Old Colony Metropolitan Planning Organization

National Highway System Intermodal Connectors Study

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Updated April 2015

Old Colony Planning Council

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The views and opinions of the Old Colony Planning Council expressed herein do not necessarily state or reflect those of the U.S. Department of Transportation.

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Contents

Introduction

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 authorized the establishment of the National Highway System (NHS), which would be the primary focus of the federal government in the post-Interstate era.

The purpose of the National Highway System is to provide an interconnected system of principal arterial routes which serves major population centers, international border crossings, ports, airports, public transportation facilities, other intermodal transportation facilities, and other major travel destinations. In addition, the NHS meets national defense requirements and serves interstate and interregional travel.

According to the Federal Highway Administration (FHWA), the National Highway System (NHS) includes the following subsystems of roadways:

1) Interstate
   The Eisenhower Interstate System of highways retains its separate identity within the NHS.

2) Other Principal Arterials
   These are highways in rural and urban areas which provide access between an arterial and a major port, airport, public transportation facility, or other intermodal transportation facility.

3) Strategic Highway Network (STRAHNET)
   This is a network of highways which are important to the United States' strategic defense policy and which provide defense access, continuity and emergency capabilities for defense purposes.

4) Major Strategic Highway Network Connectors
   These are highways which provide access between major military installations and highways which are part of the Strategic Highway Network.

5) Intermodal Connectors
   These highways provide access between major intermodal facilities and the other four subsystems making up the National Highway System.

NHS Intermodal Connectors are key conduits for the timely and reliable delivery of people and goods. Hence, it is important to evaluate the condition and performance of connectors and related investment needs. Table 1 lists the NHS Intermodal Connectors examined and evaluated in this Study.

Table 1: NHS Intermodal Connectors in the Old Colony Region

Facility ID	Facility	Type	Connector Description	Connector Length
MA78T	Bridgewater Commuter Rail Station	Public Transit Station	Burrill Avenue to Hooper Street to Plymouth Street to Route 18	0.9 miles
MA73B	Brockton Bus Terminal	Intercity Bus Terminal	Served by an existing NHS Route 27	0 miles
MA79T	Campello Transit Commuter Rail	Public Transit Station	Riverside Avenue to Montello Street to Route 123	1.4 miles
MA81T	Kingston Commuter Rail Station	Public Transit Station	Marion Drive to Gallen Road to Cranberry Road to Raboth Road to Route 3	0.9 miles
MA71B	Plymouth P&B Bus Terminal	Intercity Bus Terminal	Served by existing NHS Route 3	0 miles
MA56T	Stoughton Commuter Rail Station	Public Transit Station	Wyman Street to Perry Street to School Street to Route 27	0.7 miles

Source: Federal Highway Administration

Methodology

This study involved an evaluation of existing conditions for each NHS Intermodal Connector, a detailed summary of the deficiencies, and a list of potential improvements. This involved conducting on-site inventories of the physical condition of the connectors focused on the following five areas:

- Traffic Operations and Safety
  Evaluate operational and/or safety problems of the connector and identify issues such as a lack of proper intersection traffic control, poor traffic signal timings, and poor access management techniques.
- Geometric and Physical Features
  Evaluate physical features and identify problems such as inadequate shoulder width, turning radii, lack of stabilized shoulders, and inadequate travel way width.
- Railroad Crossings
  Review and analyze active railroad crossings near or adjacent to terminals and their possible impact on safety and potential to cause traffic operational problems.
- Bicycle and Pedestrian Accommodations
  Review existing bicycle and pedestrian facilities and identify issues such as limited sidewalk networks, a lack of shoulders for bicycle travel, and inadequate pedestrian crossing areas.

This study includes an analysis of existing and future demand as well as short-term and long-term recommendations for the investment and improvement of each connector.

Traffic Data and Turning Movement Counts

Mainline traffic data including traffic volumes, travel speeds, and vehicle classification data was collected using automated traffic recorders which collected data for a minimum of 48 consecutive weekday hours, from which a 24 hour weekday average was derived. Turning movement counts were collected manually during typical weekday peak demand hours: 7:00-9:00 AM and 4:00-6:00 PM.

Intersection Level-of-Service

Level-of-service analyses (LOS) were completed for the key intersections in the individual Intermodal Connector study areas to determine the operating conditions during the morning and afternoon peak periods. Level-of-service analysis is a quantitative measure that summarizes the overall operation of an intersection or transportation facility based on the analysis techniques published in the *Highway Capacity Manual* by the Transportation Research Board. It is based upon the operational conditions of a facility including lane use, traffic control, and lane width, and takes into account such factors as operating speeds, traffic interruptions, and freedom to maneuver.

Level-of-service represents a range of operating conditions and is summarized with letter grades from "A" to "F", with "A" being the most desirable. Table 2 shows the delay criteria for each level-of-service for both un-signalized and signalized intersections.

Table 2: Level-of-Service (LOS) Criteria Average Delay in Seconds

Level of Service	Stop Sign	Traffic Signal
A	0 to 10	0 to 10
B	10 to 15	10 to 20
C	15 to 25	20 to 35
D	25 to 35	35 to 55
E	35 to 50	55 to 80
F	>50	>80

Crash Data and Crash Rates

Crash data was obtained from the Massachusetts Department of Transportation (MassDOT) databases, which is based upon crashes reported to the Registry of Motor Vehicles (RMV) by local and state police departments. The three most recent available years, 2011 through 2013, were used for the preparation of crash rates. The crash rate is the average number of crashes per million entering vehicles at an intersection, and is calculated based on the reported crash data and peak hour traffic volumes from turning movement counts.

Traffic Signal Warrant Analyses

Chapter 2B and Chapter 4C of the *Manual on Uniform Traffic Control Devices (MUTCD) 2009 Edition* outline the requirements for the application of a multi-way stop or traffic signal respectively. Specifically, it states that the investigation of the need for both types of traffic control shall include an

analysis of factors related to the existing operation and safety at the study location and the potential to improve these conditions.

The MUTCD also makes it clear that the satisfaction of a traffic signal warrant(s) shall not in itself require the installation of a traffic control signal but rather an engineering study of traffic conditions, pedestrian conditions, and physical characteristics be completed to justify the installation of a traffic signal.

Bridgewater Commuter Rail Station (MA78T)

Connector Description

The Federal Highway Administration describes the Bridgewater Commuter Rail Station Intermodal Connector (MA78T) as "Burrill Avenue to Hooper Street to Plymouth Street to Route 18"; however, in recent years, Bridgewater State University has made modifications to the roadway network necessitating a modification to the current intermodal connector description. Specifically, the driveway connecting the Commuter Rail parking lot (previously known as "East Campus Drive") to Burrill Avenue has been changed to a pedestrian walkway and now motorists can only egress the parking lot on Great Hill Drive. Access to the Commuter Rail lot is still provided via Hooper Street and Burrill Avenue; however, commuters must continue past the new pedestrian walkway onto Burrill Avenue Extension and then onto Great Hill Drive. As such, the new description of the Bridgewater Commuter Rail Station (MA78T) should read "Great Hill Drive to Plymouth Street to Route 18".

Roadways

Route 104 (Plymouth Street and Summer Street)

Route 104 is a two lane roadway that generally runs in an east-west direction from Route 106 in the east to Route 44 in the west. East of the town center, Route 104 is known as Summer Street and Plymouth Street and runs along the northern edge of the Bridgewater State University campus. West of the town center, Route 104 is known as South Street and Pleasant Street and connects Bridgewater to Raynham and towns to the west. Route 104 is classified as an urban minor arterial (U5). The roadway generally consists of two 12 foot travel lanes with 7 foot shoulders and two 6 foot sidewalks.

Great Hill Drive

Great Hill Drive is a two lane roadway that provides the primary access to and from the Bridgewater Commuter Rail Station as well as access to several buildings on the east side of the Bridgewater State University campus. Great Hill Drive is under local jurisdiction (Town of Bridgewater) and is classified as a local roadway (U0). Great Hill Drive consists of two 12 foot travel lanes and two 2 foot shoulders with no dedicated bicycle or pedestrian accommodations.

Hooper Street

Hooper Street is a two lane roadway that provides secondary access to and from the Bridgewater Commuter Rail Station as well as access to several buildings on the east side of the Bridgewater State University campus. Hooper Street is under local jurisdiction (Town of Bridgewater) and is classified as a local roadway (U0). The roadway generally consists of two 13 foot travel lanes with no usable shoulders and has a 6 foot sidewalk on the northbound side.

Burrill Avenue

Burrill Avenue is a two lane roadway that provides secondary access to and from the Bridgewater Commuter Rail Station as well as access to several buildings on the east side of the Bridgewater State University campus. Burrill Avenue is under local jurisdiction (Town of Bridgewater) and is classified as a local roadway (U0). The roadway generally consists of two 12 foot travel lanes with no usable shoulders and two 6 foot sidewalks.

Intersections

Plymouth Street (Route 104) & Hayward Street/Great Hill Drive

Plymouth Street (Route 104), Hayward Street, and Great Hill Drive meet to form a four-way un-signalized intersection at the western edge of the study area. Hayward Street provides a channelized right-turn and shared through/left-turn lane and is under STOP control. Great Hill Drive is a main entrance to the MBTA Bridgewater Commuter Rail station as well as a connection to the Bridgewater State University campus and parking. The northbound Great Hill Drive approach is also STOP controlled and provides an exclusive left and shared right-turn/through lane. The eastbound and westbound Route 104 approaches provide one general purpose lane.

Plymouth Street (Route 104) & Hooper Street

Plymouth Street (Route 104) and Hooper Street form an un-signalized "T-type" intersection providing access to the Bridgewater State University east campus. Both the Route 104 eastbound and westbound approaches consist of general purpose lanes while the northbound approach consists of an exclusive left-turn lane under STOP control and a channelized right-turn lane under YIELD control.

Plymouth Street (Route 104) & Spring Street

The Plymouth Street (Route 104) and Spring Street/Sanger Street intersection is a four-way fully actuated signalized intersection. The Route 104 eastbound approach provides an exclusive left-turn and a shared through/right-turn lane, while the westbound approach provides a shared left/through-turn lane and an exclusive right-turn lane. The northbound (Sanger Street) approach provides a general purpose lane and the southbound Spring Street approach provides a combined left-turn/through lane and a channelized right-turn lane; however, it is not controlled by the traffic signal.

Plymouth Street (Route 104) & Burrill Avenue

Plymouth Street (Route 104) and Burrill Avenue form an un-signalized "T-type" intersection providing access to the Bridgewater State University east campus. The eastbound approach provides a combined through/right-turn lane, the westbound approach provides a combined through/left-turn lane, and the northbound approach provides a combined left and right-turn lane.

Plymouth Street (Route 104) & Summer Street

Plymouth Street (Route 104) and Summer Street join to form a fully actuated signalized "T-type" intersection. The eastbound Summer Street and westbound Pleasant Street approaches are

designated as Route 104. The eastbound approach provides a combined through/right-turn lane while the westbound approach provides an exclusive left-turn lane and a through lane. The northbound Summer Street approach provides an exclusive left-turn lane and a channelized right-turn lane, which is not controlled by the signal.

Broad Street (Route 18) & Main Street (Route 28)/Summer Street (Route 104)

These numbered routes meet to form the signalized northern intersection of the rotary. The northbound Route 104 right and U-turn movements operate independently of the traffic signal. The left-turn and through lane are exclusive lanes and are controlled by the signal. The southbound Route 18 approach consists of a single through/right-turn lane (no left turns are allowed). The eastbound Route 28 approach provides a shared left-turn/through lane and an exclusive right-turn lane. The westbound Route 104 approach provides an exclusive left-turn lane and a thorough/right-turn lane.

Figure 1 shows the Bridgewater Commuter Rail Station Intermodal Connector as well as the modified connector.

Traffic Volumes & Intersection Operations

Traffic Volumes

Old Colony Planning Council collected mainline roadway traffic counts (vehicle volumes, vehicle speeds, and vehicle classifications) on the Bridgewater Commuter Rail Station Intermodal Connector as well as on key intersecting streets in April, 2010. In addition, OCPC collected intersection turning movements during the morning and afternoon peak traffic periods in April, 2010 at key intersections of the connector. These counts were conducted in order to determine existing demand as well as to enable future transportation improvements analyses.

Table 3 displays the results of the mainline roadway traffic data collection program for the Bridgewater Commuter Rail Station Intermodal Connector.

Figure 1: Bridgewater Commuter Rail Station Intermodal Connector (MA78T)

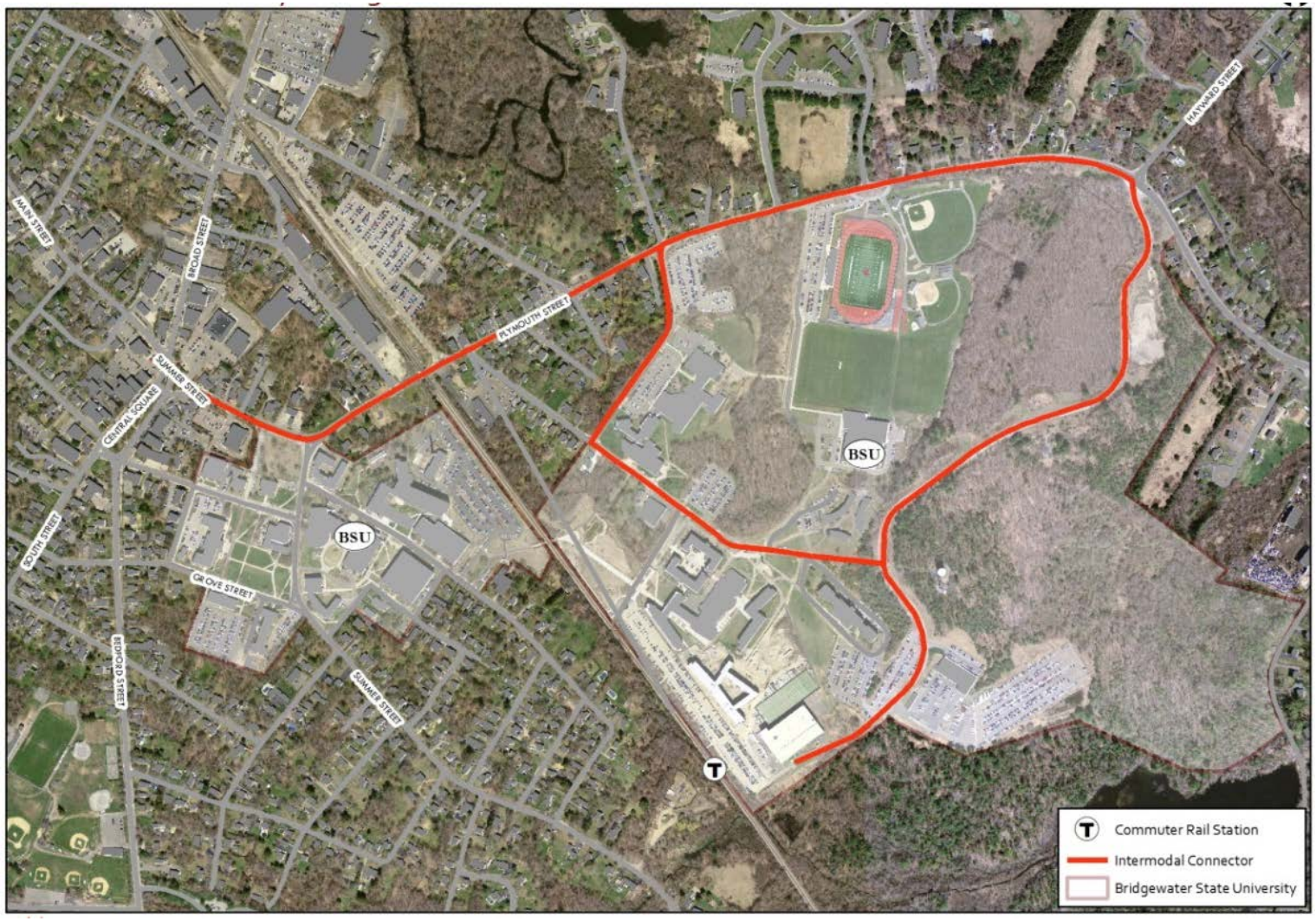

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Table 3: Bridgewater Commuter Rail Station Intermodal Connector Traffic Data Summary (2014)

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
Great Hill Drive, south of Plymouth Street (Route 104)	2,512	40 MPH	2.0%
Hayward Street, north of Plymouth Street (Route 104)	1,901	43 MPH	6.3%
Plymouth Street (Route 104), east of Great Hill Drive	11,333	44 MPH	9.0%
Plymouth Street (Route 104), west of Great Hill Drive	13,036	43 MPH	6.2%
Plymouth Street (Route 104), west of Hooper Street	18,929	34 MPH	7.0%
Burrill Avenue, south of Plymouth Street (Route 104)	3,557	30 MPH	4.1%
Hooper Street, south of Plymouth Street (Route 104)	3,776	30 MPH	3.8%
Spring Street, east of Broad Street (Route 18)	8,701	39 MPH	4.6%

The traffic data presented in Table 3 were increased to represent 2014 volumes using a 1% per year growth rate. Generally, traffic volumes on Plymouth Street (Route 104) are highest near the Hooper Street intersection and typically decrease east of Great Hill Drive. Route 104 carries a substantial volume of traffic throughout the typical day and has a high percentage of heavy vehicles as it provides access from Route 24 to points east.

Intersection Operations

Tables 4 and 5 summarize the results of the morning and afternoon peak hour level-of-service analysis at each intersection. The results of the level-of-service analyses are located in the Appendix.

Table 4: Bridgewater Commuter Rail Station Intermodal Connector Levels-of-Service (LOS)
Un-signalized Intersections

Location	AM LOS	PM LOS
Plymouth Street (Route 104) & Great Hill Drive/Hayward Street		
Great Hill Drive NB LT/TH/RT	D	F
Hayward Street SB LT/TH/RT	C	F
Plymouth Street (Route 104) & Hooper Street		
Hooper Street NB LT/TH/RT	C	F
Morris Avenue SB LT/TH/RT	F	F
Plymouth Street (Route 104) & Burrill Avenue		
Burrill Avenue NB LT/RT	F	F

Table 5: Bridgewater Commuter Rail Station Intermodal Connector Levels-of-Service (LOS)
Signalized Intersections

Location	AM LOS	PM LOS
Plymouth Street (Route 104) & Spring Street	B	B
Plymouth Street (Route 104) & Summer Street	B	C
Broad Street (Route 18) & Main Street (Route 28)/Summer Street (Route 104)	E	F

The stop sign controlled intersection approaches in the area, along with the signalized intersection of Broad Street (Route 18) at Main Street (Route 28) and Summer Street (Route 104) experience poor levels of service during peak demand hours due to high traffic volumes.

Crashes

Table 6 shows the number of crashes and crash rates for the study area intersections based on the latest 3 years of crash data (2011-2013).

Table 6: Bridgewater Commuter Rail Station Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Plymouth Street (Route 104) & Great Hill Drive/Hayward Street	5	1.67	0.28
Plymouth Street (Route 104) & Hooper Street	12	4.00	0.57
Plymouth Street (Route 104) & Burrill Avenue	8	2.67	0.28
Signalized Intersections			
Plymouth Street (Route 104) & Spring Street	9	3.00	0.39
Plymouth Street (Route 104) & Summer Street	3	1.00	0.10
Broad Street (Route 18) & Main Street (Route 28)/Summer Street (Route 104)	38	12.67	1.13

MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

The Plymouth Street (Route 104) & Hooper Street intersection demonstrated a crash rate exceeding both the Statewide Average and MassDOT District 5 average for un-signalized intersections while the Broad Street (Route 18) & Main Street (Route 28)/Summer Street (Route 104) intersection demonstrated a crash rate exceeding the both Statewide Average and MassDOT District 5 average for signalized intersections. Furthermore, the intersection of Board Street (Route 18) at Main Street (Route 28) and Summer Street (Route 104) is within the Top 5% of intersection crash clusters in the region.

Public Transportation

The Bridgewater Commuter Rail Station on the MBTA Old Colony Middleboro/Lakeville Commuter Rail Line is located adjacent to the Bridgewater State University east side campus. The station area provides over 500 vehicle parking spaces, 24 bicycle parking spaces, and numerous pedestrian accommodations. The Bridgewater Commuter Rail Station is served by 12 inbound and 12 outbound trains during the week (4 trains in both the peak morning and afternoon periods), and 8 inbound and 8 outbound trains on the weekends. Other public transportation services that serve the Bridgewater Commuter Rail Station include the Bridgewater State University campus shuttle.

Railroad Crossings

There is one active at-grade railroad crossing in the Bridgewater Commuter Rail Station NHS Intermodal Connector study area. The at-grade crossing is located on Plymouth Street (Route 104), approximately 280 feet west of the intersection of Plymouth Street and Burrill Avenue. Currently, 24 commuter trains (12 inbound, 12 outbound) per weekday cross Plymouth Street at this location. The at-grade crossing is located in a major pedestrian activity center, as it is located immediately adjacent to a Bridgewater State University parking facility and crosswalk. While the crossing does include sidewalk blocking gates that are lowered, along with activated red lights and bells well in advance of approaching trains, observations indicate students still attempt crossings even when gates are down.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Features such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just as sidewalks make it easier for a pedestrian to walk to a destination rather than drive.

Great Hill Drive, from Route 104 to MBTA Parking Lot: Great Hill Drive has generally poor connectivity for pedestrians and bicyclists. The roadway does not have sidewalks, and paved shoulder width varies from 1.9 to 2.5 feet, which is substandard to a minimum four feet to be adequately used for accommodating bicyclists.

Plymouth Street (Route 104), from Great Hill Drive to Summer Street: Plymouth Street accommodates pedestrians and bicyclists with a complete sidewalk in the westbound direction, a partial sidewalk in the eastbound direction, and bicycle accommodating shoulders on both sides of the street. The sidewalk is six-feet wide on both sides of the road, and the paved shoulder width varies from 6 feet to 7 feet.

Summer Street (Route 104), from Plymouth Street (Route 104) to Broad Street (Route 18): Summer Street provides access for pedestrians with five to six foot wide sidewalks on both sides of the street. Accessibility is limited for bicyclists, with little to no paved shoulder width on either side of the roadway, forcing bicyclists into the travel lane to share space with motor vehicles. A small section of Summer Street provides a three-foot buffer between the sidewalk and eastbound travel lane.

Hooper Street, from Burrill Avenue to Plymouth Street (Route 104): Hooper Street provides limited access for pedestrians with a 6 foot wide sidewalk on the northbound (towards Route 104) side of the road only. A portion of Hooper Street includes a vegetated buffer between the sidewalk and the roadway, which provides an added level of safety and comfort for pedestrians. Hooper Street does not include any bicycle lanes or bicycle accommodating shoulders, forcing bicyclists and motorists to share the main travel lane.

Burrill Avenue to Great Hill Drive: Burrill Avenue provides access for pedestrians with six to seven foot wide complete sidewalks on both sides of the street Burrill Avenue does not include any bicycle lanes or bicycle accommodating shoulders, forcing bicyclists and motorists to share the main travel lane.

Traffic Signal Warrant Analyses

Based on local knowledge of existing traffic patterns and the results of the intersection operations and safety analyses, Old Colony Planning Council conducted Traffic Signal Warrant Analyses at the following un-signalized intersections on the Bridgewater Commuter Rail Station Intermodal Connector:

Plymouth Street (Route 104) & Hayward Street/Great Hill Drive

Existing conditions at the intersection of Plymouth Street (Route 104) at Hayward Street and Great Hill Drive satisfied the following Warrants for Traffic Signals from the 2009 MUTCD: Warrant 1 – Eight Hour Vehicular Volume, Warrant 2 – Four Hour Vehicular Volume, and Warrant 3 – Peak Hour for the installation of a traffic signal.

Plymouth Street (Route 104) & Hooper Street

Existing conditions at the intersection of Plymouth Street (Route 104) at Hooper Street intersection satisfied the following Warrants for Traffic Signals from the 2009 MUTCD: Warrant 1 – Eight Hour Vehicular Volume, Warrant 2 – Four Hour Vehicular Volume, and Warrant 3 – Peak Hour for the installation of a traffic signal.

Brockton Bus Terminal (MA73B)

Connector Description

The Federal Highway Administration describes the Brockton Bus Terminal Intermodal Connector (MA73B) as "Served by an existing NHS Route 27". This study examined the four roadways (Court Street, Commercial Street (Route 27/123), Centre Street (Route 123), and Plymouth Street) that surround the Brockton Bus Terminal (a.k.a. – Brockton Area Transit Authority Intermodal Centre) and the key intersections.

Roadways

Centre Street (Route 123)

Centre Street (Route 123) is a two lane roadway that provides access on the east side of Brockton, between the Downtown to the town of Abington and points east. Centre Street (Route 123) is under local jurisdiction (City of Brockton) and is classified as an urban principal arterial (U3). The roadway in the study area generally consists of four 11 foot travel lanes and two 4-6 foot shoulders and 6-8 foot sidewalks; however, outside the study area Centre Street transitions to two travel lanes with smaller shoulders and sidewalks.

Commercial Street (Route 27)

Commercial Street (Route 27) is a two lane roadway connecting Court Street, Centre Street (Route 123), and School Street and Crescent Street (Route 27). It provides access to and from the Brockton Bus Terminal and Brockton Commuter Rail Station. The roadway consists of a single travel lane in each direction, which widens out to provide left turn lanes at the intersections of Court Street and Centre Street. Six to eight foot wide sidewalks are provided on both sides of the roadway. There are no striped shoulders on the roadway, and pick-up/drop-off cut outs are provided on both sides of the roadway.

Court Street (Route 27)

Court Street is a two-lane roadway connecting Commercial Street and Plymouth Street on the northern edge of the intermodal connector. It is owned and maintained by the City of Brockton and functionally classified as an urban minor arterial. The roadway features two travel lanes, 15 to 17 feet wide, a 10 foot wide shoulder on the westbound side and a 16 foot shoulder on the eastbound side of the road. However, the shoulder on the eastbound side is used for diagonal on-street parking, and the westbound shoulder is taken away prior to the intersection with Commercial Street in order to accommodate a left turn lane. Sidewalks are present on both sides of the roadway.

Plymouth Street

Plymouth Street is a two-lane roadway with 12-16 foot wide travel lanes in each direction connecting Centre Street (Route 123) and Court Street on the eastern edge of the Brockton Bus Terminal Intermodal Connector study area. It is owned and maintained by the City of Brockton, and is functionally classified as an urban minor arterial. Each side of the roadway contains a 6 to 8 foot wide shoulder, and sidewalks are included on both sides of the road.

Intersections

Centre Street (Route 123) & Plymouth Street

The intersection of Centre Street at Plymouth Street is a four-legged, un-signalized intersection with stop sign controls on the Plymouth Street northbound and southbound approaches. Supplementing the stop signs is a four-way flashing beacon suspended on an overhead mast arm, displaying a flashing RED signal to the Plymouth Street approaches and flashing AMBER signal to the Centre Street approaches. The eastbound Centre Street approach contains a shared left turn and through movement lane along with a right turn only lane. All of the three other approaches feature single, shared movement lanes. Each of the four legs of the intersection includes a crosswalk, constructed with a red concrete material. Ramps connecting the crosswalks to the sidewalks are provided, however they do not contain detectible warning surfaces.

Commercial Street (Route 27) & Centre Street (Route 123)

The intersection of Centre Street at Commercial Street is a four-legged signalized intersection. Geometric design of the approaches varies by approach:

- Centre Street (Route 123) Eastbound: This approach consists of a shared-use left turn and through movement lane, a dedicated bike lane, and a dedicated right turn only lane.
- Centre Street Westbound: This approach consists of two lanes: a shared left-turn and through movement lane, and a dedicated right turn only lane.
- Commercial Street Southbound: This approach consists of two lanes: a shared right-turn and through movement lane, and a dedicated left turn only lane.
- Commercial Street Northbound: the approach is striped as a single lane, shared movement approach. However, the lane is 20 feet wide, and often allows side-by-side stacking of vehicles at the stop line.

The traffic signal system operates on actuated, two-phased cycle: allowing eastbound and westbound movements together followed by northbound and southbound movements together. A pedestrian phase is activated by push-button request, allowing protected pedestrian crossings in all directions when activated. Each of the four legs of the intersection includes a crosswalk, constructed with a red concrete material. Ramps connecting the crosswalks to the sidewalks are provided, however they do not contain detectible warning surfaces.

Commercial Street (Route 27) & Court Street (Route 27)

The intersection of Commercial Street at Court Street is a four-legged signalized intersection. Geometric design of the approaches varies by approach:

- Court Street (Route 27) Eastbound: This approach consists of a single shared-movement lane.
- Court Street Westbound: This approach consists of two lanes: a shared right-turn and through movement lane, and a dedicated left turn only lane.
- Commercial Street (Route 27) Northbound: This approach consists of two lanes: a shared right-turn and through movement lane, and a dedicated left turn only lane.
- Private Drive: A private driveway makes up the fourth leg of this intersection. The driveway is a single shared movement lane, and controlled by the traffic signal system.

The traffic signal system operates on actuated, two-phased cycle: allowing eastbound and westbound movements together followed by northbound and southbound movements together. A pedestrian phase is activated by push-button request, allowing protected pedestrian crossings in all directions when activated. The Commercial Street and eastern Court Street leg include crosswalks, constructed with a red concrete material. Ramps connecting the crosswalks to the sidewalks are provided, however they do not contain detectible warning surfaces.

Court Street & Plymouth Street

The intersection of Court Street at Plymouth Street is a three legged, un-signalized intersection controlled by a stop sign on the Plymouth Street approach. All three approaches feature single, shared movement lanes. Standard crosswalks (parallel white lines) cross Plymouth Street and the western leg of Court Street at the intersection. Sidewalks are located on all sides.

Figure 2 shows the Brockton Bus Terminal Intermodal Connector (MA73B).

Figure 2: Brockton Bus Terminal Intermodal Connector (MA73B)

Traffic Volumes & Intersection Operations

Traffic Volumes

Old Colony Planning Council collected mainline roadway traffic counts (vehicle volumes, vehicle speeds, and vehicle classifications) on the four roadways that surround the Brockton Bus Terminal as well as on key intersecting streets. In addition, OCPC collected intersection turning movements during the morning and afternoon peak traffic periods at the intersections of the four surrounding roadways. These counts were conducted in order to determine existing demand as well as to enable future transportation improvements analyses.

Table 7 displays the results of the mainline roadway traffic data collection program for the Brockton Bus Terminal Intermodal Connector.

Table 7: Brockton Bus Terminal Intermodal Connector Traffic Data Summary (2014)

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
Centre Street (Route 123), east of Plymouth Street	13,147	37 MPH	6.6%
Centre Street (Route 123), west of Plymouth Street	12,169	N/A	N/A
Court Street, east of Plymouth Street	7,563	28 MPH	5.2%
Court Street, west of Plymouth Street	10,296	N/A	N/A
Plymouth Street, south of Centre Street (Route 123)	4,764	30 MPH	10.1%
Plymouth Street, south of Court Street	4,154	28 MPH	7.2%

The area surrounding the Brockton Bus Terminal carries a large amount of traffic, especially large trucks and buses. The highest volumes were generally recorded on Centre Street (Route 123); however, the volumes on Court Street were not too much lower. The locations on Centre Street (Route 123) and Court Street between Commercial Street (Route 27) and Plymouth Street were not suitable for accurate vehicle speed or classification data collection due to continual vehicle queuing at the signalized intersections.

Intersection Operations

Table 8 and 9 show the Brockton Bus Terminal Intermodal Connector 2014 morning (AM) and afternoon (PM) peak period levels-of-service. The results of the level-of-service analyses are located in the Appendix.

Table 8: Brockton Bus Terminal Intermodal Connector Levels-of-Service (LOS)
Un-signalized Intersections

Location	AM LOS	PM LOS
Centre Street (Route 123) & Plymouth Street		
Plymouth Street NB LT/TH/RT	F	F
Plymouth Street SB LT/TH/RT	F	F
Court Street & Plymouth Street		
Plymouth Street NB LT/TH/RT	C	C

Table 9: Brockton Bus Terminal Intermodal Connector Levels-of-Service (LOS)
Signalized Intersections

Location	AM LOS	PM LOS
Commercial Street (Route 27) & Centre Street (Route 123)	E	D
Commercial Street (Route 27) & Court Street (Route 27)	B	B

Heavy traffic volumes combined with a large volume of crossing pedestrians (resulting in numerous pedestrian "all-red" phases) result in poor levels-of-service at the intersection of Centre Street (Route 123) at Commercial Street. The stop controlled approaches on Plymouth Street at its intersection with Centre Street (Route 123) also experience heavy delays during peak hours.

Crashes

Table 10 shows the number of crashes and crash rates for the Brockton Bus Terminal Intermodal Connector intersections based on the latest 3 years of crash data (2011-2013).

Table 10: Brockton Bus Terminal Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Centre Street (Route 123) & Plymouth Street	42	14.00	2.69
Court Street & Plymouth Street	0	0	0.00
Signalized Intersections			
Commercial Street (Route 27) & Centre Street (Route 123)	20	6.67	0.91
Commercial Street (Route 27) & Court Street (Route 27)	9	3.00	0.59

MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

The Centre Street (Route 123) & Plymouth Street intersection demonstrated a crash rate exceeding both the Statewide Average and MassDOT District 5 average for un-signalized intersections, is among the Top 5% of intersection crash clusters in the region, and is one of the Top 200 Most Hazardous Intersections in Massachusetts based on MassDOT data.

The Commercial Street (Route 27) & Centre Street (Route 123) intersection demonstrated a crash rate exceeding the both Statewide Average and MassDOT District 5 average for signalized intersections, and is among the Top 5% of intersection crash clusters in the region.

Public Transportation

The Brockton Area Transit Authority (BAT) provides public transportation at the Brockton Bus Terminal Intermodal Connector. BAT is the largest Regional Transit Authority (RTA) operating primarily in the Old Colony Region with average yearly ridership just over 2.8 million boardings. BAT operates 16 fixed bus routes primarily within the City of Brockton with lines branching out to neighboring communities. BAT provides service to three MBTA Commuter Rail facilities in the City of Brockton (Campello, Brockton, and Montello) and the MBTA Red Line Ashmont Station. The Brockton Bus Terminal is located adjacent to the Downtown Brockton MBTA Commuter Rail Station, which is located on the Old Colony Middleboro/Lakeville Commuter Rail Line. The Downtown Brockton Commuter Rail Station is served by 12 inbound and 12 outbound trains during the week (4 trains in both the peak morning and afternoon periods), and 8 inbound and 8 outbound trains on the weekends.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Items such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just like the presence of sidewalks make it more feasible for a pedestrian to walk to a destination rather than drive.

The study area is well served by existing six to eight foot wide sidewalks on each side of Commercial Street, Court Street, Plymouth Street, and Centre Street. However, wide cross sections along with high travel speeds on Centre Street (Route 123) present a challenge to pedestrians attempting to safely cross the street at the intersection of Centre Street (Route 123) and Plymouth Street. The conrete material comprising the crosswalks at the area intersections have been observed to become slippery during wet conditions, creating a safety hazard for pedestrians. The material has also become weathered with age, and deterioration presents a further hazard. All of the intersections in the study area contain crosswalks, and there is one additional mid-block crosswalk on Commercial Street, halfway between Centre Street and Court Street, which is heavily utilized. It should be noted that Centre Street (Route 123) between Plymouth Street and Commercial Street along with Commercial Street between Centre Street and Court Street are among the Top 5% of crash clusters for pedestrian involved crashes within the region.

With the exception of a short bike lane on the eastbound approach to the intersection of Centre Street (Route 123) and Commercial Street, the study area does not include any bicycle specific infrastructure such as dedicated lanes or sharrows. However, existing shoulders and lane widths are generally wide enough to comfortably accommodate experienced bike riders. Furthermore, the width

of these facilities may allow for retrofitting of future bike lanes or sharrows. Bike racks are provided at the Brockton Bus Terminal, and busses serving the bus terminal contain bike racks on the front of the vehicles.

Traffic Signal Warrant Analyses

Based on local knowledge of existing traffic patterns and the results of the intersection operations and safety analyses, Old Colony Planning Council conducted Traffic Signal Warrant Analyses at the following un-signalized intersections on the Brockton Bus Terminal Intermodal Connector:

- Centre Street (Route 123) & Plymouth Street
- Court Street & Plymouth Street

Existing conditions at the intersection of Centre Street (Route 123) at Plymouth Street satisfied the following 2009 MUTCD Warrants for Traffic Signals: Warrant 1 – Eight Hour Vehicular Volume, and Warrant 2 – Four Hour Vehicular Volumes.

Conditions at the intersection of Court Street at Plymouth Street did not satisfy any of the 2009 MUTCD Warrants for Traffic Signals.

Campello Transit Commuter Rail (MA79T)

Connector Description

The Federal Highway Administration describes the Campello Transit Commuter Rail Intermodal Connector (MA79T) as "Riverside Avenue to Montello Street to Route 123". The study examined conditions along Riverside Avenue and Montello Street (Route 28) from the Campello Commuter Rail Station to Centre Street (Route 123).

Roadways

Montello Street (Route 28)

Montello Street (Route 28) in the study area is a two lane roadway, functionally classified as an Urban Principal Arterial that provides access to and from Campello Commuter Rail Station to Centre Street (Route 123). Montello Street is under local jurisdiction (City of Brockton). It consists of two travel lanes varying between 12 and 13 feet wide, with shoulders on each side which, vary between 1.8 and 2.10 feet wide.

Plain Street

Plain Street in the study area is a two lane roadway, functionally classified as an Urban Minor Arterial, providing access between Montello Street (Route 28), Riverside Avenue, and the Campello Commuter Rail Station. Plain Street is under local jurisdiction (City of Brockton). It consists of two 12 foot wide travel lanes and 4.5 to 5.5 foot shoulders on each side.

Riverside Avenue

Riverside Avenue is a two-lane local roadway that connects between Montello Street (Route 28) and Plain Street, serving as an entrance to the Campello Commuter Rail Station as well as providing access to some residences and light industrial uses. The roadway consists to two 11 to 12 foot wide travel lanes and 1.5 to 2 foot shoulders on each side.

Intersections

Montello Street (Route 28) & Centre Street (Route 123)

The intersection of Montello Street (Route 28) at Centre Street (Route 123) is a four-way intersection controlled by an actuated traffic signal system. Each approach of the intersection consists of single shared movement lanes. The traffic signal system operates on four phases: a protected GREEN signal lead for the westbound approach of Centre Street (Route 123); a permitted GREEN signal for all movements from both directions of Centre Street; a permitted GREEN signal for all movements from both directions of Montello Street (Route 128), and a lag GREEN phase for Montello Street southbound. While the system operates with a westbound GREEN signal lead and southbound GREEN lag, there is no indication to drivers that they have a protected GREEN. A pedestrian crossing "all

stop" phase is activated by push button request. The intersection has sidewalks on both sides of each approach, and crosswalks on all four legs.

Montello Street (Route 28) & School Street

The Montello Street (Route 28) at School Street intersection contains four legs, with three active approaches and one leg which is a one-way only receiving leg. The geometric layout of the intersection is as follows:

- Montello Street (Route 28) Southbound: Approach consists of a single shared right-turn/through-movement lane.
- Montello Street (Route 28) Northbound: Approach consists of two lanes: an exclusive left turn lane, and an exclusive through-movement lane.
- School Street Westbound: Approach consists of three separate exclusive movement lanes: an exclusive left turn lane, and an exclusive through-movement lane, and an exclusive right turn lane.
- Western Leg of School Street: The leg of School Street on the west side of the intersection is one-way only headed away from the intersection. It consists on one receiving lane. On-street parking and a driveway to City Hall Plaza are located on the left hand side of this leg.

The traffic signal operates on a three-phased cycle, allowing northbound Montello Street traffic to go on a protected GREEN lead signal, then both directions of Montello Street together in a permitted GREEN phase, and finally School Street westbound traffic allowed on a protected GREEN phase. The intersection also contains a pedestrian phase which creates an "all-stop" across all approaches when activate via push-button call from a pedestrian. Sidewalks are located on both sides of each approach, and each leg of the intersection includes a crosswalk

Montello Street (Route 28) & Crescent Street (Route 27/123)

The Montello Street (Route 28) at Crescent Street (Route 27/123) intersection contains four legs, with three active approaches and one leg which is a one-way only receiving leg. The geometric layout of the intersection is as follows:

- Montello Street (Route 28) Southbound: Approach consists of two lanes, a shared left turn / through movement lane, and an exclusive right turn lane.
- Crescent Street (Route 123) Eastbound: This approach consists of two shared movement lanes: a left turn / through movement lane, and a right turn / through movement lane.
- Montello Street (Route 28) Northbound: This is a single lane, shared movement approach allowing left turns, right turns, and through movements.
- Crescent Street (Route 27) Eastbound: This leg on the east side of the intersection is one-way only away from the intersection, with two receiving lanes.

The traffic signal system operating the intersection operates on three phases: a permitted GREEN for all northbound and southbound movements from Montello Street; a protected GREEN "lag" signal for the southbound approach of Montello Street, and a permitted GREEN signal for the eastbound approach of Crescent Street. The southbound right turn lane from Montello Street onto Crescent Street has a GREEN right turn arrow while the Crescent Street leg has a concurrent GREEN phase. The intersection has sidewalks on both sides of each approach, and crosswalks on all four legs. The traffic signal system includes an "all-red" pedestrian actuated phase.

Montello Street (Route 28) & Lawrence Street

Montello Street (Route 28) and Lawrence Street form a four-way intersection controlled by an actuated traffic signal system. Each approach of the intersection consists of single shared movement lanes. The traffic signal system operates on a simple two-phase cycle, allowing northbound and southbound movements together followed by eastbound and westbound movements together. The intersection has sidewalks on both sides of each approach, and crosswalks on all four legs. However, the sidewalks do not contain ramps leading into the crosswalks, severely limiting mobility and accessibility. The traffic signal system does not include any accommodation for pedestrians.

Montello Street (Route 28) & Grove Street

Montello Street (Route 28) and Grove Street form a four-way intersection controlled by an actuated traffic signal system. Each approach of the intersection consists of single shared movement lanes. The traffic signal system operates on a simple two-phase cycle, allowing northbound and southbound movements together followed by eastbound and westbound movements together. The intersection has sidewalks on both sides of each approach, and crosswalks on all four legs. However, the sidewalks do not contain ramps leading into the crosswalks, severely limiting mobility and accessibility. The traffic signal system does not include any accommodation for pedestrians.

Montello Street (Route 28) & East Nilsson Street

The Montello Street (Route 28) & East Nilsson Street intersection is a conventional four-way intersection with STOP controls on the East Nilsson Street approaches. All approach lanes have a shared left-through-right lane and lane widths are generally 12-13 feet wide with 2 foot shoulders on Montello Street (Route 28) and no usable shoulders on East Nilsson Street. Sidewalks (5 foot) and crosswalks are present on all approaches.

Montello Street (Route 28) & Perkins Avenue

Montello Street (Route 28) and Perkins Avenue form a four-way intersection controlled by a pre-timed traffic signal system. Each approach of the intersection consists of single shared movement lanes. The traffic signal system operates on a simple two-phase cycle, allowing northbound and southbound movements together followed by eastbound and westbound movements together. There is also an exclusive pedestrian phase which lights RED and AMBER signals together creating an "all stop" across all four approaches. It should be noted this type of pedestrian signal is outdated and

no longer supported by the Federal Highway Administration (FHWA) or the Massachusetts Department of Transportation (MassDOT). The intersection has sidewalks on both sides of each approach, and crosswalks on all four legs. However, the sidewalks do not contain ramps leading into the crosswalks, severely limiting mobility and accessibility.

Montello Street (Route 28) & Riverside Avenue

The intersection of Montello Street (Route 28) at Riverside Avenue is a three-way un-signalized intersection with STOP sign controls on the Riverside Avenue approach. All three approaches feature single shared-movement lanes. There are sidewalks on both sides of each of the three approaches, however only the Riverside Avenue leg has a crosswalk.

Montello Street (Route 28) & Plain Street

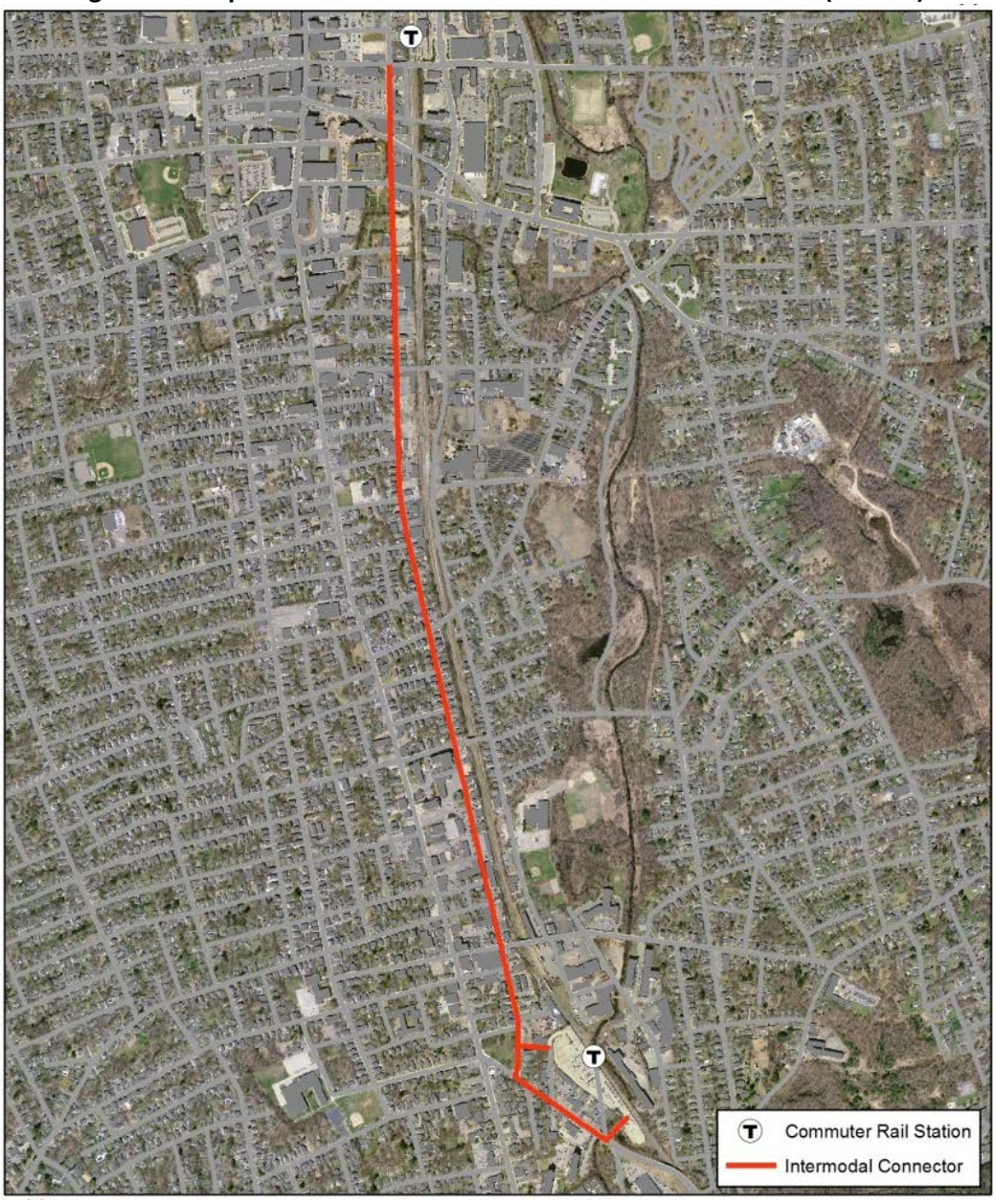
The Montello Street (Route 28) & Plain Street intersection is a three-way intersection with STOP sign controls on the Montello Street approach. All three approaches feature single shared-movement lanes. There are sidewalks on both sides of each of the three approaches; however, only the Montello Street leg has a crosswalk.

Plain Street & Riverside Avenue

The intersection of Plain Street at Riverside Avenue is a three-way un-signalized intersection with STOP sign controls on the Riverside Avenue approach. All three approaches feature single shared-movement lanes. There are sidewalks on both sides of each of the three approaches; however, only the Riverside Avenue leg has a crosswalk.

Figure 3 shows the Campello Transit Commuter Rail Intermodal Connector.

Figure 3: Campello Transit Commuter Rail Intermodal Connector (MA79T)



Traffic Volumes & Intersection Operations

Traffic Volumes

Old Colony Planning Council collected mainline roadway traffic counts (vehicle volumes, vehicle speeds, and vehicle classifications) on the Campello Transit Commuter Rail Intermodal Connector as well as on key intersecting streets. In addition, OCPC collected intersection turning movements during the morning and afternoon peak traffic periods at key intersections of the connector. These counts were conducted in order to determine existing demand as well as to enable future transportation improvements analyses.

Table 11 displays the results of the mainline roadway traffic data collection program for the Campello Transit Commuter Rail Intermodal Connector.

Table 11: Campello Transit Commuter Rail Intermodal Connector Traffic Data Summary

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
Montello Street (Route 28), north of Grove Street	8,733	29 MPH	6.4%
Montello Street (Route 28), south of Crescent Street (Route 27/123)	9,094	28 MPH	6.9%
Montello Street (Route 28), south of Grove Street	10,116	29 MPH	7.3%

Traffic volumes on Montello Street (Route 28) split at the intersection with Grove Street. Volumes recorded were highest just south of Grove Street while the lowest volumes were recorded just north of Grove Street. Grove Street is a major intersection along the Campello Transit Commuter Rail Intermodal Connector as it provides access to the east side of the City of Brockton. Montello Street (Route 28) is a major trucking route through the City of Brockton and the percentages of heavy vehicles found in Table 12 show that characteristic.

Intersection Operations

Tables 12 and 13 show the Campello Transit Commuter Rail Intermodal Connector 2014 morning (AM) and afternoon (PM) peak period levels-of-service. The results of the level-of-service analyses are located in the Appendix.

Table 12: Campello Transit Commuter Rail Intermodal Connector Levels-of-Service (LOS)

Un-signalized Intersections

Location	AM LOS	PM LOS
Montello Street (Route 28) & East Nilsson Street		
Nilsson Street EB LT/TH/RT	C	F
East Nilsson Street WB LT/TH/RT	C	F
Montello Street (Route 28) & Plain Street		
*Montello Street (**Route** 28) SB LT/TH/RT*	F	D

Table 13: Campello Transit Commuter Rail Intermodal Connector Levels-of-Service (LOS)

Signalized Intersections

Location	AM LOS	PM LOS
Montello Street (Route 28) & Centre Street (Route 123)	C	C
Montello Street (Route 28) & Crescent Street (Route 27/123)	F	F
Montello Street (Route 28) & Grove Street	B	B
Montello Street (Route 28) & Lawrence Street	B	B
Montello Street (Route 28) & Perkins Avenue	B	B
Montello Street (Route 28) & School Street	C	C

Delays occur at the STOP sign controlled approaches during the peak demand hours at the un-signalized intersections in the study area, as well as at the signalized intersection of Montello Street at Crescent Street in Downtown Brockton.

Crashes

Table 14 shows the number of crashes and crash rates for the Campello Transit Commuter Rail Intermodal Connector intersections based on the latest 3 years of crash data (2011-2013).

Table 14: Campello Transit Commuter Rail Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Montello Street (Route 28) & East Nilsson Street	16	5.33	1.14
Montello Street (Route 28) & Plain Street	3	1.00	0.20
Signalized Intersections			
Montello Street (Route 28) & Centre Street (Route 123)	28	9.33	1.35
Montello Street (Route 28) & School Street	11	3.67	0.67
Montello Street (Route 28) & Crescent Street (Route 27/123)	19	6.33	0.94
Montello Street (Route 28) & Lawrence Street	22	7.33	1.38
Montello Street (Route 28) & Grove Street	16	5.33	0.98
Montello Street (Route 28) & Perkins Avenue	13	4.33	1.09

MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

Nearly all of the study area intersections demonstrated a crash rate exceeding the Statewide Average and MassDOT District 5 average for un-signalized or signalized intersections.

The following study area intersections are among the Top 5% of intersection crash clusters in the region: Montello Street at Centre Street; Montello Street at Crescent Street; Montello Street at Lawrence Street; Montello Street at Grove Street; and Montello Street at East Nilsson Street.

Public Transportation

The Campello Commuter Rail Station on the MBTA Old Colony Middleboro/Lakeville Commuter Rail Line is located in the south side of the City of Brockton adjacent to high density housing and industrial uses. The station area provides over 500 vehicle parking spaces, 8 bicycle parking spaces, and numerous pedestrian accommodations. The Campello Commuter Rail Station is served by 12 inbound and 12 outbound trains during the week (4 trains in both the peak morning and afternoon periods), 8 inbound and 8 outbound trains on the weekends. Brockton Area Transit provides fixed route bus service within walking distance to the Campello Commuter Rail Station along Main Street.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Items such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just like the presence of sidewalks make it more feasible for a pedestrian to walk to a destination rather than drive.

The Campello Commuter Rail Station Intermodal Connector Study Area is well served by sidewalks, with both sides of all streets in the study area having sidewalks. which are generally 5 to 6 feet wide, although slightly narrower in some spots. Every intersection has a crosswalk across at least the side-street approach, and many have crosswalks on all approaches.

Montello Street (Route 28) between Centre Street (Route 123) and School Street, along with the area of Montello Street at Plain Street, are among the Top 5% for pedestrian related crash clusters in the region.

Montello Street (Route 28) does not have any bike lanes, and paved shoulder widths (1.8’ to 2.1’) are generally too narrow to adequately accommodate bicyclists, forcing bicyclists to share the travel lanes with motor vehicles.

Plain Street does not have any bike lanes, however six foot striped, paved shoulders on each side of the road are wide enough to adequately accommodate bicycle travel.

Riverside Avenue does not have any bike lanes and striped paved shoulder widths are narrow.

Several obstacles to accessibility and mobility were observed in the Study Area, including utility poles and road sign posts planted within the sidewalk, and sub-standard to non-existent curb ramps at crossings.

Traffic Signal Warrant Analyses

Based on local knowledge of existing traffic patterns and the results of the intersection operations and safety analyses, Old Colony Planning Council conducted a Traffic Signal Warrant Analysis for the intersection of Montello Street (Route 28) at East Nilsson Street. Existing conditions at the intersection did not satisfy any of the 2009 MUTCD warrants for traffic signals.

Kingston Commuter Rail Station (MA81T)

Connector Description

The Federal Highway Administration describes the Kingston Commuter Rail Station Intermodal Connector (MA81T) as "Marion Drive to Gallen Road to Cranberry Road to Raboth Road to Route 3". This study examined conditions on all of the above roadways; however, Raboth Road is now considered to be "Independence Mall Way"; therefore, it is referenced as such in the sections below.

Roadways

Cranberry Road

Cranberry Road is a two lane roadway that provides access to and from the Town of Kingston Municipal Waste Facility. Cranberry Road is under local jurisdiction (Town of Kingston) and is classified as a local roadway (U0). The roadway generally consists of two 10 to 11 foot travel lanes with 2 foot shoulders with no dedicated bicycle or pedestrian accommodations.

Gallen Road

Gallen Road is a two lane roadway that provides access to and from the Kingston Commuter Rail Station and to the several industrial uses. Gallen Road (becomes Marion Drive approximately 1,000 feet west of the intersection with Cranberry Road) is under owned and maintained by the Town of Kingston and is classified as a local roadway (U0). The roadway generally consists of two 12 foot travel lanes with 2 foot shoulders and a 6 foot sidewalk on the east side.

Independence Mall Way (previously known as Raboth Road)

Independence Mall Way is a two lane roadway that provides access to and from the Independence Mall and connects Route 3 to Commerce Way in Plymouth. Independence Mall Way is under local jurisdiction (Town of Kingston) and is classified as a local roadway (U0). In the study area, the roadway consists of an entrance and exit portions (to the Independence Mall) separated by a raised vegetated median. The entrance portion generally consists of two 13 foot travel lanes with no shoulders or any dedicated bicycle or pedestrian accommodations. The exit portion generally consists of four 11 foot travel lanes with a 3 foot shoulder and no dedicated bicycle or pedestrian accommodations.

Marion Drive

Marion Drive is a two lane roadway that provides access to and from the Kingston Commuter Rail Station and to the several industrial uses. Marion Drive is under local jurisdiction (Town of Kingston) and is classified as a local roadway (U0). The roadway generally consists of two 12 foot travel lanes with 2 foot shoulders and a 6 foot sidewalk on the east side.

Smiths Lane

Smiths Lane is a two lane roadway that runs northeast-southwest direction from Crescent Street to Route 3. Smiths Lane is under local jurisdiction (Town of Kingston) and is classified as a local roadway (U0). The roadway generally consists of two 13 to 15 foot travel lanes with two 2 foot shoulders and 2 to 4 foot sidewalks.

Intersections

Cranberry Road & Independence Mall Way

The intersection of Independence Mall Way at Cranberry Road is a three-way, signalized intersection. Geometric design of the intersection varies by approach:

- Independence Mall Way, Eastbound: The eastbound approach of Independence Mall Way consists of two travel lanes: an exclusive through movement lane, and a shared lane for through movements and left turns onto Cranberry Road.
- Independence Mall Way, Westbound: The westbound approach of Independence Mall Way consists of two though movement lanes, and an exclusive channelized right turn lane that flares off of the intersection into Cranberry Road.
- Cranberry Road, Southbound: The southbound approach of Cranberry Road consists of three lanes: two exclusive left turn lanes, and an exclusive right turn lane. Each lane contains about 130 feet of storage space before tapering back into a single lane on Cranberry Road.

The traffic signal system operates on an actuated, two-phased cycle, allowing Independence Mall Way movements followed by Cranberry Road movements. There are no sidewalks or crosswalks at the intersection, and the traffic signal system does not include any pedestrian phases.

Gallen Road & Cranberry Road

The intersection of Cranberry Road at Gallen Road is a three-way un-signalized intersection with STOP sign controls on the Gallen Road approach. All three approaches feature single shared-movement lanes. There is a sidewalk on the northern (westbound) side of Gallen Road that wraps around onto Cranberry Road; however, there are no crosswalks at the intersection as there are no safe receiving areas for pedestrians.

Smiths Lane at Route 3 Southbound Ramps and Independence Mall Way

The intersection of Smiths Lane at Route 3 Southbound and Independence Mall Way is a four-way, signalized intersection. Geometric design of the intersection varies by approach:

- Independence Mall Way, Eastbound: The eastbound approach of Independence Mall Way consists of four travel lanes: two exclusive left turn lanes, an exclusive through movement lane, and an exclusive right turn lane. There is approximately 150 feet of storage for each lane.
- Route 3 Southbound Ramps, Westbound: The Route 3 Southbound off-ramp widens out to four-lanes on its approach to the intersection with Smiths Lane. The geometric layout consists of two exclusive left turn lanes, an exclusive through movement lane, and a shared through movement and right turn lane. The two left lanes are separated from the two right lanes by a striped median. The left lanes contain 250 feet of storage, while the other lanes contain 325 feet of available storage.
- Smiths Lane, Southbound: The southbound approach of Smiths Lane consists of two lanes: a shared left turn and through movement lane, and an exclusive right turn lane. There is approximately 200 feet of storage available in the exclusive right turn lane.
- Smiths Lane, Northbound: The northbound approach of Smiths Lane consists of a shared left turn and through movement lane, an exclusive through movement lane, and an exclusive channelized right turn lane that flares off of the intersection into the Route 3 Southbound on-ramp.

The coordinated, actuated traffic signal control system operates with split phases that allow for left turns from Independence Mall Way and the Route 3 southbound off-ramp only on a concurrent protected GREEN signal, before restricting left turns and allowing all other movements from Independence Mall Way and the off-ramp. There are few bike and pedestrian accommodations, with the one exception being the ability for bicycles to call for green light. Sidewalk on Smiths Lane (north side) ends at the ramps and does not connect residential uses to the intermodal connector.

Smiths Lane & Route 3 Northbound Ramps

The intersection of Smiths Lane at Route 3 Northbound is a three-way, signalized intersection. Geometric design of the intersection varies by approach:

- Route 3 Northbound Off-Ramp: The off-ramp widens out to two lanes as it approaches the intersection with Smiths Lane: an exclusive left turn lane and an exclusive right turn lane. The approach is designed as such that each lane flares away from each other, channelized and separated by a raised island.
- Smiths Lane, Southbound: The northbound approach of Smiths Lane consists of a single through movement lane, a channelized exclusive right turn lane that flares off of the intersection into the Route 3 northbound on-ramp.

- Smiths Lane, Northbound: The northbound approach of Smiths Lane consists of two lanes: an exclusive left turn lane, and an exclusive through movement lane.

The coordinated, actuated traffic signal system allows for protected left turns from Smiths Lane onto the Route 3 northbound on-ramp by providing a leading GREEN left arrow and through movement on the Smiths Lane northbound approach, followed by all Smiths Lane movements permitted on a concurrent GREEN phase, and then finally all movements from the Route 3 ramp. The signal system does not include any pedestrian phases, as there are no sidewalks or crosswalks at the intersection.

Figure 4 shows the Kingston Commuter Rail Station Intermodal Connector.

Figure 4: Kingston Commuter Rail Station Intermodal Connector (MA81T)

Traffic Volumes & Intersection Operations

Traffic Volumes

Old Colony Planning Council collected mainline roadway traffic counts (vehicle volumes, vehicle speeds, and vehicle classifications) on the Kingston Commuter Rail Station Intermodal Connector as well as on key intersecting streets. In addition, OCPC collected intersection turning movements during the morning and afternoon peak traffic periods at key intersections of the connector. These counts were conducted in order to determine existing demand as well as to enable future transportation improvements analyses.

Table 15 displays the results of the mainline roadway traffic data collection program for the Kingston Commuter Rail Station Intermodal Connector.

Table 15: Kingston Commuter Rail Station Intermodal Connector Traffic Data Summary (2014)

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
Marion Drive, north of Gallen Road	2,551	29 MPH	12.3%
Smiths Lane, over Pilgrim Highway (Route 3)	10,195	37 MPH	5.0%

The highest traffic volumes in the study area were found on Smiths Lane between the Route 3 northbound and southbound on/off ramps. Smiths Lane connects Route 3A to Route 3 and provides direct access to the Independence Mall.

Intersection Operations

Tables 16 and 17 show the Kingston Commuter Rail Station Intermodal Connector 2014 morning (AM) and afternoon (PM) peak period levels-of-service. The results of the level-of-service analyses are located in the Appendix.

Table 16: Kingston Commuter Rail Station Intermodal Connector Levels-of-Service (LOS)
Un-signalized Intersections

Location	AM LOS	PM LOS
Gallen Road & Cranberry Road		
Gallen Road EB RT/LT	A	A

Table 17: Kingston Commuter Rail Station Intermodal Connector Levels-of-Service (LOS)
Signalized Intersections

Location	AM LOS	PM LOS
Cranberry Road & Independence Mall Way	A	A
Smiths Lane & Route 3 NB On/Off Ramps	A	B
Smiths Lane & Route 3 SB On/Off Ramps	B	D

The majority of the intersections in the Kingston Intermodal study area operate efficiently during both the morning and afternoon peak demand hours. However, occasional congestion and moderate

delays occur at the intersection of Smiths Lane and the Route 3 Southbound ramps, particularly during the weekday evening rush hour.

Crashes

Table 18 shows the number of crashes and crash rates for the study area intersections based on the latest 3 years of crash data (2011-2013).

Table 18: Kingston Commuter Rail Station Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Gallen Road & Cranberry Road	1	0.33	0.23
Signalized Intersections			
Cranberry Road & Independence Mall Way	0	0	0.00
Smiths Lane & Route 3 NB On/Off Ramps	3	1	0.24
Smiths Lane & Route 3 SB On/Off Ramps	0	0	0.00

*** Crash figures based on available date from MassDOT. Crashes in this area may be under-reported.*
MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

None of the study area intersections demonstrated a crash rate exceeding the Statewide Average and MassDOT District 5 average for un-signalized intersections; however, the Smiths Lane & Route 3 SB On/Off Ramps is a very large intersection with a high volume of traffic and can be confusing for a driver during the evening hours.

Public Transportation

The Kingston Commuter Rail Station on the MBTA Old Colony Kingston/Plymouth Commuter Rail Line is located in north Kingston behind the Independence Mall. The station area provides over 1,000 vehicle parking spaces, 14 bicycle parking spaces, and numerous pedestrian accommodations. The Kingston Commuter Rail Station is served by 12 inbound and 12 outbound trains during the week (4 trains in both the peak morning and afternoon periods), 8 inbound and 8 outbound trains on the weekends. The Greater Attleboro Taunton Regional Transit Authority (GATRA) provides fixed route bus service to the Kingston Commuter Rail Station via the intermodal connector.

Railroad Crossings

There is one active at-grade railroad crossing in the Kingston Commuter Rail Station NHS Intermodal Connector study area. The at-grade crossing is located approximately 150 feet east of the entrance to the commuter rail station on Marion Drive. Currently, 22 trains per weekday (11 inbound, 11 outbound) cross Marion Drive at this location. The crossing is equipped with gates (including sidewalk gate), lights, and bells that are activated in advance of approaching trains.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Items such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just like the presence of sidewalks make it more feasible for a pedestrian to walk to a destination rather than drive.

Pedestrian accessibility and mobility are severely limited throughout the Kingston Commuter Rail station study area, with a lack of sidewalks throughout the entire area. Gallen Road has a sidewalk on the northern (westbound) side of the roadway. However, a car dealership on the corner of Gallen Road and Cranberry Road uses the sidewalk for storage of parked vehicles, obstructing access to it.

Bicycle access and mobility is also limited, with no bike lanes in the area and a lack of accommodating shoulder, particularly on Independence Mall Way and Smiths Lane where heavy traffic volumes are present.

Plymouth P&B Bus Terminal (MA71B)

Connector Description

The Federal Highway Administration describes the Plymouth P&B Bus Terminal Intermodal Connector (MA71B) as "Served by existing NHS Route 3"; however, there is not a direct connection to Route 3 from the bus terminal. The connection involves a number of roadways that connect to the limited access portion of Route 44 and ultimately to Route 3. The roadways that provide connection to Route 44 from the bus terminal include Cherry Street, Commerce Way, Industrial Park Road, and McAuliffe Way.

Roadways

Cherry Street

Cherry Street between Commerce Way and Industrial Park Road is a two lane roadway functionally classified as an urban minor arterial, which is under the jurisdiction of the Town of Plymouth. The travel lane in each direction varies from 11.4 to 12 feet wide. Paved, striped shoulder widths vary from 2.5 feet on the northern edge (westbound direction) of the roadway to 5.6 feet on the southern edge. The roadway does not contain any sidewalks.

Commerce Way

Commerce Way between Cherry Street and McAuliffe Way is functional classified as an urban minor arterial and varies from a two-lane undivided roadway between Route 44 and Cherry Street to a four lane divided highway between Route 44 and McAuliffe Way. Travel lanes are 10 feet wide. Each side of the roadway has a five foot wide paved shoulder painted with "sharrows" to indicate their use as an active bike lane. There is a five foot wide sidewalk on the northbound side of the roadway only. The roadway is under the jurisdiction of the Town of Plymouth.

Industrial Park Road

Industrial Park Road between Cherry Street and McAuliffe Way is a two lane roadway functionally classified as an urban collector and under the jurisdiction of the Town of Plymouth. The travel lane in each direction is 14 to 15 feet wide and paved shoulder widths vary between 4.5 and 5 feet wide. Only partial sections of the roadway have sidewalks.

McAuliffe Way

McAuliffe Way is a two-lane local roadway connecting Commerce Way to Industrial Park Road. Travel lanes are 14.8 to 14.0 feet wide in each direction, with 1.2 to 1.6 feet of shoulder width. With the exception of a small portion on the corner of its intersection with Commerce Way, there are no sidewalks or bicycle facilities on McAuliffe Way. The roadway is under the jurisdiction of the Town of Plymouth.

Route 44

Route 44 is a limited access highway between Commerce Way and Route 3. The highway features two travel lanes in each direction, with a wide breakdown lane on the right hand side and a narrow shoulder on the left hand side. The eastbound and westbound sides of Route 44 are separated by a 50 to 60 foot wide vegetated median. The highway and its ramps are under the jurisdiction of the Massachusetts Department of Transportation (MassDOT).

Intersections

Cherry Street & Commerce Way

The intersection of Cherry Street at Commerce Way is a three-way intersection controlled by an actuated traffic signal system. The geometric layout of the intersection is as follows:

- Commerce Way, Northbound: The northbound approach of Commerce Way includes two travel lanes: an exclusive left turn lane and an exclusive right turn lane. The right turn lane provides 125 feet of storage, however curb cuts for a business located on the corner interfere with the queuing for the intersection and as such reduces capacity.
- Cherry Street, Eastbound: The eastbound approach of Cherry Street features a single travel lane for shared through movements and right turns. A rather wide shoulder; however, does allow for some passing on the right and occasionally acts as a de facto right turn lane.
- Cherry Street, Westbound: The westbound approach of Cherry Street features two travel lanes: an exclusive through movement lane, and an exclusive left turn lane. The left turn lane provides 175 feet of storage space.

Crosswalks are located on the Commerce Way and the eastern Cherry Street leg on the intersection, and the traffic signal system includes a pedestrian crossing phase that can be activated by push call buttons. However, there are no sidewalks on Cherry Street for receiving pedestrians.

Cherry Street & Industrial Park Road/Columbus Road

The intersection of Cherry Street at Industrial Park Road and Columbus Road is a four-way intersection controlled by STOP signs on the Industrial Park Road and Columbus Road approaches. The geometric layout of the intersection is as follows:

- Cherry Street, Eastbound: The eastbound approach of Cherry Street features a single travel lane for shared through movements, right turns, and left turns.
- Cherry Street, Westbound: The westbound approach of Cherry Street features a single travel lane for shared through movements, right turns, and left turns.
- Industrial Park Road, Northbound: The northbound approach of Industrial Park Road features two travel lanes: a shared movement lane for through movements and left turns, and an

exclusive right turn lane. The right turn lane provides approximately 250 feet of storage. The approach is controlled by a STOP sign,

- Columbus Road, Southbound: The Columbus Road southbound approach is a single travel lane for shared through movements, right turns, and left turns. The approach is controlled by a STOP sign.

Both sides of Cherry Street have a sidewalk east of the intersection, while there are no sidewalks west of the intersection. Industrial Park Road has sidewalks on both sides near the intersection; however, these sidewalks discontinue to the south of the intersection. There is a crosswalk crossing Industrial Park Road at the intersection; however, it was very faded at the time of field observation.

Commerce Way & McAuliffe Way/Colony Place

The intersection of Commerce Way at McAuliffe Way and Colony Place is a four-way intersection controlled by an actuated traffic signal system. The geometric layout of the intersection is as follows:

- Commerce Way, Northbound: The northbound approach of Commerce Way includes three travel lanes: an exclusive left turn lane, an exclusive through movement lane, and a shared movement lane for through movements and right turns. The left turn lane provides approximately 350 feet of storage. The approach also includes a bike lane.
- Commerce Way, Southbound: The southbound approach of Commerce Way includes four travel lanes: an exclusive left turn lane, two exclusive through movement lanes, and an exclusive right turn lane that flares away from the intersection through a channelized island. The left turn lane provides approximately 350 feet of storage, while the right turn lane provides approximately 200 feet of storage. The approach also includes a bike lane.
- Colony Place, Eastbound: The eastbound approach of Colony Place features three travel lanes: two exclusive left turn lanes, and a shared movement lane for through movements and right turns.
- McAuliffe Way, Westbound: The westbound approach of McAuliffe Way features three travel lanes: an exclusive left turn lane, an exclusive through movement lane, and a channelized flared right turn lane. The left turn lane provides 75 feet of storage space.

The traffic signal system includes a pedestrian crossing phase that can be activated by pedestrians using push call buttons. Crosswalks are located on the McAuliffe Way and the northern leg of Commerce Way, as well as across the channelized right turn lanes on the northeast and northwest corners.

Commerce Way & Route 44 Eastbound Ramps

The intersection of Commerce Way at the Route 44 Eastbound ramps is a three-way intersection controlled by an actuated traffic signal system. The geometric layout of the intersection is as follows:

- Commerce Way, Northbound: The northbound approach of Commerce Way includes four travel lanes: two exclusive left turn lanes, and two exclusive through movement lanes. The left turn lanes each provide approximately 350 feet of storage. The approach also includes a bike lane.
- Commerce Way, Southbound: The southbound approach of Commerce Way includes three travel lanes: two exclusive through movement lanes, and an exclusive right turn lane that flares away from the intersection through a channelized island. The right turn lane provides approximately 250 feet of storage. The approach also includes a bike lane.
- Route 44 Eastbound Off-Ramp: The off-ramp approach of Route 44 Eastbound features two travel lanes: an exclusive left turn lane and an exclusive right turn lane. The approach is designed as such that each lane flares away from each other, channelized and separated by a raised island.

The intersection does not contain any pedestrian controls or crosswalks. There is a sidewalk on the western side of the intersection along Commerce Way northbound that does not interact with the intersection.

Commerce Way & Route 44 Westbound

The intersection of Commerce Way at the Route 44 Eastbound ramps is a three-way intersection controlled by an actuated traffic signal system. The geometric layout of the intersection is as follows:

- Commerce Way, Northbound: The northbound approach of Commerce Way includes two travel lanes: an exclusive left turn lane, and an exclusive through movement lane. The left turn lanes each provide approximately 675 feet of storage. The approach also includes a bike lane.
- Commerce Way, Southbound: The southbound approach of Commerce Way includes two travel lanes: an exclusive through movement lanes and an exclusive right turn lane that flares away from the intersection through a channelized island.
- Route 44 Westbound Off-Ramp: The off-ramp approach of Route 44 Westbound features two travel lanes: an exclusive left turn lane and an exclusive right turn lane. The approach is designed as such that each lane flares away from each other, channelized and separated by a raised island.

The intersection does not contain any pedestrian controls or crosswalks. There is a sidewalk on the western side of the intersection along Commerce Way northbound that does not interact with the intersection.

Industrial Park Road & McAuliffe Way/Resnik Road

The intersection of Industrial Park Road at McAuliffe Way and Resnik Road is a four-way un-signalized intersection controlled by an all-way STOP (STOP signs on all four approaches). All four approaches

feature single, shared movement lanes. The intersection does not include any crosswalks or bicycle features.

Figure 5 shows the Plymouth P&B Bus Terminal Intermodal Connector.

Figure 5: Plymouth P&B Bus Terminal Intermodal Connector (MA71B)

Traffic Volumes & Intersection Operations

Traffic Volumes

Old Colony Planning Council collected mainline roadway traffic counts (vehicle volumes, vehicle speeds, and vehicle classifications) on the Plymouth P&B Bus Terminal Intermodal Connector as well as on key intersecting streets. In addition, OCPC collected intersection turning movements during the morning and afternoon peak traffic periods at key intersections of the connector. These counts were conducted in order to determine existing demand as well as to enable future transportation improvements analyses.

Table 19 displays the results of the mainline roadway traffic data collection program for the Plymouth P&B Bus Terminal Intermodal Connector.

Table 19: Plymouth P&B Bus Terminal Intermodal Connector Traffic Data Summary

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
Cherry Street, east of Commerce Way	9,676	37 MPH	5.3%
Cherry Street, east of Industrial Park Road	8,372	40 MPH	3.6%
Columbus Road, north of Cherry Street	329	N/A	N/A
Industrial Park Road, north of McAuliffe Way	8,108	47 MPH	13.0%
Industrial Park Road, south of Cherry Street	8,696	N/A	N/A

Intersection Operations

Tables 20 and 21 show the Plymouth P&B Bus Terminal Intermodal Connector 2014 morning (AM) and afternoon (PM) peak period levels-of-service. The results of the level-of-service analyses are located in the Appendix.

Table 20: Plymouth P&B Bus Terminal Intermodal Connector Levels-of-Service (LOS)
Un-signalized Intersections

Location	AM LOS	PM LOS
Cherry Street & Industrial Park Road/Columbus Road		
Industrial Park Road NB LT/TH/RT	C	F
Columbus Road SB LT/TH/RT	C	C
Industrial Park Road & McAuliffe Way/Resnik Road (4-Way Stop)		
Overall Intersection Level of Service	E	F

Table 21: Plymouth P&B Bus Terminal Intermodal Connector Levels-of-Service (LOS)
Signalized Intersections

Location	AM LOS	PM LOS
Cherry Street & Commerce Way	B	B
Commerce Way & Route 44 EB On/Off Ramps	B	C
Commerce Way & Route 44 WB On/Off Ramps	B	B
Commerce Way & McAuliffe Way/Colony Place	C	D

Crashes

Table 22 shows the number of crashes and crash rates for the study area intersections based on the latest 3 years of crash data (2011-2013).

Table 22: Plymouth P&B Bus Terminal Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Cherry Street & Industrial Park Road/Columbus Road	8	2.67	0.57
Industrial Park Road & McAuliffe Way/Resnik Road	4	1.33	0.27
Signalized Intersections			
Cherry Street & Commerce Way	5	1.67	0.28
Commerce Way & Route 44 EB On/Off Ramps	8	2.67	0.21
Commerce Way & Route 44 WB On/Off Ramps	9	3.00	0.38
Commerce Way & McAuliffe Way/Colony Place	12	4.00	0.41

MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

The intersection of Commerce Way at the Route 44 Westbound ramps has a crash rate exceeding the Statewide Average and MassDOT District 5 average for signalized intersections. All other intersections in the study area have a below average crash rate.

Public Transportation

The Greater Attleboro Taunton Regional Transit Authority (GATRA) provides fixed route transit service along Industrial Park Road and to Colony Place, providing connections to the Kingston Commuter Rail Station and Plymouth Commuter Rail Station.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Items such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just like the presence of sidewalks make it more feasible for a pedestrian to walk to a destination rather than drive.

Pedestrian accessibility and mobility is poor throughout the study area, with a general lack of sidewalks. Where sidewalks do exist, they are generally short in length and discontinuous. Most of the roadways in the study area do provide some level of accommodation for bicyclists. Commerce Way includes striped bike lanes, while Industrial Park Road and Cherry Street include shoulders generally wide enough to comfortably accommodate most bicyclists. McAuliffe Way does not, however, have shoulders wide enough for accommodating bicyclists, forcing bicycle riders to share the general travel lane with motorists.

Traffic Signal Warrant Analyses

Based on local knowledge of existing traffic patterns and the results of the intersection operations and safety analyses, Old Colony Planning Council conducted a Traffic Signal Warrant Analysis for the intersection of Cherry Street at Industrial Park Road and Columbus Road. Conditions at the intersection satisfied the following 2009 MUTCD Warrants for Traffic Signals: Warrant 1 – Eight Hour Vehicular Volumes; Warrant, 2 – Four Hour Vehicular Volumes; Warrant 3 – Peak Hour; and Warrant 8 – Roadway Network.

Stoughton Commuter Rail Station (MA56T)

Connector Description

The Federal Highway Administration describes the Stoughton Commuter Rail Station Intermodal Connector (MA56T) as "Wyman Street to Perry Street to School Street to Route 27".

Roadways

Perry Street

Perry Street is a two lane local roadway under the jurisdiction of the Town of Stoughton, serving a densely developed residential neighborhood. The roadway is unstriped, with a total width of pavement of just under 26 feet. The roadway has a sidewalk on one side of the roadway for the entire length.

School Street

School Street is a two-lane roadway functionally classified as an urban collector and under the jurisdiction of the Town of Stoughton. The roadway features an 11.8 foot wide travel lane in the northbound direction and 13 foot wide travel lane in the southbound direction. The western (southbound) side of the roadway includes a 5 foot wide sidewalk. Paved, striped shoulder widths are less than 2 feet wide.

Wyman Street

Wyman Street is a two lane local roadway under the jurisdiction of the Town of Stoughton, serving a densely developed residential neighborhood. The roadway is unstriped, with a total width of pavement of approximately 24.2 feet. The roadway has a sidewalk on one side of the roadway for the entire length. There are not any striped shoulders or specific accommodations for bicyclists.

Intersections

Canton Street (Route 27) & School Street/School Avenue

The intersection of Canton Street (Route 27) at School Street / School Avenue is a four-way un-signalized intersection. School Avenue merges with School Street approximately 50 feet south of the intersection. The intersection is controlled by STOP signs on each of the School Street approaches. All legs of the intersection are single lane, shared movement approaches. The intersection has sidewalks on all approaches, and crosswalks are located on the southern leg of School Street and the eastern leg of Canton Street.

Perry Street & School Street

School Street at Perry Street is a four-way un-signalized intersection, with STOP sign controls on the Perry Street approaches. All approaches to the intersection are single, shared movement lanes. A crosswalk crosses the western leg of Perry Street, connecting a sidewalk on the southbound side of School Street.

Wyman Street & Morton Street/Summer Street

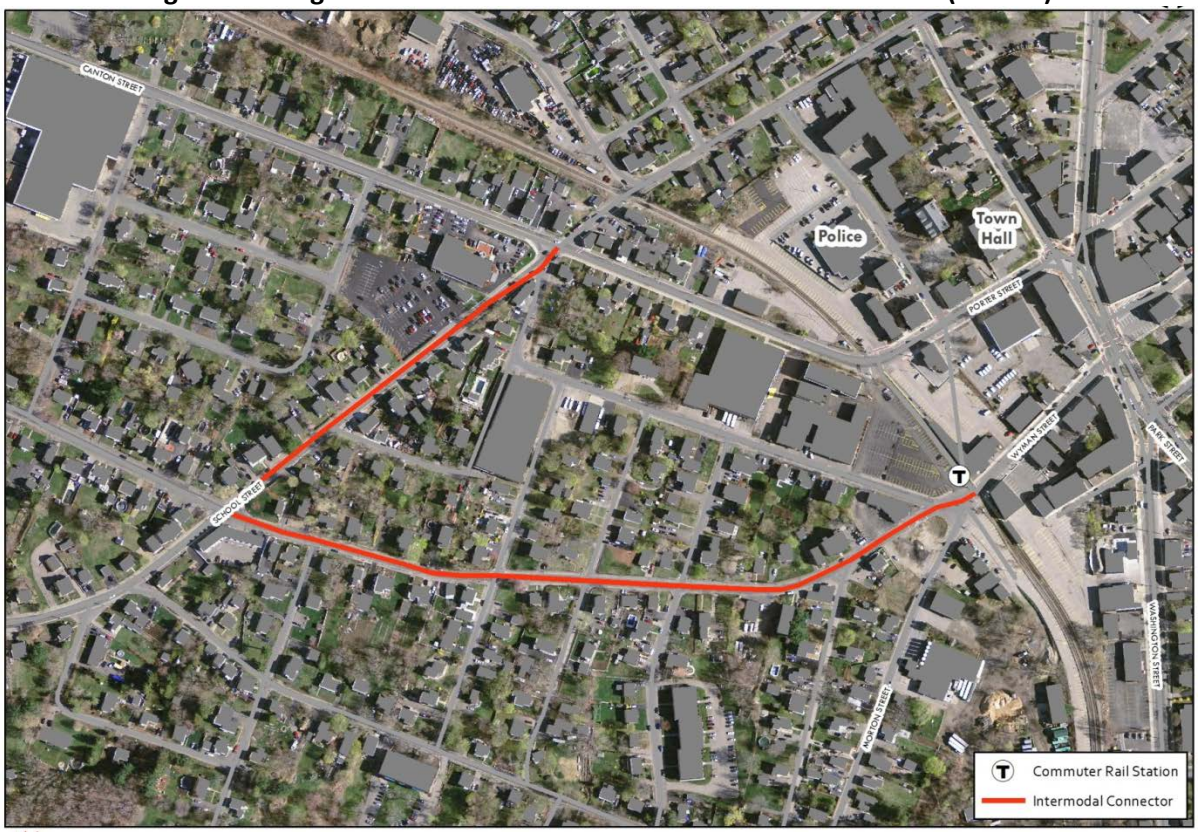
The intersection of Wyman Street at Morton Street and Summer Street is an unconventional un-signalized intersection. Wyman Street and Morton Street form a "Y" fork at the intersection, while Summer Street intersects Wyman Street from the east. Traffic controls are absent on both Wyman Street approaches, along with the Morton Street approach. Summer Street is controlled by a STOP sign. While not signed, the Wyman Street northeast-bound approach and the Morton Street northbound approach form an uncontrolled merge. All approaches to the intersection are single, shared movement lanes. A crosswalk is located on the northeastern leg of Wyman Street, connecting parking areas and the Stoughton Commuter Rail Station platform.

Wyman Street & Perry Street

Wyman Street at Perry Street is an unconventional, un-signalized "Y" style intersection that does not have any posted or striped traffic controls. Both roadways are narrow in the area of the intersection with 24 to 25 feet of pavement width on each. There are no street markings present to delineate lanes or the roadway edge. There are no crosswalks at the intersection.

Figure 6 shows the Stoughton Commuter Rail Station Intermodal Connector.

Figure 6: Stoughton Commuter Rail Station Intermodal Connector (MA56T)



Traffic Volumes & Intersection Operations

Traffic Volumes

Table 23 displays the results of the mainline roadway traffic data collection program for School Street in the Stoughton Commuter Rail Station Intermodal Connector study area. The current average daily traffic volume is estimated at 4,100 vehicles per day based on past data collection and an average annual regional growth rate of 1 percent.

Table 23: Stoughton Commuter Rail Station Intermodal Connector Traffic Data Summary

Location	Average Daily Traffic (ADT)	85th Percentile Speed	Heavy Vehicle Percentage
School Street, south of Canton Street (Route 27)	~4,100	38 MPH	2.6%

Intersection Operations

Table 24 shows the Stoughton Commuter Rail Station Intermodal Connector 2014 morning (AM) and afternoon (PM) peak period levels-of-service. The results of the level-of-service analyses are located in the Appendix.

Table 24: Stoughton Commuter Rail Station Intermodal Connector Levels-of-Service (LOS)

Un-signalized Intersections

Location	AM LOS	PM LOS
Canton Street (Route 27) & School Street/School Avenue		
School Street Northbound	F	F
School Street Southbound	F	F
Perry Street & School Street		
Perry Street Eastbound	B	B
Perry Street Westbound	B	B
Wyman Street & Morton Street/Summer Street		
Summer Street Eastbound	A	A
Wyman Street & Perry Street		
No Stop Controlled Approaches; LOS Not Applicable		

The intersection of Canton Street (Route 27) at School Street and School Avenue processes a large volume of traffic during the peak demand hours and has corresponding poor levels of service on the STOP sign controlled approaches. All other intersections process relatively light traffic volumes and have good levels of service.

Crashes

Table 25 shows the number of crashes and crash rates for the study area intersections based on the latest 3 years of crash data (2011-2013).

Table 25: Stoughton Commuter Rail Station Intermodal Connector Crash Summary (2011-2013)

Intersection	Number of Crashes	Average Per Year	Crash Rate
Un-signalized Intersections			
Canton Street (Route 27) & School Street/School Avenue	47	15.67	3.20
Perry Street & School Street	11	3.67	2.10
Wyman Street & Morton Street/Summer Street	4	1.33	1.32
Wyman Street & Perry Street	0	0	0

MassDOT Statewide and District 5 Average Crash Rate for Un-signalized Intersections: 0.60 / 0.58
MassDOT Statewide and District 5 Average Crash Rate for Signalized Intersections: 0.80 / 0.77

The intersection of Canton Street (Route 27) has a very high crash rate and is among the Top 5% of intersection crash clusters in the region. The crash rate for the intersection of School Street at Perry Street is also substantially above the regional and state averages for un-signalized intersections.

Public Transportation

The Stoughton Commuter Rail Station is an intermodal facility providing 333 parking spaces for commuters, pedestrian connections to Stoughton Square and the surrounding roadway network, and connections to local bus service via Brockton Area Transit (BAT) as well. Brockton Area Transit

provides fixed route bus service to Cobbs Corner and Downtown Brockton via Route 14. The commuter rail station is served by 16 inbound and 16 outbound trains on weekdays; The Stoughton station does not currently have weekend train service.

Railroad Crossings

There are two active at-grade railroad crossings in the Stoughton Commuter Rail Station NHS Intermodal Connector study area. The at-grade crossings are located on School Street approximately 200 feet northeast of the intersection of Canton Street at School Street, and on Wyman Street immediately adjacent to the intersection of Wyman Street at Summer Street and Morton Street. Currently, 32 trains per weekday (16 inbound, 16 outbound) cross at these crossings. The crossings are equipped with gates (including sidewalk gate), lights, and bells that are activated in advance of approaching trains.

Bicycle and Pedestrian Accommodations

Bicycle and pedestrian accommodations are essential to providing a multi-modal transportation system. Items such as bike lanes or sharrows increase the potential for bicyclists to use a particular roadway just like the presence of sidewalks make it more feasible for a pedestrian to walk to a destination rather than drive.

The area is generally well served with sidewalks on at least one side of the entire lengths of School Street, Wyman Street, and Perry Street in the Study area. The area does not include any bicycle lanes or bicycle accommodating shoulders. Traffic volumes are light enough on Wyman Street and Perry Street that most bicyclists would likely be comfortable sharing the travel lanes with motorists. Cyclists must contend with higher volumes and travel speeds on School Street.

Traffic Signal Warrant Analyses

Based on local knowledge of existing traffic patterns and the results of the intersection operations and safety analyses, Old Colony Planning Council conducted Traffic Signal Warrant Analysis for the intersection of Canton Street (Route 27) at School Street and School Avenue. Conditions at the intersection satisfy the following warrants for traffic signals from the 2009 edition of the MUTCD: Warrant 1 – Eight Hour Vehicular Volumes; Warrant 2 – Four Hour Vehicular Volumes; and Warrant 8 – Roadway Network.

Conclusions and Recommendations

Bicycle Mobility and Safety

Infrastructure for bicyclists can be substantially improved at all the NHS Intermodal Connectors analyzed in this transportation study. Accommodating bicyclists with infrastructure such as specific bike lanes or minimum 4-foot wide striped paved shoulders is essential to not only providing a safe environment for bicyclists but also for mode shift strategies aimed at reducing dependence on automobiles and increasing the use of active transportation and transit. The following strategies should be considered at all of the NHS Intermodal Connectors:

- **Bike Lanes or Minimum 4-Foot Wide Shoulders**: The inclusion of bicycle lanes or, when a bicycle lane is not feasible, a minimum 4-foot wide shoulder on each side of the roadway should be considered on all arterials and collector roadways serving the intermodal connectors. Road diets (narrowing travel lanes) may be considered in order to accommodate bike lanes or shoulders.
- **Shared Lane Markings (or "Sharrows")**: On connecting roadways between the federal-aid eligible roadway network and the transit facilities, or on when bike lanes or adequately wide shoulders are not feasible on the arterials and collectors, the use of Shared Lane Markings or "Sharrows" should be considered to alert drivers that bicyclists are also actively using the travel lanes.
- **Enhanced Signage**: MUTCD compliant "Share the Road" and similar signage should be considered on all roadways connecting to NHS Intermodal Connectors.
- **Complete Streets Policies**: The communities of Bridgewater, Brockton, and Kingston should consider adopting Complete Streets policies (Plymouth and Stoughton have adopted Complete Street policies as of January 2016).
- **Secured Bike Parking**; Providing secured bicycle parking at all transit facilities can aid in achieving mode shift goals by reducing the worry and anxiety of potential bicycle riders leaving their bicycles at a station before boarding a train or bus.

Bridgewater Commuter Rail Station (MA78T)

Broad Street (Route 18) at Main Street (Route 28) and Summer Street (Route 104)

The intersection of Broad Street (Route 18) at Main Street (Route 28) and Summer Street (Route 104), forming the northern end of the oblong traffic circle in Central Square, has a high crash rate and experiences significant delays, particularly during the peak demand hours. The intersection is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the continued study of Central Square, including this intersection, to identify both short-term and long-term strategies to improve safety while also addressing capacity and efficiency. Particular focus should be given to pedestrian and bicycle safety and mobility.

Plymouth Street (Route 104) at Hooper Street

While Hopper Street serves as a secondary entrance to and egress from the Bridgewater Commuter Rail station, it also is a major access point for the east side of the Bridgewater State University campus. As such, Hooper Street experiences heavy existing volumes from a combination of college students and commuters during the afternoon and evening hours, resulting in significant delays. Police details are often used during peak hours to direct traffic.

Recommendation: The reconstruction of the intersection, including full signalization, should be considered as a treatment option to alleviate congestion and provide better access to the Commuter Rail station and college campus.

Plymouth Street (Route 104) at Great Hill Drive / Hayward Street

Great Hill Drive serves as the primary entrance to and egress from the Bridgewater Commuter Rail station, and also as an access point for the east campus of Bridgewater State University. As such, Great Hill Drive experiences heavy existing volumes from a combination of college students and commuters during the afternoon and evening hours, resulting in significant delays.

Recommendation: The reconstruction of the intersection with either traffic signals or a roundabout should be considered as a treatment option to alleviate congestion and provide better access to the Commuter Rail station and college campus.

Great Hill Drive Pedestrian and Bicycle Access

Great Hill Drive does not currently have any sidewalks, nor does it include any bicycle lanes or bicycle accommodating shoulders within its layout. Sidewalks should be constructed along the roadway to provide access for pedestrians to the Commuter Rail station. Similarly, the roadway should be painted to include shared-lane markings ("sharrows") accompanied with appropriate signage to improve safety for bicyclists along this connecting roadway.

Brockton Area Transit (BAT) Bus Terminal (MA73B)

Centre Street (Route 123) at Plymouth Street

The intersection of Centre Street (Route 123) at Plymouth Street has a high crash rate and experiences significant delays, particularly during the peak demand hours. The intersection is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes, and is also on the MassDOT list of the Top 200 Most Hazardous Intersections in the state.

Recommendation: The intersection of Centre Street (Route 123) at Plymouth Street should be reconstructed and signalized with fully actuated traffic signals. The installation of traffic signals will not only improve capacity and efficiency at the intersection, but should also improve safety for pedestrians as well.

Centre Street (Route 123) at Commercial Street

The intersection of Centre Street (Route 123) at Commercial Street has a high crash rate and experiences moderate to occasional significant delay, particularly during the morning peak demand hour. The intersection is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures, which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying deficiencies at this location as well as potential improvements.

Commercial Street Pedestrian Safety

The entire section of Commercial Street within the Study area, including its intersections with Centre Street (Route 123) and Court Street, lay within an identified MassDOT Pedestrian Crash Cluster (an area where pedestrian involved crashes are occurring at an elevated frequency). The BAT Intermodal Centre and the Brockton Commuter Rail Station are major pedestrian trip generators connecting government, workplaces, and dense residential development in the downtown area with transit. The mid-block crosswalk in front of the BAT Intermodal Center is a particularly concentrated area of pedestrian crossings.

Recommendation: Enhance the mid-block crossing on Commercial Street (in front of the BAT Intermodal Center and Brockton Police station) with improved signage and the addition of Rectangular Rapid Flash Beacons (RRFB) to improve safety for pedestrians crossing at this busy crossing point. Efforts should also be made to address pedestrian safety at the intersections of Centre Street (Route 123) at Commercial Street; Court Street at Commercial Street; and on Centre Street north of Commercial Street as well.

Campello Commuter Rail Station (MA79T)

Downtown Area Pedestrian Crash Cluster

A portion of Montello Street (Route 28) in the study area is within a MassDOT Pedestrian Crash Cluster, an area that has been identified as having a higher than average concentration of pedestrian related crashes. The crash cluster is centered along Montello Street in the downtown area, and includes the intersections of Montello Street at Centre Street and Montello Street at School Street. The downtown area is primarily characterized by commercial development and government uses; however there is also some high density residential development in the area as well. The nearby

Brockton commuter rail station and BAT Intermodal Centre are major pedestrian trip generators for residents in the area.

Recommendation: Efforts should be made to address pedestrian safety and mobility in the study area. A walking audit may be beneficial to the city and planners on identifying any existing deficiencies and proposing potential improvements for safety in the area.

Montello Street (Route 28) at Centre Street (Route 123)

The intersection of Montello Street (Route 28) at Centre Street (Route 28) has a high crash rate and is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures that may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Montello Street (Route 28) ay Crescent Street (Route 27)

The intersection of Montello Street (Route 123) at Crescent Street (Route 27) has a high crash rate and experiences substantial delays with level-of-service ratings of "F" for both the morning and afternoon peak demand hours. The intersection is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures that may be implemented to improve both safety and capacity for all modes at this congested intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Montello Street (Route 28) at Lawrence Street

The intersection of Montello Street (Route 28) at Lawrence Street has a high crash rate and is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures that may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Montello Street (Route 28) at Grove Street

The intersection of Montello Street (Route 28) at Grove Street has a high crash rate and is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Montello Street (Route 28) at East Nilsson Street

The intersection of Montello Street (Route 28) at East Nilsson Street has a high crash rate and is among the top 5 percent of intersections (a Top 5% Crash Cluster) in the region for high frequency of crashes. This un-signalized intersection also experiences moderate to occasionally significant delay on the East Nilsson Street STOP sign controlled approaches. The afternoon peak hour level of service is rated as "F".

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Montello Street (Route 28) at Perkins Avenue

The intersection of Montello Street (Route 28) at Perkins Avenue has a high crash rate of 1.17/MEV, about 52 percent above the MassDOT District 5 regional average crash rate of 0.77/MEV for signalized intersections.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Campello Area Pedestrian Crash Cluster

The Campello commuter rail station and the adjoining neighborhood and business district on the west side of the station are within a MassDOT Pedestrian Crash Cluster, an area what has been identified as having a higher than average concentration of pedestrian related crashes. The crash cluster is centered on Main Street, and includes Plain Street and Montello Street. The area is defined by a mix of businesses and dense residential development, with relatively high traffic volumes and turning movements throughout the area. The businesses and the Campello commuter rail station are major pedestrian trip generators for residents in the area, including a high-rise residential complex just to the south and west of the study area.

Recommendation: Efforts should be made to address pedestrian safety and mobility in the study area. A walking audit may be beneficial to the city and planners on identifying any existing deficiencies and proposing potential improvements for safety in the area.

Kingston Commuter Rail Station (MA81T)

The roadway network and associated intersections serving the Kingston Commuter Rail Station are operating efficiently and safely with only moderate delay observed at the signalized intersections and low crash rates based on reported data. However, the area lacks pedestrian and bicycle infrastructure.

Recommendation: Support the further study to identify measures to improve pedestrian and bicycle mobility and safety on the network serving the Kingston Commuter Rail Station. Specifically, the feasibility of a pedestrian connection between the commuter rail station and the Kingston Collection mall should be explored, as these are the two largest trip generators in the area.

Plymouth P&B Bus Terminal (MA71B)

The roadway network and associated intersections serving the Plymouth P&B Bus Terminal are operating efficiently and safely although occasionally moderate delays occur during the afternoon peak hour . However, Industrial Park Road and McAuliffe Way lacks complete pedestrian and bicycle connectivity

Recommendation: The construction of a complete sidewalk network on Industrial Park Road and McAuliffe Way should be considered in an effort to promote non-motorized travel options in an effort to achieve local and regional mode shift goals. The Plymouth Industrial Park is home to several large employers, while Colony Place offers services such as eateries and retail establishments. There appears to be opportunity for promoting pedestrian trips between the two prominent land uses in the area given adequate infrastructure.

Stoughton Commuter Rail Station (MA56T)

Intersection of Canton Street (Route 27) at School Street and School Avenue

This intersection experience excessive delays on the side-street approaches during both the morning and afternoon peak demand hours, and has an extraordinarily high crash rate, and is a Top 5% MassDOT intersection crash cluster location.

Recommendation: Consistent with other studies and road safety audits prepared for this intersection, the full reconstruction of this intersection with the inclusion of traffic signals is recommended to improve boh safety and capacity at this location.

Intersection of School Street at Perry Street

The intersection of School Street at Perry Street has a very high crash rate of 2.10/MEV, about 262 percent above the MassDOT District 5 regional average crash rate of 0.58/MEV for un-signalized intersections.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.

Intersection of Wyman Street at Morton Street and Summer Street

The intersection of Wyman Street at Morton Street and Summer Street has a high crash rate of 1.32/MEV, about 127 percent above the MassDOT District 5 regional average crash rate of 0.58/MEV for un-signalized intersections.

Recommendation: Support the further study of this intersection and the identification of both short-term and long-term measures which may be implemented to improve safety for all modes at this intersection. A road safety audit may be beneficial in identifying both any deficiencies at this location as well as potential improvements.