TRANSPORTATION IMPACT AND ACCESS STUDY

PROPOSED CENTECH PARK NORTH, SUB-DISTRICT A

South Street
Shrewsbury, Massachusetts

Prepared for:

Bohler Engineering, P.C.

April 2019

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

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Prepared for:
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April 2019

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared this initial Transportation Impact and Access Study (TIAS) for proposed commercial development of the Centech Park North property along Route 20 and South Street in Shrewsbury, Massachusetts. The focus of the TIAS is the northerly portion of property referred to as Sub-District A which is the subject of near-term local permitting; subsequent evaluation of master plan buildout of the property to include the southerly portion of the property referred to as Sub-District B will be conducted under a separate filing under the Massachusetts Environmental Policy Act (MEPA). This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates development-related trip generation and operational impacts and identifies recommended and proposed mitigation actions to support the Sub-District A development component.

This TIAS has been developed in conformance with guidelines for preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

E.1 PROJECT DESCRIPTION

The Site comprises approximately 66.5± acres bounded by Route 20 to the south and South Street to the east in Shrewsbury, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. The property is home to a home and shed, a paved parking area and undeveloped land. Site access/egress includes two full access/egress driveways along South Street.

Under the proposed Sub-District A development program, the Site will be redeveloped to include 275,000± sf of total development off of South Street; 110,000± sf of general office space and 165,000± sf of industrial park space. On-site parking will include 694± surface parking spaces. Site access/egress is proposed via a single cul-de-sac roadway along South Street.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the development within the Town of Shrewsbury. The study area includes the following intersections:

- Route 9 (Boston Turnpike) at South Street (Signalized)
- Route 20 (Hartford Turnpike) at South Street/Green Street (Signalized)
- Route 20 (Hartford Turnpike) at Centech Boulevard/Cherry Street (Signalized)
- South Street at Charles River Labs/Umass Campus Access Road (Unsignalized)
- Proposed Site Driveway at South Street (Unsignalized)

E.3 SUMMARY OF ANALYSIS AND FINDINGS

Capacity analyses were conducted for each study area intersection to quantify existing and future year traffic operations with and without the development for the weekday morning and weekday evening peak hours. These time periods represent the highest activity periods of the proposed project and the adjacent roadway system.

The analyses presented in this TIAS are based on industry-standard trip rates published by the Institute of Transportation Engineers (ITE). The proposed development is estimated to generate approximately 194 vehicle trips during the weekday morning peak hour (163 entering and 31 exiting) and 193 vehicle trips during the weekday evening peak hour (34 entering and 159 exiting). On a daily basis, the development is estimated to generate approximately 1,628 vehicle trips on a weekday.

Under Build conditions, capacity analyses indicate that the Site Driveway approach to South Street will operate under capacity at LOS B or better during the weekday morning and weekday evening peak hours. Mainline (through) travel along South Street will continue to operate unimpeded with minimal delay. The analysis indicates that certain physical improvements at the Route 20 intersection with South Street may be necessary to support the development to support the Sub-District A portion of Centech North development. Operations at the remaining study locations are sufficient to support Sub-District A development; additional physical modifications are not required but will be subject to further evaluation under the anticipated MEPA filing that includes Sub-District B programming. Improvements as outlined in the *Conclusions and Recommendations* section of this report will enhance safety and operations with regards to the development and are consistent with long-range improvements along Route 20 that are being evaluated by MassDOT as part of a long-range corridor improvement strategy.

E.4 RECOMMENDATIONS

MDM has identified several mitigation actions that are likely to be required through the local and MassDOT permitting process to support the project. These include (a) access-related improvements, (b) off-site improvements (c) pedestrian and bicycle accommodations, and (d) a transportation demand management (TDM) program to enhance traffic operations and travel safety.

Access/Egress Improvements

- *Driveway Design*. The final driveway width and curb radii between the site driveway and South Street will be designed to accommodate the Town's largest fire apparatus (ladder truck) and service vehicles. Signs and pavement markings that comply with the Manual on Uniform Traffic Control Devices (MUTCD) will also be provided including STOP signs (R1-1) and STOP line pavement markings.

- *Sight Line Triangles.* Plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway intersection with South Street to ensure unobstructed sight lines are available.

Off-Site Improvements

- *Road Safety Audit*. The Route 9 signalized intersection with South Street experienced a crash rate above the MassDOT District 3 averages and is listed by MassDOT as a highway safety improvement program (HSIP) high crash cluster for 2013-2015. The Proponent commits to preparation of a Road Safety Audit (RSA) to identify potential short-, medium- and long-term safety/operational improvements at this location and will commit to implementation of identified short-term recommendations.

  Typical short-range improvements are limited to lower cost, easily implementable measures such as pavement restriping, supplemental or revised/updated signs, advance motorist warning controls, limited pavement and/or sidewalk repair, etc. Longer-term structural improvements are typically identified by assumed to be the responsibility of MassDOT or others and subject to State and/or Federal funding.

- *Route 20 at South Street Improvements/Optimization*. The Proponent will work with MassDOT to permit and implement geometric and signal modifications at the Route 20/South Street intersection to accommodate site trips and improve travel safety at the intersection. Geometric improvements include widening the southbound South Street approach to provide a shared through/left-turn lane and an exclusive right-turn lane. Under this improvement plan, traffic signal timing will be optimized to provide efficient traffic signal operations to accommodate project traffic increases. Improvements will be designed for compatibility with anticipated long-range improvements identified as part of the MassDOT Route 20 Corridor Improvement Study.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections*. The Site Plan will incorporate sidewalks that connect the proposed building entrances with parking areas and sidewalks along the driveway that connect to the existing sidewalk system along South Street. The Proponent also recognizes the need for extending existing sidewalks along South Street from their current terminal points to Route 9 and Route 20; however, the feasibility of constructing these sidewalk extensions is subject to further evaluation by the Proponent to determine potential land acquisition/easement requirements.

- *Crosswalks & ADA Compliant Ramps.* Marked crosswalks and ADA compliant ramps will be provided at the proposed driveway intersection with South Street and at any internal site driveway crossings.

- *Bicycle Amenities*. The Proponent will incorporate bicycle racks within the property near building entrances and the site driveway will be designed for bicycle accommodation to encourage and facilitate this mode of transportation to/from the Site. Additional means of bicycle accommodation on area roadway including appropriate roadway markings and signs will also be considered within the larger context of the future roadway improvements along the Route 20 corridor that are being considered by MassDOT.

Transportation Demand Management (TDM) Program

The Proponent is committed to reduce Site trip generation by tenant employees by implementing a TDM program, elements of which will be memorialized in a Tenant Manual and/or will be made a provision of a master deed. These elements are consistent with the Massachusetts Department of Environmental Protection (MADEP) directive to use all reasonable and feasible mitigation actions to reduce auto emissions. The TDM program includes the following elements, which are subject to selected tenant corporate policies:

- *Employee Transportation Coordinator*. The Proponent will designate a contact that will serve as transportation coordinator responsible for disseminating relevant TDM information to tenants including documentation of TDM information as part of a Tenant Manual at time of lease and/or as subject to a Master Deed for the property.

- *Public Transportation Information & Promotion*. Service and schedule information for the Worcester Regional Transit Authority (WRTA) and MBTA will be posted and public transportation subsidy program considered to promote the use of public transportation by employees and visitors. Alternative means of connecting the Site to the nearby MBTA station at Centech Boulevard (Grafton MBTA station) will also be evaluated by the Proponent such as modification of WRTA bus routes, rideshare services such as Uber and Lyft, bike share services, tenant employee carpool options, and rideshare matching services with other nearby employers along South Street that include UMass and Charles River Laboratories.

- *Bicycle Facilities and Amenities*. Bicycle parking, including visible accessible racks for visitors and employees will be provided proximate to building entrances. The Proponent will also consider a bike share service for the property that will provide tenant employees access to bicycles for access to nearby transit options, recreational purposes during break periods and alternative means of travel to area destinations.

- *Alternative Work Arrangements*. The Proponent will encourage its tenants to provide alternative work arrangements such as flextime, compressed workweek and telecommuting in order to allow employees to balance work and personal commitments, and to reduce traffic and parking demands.

- *Preferential Parking for Carpools, Vanpools and Car Sharing.* Preferential parking locations for building tenant employees who use carpools and vanpools are to be provided; specific locations and number are to be determined through refinement of the Site Plans for the project.

- *Preferential Parking for Low-Emission Vehicles.* Preferential parking locations for employees and patrons who use low-emission vehicles will be considered; charging stations for electric vehicles will also be considered during the Site Plan development process.

- *Transit Pass Subsidy.* The Proponent will encourage its tenants to offer fare subsidies for commuter rail passes for eligible employees and/or offer pre-tax payroll deductions for employee transit passes.

- *Transit System Connections.* Alternative means of connecting the Site to the nearby MBTA station at Centech Boulevard (Grafton MBTA station) will also be evaluated by the Proponent such as modification of WRTA bus routes, rideshare services such as Uber and Lyft, bike share services, tenant employee carpool options, and rideshare matching services with other nearby employers along South Street that include UMass and Charles River Laboratories.

- *MassRides*. MassRides is the Executive Office of Transportation's statewide travel options program providing free assistance to commuters, employers, students, and other traveler markets. MassRides programs may encourage workers to use alternative forms of transportation such as carpooling, vanpooling, and to utilize a large database for rideshare matching. The Proponent will promote commuter assistance programs available through MassRides by encouraging building tenants to incorporate information on MassRides as part of the employee orientation programs.

- *Guaranteed Ride Home*. The Proponent will encourage commercial tenants to offer a guaranteed ride home program that subsidizes taxi service for employees using non-auto commute options in cases of unexpected circumstances.

- *Pedestrian Infrastructure*. Sidewalk connections within the property along primary pedestrian desire lines that connect building entrances with the public sidewalk network; posting of area maps that highlight area walking/bicycle routes to promote walking and bicycle travel to/from the Site and area businesses. The Proponent also recognizes the need for extending existing sidewalks along South Street from their current terminal points to Route 9 and Route 20; however, the feasibility of constructing these sidewalk extensions is subject to further evaluation by the Proponent to determine potential land acquisition/easement requirements.

- *On-Site Support Services/Amenities*. Buildings will include services and amenities that encourage employees to remain on-site for essential services and internalize trip making to the campus including on-site mailboxes and an on-site Fed-Ex and/or UPS drop box locations. Other amenities to be considered in building programming may include an employee fitness center, showers, and cafeteria for employees – measures aimed at reducing the need to conduct off-site trips during a typical workday. Specific measures are to be evaluated in more detail during the Site Plan review process.

E.5 CONCLUSIONS

In summary, MDM finds that incremental traffic associated with the proposed Centech North Sub-District A development is expected to be modest at study intersections and will be accommodated within available capacities following implementation of access/egress improvements and off-site improvements at Route 20/South Street. Additional improvements including pedestrian and bicycle accommodations and a Transportation Demand Management (TDM) program as outlined in this study will establish a framework of accommodating Site traffic impacts and encouraging non-motorized travel modes and pedestrian/bicycle accommodation. Refinement and expansion of these mitigative actions is anticipated under a subsequent MEPA filing that will consider the master plan buildout of the property to include the Sub-District B portion of the site, and that will be memorialized as part of a MassDOT Section 61 Finding following completion of the MEPA review process.

1.0 INTRODUCTION

MDM Transportation Consultants, Inc. (MDM) has prepared this initial Transportation Impact and Access Study (TIAS) for proposed commercial development of the Centech Park North property along Route 20 and South Street in Shrewsbury, Massachusetts. The focus of the TIAS is the northerly portion of property referred to as Sub-District A which is the subject of near-term local permitting; subsequent evaluation of master plan buildout of the property to include the southerly portion of the property referred to as Sub-District B will be conducted under a separate filing under the Massachusetts Environmental Policy Act (MEPA). This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates development-related trip generation and operational impacts and identifies recommended and proposed mitigation actions to support the Sub-District A development component.

This TIAS has been developed in conformance with guidelines for preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

1.1 PROPOSED DEVELOPMENT

The Site comprises approximately 66.5± acres bounded by Route 20 to the south and South Street to the east in Shrewsbury, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. The property is home to a home and shed, a paved parking area and undeveloped land. Site access/egress includes two full access/egress driveways along South Street.

Under the proposed Sub-District A development program, the Site will be redeveloped to include 275,000± sf of total development off of South Street; 110,000± sf of general office space and 165,000± sf of industrial park space. On-site parking will include 694± surface parking spaces. Site access/egress is proposed via a single cul-de-sac roadway along South Street. The preliminary Site layout plan prepared by Bohler Engineering, P.C. is presented in **Figure 2**.

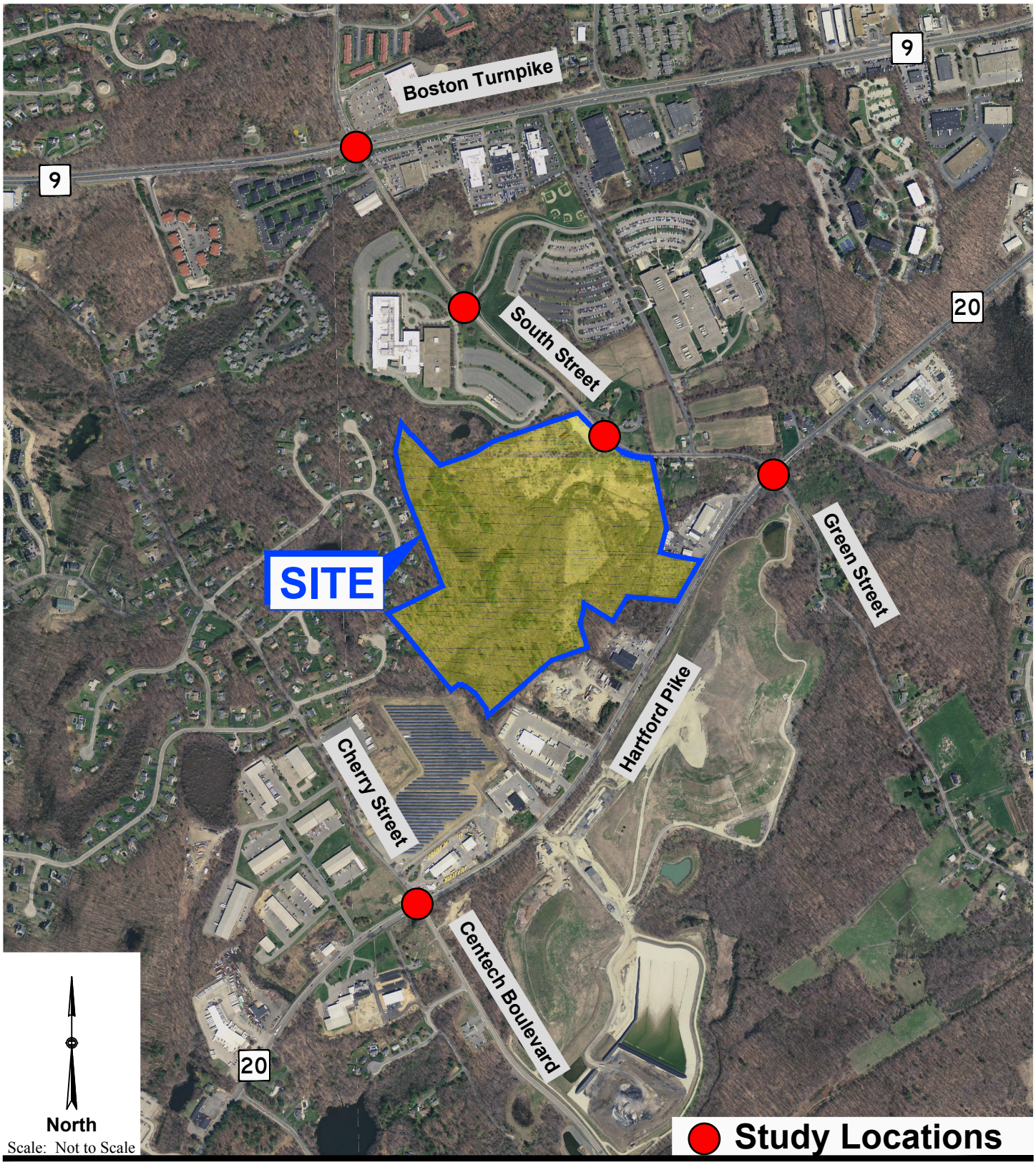

Figure 1

Site Location

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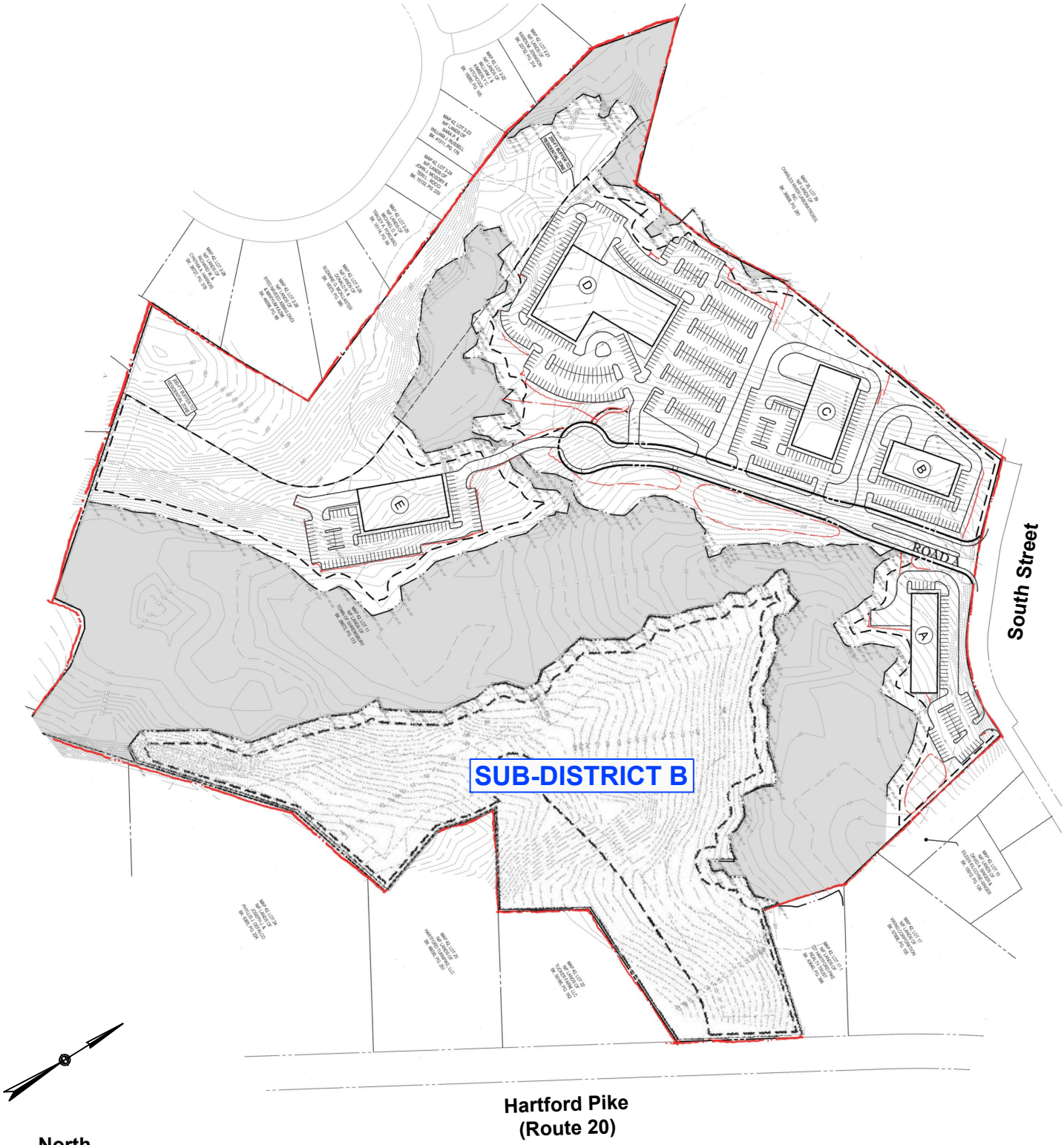

Scale: Not to Scale

Site Plan Source: Bohler Engineering

Figure 2

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Preliminary Site Plan

Date: March 2019
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1.2 STUDY METHODOLOGY

This transportation impact and access evaluation was conducted in accordance with EEA/MassDOT guidelines, and consists of several steps. The first step documents existing conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of the primary study intersections. Specific attention is given to the incremental impacts of the proposed development. Finally, off-site improvements are identified to address specific development-related access needs as required.

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site, and that are likely to sustain a measurable level of traffic impact from the development within the Town of Shrewsbury. The study area includes the following intersections as shown in **Figure 1**:

- Route 9 (Boston Turnpike) at South Street (Signalized)
- Route 20 (Hartford Turnpike) at South Street/Green Street (Signalized)
- Route 20 (Hartford Turnpike) at Centech Boulevard/Cherry Street (Signalized)
- South Street at Charles River Labs/Umass Campus Access Road (Unsignalized)
- Proposed Site Driveway at South Street (Unsignalized)

2.0 EXISTING CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, the existing roadway system and the existing traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersections within the study area. Specifically, this section presents an overview of the traffic data collection program, existing traffic volumes and safety data.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersections are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under State (MassDOT) and local (Town) jurisdiction.

2.1.1 ROADWAYS

South Street

South Street is classified by the MassDOT as an Urban Collector roadway under Town jurisdiction. South Street is generally a north-south roadway that connects Route 9 with Route 20 to the south and with Main Street to the north. South Street generally provides one lane of travel in each direction separated by a double yellow centerline. Posted advisory speed limits of 30 mph are located along the roadway in the study area. Land use along South Street consists of residential uses including Ashford Crossing and Maplewood Condominiums and commercial uses including a CVS Pharmacy with drive-through, University of Massachusetts office and R&D space, Charles River Laboratories, and a small professional office building.

Boston Worcester Turnpike (Route 9)

Route 9 is classified by the Massachusetts Executive Office of Transportation (EOT) as an Urban Other Principal Arterial roadway under MassDOT (State) jurisdiction. This roadway generally runs in an east-west direction and provides a connection among various towns and major highways along the central portion of Massachusetts. On a local basis, Route 9 is also known as Boston Worcester Turnpike and provides a connection between the Route 20 interchange located at the Northborough town line to the east and the Worcester city line at Lake Quinsigamond to the west. Within the study area, Route 9 is generally straight with rolling terrain. The roadway provides two lanes of travel in each direction, separated by a Jersey barrier median, with additional turn lanes at its major intersections. The posted speed limit along Boston Worcester Turnpike (Route 9) is 45 mph in the study area. Land use along Route 9 in the study area is primarily commercial in nature but also includes residential uses including Ashford Crossing and The Commons at Haynes Farm.

Hartford Turnpike (Route 20)

Route 20 is classified as an Urban Principal Arterial roadway by the Massachusetts Department Transportation (MassDOT) and generally runs in an east-west direction. Within in the study area, Route 20 is under MassDOT (State) jurisdiction and connects the Town of Shrewsbury with the Town of Northborough and the City of Worcester. Locally, Route 20 provides a connection between Route 9 and Route 140. Throughout the study area, Route 20 provides one to two lanes of travel in both travel directions with additional lanes provided at major intersections. Sidewalks are not provided along Route 20 within the study area. Land use along Route 20 in the study area includes a mix of land uses including retail, office, private transportation companies, and industrial buildings. The posted speed limit along Route 20 in the site vicinity is 50 mph in both directions.

Centech Boulevard

Centech Boulevard is classified as a local roadway under local (Town) jurisdiction according to the MassDOT. Centech Boulevard runs in a north-south direction providing a connection between Route 30 to the south (as Pine Street in the Town of Grafton) and Route 20 to the north. Centech Boulevard provides one wide travel lane in each direction with additional turn lanes at its intersections with Route 20 and Route 30. A sidewalk is provided along the western side of Centech Boulevard from Pine Street to approximately 100 feet south of Route 20. Land use along Centech Boulevard includes primarily vacant/undeveloped or developed industrial/ commercial properties. A fire station operated by the Shrewsbury Fire Department and property under the control of Wheelabrator Shrewsbury is also located along Centech Boulevard just south of Route 20. A Shell brand gasoline station with convenience market and drive-through Honey Dew is located on the corner of Centech Boulevard and Route 20.

Cherry Street

Cherry Street is classified as local roadway under Town jurisdiction according to the MassDOT. Cherry Street generally runs in a north-south direction connecting Route 9 (eastbound travel direction only) to the north with Route 20 to the south. Cherry Street provides one travel lane in each direction with an additional turn lane at the intersection with Route 20. Land use along Cherry Street is primarily residential with several commercial and industrial uses near the intersection with Route 20. Cherry Street continues south of Route 20, but is not continuous with Cherry Street to the north of Route 20 due to the construction of Centech Boulevard. South of Route 20, Cherry Street is a cul-de-sac roadway providing access to Centech Boulevard for several single family residential homes.

Green Street

Green Street is classified as local roadway under Town jurisdiction according to the MassDOT. Green Street generally runs in a north-south direction connecting Route 20 to the north with Centech Boulevard to the south. Green Street provides one travel lane in each direction. Land use along Green Street is primarily single family residential homes but also provides access to Grafton Job Corps near its intersection with Centech Boulevard.

2.1.2 INTERSECTIONS

Boston Worcester Turnpike (Route 9) at South Street

Route 9 meets South Street to form a four-way, signalized intersection. The Route 9 eastbound approach provides an exclusive left-turn lane, a through lane, and a through/right-turn lane. The Route 9 westbound approach provides an exclusive left-turn lane, dual through lanes, and an exclusive right-turn lane. In the project area, the Route 9 eastbound and westbound travel lanes are separated by a Jersey barrier median. The South Street northbound approach provides an exclusive left-turn lane and a through/right-turn lane. The South Street southbound approach provides an exclusive left turn lane, a shared left/through travel land and an exclusive right turn lane. Traffic signal phasing includes protected left turns along Route 9 and split phasing along South Street. Land use at the intersection consists of a Price Chopper Supermarket, a CVS Pharmacy with drive-through, Ashford Crossing, and an undeveloped parcel.

Route 20 at South Street

Route 20 intersects South Street and Green Street to form a four-way intersection under traffic signal control. The Route 20 eastbound approach to the intersection provides an exclusive left-turn lane and a shared through/right-turn lane. The Route 20 westbound approach to the intersection provides a shared left/through travel lane and a shared through/right-turn lane. The Green Street northbound approach and the South Street southbound approach to the intersection each provide a single shared left/through/right lane.

Route 20 at Centech Boulevard and Cherry Street

Route 20 intersects Centech Boulevard and Cherry Street to form a four-way intersection under traffic signal control. The Route 20 eastbound approach to the intersection provides an exclusive left-turn lane, a through lane, and a shared through/right-turn lane. The Route 20 westbound approach to the intersection provides an exclusive left-turn lane and a shared through/right-turn lane. The Centech Boulevard northbound approach and the Cherry Street southbound approach to the intersection each provide a shared through/left-turn lane and an exclusive right-turn lane. Land use at the intersection includes a Shell brand gasoline station with convenience market and drive-through Honey Dew, the Hebert's Candy Mansion, a private transportation company, and the Hills Farm Industrial Park.

2.1.3 PEDESTRIAN & BICYCLE FACILITIES

The existing pedestrian and bicycle system serving the study area has been documented. A limited network of sidewalks and crosswalks are provided in the study area as shown in **Figure 3**. There are no formal bicycle accommodations within the study area.

2.2 BASELINE TRAFFIC, PEDESTIAN & BICYCLE VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in October 2018. Automatic traffic recorder counts (ATRs) were conducted along Route 20 to the west of South Street and along South Street to the south of the Umass/Charles River Laboratories driveways. Manual turning movement counts (TMCs) were conducted at the study intersections during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods of the proposed site uses and commuter traffic periods. Traffic count data is included in the **Appendix**.

2.2.1 DAILY TRAFFIC

Daily traffic volumes along Route 20 to the west of South Street and along South Street to the south of the Umass/Charles River Laboratories driveways were collected in October 2018. The results of the counts are summarized in **Table 1**.

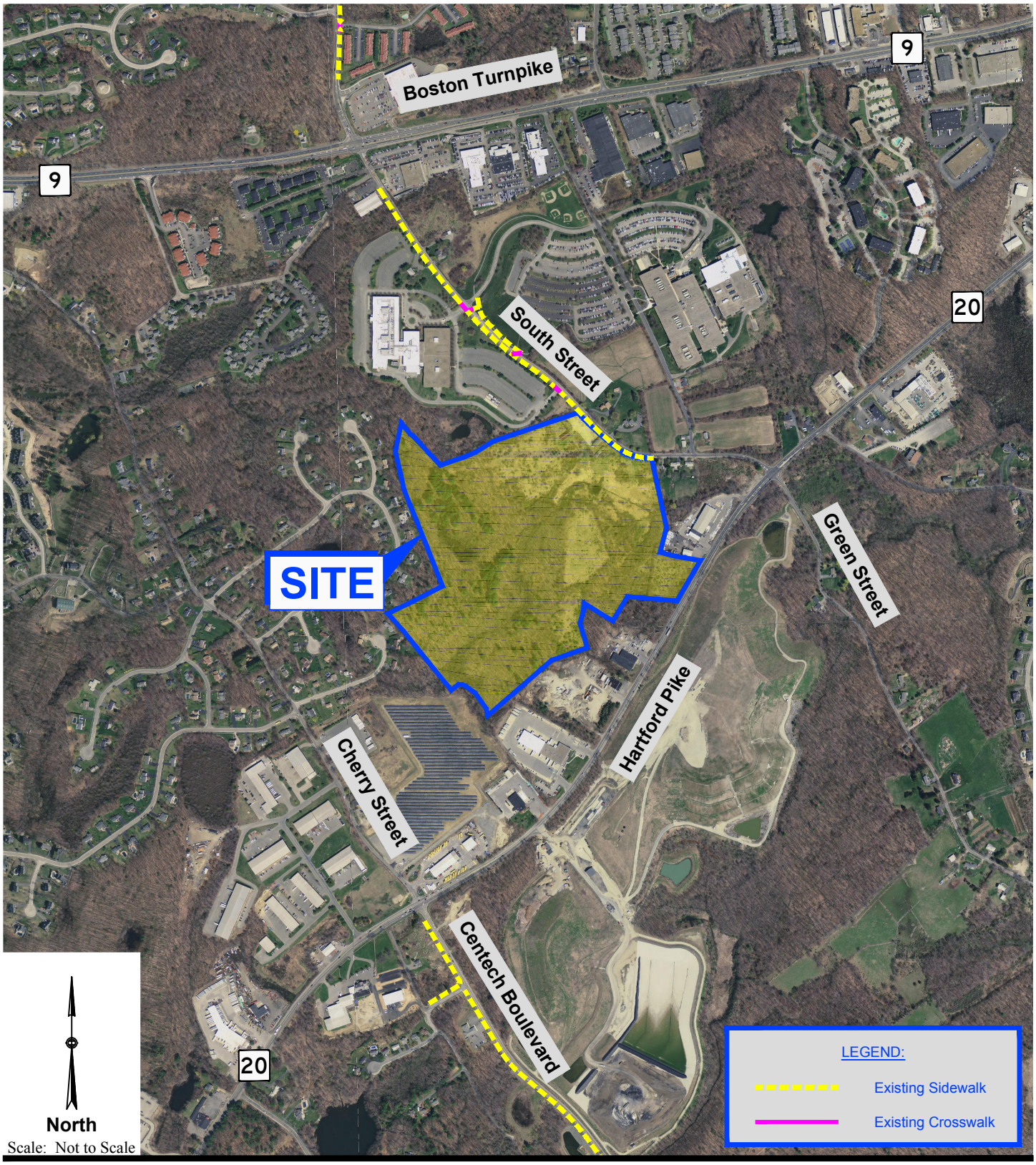

Figure 3

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Existing Pedestrian Facilities

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TABLE 1
BASELINE TRAFFIC VOLUME-SUMMARY

Time Period	Daily Volume (vpd)[1]	Percent Daily Traffic[2]	Peak Hour Volume (vph)[3]	Peak Flow Direction[4]	Peak Hour Directional Volume (vph)
Route 20 west of South Street					
Weekday Morning Peak Hour	23,130	7%	1,710	73% EB	1,251
Weekday Evening Peak Hour	23,130	8%	1,770	56% WB	990
South Street south of Umass/Charles River Laboratories Driveways					
Weekday Morning Peak Hour	5,440	8%	450	62% NB	281
Weekday Evening Peak Hour	5,440	9%	505	50% NB/SB	254

[1]Two-way daily traffic expressed in vehicles per day without seasonal adjustment.
[2]The percent of daily traffic that occurs during the peak hour.
[3]Two-way peak-hour volume expressed in vehicles per hour.
[4]NB = Northbound, SB = Southbound, EB = Eastbound, WB = Westbound

As summarized in **Table 1**:

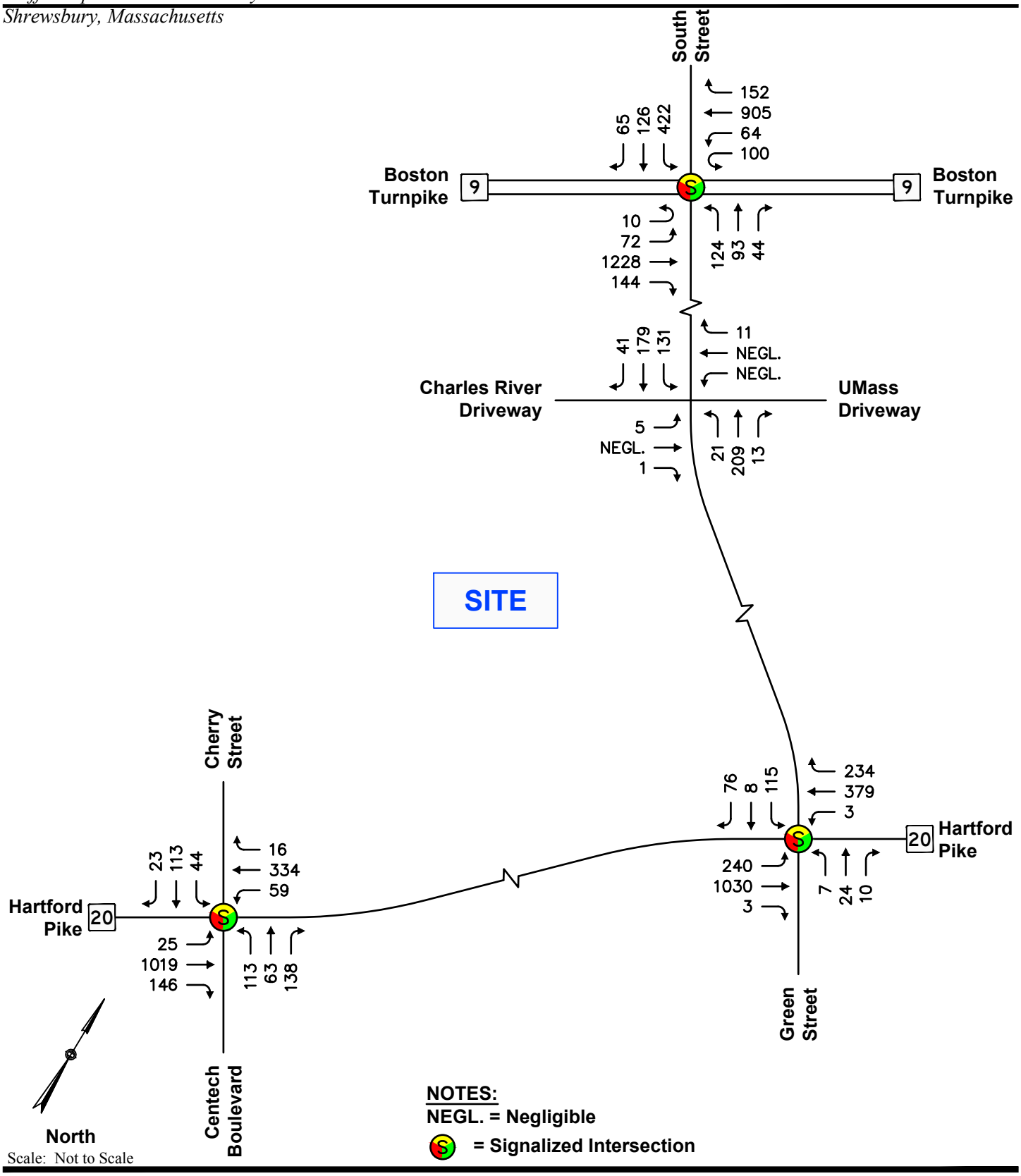
- *Route 20 west of South Street:* Daily traffic volume on Route 20 west of South Street is approximately 23,130 vehicles per day (vpd) on weekdays. Weekday peak hour traffic flow on Route 20 is approximately 7 to 8 percent of daily flow with directional flow split heavier eastbound (towards Route 9) during the weekday morning peak hour and heavier westbound during the weekday evening peak hour, consistent with commuter-related travel.

- *South Street south of Umass/Charles River Laboratories Driveway:* Daily traffic volume on South Street south of the Umass/Charles River Laboratories Driveways is approximately 5,440 vehicles per day (vpd) on weekdays. Weekday peak hour traffic flow on South Street is approximately 8 to 9 percent of daily flow with directional flow split heavier northbound (towards Route 9) during the weekday morning peak hour and split evenly during the weekday evening peak hour.

2.2.2 PEAK-HOUR VOLUMES

Manual turning movement counts (TMCs) were conducted along study area roadways and intersections in October 2018. These traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods.

Review of MassDOT permanent count station data in the area indicates that October is an above-average traffic month. Therefore, as a conservative measure, no adjustment (reduction) was applied to the observed traffic volumes to represent average conditions. Permanent count station data is provided in the **Appendix**. The resulting Baseline weekday morning and weekday evening peak-hour traffic volumes for study intersections are depicted in **Figures 4** and **Figure 5** while the observed peak hour pedestrian and bicycle volumes are provided in the **Appendix**.



Scale: Not to Scale

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Figure 4

Baseline Condition
Weekday Morning Peak Hour
Traffic Volumes

Date: March 2019
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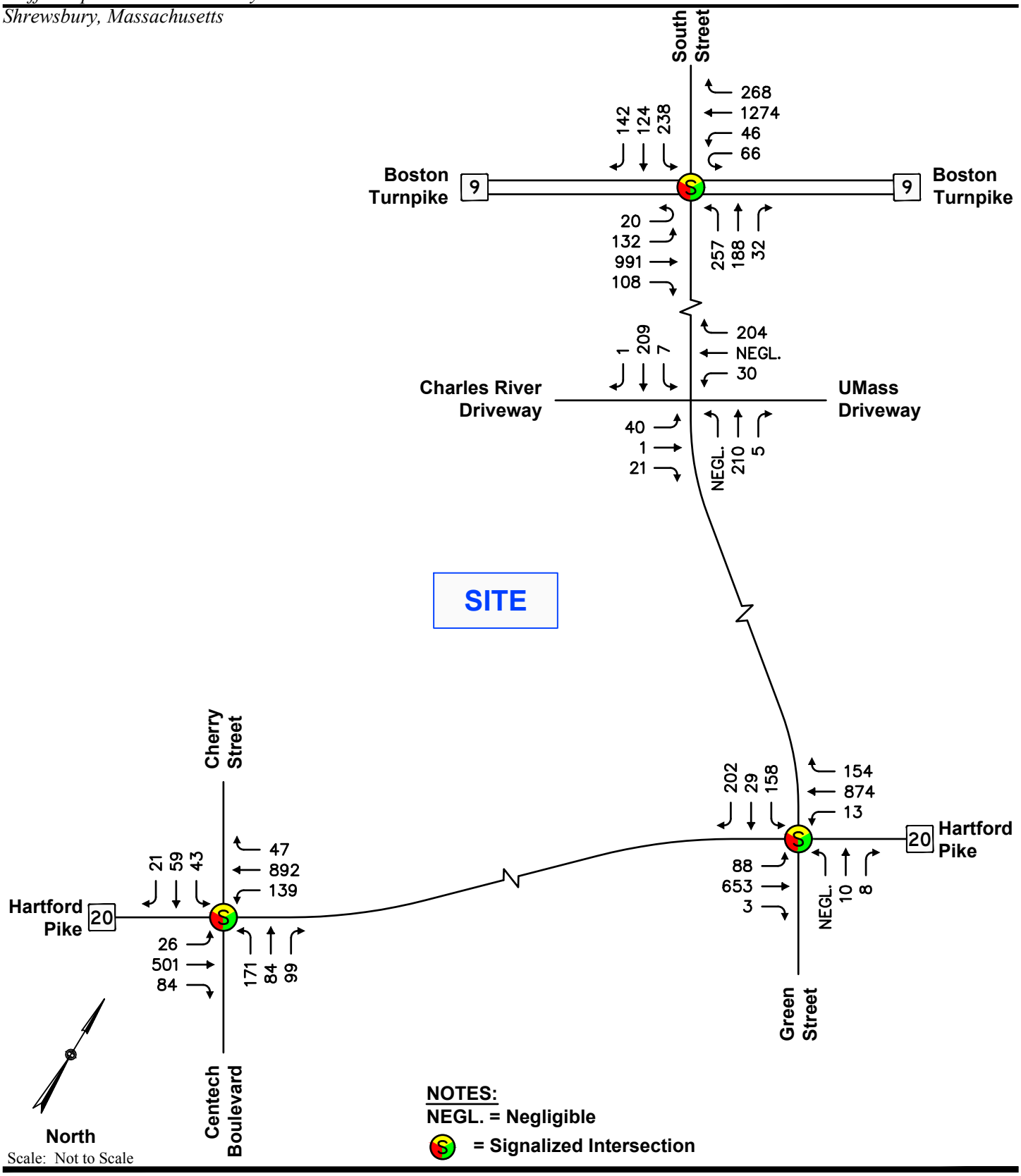

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Figure 5

Baseline Condition
Weekday Evening Peak Hour
Traffic Volumes

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2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for the South Street northbound and southbound travel directions using a radar-equipped ATR in October 2018. **Table 2** summarizes the average and 85th percentile speeds for South Street adjacent to the Site. This speed data provides a basis for determining appropriate sight lines for the proposed driveway. The speed data is provided in the **Appendix**.

TABLE 2
SPEED STUDY RESULTS – SOUTH STREET

Travel Direction	Travel Speeds		
	Regulatory[1]	Mean[2]	85th Percentile[3]
Northbound	n/a	34	38
Southbound	n/a	36	41

[1]Regulatory speed (mph)
[2]Arithmetic mean (mph)
[3]The speed at or below which 85 percent of the vehicles are traveling (mph).

As summarized in **Table 2**, the mean (average) travel speed on South Street traveling northbound is 34 mph and the 85th percentile travel speed is 38 mph. In the southbound direction, the mean travel speed is 36 mph and the 85th percentile travel speed is 41 mph.

2.4 SAFETY

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the Town of Shrewsbury for the three-year period covering 2014 through 2016 (the most recent data currently available from MassDOT). A summary of the crash data with crash rates for the study intersections with reported crashes is provided in **Table 3** with detailed data provided in the **Appendix.**

Crash rates were calculated for the study intersections as reported in Table 2. These rates quantify the number of crashes per million entering vehicles. MassDOT has determined the official District 3 (which includes the Town Shrewsbury) crash rate to be 0.61 for unsignalized intersections and 0.89 for signalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted. A review of Highway Safety Improvement Project (HSIP) locations was also conducted.

TABLE 3
INTERSECTION CRASH SUMMARY – 2014 THROUGH 2016[1]

	INTERSECTIONS			
Data Category	**Route 9 at South Street**	**Route 20 at South Street/ Green Street**	**Route 20 at Centech Blvd/ Cherry Street**	**South Street at Umass Dwy/ Charles River Dwy**
Traffic Control	Signalized	Signalized	Signalized	Unsignalized
Crash Rate[2]	**1.09**	**0.79**	**0.54**	**0.19**
MHD Dist. 3 Avg[3]	0.89	0.89	0.89	0.63
Year:				
2014	18	10	5	0
2015	17	9	9	1
2016	26	6	3	1
Total	**61**	**25**	**17**	**2**
Type:				
Angle	7	10	10	0
Rear-End	42	10	4	0
Head-On	1	0	0	0
Sideswipe	8	1	1	0
Single Vehicle	2	4	2	2
Unknown/Other	1	0	0	0
Severity:				
P. Damage Only	50	18	10	2
Personal Injury	9	7	7	0
Fatality	0	0	0	0
Not Reported	2	0	0	0
Conditions:				
Dry	48	19	15	1
Wet	9	5	1	1
Snow	4	1	1	0
Unknown	0	0	0	0
Time:				
7:00 to 9:00 AM	10	7	0	0
4:00 to 6:00 PM	15	4	7	0
Rest of Day	36	14	10	2

[1]Source: MassDOT Crash Database
[2]Crashes per million entering vehicles (MEV)
[3]District 3 Average Crash Rate

As summarized in **Table 3**:

- *Route 9 at South Street.* A total of sixty-one (61) crashes were reported for the Route 9 and South Street signalized intersection resulting in a crash rate of 1.09 which is above District-wide average of 0.89. MassDOT has listed the intersection as a top 200 crash cluster location for 2013-2015 and as a Highway Safety Improvement Program (HSIP) crash cluster for 2013-2015. The crashes involved forty-two (42) rear-end type collisions (69%), fifteen (15) angle/sideswipe type collisions (25%), two (2) single vehicle type collisions, one (1) head-on collision and one unreported collision type. The majority (85%) resulted in property damage collisions and under dry roadway conditions (79%). Forty-one percent of the crashes occurred during the weekday morning or weekday evening commuting periods. No fatalities or pedestrian-related incidents were reported.

- *Route 20 at South Street/Green Street:* A total of twenty-five (25) crashes were reported for the Route 20 and South Street/Green Street signalized intersection resulting in a crash rate of 0.79 which is below the District-wide average of 0.89. The crashes involved eleven (11) angle/sideswipe type collisions (44%), ten (10) rear-end type collisions (40%), and four (4) single vehicle type collisions. The majority (72%) resulted in property damage collisions and under dry roadway conditions (76%). Forty-four percent of the crashes occurred during the weekday morning or weekday evening commuting periods. No fatalities or pedestrian-related incidents were reported.

- *Route 20 at Centech Boulevard/Cherry Street:* A total of seventeen (17) crashes were reported for the Route 20 and Centech Boulevard/Cherry Street signalized intersection resulting in a crash rate of 0.54 which is well below the District-wide average of 0.89. The crashes involved eleven (11) angle/sideswipe type collisions (65%), four (4) rear-end type collisions (24%), and two (2) single vehicle type collisions. The majority (59%) resulted in property damage collisions and under dry roadway conditions (88%). Forty-one percent of the crashes occurred during the weekday morning or weekday evening commuting periods. No fatalities or pedestrian-related incidents were reported.

- *South Street at Umass/Charles River Laboratories Driveways:* Two (2) crashes were reported at or near the South Street unsignalized intersection with Umass/Charles River Laboratories Driveways. The resulting crash rate of 0.19 is below the District 3 average of 0.61. The reported crashes included two (2) single vehicle type collisions. Both of the crashes occurred outside the peak commuter periods

In summary, based on local crash records the study intersections generally experienced crash rates below the District 3 averages and no immediate safety countermeasures are warranted based on the crash history at the study intersections. The exception being the Route 9 intersection with South which is a listed as a as a top 200 crash cluster location and Highway Safety Improvement Program (HSIP) cluster by MassDOT. Accordingly, this HSIP location is subject to a Road Safety Audit (RSA) to be conducted by the Proponent to identify potential short-term, medium term and long-term safety/operational improvements.

2.5 SIGHT LINE ANALYSIS

An evaluation of sight lines was conducted at the proposed site driveway location to ensure that minimum recommended sight lines are available at the proposed site driveway intersection with South Street. The evaluation documents existing sight lines for vehicles as they relate to South Street with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards[1] reference two types of sight distance which are relevant at the proposed site driveway intersection: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the proposed site driveway intersection were compared to minimum SSD and ISD recommendations for the travel speeds in the site vicinity.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto Route 16. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the northbound and southbound South Street approaches to the proposed site driveway. **Table 4** presents a summary of the available SSD as they relate to South Street and AASHTO's recommended SSD.

[1] *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2011.

TABLE 4
STOPPING SIGHT DISTANCE SUMMARY
SOUTH STREET APPROACHES TO PROPOSED SITE DRIVEWAY

Approach/ Travel Direction	Available SSD	AASHTO Recommended[1]	
		Regulatory Speed[2]	85th Percentile Observed Travel Speed[3]
Northbound	320± Feet	305 Feet	280 Feet
Southbound	>500 Feet	305 Feet	315 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet.
[2]South Street Prima Facie Speed = 40 mph.
[3]85th Percentile travel speed on South Street: 38 mph NB and 41 mph SB.

As summarized in **Table 4** analysis results indicate that the with clearing and grading associated with installation of the site driveway available sight lines will exceed AASHTO's recommended SSD criteria for both travel directions along South Street based on the prima facie speed limit and the observed 85th percentile travel speeds.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "…*If the available sight distance for an entering …vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions…To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road*." AASHTO's ISD criteria are defined into several "cases". For the unsignalized site driveway location which is proposed to be under STOP sign control then the ISD in question relates to the ability to turn left or turn right from the proposed driveway at its intersection with South Street.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 14.5 feet from the edge of the travel way) for the northbound and southbound directions along South Street. **Table 5** presents a summary of the available ISD for the departure from the site driveway and AASHTO's recommended ISD.

TABLE 5
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURES TO SOUTH STREET

View Direction	Available ISD	AASHTO Minimum[1] 85th Percentile Speed[3]	AASHTO Ideal[1] Posted Speed[2]
Looking North	>500 Feet	315 Feet	445 Feet
Looking South	400± Feet	280 Feet	385 Feet

[1]Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet and adjustments for roadway grade if required. Minimum value as noted represents SSD per AASHTO guidance.
[2]South Street Prima Facie Speed = 40 mph.
[3]85th Percentile travel speed on South Street: 38 mph NB and 41 mph SB.

The results of the ISD analysis presented in **Table 5** indicate that with clearing and re-grading as part of the driveway construction the available sight lines looking north and south from the proposed site driveway onto South Street will exceed the recommended sight line requirements from AASHTO for the travel speeds. MDM recommends that any new plantings (shrubs, bushes) or physical landscape features to be located within the driveway sight lines should also be maintained at a height of 2 feet or less to ensure unobstructed lines of sight.

2.6 PUBLIC TRANSPORTATION

The Massachusetts Bay Transit Authority (MBTA) operates the Worcester/Framingham commuter rail service to the south of the site at Grafton Station with access from Centech Boulevard. The Worcester Regional Transit Authority (WRTA) operates one fixed route bus route, Route 15, in Shrewsbury. Route 15 runs between Union Station in Worcester and South Street in Shrewsbury via Route 9 to Maple Street and Main Street and turns around on South Street. The route 15 bus operates with flag stops and does not provide direct access to the site. Specific route and schedule information is provided in the **Appendix**.

3.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. To be consistent with EEA/MassDOT guidelines, a seven-year planning horizon (2025) was selected.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others that is currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of the planned roadway improvements, future No-Build traffic volumes, and projected Build traffic volumes.

3.1 PLANNED ROADWAY IMPROVEMENTS

Per discussions with MassDOT District 3 staff, planning efforts are underway for Route 20 between Route 9 and the Worcester City Line. Improvement initiatives that are currently being developed include providing a 4-lane cross section along Route 20 with additional turn lanes at its major intersections, installation of sidewalks and bicycle accommodations, and implementing pedestrian accommodations at the areas signalized intersections. The improvements in the study area include the following key features as depicted in the conceptual improvement plans developed by MassDOT (see **Appendix**):

- *4-Lane Cross Section.* Mainline travel along Route 20 will be widening to include a minimum roadway cross-section of 2 travel lanes in each direction. Additional turn lanes will be provided at area intersections.

- *Pedestrian and Bicycle Accommodations.* A sidewalk is proposed along the northern side of Route 20 and a two-way multi-use path is proposed along the southern side of Route 20. ADA compliant ramps, crosswalks, and pedestrian signal phasing at the area signalized intersections will be provided where appropriate.

- *Route 20 at South Street/Green Street.* The eastbound Route 20 approach will be widened to include an exclusive left turn lane, a through travel lane, and a shared through/right turn lane. The westbound Route 20 approach will be widened to include an exclusive left turn lane, two through travel lanes, and an exclusive right turn lane. The northbound and southbound approaches will be widened to include two lane approaches. As part of the project the above-mentioned pedestrian and bicycle accommodations will be provided along with ADA compliant ramps and pedestrian signal phasing. The intersection phasing and timing will be optimized to enhance operations and the existing signal equipment will updated.

- *Route 20 at Centech Boulevard/ Cherry Street.* The eastbound Route 20 approach will be widened to include an exclusive left-turn lane, two through travel lane, and an exclusive right-turn lane. The westbound Route 20 approach will be widened to include dual exclusive left-turn lanes, a through travel lane, and a shared through/right-turn lane. The northbound approach will be widened to include dual left-turn lanes, a through travel lane, and an exclusive right-turn lane. As part of the project the above-mentioned pedestrian and bicycle accommodations will be provided along with ADA compliant ramps and pedestrian signal phasing. The intersection phasing and timing will be optimized to enhance operations.

To provide a conservative analysis and since the Route 20 Corridor Improvements area not designed or funded, it was assumed that the improvements would not be implemented prior to the completion of the proposed Sub-District A project. The improvement as outlined for the project under *Conclusions and Recommendations* section of this report will enhance safety and operations with regards to the development and are consistent with long-range improvements along Route 20 that are currently being developed by MassDOT.

3.2 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

3.2.1 HISTORICAL AREA GROWTH

Nearby permanent count station data published by MassDOT indicates a declining (-0.7 percent per year) growth rate. For purposes of this evaluation, a 0.5 percent compounded annual growth rate was used (3.6 percent increase over a 7-year horizon). This growth rate is higher than historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. Additionally, the 0.5 percent per year growth rate is consistent with the growth rate used in other recent area traffic studies. MassDOT permanent count station data and background growth calculations are provided in the **Appendix.**

3.2.2 DEVELOPMENT-RELATED GROWTH

Development of future No-Build traffic volumes also considers traffic generated from specific area developments. Based on discussion with Town Planning Staff in Shrewsbury, Grafton and Northborough there are four (4) permitted projects in the area that may generate traffic through the study area under future conditions that are described below:

- *The Pointe at Hills Farm*. The residential project is currently permitted to include 280 apartment units to be located along Route 20 in Shrewsbury between the two Stoney Hill Road connections. The site-specific trip tracings were obtained from the TIAS prepared by Tetra Tech in November 2015. Trip tracings for the proposed development are provided in the **Appendix**.

- *Charles River Laboratories.* The Charles River building at 334 South Street in Shrewsbury includes 412,000± sf of R&D space which is currently half vacant based on discussions with the Town. To account for the full occupancy of the building, trips will be added based on the existing trip generation rates and distribution patterns for the building. Trip tracings for the proposed development are provided in the **Appendix**.

- *University of Massachusetts Office.* The UMass buildings at 333 South Street in Shrewsbury include 664,000± sf of Office/R&D space which is currently ¼ vacant based on discussions with the Town. To account for the full occupancy of the buildings, trips will be added based on the existing trip generation rates and distribution patterns for the buildings. Trip tracings for the proposed development are provided in the **Appendix**.

- *UPS Grafton.* UPS is in discussions with the Town of Grafton to develop a 900,000± sf facility within Centech Park location on Centennial Drive. The project is preliminary and no formal site plans or filings have occurred, therefore, trips for this project are not included in the future No-Build traffic volume networks.

3.3 NO-BUILD TRAFFIC VOLUMES

In addition to site-specific trips associated with the Pointe at Hills Farm residential development, and the infill of Charles River Laboratories and UMass Offices, a 0.5 percent growth rate was used (3.6 percent increase over a 7-year horizon) annual growth rate was applied to existing traffic volumes over a seven-year period to account for future traffic growth in the study area. Future No-Build traffic volumes are displayed in **Figure 6** and **Figure 7**.

3.4 SITE-GENERATED TRAFFIC – ITE BASIS

Future Build condition traffic volumes were developed by estimating the number of peak-hour trips expected to be generated by the proposed development and distributing this additional traffic onto the local roadway network. These future development-related trips were added to future No-Build traffic volumes to evaluate future traffic operations with the proposed residential development in place. The methodology utilized to estimate the future trip-generation characteristics of the proposed development are summarized below. In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for the Land Use Code (LUC) based on trip rates for General Office (LUC 710) and Industrial Park (LUC 130). **Table 6** presents the trip-generation estimates for the proposed development based on ITE methodology and EEA/MassDOT guidelines.

TABLE 6
TRIP-GENERATION SUMMARY (SUB-DISTRICT A)

Peak Hour/Direction	Office (110,000 sf)[3]	Industrial Park (165,000 sf)[4]	Total (275,000 sf)
Weekday Morning Peak Hour:			
Entering	110	53	163
Exiting	18	13	31
Total	128	66	194
Weekday Evening Peak Hour:			
Entering	20	14	34
Exiting	107	52	159
Total	127	66	193
Weekday Daily (24 hours):	1,072	556	1,628

Source: ITE *Trip Generation*, Tenth Edition; 2017.
[1]ITE LUC 710 – General Office Building applied to 110,000 sf.
[2]ITE LUC 130 – Industrial Park applied to 165,000 sf.

Based on industry-standard trip rates, the proposed development is estimated to generate approximately 194 vehicle trips during the weekday morning peak hour (163 entering and 31 exiting) and 193 vehicle trips during the weekday evening peak hour (34 entering and 159 exiting). On a daily basis, the development is estimated to generate approximately 1,072 vehicle trips on a weekday.

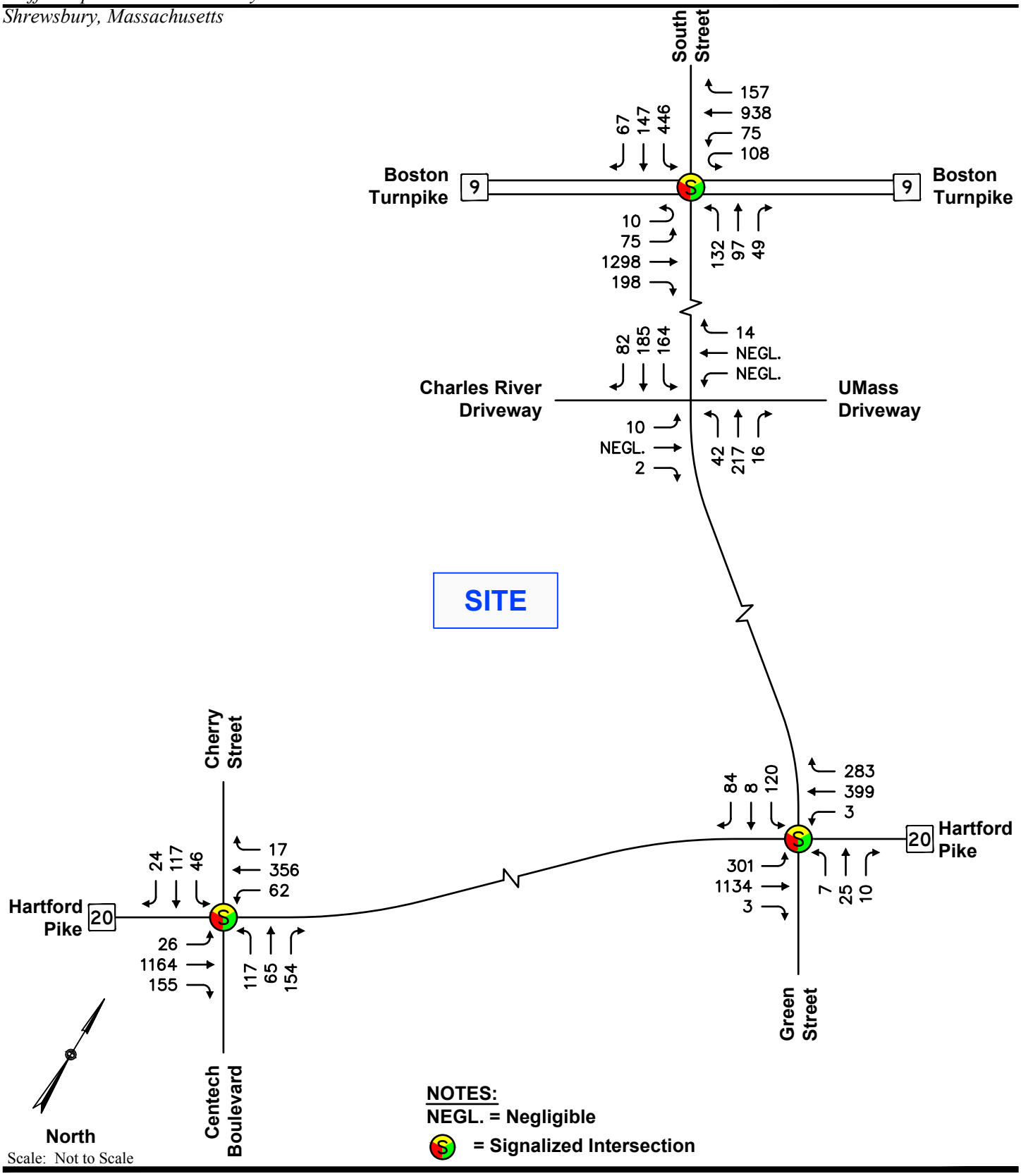

Figure 6

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2025 No-Build Condition
Weekday Morning Peak Hour
Traffic Volumes

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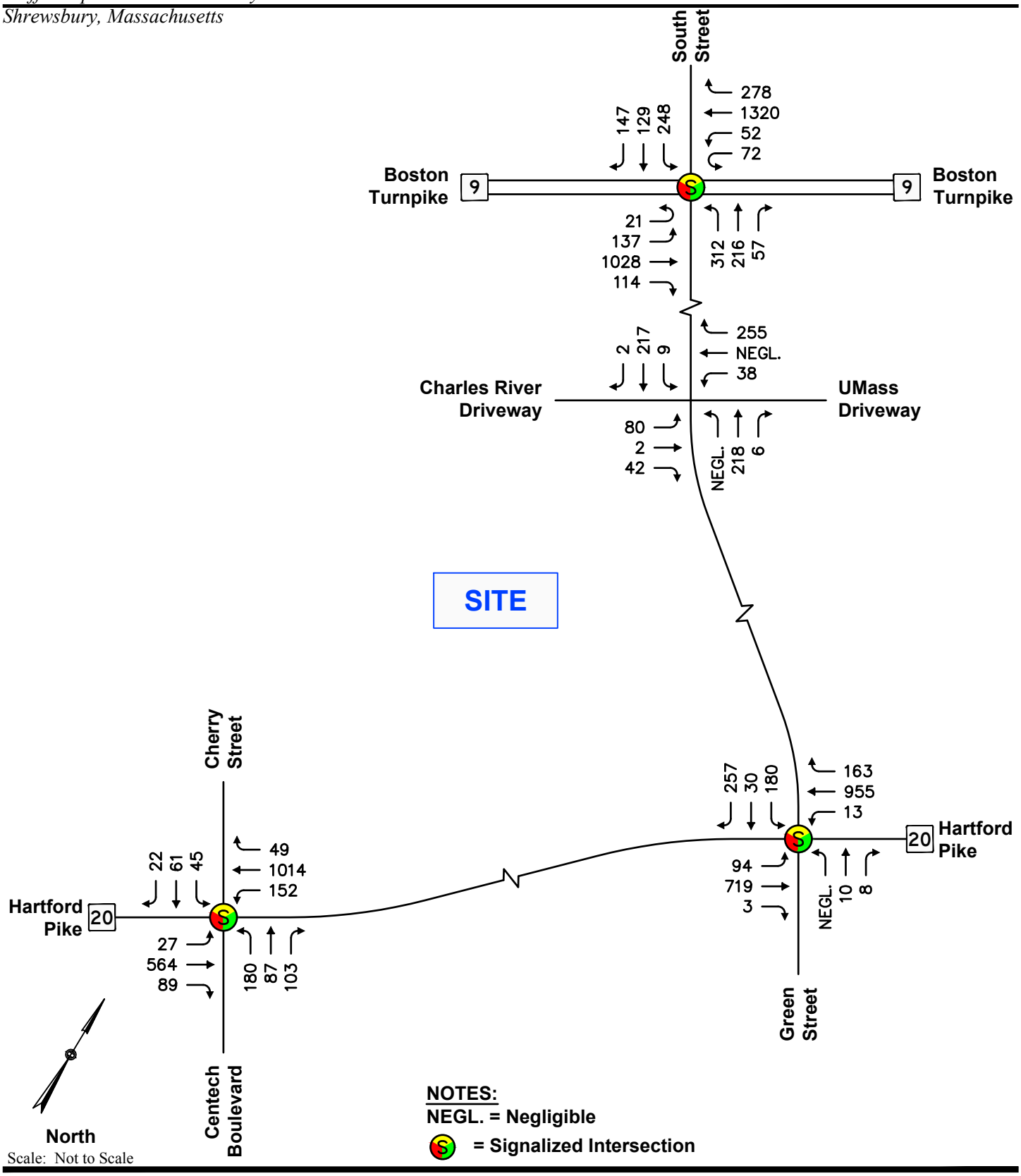

Figure 7

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2025 No-Build Condition
Weekday Evening Peak Hour
Traffic Volumes

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3.5 TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including employee place of residence, existing travel patterns along area roadways, and the efficiency of these roadways leading to the site. Journey to Work data published by the US Census, existing travel patterns in the area including the adjacent Charles River and UMass Campuses, and area roadway infrastructure will serve as the primary basis for determining the employee trip distribution pattern for the proposed Site. Preliminary trip distribution calculations for the Site are summarized in **Table 7** with supporting worksheets provided in the **Attachments.**

TABLE 7
TRIP-DISTRIBUTION PATTERNS

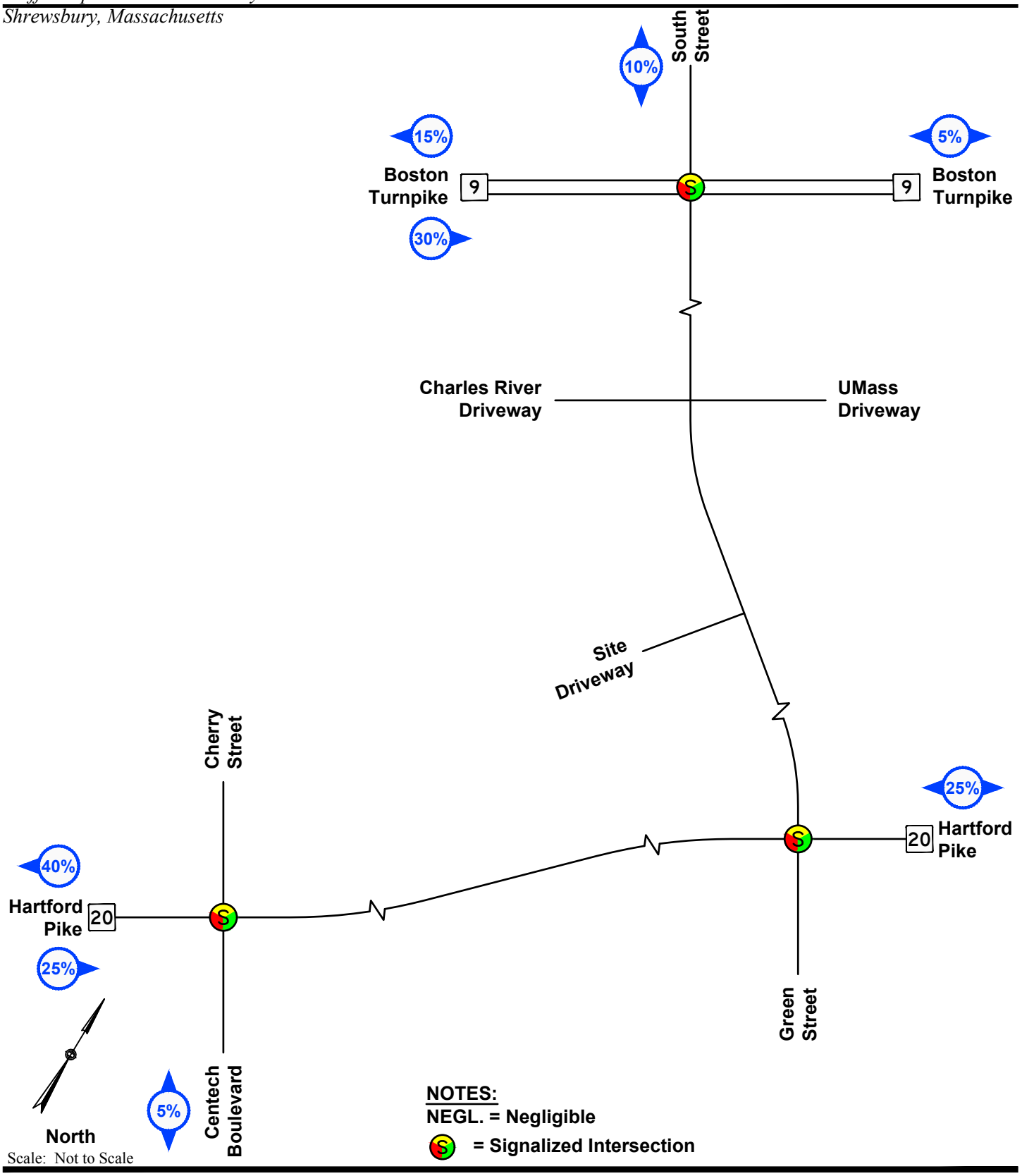
	Distribution[1]	
Roadway Segment	**Enter**	**Exit**
Route 20 (East)	25%	25%
Route 20 (West)	25%	40%
Route 9 (East)	5%	5%
Route 9 (West)	30%	15%
South Street (North)	10%	10%
Cherry Street (North)	NEGL	NEGL
Green Street (South)	NEGL.	NEGL.
Centech Boulevard (South)	5%	5%
TOTAL	**100%**	**100%**

[1]Existing travel patterns and Journey to Work Census 2010 data for workers within Shrewsbury.

Development-related trips for the Site were assigned to the roadway network using the ITE trip-generation estimates shown in **Table 7** and the distribution patterns presented in the **Table 7** and **Figure 8**. New development-related trips at each intersection for the weekday morning and weekday evening peak hours are quantified in **Figure 9** and **Figure 10**, respectively.

3.6 BUILD TRAFFIC VOLUMES

Future Build condition traffic volumes were arrived at by adding development-specific traffic volumes to the 2025 No-Build conditions. **Figure 11** and **Figure 12** presents the 2025 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours, respectively.



Scale: Not to Scale

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Figure 8

Trip Distribution

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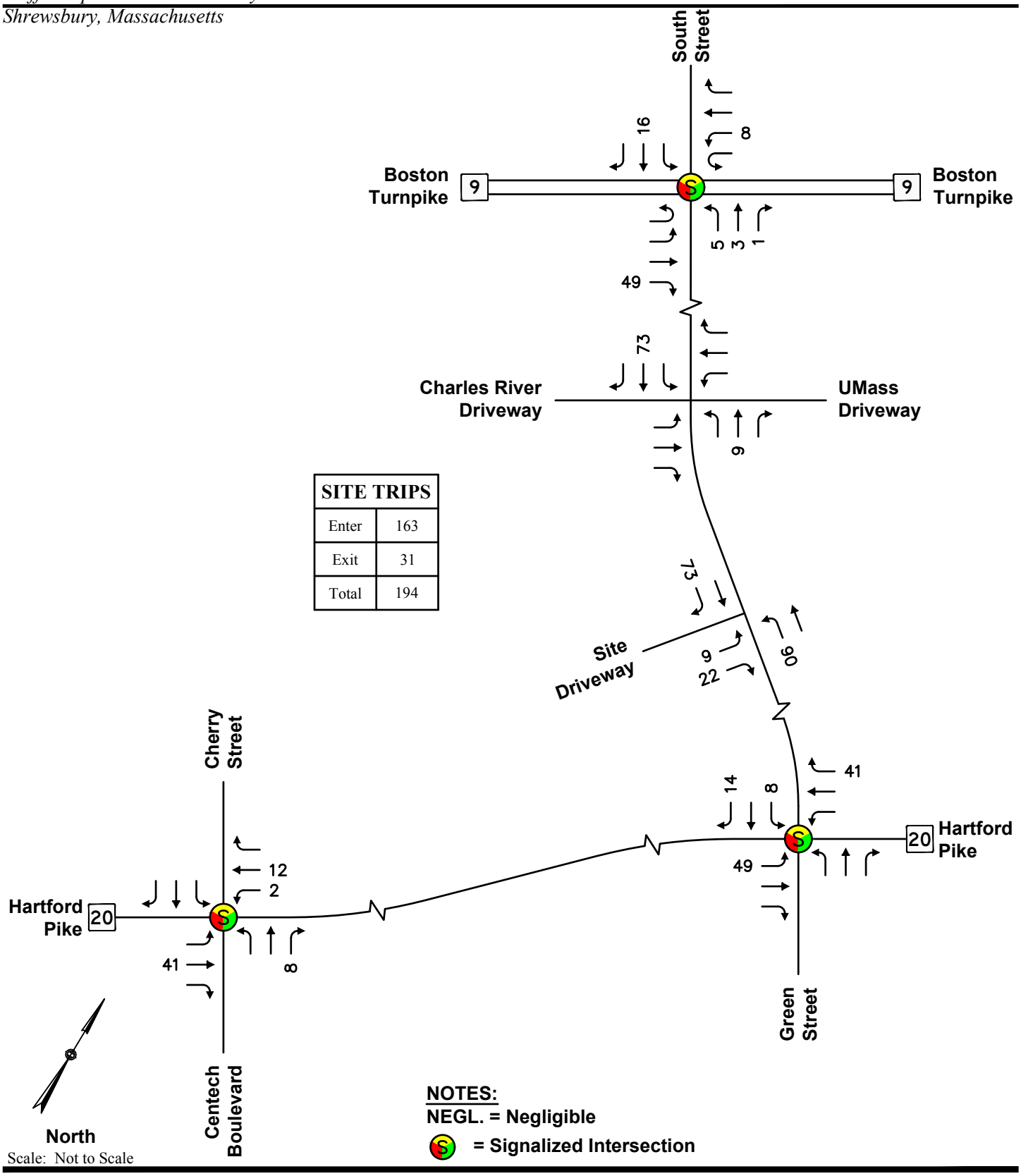

SITE TRIPS	
Enter	163
Exit	31
Total	194

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Figure 9

Site Generated Trips
Weekday Morning Peak Hour
Traffic Volumes

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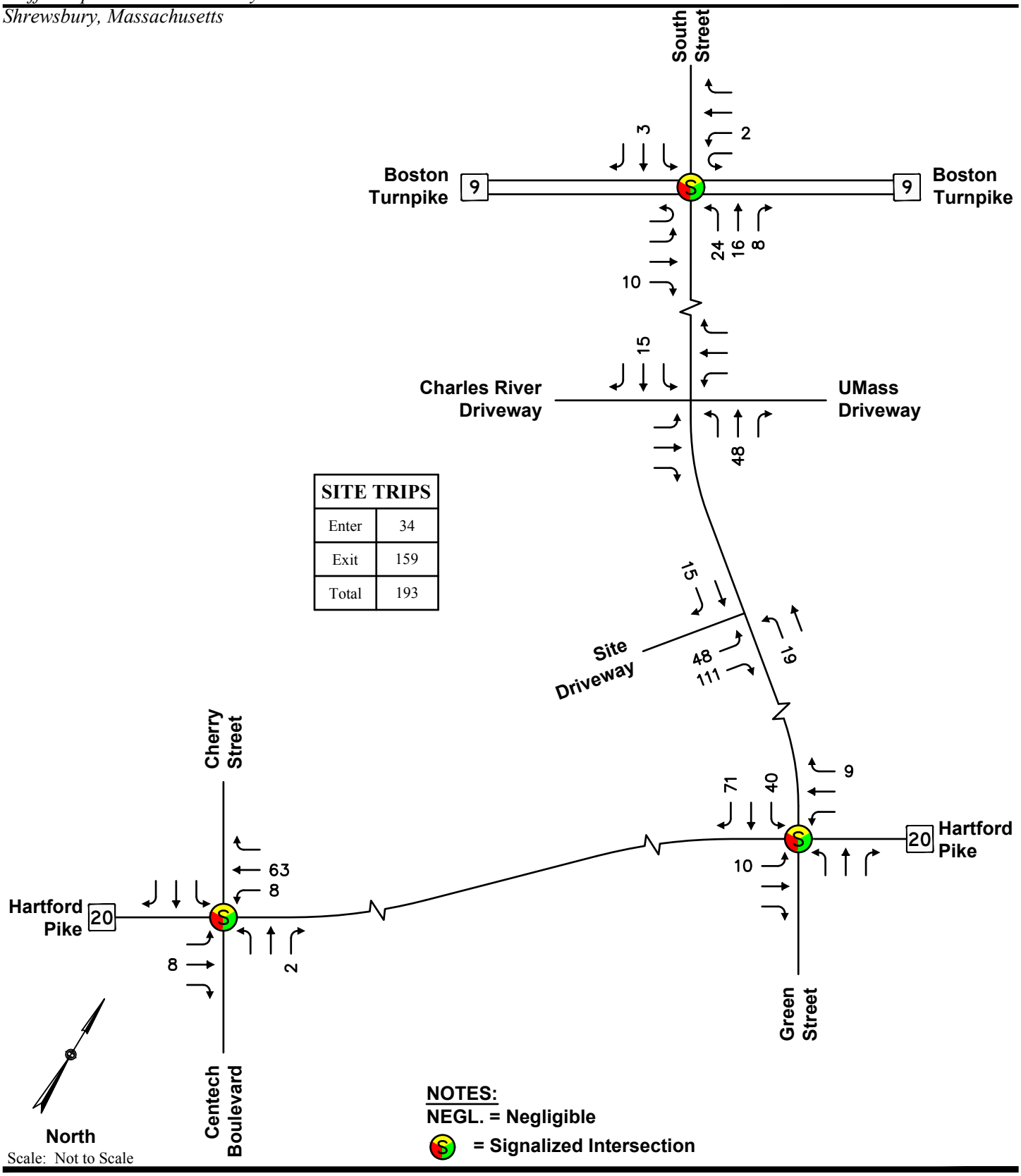

SITE TRIPS	
Enter	34
Exit	159
Total	193

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Figure 10

Site Generated Trips
Weekday Evening Peak Hour
Traffic Volumes

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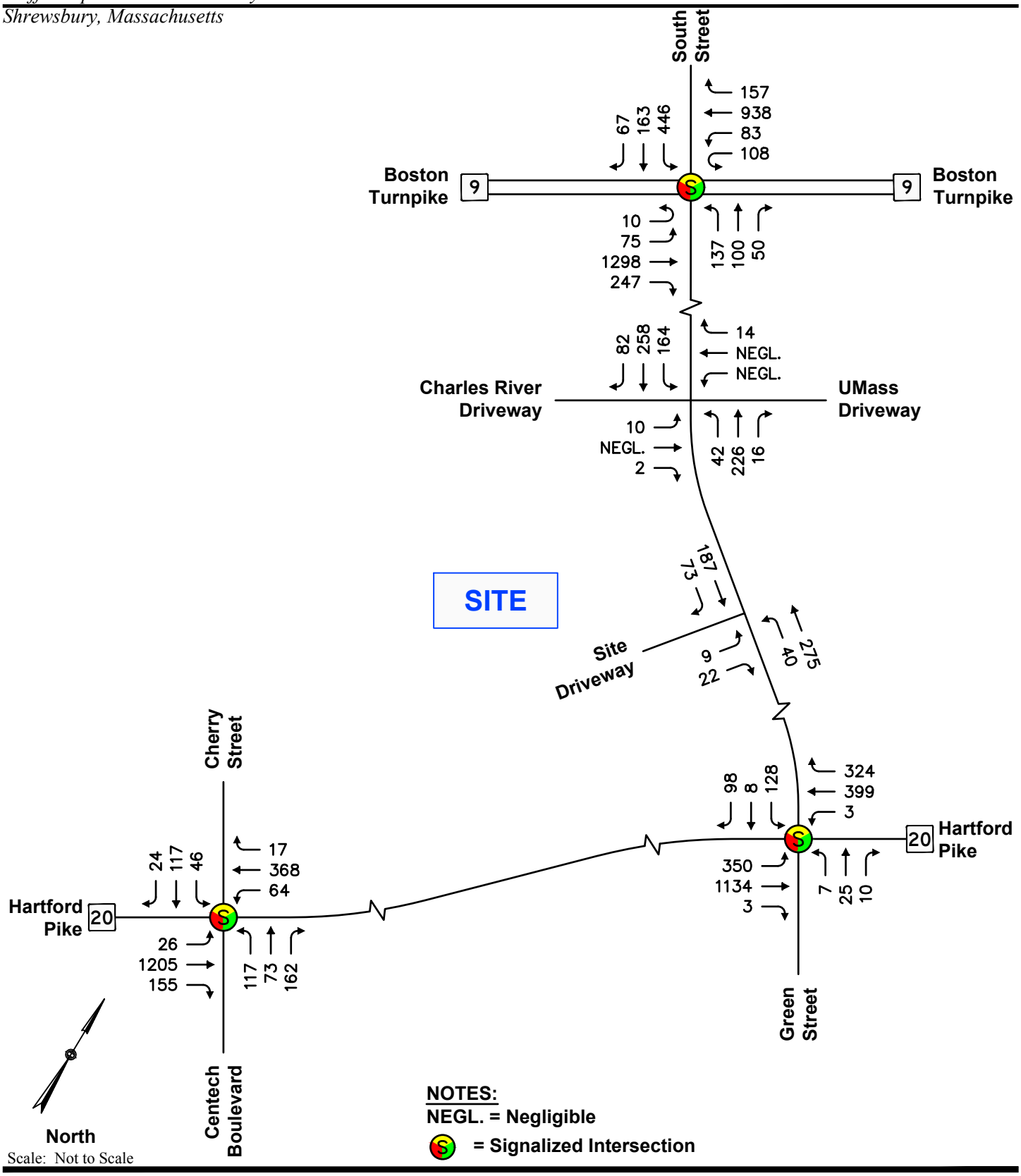

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Figure 11

2025 Build Condition
Weekday Morning Peak Hour
Traffic Volumes

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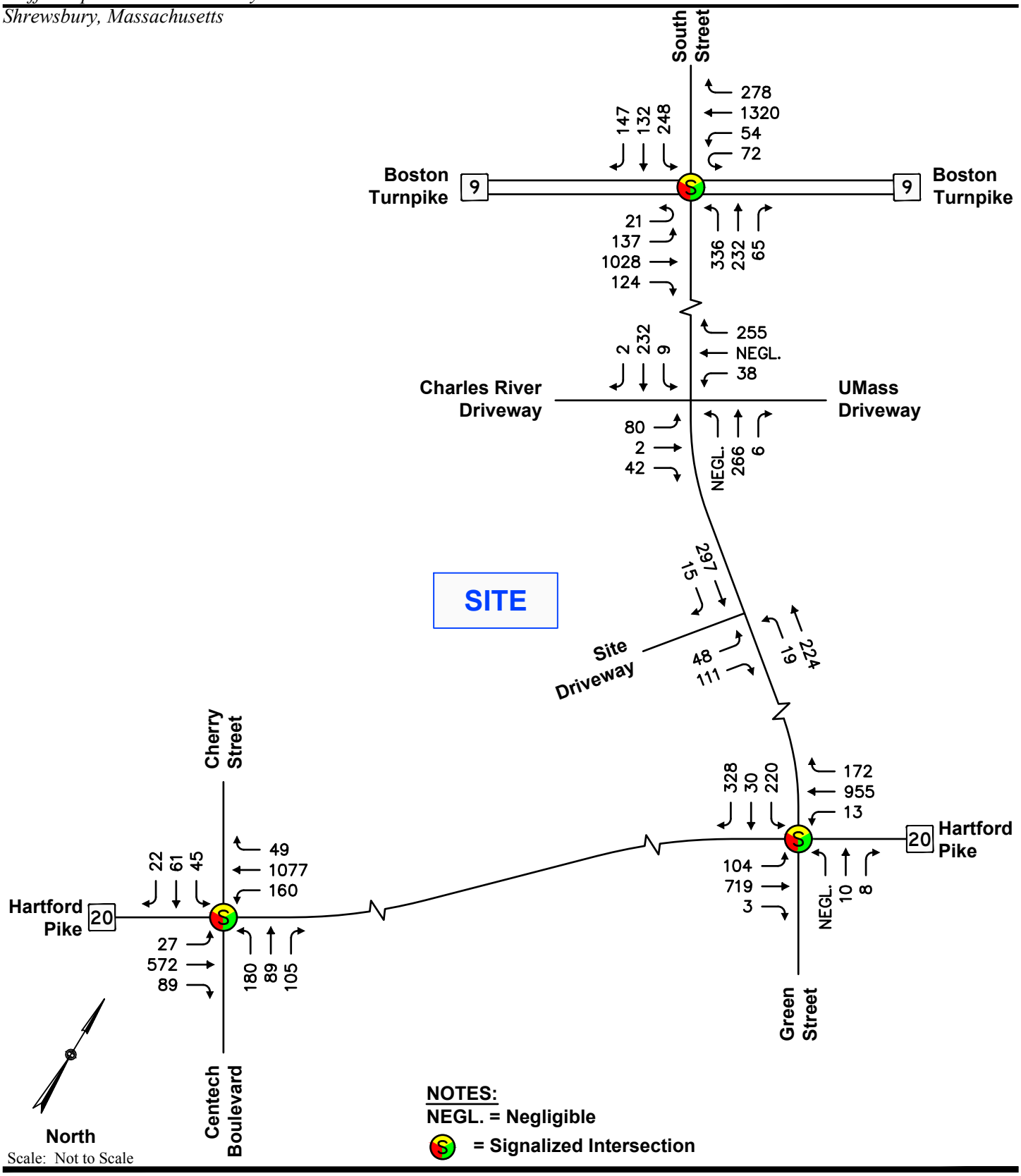

Figure 12

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2025 Build Condition
Weekday Evening Peak Hour
Traffic Volumes

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4.0 TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses for the study intersections are presented in this section for the Baseline, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements and 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix.**

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

Capacity analysis results for the weekday morning and weekday evening peak hour capacity analysis results for the study intersections are described below, with detailed analysis results presented in the **Appendix**.

4.2.1 Level of Service Analysis

The capacity analysis results for the intersections in the study area are summarized in **Table 8** and **Table 9** for the weekday morning and weekday evening peak hours, respectively. Detailed analysis results are presented in the **Appendix**.

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR

		Baseline			2025 No-Build			2025 Build		
Intersection	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Route 9 at	Eastbound	0.89	45	D	0.91	47	D	0.92	49	D
South Street	Westbound	0.75	32	C	0.81	33	C	0.84	34	C
	Northbound	0.64	64	E	0.68	67	E	0.70	69	E
	Southbound	>1.0	>80	F	>1.0	>80	F	>1.0	>80	F
	Overall	**>1.0**	**52**	**D**	**>1.0**	**60**	**E**	**>1.0**	**64**	**E**
Route 20 at	Eastbound	0.84	15	B	0.91	20	B	0.91	21	C
South Street/	Westbound	0.42	9	A	0.44	9	A	0.48	9	A
Green Street	Northbound	0.13	23	C	0.14	24	C	0.13	24	C
	Southbound	0.66	34	C	0.71	39	D	0.75	41	D
	Overall	**0.84**	**15**	**B**	**0.91**	**18**	**B**	**0.91**	**19**	**B**
Route 20 at	Eastbound	0.73	17	B	0.81	20	B	0.82	21	C
Centech Boulevard/	Westbound	0.39	11	B	0.39	11	B	0.40	11	B
Cherry Street	Northbound	0.63	30	C	0.76	37	D	0.78	38	D
	Southbound	0.44	29	C	0.50	32	C	0.51	33	C
	Overall	**0.73**	**19**	**B**	**0.76**	**22**	**C**	**0.82**	**22**	**C**
South Street at	EB Exit	0.02	17	C	0.06	22	C	0.07	25	C
UMass Dwy/	WB Exit	0.02	10	A	0.02	10	A	0.02	10	A
Charles River Dwy	Northbound	0.02	<5	A	0.04	<5	A	0.04	<5	A
	Southbound	0.11	<5	A	0.14	<5	A	0.14	<5	A
South Street at	EB Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.05	11	B
Proposed Driveway	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.03	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A

[1] Volume-to-capacity ratio
[2] Average control delay per vehicle (in seconds)
[3] Level of service
[4] n/a = not applicable

TABLE 9
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR

		Baseline			2025 No-Build			2025 Build		
Intersection	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Route 9 at	Eastbound	0.74	41	D	0.77	43	D	0.77	44	D
South Street	Westbound	0.91	45	D	0.94	49	D	0.94	49	D
	Northbound	0.85	74	E	0.99	>80	F	>1.0	>80	F
	Southbound	0.77	59	E	0.80	61	E	0.80	62	E
	Overall	**0.91**	**49**	**D**	**0.99**	**55**	**E**	**>1.0**	**58**	**E**
Route 20 at	Eastbound	0.60	11	B	0.66	12	B	0.66	12	B
South Street/	Westbound	0.70	18	B	0.76	20	B	0.77	20	C
Green Street	Northbound	0.04	17	B	0.04	18	B	0.04	18	B
	Southbound	0.80	36	D	0.91	49	D	>1.0	>80	F
	Overall	**0.80**	**19**	**B**	**0.91**	**23**	**C**	**>1.0**	**37**	**D**
Route 20 at	Eastbound	0.35	10	B	0.34	9	A	0.32	9	A
Centech Boulevard/	Westbound	0.86	21	C	0.89	22	C	0.89	23	C
Cherry Street	Northbound	0.89	59	E	>1.0	>80	F	>1.0	>80	F
	Southbound	0.42	41	D	0.74	78	E	>1.0	>80	F
	Overall	**0.89**	**25**	**C**	**>1.0**	**36**	**D**	**>1.0**	**49**	**D**
South Street at	EB Exit	0.16	16	C	0.40	23	C	0.46	28	D
UMass Dwy/	WB Exit	0.37	13	B	0.48	15	B	0.52	16	C
Charles River Dwy	Northbound	0.00	<5	A	0.00	<5	A	0.00	<5	A
	Southbound	0.01	<5	A	0.01	<5	A	0.01	<5	A
South Street at	EB Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.26	13	B
Proposed Driveway	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.02	<5	A
	Southbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A

[1] Volume-to-capacity ratio
[2] Average control delay per vehicle (in seconds)
[3] Level of service
[4] n/a = not applicable

As summarized in **Table 8** and **Table 9**:

- *Route 9 at South Street:* Under Build conditions, the signalized intersection of Route 9 at South Street will continue to operate at an overall LOS E or better during the weekday morning and weekday evening peak hours. The southbound approach will continue to operate with long delays during the weekday morning peak hour while the northbound approach will continue to operate with long delays during the weekday evening peak hour. The project will have only a minor impact on the study intersection relative to No-Build conditions.

- *Route 20 at South Street:* Under Build conditions, capacity analyses indicate the signalized intersection of Route 20 at South Street will operate at an overall LOS B or better during the weekday morning peak hour and LOS D or better during the weekday evening peak hours. With the project in place, the southbound approach will operate with long delays during the weekday evening peak hour. Improvements as outlined in the *Conclusions and Recommendations* section of this report will enhance safety and operations at this location and are consistent with long range improvements planned along Route 20 by MassDOT as described in *Section 3.1*.

- *Route 20 at Centech Boulevard/Cherry Street:* Under Build conditions, capacity analyses indicate the signalized intersection of Route 20 at South Street will operate at an overall LOS C or better during the weekday morning peak hour and LOS D or better during the weekday evening peak hours. Under No-Build conditions, the northbound and southbound approaches will operate with long delays during the weekday evening peak hour. The project will have only a minor impact on the study intersection compared to No-Build conditions. Long range improvements planned along Route 20 by MassDOT will enhance safety and operations at this location.

- *South Street at Umass Driveway/Charles River Driveway:* Under future Build conditions, the Umass and Charles River Driveways will operate under capacity at LOS D or better during the weekday morning and weekday evening peak hours. Mainline (through) travel along South Street will continue to operate unimpeded with minimal delay.

- *South Street at Proposed Site Driveway:* Under future Build conditions, the Site Driveway will operate under capacity at LOS B or better during the weekday morning and weekday evening peak hours. Mainline (through) travel along South Street will continue to operate unimpeded with minimal delay.

In summary, the analysis indicates that certain physical improvements at the Route 20 intersection with South Street may be necessary to support the development at full build-out of Sub-District A. Operations at the remaining study locations indicate that mitigation is not required to support the full build-out of the project. Improvements as outlined in the *Conclusions and Recommendations* section of this report will enhance safety and operations with regards to the development and are consistent with long-range improvements along Route 20 that are currently being developed by MassDOT.

4.2.2 Vehicle Queue Analysis

Vehicle queue results are presented for the three signalized intersections within the study area. These vehicle queues are compared to available storage lengths, which are defined as lengths of exclusive turn lanes or the distance to the nearest major intersection for through lanes. Vehicle queue results from the capacity analysis are summarized in **Table 10**, **Table 11**, and **Table 12**. Detailed worksheets of the queuing analysis are provided in the **Appendix**.

TABLE 10
VEHICLE QUEUE ANALYSIS SUMMARY
ROUTE 9 AT SOUTH STREET

		Baseline		2025 No-Build		2025 Build	
Approach	**Storage Length (feet)**	**Average Queue Length[1]**	**95th Percentile Queue Length[1]**	**Average Queue Length**	**95th Percentile Queue Length**	**Average Queue Length**	**95th Percentile Queue Length**
Weekday Morning Peak Hour							
Eastbound L	260±	68	128	73	133	74	134
Eastbound T&T/R	>1600	564	747	630	857	674	913
Westbound L	425±	135	229	156	280	164	299
Westbound T	>1600	284	410	304	438	307	442
Westbound R	650±	<25	<25	<25	<25	<25	<25
Northbound L	175±	101	172	112	182	117	188
Northbound T/R	>800	100	176	111	186	117	193
Southbound L	300±	353	613	411	662	417	664
Southbound L/T	>800	192	374	230	442	261	483
Southbound R	300±	<25	<25	<25	<25	<25	<25
Weekday Evening Peak Hour							
Eastbound L	260±	143	227	152	235	152	235
Eastbound T&T/R	>1600	430	552	472	584	478	590
Westbound L	425±	106	174	121	191	123	194
Westbound T	>1600	593	743	647	820	647	820
Westbound R	650±	<25	<25	<25	31	<25	34
Northbound L	175±	242	419	335	544	384	598
Northbound T/R	>800	196	308	259	440	287	496
Southbound L	300±	180	293	190	312	190	312
Southbound L/T	>800	172	270	184	283	187	288
Southbound R	300±	<25	64	<25	65	<25	65

[1] Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 11
VEHICLE QUEUE ANALYSIS SUMMARY
ROUTE 20 AT SOUTH STREET/GREEN STREET

		Baseline		2025 No-Build		2025 Build	
Approach	**Storage Length (feet)**	**Average Queue Length[1]**	**95th Percentile Queue Length[1]**	**Average Queue Length**	**95th Percentile Queue Length**	**Average Queue Length**	**95th Percentile Queue Length**
Weekday Morning Peak Hour							
Eastbound LT	>1000	30	73	43	92	56	111
Eastbound T/R	200±	271	642	379	876	405	876
Westbound L/T & T/R	>1000	55	116	58	126	63	131
Northbound L/T/R	>800	<25	41	<25	42	<25	42
Southbound L/T/R	>800	64	155	91	166	102	182
Weekday Evening Peak Hour							
Eastbound LT	>1000	<25	30	<25	32	<25	34
Eastbound T/R	200±	167	251	194	294	194	293
Westbound L/T & T/R	>1000	194	275	223	311	228	317
Northbound L/T/R	>800	<25	<25	<25	<25	<25	<25
Southbound L/T/R	>800	137	335	194	427	327	568

[1] Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 12
VEHICLE QUEUE ANALYSIS SUMMARY
ROUTE 20 AT CENTECH BOULEVARD/CHERRY STREET

		Baseline		2025 No-Build		2025 Build	
Approach	**Storage Length (feet)**	**Average Queue Length[1]**	**95th Percentile Queue Length[1]**	**Average Queue Length**	**95th Percentile Queue Length**	**Average Queue Length**	**95th Percentile Queue Length**
Weekday Morning Peak Hour							
Eastbound L	275±	<25	<25	<25	<25	<25	<25
Eastbound T&T/R	>1500	223	302	273	371	288	392
Westbound L	400±	<25	<25	<25	<25	<25	<25
Westbound T/R	>1500	102	164	111	178	115	185
Northbound L/T	>800	73	189	88	210	95	221
Northbound R	375±	41	98	54	108	59	113
Southbound L/T	>800	61	140	73	146	75	148
Southbound R	75±	>25	25	>25	26	<25	26
Weekday Evening Peak Hour							
Eastbound L	275±	<25	<25	<25	<25	<25	<25
Eastbound T&T/R	>1500	80	111	93	128	95	131
Westbound L	400±	<25	37	<25	40	26	42
Westbound T/R	>1500	424	643	561	921	647	1079
Northbound L/T	>800	161	414	265	444	275	452
Northbound R	375±	41	105	60	108	61	109
Southbound L/T	>800	53	145	77	194	99	219
Southbound R	75±	<25	32	<25	33	<25	33

[1] Average and 95th percentile queue lengths are reported in feet per lane.

As presented in **Table 10**, **Table 11** and **Table 12,** average and 95th percentile vehicle queues at the signalized study intersections will generally be contained within available storage lanes during the peak hours. The project will not significantly change queue lengths compared to No-Build conditions and will generally result in a nominal increase of 1 to 3 vehicles on any approach.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 RECOMMENDATIONS

MDM has identified several mitigation actions that are likely to be required through the local and MassDOT permitting process to support the project. These include (a) access-related improvements, (b) off-site improvements (c) pedestrian and bicycle accommodations, and (d) a transportation demand management (TDM) program to enhance traffic operations and travel safety. Refinement and expansion of these mitigative actions is anticipated under a subsequent MEPA filing that will consider the master plan buildout of the property to include the Sub-District B portion of the site, and that will be memorialized as part of a MassDOT Section 61 Finding following completion of the MEPA review process.

Access/Egress Improvements

- *Driveway Design*. The final driveway width and curb radii between the site driveway and South Street will be designed to accommodate the Town's largest fire apparatus (ladder truck) and service vehicles. Signs and pavement markings that comply with the Manual on Uniform Traffic Control Devices (MUTCD) will also be provided including STOP signs (R1-1) and STOP line pavement markings.

- *Sight Line Triangles.* Plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway intersection with South Street to ensure unobstructed sight lines are available.

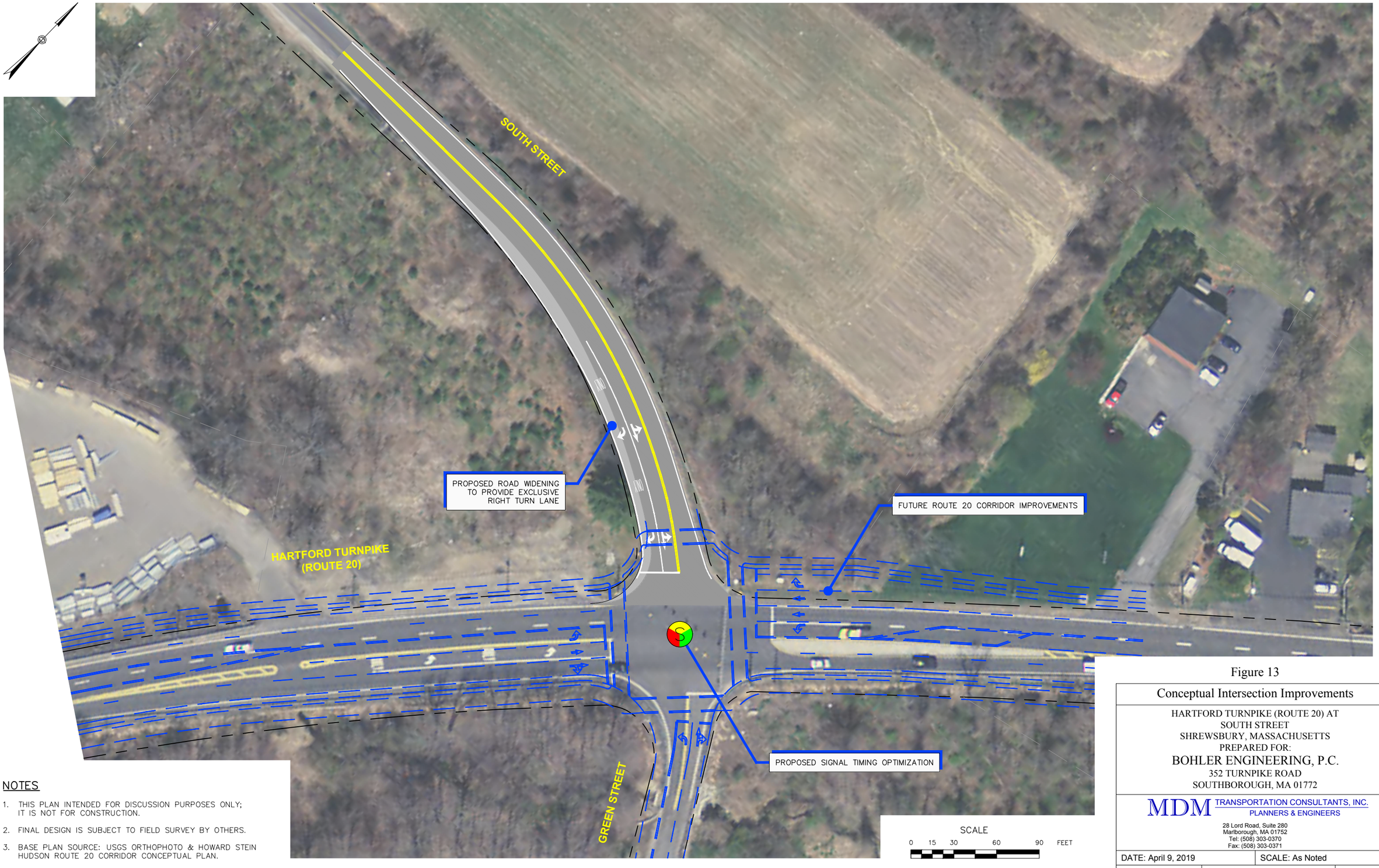
Off-Site Improvements

- *Road Safety Audit*. The Route 9 signalized intersection with South Street experienced a crash rate above the MassDOT District 3 averages and is listed by MassDOT as a highway safety improvement program (HSIP) high crash cluster for 2013-2015. The Proponent commits to preparation of a Road Safety Audit (RSA) to identify potential short-, medium- and long-term safety/operational improvements at this location and will commit to implementation of identified short-term recommendations.

Typical short-range improvements are limited to lower cost, easily implementable measures such as pavement restriping, supplemental or revised/updated signs, advance motorist warning controls, limited pavement and/or sidewalk repair, etc. Longer-term structural improvements are typically identified by assumed to be the responsibility of MassDOT or others and subject to State and/or Federal funding.

- *Route 20 at South Street Improvements/Optimization*. The Proponent will work with MassDOT to permit and implement geometric and signal modifications at the Route 20/South Street intersection to accommodate site trips and improve travel safety at the intersection. Geometric improvements include widening the southbound South Street approach to provide a shared through/left-turn lane and an exclusive right-turn lane. Under this improvement plan, traffic signal timing will be optimized to provide efficient traffic signal operations to accommodate project traffic increases. Improvements will be designed for compatibility with anticipated long-range improvements identified as part of the MassDOT Route 20 Corridor Improvement Study. Conceptual access improvements at the Route 20/South Street/Green Street signalized intersection are presented in **Figure 13**.

  Analysis results presented in **Table 13** indicate that geometric and signal modifications significantly improve traffic operations relative to No-Build conditions and offset impacts by the proposed development. As shown in **Table 14,** queuing along the South Street southbound lanes are expected to improve significantly. Additionally, southbound right turn movements onto Route 20 will have the ability to run concurrent with eastbound left turn movements to enhance efficiency. Proposed improvements are also consistent with recommended long-range improvements as cited by MassDOT for the Route 20 Corridor. The improvements will be designed to complement MassDOT's Route 20 pending improvement initiatives of providing a 4-lane Route 20 with additional turn lanes at its major intersections, installation of sidewalks and bicycle accommodations, and implementing pedestrian accommodations at the areas signalized intersections.



NOTES

1. THIS PLAN INTENDED FOR DISCUSSION PURPOSES ONLY; IT IS NOT FOR CONSTRUCTION.
2. FINAL DESIGN IS SUBJECT TO FIELD SURVEY BY OTHERS.
3. BASE PLAN SOURCE: USGS ORTHOPHOTO & HOWARD STEIN HUDSON ROUTE 20 CORRIDOR CONCEPTUAL PLAN.

Figure 13

Conceptual Intersection Improvements

HARTFORD TURNPIKE (ROUTE 20) AT
SOUTH STREET
SHREWSBURY, MASSACHUSETTS
PREPARED FOR:
BOHLER ENGINEERING, P.C.
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772

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DATE: April 9, 2019	SCALE: As Noted	
PROJECT No. 1001	File: 929 Concept Plan (2019-4-8).dwg	Sheet 1 of 1

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TABLE 13
MITIGATED SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS

		2025 No-Build			2025 Build			2025 Build (with mitigation)		
Period	Approach	v/c[1]	Delay[2]	LOS[3]	v/c	Delay	LOS	v/c	Delay	LOS
Weekday Morning Peak Hour										
Route 20 at	Eastbound	0.91	20	B	0.91	21	C	0.82	13	B
South Street/	Westbound	0.44	9	A	0.48	9	A	0.45	8	A
Green Street	Northbound	0.14	24	C	0.13	24	C	0.15	25	C
	Southbound	0.71	39	D	0.75	41	D	0.56	25	C
	Overall	**0.91**	**18**	**B**	**0.91**	**19**	**B**	**0.82**	**13**	**B**
Weekday Evening Peak Hour										
Route 20 at	Eastbound	0.66	12	B	0.66	12	B	0.61	10	A
South Street/	Westbound	0.76	20	B	0.77	20	C	0.77	20	B
Green Street	Northbound	0.04	18	B	0.04	18	B	0.05	17	B
	Southbound	0.91	49	D	>1.0	>80	F	0.74	25	C
	Overall	**0.91**	**23**	**C**	**>1.0**	**37**	**D**	**0.77**	**18**	**B**

[1]Volume-to-capacity ratio
[2]Average control delay per vehicle (in seconds)
[3]Level of service

TABLE 14
MITIGATED VEHICLE QUEUE ANALYSIS SUMMARY
ROUTE 20 AT SOUTH STREET/GREEN STREET

		2025 No-Build		2025 Build		2025 Build (with mitigation)	
Approach	**Storage Length (feet)**	**Average Queue Length[1]**	**95th Percentile Queue Length[1]**	**Average Queue Length**	**95th Percentile Queue Length**	**Average Queue Length**	**95th Percentile Queue Length**
Weekday Morning Peak Hour							
Eastbound LT	>1000	43	92	56	111	45	90
Eastbound T/R	200±	379	876	405	876	327	813
Westbound L/T & T/R	>1000	58	126	63	131	55	117
Northbound L/T/R	>800	<25	42	<25	42	<25	43
Southbound L/T/R	>800	91	166	102	182	n/a	n/a
Southbound L/T	n/a	n/a	n/a	n/a	n/a	61	126
Southbound R	n/a	n/a	n/a	n/a	n/a	<25	27
Weekday Evening Peak Hour							
Eastbound LT	>1000	<25	32	<25	34	<25	36
Eastbound T/R	200±	194	294	194	293	158	311
Westbound L/T & T/R	>1000	223	311	228	317	196	327
Northbound L/T/R	>800	<25	<25	<25	<25	<25	<25
Southbound L/T/R	>800	194	427	327	568	n/a	n/a
Southbound L/T	n/a	n/a	n/a	n/a	n/a	105	187
Southbound R	n/a	n/a	n/a	n/a	n/a	88	154

[1] Average and 95th percentile queue lengths are reported in feet per lane.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections*. The Site Plan will incorporate sidewalks that connect the proposed building entrances with parking areas and sidewalks along the driveway that connect to the existing sidewalk system along South Street. The Proponent also recognizes the need for extending existing sidewalks along South Street from their current terminal points to Route 9 and Route 20; however, the feasibility of constructing these sidewalk extensions is subject to further evaluation by the Proponent to determine potential land acquisition/easement requirements.

- *Crosswalks & ADA Compliant Ramps.* Marked crosswalks and ADA compliant ramps will be provided at the proposed driveway intersection with South Street and at any internal site driveway crossings.

- *Bicycle Amenities*. The Proponent will incorporate bicycle racks within the property near building entrances and the site driveway will be designed for bicycle accommodation to encourage and facilitate this mode of transportation to/from the Site. Additional means of bicycle accommodation on area roadway including appropriate roadway markings and signs will also be considered within the larger context of the future roadway improvements along the Route 20 corridor that are being considered by MassDOT.

Transportation Demand Management (TDM) Program

The Proponent is committed to reduce Site trip generation by tenant employees by implementing a TDM program, elements of which will be memorialized in a Tenant Manual and/or will be made a provision of a master deed. These elements are consistent with the Massachusetts Department of Environmental Protection (MADEP) directive to use all reasonable and feasible mitigation actions to reduce auto emissions. The TDM program includes the following elements, which are subject to selected tenant corporate policies:

- *Employee Transportation Coordinator*. The Proponent will designate a contact that will serve as transportation coordinator responsible for disseminating relevant TDM information to tenants including documentation of TDM information as part of a Tenant Manual at time of lease and/or as subject to a Master Deed for the property.

- *Public Transportation Information & Promotion*. Service and schedule information for the Worcester Regional Transit Authority (WRTA) and MBTA will be posted and public transportation subsidy program considered to promote the use of public transportation by employees and visitors. Alternative means of connecting the Site to the nearby MBTA station at Centech Boulevard (Grafton MBTA station) will also be evaluated by the Proponent such as modification of WRTA bus routes, rideshare services such as Uber and Lyft, bike share services, tenant employee carpool options, and rideshare matching services with other nearby employers along South Street that include UMass and Charles River Laboratories.

- *Bicycle Facilities and Amenities*. Bicycle parking, including visible accessible racks for visitors and employees will be provided proximate to building entrances. The Proponent will also consider a bike share service for the property that will provide tenant employees access to bicycles for access to nearby transit options, recreational purposes during break periods and alternative means of travel to area destinations.

- *Alternative Work Arrangements*. The Proponent will encourage its tenants to provide alternative work arrangements such as flextime, compressed workweek and telecommuting in order to allow employees to balance work and personal commitments, and to reduce traffic and parking demands.

- *Preferential Parking for Carpools, Vanpools and Car Sharing.* Preferential parking locations for building tenant employees who use carpools and vanpools are to be provided; specific locations and number are to be determined through refinement of the Site Plans for the project.

- *Preferential Parking for Low-Emission Vehicles.* Preferential parking locations for employees and patrons who use low-emission vehicles will be considered; charging stations for electric vehicles will also be considered during the Site Plan development process.

- *Transit Pass Subsidy.* The Proponent will encourage its tenants to offer fare subsidies for commuter rail passes for eligible employees and/or offer pre-tax payroll deductions for employee transit passes.

- *Transit System Connections.* Alternative means of connecting the Site to the nearby MBTA station at Centech Boulevard (Grafton MBTA station) will also be evaluated by the Proponent such as modification of WRTA bus routes, rideshare services such as Uber and Lyft, bike share services, tenant employee carpool options, and rideshare matching services with other nearby employers along South Street that include UMass and Charles River Laboratories.

- *MassRides*. MassRides is the Executive Office of Transportation's statewide travel options program providing free assistance to commuters, employers, students, and other traveler markets. MassRides programs may encourage workers to use alternative forms of transportation such as carpooling, vanpooling, and to utilize a large database for rideshare matching. The Proponent will promote commuter assistance programs available through MassRides by encouraging building tenants to incorporate information on MassRides as part of the employee orientation programs.

- *Guaranteed Ride Home*. The Proponent will encourage commercial tenants to offer a guaranteed ride home program that subsidizes taxi service for employees using non-auto commute options in cases of unexpected circumstances.

- *Pedestrian Infrastructure*. Sidewalk connections within the property along primary pedestrian desire lines that connect building entrances with the public sidewalk network; posting of area maps that highlight area walking/bicycle routes to promote walking and bicycle travel to/from the Site and area businesses. The Proponent also recognizes the need for extending existing sidewalks along South Street from their current terminal points to Route 9 and Route 20; however, the feasibility of constructing these sidewalk extensions is subject to further evaluation by the Proponent to determine potential land acquisition/easement requirements.

- *On-Site Support Services/Amenities*. Buildings will include services and amenities that encourage employees to remain on-site for essential services and internalize trip making to the campus including on-site mailboxes and an on-site Fed-Ex and/or UPS drop box locations. Other amenities to be considered in building programming may include an employee fitness center, showers, and cafeteria for employees – measures aimed at reducing the need to conduct off-site trips during a typical workday. Specific measures are to be evaluated in more detail during the Site Plan review process.

5.2 CONCLUSIONS

In summary, MDM finds that incremental traffic associated with the proposed Centech North Sub-District A development is expected to be modest at study intersections and will be accommodated within available capacities following implementation of access/egress improvements and off-site improvements at Route 20/South Street. Additional improvements including pedestrian and bicycle accommodations and a Transportation Demand Management (TDM) program as outlined in this study will establish a framework of accommodating Site traffic impacts and encouraging non-motorized travel modes and pedestrian/bicycle accommodation. Refinement and expansion of these mitigative actions is anticipated under a subsequent MEPA filing that will consider the master plan buildout of the property to include the Sub-District B portion of the site, and that will be memorialized as part of a MassDOT Section 61 Finding following completion of the MEPA review process.