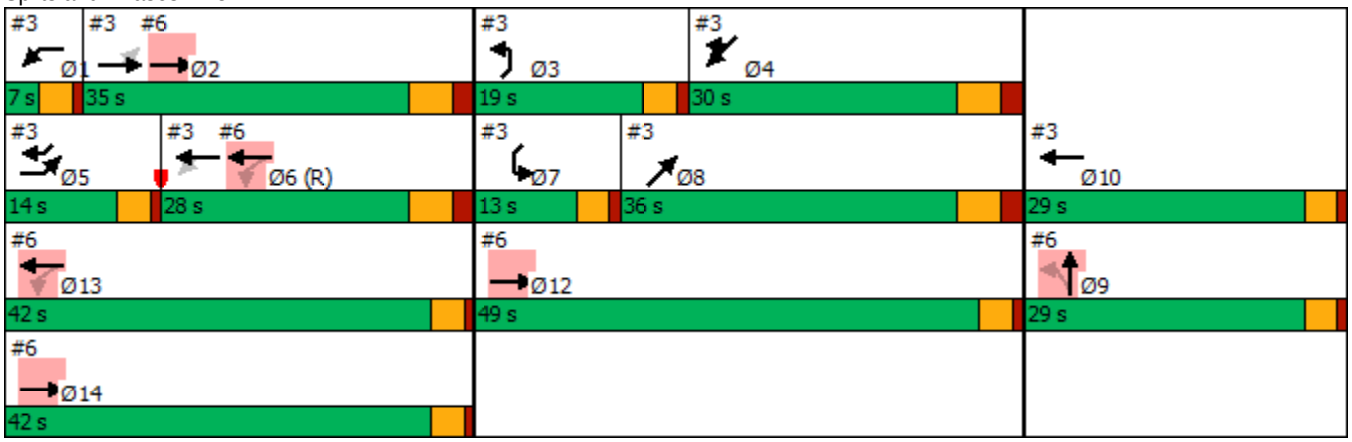
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Future Volume (vph)	141	500	114	34	422	0	143	253	88	67	297	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	125		50	75		0
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		404			132			636			144	
Travel Time (s)		9.2			3.0			14.5			3.3	
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Growth Factor	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	164	715	0	41	514	0	161	384	0	78	346	162
Turn Type	pm+pt	NA		custom	NA		Prot	NA		Prot	NA	pt+ov
Protected Phases	5	2		1	6 10		3	8		7	4	4 5
Permitted Phases	2			6								
Detector Phase	5	2		1	6 10		3	8		7	4	4 5
Switch Phase												
Minimum Initial (s)	3.0	1.0		3.0			3.0	5.0		5.0	3.0	
Minimum Split (s)	7.0	8.0		7.0			7.0	30.0		9.5	30.0	
Total Split (s)	14.0	35.0		7.0			19.0	36.0		13.0	30.0	
Total Split (%)	11.7%	29.2%		5.8%			15.8%	30.0%		10.8%	25.0%	
Maximum Green (s)	10.0	29.0		3.0			15.0	30.0		9.0	24.0	
Yellow Time (s)	3.0	4.0		3.0			3.0	4.0		3.0	4.0	
All-Red Time (s)	1.0	2.0		1.0			1.0	2.0		1.0	2.0	
Lost Time Adjust (s)	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Total Lost Time (s)	4.0	6.0		4.0			4.0	6.0		4.0	6.0	
Lead/Lag	Lead	Lag		Lead			Lead	Lag		Lead	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes			Yes	Yes		Yes	Yes	
Vehicle Extension (s)	3.0	3.0		3.0			3.0	3.0		3.0	3.0	
Recall Mode	None	None		None			None	Max		None	None	
Walk Time (s)								7.0			7.0	
Flash Dont Walk (s)								17.0			17.0	
Pedestrian Calls (#/hr)								20			20	
Act Effct Green (s)	38.0	30.4		27.2	45.2		13.9	32.6		8.5	25.1	32.9
Actuated g/C Ratio	0.32	0.25		0.23	0.38		0.12	0.27		0.07	0.21	0.27
v/c Ratio	0.64	0.83		0.36	0.39		0.78	0.79		0.61	0.88	0.37
Control Delay	43.6	52.3		19.2	9.3		76.2	54.6		74.8	70.6	21.2
Queue Delay	0.0	0.0		0.2	1.5		0.0	0.0		0.0	0.0	0.0
Total Delay	43.6	52.3		19.3	10.8		76.2	54.6		74.8	70.6	21.2
LOS	D	D		B	B		E	D		E	E	C
Approach Delay		50.7			11.5			61.0			57.5	
Approach LOS		D			B			E			E	
Queue Length 50th (ft)	95	281		11	140		122	285		60	265	59
Queue Length 95th (ft)	154	#380		m25	m173		#220	#453		#121	#443	96

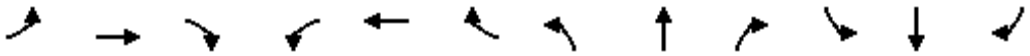
Lane Group	Ø6	Ø9	Ø10	Ø12	Ø13	Ø14
Lane Configurations						
Traffic Volume (vph)						
Future Volume (vph)						
Ideal Flow (vphpl)						
Storage Length (ft)						
Storage Lanes						
Taper Length (ft)						
Right Turn on Red						
Link Speed (mph)						
Link Distance (ft)						
Travel Time (s)						
Confl. Peds. (#/hr)						
Peak Hour Factor						
Growth Factor						
Heavy Vehicles (%)						
Shared Lane Traffic (%)						
Lane Group Flow (vph)						
Turn Type						
Protected Phases	6	9	10	12	13	14
Permitted Phases						
Detector Phase						
Switch Phase						
Minimum Initial (s)	2.5	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	8.5	27.0	28.0	22.5	22.0	22.5
Total Split (s)	28.0	29.0	29.0	49.0	42.0	42.0
Total Split (%)	23%	24%	24%	41%	35%	35%
Maximum Green (s)	22.0	25.0	25.0	45.0	38.0	38.0
Yellow Time (s)	4.0	3.0	3.0	3.0	3.0	3.0
All-Red Time (s)	2.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)						
Total Lost Time (s)						
Lead/Lag	Lag					
Lead-Lag Optimize?	Yes					
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	C-Max	Max	None	None	None	None
Walk Time (s)			7.0			
Flash Dont Walk (s)			17.0			
Pedestrian Calls (#/hr)			20			
Act Effct Green (s)						
Actuated g/C Ratio						
v/c Ratio						
Control Delay						
Queue Delay						
Total Delay						
LOS						
Approach Delay						
Approach LOS						
Queue Length 50th (ft)						
Queue Length 95th (ft)						

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Internal Link Dist (ft)		324			52			556			64	
Turn Bay Length (ft)	200						125			75		
Base Capacity (vph)	259	862		115	1333		223	487		134	393	440
Starvation Cap Reductn	0	0		3	608		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.63	0.83		0.37	0.71		0.72	0.79		0.58	0.88	0.37

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 120			
Offset: 0 (0%), Referenced to phase 6:WBTL, Start of Green			
Natural Cycle: 100			
Control Type: Actuated-Coordinated			
Maximum v/c Ratio: 0.93			
Intersection Signal Delay: 45.9		Intersection LOS: D	
Intersection Capacity Utilization 65.6%		ICU Level of Service C	
Analysis Period (min) 15			
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
m Volume for 95th percentile queue is metered by upstream signal.			

Splits and Phases: 3:





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	413	248	43	325	7	130	84	45	0	0	0
Future Volume (vph)	0	413	248	43	325	7	130	84	45	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	15	12	12	12	12	12	12	12
Storage Length (ft)	0		0	200		0	0		50	0		0
Storage Lanes	0		0	1		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			Yes			Yes
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		132			281			588			156	
Travel Time (s)		3.0			6.4			13.4			3.5	
Confl. Peds. (#/hr)	13		11	11		13	2		3			
Peak Hour Factor	0.88	0.88	0.88	0.86	0.86	0.86	0.80	0.80	0.80	0.92	0.92	0.92
Growth Factor	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	796	0	53	410	0	0	343	0	0	0	0
Turn Type		NA		Perm	NA		Perm	NA				
Protected Phases		2 12 14			6 13			9				
Permitted Phases				6 13			9					
Detector Phase		2 12 14		6 13	6 13		9	9				
Switch Phase												
Minimum Initial (s)							5.0	5.0				
Minimum Split (s)							27.0	27.0				
Total Split (s)							29.0	29.0				
Total Split (%)							24.2%	24.2%				
Maximum Green (s)							25.0	25.0				
Yellow Time (s)							3.0	3.0				
All-Red Time (s)							1.0	1.0				
Lost Time Adjust (s)								0.0				
Total Lost Time (s)								4.0				
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)							3.0	3.0				
Recall Mode							Max	Max				
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		85.0		36.0	36.0			25.0				
Actuated g/C Ratio		0.71		0.30	0.30			0.21				
v/c Ratio		0.33		0.32	0.35			0.93				
Control Delay		0.2		38.9	33.7			77.6				
Queue Delay		1.5		0.0	0.2			0.0				
Total Delay		1.7		38.9	33.9			77.6				
LOS		A		D	C			E				
Approach Delay		1.7			34.5			77.6				
Approach LOS		A			C			E				
Queue Length 50th (ft)		0		32	130			257				

Lane Group	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	Ø10	Ø12	Ø13	Ø14
Lane Configurations												
Traffic Volume (vph)												
Future Volume (vph)												
Ideal Flow (vphpl)												
Lane Width (ft)												
Storage Length (ft)												
Storage Lanes												
Taper Length (ft)												
Right Turn on Red												
Link Speed (mph)												
Link Distance (ft)												
Travel Time (s)												
Confl. Peds. (#/hr)												
Peak Hour Factor												
Growth Factor												
Heavy Vehicles (%)												
Shared Lane Traffic (%)												
Lane Group Flow (vph)												
Turn Type												
Protected Phases	1	2	3	4	5	6	7	8	10	12	13	14
Permitted Phases												
Detector Phase												
Switch Phase												
Minimum Initial (s)	3.0	1.0	3.0	3.0	3.0	2.5	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	7.0	8.0	7.0	30.0	7.0	8.5	9.5	30.0	28.0	22.5	22.0	22.5
Total Split (s)	7.0	35.0	19.0	30.0	14.0	28.0	13.0	36.0	29.0	49.0	42.0	42.0
Total Split (%)	6%	29%	16%	25%	12%	23%	11%	30%	24%	41%	35%	35%
Maximum Green (s)	3.0	29.0	15.0	24.0	10.0	22.0	9.0	30.0	25.0	45.0	38.0	38.0
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0	3.0	3.0	3.0	3.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)												
Total Lost Time (s)												
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag				
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Recall Mode	None	None	None	None	None	C-Max	None	Max	None	None	None	None
Walk Time (s)				7.0				7.0	7.0			
Flash Dont Walk (s)				17.0				17.0	17.0			
Pedestrian Calls (#/hr)				20				20	20			
Act Effct Green (s)												
Actuated g/C Ratio												
v/c Ratio												
Control Delay												
Queue Delay												
Total Delay												
LOS												
Approach Delay												
Approach LOS												
Queue Length 50th (ft)												

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (ft)		0		68	166			#354				
Internal Link Dist (ft)		52			201			508			76	
Turn Bay Length (ft)				200								
Base Capacity (vph)		2416		168	1176			370				
Starvation Cap Reductn		1363		0	0			0				
Spillback Cap Reductn		0		0	257			0				
Storage Cap Reductn		0		0	0			0				
Reduced v/c Ratio		0.76		0.32	0.45			0.93				

Intersection Summary	
Area Type:	Other
Cycle Length: 120	
Actuated Cycle Length: 120	
Offset: 0 (0%), Referenced to phase 6:WBTL, Start of Green	
Natural Cycle: 100	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.93	
Intersection Signal Delay: 27.4	Intersection LOS: C
Intersection Capacity Utilization 52.9%	ICU Level of Service A
Analysis Period (min) 15	

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 6:

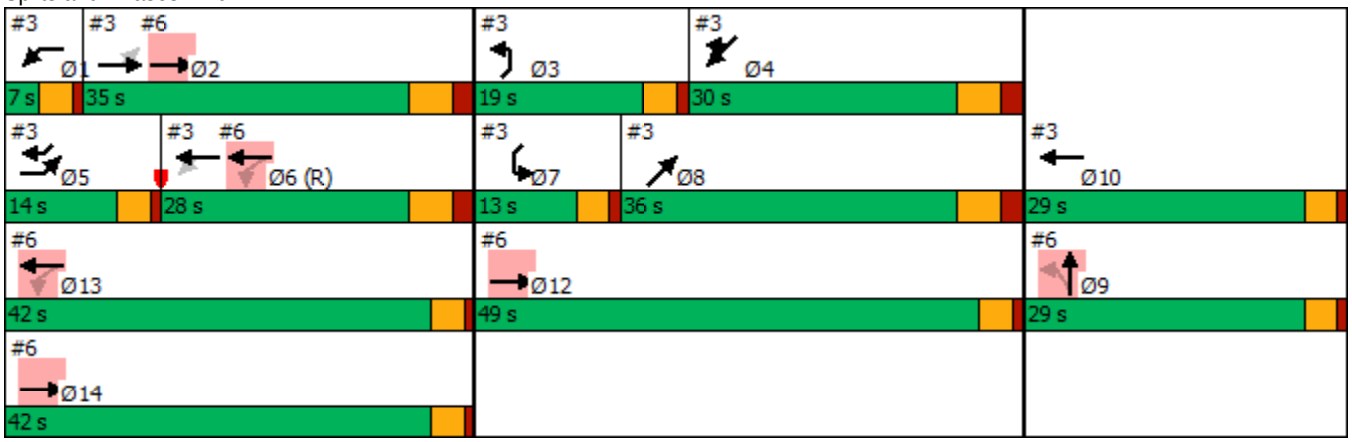


Table I-4
Intersection Capacity Analysis
Alternative 3 under Projected 2030 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L	C	26	0.36	108	C	34	0.55	#157
Adams Street EB	T/R	D	51	0.79	#336	D	39	0.75	#383
Adams Street WB	L	D	51	0.68	#177	D	35	0.50	#91
Adams Street WB	T/R	D	42	0.51	192	C	32	0.46	178
Furnace Brook Parkway NB	L	D	50	0.88	#334	D	43	0.83	#292
Furnace Brook Parkway NB	T/R	C	33	0.60	384	D	39	0.77	#520
Furnace Brook Parkway SB	L	C	23	0.29	69	C	28	0.37	68
Furnace Brook Parkway SB	T	D	54	0.86	#417	D	50	0.80	#400
Furnace Brook Parkway SB	R	D	41	0.61	233	C	37	0.46	167
Intersection (1) Average	-	D	45	-	-	D	39	-	-
Adams Street EB	T/R	A	0	0.19	-	A	0	0.27	-
Adams Street WB	T	A	0	0.15	-	A	0	0.14	-
Common Street NB	R	A	9	0.12	11	A	9	0.09	7
Intersection (2) Average	-	A	1	-	-	A	1	-	-

Notes:
• Intersection: (1) Adams Street at Furnace Brook Parkway, (2) Adams Street at Common Street
• Approach: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound
• Turning movement: L = Left turn, T = Through movement, R = Right turn
• LOS = Lever of Service
• Delay (seconds) = Average delay per vehicle
• V/C = Volume to capacity ratio
• 95th Queue (feet) = the maximun back of queue with 95th percentile traffic volumes.
• #: 95th percentile volume exceeds capacity. The queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	84	342	122	117	311	11	255	271	74	71	320	191
Future Volume (vph)	84	342	122	117	311	11	255	271	74	71	320	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	250		0	75		150
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		426			132			636			294	
Travel Time (s)		9.7			3.0			14.5			6.7	
Confl. Peds. (#/hr)	2		11	11		2	6		9	9		6
Peak Hour Factor	0.90	0.90	0.90	0.95	0.95	0.95	0.95	0.95	0.95	0.75	0.75	0.75
Growth Factor	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%	105%
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	3%	3%	3%	2%	2%	2%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	98	541	0	129	356	0	282	382	0	99	448	267
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6			2			4			8		8
Detector Phase	1	6		5	2		7	4		3	8	8
Switch Phase												
Minimum Initial (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	5.0	5.0
Minimum Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (s)	10.0	30.0		10.0	30.0		18.0	49.0		9.0	40.0	40.0
Total Split (%)	8.0%	24.0%		8.0%	24.0%		14.4%	39.2%		7.2%	32.0%	32.0%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None		None	None	None
Act Effct Green (s)	32.5	24.4		32.5	24.4		54.1	43.0		40.9	33.8	33.8
Actuated g/C Ratio	0.30	0.23		0.30	0.23		0.50	0.40		0.38	0.31	0.31
v/c Ratio	0.36	0.79		0.68	0.51		0.88	0.60		0.29	0.86	0.61
Control Delay	34.2	51.2		50.9	41.9		49.7	33.3		22.6	54.0	41.4
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	34.2	51.2		50.9	41.9		49.7	33.3		22.6	54.0	41.4
LOS	C	D		D	D		D	C		C	D	D
Approach Delay		48.6			44.3			40.2			46.0	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	41	163		55	100		91	171		28	246	133
Queue Length 95th (ft)	108	#336		#177	192		#334	384		69	#417	233
Internal Link Dist (ft)		346			52			556			214	
Turn Bay Length (ft)	200						250			75		150
Base Capacity (vph)	272	681		191	700		322	646		341	535	446
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0

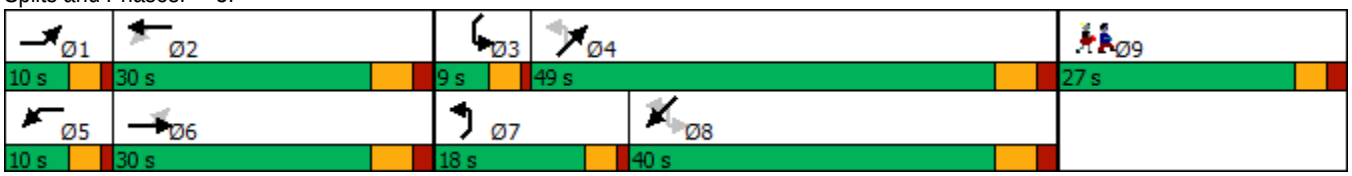
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	22%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.36	0.79		0.68	0.51		0.88	0.59		0.29	0.84	0.60

Intersection Summary			
Area Type:	CBD		
Cycle Length: 125			
Actuated Cycle Length: 108.2			
Natural Cycle: 125			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.88			
Intersection Signal Delay: 44.9		Intersection LOS: D	
Intersection Capacity Utilization 76.2%		ICU Level of Service D	
Analysis Period (min) 15			

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	309	176	0	428	0	88
Future Volume (Veh/h)	309	176	0	428	0	88
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.86	0.86	0.82	0.82
Hourly flow rate (vph)	353	201	0	523	0	113
Pedestrians	1			1	15	
Lane Width (ft)	12.0			15.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	0			0	1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	132					
pX, platoon unblocked			0.86		0.86	0.86
vC, conflicting volume			569		731	293
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			172		360	0
tC, single (s)			4.2		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	88
cM capacity (veh/h)			1182		511	909

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	235	319	262	262	113
Volume Left	0	0	0	0	0
Volume Right	0	201	0	0	113
cSH	1700	1700	1700	1700	909
Volume to Capacity	0.14	0.19	0.15	0.15	0.12
Queue Length 95th (ft)	0	0	0	0	11
Control Delay (s)	0.0	0.0	0.0	0.0	9.5
Lane LOS					A
Approach Delay (s)	0.0		0.0		9.5
Approach LOS					A

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	30.4%	ICU Level of Service	A
Analysis Period (min)	15		

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	141	500	114	77	338	7	260	337	88	67	297	139
Future Volume (vph)	141	500	114	77	338	7	260	337	88	67	297	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	0		0	250		0	75		150
Storage Lanes	1		0	1		0	1		0	1		1
Taper Length (ft)	170			25			25			25		
Right Turn on Red			No			No			No			No
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		438			132			636			284	
Travel Time (s)		10.0			3.0			14.5			6.5	
Confl. Peds. (#/hr)	27		17	17		27	22		14	14		22
Peak Hour Factor	0.91	0.91	0.91	0.87	0.87	0.87	0.94	0.94	0.94	0.91	0.91	0.91
Growth Factor	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Shared Lane Traffic (%)												
Lane Group Flow (vph)	164	715	0	94	421	0	293	479	0	78	346	162
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases	6			2			4			8		8
Detector Phase	1	6		5	2		7	4		3	8	8
Switch Phase												
Minimum Initial (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	1.0	1.0
Minimum Split (s)	7.0	27.0		7.0	27.0		7.0	27.0		7.0	27.0	27.0
Total Split (s)	8.0	28.0		8.0	28.0		15.0	35.0		7.0	27.0	27.0
Total Split (%)	7.6%	26.7%		7.6%	26.7%		14.3%	33.3%		6.7%	25.7%	25.7%
Yellow Time (s)	3.0	4.0		3.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	None	Max		None	Max		None	None		None	None	None
Act Effct Green (s)	29.7	24.5		28.7	22.6		37.5	30.0		25.2	20.1	20.1
Actuated g/C Ratio	0.34	0.28		0.33	0.26		0.43	0.34		0.29	0.23	0.23
v/c Ratio	0.55	0.75		0.50	0.46		0.83	0.77		0.37	0.80	0.46
Control Delay	33.8	38.5		35.1	32.0		43.4	39.4		28.1	50.0	37.1
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Delay	33.8	38.5		35.1	32.0		43.4	39.4		28.1	50.0	37.1
LOS	C	D		D	C		D	D		C	D	D
Approach Delay		37.6			32.6			40.9			43.5	
Approach LOS		D			C			D			D	
Queue Length 50th (ft)	50	165		28	87		83	194		19	150	64
Queue Length 95th (ft)	#157	#383		#91	178		#292	#520		68	#400	167
Internal Link Dist (ft)		358			52			556			204	
Turn Bay Length (ft)	200						250			75		150
Base Capacity (vph)	300	951		188	907		355	626		209	462	375
Starvation Cap Reductn	0	0		0	0		0	0		0	0	0
Spillback Cap Reductn	0	0		0	0		0	0		0	0	0

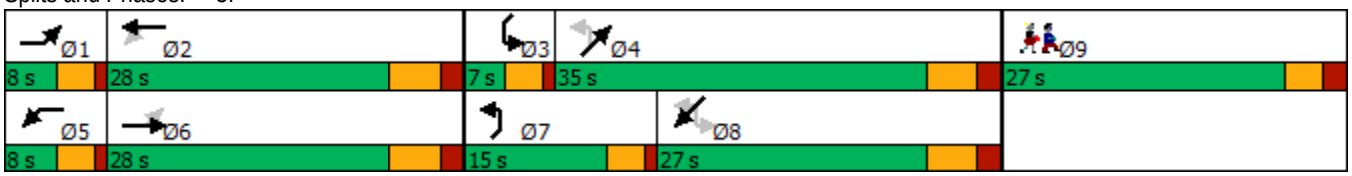
Lane Group	Ø9
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Right Turn on Red	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Confl. Peds. (#/hr)	
Peak Hour Factor	
Growth Factor	
Heavy Vehicles (%)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Detector Phase	
Switch Phase	
Minimum Initial (s)	15.0
Minimum Split (s)	27.0
Total Split (s)	27.0
Total Split (%)	26%
Yellow Time (s)	3.0
All-Red Time (s)	2.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	
Lead-Lag Optimize?	
Recall Mode	None
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Storage Cap Reductn	0	0		0	0		0	0		0	0	0
Reduced v/c Ratio	0.55	0.75		0.50	0.46		0.83	0.77		0.37	0.75	0.43

Intersection Summary			
Area Type:	Other		
Cycle Length: 105			
Actuated Cycle Length: 87.6			
Natural Cycle: 105			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.83			
Intersection Signal Delay: 38.9		Intersection LOS: D	
Intersection Capacity Utilization 71.8%		ICU Level of Service C	
Analysis Period (min) 15			

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 3:



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (veh/h)	413	248	0	388	0	58
Future Volume (Veh/h)	413	248	0	388	0	58
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.88	0.88	0.86	0.86	0.80	0.80
Hourly flow rate (vph)	497	299	0	478	0	77
Pedestrians	2			3	11	
Lane Width (ft)	12.0			15.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	0			0	1	
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)	132					
pX, platoon unblocked			0.82		0.82	0.82
vC, conflicting volume			807		898	412
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			311		424	0
tC, single (s)			4.1		6.9	7.0
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	91
cM capacity (veh/h)			1011		448	869

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1
Volume Total	331	465	239	239	77
Volume Left	0	0	0	0	0
Volume Right	0	299	0	0	77
cSH	1700	1700	1700	1700	869
Volume to Capacity	0.19	0.27	0.14	0.14	0.09
Queue Length 95th (ft)	0	0	0	0	7
Control Delay (s)	0.0	0.0	0.0	0.0	9.5
Lane LOS					A
Approach Delay (s)	0.0		0.0		9.5
Approach LOS					A

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	35.3%	ICU Level of Service	A
Analysis Period (min)	15		

Table I-5
Intersection Capacity Analysis
Alternative 4 under Projected 2030 AM and PM Peak-Hour Traffic Conditions

Intersection Approach	Lane Group	AM LOS	AM Delay	AM V/C	95th Queue	PM LOS	PM Delay	PM V/C	95th Queue
Adams Street EB	L/T	B	13	0.52	75	C	17	0.68	125
Adams Street EB	T/R	A	9	0.36	50	A	9	0.40	50
Adams Street WB	L/T	B	10	0.34	25	B	12	0.37	50
Adams Street WB	T/R	A	9	0.34	50	B	11	0.37	50
Furnace Brook Parkway NB	L	A	7	0.18	25	B	10	0.28	25
Furnace Brook Parkway NB	T/R	A	10	0.40	50	C	17	0.60	100
Furnace Brook Parkway SB	L/T	C	17	0.61	100	B	12	0.43	50
Furnace Brook Parkway SB	T/R	C	16	0.61	100	B	11	0.44	50
Common Street NWB	L/T	C	15	0.56	100	C	23	0.67	125
Intersection Average	-	B	13	-	-	B	14	-	-

Notes:
• This double-lane roundabout alternative contains five approaches from Adams Street, Furnace Brook Parkway, and Common Street.
• The right-turn from Common Street to Adams Street is separated from the roaundabout (see Figure 7).
• The analysis is summarized from Synchro roundabout reports based on Highway Capacity Manual 6th Version.
• Approach: NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound, NWB = Northwest bound
• Turning movement: L = Left turn, T = Through movement, R = Right turn
• LOS = Lever of Service
• Delay (seconds) = Average delay per vehicle
• V/C = Volume to capacity ratio
• 95th Queue (feet) = the estimated length of queueing vehicles (25 feet per vehicle) with 95th percentile traffic volumes.

Intersection	
Intersection Delay, s/veh	12.8
Intersection LOS	B

Approach	EB	WB	NW	NE
Entry Lanes	2	2	1	2
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	639	460	375	437
Demand Flow Rate, veh/h	652	477	394	450
Vehicles Circulating, veh/h	692	763	833	663
Vehicles Exiting, veh/h	944	464	280	681
Ped Vol Crossing Leg, #/h	6	15	15	15
Ped Cap Adj	0.998	0.996	0.998	0.994
Approach Delay, s/veh	11.5	9.7	15.0	8.9
Approach LOS	B	A	C	A

Lane	Left	Right	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	TR	LR	L	TR
Assumed Moves	LT	R	LT	TR	LR	L	TR
RT Channelized							
Lane Util	0.572	0.428	0.470	0.530	1.000	0.293	0.707
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.535	2.667	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.328	4.645	4.328
Entry Flow, veh/h	373	279	224	253	394	132	318
Cap Entry Lane, veh/h	714	789	669	742	699	734	808
Entry HV Adj Factor	0.980	0.978	0.966	0.964	0.952	0.970	0.972
Flow Entry, veh/h	366	273	216	244	375	128	309
Cap Entry, veh/h	699	770	643	713	664	707	781
V/C Ratio	0.523	0.355	0.336	0.342	0.564	0.181	0.396
Control Delay, s/veh	13.3	9.0	10.1	9.4	15.0	7.1	9.6
LOS	B	A	B	A	C	A	A
95th %tile Queue, veh	3	2	1	2	4	1	2

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Approach	SW
Entry Lanes	2
Conflicting Circle Lanes	2
Adj Approach Flow, veh/h	815
Demand Flow Rate, veh/h	831
Vehicles Circulating, veh/h	805
Vehicles Exiting, veh/h	435
Ped Vol Crossing Leg, #/h	2
Ped Cap Adj	1.000
Approach Delay, s/veh	16.6
Approach LOS	C

Lane	Left	Right
Designated Moves	LT	TR
Assumed Moves	LT	TR
RT Channelized		
Lane Util	0.471	0.529
Follow-Up Headway, s	2.667	2.535
Critical Headway, s	4.645	4.328
Entry Flow, veh/h	391	440
Cap Entry Lane, veh/h	644	716
Entry HV Adj Factor	0.979	0.982
Flow Entry, veh/h	383	432
Cap Entry, veh/h	630	703
V/C Ratio	0.608	0.614
Control Delay, s/veh	17.2	16.0
LOS	C	C
95th %tile Queue, veh	4	4

Intersection	
Intersection Delay, s/veh	14.0
Intersection LOS	B

Approach	EB	WB	NB	NE
Entry Lanes	2	2	1	2
Conflicting Circle Lanes	2	2	2	2
Adj Approach Flow, veh/h	903	446	354	545
Demand Flow Rate, veh/h	921	455	364	551
Vehicles Circulating, veh/h	523	920	1121	917
Vehicles Exiting, veh/h	866	565	347	527
Ped Vol Crossing Leg, #/h	6	15	15	15
Ped Cap Adj	0.996	1.000	1.000	1.000
Approach Delay, s/veh	13.4	11.3	22.5	14.6
Approach LOS	B	B	C	B

Lane	Left	Right	Left	Right	Left	Left	Right
Designated Moves	LT	R	LT	TR	LR	L	TR
Assumed Moves	LT	R	LT	TR	LR	L	TR
RT Channelized							
Lane Util	0.610	0.390	0.470	0.530	1.000	0.296	0.704
Follow-Up Headway, s	2.667	2.535	2.667	2.535	2.535	2.667	2.535
Critical Headway, s	4.645	4.328	4.645	4.328	4.328	4.645	4.328
Entry Flow, veh/h	562	359	214	241	364	163	388
Cap Entry Lane, veh/h	834	910	579	650	548	581	651
Entry HV Adj Factor	0.981	0.981	0.980	0.981	0.973	0.988	0.990
Flow Entry, veh/h	551	352	210	236	354	161	384
Cap Entry, veh/h	815	889	567	637	533	574	645
V/C Ratio	0.676	0.396	0.370	0.371	0.665	0.281	0.596
Control Delay, s/veh	16.5	8.7	11.9	10.8	22.5	10.1	16.5
LOS	C	A	B	B	C	B	C
95th %tile Queue, veh	5	2	2	2	5	1	4

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Approach	SW
Entry Lanes	2
Conflicting Circle Lanes	2
Adj Approach Flow, veh/h	586
Demand Flow Rate, veh/h	592
Vehicles Circulating, veh/h	797
Vehicles Exiting, veh/h	578
Ped Vol Crossing Leg, #/h	9
Ped Cap Adj	0.998
Approach Delay, s/veh	11.5
Approach LOS	B

Lane	Left	Right
Designated Moves	LT	TR
Assumed Moves	LT	TR
RT Channelized		
Lane Util	0.470	0.530
Follow-Up Headway, s	2.667	2.535
Critical Headway, s	4.645	4.328
Entry Flow, veh/h	278	314
Cap Entry Lane, veh/h	648	721
Entry HV Adj Factor	0.990	0.988
Flow Entry, veh/h	275	310
Cap Entry, veh/h	641	711
V/C Ratio	0.430	0.436
Control Delay, s/veh	11.9	11.1
LOS	B	B
95th %tile Queue, veh	2	2

APPENDIX K

Comments from City of Quincy

CITY OF QUINCY, MASSACHUSETTS
Department of Traffic, Parking, Alarm and Lighting

Thomas P. Koch
Mayor

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To: Chen-Yuan Wang & Mark Abbott
MPO Staff

From: Allison Ruel, Traffic Engineer

CC: Chris Cassani, TPAL Director

RE: Safety and Operations Analyses at Selected Intersections, FFY 2020
Adams Street at Furnace Brook Parkway and Common Street in Quincy

I have reviewed the memorandum summarizing the safety and operations analyses and proposed improvements for the intersections of Adams Street at Furnace Brook Parkway and Common Street in Quincy.

The report details the crash history of the intersection, discussing that the intersection of Adams Street and Furnace Brook Parkway is an HSIP eligible high crash location with 47 crashes over a 5-year period and the adjacent intersection of Adams Street and Common Street experienced 27 crashes over a 5-year period for a total of 72 crashes in the intersection cluster over the period reviewed. A significant number of crashes at both locations are angle collisions resulting from uncontrolled or permissive movements through the intersection.

There are also deficiencies at the intersection that aid in the crash experience and traffic congestion at this location including the geometry of the intersection, the lack of exclusive turn lanes, inadequate signal displays, pedestrian accessibility and safety, and lack of bicycle facilities. The report also identifies the desire line from the unsignalized Common Street approach to connect to Adams Street and Furnace Brook Parkway and the difficulties that presents.

Based on the analysis conducted several short-term and long-term recommendations were proposed. The short-term improvements include enforcing existing speed and turn restriction regulations, enlarging the 'Do Not Block the Box" striping, optimizing traffic signal timings, restriping travel lanes to reduce lanes widths and better accommodate bicycles, add backplates to existing signal heads to improve visibility, add an additional stop sign on Common Street, and more clearly define the parking spaces on Adams Street. We agree that these short-term improvements would have a benefit on improving safety and reducing traffic congestion at these intersections.

Four long-term alternatives were identified in the report at the two intersections to maximize safety and operations for the intersections:

Alternative 1 proposed to reconstruct the two intersections and upgrade the traffic signal at the Adams Street/Furnace Brook Parkway intersection, while leaving the Common Street intersection unsignalized. While this alternative would help mitigate many of the issues at the Adams Street/Furnace Brook Parkway intersection, it would not have a significant impact on the safety issues that exist at the Adams Street and Common Street

intersection and therefore is not preferred by the City.
Alternative 2 proposes to reconstruct both intersections, upgrade signals at the intersection of Adams Street/Furnace Brook Parkway and signalize the Common Street intersection as part of a single clustered intersection. This alternative would have similar geometric and lane improvements as Alternative 1, but the signalized control of Common Street would help mitigate many of the safety issues without restricting movements exiting Common Street and is therefore the City's preferred alternative of the signalized Alternatives presented.

Alternative 3 proposes to reconstruct both intersections, upgrade signals at Adams Street and Furnace Brook Parkway, and extend the median on Adams Street to restrict Common Street to a right-in/right-out condition. Common Street provides a critical connection to Copeland Street and Centre Street to South and West Quincy and restricting connectivity to/from this roadway at Adams Street is not preferred by the City.

Alternative 4 reconstructs both intersections into a double-lane modern roundabout, tying in Common Street vis a separate approach. The alternative also moves bicycles to off-street facilities. We agree the isolated nature of this intersection cluster and the traffic calming and improvement on traffic congestion that a roundabout alternative brings makes this the preferred alternative. We ask that non-traditional roundabout alternatives to be further evaluated in the design process, including potentially an ellipse, a double roundabout, or a "Figure 8" or "Peanut" shaped roundabout. The Common Street and Adams Street approaches to the east are very close together in the existing concept which may be confusing to motorists. We also have concerns over the school zone crossing with the current roundabout concept. Under existing conditions, the intersection is managed by a crossing guard who stops travel in all directions for children to cross the road.

In summary, we feel that the reconstruction of this intersection to an unsignalized roundabout alternative is the preferred alternative, though there should be more exploration of non-traditional roundabout designs through the design process. If a signalized alternative is entertained, it is important that the Common Street approach be tied into the signal system to provide safer access while still maintaining full connectivity to and from the roadway.

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APPENDIX L

MassDOT Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

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

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

2. Planning

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

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

3. Project Initiation

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

4. Environmental Permitting, Design, and Right-of-Way Process

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

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design

There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition
A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)
Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement
Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction
After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

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

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office which provides guidance to the proponent on the subsequent steps of the process.	The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.	For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office, and formally reviewed by the PRC.	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months
Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT district and appropriate sections is completed in this step.	3 to 48+ months
Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
Step VI: Procurement The project is advertised for construction and a contract awarded.	Administration of competing projects can influence the advertising schedule.	1 to 12 months
Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.	The duration for this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month

Source: MassDOT Highway Division Project Development and Design Guide