# Traffic Impact and Access Study

*TEC Project File No.T0852.04*

# *The Landing - Lancaster*

McGovern Boulevard – Lancaster, Massachusetts

Prepared for: **Town of Lancaster, Massachusetts**
Prescott Building
701 Main Street
Lancaster, Massachusetts 01523

On Behalf of: **Capital Group Properties**
259 Turnpike Road, #100
Southborough, Massachusetts 01772

Prepared by: **TEC, Inc.**
146 Dascomb Road
Andover, Massachusetts 01810

I have reviewed this document as it relates to the proposed design and have determined the design to be safe for public health and welfare in conformity with accepted engineering standards.

COMMONWEALTH OF MASSACHUSETTS
SAMUEL W. GREGORIO
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REGISTERED PROFESSIONAL ENGINEER

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**REVISED October 31, 2022**

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# EXECUTIVE SUMMARY

TEC, Inc. (TEC) has been retained by Capital Group Properties (the "Applicant") to prepare a Traffic Impact and Access Study (TIAS) for the proposed Landing - Lancaster (the "Project") along McGovern Boulevard and Lunenburg Road (Route 70) in Lancaster, Massachusetts. The Applicant proposes to construct the Project as a dynamic mixed-use housing, industrial / commercial, and retail redevelopment, intended as a "*Live* | *Work* | *Play*" mix of uses to bolster the surrounding neighborhood while utilizing the site's proximity to regional access points on both Route 2, Interstate 495 (I-495), and Interstate 190 (I-190).

The study was prepared in accordance with Massachusetts Department of Transportation's (MassDOT) *Transportation Impact Assessment (TIA) Guidelines*[1] and was prepared in consultation with both the Town of Lancaster and the MassDOT District 3 Office. The Project is concurrently being reviewed by various state agencies, including MassDOT, as part of the Massachusetts Environmental Policy Act (MEPA) review process.

## PROJECT DESCRIPTION

The site is currently occupied by multiple retail and industrial establishments. Along McGovern Boulevard, the existing site includes the FC Stars outdoor soccer complex comprised of three (3) soccer fields, a 11,800 square foot (SF) J.B. Hunt Transport Services facility, a 2,300 SF Dunkin Donuts, a 5,000 SF Mobil gas station with convenience market, and the recently closed soil / gravel yard for Central Mass Sand & Gravel. The Project will retain the existing three (3) outdoor soccer fields, Dunkin Donuts, and Mobil Gas Station and raze both the existing J.B. Hunt Transport Services facility and the Central Mass Sand & Gravel site. The proposed mixed-use development program includes construction of a 2,424,250 square foot (SF) industrial park, 73,450 SF of professional office, 41,300 SF of additional retail space (48,600 SF total with existing Dunkin Donuts and Mobil), and 150 residential apartment units.

The Project proposes to retain the access/egress to the site via McGovern Boulevard and the minor retail driveways for the existing Mobil Gas Station and Dunkin Donuts along Lunenburg Road. The J.B. Hunt Transport Services facility is currently accessed via a separate full access/egress driveway along Lunenburg Road which will be closed. Individual minor driveways along Lunenburg Road will be constructed specifically for turning movements to/from on-site retail tenants along the site frontage similar to the existing Mobil Gas Station and Dunkin Donuts.

[1] *Transportation Impact Assessment (TIA) Guidelines*; Massachusetts Department of Transportation; March 13, 2014.

## STUDY PARAMETERS

This following study is based on current traffic data collected at key study area intersections in December 2018 and August 2019, prior to the onset of the COVID-19 pandemic. These key locations include:

1. Main Street (Route 70/117) / Seven Bridge Road (Route 117) / Driveway
2. Main Street (Route 70/117) / Lunenburg Road (Route 70)
3. Lunenburg Road (Route 70) / McGovern Boulevard
4. Lunenburg Road (Route 70) / Old Union Turnpike
5. Lunenburg Road (Route 70) / Woods Lane / Fort Pond Road
6. Old Union Turnpike / Route 2 (Interchange 103) Eastbound Ramps
7. Fort Pond Road / Route 2 (Interchange 103) Westbound Ramps

The future planning horizon examines traffic operations under existing conditions (2019), as well as a 11-year planning horizon (2030) for traffic-volume projections, which includes an evaluation of the No-Build conditions (without the proposed project), Build conditions (with the proposed project), and Build with Mitigation conditions (with the proposed project and any proposed mitigation).

## SITE TRIP GENERATION ESTIMATES

The TIAS provides a detailed assessment of estimated site-generated traffic based on industry standard trip rates published in the Institute of Transportation Engineers (ITE) publication, *Trip Generation, 11th Edition*. Although the business goals of perspective tenants are to not have industrial park shift changes overlap with the general commuter peak hour along Lunenburg Road, the projections assume a conservative (worst-case) scenario to present the overlapping of shift changes and commuter peak period. The proposed mixed-use redevelopment is thereby anticipated to generate 7,610 new vehicle trips during the average weekday, with 864 new vehicle trips (673 entering and 191 exiting) during the weekday morning peak hour and 822 new vehicle trips (210 entering and 612 exiting) during the weekday evening peak hour. On a typical Saturday the development is anticipated to generate 8,074 new vehicle trips with 926 new vehicle trips (345 entering and 581 exiting) during the Saturday midday peak hour.

## PROPOSED TRANSPORTATION IMPROVEMENTS

Independent of the Project's off-site transportation mitigation, MassDOT is currently in the process of planning, designing, or completing significant transportation improvements in the vicinity of the project that will provide significant reserve capacity to the area roadway network. These improvements, which are to occur regardless of the Landing - Lancaster, include:

- Reconstruction of the intersections of Main Street (Route 70/117) / Lunenburg Road (Route 70) and Main Street (Route 70/117) / Seven Bridge Road (Route 117) to provide new traffic signals, turn lanes, and enhanced pedestrian and bicycle accommodations. This project, identified as MassDOT Project File No. 608779, is currently under construction.

- Reconstruction of Route 2 Interchange 103 (formerly Interchange 35) to provide expanded freeway acceleration and deceleration lanes, relocation of ramps, and the addition of intersection improvements for the Lunenburg Road / Fort Pond Road intersection. Based on recent discussions with MassDOT, no specific project alternative has been identified and it is expected that the design of any alternative, or programming on the Transportation Improvement Program (TIP) is a few years away. Design of improvements at Interchange 102 (formerly Interchange 34) to the immediate west with Old Union Turnpike had previously commence; however, there is no programming in place for a future TIP year of construction and funding.

The Applicant is committed to implement and construct transportation mitigation measures to both complement the above-mentioned MassDOT improvements and further improve both traffic operations and safety and address existing and future deficiencies for all users. This includes off-site roadway improvements along Main Street, McGovern Boulevard, Lunenburg Road, and the Route 2 Westbound (WB) Ramps at Interchange 103 (formerly Interchange 35). The proposed improvements will include, but are not limited to:

- Provide traffic signal timing optimization at each stage of occupancy to two new traffic signals along Main Street being constructed as part of the upcoming MassDOT Project File No. 608779.
- Construction of a fully actuated traffic signal at the intersection of Lunenburg Road / McGovern Boulevard.
- Reconstruction / widening of Lunenburg Road to provide a northbound left-turn lane and southbound right-turn lane onto McGovern Boulevard.
- Construction of a shared-use path along the westerly side of Lunenburg Road adjacent to the site to introduce pedestrian and bicycle accommodations.
- Reconstruction of McGovern Boulevard to consist of a two to four-lane cross-section with multimodal roadway accommodations that will enhance healthy transportation alternatives such as walking and bicycling along McGovern Boulevard.
- Construction of an interim traffic signal at the intersection of Lunenburg Road / Fort Pond Road / Woods Lane within the existing intersection geometry.
- Construct modifications to the Route 2 WB Interchange 103 (formerly Interchange 35) off-ramp deceleration lane and roadway shoulder to extend queue storage.
- Construct minor modifications to the Route 2 WB Interchange 103 (formerly Interchange 35) on-ramp acceleration lane and freeway shoulder to slightly extend acceleration area based on constraints of the Route 70 bridge.

The Applicant has also committed to several Transportation Demand Management (TDM) measures aimed to reduce single-occupancy vehicle (SOV) trips and overall vehicular traffic to/from the redevelopment site and better manage traffic generated by the proposed project. Finally, the Applicant has committed to implementing a Traffic Monitoring Plan (TMP), which is intended to monitor traffic operations and parking occupancy throughout the construction and for a period following completion of the Project. A detailed review of these mitigation measures is further defined in this TIAS.

# I. INTRODUCTION

## PURPOSE OF STUDY

TEC, Inc. (TEC) has been retained by Capital Group Properties (the "Applicant") to prepare a Traffic Impact and Access Study (TIAS) for the proposed Landing - Lancaster (the "Project") along McGovern Boulevard and Lunenburg Road (Route 70) in Lancaster, Massachusetts. The Applicant proposes to construct the Project as a dynamic mixed-use housing, industrial / commercial, and retail redevelopment, intended as a "*Live* | *Work* | *Play*" mix of uses to bolster the surrounding neighborhood while utilizing the site's proximity to regional access points on both Route 2, Interstate 495 (I-495), and Interstate 190 (I-190).

The existing site is currently occupied by an FC Stars outdoor soccer complex comprised of three (3) soccer fields, a 11,800 square foot (SF) J.B. Hunt Transport Services facility, a 2,300 SF Dunkin Donuts, a 5,000 SF Mobil gas station with convenience market, and the recently closed soil / gravel yard for Central Mass Sand & Gravel. The Project consists of redeveloping the existing site; but retaining the existing three (3) outdoor soccer fields, Dunkin Donuts, and Mobil Gas Station. The proposed mixed-use development program includes construction of a 2,424,250 square foot (SF) industrial park, 73,450 SF of professional office, 41,300 SF of additional retail space (48,600 SF total with existing Dunkin Donuts and Mobil), and 150 residential apartment units.

The Project proposes to retain the access/egress to the site via McGovern Boulevard and the minor retail driveways for the existing Mobil Gas Station and Dunkin Donuts along Lunenburg Road. The J.B. Hunt Transport Services is currently accessed via a separate full access/egress driveway along Lunenburg Road which will be closed. Individual minor driveways along Lunenburg Road, at the site frontage, will be constructed specifically for turning movements to/from on-site retail tenants similar to the existing Mobil Gas Station and Dunkin Donuts.

## Changes Since the October 2021 TIAS

Since the filing of the TIAS with the Town of Lancaster in October 2021, the Applicant has modified the building program resulting in a reduction of overall floor area within the industrial component, a slight increase in the overall floor area within the office component, and the release of the prospective tenant for Building "A". The change in building footprints throughout the site will result in a reduction of site generated traffic as compared to the original TIAS. The reduction in projected site generated traffic for the site effects the results of the traffic impact analysis and generally reduces the overall impact of the site of the study area roadways and intersections.

In addition, TEC has updated information related to the specific developments by others at 584 & 696 Fort Pond Road. Although two separate projects, the project are directly adjacent to each other and are combined for the purpose of this TIAS. Since the last version of the TIAS, the

overall industrial land use square footage has been reduced to 826,700 SF (still in planning stage) and was confirmed by the Town of Lancaster Community Development and Planning Department on October 27, 2022.

## Past Vanasse and Associates Peer Review

On September 7, 2021, Vanasse and Associates, Inc. (VAI) issued a traffic engineering peer review[2] of the original project TIAS on behalf of the Town of Lancaster. The peer review focused on vehicle and pedestrian access and circulation, MassDOT design standards, Town Zoning requirements as they relate to access, parking and circulation, and accepted Traffic Engineering and Transportation Planning practices. VAI found that the materials in the TIAS were prepared in a professional manner and following the applicable standards of care. VAI did submit eleven (11) specific comments each of which were addressed within this revised TIAS issued to the Town of Lancaster in October 2021 and specifically summarized in TEC's *Response to Traffic Engineering Peer Review*[3] submitted to the Town of Lancaster concurrently with this revised TIAS. The following changes were incorporated into the operational and safety analyses of the revised October 2021 TIAS and continue to be incorporated in this version of the TIAS:

- TEC had added background traffic to the study area related to a proposed 372,000 SF warehouse and distribution facility at 435 Leominster-Shirley Road in Lunenburg, MA. This separate project results in an increase in the projected traffic volumes at several study area intersections in the No-Build, Build, and Build with Mitigation conditions.
- TEC had modified the operational analyses to adjust heavy vehicle percentages on specific movements in the Build and Build with Mitigation conditions. This modification does not result in substantive changes to the results of the analyses.
- TEC had modified the Applicant's off-site mitigation commitments to include interim pedestrian crossing infrastructure at the intersection of Lunenburg Road / McGovern Boulevard. This infrastructure would be installed prior to first building occupancy unless the proposed traffic signal as proposed is constructed prior to first building occupancy.
- TEC had modified the Transportation Monitoring Program (TMP), which is to be completed at intervals following occupancy of the site, to evaluated additional locations and timeframes. In addition, the TMP outlines additional thresholds for alternative mitigation measures.

## METHODOLOGY

TEC has evaluated the traffic operations for the study area under existing and future conditions consistent with the *Transportation Impact Assessment (TIA) Guidelines* issued by the Massachusetts Department of Transportation (MassDOT)[4] and the standards of the Traffic Engineering and Transportation Planning professions for the preparation of such reports. The

[2] *Traffic Engineering Peer Review - Capital Commerce Center – Lunenburg Road and McGovern Boulevard – Lancaster, Massachusetts;* Vanasse and Associates, Inc.; Andover, MA; September 7, 2021
[3] *Capital Commerce Center – Lunenburg Road – Lancaster, Massachusetts - Response to Traffic Engineering Peer Review*; TEC; Andover, MA; October 15, 2021
[4] *Transportation Impact Assessment (TIA) Guidelines*; Massachusetts Department of Transportation; March 13, 2014.

future planning horizon examines traffic operations under existing conditions (2019), as well as a 11-year planning horizon (2030) for traffic-volume projections, which includes an evaluation of the No-Build conditions (without the proposed project), Build conditions (with the proposed project), and Build with Mitigation conditions (with the proposed project and any proposed mitigation).

# II. EXISTING CONDITIONS

## TRAFFIC STUDY AREA

A comprehensive field inventory of existing traffic conditions on the study area corridors and intersections was conducted during various site visits by TEC staff from March 2019 through August 2019. The field investigations consisted of existing roadway geometrics, operating characteristics, study area safety concerns, and multi-modal accommodations.

### Study Area Intersections

The study area was selected to contain the major roadways providing local access/egress to/from the project site. This includes an evaluation of intersection in which the site-generated trips increase the peak hour traffic volume by more than 5 percent and/or by more than 100 vehicles per hour per MassDOT's *TIA Guidelines* (Section 3.I.C). The following intersections were therefore evaluated as part of the study area:

1. Main Street (Route 70/117) / Seven Bridge Road (Route 117) / Driveway
2. Main Street (Route 70/117) / Lunenburg Road (Route 70)
3. Lunenburg Road (Route 70) / McGovern Boulevard
4. Lunenburg Road (Route 70) / Old Union Turnpike
5. Lunenburg Road (Route 70) / Woods Lane / Fort Pond Road
6. Old Union Turnpike / Route 2 (Interchange 103) Eastbound Ramps
7. Fort Pond Road / Route 2 (Interchange 103) Westbound Ramps

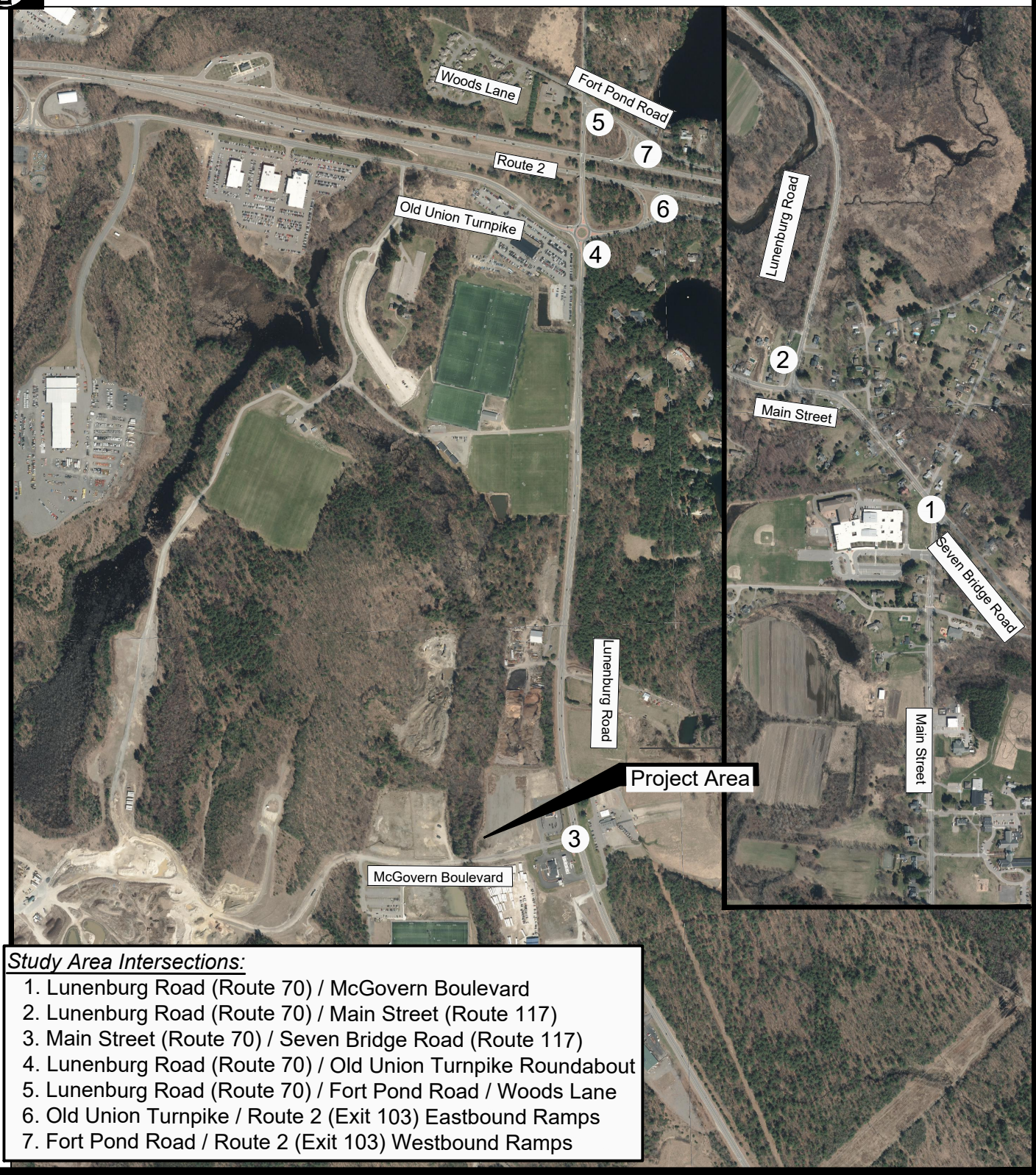
The study area intersections and project limits are shown graphically in Figure 1.

## GEOMETRY

The field inventory included collection of existing roadway geometrics, pedestrian and bicycle accommodations, traffic volumes, sight distances, and safety data for the existing study area. A description of the existing roadway and intersection inventory is provided within this section.

North

1" = 1000'




*Study Area Intersections:*

1. Lunenburg Road (Route 70) / McGovern Boulevard
2. Lunenburg Road (Route 70) / Main Street (Route 117)
3. Main Street (Route 70) / Seven Bridge Road (Route 117)
4. Lunenburg Road (Route 70) / Old Union Turnpike Roundabout
5. Lunenburg Road (Route 70) / Fort Pond Road / Woods Lane
6. Old Union Turnpike / Route 2 (Exit 103) Eastbound Ramps
7. Fort Pond Road / Route 2 (Exit 103) Westbound Ramps

**Figure 1**

**Project Location Map &**
**Study Area Intersections**

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The Engineering Corp

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## Roadways

*Lunenburg Road (Route 70)*

Lunenburg Road, signed as MA State Route 70, is a north-south urban principal arterial roadway maintained by the Town of Lancaster. The roadway provides regional connection between the Town of Shirley to the north and Main Street (Route 70/117) to the south. In the vicinity of the project site, Lunenburg Road is approximately 44-feet wide with 10-foot shoulders. Directional flow along Lunenburg Road is separated by a double-yellow centerline. A posted/regulated speed along the corridor is 50 miles per hour (mph)[5] in the vicinity of McGovern Boulevard. Land uses along Lunenburg Road generally include light industrial and light commercial uses. There are no sidewalks or bicycle accommodations provided along Lunenburg Road.

## Existing Intersections

*Main Street (Route 70/117) / Seven Bridge Road (Route 117) / Driveway*

Main Street and a residential driveway intersect Seven Bridge Road to form a three-legged, stop-controlled intersection. The Main Street eastbound approach operates under free-flow conditions and consists of a general-purpose travel lane with a gentle channelized right-turn onto Main Street heading south which operates under free-flow conditions. The Main Street northbound approach operates under stop-control and consists of a single general-purpose travel lane. Directional flow along the Main Street northbound approach is separated by a raised asphalt median at the intersection and a painted double-yellow centerline. The Seven Bridge Road westbound approach operates under free-flow conditions and consists of a single general-purpose travel lane with directional flow separated by a double-yellow centerline. A continuous sidewalk, separated by a grass buffer, is provided along the southerly side of Main Street from the west and the westerly side of Main Street from the south. There are no crosswalks or bicycle accommodations provided at the intersection.

As part of the current Main Street Improvement Project (MassDOT Project File No. 608779), a new fully actuated traffic signal is currently under construction at this location. The Main Street eastbound approach will be widened to include a through lane and an exclusive right-turn lane. The Seven Bridge Road westbound approach will be widened to include an exclusive left-turn lane and a through lane. Bicycle lanes will be installed along Main Street northbound, and a new shared-use path will be constructed along the southerly side of Main Street between Lunenburg Road and a point 275-feet south of Seven Bridge Road.

*Main Street (Route 70/117) / Lunenburg Road (Route 70)*

Lunenburg Road intersects Main Street to form a three-legged, stop-controlled intersection. The Lunenburg Road southbound approach operates under stop-control and consists of an exclusive left-turn lane and an exclusive right-turn lane with directional flow separated by a marked double-yellow centerline and a short divisional island on the approach. The Main Street eastbound and westbound approaches operate under free-flow conditions and consist of a single general-purpose travel lane with directional flow separated by a double-yellow centerline. A sidewalk,

[5] MassDOT Speed Regulation 619-A dated March 2, 1977

separated by a grass buffer, is provided along the southerly side of Main Street. There are no crosswalks or bicycle accommodations provided at the intersection.

As part of the current Main Street Improvement Project (MassDOT Project File No. 608779), a new fully actuated traffic signal is currently under construction at this location. The Main Street eastbound approach will be widened to include an exclusive left-turn lane and a through lane. The Main Street westbound approach will be widened to include a through lane and an exclusive right-turn lane and a through lane. The Lunenburg Road southbound approach will be widened to include exclusive left-turn and right-turn lanes. Bicycle lanes will be installed along Lunenburg Road southbound a new shared-use path will be constructed along the southerly side of Main Street between Lunenburg Road and a point 275-feet south of Seven Bridge Road.

*Lunenburg Road (Route 70) / McGovern Boulevard*

McGovern Boulevard intersections Lunenburg Road to form a three-legged, stop-controlled intersection. The McGovern Boulevard eastbound approach operates under stop-control and consists of a single general-purpose travel lane with directional flow separated by a raised landscaped median. The Lunenburg Road northbound and southbound approaches operate under free-flow conditions and consist of a single general-purpose travel lane with directional flow separated by a marked centerline. No pedestrian or bicycle accommodations are provided at this intersection. Advanced warning signage with flashers noting: “Business District Ahead – Vehicles Entering & Exiting” is posted along both sides of Lunenburg Road approximately 2,000-feet from the intersection.

*Lunenburg Road (Route 70) / Old Union Turnpike*

Old Union Turnpike intersects Lunenburg Road to form a four-legged roundabout intersection. The intersection was reconstructed as a roundabout in 2013 as part of MassDOT Project File No. 605216 which created a significant amount of reserve capacity at the intersection. All four intersection approaches consist of a single general-purpose travel lane with directional flow separated by a splitter island. In addition, each approach enters the roundabout under yield-control. The roundabout’s inscribed circle is approximately 130-feet in diameter and is comprised of a 17.5-foot travel lane and a 10-foot truck brick truck-apron. Crosswalks are provided across the eastbound and northbound approaches to the roundabout; however, sidewalks do not carry out past the immediately roundabout limits. There are no formal bicycle accommodations through the roundabout.

*Lunenburg Road (Route 70) / Fort Pond Road / Woods Lane*

Fort Pond Road and Woods Lane intersect Lunenburg Road to form a four-legged stop-controlled intersection. In addition to the standard roadway connections, the driveway to the Heart of New England Council Boy Scouts of America Service Center enters Lunenburg Road directly opposing Fort Pond Road. Woods Lane is offset to the north by approximately 100-feet. The Woods Lane eastbound approach is under stop-control and consists of a general-purpose travel lane with directional flow unmarked. The Fort Pond Road westbound approach is under stop-control and consists of an exclusive left-turn lane and a channelized through/right-turn lane with directional flow separated by a raised asphalt median. The Lunenburg northbound approach is free-flowing and consists of shared left-turn/through lane and a channelized right-turn lane with directional flow separated by a marked centerline. The Lunenburg Road southbound

approach is free-flowing and consists of a single general-purpose travel lane with directional flow separated by a marked centerline. No pedestrian or bicycle accommodations are provided at this intersection.

*Old Union Turnpike / Route 2 Interchange 103 Eastbound Ramps*

The Route 2 Interchange 103 (formerly Interchange 35) Eastbound (EB) Ramps intersect Old Union Turnpike to form a three-legged unsignalized intersection. The Route 2 EB Ramps southbound approach consists of an exclusive left-turn lane under stop-control and a channelized right-turn lane under yield-control. Directional flow along the ramps is separated by a raised landscaped median. The Old Union Turnpike eastbound approach is free-flowing and consists of a single general-purpose travel lane with directional flow separated by a marked centerline. The Old Union Turnpike westbound approach is free-flowing and consists of a through lane and a channelized right-turn lane under yield-control with directional flow separated by a marked centerline. There are no formal bicycle accommodations. MassDOT recently installed new 'Do Not Enter', 'One-Way', and 'Wrong Way' signage along the Route 2 EB Ramps as part of their recent Wrong Way Crash initiative.

*Fort Pond Road / Route 2 Interchange 103 Westbound Ramps*

The Route 2 Interchange 103 (formerly Interchange 35) Westbound (WB) Ramps intersect Fort Pond Road to form a three-legged unsignalized intersection. The Route 2 WB Ramps northbound approach consists of an exclusive left-turn lane under stop-control and a channelized right-turn lane under yield-control. Directional flow along the ramps is separated by a raised landscaped median. The Fort Pond Road eastbound approach is free-flowing and consists of a through lane and a channelized right-turn lane under yield-control with directional flow separated by a marked centerline. The Fort Pond Road westbound approach is free-flowing and consists of a single general-purpose travel lane with directional flow separated by a marked centerline. There are no formal bicycle accommodations. MassDOT recently installed new 'Do Not Enter', 'One-Way', and 'Wrong Way' signage along the Route 2 WB Ramps as part of their recent Wrong Way Crash initiative.

## PUBLIC TRANSPORTATION

The Project is situated on the eastern edge of the Montachusett Regional Transit Authority (MART) region; however, currently no service is provided in the vicinity of the site.

## EXISTING TRAFFIC VOLUMES

Traffic volume data for this report was obtained from Manual Turning Movement Counts (TMCs) and supplemented with Automatic Traffic Recorder (ATR) counts conducted at the study area intersections. The details of the data collection effort for this project are described below.

### Turning Movement Counts

To establish existing traffic-volume conditions within the study area, manual TMCs were conducted at the study area intersections on multiple dates during the typical weekday and the typical Saturday including traffic volumes within the defined weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 PM to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods. Areas schools were generally in regular session during the dates in which the weekday

TMCs were collected. Saturday TMCs were conducted during late summer when tourism and outdoor activities were generally at peak season.

Weekday traffic counts performed as part of this project are currently more than two years old from the date of TIAS submission; however, all traffic counts included in the project were conducted pre-COVID 19 and reflect a conservative condition of traffic volumes as compared to current 2021 conditions. Traffic counts and adjustments used as part of this TIAS follow current / former MassDOT guidelines (Engineering Directive E-20-005) for use of historical traffic counts during the COVID-19 pandemic. Table 1 presents the date, time period, and nature of each TMC performed. A detailed summary of the TMCs partitioned into 15-minute intervals is provided in Appendix A.

**Table 1 – Turning Movement Count Summary**

| | Dates of Counts | |
|---|---|---|
| **Intersection** | **Weekday** | **Saturday** |
| Main Street / Seven Bridge Road / Shirley Road | 12/19/2018 | 8/17/2019 |
| Main Street / Lunenburg Road | 12/19/2018 | 8/17/2019 |
| Lunenburg Road / McGovern Boulevard | 12/19/2018 | 8/17/2019 |
| Lunenburg Road / Old Union Turnpike | 12/19/2018 | 8/17/2019 |
| Lunenburg Road / Woods Lane / Fort Pond Road | 12/19/2018 | 8/17/2019 |
| Old Union Turnpike / Route 2 Exit 103 EB Ramps | 12/19/2018 | 8/17/2019 |
| Fort Pond Road / Route 2 Exit 103 WB Ramps | 12/19/2018 | Not Collected |

## Automatic Traffic Recorder Counts

Automatic Traffic Recorder (ATR) counts were conducted concurrently with the TMCs from Tuesday, December 18, 2018 to Wednesday, December 19, 2018 to gather daily traffic-volume, vehicle classification, and speed data for the study area roadways during a continuous 48-hour time period. The ATR provided volume, speed, and classification data for Lunenburg Road, north of the Kimball Farm Driveway. A summary of the weekday ATR traffic data is presented in Table 2. A detailed summary of the ATR counts, partitioned into 15-minute intervals, are provided in Appendix B.

**Table 2 – 2019 Weekday Traffic Volume Summary**

| | | Weekday Morning Peak Hour | | | Weekday Evening Peak Hour | | |
|---|---|---|---|---|---|---|---|
| **Location** | **Weekday Traffic Volume[a]** | **Traffic Volume[b]** | **K Factor[c]** | **Directional Distribution[d]** | **Traffic Volume** | **K Factor** | **Directional Distribution** |
| Lunenburg Road, north of Kimball Farm Dwy | 10,977 | 712 | 6.5 | 51.3% SB | 1,022 | 9.3 | 62.7% NB |

[a] Daily traffic expressed in vehicles per day
[b] Hourly traffic expressed in vehicles per hour
[c] Percent of daily traffic volumes which occurs during the peak hour
[d] Percent of peak-hour volume in the predominant direction of travel
NB = Northbound; SB = Southbound

Lunenburg Road, in the vicinity of McGovern Boulevard, carries approximately 11,000 vehicles per day (vpd) on an average weekday. Directional distribution along the roadway was roughly split 50-50 during the weekday morning peak hour and heavily weighted northbound in the

weekday evening peak hour. Speed data indicates that the average speed and 85th percentile speed along Lunenburg Road northbound are 47 and 52 mph, respectively. The average speed and 85th percentile speed along Lunenburg Road southbound are 50 and 55 mph, respectively. This indicates that vehicular traffic along the corridor is generally traveling at or in the immediately vicinity of the posted and regulated speed limit of 50 mph.

## Seasonal Adjustment

In accordance with MassDOT standards, traffic volumes are typically adjusted to reflect average-month conditions for preparation of a traffic impact assessment. A review of historic traffic volume counts collected by MassDOT at a permanent count station along Route 2 in Lancaster[6] indicated that traffic volumes in December are approximately 5.6 percent lower than average-month conditions. The traffic volumes at this location also indicate that traffic volumes in August are approximately 7.1 percent higher than average-month conditions. Therefore, the December 2018 traffic volumes were upwardly adjusted by 5.6 percent to reflect a conservative analysis scenario. August 2019 traffic counts were unadjusted to reflect a conservative analysis scenario. Although these counts are along a freeway roadway, Lunenburg Road through the study area generally operates consistent with commuter and tourist seasonal patterns.

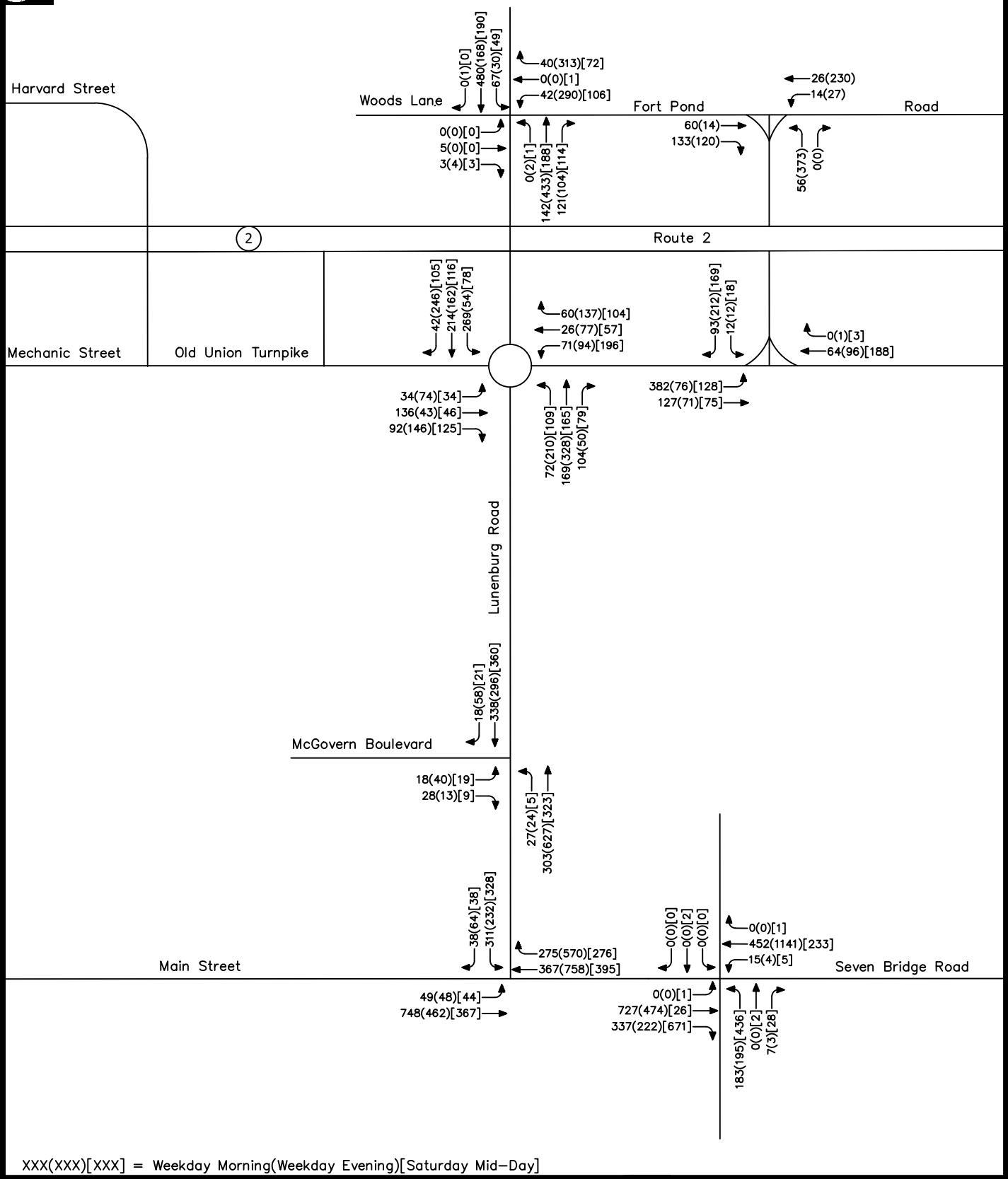
As noted, December 2018 counts are present in the study area and represent a condition in the past. To analyze a comparative existing condition at these intersection locations, 2018 traffic volumes were upwardly adjusted to reflect a 2019 condition. This was done by utilizing a 0.5 percent per year ambient growth rate over the one-year period. The growth rate is further described in the “Future Conditions” section of this TIAS. No further traffic volume growth adjustments to the current year of 2021 were made to be consistent with published MassDOT recommendations during the COVID-19 pandemic. The compiled seasonal adjustment data is provided in Appendix C. The resulting 2019 Existing Condition weekday morning and weekday evening peak hour traffic volumes are shown graphically in Figure 2.

## SAFETY ANAYSIS AND REVIEW

A comprehensive traffic safety analysis was conducted for the study area intersections. The traffic safety analysis included the compilation and examination of study intersection crash data, a general safety review with consideration given to items on the MassDOT Safety Review Prompt List, and sight distance measurements. Details of each step in the traffic safety analysis are described in the following section.

[6] MassDOT Permanent Count Station 34 – Lancaster – Route 2 – west of Route 70

Not to Scale




XXX(XXX)[XXX] = Weekday Morning(Weekday Evening)[Saturday Mid-Day]

**Figure 2**

**2019 Existing Conditions
Weekday Morning, Weekday Evening,
and Saturday Mid-Day
Peak Hour Traffic Volumes**

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## Crash History and Data

Crash data for the study area intersections were compiled and analyzed for the most recent consecutive five-year period (2015-2019) of complete data on file with the MassDOT Interactive Mapping Portal for Analysis and Crash Tracking (IMPACT) online website. For the intersections along Main Street, historical crash information was acquired from the Main Street (Route 70/117) Improvements *Functional Design Report* (FDR)[7]. For the Route 2 Interchange 103 (formerly Interchange 35) freeway off-ramp intersections and interchange with Old Union Turnpike and Fort Pond Road, individual crash reports were acquired from the MassDOT Traffic and Safety Engineering Section for 2014 through 2018. The crash history for each ramp, separate from the interchange in its entirety, was summarized in a letter to MassDOT titled *Supplemental Crash Data Summary – Route 2 Interchange 35 Ramps*[8]. The motor vehicle crash data was reviewed to determine if any crash trends exist within the study area. Summaries of the vehicle crash data and intersection crash rates are provided in Table 3.

*Highway Safety Improvement Plan Eligible*

The U.S. Congress enacted the "Fixing America's Surface Transportation Act" (FAST) Act in 2015. This act provides guidance and funding for the implementation of a State Highway Safety Improvement Program (HSIP), continuing upon the past SAFETEA-LU legislation from 2005. As part of this program, all states are required to develop a Strategic Highway Safety Plan (SHSP). The MassDOT guidelines require a Road Safety Audit (RSA) to be conducted where HSIP-eligible crash clusters are present within the study area of a private development sphere of influence, prior to finalizing the Massachusetts Environmental Policy Act (MEPA) process. An intersection is defined as HSIP-eligible if the intersection is within the top 5% of clusters in its respective Regional Planning Commission (RPC) boundaries based on Equivalent Property Damage Only (EPDO). EPDO rates crashes based on the collision severity.

Based on the MassDOT online crash cluster database, the Main Street / Lunenburg Road intersection is considered 2017 HSIP-eligible (current crash years of HSIP-eligibility). The Route 2 Interchange 103 (formerly Interchange 35) was also considered '2015' HSIP-eligible. Many freeway interchanges across the Commonwealth are noted as HSIP-eligible locations; however, this is generally the result of crashes being geocoded on the center of the interchange, as opposed to the specific crash location along a freeway segment, along the ramps, or other location of the interchange. At the time of the original state review process, the interchange was no longer on the HSIP-eligible listing; however, TEC coordinated with MassDOT to complete an evaluation of the crash history at the interchange's surface intersection using individual crash reports and confirmed that the study area intersections were not HSIP-eligible. A letter confirming this was sent to MassDOT on September 13, 2019.

[7] *Functional Design Report – Main Street (Route 70/117) Improvements – Lancaster, MA*; prepared by TEC, Inc.; Revised April 1, 2019
[8] *Supplemental Crash Data Summary – Route 2 Interchange 35 Ramps*; prepared by TEC, Inc.; September 13, 2019

## Table 3 - Crash Data Summary

| | | Main Street / Seven Bridge Road / Shirley Road [a] | Main Street / Lunenburg Road [a] | Lunenburg Road / McGovern Boulevard | Lunenburg Road / Old Union Turnpike |
|---|---|---|---|---|---|
| **Crash Year:** | 2012 | 4 | 5 | - | - |
| | 2013 | 4 | 11 | - | - |
| | 2014 | 0 | 2 | - | - |
| | 2015 | 2 | 8 | 0 | 4 |
| | 2016 | 2 | 13 | 0 | 0 |
| | 2017 | - | - | 0 | 4 |
| | 2018 | - | - | 0 | 5 |
| | 2019 | - | - | 0 | 4 |
| | **TOTAL** | **12** | **39** | **0** | **17** |
| **Annual Average** | | ***2.40*** | ***7.80*** | ***0.00*** | ***3.40*** |
| **Crash Rate (MEV):** | | ***0.30*** | ***0.94*** | ***0.00*** | ***0.50*** |
| **Significant:** | | **No** | **Yes** | **No** | **No** |
| **Type:** | Angle | 10 | 15 | 0 | 3 |
| | Rear-end | 0 | 12 | 0 | 6 |
| | Sideswipe | 1 | 0 | 0 | 1 |
| | Single | 0 | 10 | 0 | 6 |
| | Head-On | 1 | 1 | 0 | 0 |
| | Ped / Bike | 0 | 0 | 0 | 0 |
| | Not Reported | 0 | 1 | 0 | 1 |
| | **TOTAL** | **12** | **39** | **0** | **17** |
| **Surface Conditions:** | Dry | 7 | 26 | 0 | 13 |
| | Wet | 3 | 9 | 0 | 2 |
| | Snow/Slush/Ice | 0 | 4 | 0 | 2 |
| | Other / Unknown | 2 | 0 | 0 | 0 |
| | **TOTAL** | **12** | **39** | **0** | **17** |
| **Severity:** | PDO | 10 | 31 | 0 | 13 |
| | Non-Fatal Injury | 2 | 8 | 0 | 3 |
| | Not Reported | 0 | 0 | 0 | 1 |
| | **TOTAL** | **12** | **39** | **0** | **17** |
| **Day of Week:** | Monday-Friday | 11 | 28 | 0 | 13 |
| | Saturday-Sunday | 1 | 11 | 0 | 4 |
| | **TOTAL** | **12** | **39** | **0** | **17** |
| **Time of Day:** | 6:00AM-9:00AM | 3 | 6 | 0 | 2 |
| | 9:00AM-3:00PM | 2 | 13 | 0 | 4 |
| | 3:00PM-6:00PM | 1 | 8 | 0 | 3 |
| | 6:00PM-6:00AM | 5 | 12 | 0 | 8 |
| | **TOTAL** | **12** | **39** | **0** | **17** |

[a] From *Functional Design Report – Main Street (Route 70/117) Improvements – Lancaster, MA*; prepared by TEC, Inc.; Revised April 1, 2019

## Table 3 - Crash Data Summary (Continued)

| | | Lunenburg Road / Woods Lane / Fort Pond Road | Old Union Turnpike / Route 2 Exit 103 EB [b] | Fort Pond Road / Route 2 Exit 103 WB [b] |
|---|---|---|---|---|
| **Crash Year:** | 2012 | - | - | - |
| | 2013 | - | - | - |
| | 2014 | - | 0 | 0 |
| | 2015 | 2 | 1 | 0 |
| | 2016 | 2 | 0 | 0 |
| | 2017 | 0 | 1 | 0 |
| | 2018 | 2 | 3 | 1 |
| | 2019 | 3 | - | - |
| | **TOTAL** | **9** | **5** | **1** |
| **Annual Average** | | ***1.80*** | ***1.00*** | ***0.20*** |
| **Crash Rate (MEV):** | | ***0.34*** | ***0.58*** | ***0.07*** |
| **Significant:** | | **No** | **No** | **No** |
| **Type:** | Angle | 6 | 2 | 1 |
| | Rear-end | 1 | 1 | 0 |
| | Sideswipe | 1 | 0 | 0 |
| | Single | 0 | 1 | 0 |
| | Head-On | 1 | 0 | 0 |
| | Ped / Bike | 0 | 1 | 0 |
| | Not Reported | 0 | 0 | 0 |
| | **TOTAL** | **9** | **5** | **1** |
| **Surface Conditions:** | Dry | 8 | 5 | 1 |
| | Wet | 0 | 0 | 0 |
| | Snow/Slush/Ice | 0 | 0 | 0 |
| | Other / Unknown | 1 | 0 | 0 |
| | **TOTAL** | **9** | **5** | **1** |
| **Severity:** | PDO | 5 | 2 | 0 |
| | Non-Fatal Injury | 4 | 3 | 1 |
| | Not Reported | 0 | 0 | 0 |
| | **TOTAL** | **9** | **5** | **1** |
| **Day of Week:** | Monday-Friday | 5 | 3 | 1 |
| | Saturday-Sunday | 4 | 2 | 0 |
| | **TOTAL** | **9** | **5** | **1** |
| **Time of Day:** | 6:00AM-9:00AM | 0 | 2 | 0 |
| | 9:00AM-3:00PM | 4 | 1 | 1 |
| | 3:00PM-6:00PM | 3 | 1 | 0 |
| | 6:00PM-6:00AM | 2 | 1 | 0 |
| | **TOTAL** | **9** | **5** | **1** |

[b] From *Supplemental Crash Data Summary – Route 2 Interchange 35 Ramps*; prepared by TEC, Inc.; September 13, 2019

Prior to this Town and MEPA review processes, TEC and the City of Lancaster facilitated an RSA for the intersection of Main Street / Lunenburg Road in coordination with the MassDOT Traffic and Safety Engineering Section. An RSA, as defined by the FHWA, is the *formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team*. The RSA report for this location was published on May 27, 2017[9]. A copy of the RSA, as approved by MassDOT, is provided in Appendix D.

*Crash Rate Worksheets*

In addition to examining the number of crashes at the study area intersections, a crash rate was calculated to compare the occurrence of crashes to the volume of traffic passing through the intersection. The crash rate per million entering vehicles (MEV) was calculated using the evening peak hour volumes from the TMCs and a calculated K-factor obtained from the ATR counts to establish a daily intersection traffic volume. The crash rates at each of the study area intersections were compared to the statewide and district-wide averages published by MassDOT in June 2018 to determine the significance of the crash occurrence. The statewide average for unsignalized intersections is 0.57, and the District 3 average for unsignalized intersections is 0.61. A compilation of the MEV rate calculation worksheets and detailed crash data are provided in Appendix E.

## Crash Data Summary

*Main Street / Seven Bridge Road / Shirley Road*

The Main Street (Route 70/117) / Seven Bridge Road (Route 117) intersection experienced less than three (2.4) crashes per year over the five-year study period, yielding a crash rate of 0.30 crashes per MEV. The crash rate for this intersection is significantly lower than the statewide and district-wide averages for unsignalized intersections. Approximately, 83 percent (10 of 12) of the crashes were angled crashes, and the remaining 17 percent (2 of 10) of the crashes were equally distributed amongst sideswipe and head-on crashes. The reported crashes were heavily skewed toward the first half of the week, with 75 percent (9 of 12) of the crashes occurring Monday through Wednesday. Of the reported crashes, 42 percent (5 of 12) were attributed to “failure to yield right-of-way”, 33 percent (4 of 12) were “inattention / distracted”, 17 percent (2 of 12) were “visibility obstructed / glare” and the remaining 8 percent (1 of 12) were “erratic / aggressive / reckless driving”.

*Main Street / Lunenburg Road*

The intersection of Main Street / Lunenburg Road experienced a total of 39 reported crashes (7.8 per year) at the intersection during the five-year study period. The crash rate for this intersection is significantly higher than the statewide and district-wide averages for unsignalized intersections, with 0.94 crashes per MEV. Approximately 40 percent of the crashes (15 of 39) were angled crashes, 30 percent (12 of 39) were rear-end crashes, 25 percent (10 of 39) were single vehicle crashes, and the remaining 5 percent (2 of 39) were equally distributed amongst head-on and other/not reported crashes at the intersection over the five-year study period. Of the reported crashes, 44 percent (17 of 39) were attributed to “inattention/distracted”, 21 percent (8 of 39) were

[9] *Main Street (Route 117) / Lunenburg Road (Route 70) – Lancaster, Massachusetts - Road Safety Audit*; TEC, Inc.; Lawrence, Massachusetts; July 18, 2017

"failure to yield right-of-way" or "other /not reported". Further details related to crash history is provided in the RSA report.

*Lunenburg Road / Old Union Turnpike*

The intersection of Lunenburg Road / Old Union Turnpike experienced a total of seventeen (17) reported crashes (3.40 per year) at the intersection during the five-year study period. The crash rate for this intersection is significantly lower than the statewide and district-wide averages for unsignalized intersections, with 0.35 crashes per MEV. Six (6) of the crashes were rear-end crashes on the approach to the roundabout. Six (6) additional crashes were single vehicle crashes. Additionally, only three (3) crashes were non-fatal injury crashes as the impact of crashes at roundabouts is traditionally low impact. Only five (5) of the crashes occurred during either the weekday morning or weekday evening peak periods, indicating that congestion may not be a leading factor in crashes at this location.

*Route 2 Interchange 103*

The Route 2 Interchange 103 (formerly Interchange 35) and associated ramp network experienced 61 reported crashes (12.2 per year) during the five-year study period. The overwhelming majority of these crashes occurred on the freeway in the vicinity of the interchange with no effect or cause related to the surface intersection with Old Union Turnpike and Fort Pond Road. Individual crash reports were processed from the MassDOT Traffic and Safety Engineering Section for 2014 through 2018 in order to determine the crash history of the two surface intersections as part of the study area. The crash reports show that over the five-year period, only six (6) crashes occurred; five (5) at the intersection of Old Union Turnpike / Route 2 Exit 103 EB Ramps and one (1) at the intersection of Fort Pond Road / Route 2 Exit 103 WB Ramps. Each location experienced less than two crashes per year on average and therefore it was deemed that no notable crash trend exists for the five-year study period.

All other study area intersections experienced less than two crashes per year on average and therefore it was deemed that no notable crash trend exists for the four-year study period.

## Sight Distance Measurements

TEC measured the available sight distances at the various stop-controlled approaches of the study area intersections. The available sight lines were compared to minimum requirements established by the American Association of State Highway and Transportation Officials (AASHTO).

Sight distance represents the length of roadway that is visible to a driver traveling within the roadway. Two types of sight distance are typically evaluated for driveways and intersections: stopping sight distance (SSD) and intersection sight distance (ISD). SSD is the minimum distance required for a driver traveling along a roadway to perceive an object in the roadway and stop safely in advance of the object when traveling on a wet pavement surface. SSD is measured from an eye height of 3.5-feet to an object height of 2-feet above the ground, which is equivalent to a driver viewing the taillight of a vehicle ahead. SSD is measured along the centerline of the travel lane approaching the driveway or intersection.

ISD represents the length of the roadway visible to a driver waiting to exit a driveway or minor street. Minimum ISD requirements are based on the distance required for a driver to exit a minor street onto a major street without requiring an approaching vehicle to reduce its speed from the design speed to less than 70 percent of the design speed. ISD is measured from an eye height of 3.5-feet to an object height of 3.5-feet and is measured from a distance 14.5-feet beyond the edge of the travel-way of the major roadway to represent a driver waiting to exit a driveway or minor roadway.

SSD is typically considered the critical sight distance, as it represents the minimum distance required for safe stopping, while ISD represents an acceptable speed reduction for approaching vehicles. The ISD, however, must be at least equal to the minimum required SSD in order to prevent a driver from entering the roadway when an approaching vehicle is too close to safely stop. The guidance provided by AASHTO states:

> *"If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."*

Tables 4 and 5 provide a summary of the available SSD and ISD at the intersection of Lunenburg Road / McGovern Boulevard, respectively.

**Table 4 – Existing Stopping Sight Distance Measurements**

| Approach / Direction | Operating Speed [a] | AASHTO Recommended Minimum | Measured Stopping Sight Distance |
|---|---|---|---|
| Lunenburg Road at McGovern Boulevard: | | | |
| *Lunenburg Road northbound* | 52 MPH | 455 FT | > 700 FT |
| *Lunenburg Road southbound* | 55 MPH | 495 FT | > 700 FT |

[a] Operating speeds calculated as 85th percentile speed from ATR counts on December 18 through December 19, 2018

**Table 5 – Existing Intersection Sight Distance Measurements**

| Approach / Direction | Operating Speed [a] | AASHTO Desired Minimum [b] | AASHTO Recommended Minimum | Measured Intersection Sight Distance |
|---|---|---|---|---|
| Lunenburg Road at McGovern Boulevard: | | | | |
| *North of McGovern Boulevard* | 55 MPH | 610 FT | 495 FT | > 700 FT |
| *South of McGovern Boulevard* | 52 MPH | 575 FT | 455 FT | > 700 FT |

[a] Operating speeds calculated as 85th percentile speed from ATR counts on December 18 through December 19, 2018
[b] ISD calculated using time gap ($t_g$) at design speed of 6.5 seconds for passenger car left-turn

As shown in Tables 4 and 5, the ISD and SSD at the intersection of Lunenburg Road / McGovern Boulevard are well in excess of AASHTO minimum recommendations.

# III. FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2030, which reflects a 11-year planning horizon from the original date of permitting. The traffic conditions for the year 2030, under No-Build conditions, were developed to document the operating conditions independent of the proposed project; including all existing traffic and new traffic resulting from background growth. Anticipated site-generated traffic volumes for the proposed redevelopment were superimposed upon the No-Build traffic networks to reflect the Build conditions with the proposed project.

## BACKGROUND TRAFFIC GROWTH

Traffic growth is a function of the expected land development in the immediate area and the surrounding region. Several methods can be used to estimate this growth. Traffic engineers frequently employ an annual percentage increase in traffic growth, which is applied to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a greater or a lesser rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This procedure produces a more realistic estimate of growth for local traffic; however, the potential growth in population and development external to the study area are not accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were considered.

### General Background Growth

To project traffic to a future horizon year, TEC utilized MassDOT published year-by-year annual growth data between 2016 and 2019. The data indicates that for urban minor arterials, traffic volumes between 2016 and 2017 grew 1.7 percent, between 2017 and 2018 growing 0.3 percent, and between 2018 and 2019 decreasing 0.4 percent. This equates to an annual growth rate of approximately 0.53 percent per year on average between 2016 and 2019. To provide a consistent analysis scenario, a 0.5 percent per year compounded annual background traffic growth rate was used to account for potential future traffic growth external to the study area and any presently unforeseen development. MassDOT historic count station data have been included in Appendix F.

### Specific Developments by Others

TEC coordinated with both the Town of Lancaster Community Development and Planning Department and the Town of Lunenburg Planning Board to identify nearby private and public development projects in the vicinity of the study area that are either in the planning process or

were recently approved by the municipal Planning Board. After discussions with officials in both communities and a review of recently approved projects, there was two specific projects that had been identified that are anticipated to contribute significant amount of additional traffic volumes to the study area. A description of the development is provided below:

- *Fort Pond Road Industrial Developments* – Two separate entities are currently in the planning stage for expansion to and addition of an industrial park development along the northerly side of Fort Pond Road, near Shirley Road, in Lancaster. Combined, both sites, at a conceptual level, to construct approximately 826,700 SF of new industrial space with access/egress provided along a single driveway approximately 1,400-feet west of Shirley Road and the Route 2 Interchange 105 (formerly Interchange 36). A solar panel array is also proposed, but not expected to generate measurable traffic. No traffic impact assessment has been completed to date for either project; therefore, TEC projected site generated traffic based on industry standard trip rates published in the Institute of Transportation Engineers' (ITE) publication *Trip Generation, 11th Edition* for Land Use Code (LUC) 130 – Industrial Park. The distribution of industrial park site-generated traffic volumes was based on gravity models using 2019 U.S. Census Bureau Journey-to-Work/Home data for the Town of Lancaster. Further details regarding the trip generation and distribution calculations are provided in Appendix G. The resulting development traffic volumes for the weekday morning, weekday evening, and Saturday midday peak-hours are illustrated in Figure 3.
- *#435 Leominster-Shirley Road Development* – JMC/TBG Lunenburg, LLC is actively within public hearings with the Town of Lunenburg Planning Board for the construction of an approximate 372,000 SF warehouse and distribution facility. Access to the proposed site is located along Leominster-Shirley Road north of Route 2. TEC projected site generated traffic through the study area based on trip generation and distribution data provided within a *Trip Generation and Site Access Letter*[10], prepared by Greenman-Pedersen, inc. (GPI) in July 2021. Overall, the letter identifies 30 percent of site traffic to traverse the study area with 15% each entering/exiting from Route 2 eastbound and westbound. Further details regarding the trip generation and distribution calculations are provided in Appendix G. The resulting development traffic volumes for the weekday morning, weekday evening, and Saturday midday peak-hours are illustrated in Figure 3.

*FC Soccer Complex*

At the time of the weekday TMCs in December 2018, no outdoor activities were being hosted at the FC Stars outdoor soccer complex. To provide a conservative analysis, site-generated trips were estimated for the three (3) existing outdoor soccer fields and superimposed on the seasonally adjusted 2030 No-Build traffic volumes to simulate a condition in which the soccer fields were in active season. To estimate the potential traffic volumes generated by the additional use, TEC utilized standard trip rates published in the ITE industry standard publication *Trip Generation, 10th Edition* for LUC 488 – Soccer Complex. The new traffic volumes were distributed along the roadway network based on a gravity model that incorporated population within a 7.5-

[10] *Trip Generation and Site Access Letter – Industrial Development – 535 Leominster-Shirley Road – Lunenburg, Massachusetts*; Greenman-Pedersen, Inc.; Wilmington, MA; July 15, 2021

mile radius. The resulting FC Soccer weekday morning and weekday evening peak-hour traffic-volume networks is illustrated in Figure 3. No projections were made for the Saturday midday peak hour as traffic counts conducted for this period were collected in August 2019 when outdoor activities were generally at peak season.

## INDEPENDENT IMPROVEMENT PROJECTS

### Main Street Traffic Signal Project (MassDOT Project 608779)

The Town of Lancaster and MassDOT are currently at the final design stage for roadway and traffic improvements along the Main Street corridor from Lunenburg Road and Seven Bridge Road. The improvements have been designated under state funding as MassDOT Project File No. 608779. The proposed improvements are needed to address existing safety and operational deficiencies regarding the intersection geometry, conflicting turning movements, multi-modal accommodations, and delays.

- Installation of a fully actuated traffic signal at the intersections of Main Street / Lunenburg Road and Main Street / Seven Bridge Road with vehicular, bicycle, and pedestrian detection.
- Minor widening or pavement removal to accommodate turn lanes at both traffic signals and consistent cross-sections within the project limits.
- Realignment of Otis Street and Buttonwood Lane approaches to Main Street, providing perpendicular intersections.
- Construction of a new shared-use path along the southerly side of Main Street, from Lunenburg Road to the Mary Rowlandson Elementary School.
- Construction of a sidewalk with granite curbing along the southerly side of Main Street, west of Lunenburg Road, and along the northerly side of Main Street, west of Seven Bridge Road.
- Realignment of the Main Street / Seven Bridge Road intersection and removal of existing channelizing traffic islands.
- Minor reconstruction of existing stormwater drainage infrastructure and installation of new stormwater drainage infrastructure within the project limits.
- Striping of enhanced bicycle accommodations, including bicycle lanes along Lunenburg Road, bicycle lanes along Main Street northbound south of Seven Bridge Road.
- Striping of new pavement markings and installation of new *Manual on Uniform Traffic Control Devices* (*MUTCD*) compliant regulatory, warning and guide signs throughout the project limits.
- Construction of new Americans with Disabilities Act (ADA) / Architectural Access Board (AAB) accessible curb ramps, where necessary, within the project limits; and
- Pavement resurfacing within the project limits.

Construction of the Main Street corridor improvements commenced earlier in 2022.

Not to Scale

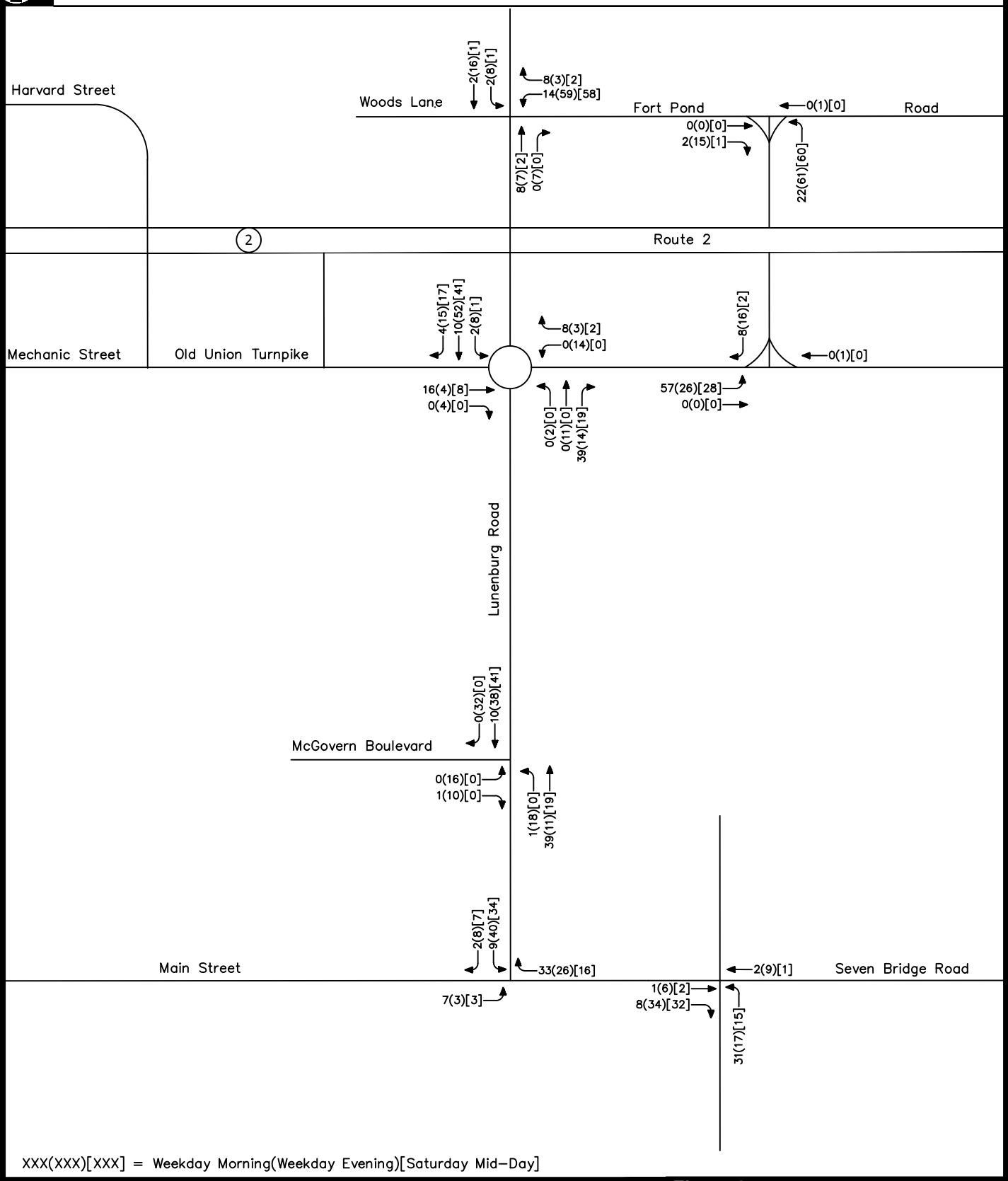



**Figure 3**

**FC Soccer Project (Existing) Trips & Other Development Trips Weekday Morning, Weekday Evening, and Saturday Mid-Day Peak Hour Traffic Volumes**

TEC, Inc.
146 Dascomb Road
Andover, MA 01810

## Future Route 2 Interchange 103 Improvements

In February 2016, MassDOT, in coordination with TranSystems, prepared an alternatives analysis for improvements along several Route 2 interchanges east of Interstate 190[11] in Harvard and Lancaster, MA. The study identified five (5) Interchange 103 (formerly Interchange 35) conceptual alternatives that would directly affect the study area of the Landing - Lancaster TIAS. A brief description of each alternative is provided below:

- Alternative #1 – Relocates the Route 2 EB off-ramp west of the Route 70 overpass. This relocation places the ramp exit approximately 1,100 feet from the proposed Interchange 102 (formerly Interchange 34) on-ramp, which does not provide adequate distance for the Interchange 102 acceleration lane. Accordingly, an auxiliary lane is provided between the two ramps. The ramp terminal is located on Old Union Turnpike approximately 400 feet west of the Route 70 roundabout. The Route 2 WB on-ramp is retained. The Route 2 WB on-ramp would be relocated west of the Route 70 Bridge with a terminal on Route 70 approximately opposite Fort Pond Road. This ramp relocation results in a 750-foot auxiliary lane between the ramp and the Johnny Appleseed Visitor Center exit. The Route 2 WB off-ramp is retained. The four-way intersection this ramp forms with Route 70 and Fort Pond Road includes installation of a traffic signal.
- Alternative #2 – Identical to Alternative #1 on the Route 2 EB side. On the westbound side, the alternative relocates the Route 2 WB off-ramp connecting directly to Route 70 in a half-diamond configuration. To enable Fort Pond Road to remain on its current alignment, this ramp is located tight to the Route 70 Bridge over Route 2. The Route 2 WB on-ramp terminal is located opposite the westbound off-ramp. The intersection of the relocated Route 2 WB ramps with Route 70 includes addition of a traffic signal. Locating this intersection near the bridge over Route 2 also improves vertical sight distance as it is placed closer to the apex of the crest vertical curve. The existing intersection of Fort Pond Road with Route 70 remains unsignalized and the intersection with Woods Lane remains in its existing configuration.
- Alternative #3 - This alternative maintains ramp and intersection configuration on the Route 2 WB side identical to Alternative #2. The Route 2 EB off-ramp is relocated to connect directly to Route 70. The ramp diverges from Route 2 in a similar fashion as under Alternatives #1 and #2 and forms an unsignalized T-intersection with Route 70 south of the bridge over Route 2.
- Alternative #4 – Similar to Alternative #1 except it replaces a signalized intersection of Route 70 and Fort Pond Road with a roundabout. Woods Lane is relocated to the north to provide separation from the roundabout. Due to space requirements, the roundabout further impacts the Boy Scouts of America property and Woods Lane relocation requires minor right-of-way acquisition from the parcel located just to the north.
- Alternative #5 – This alternative eliminates the Route 2 EB off-ramp and combines it with the Interchange 102 (formerly Interchange 34) eastbound off-

[11] *Route 2 Interchange Improvements Alternatives Analysis; Harvard / Lancaster, MA*; prepared by TranSystems; February 2016.

ramp. On the Route 2 WB side, this alternative could be identical to any of the alternatives described above.

At this time, each alternative presents a significantly superior condition in terms of traffic safety and/or traffic operations over the existing condition. Further investigation of the alternatives is still being considered by MassDOT for future projects. Based on recent discussions with MassDOT, no specific project has been identified at this interchange and it is expected that the design of any alternative, or programming on the Transportation Improvement Program (TIP) remains a few years away. The TIAS does not assume that the improvements will be in place by the 2030 horizon year; however, it is understood that these improvements may be in place should funding become available. Currently the adjacent interchange to the west was recently in the 25% Design process and signifies MassDOT's commitment to reconstruction of these several interchanges. The design for this location has more recently been put on hold. Further discussion of traffic operations in relation to the project is summarized in the capacity and queue analysis section.

## 2030 NO-BUILD TRAFFIC VOLUMES

The 2030 No-Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks were developed by applying the 0.5 percent per year compounded annual background traffic growth rate on the 2019 Existing Condition peak-hour traffic volumes over the 11-year design horizon (dependent on date of traffic count) and adding the projected traffic generated by the existing FC Soccer facility and the proposed traffic generated by the Fort Pond Road Industrial Development. The resulting 2030 No-Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks are illustrated in Figure 4.

## SITE GENERATED TRAFFIC

The Landing - Lancaster Project consists of redeveloping the existing site, but retaining the existing FC Stars soccer complex, Dunkin Donuts, and Mobil Gas Station.

The proposed mixed-use development program includes construction of a 2,424,250 SF industrial park, 73,450 SF of professional office, 41,300 SF of additional retail space (48,600 SF total with existing Dunkin Donuts and Mobil), and 150 residential apartment units. The Project proposes to retain the access/egress to the site via McGovern Boulevard. TEC estimated the site-generated traffic based on industry standard trip rates published in the ITE publication, *Trip Generation, 11th Edition* for LUC 130 – Industrial Park, LUC 221 – Multifamily Housing Mid-Rise, LUC 710 – Office, and LUC 821 – Shopping Plaza (40k-150k).

Not to Scale

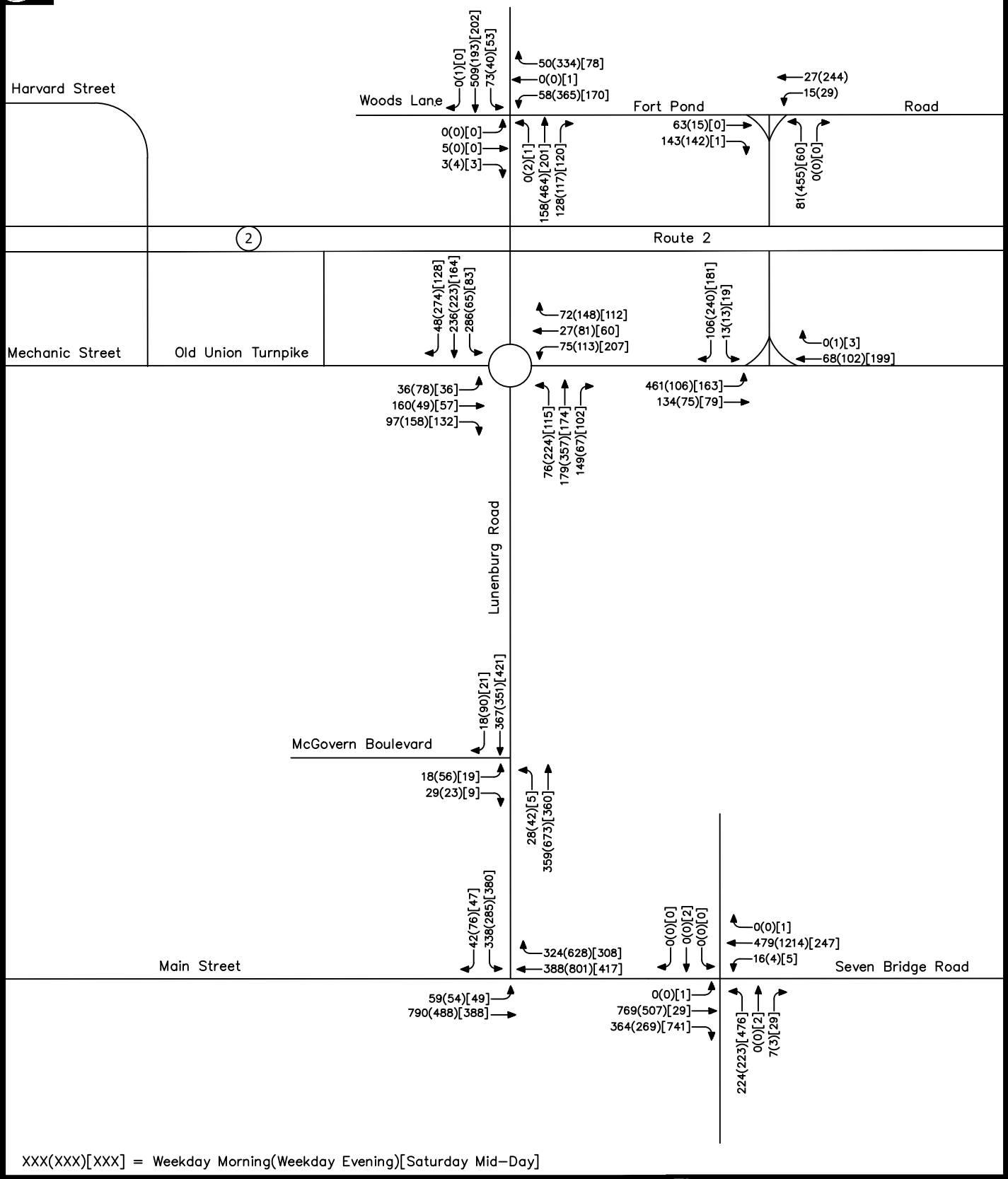



**Figure 4**

**2028 No-Build Conditions**
**Weekday Morning, Weekday Evening, and Saturday Mid-Day**
**Peak Hour Traffic Volumes**

TEC, Inc.
146 Dascomb Road
Andover, MA 01810

## Parameters and Credits

*LUC 130 – Industrial Park Peak Hour Data Extraction*

The ITE publication *Trip Generation, 11th Edition* provides standard trip rates and equations for dozens of land uses. The data as provided typically denotes the number of trips versus a specific independent variable. It is not uncommon that the data as presented in the publication is modified to closely mimic the specific land use and type. For instance, if a development is in a rural area, removing urbanized-related data is appropriate. Or, if data is provided for a land use on a large scale of building footprints, specific parts of the data can be extracted to provide a more accurate depiction of a specific development plan within a size range. In 2019, ITE released its online application version of the *Trip Generation, 11th Edition* publication. One of the several goals of the online application was to simplify the specific querying of data for engineers and planners to provide a more pointed and precise selection of land use data to individual development proposals. If specific data is extracted, it is important to provide justification for the extraction.

TEC has provided extracted site trip generation data under LUC 130 – Industrial Park for the weekday morning and weekday evening peak hours. *Trip Generation, 11th Edition* provides only an 'average rate' equation for these two time periods under this land use; however as typical industrial parks get larger, the data advocates that the 'average rate' equations significantly overestimate site traffic. For example, in the weekday morning and weekday evening peak hour, all industrial parks with more than 1,600,000 SF represented in the data have trip ends well below the 'average rate' line. To moderate this significant overestimation, TEC queried only the data for industrial parks with more than 1,000,000 SF of gross floor area. This allows the trip generation for the weekday morning and weekday evening peak hours to be considerably more realistic in nature, while still being conservative to the ITE data points. This methodology was only conducted for the weekday morning and weekday evening peak hours as the weekday daily calculation is based upon a fitted curve and the Saturday daily and Saturday midday calculations provide too small of a sample size to justify extracted data points. The methodology utilized for this land use was approved by MassDOT District 3 upon discussion. Worksheets directly from the ITE online application are included in Appendix H.

*LUC 130 – Industrial Park Saturday Data*

The ITE publication *Trip Generation, 11h Edition* has limited data on traffic to/from industrial park uses (LUC 130) on Saturday and during the Saturday peak hour of generator (utilized for the Saturday midday peak hour) with only five (5) and two (2) data points, respectively. In addition, the larger industrial park independent variable data point (gross floor area in square footage) is for 511,000 SF: only 20% the size of the proposed industrial square footage. The use of this Saturday data results in Saturday trip generation that is significantly higher than a typical weekday, which is both wildly divergent from other similar industrial land uses in the publication and contradictory from anecdotal knowledge of industrial use operations. TEC believes this is directly related to the limited data set for Saturday as compared to a typical weekday.

TEC therefore considered LUC 154 – High-Cube Transload and Short-Term Storage Warehouse, a similar land use, where more than nine (9) data points were available on Saturday and the Saturday peak hour of generator. In addition, the use provides data points up to 1,200,000 SF, still less but more comparable to the proposed site. TEC did not directly use the trip generation equations for this use as the overall trips would be unjustifiably lower than expected; however,

TEC utilized the trip generation rate for this land use and compared it to the weekday daily rate as a direct interpolation of the LUC 130 – Industrial Park weekday daily rate. The result provides a trip total for Saturday directly proportional to a typical weekday utilizing the similar use.

*Existing Land Uses Trip Generation Credit*

The existing site includes several minor uses over the two distinct development zones. Within the development zone connected to McGovern Boulevard, the site includes the FC Stars outdoor soccer complex comprised of three (3) soccer fields, a 11,800 SF J.B. Hunt Transport Services facility, a 2,300 SF Dunkin Donuts, a 5,000 SF Mobil gas station with convenience market, and the recently closed soil / gravel yard for the Central Mass Sand & Gravel. Although recently closed, Central Mass Sand & Gravel has been included has an existing use as the 2018/2019 traffic counts would include volumes from this tenant.

TEC previously noted that site generated traffic related to the FC Stars outdoor soccer complex was assessed as part of the weekday morning and weekday evening No-Build scenarios as the December 2018 traffic counts would not generate for traffic volumes at this facility because it is a seasonal operation (assumed to be included in traffic counts for the Saturday midday peak hour). Traffic generated by the other existing land uses would be present in the December 2018 and April 2019 traffic counts.

The existing land uses to be removed from the site do generate a modest amount of traffic volumes throughout the course of typical weekday. The Applicant reached out to both J.B. Hunt Transport Services and Central Mass Sand & Gravel, when previously opened, to obtain existing empirical trip generation data for a typical weekday. Based on these conversations, both sites combined generate approximately 416 vehicle trips on a typical day based on 350 total truck trips (175 entering and 175 exiting) per day and 22 combined daily employees. Whereas Central Mass Sand & Gravel typically did not draw substantial traffic on a typical Saturday, Saturday trip generation estimates for the J.B. Hunt Transport Services trips were estimated based on the ITE *Trip Generation, 11th Edition* for LUC 130 – Industrial Park. A limited trip generation credit has been taken for both the 11,800 SF J.B. Hunt Transport Services facility and the Central Mass Sand & Gravel site. This credit is depicted in Table 7.

*Internal Capture*

It is reasonable to expect that some site-generated trips to the site will be shared amongst multiple land uses. For example, someone traveling to the industrial park may choose to visit the retail buildings within the Project site. More precisely, some site-generated trips to the site will be shared amongst the existing and separated proposed land uses. For example, someone travelling to the industrial park may decide to purchase gas at the Mobil Station or a coffee at Dunkin Donuts adjacent to the Project site. This internal capture can occur as the proposed mixed retail uses, the existing Mobil gas station, and the Dunkin Donuts provide direct access/egress to/from the proposed Project along McGovern Boulevard without exiting onto Lunenburg Road. As a result, a reduction in the overall external trips experienced at the site driveways can be anticipated as a result of multi-use, or shared, trips that include stops at more than one use on the site.

Although a large amount of sharing can occur it is likely that much of this internal capture will still be with new trips to the site as the trips that are currently, or potentially will travel to/from the retail

areas and uses would be established once the Project is constructed. Based on information contained in the industry standard ITE publication *Trip Generation Handbook, 3rd Edition*, multi-use trips were assigned for trip sharing amongst the industrial park, office, residential, and the retail uses. Credit was not taken for internal capture between the proposed uses / existing land uses and the soccer complex. This provides an overall conservative analysis of site trip generation. The multi-use trip generation worksheets are included in Appendix H.

*Pass-by Trips*

Not all the trips generated by the proposed redevelopment will be new to the roadway network. Many of the trips generated by the proposed redevelopment are already present in the existing traffic flow passing by the site and may decide to visit the site on their way to another destination. For example, a driver travelling along Lunenburg Road on the way home from work may stop at the on-site neighborhood retail and then continue their trip home. These vehicle trips are known as "pass-by" trips and are subtracted from the total trips to calculate the total primary (or "new") trips that affect the volume of traffic within the study area away from the site. Based on information contained in the industry standard ITE publication *Trip Generation Handbook, 3rd Edition*, approximately 26 to 34 percent of the general retail / shopping center site-generated traffic is expected to be pass-by traffic. TEC has confirmed that the number of pass-by trips estimated for the project is less than 15 percent of the adjacent street traffic per MassDOT standards.

**Trip Generation Summary**

Tables 6 and 7 provide a summary of the resulting trip generation estimate separated by LUC and the total trip generation separated by multi-use, transit, pass-by, and primary trips. The detailed trip generation calculation worksheets are provided in Appendix H.

## Table 6 – Total New Trip Generation Summary by Land Use Code

| Time Period | Industrial Park (LUC 130) | Multifamily Housing (LUC 221) | Professional Office (LUC 710) | General Retail (LUC 820) | Total Trips |
|---|---|---|---|---|---|
| *Weekday Daily* | | | | | |
| IN | 2,464 | 335 | 398 | 1,394 | 4,591 |
| OUT | 2,464 | 335 | 398 | 1,394 | 4,591 |
| TOTAL | 4,928 | 670 | 796 | 2,788 | 9,182 |
| *Weekday Morning* | | | | | |
| IN | 556 | 13 | 99 | 45 | 713 |
| OUT | 148 | 43 | 13 | 27 | 231 |
| TOTAL | 704 | 56 | 112 | 72 | 944 |
| *Weekday Evening* | | | | | |
| IN | 133 | 35 | 18 | 105 | 291 |
| OUT | 473 | 23 | 88 | 109 | 693 |
| TOTAL | 606 | 58 | 106 | 214 | 984 |
| *Saturday Daily* | | | | | |
| IN | 2,743 | 350 | 81 | 1,674 | 4,848 |
| OUT | 2,743 | 350 | 81 | 1,674 | 4,848 |
| TOTAL | 5,486 | 700 | 162 | 3,348 | 9,696 |
| *Saturday Midday* | | | | | |
| IN | 224 | 31 | 21 | 133 | 409 |
| OUT | 476 | 29 | 17 | 123 | 645 |
| TOTAL | 700 | 60 | 38 | 256 | 1,054 |

## Table 7 – External Trip Generation Summary

| Time Period | Total Trips [a] | Multi-Use Trip Credit | Existing Trip Credit | Pass-by Trips | External Primary Trips |
|---|---|---|---|---|---|
| *Weekday Daily* | | | | | |
| IN | **4,591** | 480 | 208 | **306** | **3,805** |
| OUT | **4,591** | 480 | 208 | **306** | **3,805** |
| TOTAL | **9,182** | 960 | 416 | **612** | **7,610** |
| *Weekday Morning* | | | | | |
| IN | **713** | 35 | 42 | **5** | **673** |
| OUT | **231** | 35 | 20 | **5** | **191** |
| TOTAL | **944** | 70 | 62 | **10** | **864** |
| *Weekday Evening* | | | | | |
| IN | **291** | 52 | 20 | **29** | **210** |
| OUT | **693** | 52 | 42 | **29** | **612** |
| TOTAL | **984** | 104 | 62 | **58** | **822** |
| *Saturday Daily* | | | | | |
| IN | **4,848** | 427 | 12 | **384** | **4,037** |
| OUT | **4,848** | 427 | 12 | **384** | **4,037** |
| TOTAL | **9,696** | 854 | 24 | **768** | **8,074** |
| *Saturday Midday* | | | | | |
| IN | **409** | 35 | 2 | **29** | **345** |
| OUT | **645** | 35 | 2 | **29** | **581** |
| TOTAL | **1,054** | 70 | 4 | **58** | **926** |

[a] From Table 6

As shown in Table 7, the proposed mixed-use development is anticipated to generate 7,610 new vehicle trips during the average weekday, with 864 new vehicle trips (673 entering and 191 exiting) during the weekday morning peak hour and 822 new vehicle trips (210 entering and 612 exiting) during the weekday evening peak hour. On a typical Saturday the development is anticipated to generate 8,074 new vehicle trips with 926 new vehicle trips (345 entering and 581 exiting) during the Saturday midday peak hour.

## Heavy Vehicle Trip Generation

The previously mentioned site trip generation includes both passenger vehicles and heavy vehicles, such as tractor-trailers or box trucks. Without specific tenants identified, the number of passenger vehicles vs. heavy vehicles cannot be specifically determined. It is reasonable to assume that an overwhelming majority of traffic to/from the site would be passenger vehicles for employees to service the industrial park. Whereas tractor-trailer parking and loading bays are provided at various locations within the site, many tractor-trailers will be parked on-site and not necessarily utilized on a day-to-day basis. Specifically, the number of tractor-trailer parking spaces does not correlate to day-to-day, or hour-by-hour, truck traffic to/from the site.

### Existing Heavy Vehicle Traffic

A major component of the Project is the removal of two existing land uses on the site: including, the 11,800 SF J.B. Hunt Transport Services facility and the recently closed Central Mass Sand & Gravel site. The existing land uses to be removed from the site contribute a significant number of heavy vehicles to the roadway network on a typical day. As previously noted, empirical estimates from the on-site uses identified 350 heavy vehicle trips on a typical weekday, 40 during each the weekday morning and weekday evening peak hour, primarily in the form of tractor-trailer and/or gravel trucks. As part of the Project, all 350 of these truck trips would be eliminated.

### Proposed Heavy Vehicle Traffic

The ITE publication *Trip Generation, 11$^{h}$ Edition* has limited data on heavy vehicle traffic to/from industrial park uses (LUC 130) with only three (3) data points identified for each the weekday daily, weekday morning, and weekday evening. In addition, the larger industrial park independent variable data point (gross floor area in square footage) is for 435,000 SF; only 20% the size of the proposed industrial square footage. TEC therefore considered LUC 155 – High-Cube Fulfillment Center Warehouse – Non-Sort, a similar land use, where more than ten (10) data points were available for comparing heavy-vehicle traffic to overall traffic generated by the use. In addition, the use provides data points up to 1,472,000 SF, more comparable to the proposed site. This data is still limited and does not necessarily represent specific tenants or mixes of tenants. The data showed that this land use generates 6% to 13% percent trucks during the typical weekday and the corresponding peak hours.

Table 8 summarizes the proposed and existing truck traffic for the industrial land uses on-site utilizing the data as shown in the ITE publication.

**Table 8 – Potential Heavy Vehicle Trip Generation**

| | | Industrial Park Trucks | | | |
|---|---|---|---|---|---|
| Time Period | Industrial Park Primary Trips [a] | HV as a % of Total Trips [b] | Total Industrial Park HV | Estimated Existing HV (Empirical) | NET HV Traffic |
| *Weekday Daily* | | | | | |
| IN | 2,407 | | 305 | 175 | **130** |
| OUT | 2,390 | 12.7% | 305 | 175 | **130** |
| TOTAL | 4,797 | | 610 | 350 | **260** |
| *Weekday Morning* | | | | | |
| IN | 547 | | 41 | 20 | **21** |
| OUT | 131 | 13.3% | 49 | 20 | **29** |
| TOTAL | 678 | | 90 | 40 | **50** |
| *Weekday Evening* | | | | | |
| IN | 129 | | 14 | 20 | **-6** |
| OUT | 463 | 6.3% | 23 | 20 | **3** |
| TOTAL | 592 | | 37 | 40 | **-3** |

[a] From Table 6 with subtraction of associated multi-use trips. See Trip Generation Summary in Appendix H.
[b] Percentages based on LUC 155 – High-Cube Fulfillment Center Warehouse, a similar use, ratio of truck traffic to all traffic based on limited LUC 130 – Industrial Park data.

Overall, the net heavy vehicle traffic from the site is expected to be approximately 260 trucks per day with only 50 truck trips (21 entering and 29 existing) during the weekday morning peak hour and 3 less truck trips (-6 entering and 3 exiting) during the weekday evening peak hour.

Where the distribution of existing truck traffic changes on a daily basis based on the nature of the existing uses, all subsequent analysis assumes the addition of new heavy vehicles without the removal of existing heavy vehicle traffic from the roadway network. This includes the projection of truck traffic shown in Figure 5b and within the heavy vehicle percentages utilized in the traffic operational analysis chapter.

## SITE TRIP DISTRIBUTION

The Project proposes to retain the access/egress to the site via McGovern Boulevard and the minor retail driveway for the existing Mobil Gas Station and Dunkin Donuts. The J.B. Hunt Transport Services is currently accessed via a separate full access/egress driveway along Lunenburg Road and will be closed. Individual minor driveways along Lunenburg Road, at the site frontage, will be constructed specifically for turning movements for on-site retail tenants similar to the existing Mobil Gas Station and Dunkin Donuts.

### Calculating Distribution by Land Use

*Industrial Park and Office Land Uses*

The distribution of industrial park and office space site-generated traffic volumes was based on gravity models using 2019 U.S. Census Bureau Journey-to-Work/Home data for the Town of Lancaster. The industrial park and office space distribution models the commutes of workers to Lancaster from the top 15 residential cities and towns, which represent approximately 87 percent of total Lancaster workforce. The top 62 percent of resident communities generally allow for an

approximation of overall distribution of traffic. Additional communities at this level each contribute less than 0.9 percent of the Lancaster workforce each which is deemed to not change the distribution of traffic calculations significantly.

As previously mentioned, a limited number of trips to/from the industrial land use on-site is projected to be heavy vehicles. As also noted in the above-mentioned section, the percentage of trucks can widely change based on the specific tenants or mixes of tenants. Similarly, the distribution of truck traffic can widely change day-to-day based on the type, number, and origin of the truck trip. Generally, much of the truck traffic is anticipated to travel to/from the freeway systems. To-date, the Applicant has not directly proposed, and the Town has not restricted potential truck travel direction to/from the site. Where freeway access is available in all directions (Route 2 to the north and I-190 / I-495 to the south), the overall distribution of industrial park truck traffic is anticipated to mimic the overall vehicle trip distribution for the land use.

*Residential Land Use*

The distribution of the multi-family residential site-generated traffic volumes was based on gravity models using 2019 U.S. Census Bureau Journey-to-Work/Home data for the Town of Lancaster. The residential distribution models the commutes of residents from Lancaster to the top 15 workforce cities and towns, which represent approximately 90 percent of total Lancaster residents. The top 50 percent of workforce communities generally allow for an approximation of overall distribution of traffic. Additional communities at this level each contribute less than 1.2 percent of the Lancaster residents each which is deemed to not change the distribution of traffic calculations significantly.

*Retail Land Use*

The distribution of retail site-generated traffic volumes was based on a gravity model using 2017 U.S. Census Bureau estimated population data, location of competing opportunities, and travel time for the surrounding communities within a 7.5-mile radius of the Project site. The retail distribution models the commutes of residents from the Town of Lancaster and eleven (11) adjacent communities to/from the Project site after weighting each community based on total population.

*Trip Distribution Summary*

The resulting primary trip distributions for the hotel, industrial park, residential units, and soccer complex are shown in Table 9. Trip distribution gravity models are included in Appendix I. The weekday morning, weekday evening, and Saturday midday site-generated traffic-volume networks are presented in Figure 5a.

**Table 9 – Trip Distribution Summary**

| Direction | Industrial Park | Office | Residential | Retail |
|---|---|---|---|---|
| Route 2 to/from east | 2% | 2% | 32% | 18% |
| Route 2 to/from west | 45% | 45% | 21% | 7% |
| Mechanic Street to/from west | 5% | 5% | 2% | 2% |
| Fort Pond Road to/from east | 1% | 1% | 1% | 1% |
| Old Union Tnpk to/from east | 1% | 1% | 1% | 1% |
| Route 117 to/from east | 7% | 7% | 24% | 23% |
| Route 117 to/from west | 13% | 13% | 4% | 5% |
| Route 70 to/from north | 8% | 8% | 1% | 28% |
| Route 70 to/from south | 18% | 18% | 14% | 15% |
| **Total** | **100%** | **100%** | **100%** | **100%** |

To highlight the movement of new truck traffic to/from the site, the projected weekday morning, weekday evening, and Saturday midday site-generated truck-specific traffic-volume networks are presented in Figure 5b. Note that the truck volumes presented in Figure 5b are included within the overall trip generation estimates presented in Figure 5a.

## 2030 BUILD TRAFFIC VOLUMES

The 20308 Build Condition traffic-volume networks consist of the 2030 No-Build traffic volumes with the addition of the site-generated traffic for the proposed redevelopment. The resulting 2030 Build weekday morning, weekday evening, and Saturday midday peak-hour traffic-volume networks are presented in Figure 6.

Not to Scale

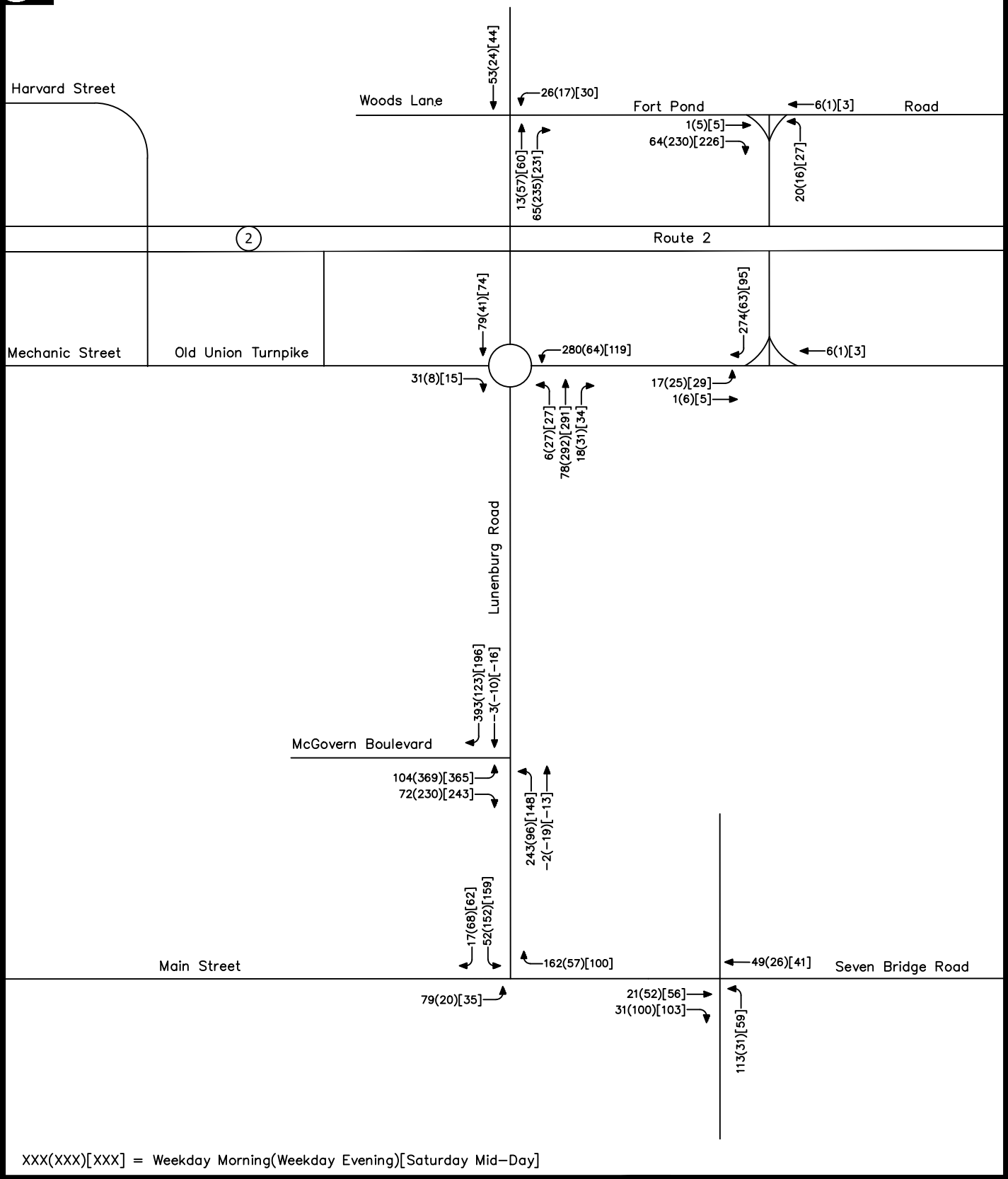
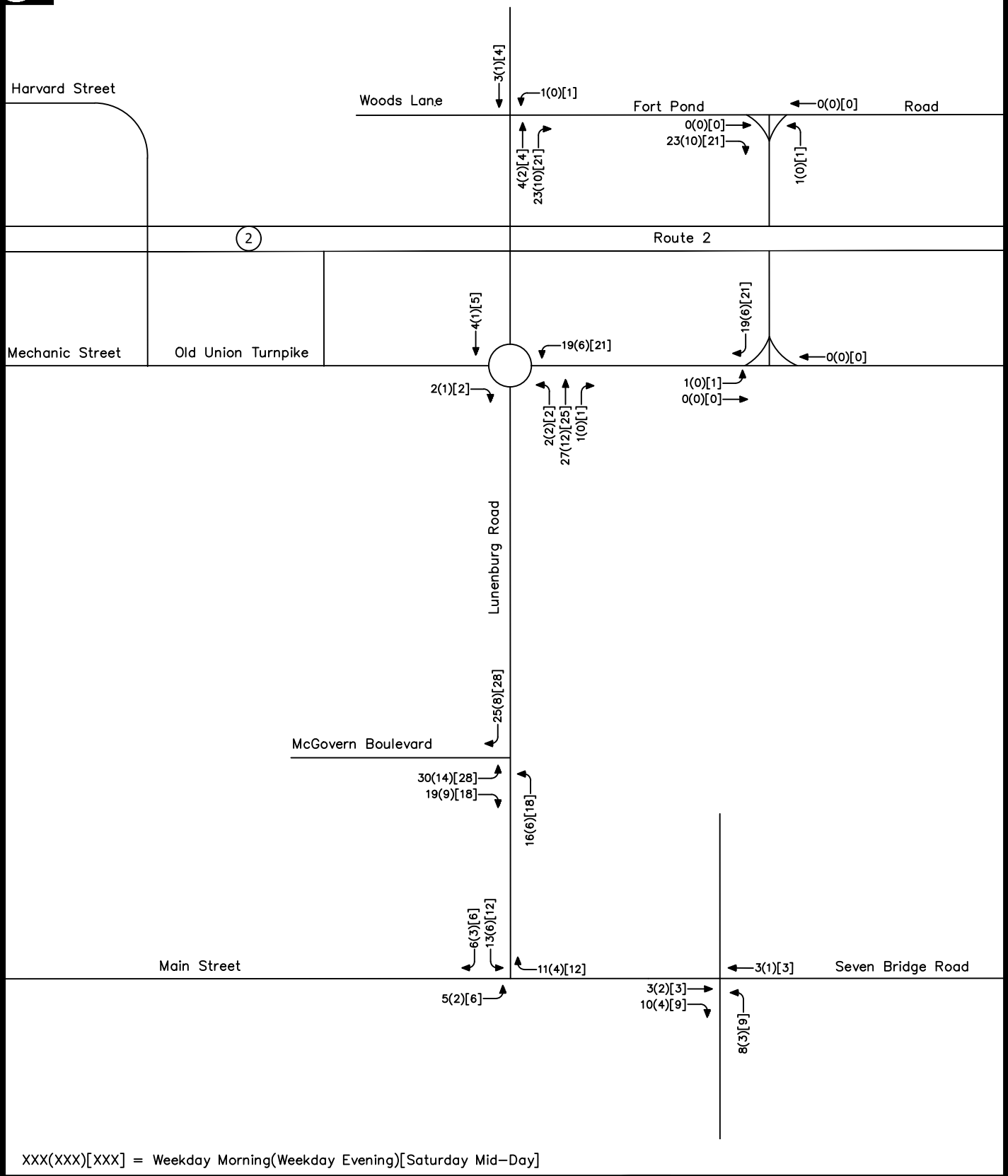



**Figure 5a**

**Site-Generated Traffic**
**Weekday Morning, Weekday Evening, and Saturday Mid-Day**
**Peak Hour Traffic Volumes**

TEC, Inc.
146 Dascomb Road
Andover, MA 01810

Not to Scale




XXX(XXX)[XXX] = Weekday Morning(Weekday Evening)[Saturday Mid-Day]

**Figure 5b**

**Site-Generated Traffic - Trucks Only
Weekday Morning, Weekday Evening, and Saturday Mid-Day
Peak Hour Traffic Volumes**

TEC, Inc.
146 Dascomb Road
Andover, MA 01810

Not to Scale

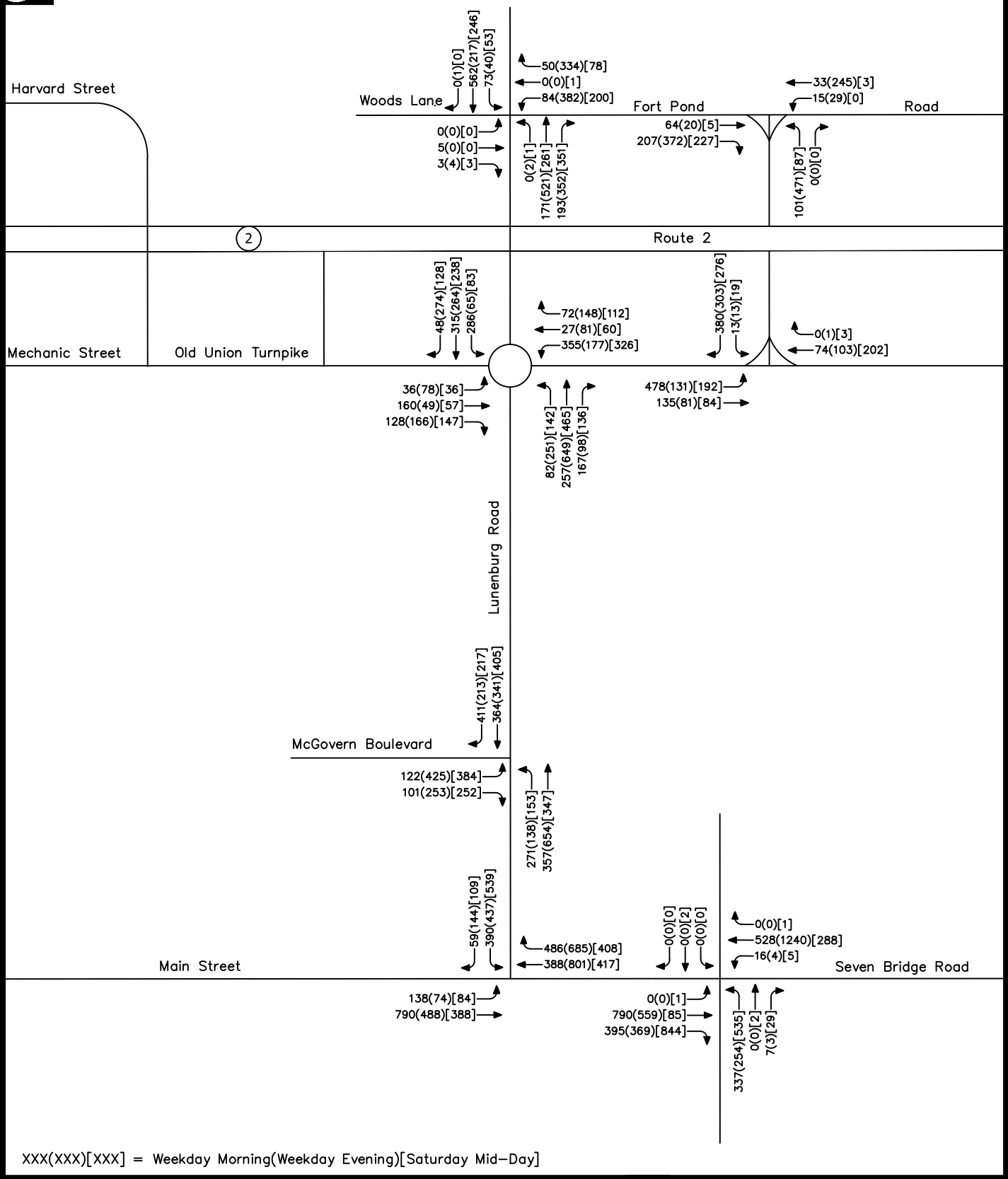



**Figure 6**

**2028 Build Conditions**
**Weekday Morning, Weekday Evening, and Saturday Mid-Day**
**Peak Hour Traffic Volumes**

TEC, Inc.
146 Dascomb Road
Andover, MA 01810

# IV. WARRANTS

## LEFT-TURN LANE WARRANTS

A left-turn lane warrant analysis was conducted for the intersection of Lunenburg Road / McGovern Boulevard using hourly traffic volumes based on TMCs conducted in December 2018. The potential left-turn lane along Lunenburg Road northbound was analyzed under both unsignalized and signalized intersection conditions.

The *MassHighway Project Development and Design Guide*[12] define left-turn lane volume warrants at unsignalized and signalized intersections based on the Transportation Research Board's (TRB) publication, the *Highway Capacity Manual (HCM) 6th Edition*[13]. The criteria are based on the operating speed of the roadway (50 mph posted), the opposing volume, and the percent of left-turning vehicles for the advancing vehicle volume. Based on both the signalized and unsignalized operating conditions on Lunenburg Road, the traffic volumes do warrant the construction of a left-turn lane on the Lunenburg Road northbound approach.

An excerpt from the *MassHighway PDDG* noting the criteria for the introduction of a left-turn lane by traffic volume is provided in Appendix J.

## TRAFFIC SIGNAL WARRANTS

A traffic signal warrant analyses was conducted for the intersections of Lunenburg Road at McGovern Boulevard and Lunenburg Road at Fort Pond Road to document the warranting condition should a traffic signal be recommended as mitigation for the project. TEC performed the traffic signal warrant analyses based on criteria contained within the *MUTCD*[14]. The *MUTCD* contains eight warrants for evaluating the need for installation of a traffic signal. The two multi-hour volume-related warrants were evaluated to determine whether a traffic signal is warranted at the four intersections described above. These warrants include:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume

For the purposes of this analysis, TEC utilized TMCs and 12-hour ATRs conducted at the subject intersections to assess the warranting conditions over a typical weekday.

[12] *MassHighway Project Development and Design Guide*, MassHighway (now Massachusetts Department of Transportation (MassDOT) – Highway Division); Boston, Massachusetts, 2006
[13] *Highway Capacity Manual 6th Edition*; Transportation Research Board; Washington, DC; 2016
[14] *Manual on Uniform Traffic Control Devices (MUTCD)* – Federal Highway Administration / U.S. DOT – 2009 Edition.

Site-generated traffic volumes to be utilized in the traffic signal warrant analyses were assessed based on trip generation rates obtained in the ITE publication, *Trip Generation, 11th Edition*. As many hours during the day are not represented based on the ITE trip generation data, TEC projected site generated traffic onto the non-peak hours based on engineering judgement for each land use.

**Warrant Adjustments – Lunenburg Road at McGovern Boulevard**

*85th Percentile Speed greater than 40 MPH* **-** As noted in the ATR counts collected in December 2018, vehicle speeds along Lunenburg Road northbound and southbound entering the intersection at McGovern Boulevard were measured with an 85th percentile speed at or greater than 40 mph during free-flow conditions. Therefore, the *MUTCD* notes that traffic volumes reductions in the 70% and 56% columns of Table 4C.1 of the *MUTCD* shall govern for use in the traffic signal warrant.

*Right-Turn Side-Street Traffic Volumes* - The McGovern Boulevard eastbound approach is proposed to consist of an exclusive left-turn lane and an exclusion right-turn lane. For this approach geometry, the *MUTCD* states:

> *"…engineering judgment and rationale should be applied to a street approach with one through/left-turn lane plus a right-turn lane. In this case, the degree of conflict of minor-street right-turn traffic with traffic on the major street should be considered. Thus, right-turn traffic should not be included in the minor-street volume if the movement enters the major street with minimal conflict. The approach should be evaluated as a one-lane approach with only the traffic volume in the through/left-turn lane considered." (MUTCD - Sect 4C.01 ¶10)*

Right-turns exiting the minor-street can generally be discounted at a traffic signal due to the lesser conflict seen between right-turns on minor-streets and major-street traffic. At the intersection of Lunenburg Road / McGovern Boulevard, a 100 percent reduction for right-turns was applied to the McGovern Boulevard eastbound approach based on the potential for a lesser vehicle conflict for right-turning vehicles and the presence of an exclusive right-turn lane.

*Number of Lanes* - As part of this traffic signal warrant analysis, the Lunenburg Road "major street" approach and the McGovern Boulevard "minor street" approach to the intersection were designated as one-lane approaches. The *MUTCD* provides guidance that states:

> *"Engineering judgment should also be used in applying various traffic signal warrants to cases where approaches consist of one lane plus one left-turn or right-turn lane. The site-specific traffic characteristics should dictate whether an approach is considered as one lane or two lanes. For example, for an approach with one lane for through and right-turning traffic plus a left-turn lane, if engineering judgment indicates that it should be considered a one-lane approach because the traffic using the left-turn lane is minor, the total traffic volume approaching the intersection should be applied against the signal warrants as a one-lane approach. The approach should be considered two lanes if approximately half of the traffic on the approach turns left and the left-turn lane is of sufficient length to accommodate all left-turn vehicles." (MUTCD Section 4C.01 ¶9)*

This paragraph generally states that engineering judgement shall be utilized in determination of number of travel lanes on the major and minor street. The Lunenburg Road northbound approach consists of "one" lane as the level of left-turning volume within an exclusive left-turn lane represents only 22 to 45 percent of the approach volume. In addition, as right-turns will not be evaluated along McGovern Boulevard, the McGovern Boulevard approach will be considered a one-lane approach within the traffic signal warrant calculations.

**Warrant Adjustments – Lunenburg Road at Fort Pond Road / Woods Lane**

*Right-Turn Side-Street Traffic Volumes* - The Fort Pond Road westbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane. The right-turn lane also serves 'through' movements to Woods Lane. For this approach geometry, the *MUTCD* states:

> *"…engineering judgment and rationale should be applied to a street approach with one through/left-turn lane plus a right-turn lane. In this case, the degree of conflict of minor-street right-turn traffic with traffic on the major street should be considered. Thus, right-turn traffic should not be included in the minor-street volume if the movement enters the major street with minimal conflict. The approach should be evaluated as a one-lane approach with only the traffic volume in the through/left-turn lane considered." (MUTCD - Sect 4C.01 ¶10)*

Right-turns exiting the minor-street can generally be discounted at a traffic signal due to the lesser conflict seen between right-turns on minor-streets and major-street traffic. At the intersection of Lunenburg Road / Fort Pond Road, a 100 percent reduction for right-turns was applied to the Fort Pond Road westbound approach based on the potential for a lesser vehicle conflict for right-turning vehicles and the presence of an exclusive / channelized right-turn lane.

**Warrant Results**

Based on the existing traffic volumes and the addition of the projected site-generated trips for each proposed land use, the intersection of Lunenburg Road / McGovern Boulevard meets the criteria for Warrant 1 and Warrant 2. As a traffic signal is warranted and due to the operating and safety conditions of the intersection without a traffic signal in place, installation of a traffic signal at this intersection is recommended as part of the off-site corridor improvements along Lunenburg Road. The off-site mitigation section of this TIAS defines the timing and scope of the traffic signal installation. The signal warrant analysis worksheets are included in Appendix K.

Based on the existing traffic volumes and the addition of the projected site-generated trips for each proposed land use, the intersection of Lunenburg Road / Fort Pond Road / Woods Lane meets the criteria for Warrant 2 at full build out. New traffic volume data was not obtained as part of the TIAS due to the COVID-19 pandemic's effect on statewide traffic volumes. As a traffic signal may be warranted and due to the operating and safety conditions of the intersection without a traffic signal in place, installation of a traffic signal at this intersection is recommended as part of the off-site corridor improvements along Lunenburg Road. The off-site mitigation section of this TIAS defines the timing and scope of the traffic signal installation, including the location's reconstruction as part of a MassDOT interchange reconstruction project. The signal warrant analysis worksheets are included in Appendix K.

# V. TRAFFIC OPERATIONS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, Build, and Build with Mitigation traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

## METHODOLOGY

### Levels of Service

A primary result of capacity analyses is the assignment of level-of-service to traffic facilities under various traffic-flow conditions.[15] The concept of level-of-service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing the worst. Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

### Queue Length Analysis

Vehicle queue analyses are a direct measurement of an intersection's ability to process vehicles under various traffic control and volume scenarios and lane use arrangements. The vehicle queue analysis was performed using the Synchro 11.0™ intersection capacity analysis software which is also based upon the methodology and procedures presented in the *HCM 6th Edition*. Synchro reports the 95th percentile queues for unsignalized intersections and both the 50th (average) and 95th percentile vehicle queues for signalized intersections, which are based on the number of vehicles that experience a delay of six (6) seconds or more at an intersection and is a function of the traffic signal timing; vehicle arrival patterns during the analysis period; and the saturation flow rate. The 50th percentile or average vehicle queue is the average number of vehicles that are projected to be delayed by six seconds or more at the intersection under study during the analysis period. The 95th percentile vehicle queue is the vehicle queue length that will

[15] The capacity analysis methodology is based on the concepts and procedures presented in the *Highway Capacity Manual 6th Edition*; Transportation Research Board; Washington, DC; 2016

be exceeded only five (5) percent of the time; or approximately three (3) minutes out of 60 minutes during the peak one hour of the day. During the remaining 57 minutes, the vehicle queue length will be less than the 95th percentile queue length.

## Impact of Industrial Park Heavy Vehicles

The capacity and queue analysis presented for the 2030 Build and 2030 Build with Mitigation conditions incorporates a change in percentage for heavy vehicles as part of the traffic stream. Utilizing the specified truck trip generation for the industrial park use described in Table 8, the heavy vehicles percentage on each intersection movement within the study area was adjusted to include the increase in heavy vehicles from background growth and the increase in heavy vehicle traffic from the proposed Project. Overall, the heavy vehicle percentages reflected in the 2030 Build and 2030 Build with Mitigation conditions result in a conservative heavy vehicle condition as the analysis does not consider the removal of the existing truck traffic to/from the site; such as the 11,800 SF J.B. Hunt Transport Services facility and the Central Mass Sand & Gravel site.

## PARAMETERS FOR TRAFFIC IMPACT ANALYSIS

## Unsignalized Intersections

The levels of service of two-way stop-controlled unsignalized intersections are determined by application of a procedure described in the *HCM 6th Edition*. Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and stop signs. Control delay includes the effects of initial deceleration delay approaching a stop sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level of service at unsignalized intersections are also given in the *HCM 6th Edition*. Table 10 summarizes the relationship between level of service and average control delay.

**Table 10 – Level-of-Service Criteria for Unsignalized Intersections [a]**

| Level of Service (v/c ≤ 1.0) | Level of Service (v/c > 1.0) | Average Control Delay (seconds per vehicle) | Description |
|---|---|---|---|
| A | F | ≤10.0 | LOS A represents a condition with little or no control delay to minor street traffic. |
| B | F | 10.1 to 15.0 | LOS B represents a condition with short control delays to minor street traffic. |
| C | F | 15.1 to 25.0 | LOS C represents a condition with average control delays to minor street traffic. |
| D | F | 25.1 to 35.0 | LOS D represents a condition with long control delays to minor street traffic. |
| E | F | 35.1 to 50.0 | LOS E represents operating conditions at or near capacity level, with very long control delays to minor street traffic. |
| F | F | >50.0 | LOS F represents a condition where minor street demand volume exceeds capacity of an approach lane, with excessive control delays resulting. |

[a] Source: *Highway Capacity Manual 6th Edition*; Transportation Research Board; Washington D.C.; 2016

## Signalized Intersections

LOS for signalized intersections is calculated using the operational analysis methodology of the *HCM 6th Edition*. This method assesses the effects of signal type, timing, phasing, progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or signal delay per vehicle. Control or signal delay can be related to driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay.

Table 11 summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

**Table 11 – Level-of-Service Criteria for Signalized Intersections[a]**

| Level of Service (v/c ≤ 1.0) | Level of Service (v/c > 1.0) | Average Control Delay (seconds per vehicle) | Description |
|---|---|---|---|
| A | F | ≤10.0 | LOS A describes operations with very low control delay; most vehicles do not stop at all. |
| B | F | 10.1 to 20.0 | LOS B describes operations with relatively low control delay. However, more vehicles stop than LOS A. |
| C | F | 20.1 to 35.0 | LOS C describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping. |
| D | F | 35.1 to 55.0 | LOS D describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable, whereby motorists are not able to get through the signal on one cycle. |
| E | F | 55.1 to 80.0 | LOS E describes operations with high control delay values. Individual cycle failures are frequent occurrences. |
| F | F | >80.0 | LOS F describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels. |

[a] Source: *Highway Capacity Manual 6th Edition*; Transportation Research Board; Washington D.C.; 2016

## Roundabout Intersections

The capacity and queue analysis for the roundabout location was performed using the Georgia Department of Transportation (GDOT) Version 4.2 Roundabout Analysis Tool software which is also based upon the methodology and procedures presented in the *HCM 6th Edition*. This analysis tool is utilized over Synchro as it is a MassDOT approved methodology. The levels-of-service of roundabouts are equivalent to the levels-of-service of unsignalized intersections and are determined by application of a procedure described in the *HCM 6th Edition*. Level-of-service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and stop-signs. Control delay includes the effects of initial deceleration delay approaching a stop-sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. Definitions for level-of-service at roundabout intersections are also given in the *HCM 6th Edition*. Table 12 summarizes the relationship between level-of-service and average control delay.

**Table 12 – Level-of-Service Criteria for Roundabouts [a,b]**

| Level-of-Service (v/c < 1.0) | Level-of-Service (v/c ≥ 1.0) | Average Control Delay (seconds per vehicle) | Description |
|---|---|---|---|
| A | F | ≤10.0 | LOS A represents a condition with little or no control delay to minor street traffic. |
| B | F | 10.1 to 15.0 | LOS B represents a condition with short control delays to minor street traffic. |
| C | F | 15.1 to 25.0 | LOS C represents a condition with average control delays to minor street traffic. |
| D | F | 25.1 to 35.0 | LOS D represents a condition with long control delays to minor street traffic. |
| E | F | 35.1 to 50.0 | LOS E represents operating conditions at or near capacity level, with very long control delays to minor street traffic. |
| F | F | >50.0 | LOS F represents a condition where minor street demand volume exceeds capacity of an approach lane, with excessive control delays resulting. |

[a] Source: *Highway Capacity Manual 6th Edition*; Transportation Research Board; Washington D.C.; 2016
[b] Based on unsignalized intersection LOS

## TRAFFIC IMPACT ANALYSIS RESULTS

Level-of-service analyses were conducted for the 2019 Existing, 2030 No-Build, 2030 Build, and 2030 Build with Mitigation Conditions for the study area intersections. The results of the intersection capacity analysis are summarized in Table 13. The capacity analysis worksheets are provided in Appendix L.

*Main Street / Seven Bridge Road / Driveway*

The intersection of Main Street / Seven Bridge Road / Driveway is to be reconstructed with a fully actuated traffic signal as part of a separate MassDOT project. The Main Street northbound movement at the intersection is anticipated to operate at LOS E during both the weekday morning and weekday evening peak hours and LOS F during the Saturday midday peak hours with the projection of site generated traffic volumes. Improvements are recommended and proposed at this intersection as part of the project's off-site mitigation, which include optimizing traffic signal timings at the newly constructed traffic signals to accommodate the site-generated trips. With this mitigation, all roadway movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS D or better).

*Main Street / Lunenburg Road*

The intersection of Main Street / Lunenburg Road is to be reconstruction with a fully actuated traffic signal as part of a separate MassDOT project. The Lunenburg Road southbound left-turn movement, the critical movement, is anticipated to operate at LOS F during the weekday evening peak hour with the projection of site generated traffic volumes. Improvements are recommended and proposed at this intersection as part of the project's off-site mitigation, which include optimizing traffic signal timings at the newly constructed traffic signals to accommodate the site-generated trips. With this mitigation, all roadway movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS D or better).

*Lunenburg Road / McGovern Boulevard*

With the addition of site generated traffic and the existing geometric conditions in place, the McGovern Boulevard eastbound approach would operate at elevated levels-of-service. Improvements are recommended and proposed at this intersection as part of the project's off-site mitigation and will consist of full intersection reconstruction to provide turning lanes along Lunenburg Road, separate left-turn and right-turn lanes along McGovern Boulevard, and the installation of a traffic control signal. With these improvements, all movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS C or better) with volume-to-capacity (V/C) ratios well below 1.00 which indicates that the intersection can accommodate the additional demand created by the site.

*Lunenburg Road / Old Union Turnpike*

Specific traffic operational improvements are not proposed at the intersection of Lunenburg Road / Old Union Turnpike. The intersection of Lunenburg Road / Old Union Turnpike was recently reconstructed as a roundabout in 2013 to provide reserve capacity. Under 2030 Build Conditions, the Old Union Turnpike westbound movement is anticipated to operate at LOS E or F during the weekday evening and Saturday midday peak hours, respectively. This level of delay is only expected during this short time period of a typical weekday or typical Saturday and is dependent on the conservative level of site generated traffic allocated to the location. In addition, these results assume a calculation where no removal of existing truck traffic was projected thereby resulting in a more conservative overall analysis. Although the roundabout is under Town control, MassDOT District 3 has noted that the roundabout is preferable to any enhanced mitigation at this location as:

- Traffic patterns through this roundabout are likely to change with the reconstruction of the Route 2 Interchange 103. This project, although not on the TIP, could be completed prior to full build-out of the Landing - Lancaster;
- Because of the heavy industrial nature of the site and the residential nature of the surroundings, an overwhelming number of vehicles in the area traverse the roundabout in only a short period of the typical day; including Saturday for the "lunch-time" midday peak. This would suggest that much of the remaining day the roundabout would operate well under capacity; and
- For the short-lived nature of possible congestion, the roundabout's limited conflict points render the geometry to be a safer condition as opposed to a standard unsignalized location or a signalized location.

There are no practical means to mitigate project related impacts at the intersection based on the short period of elevated levels-of-service. This includes expansion of the roundabout, which would impact wetland areas on the southeast corner, an existing drainage swale between the car dealership and the roundabout on the southwest corner, and the grading on the northerly side of the roundabout with the existing drop-off to the Route 2 eastbound bore.

*Lunenburg Road / Fort Pond Road / Woods Lane*

Under both 2030 No-Build and Build Conditions, the Fort Pond Road westbound approach is anticipated to operate at elevated levels-of-service (LOS F) during the weekday evening peak hour and LOS E during the weekday morning and Saturday midday peak hours. This level of delay is only expected during this short time period of a typical weekday or Saturday and is specifically dependent on the conservative level of site generated traffic allocated to the location. All other movements at this intersection are anticipated to operate at acceptable levels of service (LOS D or better) with V/C ratios well below 1.00 which indicates that the intersection can accommodate the additional demand created by the site. With the construction of any of the five improvement alternatives identified by MassDOT as part of the future project, traffic operations and safety at the intersection are anticipated to greatly improve.

Although delay is anticipated to only occur during the minimal peak time periods, the level of delay and the length of queue are elevated. For instance, the queue along Fort Pond Road westbound is longer than the distance between the stop-line and the Route 2 WB Off-ramp, effectively extending the queue onto the ramp and potentially Route 2. Improvements are recommended and proposed at this intersection as part of the project's off-site mitigation and will consist installation of a temporary/interim fully actuated traffic signal. The existing geometry will be maintained. The scheduling of this installation is described in the Mitigation section of this TIAS. With these improvements, all movements at this intersection are expected to operate at acceptable levels of service (LOS D or better) with V/C ratios well below 1.00 which indicates that the intersection can accommodate the additional demand created by the site. Along the Fort Pond Road westbound approach, the queue is not anticipated to be greater than 218-feet and therefore will not extend past the Route 2 WB Off-ramp, thereby not exacerbating the queuing along the ramp.

Interchange improvements along Route 2 are expected to change the characteristics of the intersection; including potential intersection relocation, as part of a future MassDOT project. For the purposes of this TIAS, no alternative for improvement has been identified and therefore the No-Build and Build scenarios assume the existing geometry and intersection control.

*Old Union Turnpike / Route 2 EB Ramps [Exit 103]*

Specific traffic operational improvements are not proposed at the intersection of Old Union Turnpike / Route 2 EB Interchange 103 (formerly Interchange 35) Ramps; however, interchange improvements along Route 2 are expected to change the characteristics of the intersection as part of a future MassDOT project. All five interchange alternatives remove the Route 2 EB off-ramp movements and shift them to the west along either Old Union Turnpike or Route 70. These improvements are not scheduled on the state TIP and therefore cannot be anticipated for completion prior to the 2030 horizon year. For the purposes of this TIAS the No-Build and Build scenarios assume the existing geometry and intersection control. Under 2030 Build Conditions, all movements at the intersection are expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios except the southbound left-turn movement during the weekday morning peak hour. This movement operates with at LOS E, just over the threshold for LOS D, and includes only 13 vehicles in the corresponding hour (1 car every 4 minutes). For all scenarios and movements, the queues will not extend in any significant length.

*Fort Pond Road / Route 2 WB Ramps [Exit 103]*

Interchange improvements along Route 2 are expected to change the characteristics of the Fort Pond Road / Route 2 WB Interchange 103 (formerly Interchange 35) Ramp intersection as part of a future MassDOT project. All five interchange alternatives modify the Route 2 WB ramps. Two (2) of the alternatives retain the Route 2 WB off-ramp condition along Fort Pond Road while moving the on-ramp condition to the west side of Route 70. These conditions would generally retain traffic operation conditions exiting the off-ramp. The other three (3) alternatives shift the on- and off-ramps into a diamond interchange pattern along Route 70, separating out the Fort Pond Road traffic volumes. These improvements are not scheduled on the state TIP and therefore cannot be anticipated for completion prior to the 2030 horizon year. For the purposes of this TIAS, the No-Build and Build scenarios assume the existing geometry and intersection control.

Under 2030 Build Conditions, all movements at the intersection are expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios with exception of the Route 2 off-ramp northbound left-turn movement, which will operate at LOS E during the weekday evening peak hour. Although the ramp will operate at an elevate level-of-service, the ramp approach will generally operate in a consistent manner as existing conditions as the additional traffic will also result in a more consistent flow of traffic. In addition, the installation of the temporary traffic signal at the intersection of Lunenburg Road / Fort Pond Road / Woods Lane will create new gaps in the traffic flow along Fort Pond resulting in quicker flow from the Route 2 off-ramp. Therefore, the delay along this approach is expected to be better than reported from the analysis software.

As discussed with MassDOT, there are no practical off-site mitigation alternatives for this approach that would result in a reduction of LOS. The level of impact from the project and the traffic volumes along the ramp do not warrant a change in control at the intersection. Geometric improvements are recommended and proposed at this location as part of the project's off-site mitigation and will include a commitment to extend the queue storage and deceleration lane along the Route 2 WB Off-Ramp to ensure project related traffic does not conflict with Route 2 mainline volumes. The projected 95$^{th}$ percentile queue along the ramp is anticipated to be 290-feet at full build-out. This mitigation does not alter the results of the capacity and queue analysis.

## Table 13 – Intersection Capacity and Queue Analysis Summary

| Intersection / Lane Group | 2019 Existing V/C[a] | 2019 Existing Delay[b] | 2019 Existing LOS[c] | 2019 Existing Queue[d] | 2030 No-Build V/C | 2030 No-Build Delay | 2030 No-Build LOS | 2030 No-Build Queue | 2030 Build V/C | 2030 Build Delay | 2030 Build LOS | 2030 Build Queue | 2030 Build w/ Mitigation V/C | 2030 Build w/ Mitigation Delay | 2030 Build w/ Mitigation LOS | 2030 Build w/ Mitigation Queue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Main Street / Seven Bridge Road / Shirley Road** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EBL/T | - | - | - | - | 0.78 | 9.1 | A | 160/274 | 0.80 | 9.3 | A | 170/288 | 0.82 | 11.7 | B | 260/465 |
| Main Street EBR | - | - | - | - | 0.32 | 1.7 | A | <25/<25 | 0.35 | 1.7 | A | <25/<25 | 0.34 | 1.5 | A | <25/<25 |
| Seven Bridge Road WB | 0.02 | 9.4 | A | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Seven Bridge Road WBL | - | - | - | - | 0.07 | 14.9 | B | <25/<25 | 0.07 | 15.7 | B | <25/<25 | 0.08 | 19.1 | B | <25/<25 |
| Seven Bridge Road WBT/R | - | - | - | - | 0.49 | 6.2 | A | 74/122 | 0.53 | 6.5 | A | 85/137 | 0.55 | 7.8 | A | 131/224 |
| Main Street NB | 2.03 | 567.6 | F | 438 | 0.66 | 20.9 | C | 38/159 | 1.00 | 65.8 | E | 79/303 | 0.83 | 23.6 | C | 116/221 |
| Shirley Road SB | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **8.4** | **A** | **-** | **-** | **16.5** | **B** | **-** | **-** | **10.8** | **B** | |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EBL/T | - | - | - | - | 0.39 | 4.6 | A | 90/153 | 0.44 | 5.3 | A | 119/176 | 0.44 | 5.5 | A | 119/217 |
| Main Street EBR | - | - | - | - | 0.20 | 0.8 | A | <25/<25 | 0.28 | 0.9 | A | <25/<25 | 0.28 | 0.9 | A | <25/<25 |
| Seven Bridge Road WB | 0.01 | 8.4 | A | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Seven Bridge Road WBL | - | - | - | - | 0.01 | 6.2 | A | <25/<25 | 0.01 | 7.5 | A | <25/<25 | 0.01 | 7.8 | A | <25/<25 |
| Seven Bridge Road WBT/R | - | - | - | - | 0.93 | 20.5 | C | 518/1036 | 0.96 | 26.9 | C | 644/1072 | 0.97 | 28.5 | C | 648/1161 |
| Main Street NB | 3.49 | 1264.6 | F | 555 | 0.85 | 51.7 | D | 91/171 | 0.89 | 64.1 | E | 112/219 | 0.87 | 50.6 | D | 114/198 |
| Shirley Road SB | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **17.6** | **B** | **-** | **-** | **21.9** | **C** | **-** | **-** | **21.3** | **C** | **-** |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EBL/T | - | - | - | - | 0.04 | 6.4 | A | <25/<25 | 0.09 | 5.7 | A | <25/39 | 0.14 | 14.8 | B | <25/73 |
| Main Street EBR | - | - | - | - | 0.80 | 6.7 | A | <25/<25 | 0.86 | 9.0 | A | <25/<25 | 0.83 | 9.5 | A | <25/<25 |
| Seven Bridge Road WB | 0.01 | 7.3 | A | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Seven Bridge Road WBL | - | - | - | - | 0.01 | 6.6 | A | <25/<25 | 0.01 | 6.1 | A | <25/<25 | 0.02 | 5.8 | B | <25/<25 |
| Seven Bridge Road WBT/R | - | - | - | - | 0.31 | 7.6 | A | 36/104 | 0.32 | 6.7 | A | 44/119 | 0.51 | 17.7 | B | 103/226 |
| Main Street NB | 1.63 | 331.9 | F | 845 | 1.71 | 354.2 | F | 95/369 | 2.25 | 599.8 | F | 145/442 | 0.90 | 25.6 | C | 162/376 |
| Shirley Road SB | 0.01 | 11.1 | B | <25 | 0.38 | 42.5 | B | <25/<25 | 0.39 | 47.2 | D | <25/<25 | 0.39 | 51.1 | D | <25/<25 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **121.7** | **F** | **-** | **-** | **195.2** | **F** | **-** | **-** | **16.2** | **B** | **-** |
| **Main Street / Lunenburg Road** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EB | 0.06 | 9.2 | A | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Main Street EBL | - | - | - | - | 0.15 | 8.2 | A | <25/<25 | 0.38 | 10.3 | B | 27/49 | 0.38 | 10.4 | B | 35/65 |
| Main Street EBT | - | - | - | - | 0.83 | 11.2 | B | 273/427 | 0.84 | 13.1 | B | 273/427 | 0.85 | 14.4 | B | 353/627 |
| Main Street WBT | - | - | - | - | 0.59 | 13.2 | B | 132/213 | 0.63 | 16.1 | B | 139/230 | 0.64 | 16.4 | B | 161/255 |
| Main Street WBR | - | - | - | - | 0.35 | 4.5 | A | <25/<25 | 0.53 | 5.9 | A | <25/<25 | 0.53 | 5.9 | A | <25/<25 |
| Lunenburg Road SBL | 2.73 | 855.4 | F | 768 | 0.86 | 23.0 | C | 138/360 | 0.89 | 32.7 | C | 168/436 | 0.88 | 22.6 | C | 202/352 |
| Lunenburg Road SBR | 0.08 | 12.3 | B | <25 | 0.09 | 12.5 | B | <25/37 | 0.12 | 11.9 | B | <25/45 | 0.11 | 11.6 | B | <25/41 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **12.5** | **B** | **-** | **-** | **15.3** | **B** | **-** | **-** | **14.0** | **B** | **-** |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EB | 0.10 | 13.2 | B | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Main Street EBL | - | - | - | - | 0.22 | 12.6 | B | <25/<25 | 0.33 | 16.5 | B | <25/27 | 0.37 | 19.3 | B | <25/41 |
| Main Street EBT | - | - | - | - | 0.41 | 5.8 | A | 120/177 | 0.43 | 7.6 | A | 120/177 | 0.46 | 9.8 | A | 181/265 |
| Main Street WBT | - | - | - | - | 0.83 | 17.2 | B | 400/694 | 0.86 | 22.6 | C | 408/696 | 0.93 | 36.3 | D | 584/840 |
| Main Street WBR | - | - | - | - | 0.56 | 4.7 | A | <25/<25 | 0.59 | 4.8 | A | <25/39 | 0.59 | 5.0 | A | <25/44 |
| Lunenburg Road SBL | 2.79 | 909.5 | F | 590 | 0.86 | 37.2 | D | 166/335 | 1.10 | 105.4 | F | 336/581 | 0.92 | 43.3 | D | 263/446 |
| Lunenburg Road SBR | 0.26 | 23.8 | C | 25 | 0.20 | 21.7 | C | 31/69 | 0.32 | 23.2 | C | 62/121 | 0.28 | 20.7 | C | 55/96 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **13.9** | **B** | **-** | **-** | **28.8** | **C** | **-** | | **23.0** | **C** | **-** |

[a] Volume-to-capacity ratio,
[b] Delay expressed in seconds per vehicle (average)
[c] Level of service,
[d] 50th/95th Percentile Queue [95th Percentile Queue only for unsignalized intersections]

## Table 13 – Intersection Capacity and Queue Analysis Summary (Continued)

| Intersection / Lane Group | 2019 Existing V/C[a] | 2019 Existing Delay[b] | 2019 Existing LOS[c] | 2019 Existing Queue[d] | 2030 No-Build V/C | 2030 No-Build Delay | 2030 No-Build LOS | 2030 No-Build Queue | 2030 Build V/C | 2030 Build Delay | 2030 Build LOS | 2030 Build Queue | 2030 Build w/ Mitigation V/C | 2030 Build w/ Mitigation Delay | 2030 Build w/ Mitigation LOS | 2030 Build w/ Mitigation Queue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Main Street / Lunenburg Road** | | | | | | | | | | | | | | | | |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| Main Street EB | 0.05 | 9.3 | A | <25 | - | - | - | - | - | - | - | - | - | - | - | - |
| Main Street EBL | - | - | - | - | 0.14 | 8.7 | A | <25/<25 | 0.27 | 12.0 | B | <25/33 | 0.28 | 12.4 | B | <25/45 |
| Main Street EBT | - | - | - | - | 0.42 | 7.2 | A | 88/142 | 0.45 | 10.2 | B | 88/140 | 0.46 | 10.7 | B | 124/192 |
| Main Street WBT | - | - | - | - | 0.70 | 14.3 | B | 141/239 | 0.73 | 19.3 | B | 146/249 | 0.75 | 20.0 | C | 188/302 |
| Main Street WBR | - | - | - | - | 0.34 | 4.6 | A | <25/<25 | 0.41 | 4.8 | A | <25/<25 | 0.41 | 4.8 | A | <25/<25 |
| Lunenburg Road SBL | 1.45 | 263.5 | F | 498 | 0.84 | 17.5 | B | 125/316 | 0.93 | 39.3 | D | 221/518 | 0.91 | 25.2 | C | 234/497 |
| Lunenburg Road SBR | 0.08 | 12.3 | B | <25 | 0.09 | 10.5 | B | <25/29 | 0.18 | 10.5 | B | <25/59 | 0.17 | 10.2 | B | <25/57 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **11.2** | **B** | **-** | **-** | **19.2** | **B** | **-** | **-** | **15.5** | **B** | **-** |
| **Lunenburg Road / McGovern Boulevard** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| McGovern Boulevard EB | 0.11 | 13.7 | B | <25 | 0.12 | 14.7 | B | <25 | 2.64 | 839.3 | F | 565 | - | - | - | - |
| McGovern Boulevard EBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.45 | 16.5 | B | 37/87 |
| McGovern Boulevard EBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.39 | 16.2 | B | <25/34 |
| Lunenburg Road NB | 0.03 | 8.2 | A | <25 | 0.03 | 8.3 | A | <25 | 0.37 | 12.4 | B | 43 | - | - | - | - |
| Lunenburg Road NBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.59 | 10.0 | B | 36/75 |
| Lunenburg Road NBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.38 | 5.6 | A | 50/102 |
| Lunenburg Road SBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.70 | 15.5 | B | 106/199 |
| Lunenburg Road SBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.56 | 8.1 | A | <25/43 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **10.7** | **B** | **-** |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | | | |
| McGovern Boulevard EB | 0.19 | 20.1 | C | <25 | 0.34 | 27.4 | D | 35 | 4.39 | 1579.8 | F | 1795 | - | - | - | - |
| McGovern Boulevard EBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.81 | 19.6 | B | 132/278 |
| McGovern Boulevard EBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.55 | 14.4 | B | <25/42 |
| Lunenburg Road NB | 0.02 | 8.1 | A | <25 | 0.04 | 8.4 | A | <25 | 0.15 | 9.3 | A | <25 | - | - | - | - |
| Lunenburg Road NBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.35 | 10.7 | B | 26/53 |
| Lunenburg Road NBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.76 | 11.9 | B | 179/303 |
| Lunenburg Road SBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.75 | 18.3 | B | 109/189 |
| Lunenburg Road SBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.25 | 5.2 | A | <25/<25 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | | **14.1** | **B** | **-** |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| McGovern Boulevard EB | 0.08 | 16 | C | <25 | 0.08 | 15.1 | C | <25 | 3.58 | 1210.8 | F | 1655 | - | - | - | - |
| McGovern Boulevard EBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.81 | 20.4 | C | 131/264 |
| McGovern Boulevard EBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.60 | 15.4 | B | <25/43 |
| Lunenburg Road NB | 0.01 | 8.1 | A | <25 | 0.01 | 8.3 | A | <25 | 0.19 | 10.1 | B | <25 | - | - | - | - |
| Lunenburg Road NBL | - | - | - | - | - | - | - | - | - | - | - | - | 0.45 | 11.4 | B | <25/60 |
| Lunenburg Road NBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.41 | 8.1 | A | 80/136 |
| Lunenburg Road SBT | - | - | - | - | - | - | - | - | - | - | - | - | 0.78 | 18.6 | B | 137/259 |
| Lunenburg Road SBR | - | - | - | - | - | - | - | - | - | - | - | - | 0.27 | 4.7 | A | <25/<25 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **14.1** | **B** | **-** |
| **Lunenburg Road / Old Union Turnpike** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Old Union Turnpike EB | 0.37 | 9.7 | A | 45 | 0.44 | 11.4 | B | 58 | 0.72 | 28.9 | D | 147 | | | | |
| Old Union Turnpike WB | 0.18 | 5.7 | A | <25 | 0.20 | 6.0 | A | <25 | 0.57 | 12.9 | B | 99 | | | | |
| Lunenburg Road NB | 0.46 | 10.9 | B | 68 | 0.57 | 13.9 | B | 99 | 0.73 | 20.8 | C | 180 | | | | |
| Lunenburg Road SB | 0.50 | 9.1 | A | 75 | 0.55 | 10.0 | B | 89 | 0.86 | 30.0 | D | 271 | | | | |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | No Mitigation Proposed | | |
| Old Union Turnpike EB | 0.27 | 6.3 | A | 27 | 0.32 | 7.5 | A | 35 | 0.37 | 9.0 | A | 43 | | | | |
| Old Union Turnpike WB | 0.44 | 11.3 | B | 59 | 0.52 | 13.5 | B | 77 | 0.87 | 44.5 | E | 238 | | | | |
| Lunenburg Road NB | 0.52 | 9.1 | A | 79 | 0.59 | 10.6 | B | 100 | 0.91 | 29.3 | D | 362 | | | | |
| Lunenburg Road SB | 0.53 | 11.1 | B | 82 | 0.67 | 15.5 | C | 136 | 0.78 | 23.2 | C | 204 | | | | |

[a] Volume-to-capacity ratio,
[b] Delay expressed in seconds per vehicle (average)
[c] Level of service,
[d] 50th/95th Percentile Queue [95th Percentile Queue only for unsignalized intersections]

**Table 13 – Intersection Capacity and Queue Analysis Summary (Continued)**

| Intersection / Lane Group | 2019 Existing V/C[a] | 2019 Existing Delay[b] | 2019 Existing LOS[c] | 2019 Existing Queue[d] | 2030 No-Build V/C | 2030 No-Build Delay | 2030 No-Build LOS | 2030 No-Build Queue | 2030 Build V/C | 2030 Build Delay | 2030 Build LOS | 2030 Build Queue | 2030 Build w/ Mitigation V/C | 2030 Build w/ Mitigation Delay | 2030 Build w/ Mitigation LOS | 2030 Build w/ Mitigation Queue |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lunenburg Road / Old Union Turnpike** | | | | | | | | | | | | | | | | |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| Old Union Turnpike EB | 0.35 | 8.7 | A | 39 | 0.34 | 8.7 | A | 38 | 0.47 | 13.6 | B | 64 | | | | |
| Old Union Turnpike WB | 0.54 | 11.5 | B | 84 | 0.49 | 10.2 | B | 71 | 1.01 | 66.4 | F | 401 | | No Mitigation Proposed | | |
| Lunenburg Road NB | 0.44 | 8.1 | A | 58 | 0.43 | 7.9 | A | 56 | 0.83 | 21.5 | C | 263 | | | | |
| Lunenburg Road SB | 0.50 | 11.5 | B | 75 | 0.54 | 12.1 | B | 86 | 0.79 | 26.0 | D | 202 | | | | |
| **Lunenburg Road / Fort Pond Road / Woods Lane** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Woods Lane EB | 0.02 | 15.1 | C | <25 | 0.02 | 15.8 | C | <25 | 0.03 | 16.8 | C | <25 | 0.34 | 26.9 | C | <25/<25 |
| Fort Pond Road WBL | 0.16 | 20.7 | C | <25 | 0.24 | 23.9 | C | <25 | 0.38 | 30.3 | D | 43 | 0.40 | 16.7 | B | <25/69 |
| Fort Pond Road WBT/R | 0.05 | 9.3 | A | <25 | 0.06 | 9.5 | A | <25 | 0.06 | 9.5 | A | <25 | 0.26 | 15.9 | B | <25/<25 |
| Lunenburg Road NB | 0.00 | 0.0 | A | <25 | 0.00 | 0.0 | A | <25 | 0.00 | 0.0 | A | <25 | 0.22 | 6.0 | A | <25/56 |
| Lunenburg Road SB | 0.05 | 7.6 | A | <25 | 0.05 | 7.7 | A | <25 | 0.05 | 7.7 | A | <25 | 0.70 | 9.3 | A | 76/277 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **9.8** | **A** | **-** |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | | | |
| Woods Lane EB | 0.01 | 9.2 | A | <25 | 0.01 | 9.4 | A | <25 | 0.01 | 9.5 | A | <25 | 0.37 | 39.3 | D | <25/<25 |
| Fort Pond Road WBL | 1.08 | 112.6 | F | 320 | 1.55 | 300.9 | F | 620 | 1.88 | 447.1 | F | 768 | 0.78 | 18.7 | B | 93/218 |
| Fort Pond Road WBT/R | 0.62 | 20.8 | C | 105 | 0.69 | 24.6 | C | 133 | 0.75 | 30.2 | D | 160 | 0.74 | 17.7 | B | <25/62 |
| Lunenburg Road NB | 0.01 | 7.6 | A | <25 | 0.01 | 7.7 | A | <25 | 0.01 | 7.7 | A | <25 | 0.78 | 17.9 | B | 129/386 |
| Lunenburg Road SB | 0.03 | 8.7 | A | <25 | 0.05 | 8.8 | A | <25 | 0.05 | 9.0 | A | <25 | 0.40 | 11.6 | B | 56/195 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | | **17.0** | **B** | **-** |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| Woods Lane EB | 0.01 | 9.4 | A | <25 | 0.01 | 9.5 | A | <25 | 0.01 | 9.8 | A | <25 | 0.36 | 34.6 | C | <25/<25 |
| Fort Pond Road WBL | 0.31 | 17.6 | C | 33 | 0.53 | 24.3 | C | 73 | 0.73 | 41.3 | E | 135 | 0.65 | 13.6 | B | 31/122 |
| Fort Pond Road WBT/R | 0.11 | 10.1 | B | <25 | 0.12 | 10.3 | B | <25 | 0.13 | 10.8 | B | <25 | 0.28 | 11.2 | B | <25/26 |
| Lunenburg Road NB | 0.01 | 7.7 | A | <25 | 0.01 | 7.7 | A | <25 | 0.01 | 7.8 | A | <25 | 0.44 | 9.2 | A | 35/128 |
| Lunenburg Road SB | 0.05 | 7.9 | A | <25 | 0.05 | 7.9 | A | <25 | 0.05 | 8.1 | A | <25 | 0.52 | 9.7 | A | 43/156 |
| **Overall Intersection** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **10.7** | **B** | **-** |
| **Old Union Turnpike / Route 2 EB Ramps** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Old Union Turnpike EB | 0.27 | 8.3 | A | 28 | 0.33 | 8.6 | A | 38 | 0.34 | 8.7 | A | 38 | | | | |
| Route 2 Ramp SBL | 0.07 | 25.8 | D | <25 | 0.10 | 34.9 | D | <25 | 0.11 | 38.2 | E | <25 | | | | |
| Route 2 Ramp SBR | 0.11 | 9.2 | A | <25 | 0.12 | 9.3 | A | <25 | 0.42 | 11.4 | B | 53 | | | | |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | | | |
| Old Union Turnpike EB | 0.06 | 7.6 | A | <25 | 0.09 | 7.7 | A | <25 | 0.11 | 7.8 | A | <25 | | | | |
| Route 2 Ramp SBL | 0.02 | 11.3 | B | <25 | 0.03 | 12.3 | B | <25 | 0.03 | 13.2 | B | <25 | | No Mitigation Proposed | | |
| Route 2 Ramp SBR | 0.27 | 10.3 | B | 28 | 0.31 | 10.6 | B | 33 | 0.39 | 11.4 | B | 48 | | | | |
| *Saturday Midday Peak Period* | | | | | | | | | | | | | | | | |
| Old Union Turnpike EB | 0.18 | 8.7 | A | <25 | 0.15 | 8.3 | A | <25 | 0.18 | 8.4 | A | <25 | | | | |
| Route 2 Ramp SBL | 0.11 | 20.0 | C | <25 | 0.07 | 16.4 | C | <25 | 0.08 | 18.2 | C | <25 | | | | |
| Route 2 Ramp SBR | 0.38 | 13.0 | B | 45 | 0.27 | 11.1 | B | 28 | 0.42 | 12.9 | B | 53 | | | | |
| **Fort Pond Road / Route 2 WB Ramps** | | | | | | | | | | | | | | | | |
| *Weekday Morning Peak Period* | | | | | | | | | | | | | | | | |
| Fort Pond Road WB | 0.01 | 7.4 | A | <25 | 0.01 | 7.4 | A | <25 | 0.01 | 7.4 | A | <25 | | | | |
| Route 2 Ramp NBL | 0.08 | 9.6 | A | <25 | 0.11 | 9.8 | A | <25 | 0.14 | 10.0 | B | <25 | | | | |
| *Weekday Evening Peak Period* | | | | | | | | | | | | | | No Mitigation Proposed | | |
| Fort Pond Road WB | 0.02 | 7.4 | A | <25 | 0.02 | 7.4 | A | <25 | 0.02 | 7.4 | A | <25 | | | | |
| Route 2 Ramp NBL | 0.89 | 41.5 | E | 258 | 0.88 | 38.9 | E | 255 | 0.92 | 45.3 | E | 290 | | | | |

[a] Volume-to-capacity ratio,
[b] Delay expressed in seconds per vehicle (average)
[c] Level of service,
[d] 50th/95th Percentile Queue [95th Percentile Queue only for unsignalized intersections]

# VI. OFF-SITE MITIGATION

After evaluating the operations and safety of the study area roadways and intersections, the next step is to identify measures to improve the roadways and intersections based on existing and future deficiencies. The Project has impacts in the area immediately adjacent to the site and requires mitigation. The following section provides a summary of measures that are recommended to improve the existing and future operations and safety of the study area intersections. These recommended measures were noted in the previous capacity and queue analysis and complement improvements to be completed by MassDOT separate from this Project.

The Applicant has proposed a comprehensive transportation mitigation program in the vicinity of the site to improve vehicular, bicycle, and pedestrian operations and safety. The Applicant also seeks to significantly improve multi-modal accommodations for bicycles and pedestrians along McGovern Boulevard to service not only the Landing - Lancaster Project, but other existing and future developments in the vicinity of the Lunenburg Road intersection with McGovern Boulevard.

## OFF-SITE COMMITTMENTS

The Applicant is committed to the following off-site improvement measures to complement other improvement measures being implemented along the area roadways by the Town of Lancaster and MassDOT and mitigate the impact of site generated traffic volumes.

### Intersection Improvements

The Applicant has committed to the following improvements at the intersection of Main Street / Seven Bridge Road:

- Modify traffic signal timings and parameters (traffic signal to be constructed as part of MassDOT Project No. 608779) post-occupancy (or at Master Plan occupancy milestone intervals) to accommodate the additional traffic flow from the Project site. The implementation of these improvements will be reviewed and coordinated with the Town of Lancaster, who will hold jurisdiction, at agreed upon occupancy thresholds.

The Applicant has committed to the following improvements at the intersection of Lunenburg Road / Main Street:

- Modify traffic signal timings and parameters (traffic signal to be constructed as part of MassDOT Project No. 608779) post-occupancy (or at Master Plan occupancy milestone intervals) to accommodate the additional traffic flow from the Project site. The implementation of these improvements will be reviewed and coordinated with

the Town of Lancaster who will hold jurisdiction, at agreed upon occupancy thresholds; and

- Implement short-term, low-cost improvement measures at the intersections which were not included or superseded as part of MassDOT Project No. 608779; including the installation of advance speed reduction signage (W3-5) along Lunenburg Road southbound. All other short-term / low-cost measures have been incorporated by the current MassDOT project.

The Applicant has committed to the following improvements at the intersection of Lunenburg Road / McGovern Boulevard:

- Construct a fully actuated traffic signal. Provide new demand-based vehicular and bicycle detection as part of the new traffic signal, as well as providing accommodations for emergency-vehicle pre-emption and a protected pedestrian crossing. The traffic signal at this location will be built in two stages:
    - Subsurface and foundational infrastructure for the traffic signal will be constructed prior to first occupancy and in conjunction with roadway improvements along both Lunenburg Road and McGovern Boulevard;
    - Traffic signal control and above-ground infrastructure for the traffic signal will be install prior to building occupancy of a perspective tenant where *MUTCD* Warrant #1 or Warrant #2 are realized;
- Widen McGovern Boulevard to provide two eastbound travel lanes including an exclusive left-turn lane and an exclusive right-turn lane;
- Widen the Lunenburg Road northbound approach to introduce an exclusive left-turn lane operating under protected-permitted signal phasing;
- Widen Lunenburg Road southbound approach to introduce an exclusive right-turn lane operating under permissive-overlap signal phasing;
- Provide ADA / AAB compliant pedestrian accommodations; including a crosswalk across McGovern Boulevard and Lunenburg Road, accessible ramps, and audio/vibratory pedestrian signal equipment;
- Construct new a 10-foot wide shared-use path along the westerly side of Lunenburg Road, north of McGovern Boulevard within the intersection limits including a pedestrian connection to Kimball Farm. Construct a 5-foot-wide sidewalk along the westerly side of Lunenburg Road, south of McGovern Boulevard within the intersection limits;
- Maintain 5-foot minimum shoulders to accommodate bicycle access along each side of Lunenburg Road; and
- Reconstruct private commercial driveways immediately north of McGovern Boulevard to accommodate the widened roadway.

**Temporary Improvements (Lunenburg Road / Fort Pond Road / Woods Lane)**

Sufficient traffic volume data was not available for the intersection of Lunenburg Road / Fort Pond Road / Woods Lane due to the onset of the COVID-19 pandemic to perform an 8-hour traffic

signal warrant analysis. Utilizing the peak hour traffic volumes from December 2018 at this location, the intersection would generally be expected to marginally meet only one traffic signal warrant, Warrant 2 – Four-Hour Volume, in an opening year condition without the Project. It is expected that the full build-out of the Master Plan will be completed over many years and will most likely not be completed prior to construction of MassDOT's improvements at Route 2 Interchange 103 (formerly Interchange 35). Each alternative outlined by MassDOT would greatly enhance traffic operations and safety both with and without the Master Plan related traffic volumes.

The Applicant has committed to construct an interim / temporary traffic signal, without additional roadway widening, at the intersection of Lunenburg Road / Fort Pond Road / Woods Lane prior to an imminent building-occupancy where *MUTCD* Warrant #1 or Warrant #2 are met. The temporary traffic signal will be dependent on updated *MUTCD* traffic signal warrants post COIVD-19 pandemic. Therefore, prior to immediate building-occupancy, the Applicant will reconduct traffic counts at the intersection (adjusted for COVID-19) for a typical weekday and add traffic to be generated by the immediate tenant. Upon credibly satisfying *MUTCD* Warrant #1 or Warrant #2, the Applicant will install the temporary/interim traffic signal. The interim traffic signal would generally consist of the following elements:

- Maintain existing geometric layout of the intersection approaches;
- Signal housings installed overhead utilizing span wire between utility poles (rated for loading);
- Installation of emergency vehicle pre-emption system;
- Installation of wire loop detectors on each approach within the pavement top-course; and
- Removal of all existing control signage; such as stop-signage on the Fort Pond Road and Woods Lane approaches.

This mitigation measure is meant to be an interim measure to mitigate both existing and future traffic operations prior to the improvements being evaluated by MassDOT at Interchange 103 (formerly Interchange 35). As the Master Plan build-out phasing is currently unknown, the level of traffic generated by the site will dictate when *MUTCD* traffic signal warrants are satisfied and will be evaluated at each perspective building occupancy stage.

**Freeway Improvements**

The Applicant has committed to construct improvements along the Route 2 WB On and Off-Ramps at Interchange 103 (formerly Interchange 35) as a temporary measure prior to full interchange reconstruction as part of an upcoming MassDOT Project. The construction will include the widening of pavement along the shoulder and marked deceleration lane for the Route 2 WB Off-Ramp in order to provide a consistent lane width and proper tapers to accommodate the 95$^{th}$ percentile queue (290-feet) for the stop-control movement along the ramp at Fort Pond Road. The construction will also include limited widening of pavement along the shoulder and marked acceleration area along the Route 2 WB On-Ramp based on the constraints of the Route 70 Bridge. Due to the bridge abutment conflict, the additional widening will extend approximately 375-feet and result in a 75-foot acceleration lane prior to the start of taper. The improvement will also modify the pavement markings on the Route 2 corridor to extend the taper to 720-feet.

## Pedestrian Accommodations

The Applicant will construct a 5-foot sidewalk along each side of McGovern Boulevard between Lunenburg Road and the internal roundabout adjacent to Building "A" to provide connectivity between land uses on the site and to Lunenburg Road. This includes connectivity to the several retail parcels previously constructed (Dunkin Donuts and Mobil Station), future retail as programmed for the parcels on the west side of Lunenburg Road, and the existing Kimball Farm along the east side of Lunenburg Road. Additional pedestrian crossings will be provided across McGovern Boulevard within the site. Final layout of on-site pedestrian and bicycle accommodations, internal site circulation, and other on-site transportation networks will be designed following the Town process.

The Applicant has also committed to construct new 10-foot shared use path along the westerly side of Lunenburg Road north of McGovern Boulevard and a 5-foot sidewalk along the westerly side of Lunenburg Road south of McGovern Boulevard within the intersection reconstruction project limits, including a pedestrian connection to Kimball Farm under traffic signal control.

### Interim Pedestrian Improvements

Whereas the installation of the proposed traffic signal at the intersection of Lunenburg Road / McGovern Boulevard is subject to meeting *MUTCD* traffic signal warrants prior to an imminent building-occupancy, the Applicant is committed to provide interim pedestrian infrastructure at the intersection in the absence of protected pedestrian phasing as part of the traffic signal. To assist pedestrian crossing maneuvers across Lunenburg Road between the site and Kimball's the Applicant is committed to install an interim Rectangular Rapid Flashing Beacon (RRFB) at the crosswalk across the Lunenburg Road southbound leg. Following completion of the traffic signal installation, when warranted, the RRFB will be removed and be donated to the Town of Lancaster to be reused at another location within the Town as needed.

## Bicycle Accommodations

The Applicant is committed to construct bicycle accommodations along McGovern Boulevard between Lunenburg Road and the internal roundabout adjacent to Building "A" to provide connectivity between land uses on the site and to Lunenburg Road. These bicycle accommodations will be in the form of 5-foot bicycle lanes and supplemented with *MUTCD*-compliant bicycle signage. In addition, bicycle racks will be provided on-site at various locations to promote the use of bicycle travel. Final layout of on-site pedestrian and bicycle accommodations, internal site circulation, and other on-site transportation networks will be designed following the Town process.

The Applicant is also committed to bicycle improvements along Lunenburg Road. The improvements along Lunenburg Road are generally short in nature and are along a high-speed arterial with wide shoulders. Within the reconstruction intersection zone, the Applicant will maintain 5-foot minimum shoulders to accommodate bicycle access along each side of Lunenburg Road within the limits of improvements. In addition, the Applicant has also committed to construct new 10-foot shared use path along the westerly side of Lunenburg Road north of McGovern Boulevard within the intersection reconstruction project limits to additionally facilitate bicycle travel.

## Public Transportation Accommodations

The Applicant has reached out to MART on the feasibility of extending service along MART Bus Route 8 to/from its current terminus at Orchard Hill Park (Target / Kohl's). Orchard Hill Park is situated on the northerly side of Route 2 Interchange 102 approximately 2 miles from the proposed Landing - Lancaster. Based on these discussions, MART has approved bus service to the site. MART Bus Route 8 also connects to the Massachusetts Bay Transportation Authority (MBTA) Commuter Rail nearby via the Mall at Whitney Field. The North Leominster transit station (one stop away) provides daily commuter rail service to Boston, Cambridge, and Fitchburg, and fourteen other MBTA stations in between.

To extend MART Bus Route 8 to the Landing - Lancaster will cost (as a preliminary estimate) approximately $110,000/year. The Commonwealth of Massachusetts will pay 50% of that amount, and the Town of Lancaster will be responsible for 50%, which is approximately $55,000/year. The approximate cost of the Bus Shelter is about $5,000 to $10,000, depending on the design selected and approved by MART, and is the responsibility of the Landing - Lancaster. The cost structure for the public transportation connection is currently being coordinated with the Town of Lancaster and MART.

MART has recommended two bus stops and shelters within the site for a project of this size. The Landing - Lancaster is currently aiming to propose these stops / shelters with one in the 40R District adjacent to the mixed-income, multi-family housing and one within the Industrial Commercial Overlay District near the largest distribution center (Building "A").

## Mitigation Implementation Thresholds

At this time, the project is in very early stages of phasing development and, therefore, the overall phasing sequence has not yet been determined. The Master Plan full build-out of each building will ultimately be dictated by market demand as individual tenants, buyers, or builders are identified and secured by the Applicant.

As the order of the Master Plan's build-out is dependent on market demand, certain portions of the mitigation for the Project are also intended to be phased to meet the demands of the site and surrounding community. The following section describes the order for construction of off-site transportation mitigation and a description of the methodology utilized to determine the process.

*Main Street Traffic Signal Optimization & Lunenburg Road Signage*

The optimization of signal timings to practical effect is dependent on specific construction milestones over the course of the Master Plan's full-build out. The Applicant has committed to coordinate with the Town of Lancaster to implement traffic signal timing optimization at the intersection of Main Street / Seven Bridge Road / Shirley Road and Main Street / Lunenburg Road at agreed upon construction milestones through post-occupancy. These milestones may be directly related to Town feedback on traffic operations during the full build-out period.

Prior to issuance of the first occupancy permit, the Applicant has committed construct advance signage along Lunenburg Road southbound in advance of Main Street as identified in the previous RSA.

*Lunenburg Road / McGovern Boulevard Intersection Improvements*

Prior to issuance of the first occupancy permit, the Applicant has committed to construct all mitigation improvements at the intersection of Lunenburg Road / McGovern Boulevard with the exception of the above-ground traffic signal infrastructure. This includes all roadway widening for Lunenburg Road, the modified cross-section of McGovern Boulevard, turning lanes and bicycle accommodations, all sidewalks and accessible ramps, and all subsurface traffic signal components (conduits, handholes, and foundations). The Applicant has committed to construct and install the above-ground traffic signal infrastructure prior to an imminent building-occupancy where site generated trips reach a level where a minimum of *MUTCD* traffic signal warrants at met. Evaluation of minimum traffic signal warrant thresholds will require 12-hour (7:00 AM to 7:00 PM) manual TMC during a typical weekday. As the Master Plan build-out phasing is currently unknown, the level of traffic generated by the site will dictate when *MUTCD* traffic signal warrants are satisfied.

*McGovern Boulevard*

The Applicant has committed to reconstruct McGovern Boulevard from the existing FC Stars Soccer driveway connection to Lunenburg Road prior to issuance of the first occupancy permit. For other portions of the Master Plan west of this location, the Applicant is committed to construct each segment of McGovern Boulevard as needed based on building footprint location. Therefore, each new segment will advance further west into the Master Plan up to the site driveway location of the subject building prior to occupancy of said building.

*Lunenburg Road / Fort Pond Road / Woods Lane*

In the event that improvements at this location are not completed by MassDOT prior to full-occupancy of the development, the Applicant has committed to construct an interim / temporary traffic signal, without additional roadway widening, at the intersection of Lunenburg Road / Fort Pond Road / Woods Lane prior to an imminent building-occupancy where *MUTCD* traffic signal warrants are met as part of updated traffic volumes post COVID-19. Evaluation of minimum traffic signal warrant thresholds will require 12-hour (7:00 AM to 7:00 PM) manual TMC during a typical weekday. As the Master Plan build-out phasing is currently unknown, the level of traffic generated by the site will dictate when *MUTCD* traffic signal warrants are satisfied and will be evaluated at each perspective building occupancy stage. The mitigation measure is meant to be an interim measure to mitigate both existing and future traffic operations prior to the improvements being evaluated by MassDOT at Interchange 103 (formerly Interchange 35). The interim traffic signal would generally consist of the following elements:

- Maintain existing geometric layout of the intersection approaches;
- Signal housings installed overhead utilizing span wire between utility poles (rated for loading);
- Installation of emergency vehicle pre-emption system;
- Installation of wire loop detectors on each approach within the pavement top-course; and
- Removal of all existing control signage; such as stop-signage on the Fort Pond Road and Woods Lane approaches.

## Transportation Demand Management Measures

The Applicant has commitment to research and provide a dynamic TDM program in order to reduce SOV trips to/from the site. At this time, the Applicant is committed to provide the following TDM measures:

*Parking Measures*

- Preferential Parking - Provide preferential parking for rideshare, carpool, and hybrid vehicles at locations throughout the site's parking areas in close proximity to major entranceways. The designated spaces will be monitored to ensure that the license plates of those employees parking in the spots each day match the registrations of participants. Employees will only be allowed to use these spaces on the days that they are carpooling;
- Electric Vehicle Stations – Provide electric vehicle (EV) charging stations at locations throughout the site's parking areas in close proximity to major entranceways.
- Provide Tractor-trailer Parking On-Site – The site will include parking spaces for tractor-trailers to be stored on-site. As an industrial park complex, this will minimize the need for tractor trailers, which create higher levels of emissions, to make additional site trips to/from a separate location to park when unneeded as part of the day-to-day commerce; and
- Reduced Parking Supply – The Applicant is committed to reducing the parking supply by providing minimal number of parking spaces below Town of Lancaster Zoning requirements to a level of the demand need only. The current parking layout provides a parking supply that is both below Town of Lancaster Zoning and ITE parking demand estimates.

*Bicycle and Pedestrian Measures*

- Pedestrian Signal Equipment – Install new pedestrian signal equipment at the intersection of Lunenburg Road / McGovern Boulevard;
- Sidewalk Connectivity - Provide connectivity of sidewalk infrastructure along McGovern Boulevard to land uses within the site and along Lunenburg Road within the construction limits;
- Bicycle Accommodations - Provide striping improvements for bicycle lanes along McGovern Boulevard and Lunenburg Road with complementary bike signs;
- ADA/AAB Compliance in Vicinity of Site - Provide ADA/AAB improvements at curb ramps near the site;
- Bicycle Racks - Provide secure, weather protected, long-term bicycle parking for employees at designated locations within the site. Provide bicycle racks for short-term users at several locations on-site; and
- Employee Shower Facilities - Coordinate with tenants to provide showers for employees who commute by walking or biking.

*Public Transportation Measures*

- Bus Service – The Applicant is coordinating with MART to extend Bus Route 8 into the site. The Applicant will construct bus shelters / stops at two locations within the project to facilitate public transportation usage.

- Maps / Schedules - Public transportation schedules with transit maps for Bus Route 8, the MBTA Commuter Rail, as well as for all nearby routes will be provided to each resident upon move-in and will be posted within each floor of the residential buildings. Schedules and maps will also be provided in the lobby and near doorways in all other on-site buildings.

*Other Measures*

- Employee Transportation Coordinator (ETC) – An ETC will be provided on-site to oversee, implement, monitor, and evaluate TDM measures, employed or funded by the Applicant. The ETC will be responsible for managing rideshare and carpool programs, as well as distributing information to employees to encourage alternative means of transportation. The ETC will be responsible for posting and distributing announcements, holding promotional events to encourage rideshare, bicycling, and walking;
- Marketing of Transportation Options and Benefits - A welcome packet for all tenants and employees will be distributed at move-in which includes information for all transportation related benefits, promotions, and local transportation options; including location of MART / MBTA stops, transit schedules, EV and carpool parking locations, and any other emerging new mobility locations;
- NuRide – The ETC will actively register employees with NuRide, as requested, to encourage ridesharing and “green” trips. The ETC, with NuRide, will develop an employee rideshare program to encourage employees to seek alternatives to driving to work alone;
- Vanpool and Carpool – The Applicant, and the ETC, will encourage vanpool and carpooling participation through marketing, events, and vanpool formation meetings. The ETC will implement a ride-matching program to assist employees in finding appropriate carpool matches. The ETC will contact employees to determine if they receive their match-lists, review the lists with them and see if they have contacted anyone on the list or would like assistance in contacting people;
- Guaranteed Ride Home Program – The ETC will be responsible for providing all employees who carpool, bicycle, or walk to work with an emergency ride home. This program eliminates the fear of being stranded on days that the employees are ridesharing or having to walk or bicycle in inclement weather conditions;
- On-Site Laundry Services - The Applicant will provide laundry services on-site to allow for the reduction of trips to/from the site of nearby laundromats;
- Flex Hours - Encourage tenants within the mixed-use development to provide flexible hours to employees;

- Direct Deposit for Employees - Encourage tenants within the mixed-use development to provide direct deposit to reduce employee trips to/from the site;
- Site Amenities – The site includes several on-site amenities; such as Dunkin Donuts, Mobil Gas Station, and other future retail space currently not constructed. This location will assist in reducing vehicular demand and increase multi-use trips, which include parking capacity sized to meet minimum local requirements without providing excessive parking;
- Promotional Events and Activities – The ETC will be responsible for organizing promotional events and activities to encourage rideshare and alternative transportation means. In addition, the ETC will distribute brochures to all new employees and residents during, and post posters and bulletins on various subjects from carpooling to the Guaranteed Ride Home program throughout the site; and
- Transportation Monitoring Program – The Applicant is committed to implement a TMP, which is intended to monitor traffic operations and parking occupancy throughout the construction and for a period following completion of the Project. The scope of the TMP will be developed in coordination with MassDOT, and will include providing traffic counts, TDM compliance, and parking information to the MassDOT District 3 office and the Town of Lancaster.

***Transportation Monitoring Program***

The Applicant is committed to implementing a TMP, which is intended to monitor traffic operations, parking occupancy, public transportation utilization, and pedestrian / bicycle use for a period following completion of the Project. The TMP will include providing traffic count information to the MassDOT District 3 office and the Town of Lancaster for use of tracking site-generated trips. The intent of the monitoring program is to ensure that the Project impacts are consistent with those predicted in the Project's permitting process, evaluate the effectiveness of the TDM measures in meeting the mode share targets, and assess the need for additional off-site improvements or TDM measures.

The MassDOT / Town of Lancaster monitoring program will include evaluation of the following:

- Traffic operations at the intersections of:
  - Main Street / Seven Bridge Road
  - Main Street / Lunenburg Road
  - Lunenburg Road / McGovern Boulevard
  - Lunenburg Road / Old Union Turnpike
  - Lunenburg Road / Fort Pond Road / Woods Lane
- Adequacy of the constructed parking supply;
- Safety evaluations based on available crash data, and
- Effectiveness of TDM measures

As part of the monitoring program, the Applicant will complete the following tasks annually for five years following occupancy of the proposed mixed-use development:

- Collect manual Turning Movement Counts (TMCs) during the weekday morning (7:00 AM to 9:00 AM), weekday evening (4:00 to 6:00 PM), and Saturday midday (11:00 AM to 2:00 PM) peak periods at the following intersections;
    - Main Street / Seven Bridge Road
    - Main Street / Lunenburg Road
    - Lunenburg Road / McGovern Boulevard
    - Lunenburg Road / Old Union Turnpike
    - Lunenburg Road / Fort Pond Road / Woods Lane
- Collect ATR data for a continuous 7-day week-long period along Lunenburg Road and McGovern Boulevard;
- Collect parking demand counts during the peak parking demand periods for the specific land use areas; including:
    - Residential - 5:00 AM to 9:00 AM;
    - Retail, Office, and Industrial - 10:00 AM to 1:00 PM; and
- Collect motor vehicle crash reports from the Town of Lancaster Police Department for the most recent one-year period to ascertain changes in crash frequency, crash trends, and severity at the monitored locations;
- Complete an employee travel survey to gage employee travel patterns and mode share;
- Compare the TMCs collected above with those projected within the TIAS for the Project to determine whether the total vehicles entering each intersection exceeds the volumes projected;
- Perform a capacity and queuing analysis using Synchro analysis software to evaluate the traffic operations at each of the intersections listed above and compare to the operations projected in the TIAS prepared for the Project;
- Assess whether additional mitigation is necessary at any of the study intersections and identify measures to improve operations and/or reduce vehicular traffic volumes. The need or evaluation for further mitigation will be conditioned upon:
    - The measured site generated traffic volumes for the Project exceed the projected site generated traffic volumes established in this TIAS, or subsequent revisions as presented to the Town of Lancaster, by more than 10 percent (i.e., 110 percent of the projected site generated traffic volumes;
    - One or more of the movements at the monitored intersections is identified to be operating at or over capacity (defined as a V/C ratio equal to or exceeds 1.00;
    - There is a pronounced increase in the frequency of occurrence of motor vehicle crashes at a monitored location and the calculated motor vehicle crash rat excess the MassDOT average crash rate for similar locations;

Corrective actions to reduce the unmitigated impact of the Project should be proposed and implemented based on the thresholds listed above. The corrective actions should be documented in the TMP, approved and coordinated with the Town and/or MassDOT if desired by the agencies, and be undertaken by the Applicant subject to receipt of all necessary rights, permits, and approvals;

- Assess whether the constructed parking supply is adequate for the parking demand as observed; and
- Prepare a memorandum summarizing the results of the TMCs, ATRs, parking demand counts, traffic impact analysis for submission to MassDOT District 3 and the Town of Lancaster.

The monitoring program will occur on an annual basis beginning six months after issuance of the first occupancy permit and continuing for five years following full occupancy of the project. The monitoring program may be suspended at any time upon agreement with MassDOT and the Town of Lancaster that the Project has sufficiently provided evidence that the upper limits of vehicle delay and trip projection would not be feasibly satisfied. The annual nature of the monitoring program may be postponed in consultation with the Town and MassDOT based on lack of need circumstances if no new development has occurred during full build-out. The monitoring program may also be suspended if five years have passed since the issuance of an occupancy permit for the project and will recommence should an additional occupancy permit be issued.

# VII. CONCLUSION

TEC has examined the potential traffic impacts associated with the proposed Landing - Lancaster in Lancaster, Massachusetts on the study area roadways and intersections. The following is a summary of the results and conclusions of this effort:

- The existing site is currently occupied by an FC Stars outdoor soccer complex comprised of three (3) soccer fields, a 11,800 square foot (SF) J.B. Hunt Transport Services facility, a 2,300 SF Dunkin Donuts, a 5,000 SF Mobil gas station with convenience market, and the recently closed soil / gravel yard for Central Mass Sand & Gravel.
- The Project consists of redeveloping the existing site; but retaining the existing three (3) outdoor soccer fields, Dunkin Donuts, and Mobil Gas Station. The proposed mixed-use development program includes construction of a 2,424,250 SF industrial park, 73,450 SF of professional office, 41,300 SF of additional retail space (48,600 SF total with existing Dunkin Donuts and Mobil), and 150 residential apartment units.
- The Project proposes to retain the access/egress to the site via McGovern Boulevard and the minor retail driveways for the existing Mobil Gas Station and Dunkin Donuts along Lunenburg Road. Individual minor driveways along Lunenburg Road, at the site frontage, will be constructed specifically for turning movements to/from on-site retail tenants similar to the existing Mobil Gas Station and Dunkin Donuts.
- The Route 2 Interchange 103 (formerly Interchange 35) and associated ramp network has experienced a significant number of crashes; however, an overwhelming majority of these crashes occurred on the freeway in the vicinity of the interchange with no effect or cause related to the surface intersection with Old Union Turnpike and Fort Pond Road. Individual crash reports were processed from the MassDOT Traffic and Safety Engineering Section for 2014 through 2018 in order to determine the crash history of the two surface intersections as part of the study area. An evaluation of these reports indicates that the surface intersections at the ramps at not HSIP-eligible.
- The intersection sight distance (ISD) and stopping sight distance (SSD) at the intersection of Lunenburg Road / McGovern Boulevard are well in excess of AASHTO minimum recommendations.
- Separate from the Project, MassDOT is currently evaluating alternatives for reconstruction of several Route 2 interchanges in Harvard and Lancaster, MA. Specifically, MassDOT is in the planning stages for reconstruction of Interchange

103 (formerly Interchange 35). These improvements are expected to greater improve operations and safety in the vicinity of Route 2.

- The proposed mixed-use redevelopment is thereby anticipated to generate 7,610 new vehicle trips during the average weekday, with 864 new vehicle trips (673 entering and 191 exiting) during the weekday morning peak hour and 822 new vehicle trips (210 entering and 612 exiting) during the weekday evening peak hour. On a typical Saturday the development is anticipated to generate 8,074 new vehicle trips with 926 new vehicle trips (345 entering and 581 exiting) during the Saturday midday peak hour.
- Based on both the signalized and unsignalized operating conditions on Lunenburg Road, the traffic volumes warrant the construction of a left-turn lane on the Lunenburg Road northbound approach at its intersection with McGovern Boulevard.
- Operational improvements are recommended and proposed at the intersection of Main Street / Seven Bridge Road / Driveway including re-timing of the new signal to accommodate the site-generated trips. With this mitigation, all roadway movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS D or better).
- Operational improvements are recommended and proposed at the intersection of Main Street / Lunenburg Road including re-timing of the new signal to accommodate the site-generated trips. With this mitigation, all roadway movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS D or better).
- Geometric and signalization improvements are recommended and proposed at the intersection of Lunenburg Road / McGovern Boulevard including slight widening to accommodate axillary turn-lanes and construction of a fully actuated traffic signal and providing an exclusive left-turn and right-turn lane on McGovern Boulevard. With this mitigation, all movements during the weekday morning, weekday evening, and Saturday midday peak hours are expected to operate at acceptable levels of service (LOS C or better). Full traffic signal implementation will not be installed by the Applicant until the level of site traffic is elevated to an *MUTCD* warranted condition during the stage construction.
- The intersection of Lunenburg Road / Old Union Turnpike was recently reconstructed as a roundabout in 2013 to provide a substantial amount of new reserve capacity. Under 2030 Build Conditions, several intersection movements are anticipated to operate at LOS E or F. This level of delay is only expected during this short time of a typical weekday and is dependent on the conservative level of site generated traffic allocated to the location. There are no practical means to mitigate project related impacts on this approach based on the short period of elevated levels-of-service during the overlapping time period.
- Under both 2030 No-Build and Build Conditions, the Fort Pond Road westbound approach at Lunenburg Road is anticipated to operate at an elevated level-of-

service during the weekday evening and Saturday midday peak period at its intersection with Lunenburg Road. A temporary/interim traffic signal, utilizing the existing geometry, is recommended, and proposed at his intersection. With this mitigation, all movements at this intersection are expected to operate at acceptable levels of service (LOS D or better) with a Fort Pond Road westbound queue not anticipated to be greater than 218-feet, less than the link distance to the Route 2 WB Off-ramp. The interim traffic signal will not be installed by the Applicant until the level of site traffic is elevated to an *MUTCD* warranted condition during the staged construction.

- Under 2030 Build Conditions, all movements at the intersection are expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios except the southbound left-turn movement during the weekday morning peak hour. This movement operates with at LOS E, just over the threshold for LOS D, and includes only 13 vehicles in the corresponding hour (1 car every 4 minutes). For all scenarios and movements, the queues will not extend in any significant length.

- Under 2030 Build Conditions, all movements at the intersection of Fort Pond Road / Route 2 WB Exit 103 Ramps are expected to operate at acceptable levels of service (LOS D or better) during all peak hour analysis scenarios with exception of the Route 2 off-ramp left-turn movement which will operate at an elevated level-of-service during the weekday evening peak hour. Although the ramp will operate at an elevated level-of-service, the ramp approach will generally operate in a consistent manner to existing conditions as the additional traffic will also result in a more consistent flow of traffic. Geometric improvements are recommended and proposed at this location as part of the project's off-site mitigation and will include a commitment to extend the queue storage and deceleration lane along the Route 2 WB Off-Ramp to ensure project related traffic does not conflict with Route 2 mainline volumes. Additional acceleration area will also be provided along the Route 2 WB On-Ramp.

- The Applicant seeks to significantly improve accommodations for bicycles and pedestrians along Lunenburg Road and McGovern Boulevard to service not only the project; but other existing developments in the vicinity.

- The Applicant is currently working with the Town of Lancaster and MART to provide service from MART Bus Route 8 to the site; including stops at potentially two locations along McGovern Boulevard; and

- The Applicant has commitment to research and provide a dynamic and extensive TDM program in order to reduce SOV trips to/from the site and promote multi-modal travel. A full compilation of TDM measures have been identified and include provisions to reduce on-site parking, increase pedestrian and bicycle travel, promote transit use to/from the site, and decrease the impacts of vehicle emissions.

In conclusion, with implementation of the proposed improvements, the anticipated traffic generated by the Landing - Lancaster Project can be safely and efficiently accommodated within

the study area corridors and intersections upon implementation of off-site mitigation. The Applicant has committed to work cooperatively with the Town of Lancaster to implement the robust transportation mitigation program.