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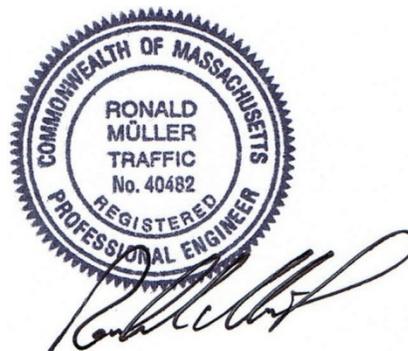
Traffic Impact and Access Study

**The Oasis at Plymouth
Home Depot Drive
Plymouth, Massachusetts**

Prepared for:

**RRSP Acquisitions LLC
75 Lambert Lind Highway
Warwick, RI 02886**

December 7, 2018



Quality



Accuracy



Integrity





Traffic Impact and Access Study

To: Mr. Nic Reuter, Director of Operations Reg: The Oasis at Plymouth
RRSP Acquisitions LLC Mixed-Use Development
75 Lambert Lind Highway Home Depot Drive
Warwick, RI 02886 Plymouth, Massachusetts

From: Ron Müller, P.E., Principal Date: December 7, 2018
Project #: 18026

INTRODUCTION

Ron Müller & Associates (RMA) has conducted this Traffic Impact and Access Study to evaluate the traffic impacts of a proposed mixed-use development project on approximately 46.5 acres of land located at the end of Home Depot Drive in Plymouth, Massachusetts. As currently proposed, the site will be developed with six residential apartment buildings containing a total of 320 units to be known as The Oasis at Plymouth. As the site can accommodate additional development, the present plan is to construct up to 70,000 square feet of medical office space, although no tenants have been identified yet. Access to the site will be provided through an extension of the existing Home Depot Drive. The site is bounded by Route 3 to the north, commercial land to the south and east, and residential uses to the west. The site location in relation to the surrounding roadways is shown on Figure 1.

This study provides an estimate of the expected traffic generation and distribution characteristics of the project, evaluates the impacts of that traffic along Long Pond Road, and determines the necessity for improvements to the area roadway system. As documented in this report, the proposed project will generate significantly less traffic than the previously proposed factory outlet center on the site that was approved by the state in 2014. However, to mitigate the project's traffic impacts, the same geometric and traffic control improvements will be implemented along Long Pond Road as were proposed for the factory outlet center. In addition, several transportation demand management strategies will be implemented to reduce the volume of traffic generated by the project. With implementation of these measures, the impacts of the project on Long Pond Road and its major intersections will be minimized with minimal changes in delay and level of service predicted over the No-Build conditions.

Figure 1
Site Location Map



SITE HISTORY

In 1999, Viking Acquisitions LLC submitted an Expanded Environmental Notification Form (ENF) and Single Environmental Impact Report (EIR) to the Massachusetts Environmental Policy Act (MEPA) office of the Executive Office of Energy and Environmental Affairs (EEA) for the development of a 133,220 square foot (sf) Home Depot store. Since the site could accommodate additional development, the Expanded ENF evaluated a mix of by-right uses including office, motel, and restaurant space.

The project was subject to MEPA review because it required an indirect Highway Access Permit from the Massachusetts Department of Transportation (MassDOT), generated more than 3,000 new daily vehicle trips, and created more than 10 acres of impervious surface. MEPA jurisdiction was therefore limited to transportation and land issues. On July 30, 1999, an EEA Certificate was issued stating that the Single EIR adequately and properly complied with MEPA and its implementing regulations. The Home Depot store has since been constructed and opened for business in November 2000. All required improvements and off-site traffic mitigation measures were completed prior to opening.

In April 2000, the Town voted to rezone the area to Highway Commercial, allowing retail and commercial uses to be constructed in a defined zone along Long Pond Road. In 2001, Viking Acquisitions LLC (subsequently Harald LLC) submitted a Notice of Project Change (NPC) and Supplemental EIR for the construction of approximately 100,000 square feet of retail and restaurant space and an outparcel to contain a gas station/convenience store with drive-through window and car wash. On March 16, 2001, an EEA Certificate was issued stating that the Supplemental EIR adequately and properly complied with MEPA and its implementing regulations. A total of 211,350 square feet of retail space (including the Home Depot), a 130-room hotel, and the gas station/convenience store have since been constructed on the site (Home Depot Plaza).

In April 2008, Harald LLC submitted a second NPC to the MEPA office for the construction of a 64,000 square foot medical center, including 49,000 square feet of medical office space and a 15,000 square foot pharmacy, on the site of the former Memorial Press Group (MPG) building as an expansion of the Home Depot Plaza. On June 6, 2008, an EEA Certificate was issued stating that the project required no further MEPA review. However, the project was subsequently denied at the Plymouth Zoning Board of Appeals due to height restrictions.

In April 2010, a third NPC was submitted to MEPA to replace the medical center with a 27,550 square foot Honda dealership. On May 7, 2010, an EEA Certificate was issued stating that the project required no further review and that state agencies could act on the necessary permits. The Honda dealership opened for business in July 2011.

In June 2008, Harald LLC purchased additional residential land behind Home Depot (the site of the currently proposed project) and in October 2009, the Town voted to expand the Highway

Commercial zone to include this site and allow retail and commercial uses to be constructed. At the time, the Town of Plymouth and Harald LLC entered into a Memorandum of Understanding (MOU) that stipulated certain development limitations on the basis of traffic generation and required the implementation of specific traffic improvements associated with development of the site.

In 2014, Paragon Outlets Plymouth LLC on behalf of Harald LLC submitted a fourth NPC and Supplemental EIR to MEPA for development of the MOU-subject property to include a 396,000 square foot factory outlet center. On September 12, 2014 an EEA Certificate was issued stating that the Supplemental EIR adequately and properly complied with MEPA and its implementing regulations. On January 22, 2015 MassDOT issued a Section 61 Finding for the project stipulating the required traffic improvements, which were the same as those required in the MOU. Paragon Outlets Plymouth LLC subsequently withdrew the project. The currently proposed 320 apartment units and 70,000 square feet of medical office space replace the prior factory outlet center project.

EXISTING CONDITIONS

Study Area

Evaluation of the traffic impacts associated with the proposed site development requires an evaluation of existing and projected traffic volumes, the volume of traffic expected to be generated by the project, and the impact that this traffic will have on the adjacent streets and nearby intersections. In preparing this study for the site, the following intersections were analyzed and evaluated in accordance with the Memorandum of Understanding (MOU) that was created between Harald LLC and the Town of Plymouth for the rezoning of this land:

- South Street at Obery Street
- Long Pond Road at Route 3 Northbound Ramps
- Long Pond Road at Route 3 Southbound Ramps
- Long Pond Road at Home Depot Drive/County Road
- Long Pond Road at Shops at 5 Driveway
- Long Pond Road at Holman Road
- Long Pond Road at Camelot Drive
- Home Depot Driveway at the hotel and Honda dealership access driveways

The proposed development is expected to have a negligible effect on traffic operations beyond this study area. The internal Home Depot Drive intersection with the access driveways to the Honda dealership/99 Restaurant to the north and the hotel/retail areas to the south was not required for study in the MOU, but was added in this report to document internal operational conditions to determine if the existing all-way stop controlled intersection can accommodate the projected volumes.

Long Pond Road varies between a two and four lane roadway (one/two lanes in each direction) with a well-defined double yellow center and white edge lines provided within the study area. Between the Home Depot Drive and Camelot Drive intersections, a center turn lane is provided which includes exclusive left-turn lanes at major intersections. A sidewalk is provided on the westerly side of Long Pond Road from Obery Street to the Honda dealership driveway. South of the Honda Dealership driveway, sidewalks are provided on both sides of the street until the Long Pond Road intersection with Camelot Drive. South of Camelot Drive, only the sidewalk on the westerly side of Long Pond Road continues. Painted crosswalks are provided at each of the study area signalized intersections allowing for the crossing of Long Pond Road with the exception of the Route 3 ramps where there are no pedestrian accommodations on the interchange ramps. Land use along Long Pond Road within the study area is predominantly commercial. The six existing traffic signals along Long Pond Road within the study area operate as a coordinated signal system.

Long Pond Road and Obery Street/South Street meet to form a three-way signalized intersection. The northbound Long Pond Road approach provides a through lane and a shared through/right-turn lane. In addition, a channelized right-turn lane is provided on the northbound approach in advance of the signal removing these vehicles from the signal operation. The South Street southbound approach provides a shared left-turn/through lane and the Obery Street westbound approach provides a shared left-/right-turn lane. The signal operates under two-phase control with permissive movements only. Land use in the area of this intersection is commercial and residential (apartments). Crosswalks are provided on the South Street southbound and Obery Street westbound intersection approaches. A future improvement project is proposed at this location which will include roadway widening and signal improvements as well as new sidewalks, bicycle accommodations, drainage upgrades, new pavement markings, and signs.

Long Pond Road and the Route 3 Northbound Ramps meet to form a three-way signalized intersection. The northbound Long Pond Road approach provides two through lanes and an exclusive channelized right-turn lane which is under yield control. The Long Pond Road southbound approach provides a through lane and an exclusive left-turn lane. The Route 3 off-ramp westbound approach provides a left-turn lane and a channelized right-turn lane under yield control. The signal operates under three-phase control with protected/permissive southbound left-turn movements. The westbound left-turn movements from Route 3 are protected as there is no opposing traffic. Land use in the area of this intersection consists of vacant, wooded land.

Long Pond Road and the Route 3 Southbound Ramps meet to form a three-way signalized intersection with a Route 3 southbound slip ramp on the Long Pond Road northbound approach. The Long Pond Road northbound approach provides a left-turn lane and two through lanes. The slip ramp is provided in advance of the signal removing these vehicles from the signal operation. The Long Pond Road southbound approach provides two through lanes and a channelized right-turn lane under yield control. The Route 3 southbound off-ramp eastbound approach provides a left-turn lane and a channelized right-turn lane under yield control. The signal operates under three-phase control with protected/permissive northbound left-turn movements. The eastbound left-turn movements from Route 3 are protected as there is no opposing traffic. Land use in the

area of this intersection consists of the Honda automobile dealership in the southwest corner and the Plymouth Police Station in the southeast corner. There is a crosswalk provided across the Route 3 eastbound approach, but no pedestrian phase exists within the signal operation. The Route 3 on ramp also provides access to the Route 3 service plaza on the southerly side of Route 3.

Long Pond Road, Home Depot Drive and County Drive meet to form a four-way signalized intersection. The Long Pond Road northbound approach provides a left-turn lane, a through lane, and a shared through/right-turn lane. The Long Pond Road southbound approach provides a left-turn lane, two through lanes, and a channelized right-turn lane under yield control. The Home Depot Drive eastbound approach and the County Drive westbound approach each provide a shared left-turn/through lane and an exclusive right-turn lane. The signal operates with protected/permissive northbound and southbound left-turn movements while the eastbound and westbound approaches operate under permissive control only. Land use in the area of this intersection is exclusively commercial. Crosswalks are provided on the Long Pond Road northbound, the Home Depot Drive westbound, and the County Drive eastbound approaches.

Traffic improvements were recently completed at this intersection as part of a gas station development in the northeast corner. These include the installation of a median on Long Pond Road north of the intersection to eliminate left-turn movements at adjacent driveways; widening of Long Pond Road northbound to receive a future double left-turn movement from Home Depot Drive; closing of the Police Station driveway; traffic signal timing improvements including increased clearance times; and a \$100,000 monetary contribution to the Town of Plymouth toward future improvements to the Long Pond Road corridor.

Long Pond Road, Shops at 5, and Shops at Long Pond driveway meet to form a four-way signalized intersection. The Long Pond Road northbound approach provides a short left-turn lane, a through lane, and a shared through/right-turn lane. The Long Pond Road southbound approach provides a double left-turn lane and a shared through/right-turn lane. The Shops at 5 westbound approach provides a shared left-turn/through lane and a double right-turn lane. The Shops at Long Pond eastbound approach provides an exclusive left-turn lane and a shared left-turn/through/right-turn lane. The signal operates with protected northbound and southbound left-turn movements while the eastbound and westbound traffic operate under split (protected) phasing. Land use in the area of this intersection is commercial. Crosswalks are provided on the Long Pond Road northbound, the Shops at 5 westbound, and the Shops at Long Pond eastbound approaches.

Long Pond Road and Holman Road meet to form a three-way unsignalized intersection with stop-sign control on the Holman Road approach. This intersection is located approximately 180 feet to the south of the Shops at 5 signalized intersection (northbound stop line). The Long Pond Road northbound approach provides a left-turn lane and two through lanes. The Long Pond Road southbound approach provides a shared through/right-turn lane. The Holman Road eastbound approach provides a shared left-/right-turn lane under stop control. Land use in the area of this intersection is commercial. A crosswalk is provided across Holman Road.

Long Pond Road and Camelot Drive meet to form a three-way signalized intersection. The northbound Long Pond Road approach provides a through lane and shared through/right-turn lane. The Long Pond Road southbound approach provides an exclusive left-turn lane and two through lanes. Camelot Drive provides a single lane approach. The signal operates under three-phase control with protected southbound left-turn movements. The westbound movements from Camelot Drive are protected as there is no opposing traffic. Land use in the area of this intersection is commercial. Crosswalks are provided on the Long Pond Road northbound and Camelot Drive westbound approaches.

Home Depot Drive and the Honda Dealership and Hotel Access Driveways meet to form a four-way unsignalized intersection under all-way stop control. The eastbound Home Depot Drive approach as well as the northbound hotel access driveway and the southbound Honda dealership access driveway each provide a single lane approach while the Home Depot Drive westbound approach provides an exclusive left-turn lane and a shared through/right-turn lane. It is noted that the westbound through lane does not line up with the westbound receiving lane and can sometimes lead to driver confusion as to which lane to be in. Each approach is under stop-sign control although no plaques exist denoting the all-way control. Crosswalks are provided across all four approaches. Land use in the area of this intersection is retail and commercial.

Public Transportation

Plymouth is serviced by the Greater Attleboro Taunton Regional Transit Authority (GATRA) along the Mayflower Link bus route. Within the study area, there are three stops including the Exit 5 Plymouth & Brockton Street Railway Bus Stop (at the park and ride - closest to the project site), the Shops at 5 retail center, and at the Long Pond Medical Center. The Mayflower Link bus provides access to Plymouth Center where separate bus lines, the Freedom Link and the Liberty Link, provide access to the Plymouth and Kingston Massachusetts Bay Transportation Authority (MBTA) commuter rail lines. The Mayflower Link bus runs every hour between 7:00 AM and 5:54 PM Monday through Friday and from 9:00 AM to 5:54 PM on Saturdays. There is no bus service on Sundays or holidays. The headway between stops is approximately one hour. Fares are \$1.00 for adults, and \$0.50 for the elderly, disabled, medicare, and students. Children 6 years old or younger ride free with an adult. One-day, three-day and monthly passes as well as 10-ride passes are also available. Current public transportation information can be found on the gatra.org website.

The Plymouth & Brockton Street Railway Bus service provides a 7-day service connection from the Exit 5 park and ride lot to the South Station Transportation Center, Park Square (200 Stuart St.), and Logan International Airport in Boston as well as the Hyannis Transportation Center. Bus stops along this line also include the park and ride lots in Rockland, Sagamore, and Barnstable. Rates and times vary but can be found on the Plymouth & Brockton Street Railway website (www.p-b.com).

Traffic Volumes

Base traffic conditions within the study area were developed by conducting automatic traffic recorder (ATR) counts on Long Pond Road south of Route 3 and on Home Depot Drive to collect weekday and weekend traffic volume data as well as by conducting manual turning movement and vehicle classification counts (TMCs) at the study area intersections. The ATR counts were performed for a 72-hour period to collect weekday and Saturday daily volumes in September 2018. The TMCs were performed in September 2018 during the weekday AM peak period (7:00 to 9:00 AM), the weekday PM peak period (4:00 to 6:00 PM), and the Saturday midday peak period (11:00 AM to 2:00 PM) to collect peak hour data, with the exception of the Long Pond Road intersection with Home Depot Drive. Peak period counts at this location were conducted in October 2018. A comparison of data found the Saturday peak period counts to be lower than September counts along the corridor, likely due to adverse weather conditions at the time of the count. Previously collected Saturday peak period counts in 2016 by the gas station project at the intersection of Long Pond Road and Home Depot Drive were found to be higher and therefore used in this report to provide a conservative analysis condition¹. All traffic count data are provided in the Appendix.

To determine if the count data needed to be adjusted to represent annual average month conditions consistent with state and local guidelines for traffic impact assessment, historical traffic volume data were obtained from the Massachusetts Department of Transportation (MassDOT). Although there is a permanent count station on Route 3 in Plymouth² at the Bourne Town Line, this roadway may not be representative of the seasonal fluctuation in traffic on local streets. Traffic volumes on Route 3 are heavily affected by seasonal tourist traffic.

However, both the count station on Route 3 and data from a count station on Route 123 in Abington³ show September and October traffic volumes to approximate annual average conditions. Accordingly, no adjustments were made to the September and October volumes. The MassDOT traffic count and seasonal adjustment data are provided in the Appendix and the existing traffic flows are summarized in Table 1. The 2018 Existing peak hour traffic flow networks are provided on Figures 2, 3, and 4, representing weekday AM, Weekday PM, and Saturday midday peak hour conditions, respectively.

¹ *Traffic Impact Study*; Gasoline Station Development, Long Pond Road, Plymouth, Massachusetts; Prepared by McMahon Associates, Inc.; May 2016.

² *MassDOT Automatic Traffic Recorder Report*; Sta. 20, Rt. 3 north of Bourne Town Line; Plymouth, MA; 2001-2005.

³ *MassDOT Automatic Traffic Recorder Report*; Sta. 703, Rt. 123 at Brockton City Line; Abington, MA; 2002 to 2006.

Figure 2
 2018 Existing Weekday AM
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between
 Intersections Due To Numerous Driveways
 And Intersecting Streets Not Shown

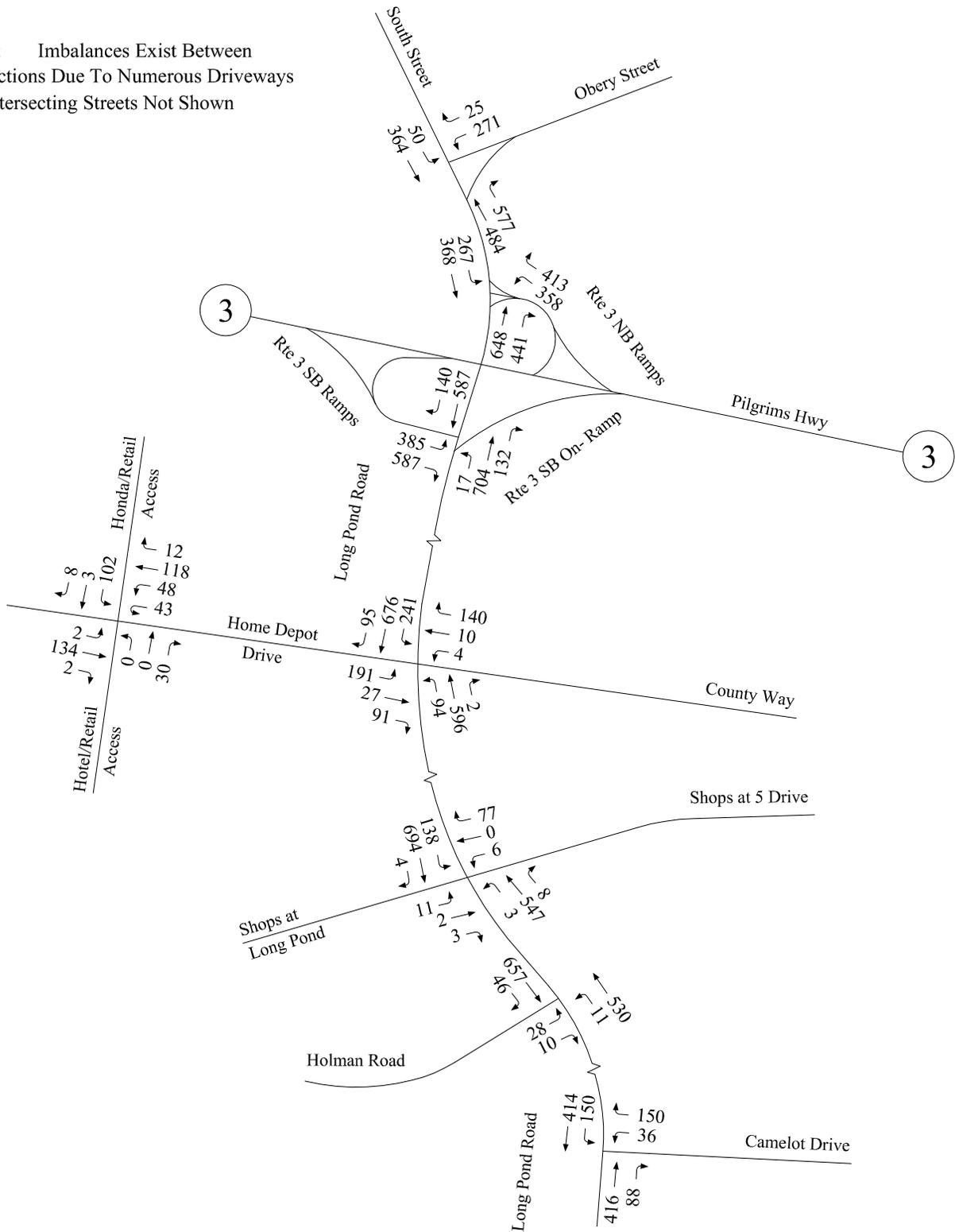


Figure 3
 2018 Existing Weekday PM
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between
 Intersections Due To Numerous Driveways
 And Intersecting Streets Not Shown

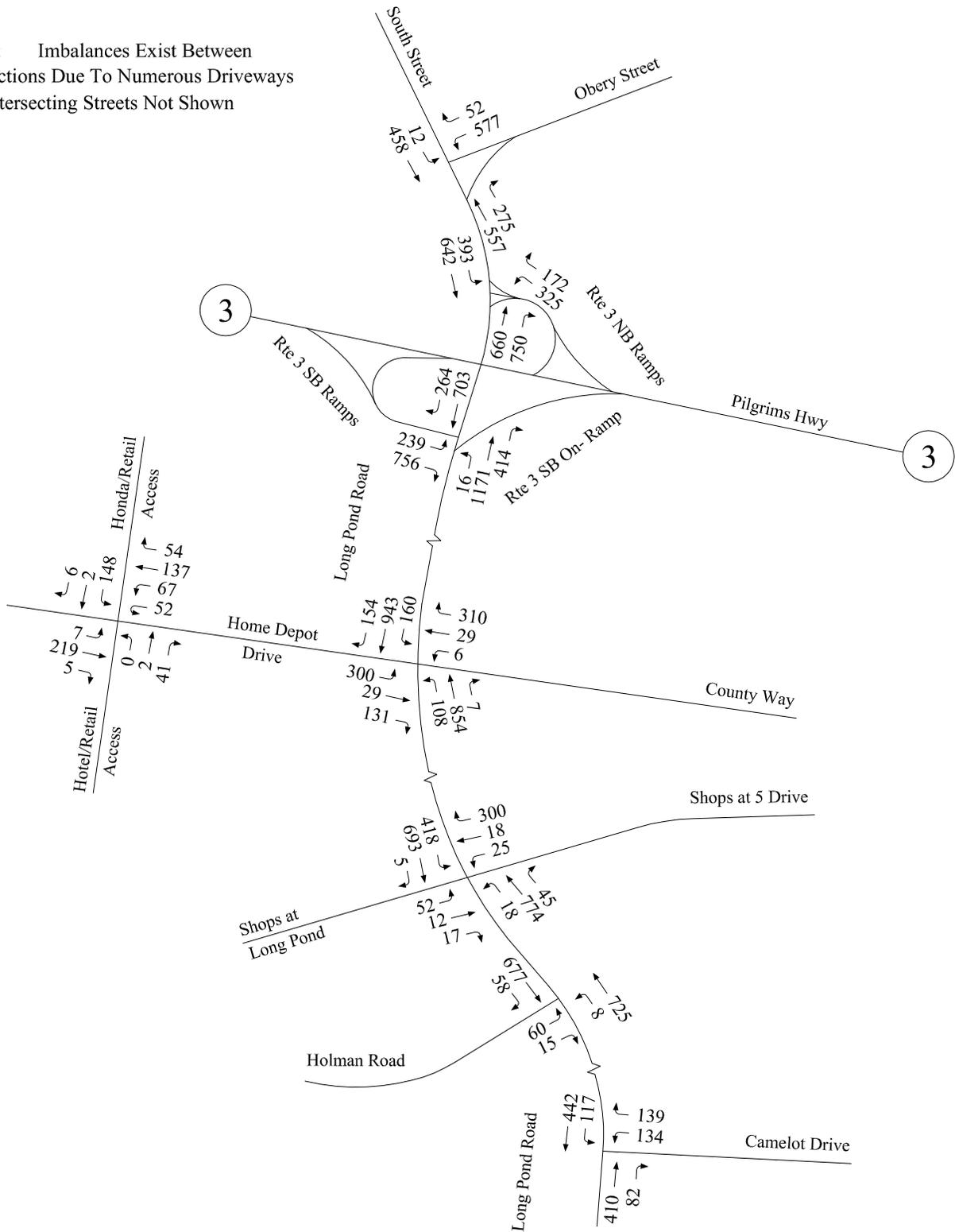


Figure 4
 2018 Existing Saturday
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between
 Intersections Due To Numerous Driveways
 And Intersecting Streets Not Shown

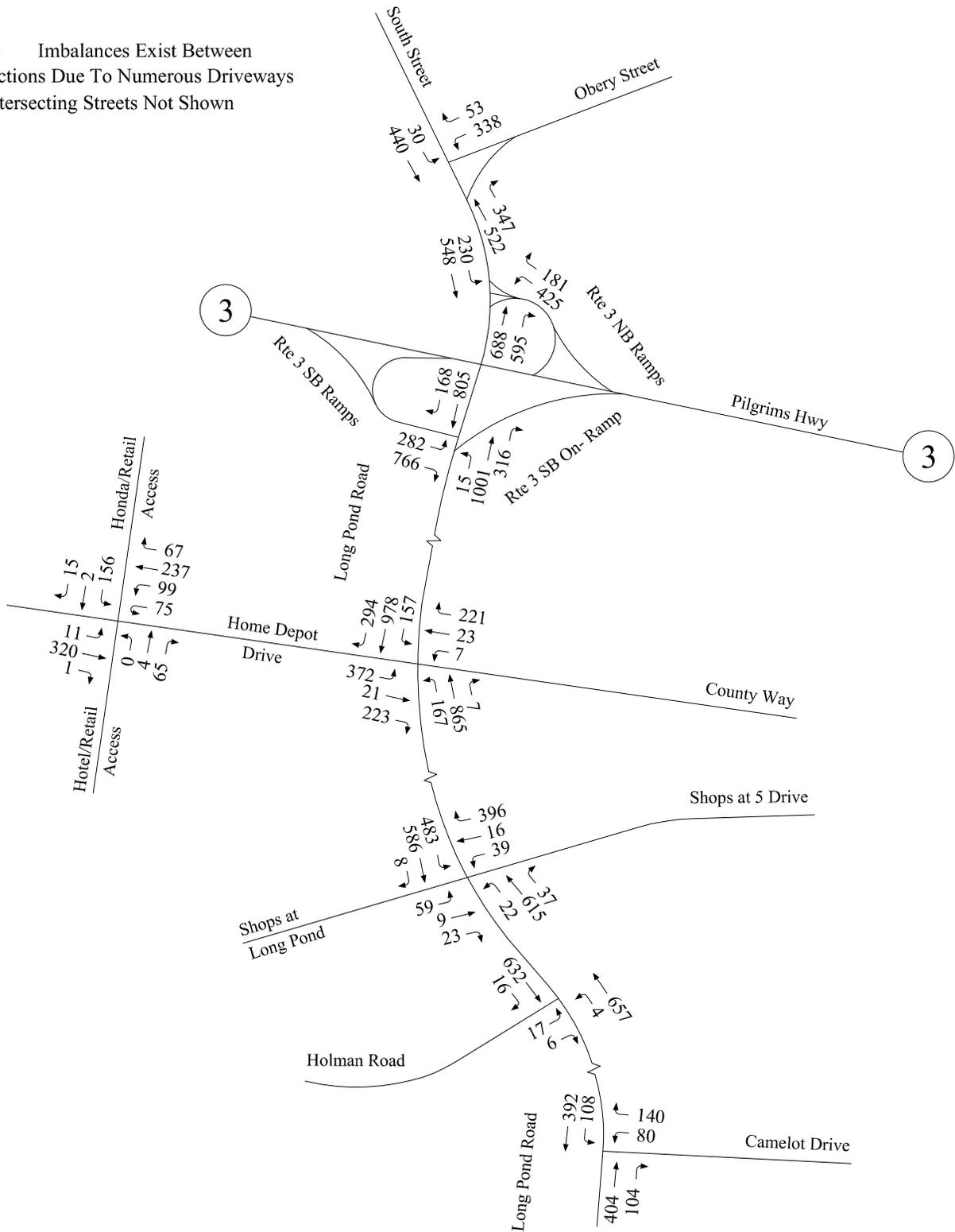


Table 1
Existing Average-Month Traffic Volume Summary

Location/Time Period	Daily Volume ^a	Peak Hour Volume ^b	K-Factor ^c	Directional Distribution ^d
Long Pond Road				
North of the Site:				
Weekday	36,300	AM: 1,939 PM: 2,721	5.3% 7.5%	52% SB 54% NB
Saturday	31,190	Midday: 2,887	9.3%	51% NB

^a In vehicles per day.

^b In vehicles per hour from TMCs.

^c Percentage of daily traffic occurring during the peak hour.

^d NB = northbound, SB=southbound.

Accidents

Accident data for the study area intersections were obtained from MassDOT for the period between 2014 and 2016, the latest four years of available data. A summary of the MassDOT accident data at the study area intersections is provided in Table 2. In addition to the summary, accident occurrence should also be compared to the volume of traffic through a particular intersection to determine any significance. Accordingly, an accident rate was calculated for each intersection and compared with the statewide and district-wide averages.

An intersection accident rate is a measure of the frequency of accidents compared to the volume of traffic through an intersection and is presented in accidents per million entering vehicles (acc/mev). For signalized intersections, the statewide average accident rate is 0.78 acc/mev and the district-wide (District 5) accident rate is 0.75 acc/mev. For unsignalized intersections, the statewide and district-wide average accident rate is 0.57 acc/mev. A comparison of the calculated accident rate to the statewide and district-wide averages can be used to establish the significance of accident occurrence and whether or not potential safety problems exist. The crash rate worksheets are provided in the Appendix.

Table 2
Accident Summary

Location	Number of Accidents			Severity ^a			Accident Type ^b						% During Wet/Icy Conditions
	Total	Avg./Year	Accident Rate ^c	PD	PI	F	CM	RE	HO	FO	Ped	Other	
South Street at Obery Street	19	6.3	0.68	14	5	0	12	4	2	1	0	0	21%
Long Pond Rd. at Rte. 3 NB Ramps	56	18.7	1.32	26	29	0	44	9	0	0	0	3	30%
Long Pond Rd. at Rte. 3 SB Ramps	27	9.0	0.53	21	5	1	6	19	0	1	0	1	30%
Long Pond Rd. at Home Depot Dr.	22	7.3	0.50	18	4	0	15	6	0	1	0	0	32%
Long Pond Rd. at Shops at 5 Drive	3	1.0	0.09	2	1	0	2	0	0	1	0	0	0%
Long Pond Rd. at Holman Road	0	0.0	0.00	0	0	0	0	0	0	0	0	0	0%
Long Pond Rd. at Camelot Drive	4	1.3	0.21	4	0	0	2	2	0	0	0	0	0%
Home Depot Dr. at Access Driveways	3	1.0	0.28	2	1	0	1	2	0	0	0	0	33%

Source: MassDOT Traffic Operations Safety Management System – 2014 through 2016 data.

^a PD = property damage only; PI = personal injury; F = fatality.

^b CM = cross movement/angle; RE = rear end; HO = head on; FO = fixed object; Ped = pedestrian.

^c Measured in accidents per million entering vehicles.

As shown in Table 2, the Long Pond Road intersections with the Route 3 Northbound Ramps, the Route 3 Southbound Ramps, and with Home Depot Drive/County Drive experienced the highest number of accidents over the three-year analysis period. These locations are considered High Crash Clusters according to MassDOT’s Top Crash Location Mapping service. As required by MassDOT’s Highway Safety Improvement Program (HSIP), a Road Safety Audit (RSA) has been performed to identify potential road safety issues and opportunities for short-term, mid-term, and long-term safety improvements for all road users. The evaluations and conclusions regarding the accident history for these three study locations can be found in the RSA prepared by TrafInfo Communications, Inc. on behalf of the project proponent. The detailed accident information for these locations, including collision diagrams, summary charts, and accident listings can also be found in the Appendix to this report.

Of the remaining study intersections along Long Pond Road, the intersection with South Street and Obery Street experienced, on average, about six accidents per year over the three-year analysis period. The accident rate for the intersection is 0.68 acc/mev, which is lower than both the statewide and district-wide averages for signalized intersections. Of these collisions,

approximately 26 percent (5 of 19 incidents) involved injuries. Almost two-thirds of the reported accidents involved cross movement-type collisions while the remaining were rear end, head-on, and fixed-object accidents. About 20 percent of the reported accidents occurred under wet or icy/snowy roadway conditions. Improvements are proposed at this location independent of the proposed project as part of a town/state improvement project with construction expected to begin in the spring of 2019. The measures are expected to improve the overall safety of the intersection with improved operations, wider lanes, and better markings and signage. Further description of these improvements is provided in the *Planned Roadway Improvements* section of this report.

The Long Pond Road intersections with the Shops at 5 driveway, Holman Road, and Camelot Drive as well as the Home Depot Drive intersection with the hotel and Honda dealership access driveways experienced, on average, less than 2 accidents per year over the three-year analysis period. The accident rates for these intersections are significantly below both the statewide and district-wide averages. No particular accident trends are apparent at these locations.

FUTURE CONDITIONS

Traffic Growth

Future traffic conditions were projected to the year 2025, representing a 7-year design horizon consistent with MassDOT requirements for traffic impact analysis and functional design reports for highway improvement projects. To project traffic conditions within this design horizon, two components of traffic growth were included. First, an annual average traffic growth rate was determined to account for general population growth and smaller development projects (i.e. residential subdivisions) that may impact traffic along Long Pond Road in the site vicinity. Based on MassDOT Transportation Data Management System information, the closest permanent traffic count stations to the site are located on Route 3 at the Bourne Town Line and on Route 3 in Norwell. These count stations may not be representative of traffic growth along Long Pond Road. A comparison of ATR counts collected on Long Pond Road for this study and the study prepared in 2013 for the previously proposed factory outlet center shows that 2013 and 2018 weekly average volumes on Long Pond Road are nearly identical. A comparison of these counts is provided in the Appendix. Based on traffic projections provided by the Old Colony Planning Council (OCPC), traffic growth in the study area can be expected to grow at an annual rate 0.5 percent. Therefore, a 0.5 percent annual growth rate was used for the purposes of this analysis.

Second, any planned or approved specific developments in the area that would generate a significant volume of traffic on study area roadways within the next seven years were included. Based on discussions with the Plymouth Planning Department, the following developments have been approved or are under construction:

- *Obery Street Village Residential Development*; a 42-unit residential apartment community located on Lot 45C off of Obery Street.
- *Gasoline Station Development (Global Partners)*; a convenience store and gasoline station on the northeast corner of the Long Pond Road, Home Depot Drive, and County Drive.
- *Shops at 5*; approximately 50,000 square feet of vacant space within the existing shopping plaza.

In addition, there is currently approximately 6,000 square feet of vacant retail space within the Home Depot Plaza. The traffic to be generated by the vacant retail space within Home Depot Plaza and the Shops at 5 was estimated using trip-generation rates provided in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*⁴ for Shopping Center (Land Use Code 820). The gasoline station traffic was estimated using ITE trip rates for a Convenience Store with Gas Pumps (Land Use Code 853) as well as the traffic study submitted on behalf of the project.⁵ The traffic to be generated by the Obery Street Residential Development project was estimated based on studies submitted on behalf of the project.^{6,7} The trip generation worksheets for these background development projects and the corresponding trip assignment networks are provided in the Appendix.

Planned Roadway Improvements

Obery Street - MassDOT and the Town of Plymouth have a project to provide geometric and traffic control improvements along Obery Street (Project #606264). The project will include roadway widening and signal improvements as well as new sidewalks, bicycle accommodations, drainage upgrades, new pavement markings, and signs. At the intersection of Obery Street and South Street, the improvements include the widening of Obery Street to provide a double left-turn lane and an exclusive right-turn lane on the Obery Street approach, restriping of South Street to provide an exclusive southbound left-turn lane and a single through lane, restriping the south leg of the intersection to provide two southbound lanes and a single northbound approach lane, and new traffic signal equipment. The project also includes signal timing and coordination changes at the Long Pond Road intersection with the Route 3 northbound ramps. The project has been advertised for construction bids and is expected to begin in early 2019. Therefore, the improvements proposed as part of this state roadway project are included in the future No-Build and Build analysis conditions.

⁴*Trip Generation Manual, 10th Edition*; Institute of Transportation Engineers; Washington, DC; 2017.

⁵*Traffic Impact Study*; Gasoline Station Development, Long Pond Road; Prepared by McMahon Associates, Inc.; Dated May 2016.

⁶*Transportation Impact Assessment Memorandum*; Proposed Obery Street Village Residential Development, Obery Street – Lot 45C; Prepared by Vanasse & Associates, Inc.; Dated June 30, 2015.

⁷*Technical Letter*; Proposed Obery Street Village Residential Development, Obery Street – Lot 45C; Prepared by Vanasse & Associates, Inc.; Dated July 21, 2015.

Long Pond Road - As part of the Global Partners gasoline station development, improvements were recently completed at the Long Pond Road intersection with Home Depot Drive and County Drive. These included the following:

- a widening of Long Pond Road to provide a center median from the intersection north to the existing Police Station driveway;
- accommodation for a future double left-turn lane out of Home Depot Drive;
- new pavement markings on the intersection approaches;
- sidewalk construction along the site frontage on Long Pond Road and County Drive;
- the closing of the existing Police Station Driveway on Long Pond Road;
- traffic signal improvements at the intersection including increased signal clearance intervals and new signal backplates with retroreflective borders;
- installation of lane use signs on Long Pond Road and on Home Depot Drive;
- a monetary contribution to the Plymouth Police Department to implement signal preemption equipment; and
- a \$100,000 contribution to the Town of Plymouth for future traffic improvements within the Long Pond Road corridor.

As these improvements were recently completed, they are included in all analysis conditions

No-Build Conditions

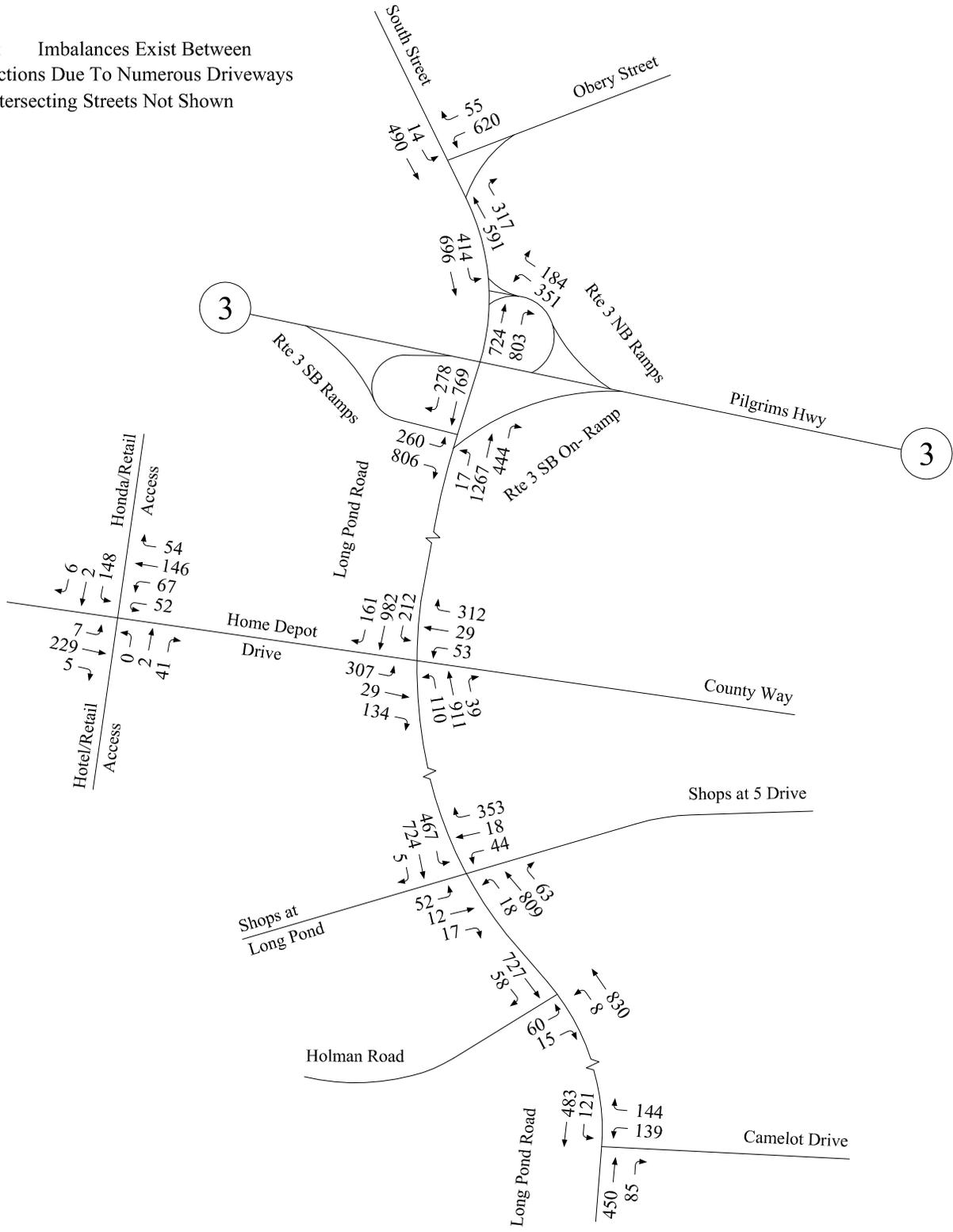
The 2025 No-Build networks were accordingly developed by applying a compounded 0.5 percent annual growth rate (3.6 percent compounded over seven years) to the existing adjacent street volumes, adding the traffic volumes to be generated by other developments in the area, and assuming completion of the area improvement projects. The 2025 No-Build peak-hour traffic-flow networks are shown on Figures 5 through 7 for the analyzed peak hours.

Trip Generation

The traffic to be generated by the proposed mixed-use development project was estimated using the ITE *Trip Generation Manual*. Traffic generation was determined using Land Use Code 221 (Multifamily Housing, Mid-Rise) for 320 dwelling units and Land Use Code 720 (Medical-Dental Office Building) for up to 70,000 square feet of gross floor area. The project site is accessed via Home Depot Drive, which also provides access to 211,350 square feet of retail

Figure 6
 2025 No-Build Weekday PM
 Peak Hour Traffic Volumes

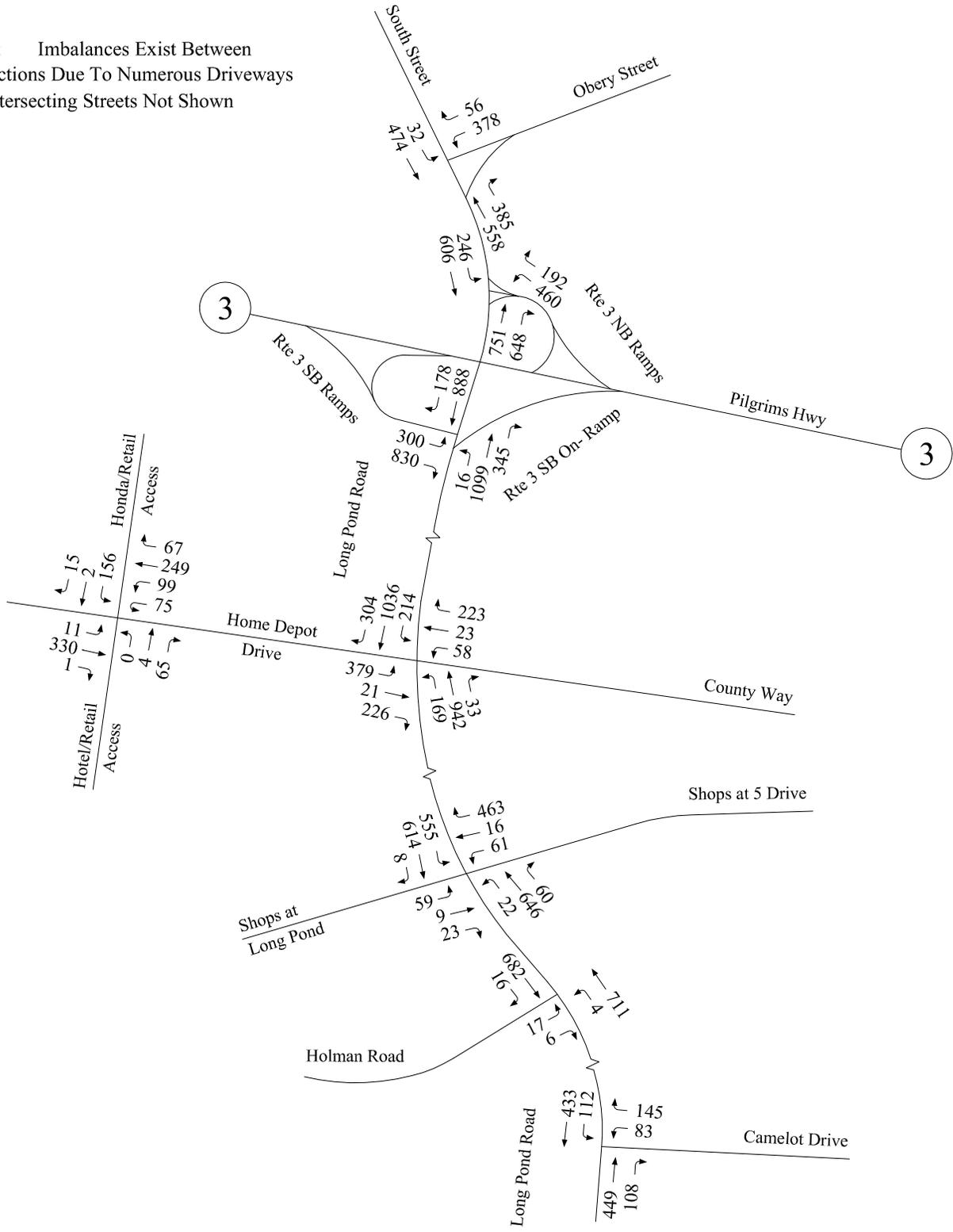
NOTE: Imbalances Exist Between
 Intersections Due To Numerous Driveways
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NOT TO SCALE

Figure 7
 2025 No-Build Saturday
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between
 Intersections Due To Numerous Driveways
 And Intersecting Streets Not Shown



↑
 ↓
 NOT TO SCALE

space, a 130-room hotel, a gas station/convenience store, and a 27,550 square foot automobile dealership. This accordingly provides an opportunity for shared trips between the existing and proposed uses that will reduce the volume of vehicular traffic to and from the site and onto Long Pond Road.

Using information in the *ITE Trip Generation Handbook*, internal capture rates can be calculated between the proposed residential units and the existing retail opportunities, as well as between the proposed medical office space and the existing retail opportunities. Although some shared-use trips may also occur between the proposed residential units and medical offices, no such trip credit was assumed in this report to present a conservative analytical framework. The internal capture worksheets are provided in the Appendix.

As a result, it is expected that on a daily basis, 11 percent of the residential trip generation and 6 percent of the medical office trip generation will be shared trips with the existing retail uses. During the weekday PM and Saturday midday peak hours, it is expected that 10 percent of the residential trip generation and 4 percent of the medical office generation will be shared trips. No shared-use trip credit was assumed for the weekday AM peak hour due to the relatively low retail trip generation during this time period. As the proposed uses are not conducive to attracting traffic from the adjacent roadways, no pass-by trip credit assumed in this report. A summary of the expected traffic generation is provided in Table 3 and all trip generation calculations are provided in the Appendix.

Table 3
Trip Generation Summary

Time Period	Total Residential Trips ^a	Internal Capture Trips ^b	External Residential Trips ^c	Total Medical Office Trips ^d	Internal Capture Trips ^e	External Medical Office Trips ^c	Total External Trips
Weekday Daily	1,740	-190	1,550	2,600	-150	2,450	4,000
Weekday AM Peak							
Enter	28	0	28	127	0	127	155
Exit	<u>79</u>	<u>0</u>	<u>79</u>	<u>36</u>	<u>0</u>	<u>36</u>	115
Total	107	0	107	163	0	163	270
Weekday PM Peak							
Enter	82	-8	74	67	-3	64	138
Exit	<u>53</u>	<u>-5</u>	<u>48</u>	<u>172</u>	<u>-7</u>	<u>165</u>	213
Total	135	-13	122	239	-10	229	351
Saturday Daily	1,390	-150	1,240	600	-40	560	1,800
Saturday Peak							
Enter	69	-7	62	168	-7	161	223
Exit	<u>72</u>	<u>-7</u>	<u>65</u>	<u>127</u>	<u>-5</u>	<u>122</u>	187
Total	141	-14	127	295	-12	283	410

^a ITE Land Use Code 221 (Multifamily Housing/Mid-Rise) for 320 units.

^b Residential Multi-Purpose: Weekday & Saturday Daily 11%; AM Peak Hour 0%; PM and Saturday Peak Hours 10%.

^c External trips are calculated by subtracting the internal capture trips from the total expected generation.

^d ITE Land Use Code 720 (Medical-Dental Office Building) for 70,000 square feet.

^e Medical Office Multi-Purpose: Weekday & Saturday Daily 6%; AM Peak Hour 0%; PM and Saturday Peak Hours 4%.

MEPA Thresholds

On September 12, 2014 the Secretary of Environmental Affairs issued a Certificate on the previously proposed expansion of the Home Depot Plaza (396,000 square foot factory outlet center) stating that the Single Environmental Impact Report prepared at the time adequately and properly complied with MEPA and its implementing regulations. The factory outlet center project was never constructed and the land owner has since continuously advertised the property for purchase and development. The currently proposed apartment and medical office development replaces the factory outlet center and therefore represents a change to the approved project. The MEPA regulations regarding Notices of Project Change (301 CMR 11.10) require the Secretary to consider the following in determining if a project change might significantly increase the environmental consequences, provided that the change in itself does not exceed any review thresholds:

- a change in the size of the project of 10 percent or more;
- an increase in environmental impacts of 25 percent or more of any review threshold;
- the date of commencement or completion of a project change;
- a change of the project site;
- a new state permit required for the project change;
- for projects with net benefits to environmental quality and resources or public health, any change that prevents or delays realization of such benefits; and
- for projects involving lapse of time, and changes in the ambient environment.

The current project will be approximately 548,500 square feet in size, including the residential apartment units, clubhouse, and medical office space. While this represents more than a 10 percent increase in the size of the project, the traffic impacts of this project change will be significantly less, as documented in this report.

With regard to transportation thresholds, the prior factory outlet center was expected to generate 9,680 daily vehicle trips (unadjusted for internal capture trips). This compares with 4,340 daily vehicles trips (also unadjusted for internal capture trips) expected for the current project, a reduction of 5,340 daily trips. The prior factory outlet center was proposing 1,995 parking spaces whereas the current project is proposing a total of 999 parking spaces, a reduction in parking of 996 spaces.

On January 22, 2015 MassDOT issued a Section 61 Finding for the factory outlet center project stipulating the traffic improvements required to be implemented for that project. On the surrounding public streets, these included:

- widening the Route 3 southbound off-ramp to provide a double right-turn lane onto Long Pond Road under traffic signal control;
- widening Home Depot Drive to provide a double left-turn lane onto Long Pond Road and associated signal improvements;
- installing directional signage on Long Pond Road and on Home Depot Drive to better direct motorists to Route 3; and
- implementing a coordinated traffic signal system along Long Pond Road from the Route 3 northbound ramps south to Camelot Drive.

As documented in the *Mitigation* section of this report, these same measures are also proposed to be implemented by the current project proponent. Therefore, there will be no change in the realization of these environmental benefits. It should be noted that the Section 61 Finding also documented roadway improvements that were proposed to be implemented along Home Depot Drive, a private driveway. These were necessitated at the time due to the significantly higher traffic generation of the factory outlet center.

No new state permits are required for the current project. Regarding any potential changes in the ambient environment, this traffic study documents that traffic conditions along Long Pond Road have not changed significantly over those documented for the factory outlet center project and the mitigation measures proposed will allow better traffic operations than for the factory outlet center due to the significantly lower trip generation.

Comparing the total MEPA-approved trip generation for the Hope Depot Plaza as documented in the September 12, 2014 MEPA Certificate with the currently proposed project yields a significant reduction in Home Depot Plaza traffic as documented in Table 4.

Table 4
Trip Generation Comparison – Approved vs. Proposed

Time Period	MEPA Approved ^a	Existing Site Trips ^b	Proposed Site Trips ^c	Total Site Trips ^d	Difference In Trips ^e
Weekday Daily	20,070	9,840	4,000	13,840	-6,230
Weekday PM Peak Hour	1,238	939	351	1,290	+52
Saturday Daily	25,370	10,300	1,800	12,100	-13,270
Saturday Peak Hour	2,256	1,255	410	1,664	-592

^a MEPA Certificate on Single EIR, September 12, 2014.

^b Daily volumes from September 2018 counts on Home Depot Drive by doubling exiting volume. Peak hour volumes from traffic flow networks by doubling exiting volumes on Home Depot Drive. The Shell station and the automobile dealership have separate access points, but all site traffic has to exit via Home Depot Drive. Volumes adjusted to account for full occupancy using ITE *Trip Generation Manual* for LUC 820 (Shopping Center).

^c From Table 3.

^d Existing Site trips plus proposed site trips.

^e Proposed Site trips minus MEPA Approved trips.

As shown in Table 4, the combination of existing site traffic plus the proposed expansion traffic shows that the total daily traffic generation will be 6,230 trips less than approved on a weekday daily basis and 13,270 trips less than approved on a Saturday daily basis. During the critical peak hours, the expansion project will generate 52 vehicle trips more during the weekday PM peak hour, but 592 vehicle trips less than approved during the Saturday peak hour. Accordingly,

submission of a Supplemental EIR should not be required for the current project as no traffic review thresholds will be exceeded.

Comparison with MOU Trip Thresholds

The 2009 Memorandum of Understanding (MOU) between the Town of Plymouth and the land owner for rezoning of the subject site stipulated certain development limitations on the basis of traffic generation and required the implementation of specific traffic improvements associated with development of the site. A comparison of the currently expected trip generation to the traffic thresholds identified in the MOU is shown in Table 5.

Table 5
Trip Generation vs. MOU Thresholds

<u>Time Period</u>	<u>MOU Thresholds ^a</u>	<u>Proposed Site Trips ^b</u>	<u>Difference In Trips</u>	<u>Percent Difference</u>
Weekday PM Peak Hour	850	351	-499	-59%
Saturday Peak Hour	730	410	-320	-44%

^a August 2009 Memorandum of Understanding between the Town of Plymouth and Harald LLC.

^b From Table 3.

As shown, the currently proposed project will generate significantly less traffic than the MOU limitations with traffic projections between 44 and 59 percent lower than the thresholds identified in the MOU. Regardless of the significantly lower trip generation, the project proponent is committed to implementing all of the required traffic improvements as documented in the *Mitigation* section of this report.

Trip Distribution

Two trip generation models were developed for the two different uses proposed on the site. For the residential portion of the development, US Census Bureau's Journey to Work data for the work place location of those living in Plymouth were used to estimate the expected trip distribution of these site generated trips. Based on this data and expected travel routes, approximately 65 percent of the new residential site traffic is expected to and from the north on Route 3 and 15 percent to and from the south on Route 3. Of the remaining traffic, 10 percent is expected to and from the north on South Street, 5 percent to and from the south on Long Pond Road, and 5 percent to and from the east on Obery Street.

For the medical office portion of the development, the distribution is based on existing travel patterns at the study area intersections, surrounding population densities, competing opportunities, and expected travel routes to the site. The distribution of traffic is expected to be similar to that of the Home Depot Plaza, but have a slightly greater regional draw from Route 3. Accordingly, approximately 40 percent of the new site traffic is expected to and from the north on Route 3 and 20 percent to and from the south on Route 3. Of the remaining traffic, 15 percent is expected to and from the north on South Street, 15 percent to and from the south on Long Pond Road, and 10 percent to and from the east on Obery Street. The additional traffic from the residential and medical office portions of the development is shown on Figures 8 through 10.

Build Conditions

Based on the traffic generation and distribution estimates for this project, the traffic volumes generated by the proposed project were assigned to the roadway network as shown on Figures 8 through 10 and added to the 2025 No-Build traffic volumes to develop the 2025 Build traffic volumes conditions. The 2025 Build traffic volume networks are graphically depicted on Figures 11 through 13.

Traffic Increases

The proposed project will result in increases in traffic on the study area roadways. The traffic-volume increases beyond the study area are expected to be greatest on Route 3 in the range of 135 to 197 vehicles during the peak hours to the north and in the range of 48 to 75 peak hour vehicles to the south. Lesser traffic increases are expected on the other study area roadways with increases in the range of 35 to 56 peak hour vehicles on South Street to the north and 30 to 48 peak hour vehicles on Long Pond Road to the south. Increases on Obery Street are expected in the range of 22 to 34 peak hour vehicle trips as a result of the proposed mixed-use development project.

Figure 8
 Site Generated Weekday AM
 Peak Hour Traffic Volumes

Legend

xx = Residential Component
 (xx) = Commercial Component

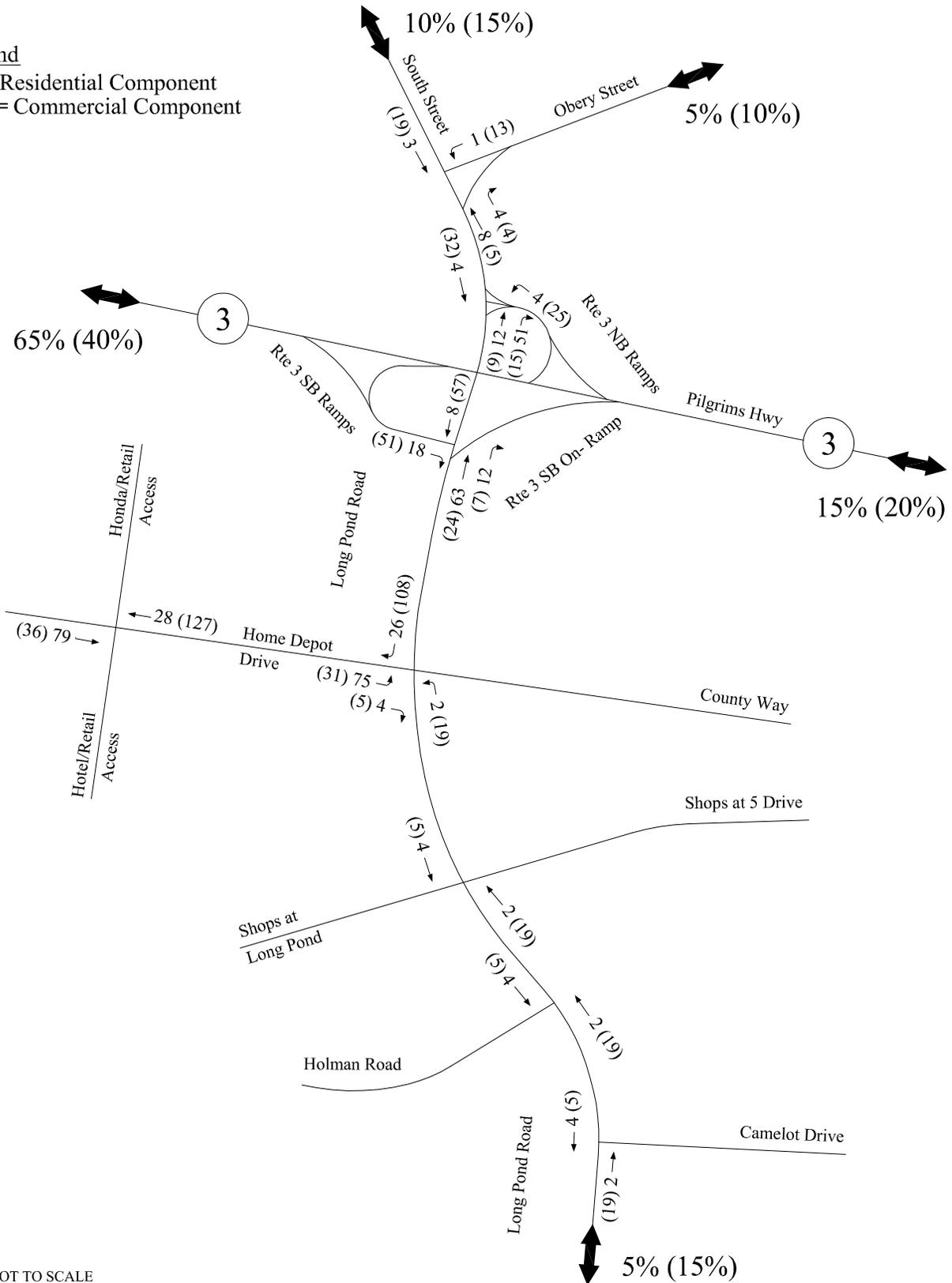


Figure 9
 Site Generated Weekday PM
 Peak Hour Traffic Volumes

Legend

xx = Residential Component
 (xx) = Commercial Component

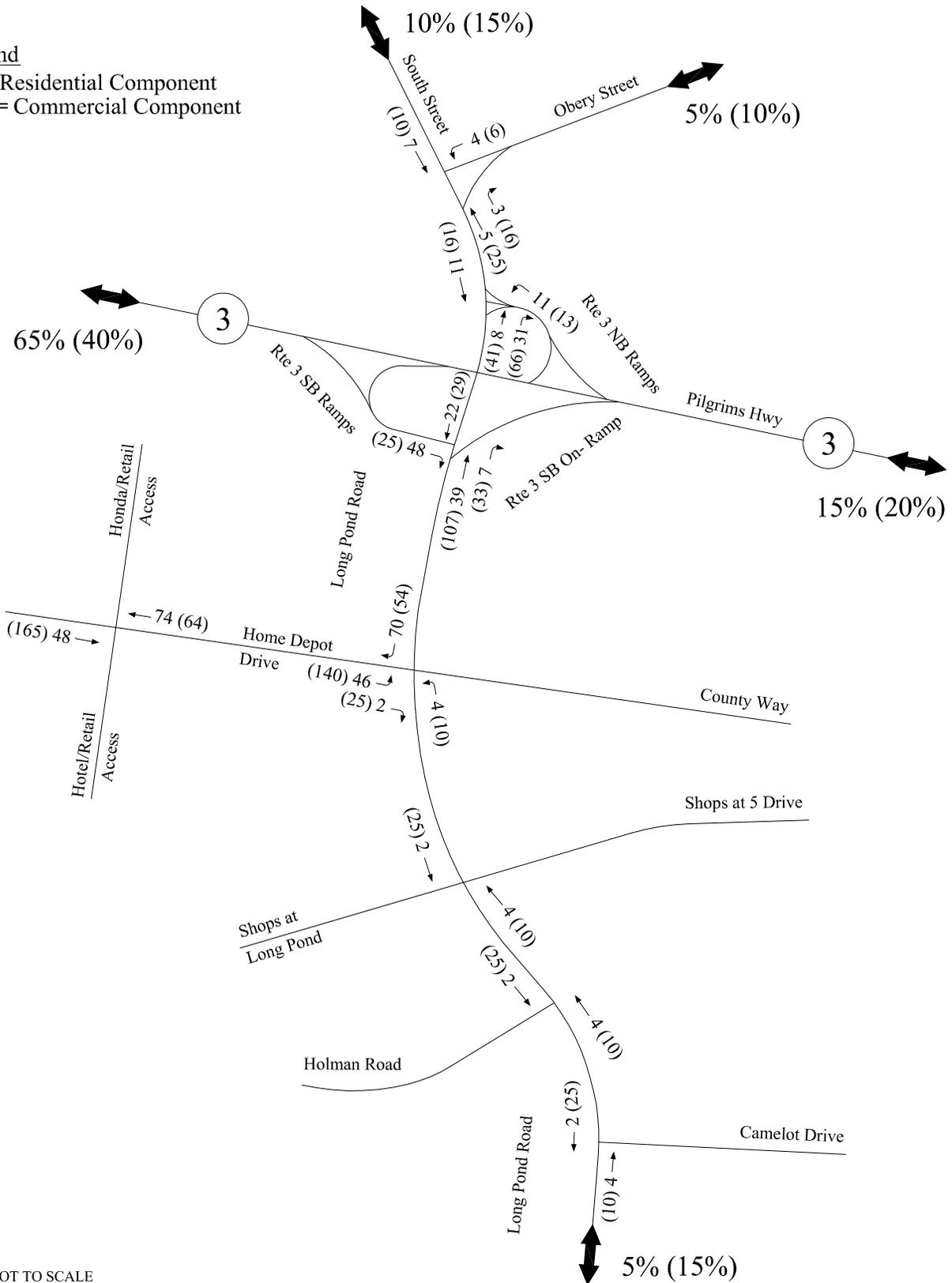


Figure 10
 Site Generated Saturday
 Peak Hour Traffic Volumes

Legend

xx = Residential Component
 (xx) = Commercial Component

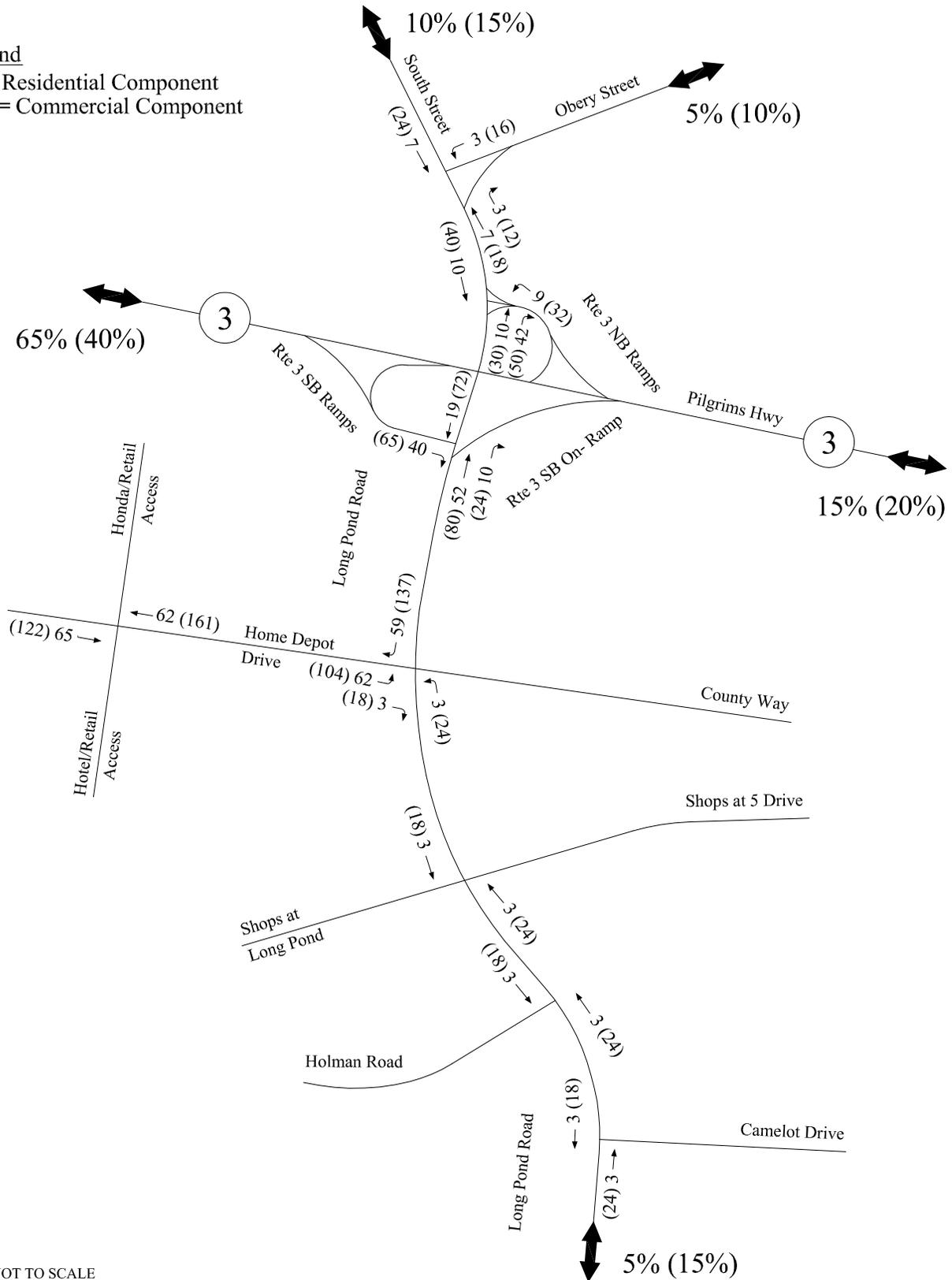


Figure 11
 2025 Build Weekday AM
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between Intersections Due To Numerous Driveways And Intersecting Streets Not Shown

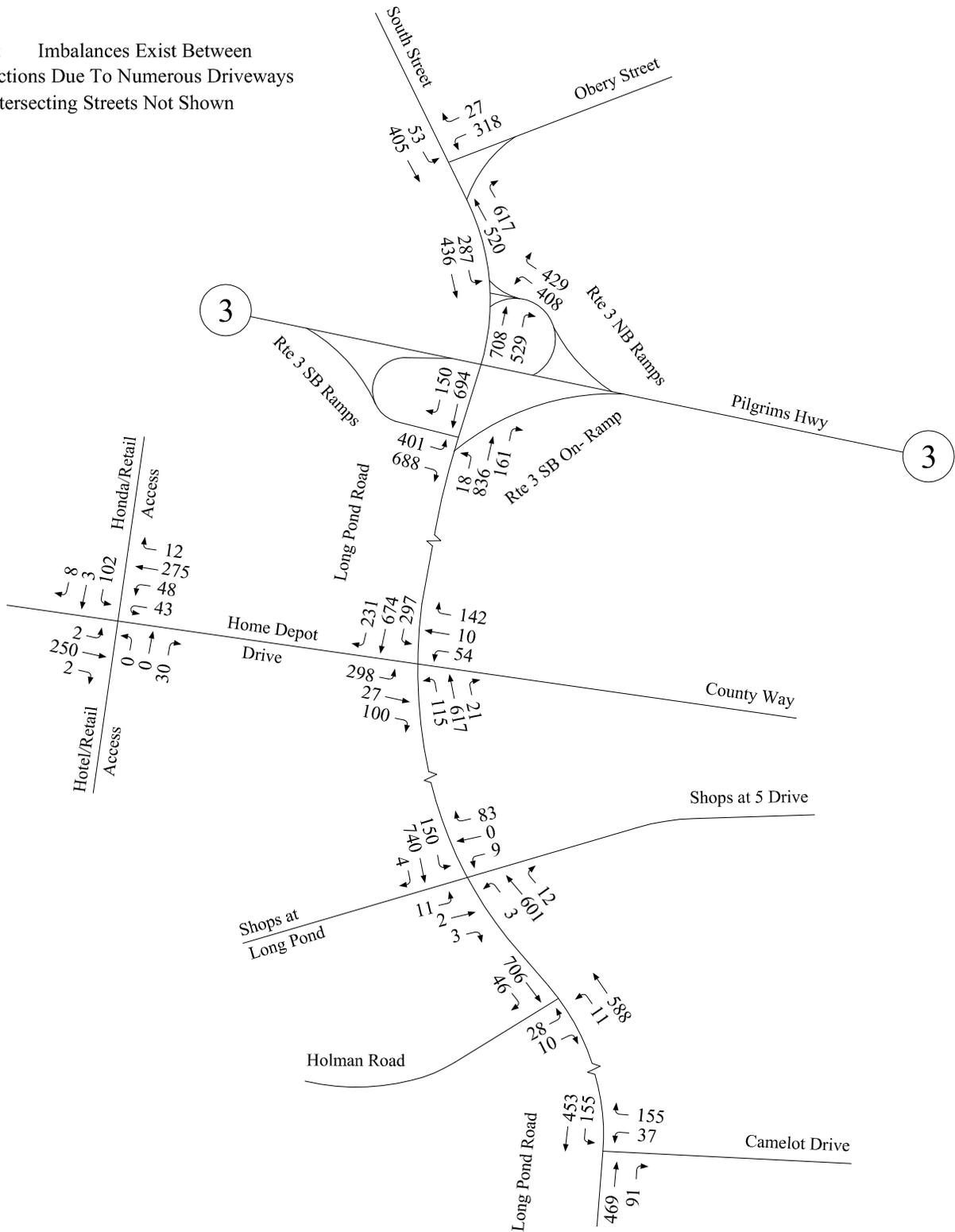


Figure 12
 2025 Build Weekday PM
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between Intersections Due To Numerous Driveways And Intersecting Streets Not Shown

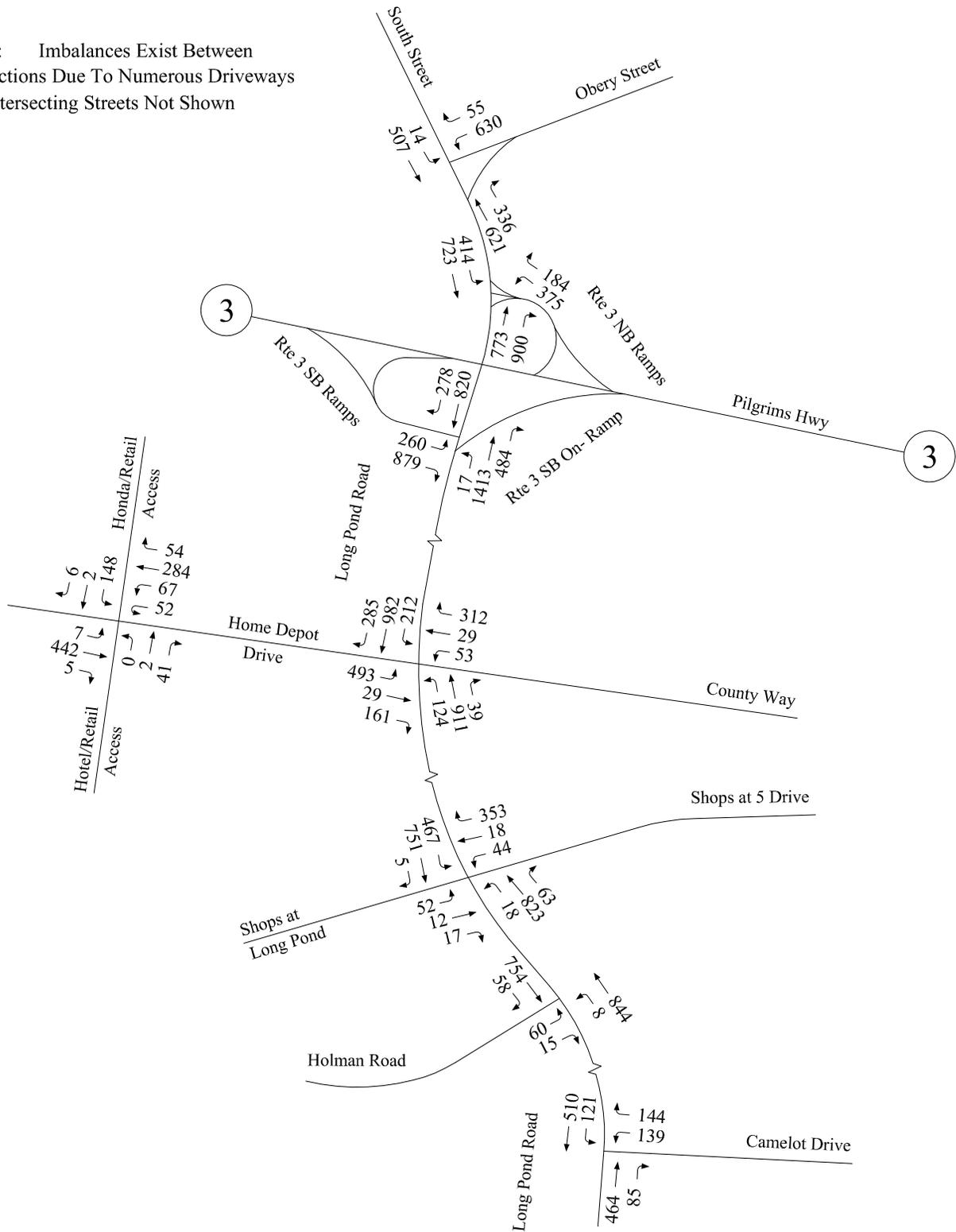
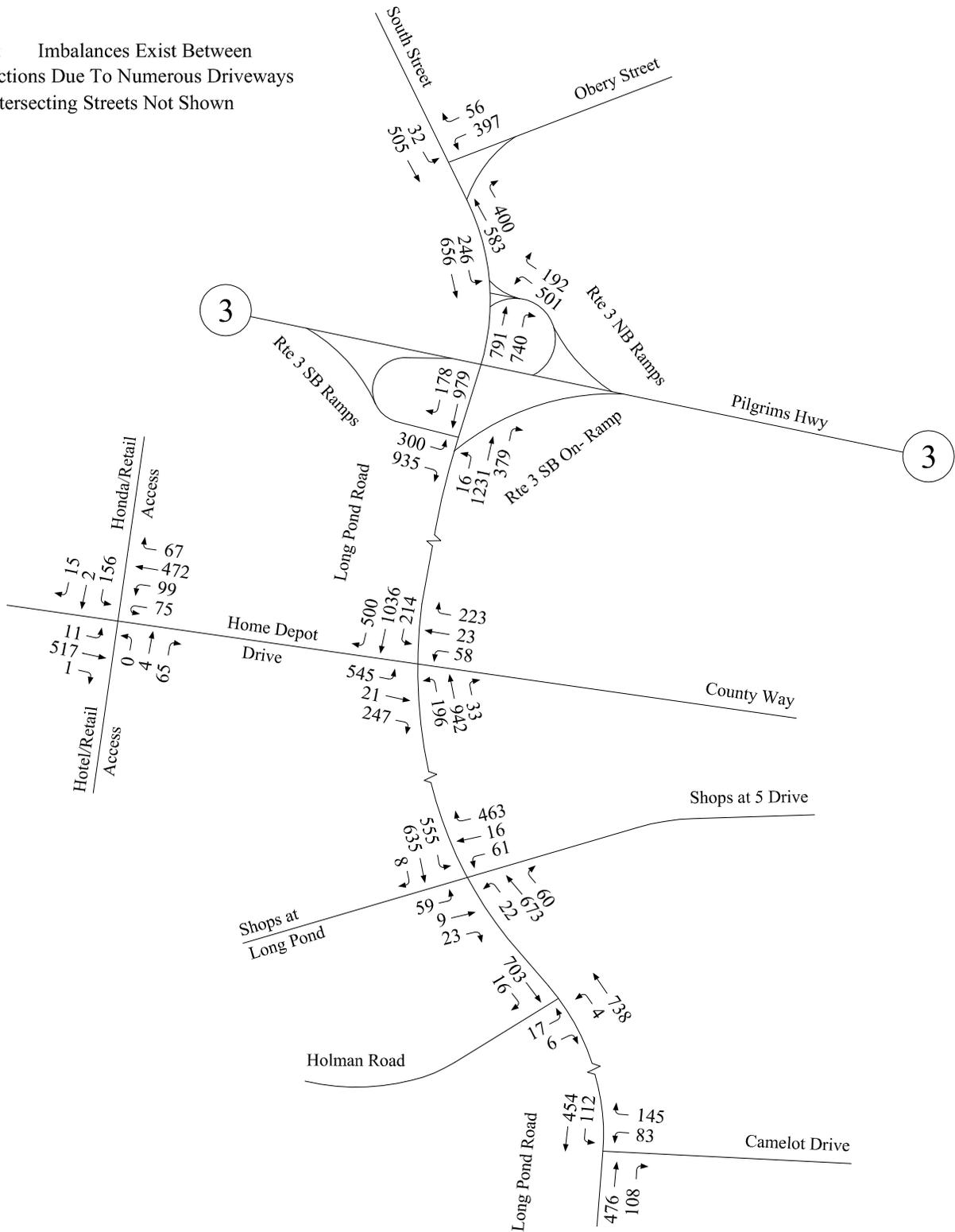


Figure 13
 2025 Build Saturday
 Peak Hour Traffic Volumes

NOTE: Imbalances Exist Between Intersections Due To Numerous Driveways And Intersecting Streets Not Shown



CAPACITY ANALYSIS

Level-of-service (LOS) analyses were conducted at the study area intersections under existing and projected volume conditions to determine the effect that the site generated traffic will have on traffic operations. The capacity analysis methodology is based on the concepts and procedures in the *Highway Capacity Manual*⁸ (HCM) and is described in the Appendix. The maximum back of queue during an average signal cycle and a 95th percentile signal cycle were calculated for each lane group during the peak periods studied. The back of queue is the length of a backup of vehicles from the stop line of a signalized intersection to the last car in the queue that is required to stop, regardless of the signal indication. The length of this queue depends on a number of factors including signal timing, vehicle arrival patterns, and the saturation flow rate. For unsignalized intersections, the 95th percentile queue represents the length of queue of the critical minor-street movement that is not expected to be exceeded 95 percent of the time during the analysis period (typically one hour). In this case, the queue length is a function of the capacity of the movement and the movement's degree of saturation.

The Synchro version 8.0 analysis program was used for all capacity analyses. The use of the 2010 HCM method was used for all study area intersections. The level-of-service and queue results are presented in Table 6 and are discussed below. All analysis worksheets are provided in the Appendix.

⁸*Highway Capacity Manual 2000*; Transportation Research Board; Washington, DC; 2000.

Table 6
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at South Street and Obery Street												
<i>Weekday AM Peak</i>												
WB Left/Right	0.84	39.2	D	149/215	0.78	39.8	D	90/127	0.79	39.6	D	95/132
WB Right	--	--	--	--	0.11	32.4	C	0/19	0.11	32.0	C	0/19
NB Thru	0.22	2.0	A	27/81	0.44	22.3	C	63/116	0.45	22.8	C	45/118
SB Left/Thru	0.35	7.5	A	104/210	0.11	7.3	A	7/20	0.12	7.7	A	7/20
SB Thru	--	--	--	--	0.29	4.2	A	68/124	0.31	4.5	A	75/136
Overall	--	13.1	B	--	--	20.6	C	--	--	20.8	C	--
<i>Weekday PM Peak</i>												
WB Left/Right	0.95	48.2	D	321/522	0.88	42.7	D	182/239	0.89	42.9	D	185/243
WB Right	--	--	--	--	0.16	27.6	C	0/24	0.16	27.4	C	0/24
NB Thru	0.35	26.3	C	146/201	0.58	21.1	C	277/277	0.61	22.0	C	48/391
SB Left/Thru	0.55	19.5	B	210/323	0.04	10.4	B	3/10	0.04	11.0	B	3/10
SB Thru	--	--	--	--	0.42	8.6	A	137/216	0.44	8.9	A	145/226
Overall	--	32.7	C	--	--	25.3	C	--	--	25.7	C	--
<i>Saturday Peak Hour</i>												
WB Left/Right	0.90	44.2	D	233/555	0.67	17.3	B	59/115	0.68	17.9	B	67/121
WB Right	--	--	--	--	0.17	14.2	B	0/20	0.17	14.6	B	0/20
NB Thru	0.24	8.1	A	136/151	0.76	11.7	B	156/287	0.77	11.9	B	168/310
SB Left/Thru	0.42	10.1	B	243/299	0.09	8.0	A	4/14	0.10	8.2	A	4/14
SB Thru	--	--	--	--	0.46	5.9	A	80/153	0.49	6.1	A	89/169
Overall	--	19.0	B	--	--	11.3	B	--	--	11.6	B	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Route 3 Northbound Ramps												
<i>Weekday AM Peak</i>												
WB Left	0.92	56.2	E	201/294	0.93	58.0	E	210/346	0.98	69.3	E	221/395
NB Thru	0.41	26.8	C	154/254	0.45	28.0	C	194/265	0.47	28.5	C	231/265
SB Left	0.59	10.0	A	90/117	0.67	14.2	B	106/155	0.33	15.9	B	116/155
SB Thru	0.34	0.8	D	151/179	0.37	14.4	B	185/215	0.33	22.1	C	179/231
Overall	--	24.6	C	--	--	29.1	C	--	--	34.0	C	--
<i>Weekday PM Peak</i>												
WB Left	0.90	50.5	D	171/248	0.91	52.7	D	189/279	0.92	54.6	D	189/342
NB Thru	0.38	4.4	A	172/172	0.45	6.6	A	172/175	0.50	13.0	B	178/185
SB Left	0.63	9.1	A	108/157	0.69	11.1	B	55/281	0.76	15.6	B	112/320
SB Thru	0.52	23.6	C	177/289	0.58	10.2	B	79/402	0.61	11.4	B	328/412
Overall	--	18.8	B	--	--	16.0	B	--	--	19.8	B	--
<i>Saturday Peak Hour</i>												
WB Left	0.87	20.9	C	157/321	0.89	24.0	C	195/385	0.91	29.7	C	226/440
NB Thru	0.57	15.3	B	132/227	0.61	17.0	B	164/252	0.65	18.6	B	189/267
SB Left	0.49	10.1	B	47/104	0.56	11.4	B	58/127	0.59	12.8	B	65/135
SB Thru	0.54	8.6	A	137/275	0.60	9.9	A	181/316	0.66	11.6	B	232/357
Overall	--	14.0	B	--	--	15.8	B	--	--	18.4	B	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Route 3 Southbound Ramps												
<i>Weekday AM Peak</i>												
EB Left	1.05	93.7	F	203/266	1.09	107.6	F	212/275	1.09	107.6	F	162/291
EB Right	1.79	402.3	F	146/242	1.89	446.0	F	158/301	2.10	538.9	F	203/499
NB Left	0.04	7.5	A	6/17	0.05	7.8	A	4/16	0.05	8.2	A	7/12
NB Thru	0.33	6.7	A	172/264	0.35	12.4	B	176/282	0.39	19.8	B	243/291
SB Thru	0.30	20.6	C	103/185	0.32	21.0	C	122/194	0.35	21.7	C	141/198
SB Right	0.16	17.9	B	13/42	0.17	18.2	B	15/42	0.17	18.2	B	16/36
Overall	--	120.6	F	--	--	134.4	F	--	--	160.8	F	--
<i>Weekday PM Peak</i>												
EB Left	0.62	33.8	C	94/187	0.67	35.6	D	113/214	0.67	35.6	D	124/223
EB Right	2.19	580.3	F	277/622	2.34	645.1	F	381/738	2.55	740.5	F	583/875
NB Left	0.04	6.0	A	3/4	0.04	6.0	A	2/3	0.04	6.0	A	3/3
NB Thru	0.50	0.5	A	325/325	0.54	0.6	A	114/114	0.61	0.4	A	122/122
SB Thru	0.34	0.3	A	203/203	0.37	0.3	A	202/204	0.40	0.4	A	200/211
SB Right	0.28	0.6	A	23/38	0.30	0.6	A	31/34	0.30	0.5	A	20/37
Overall	--	142.2	F	--	--	156.1	F	--	--	180.4	F	--
<i>Saturday Peak Hour</i>												
EB Left	0.73	39.2	D	106/202	0.78	42.2	D	122/228	0.78	42.2	D	130/241
EB Right	2.22	594.5	F	285/629	2.41	677.6	F	394/761	2.71	813.8	F	628/951
NB Left	0.04	7.0	A	0/4	0.05	7.2	A	3/3	0.05	7.5	A	3/3
NB Thru	0.43	0.4	A	293/293	0.48	0.3	A	209/209	0.53	0.2	A	255/255
SB Thru	0.39	10.1	B	213/235	0.43	10.5	B	229/248	0.48	10.8	B	246/260
SB Right	0.18	8.6	A	0/36	0.19	8.7	A	0/34	0.19	8.7	A	0/32
Overall	--	157.0	F	--	--	177.2	F	--	--	216.0	F	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Home Depot Drive/County Drive												
<i>Weekday AM Peak</i>												
EB Left	0.59	33.3	C	116/174	0.70	41.6	D	116/177	1.11	121.9	F	177/335
EB Thru/Right	0.30	26.7	C	14/53	0.28	24.8	C	14/53	0.30	25.0	C	12/55
WB Left/Thru	0.03	24.6	C	7/20	0.19	27.6	C	34/65	0.19	27.9	C	30/65
WB Right	0.31	23.4	C	10/42	0.29	21.2	C	32/60	0.28	20.9	C	27/60
NB Left	0.33	14.7	B	16/41	0.33	17.7	B	17/94	0.40	17.8	B	22/113
NB Thru/Right	0.45	14.6	B	76/111	0.64	17.5	B	98/271	0.64	17.6	B	90/271
SB Left	0.65	21.5	C	43/94	0.72	21.4	C	40/147	0.71	21.1	C	54/174
SB Thru	0.50	30.3	C	152/253	0.54	32.3	C	140/250	0.55	32.4	C	185/251
Overall	--	23.6	C	--	--	25.5	C	--	--	36.4	D	--
<i>Weekday PM Peak</i>												
EB Left	0.75	35.0	D	167/240	0.99	82.6	F	170/283	1.67	352.9	F	355/548
EB Thru/Right	0.30	22.0	C	13/53	0.30	21.7	C	12/55	0.35	22.1	C	12/58
WB Left/Thru	0.06	20.0	C	15/34	0.19	23.1	C	37/70	0.20	23.8	C	34/70
WB Right	0.53	21.7	C	92/149	0.50	20.0	C	85/146	0.49	19.8	B	85/146
NB Left	0.41	19.1	B	24/59	0.43	19.0	B	3/3	0.54	21.0	C	3/3
NB Thru/Right	0.69	39.4	D	281/344	0.85	25.4	C	322/408	0.85	25.3	C	322/408
SB Left	0.66	24.4	C	57/83	0.75	24.2	C	75/144	0.75	24.8	C	79/114
SB Thru	0.75	11.7	B	295/348	0.83	15.6	B	284/326	0.84	30.1	C	284/273
Overall	--	25.1	C	--	--	26.8	C	--	--	74.0	E	--
<i>Saturday Peak</i>												
EB Left	1.53	295.4	F	218/409	1.82	427.1	F	246/422	2.84	885.5	F	455/655
EB Thru/Right	0.54	27.7	C	40/107	0.53	26.8	C	28/90	0.58	27.7	C	37/106
WB Left/Thru	0.07	23.3	C	13/34	0.28	30.4	C	36/75	0.30	31.3	C	37/76
WB Right	0.42	22.8	C	60/116	0.36	19.1	B	56/104	0.36	19.1	B	56/104
NB Left	0.65	22.3	C	42/85	0.69	24.3	C	83/158	0.80	34.4	C	98/201
NB Thru/Right	0.62	8.7	A	130/164	0.79	18.6	B	318/383	0.79	18.5	B	318/384
SB Left	0.44	14.8	B	61/81	0.64	19.3	B	81/135	0.64	18.7	B	76/115
SB Thru	0.71	23.7	C	308/346	0.79	26.5	C	318/351	0.79	25.6	C	305/305
Overall	--	52.4	D	--	--	69.0	E	--	--	156.4	F	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Shops at 5/Shops at Long Pond												
<i>Weekday AM Peak</i>												
EB Left	0.11	39.9	D	7/23	0.11	39.9	D	7/23	0.11	39.9	D	7/23
EB Left/Thru/Rt	0.05	39.5	D	3/13	0.05	39.5	D	3/13	0.05	39.5	D	3/13
WB Left/Thru	0.06	39.6	D	4/17	0.09	39.8	D	5/20	0.09	39.8	D	5/20
WB Right	0.17	30.0	C	17/30	0.17	29.2	C	18/30	0.17	29.2	C	18/30
NB Left	0.01	28.8	C	2/4	0.01	36.8	D	2/6	0.01	36.8	D	2/6
NB Thru/Right	0.38	1.4	A	93/174	0.41	26.7	C	164/224	0.42	27.1	C	173/233
SB Left	0.56	39.7	D	47/77	0.60	37.6	D	53/86	0.60	37.4	D	52/85
SB Thru/Right	0.97	40.5	D	241/650	1.05	48.2	D	170/667	1.06	51.1	D	184/668
Overall	--	25.3	C	--	--	38.1	D	--	--	39.4	D	--
<i>Weekday PM Peak</i>												
EB Left	0.46	43.2	D	30/67	0.36	43.2	D	30/67	0.46	43.2	D	30/67
EB Left/Thru/Rt	0.27	41.2	D	17/43	0.21	41.2	D	17/43	0.27	41.2	D	17/43
WB Left/Thru	0.37	42.1	D	25/60	0.40	45.4	D	36/89	0.54	45.4	D	37/89
WB Right	0.44	28.2	C	52/82	0.48	29.7	C	64/96	0.61	33.4	C	65/96
NB Left	0.05	29.7	C	11/32	0.17	30.1	C	11/28	0.07	32.8	C	11/29
NB Thru/Right	0.54	20.9	C	265/310	0.73	23.0	C	275/318	0.61	23.3	C	279/326
SB Left	0.85	35.9	D	42/114	0.77	36.6	D	158/212	0.88	33.9	C	158/194
SB Thru/Right	1.00	35.2	D	439/582	0.75	42.1	D	86/581	0.99	21.7	C	128/593
Overall	--	29.8	C	--	--	33.0	C	--	--	27.2	C	--
<i>Saturday Peak</i>												
EB Left	0.60	47.2	D	33/71	0.60	47.2	D	33/71	0.60	47.2	D	33/71
EB Left/Thru/Rt	0.35	43.1	D	18/46	0.35	43.1	D	18/46	0.35	43.1	D	18/46
WB Left/Thru	0.46	43.2	D	29/70	0.66	53.1	D	41/112	0.66	53.1	D	41/112
WB Right	0.48	25.9	C	60/103	0.54	26.0	C	71/122	0.56	27.0	C	72/122
NB Left	0.05	26.6	C	13/38	0.05	25.8	C	13/36	0.05	26.5	C	13/34
NB Thru/Right	0.43	19.0	B	132/255	0.48	20.7	C	211/238	0.50	21.1	C	221/250
SB Left	0.84	43.6	D	150/205	0.90	35.1	D	181/242	0.90	35.1	D	181/243
SB Thru/Right	0.88	40.7	D	364/482	0.95	25.7	C	63/237	0.95	25.2	C	75/248
Overall	--	32.7	C	--	--	28.0	C	--	--	28.0	C	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Holman Road												
<i>Weekday AM Peak</i>												
NB Left	0.01	9.3	A	--/0	0.01	9.5	A	--/0	0.02	9.5	A	--/0
EB Left/Right	0.15	20.8	C	--/25	0.17	22.4	C	--/25	0.17	23.1	C	--/25
<i>Weekday PM Peak</i>												
NB Left	0.01	9.4	A	--/0	0.01	9.6	A	--/0	0.01	9.7	A	--/0
EB Left/Right	0.36	30.2	D	--/50	0.42	37.0	E	--/50	0.45	40.0	E	--/75
<i>Saturday Peak</i>												
NB Left	0.01	9.1	A	--/0	0.01	9.3	A	--/0	0.01	9.4	A	--/0
EB Left/Right	0.10	20.1	C	--/25	0.11	22.2	C	--/25	0.11	23.2	C	--/25
Long Pond Road at Camelot Drive												
<i>Weekday AM Peak</i>												
WB Left/Right	0.85	46.5	D	21/82	0.85	48.6	D	21/84	0.85	48.6	D	21/84
NB Thru/Right	0.31	13.0	B	74/146	0.34	13.7	B	82/160	0.35	13.8	B	86/166
SB Left	0.84	43.8	D	89/138	0.85	46.6	D	81/81	0.85	46.6	D	76/77
SB Thru	0.19	0.2	A	35/80	0.20	0.2	A	0/1	0.21	0.2	A	0/1
Overall	--	17.4	B	--	--	18.0	B	--	--	17.9	B	--
<i>Weekday PM Peak</i>												
WB Left/Right	0.87	45.5	D	106/177	0.90	56.7	E	112/185	0.90	56.7	E	112/185
NB Thru/Right	0.32	14.8	B	92/169	0.35	15.3	B	103/186	0.36	15.4	B	107/192
SB Left	0.80	48.5	D	80/80	0.80	48.5	D	69/75	0.80	48.5	D	65/71
SB Thru	0.22	6.5	A	7/13	0.24	6.7	A	14/68	0.25	6.7	A	14/76
Overall	--	21.3	C	--	--	23.4	C	--	--	23.1	C	--
<i>Saturday Peak</i>												
WB Left/Right	0.84	42.6	D	69/135	0.86	51.2	D	73/141	0.86	51.2	D	73/141
NB Thru/Right	0.29	12.2	B	80/150	0.32	12.7	B	91/167	0.34	12.9	B	97/177
SB Left	0.79	49.2	D	68/119	0.79	49.2	D	65/93	0.79	49.2	D	64/87
SB Thru	0.18	5.1	A	5/31	0.20	5.2	A	17/39	0.20	5.3	A	18/42
Overall	--	18.6	B	--	--	19.9	B	--	--	19.6	B	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 6 (continued)
Level-of-Service Analysis Summary

Location/Peak Hour Movement	2018 Existing				2025 No-Build				2025 Build			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Home Depot Drive at Hotel Access/Honda Access												
<i>Weekday AM Peak</i>												
NB Approach	0.04	7.7	A	--/25	0.04	7.7	A	--/25	0.05	8.5	A	--/25
EB Approach	0.20	8.9	A	--/25	0.20	8.9	A	--/25	0.39	11.1	B	--/50
WB Left	0.16	9.3	A	--/25	0.16	9.3	A	--/25	0.16	9.6	A	--/25
WB Thru/Right	0.20	9.0	A	--/25	0.20	9.0	A	--/25	0.46	12.3	B	--/75
SB Approach	0.18	9.2	A	--/25	0.18	9.2	A	--/25	0.20	10.3	B	--/25
<i>Weekday PM Peak</i>												
NB Approach	0.07	8.5	A	--/25	0.07	8.6	A	--/25	0.08	10.0	A	--/25
EB Approach	0.36	10.9	B	--/50	0.38	11.2	B	--/50	0.77	24.2	C	--/200
WB Left	0.22	10.3	B	--/25	0.22	10.3	B	--/25	0.24	11.1	B	--/25
WB Thru/Right	0.31	10.2	B	--/50	0.33	10.4	B	--/50	0.60	17.0	C	--/100
SB Approach	0.27	10.8	B	--/50	0.28	10.9	B	--/50	0.32	13.0	B	--/50
<i>Saturday Peak</i>												
NB Approach	0.13	10.1	B	--/25	0.13	10.2	B	--/25	0.16	11.9	B	--/25
EB Approach	0.57	15.9	C	--/100	0.59	16.5	C	--/100	0.98	59.7	F	--/365
WB Left	0.34	12.4	B	--/50	0.34	12.5	B	--/50	0.37	13.9	B	--/50
WB Thru/Right	0.53	14.8	B	--/100	0.56	15.5	C	--/100	1.04	63.1	F	--/365
SB Approach	0.34	12.8	B	--/50	0.34	12.9	B	--/50	0.40	15.5	C	--/50

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Long Pond Road at South Street and Obery Street

This signalized intersection currently operates at acceptable levels (LOS B to C) during the peak hours, although long queues currently form on the Obery Street approach to South Street. All movements at this intersection operate at acceptable levels with volume to capacity (v/c) ratios of 0.95 or less. Improvements are proposed at this intersection as part of a state improvement project that will widen Obery Street to provide a double left-turn lane and an exclusive right-turn lane and restripe South Street to provide an exclusive southbound left-turn lane and a single northbound through lane. With these improvements, the intersection will continue to operate at these levels under the future No-Build and Build conditions. The traffic added by the proposed mixed-use development will increase delays slightly, but will not have a measurable impact on the operations of this intersection.

Long Pond Road at the Route 3 Northbound Ramps

This signalized intersection currently operates at acceptable levels (LOS B to C) during the analyzed peak hours. The Obery Street state improvement project proposes to make some minor adjustments to the signal timing settings to improve coordination between the northbound ramps and the new intersection geometry at Obery Street. Under future No-Build conditions, this intersection will continue to operate at LOS B to C during the peak hours. The traffic added by the proposed mixed-use development will increase delays slightly, particular on the Route 3 northbound off-ramp left-turn movement. Additional signal timing changes are recommended to improve signal coordination along the entire Long Pond Road corridor as described in the *Mitigation* section of this report.

Long Pond Road at the Route 3 Southbound Ramps

This signalized intersection currently operates at LOS F during the weekday AM, weekday PM, and Saturday peak hours with very long delays and queues for the right-turn movement off the Route 3 ramps. This condition is exacerbated under future traffic volume conditions, particularly with the addition of site-generated traffic. Improvements are proposed that will mitigate the projects impacts at this location as described in the *Mitigation* section of this report.

Long Pond Road at Home Depot Drive and County Drive

This signalized intersection currently operates at LOS C to D during the peak hours, although left turns exiting Home Depot Drive during the Saturday peak hour currently operate with long delays and queues. Under No-Build and Build conditions, these left-turns are expected to operate at LOS F and over capacity during all peak hours. Improvements are proposed including widening the Home Depot Drive approach to Long Pond Road that will mitigate the projects impacts at this location as described in the *Mitigation* section of this report.

Long Pond Road at Shops at 5 and Shops at Long Pond Driveways

This signalized intersection currently operates at acceptable levels (LOS C) during the peak hours and will continue to operate at acceptable levels (LOS C to D) under future No-Build and Build conditions. All movements operate at a LOS D or better under all analyzed conditions and time periods. Signal timing changes are recommended to improve signal coordination along the corridor as described in the *Mitigation* section of this report.

Long Pond Road at Holman Road

Left and right turns exiting Holman Road currently operate at LOS C to D during the analyzed peak hours. Turns exiting Holman Road are expected to experience longer delays at LOS E during the weekday PM peak hour under both No-Build and Build conditions, but operate well below capacity (volume-to-capacity ratio of 0.45). However, this intersection is located in close proximity to the Shops at 5 signalized intersection. A vehicle queue of approximately 180 feet or longer on the Long Pond Road northbound approach limits the ability for vehicles to turn left out of Holman Road and actual delays are therefore expected to be longer than as modeled. This is an existing condition and the addition of site generated traffic will not have a measurable impact on the operations of this intersection.

Long Pond Road at Camelot Drive

This signalized intersection currently operates at LOS B to C during the peak hours and is expected to continue to operate at these levels under future No-Build and Build conditions. All movements operate at LOS D or better with the exception of the Camelot Drive approach during the weekday PM peak hour, which is expected to operate at LOS E under both No-Build and Build conditions. All lane groups maintain ample capacity with v/c ratios of 0.90 or less. The traffic added by the proposed mixed-use development will increase delays slightly, but will not have a measurable impact on the operations of this intersection. Signal timing changes are recommended to improve signal coordination along the corridor and the Camelot Drive operation as described in the *Mitigation* section of this report.

Home Depot Drive at the Hotel and Honda Dealership Access Driveways

All approaches at this all-way stop unsignalized intersection currently operate at LOS B to C during the peak hours and will continue to operate at these levels under the No-Build conditions. The addition of mixed-use development traffic is expected to add traffic but still operate at LOS B to C during the weekday AM and PM peak hours. During the Saturday midday peak hour, the Home Depot Drive eastbound and westbound approaches are expected to operate with long delays at LOS F under the Build condition with 95th percentile vehicle queues extending to but not onto Long Pond Road. Potential future improvements to this intersection are described in the *Mitigation* section of this report.

MITIGATION

As a result of the project and review of the expected traffic impacts on the study area roadways and intersections, several improvements are recommended to mitigate these impacts as described below. Additional measures are also recommended to improve vehicle flow through the study corridor as well as commit to transportation demand management (TDM) measures. The proponent has committed to fully fund and implement these recommended improvements, which include all the measures stipulated in the Memorandum of Understanding (MOU) between the Town of Plymouth and the property owner.

Long Pond Road at Home Depot Drive and County Drive

Without any improvements, left-turns from the Home Depot Drive approach are expected to operate at LOS F and over capacity under No-Build and Build conditions. In addition, the Road Safety Audit (RSA) for this location has identified safety concerns with a significant number of angle crashes that are likely due to the protected-permissive left-turn phasing on Long Pond Road and the concurrent phasing for Home Depot Drive and County Drive. To mitigate the impacts of the project and reduce to potential for accidents, the project proponent will widen the Home Depot Drive approach to provide a left-turn lane, a shared left-turn/through, and an exclusive right-turn lane. To accommodate the double left-turn movement and improve intersection safety, the Home Depot Drive and County Drive approaches will be split-phased. Additional signal heads will be installed to accommodate the new lane arrangement and all new signal heads will have retro-reflective backplates consistent with the recommendations of the RSA.

These improvements are consistent with the requirements of the MOU. However, the MOU also required that the stop line and vehicle detectors on the Long Pond Road southbound approach be moved back approximately 20 feet to accommodate the new double left-turn lane. This change is no longer required as the improvements recently completed by the Global gas station development widened the northbound receiving lanes on Long Pond Road and were designed specifically to accommodate the double left-turn movement. The signal clearance intervals at the intersection were recently updated to current standards by the gas station development and no further changes to these settings will be necessary. These changes should also help to reduce future accident occurrence.

In addition to the above and consistent with the recommendations in the RSA, a “No Turn on Red” sign will be installed on the County Drive approach to improve safety due to limited sight distance for vehicles turning right from County Drive. Also consistent with the RSA recommendations, all pedestrian signal heads will be replaced and updated with count-down pedestrian signal heads and new APS-style push buttons will be installed. Finally, pedestrian warning signs will be installed on the Long Pond Road southbound right-turn lane into Home Depot Drive to warn motorists of the uncontrolled pedestrian crossing at this location. The

project proponent has committed to implementing all of the above improvements, which are shown on the conceptual plan provided on Figure 14.

As shown in Table 7, substantially improved traffic operations can be achieved with these improvements with overall LOS B to D operations during the peak hours with all movement operating under capacity. Additional safety-related improvements were investigated as suggested in the RSA such as providing protected-only phasing for the Long Pond Road left-turn movements. However, such phasing would significantly reduce the capacity of the intersection and substantially increase vehicle queuing on most approaches. This change was therefore not incorporated into the design.

Long Pond Road at the Route 3 Southbound Ramps

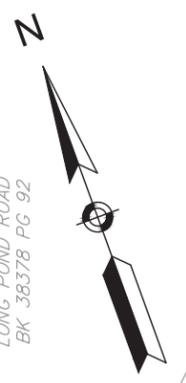
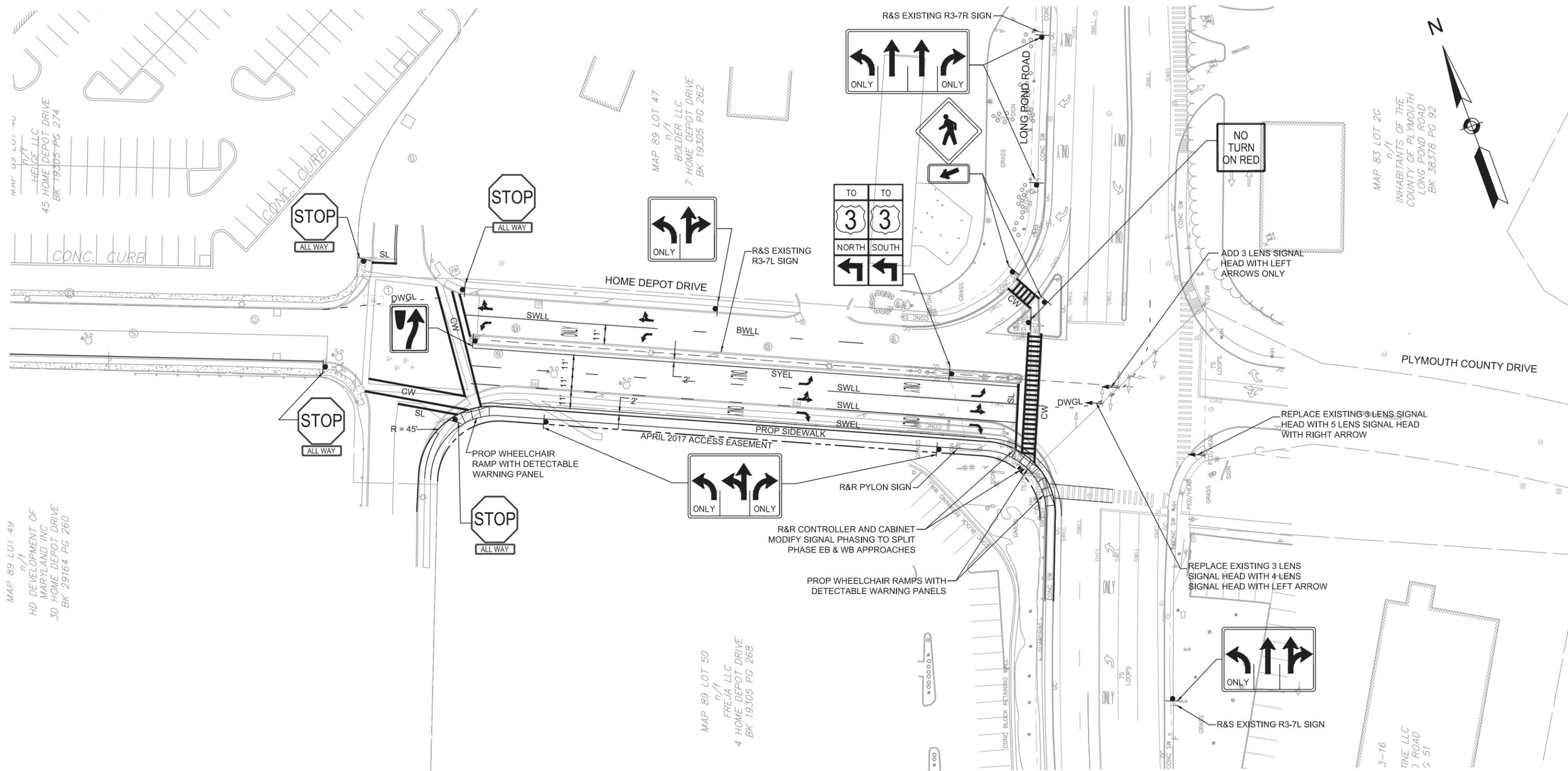
The right-turn movement from the Route 3 southbound off ramp currently operates at LOS F with long vehicle queues on the ramps. These conditions will be exacerbated with additional growth in traffic such as the proposed development. Consistent with the requirements of the MOU, the project proponent will widen the Route 3 southbound ramps to provide a double right-turn lane under traffic signal control. With these improvements, intersection operations are expected to improve significantly with overall LOS B to C traffic operations and all movements operating at LOS D or better during the peak hours, as shown in Table 7. Queues for the off-ramp right-turn movement will be substantially reduced. This should also help to minimize rear-end collisions caused by the current yield control for this movement.

In addition to these improvements and as recommended in the RSA, the proponent will install a pedestrian signal for crossing the Route 3 ramps including count-down pedestrian signal heads, APS-style push buttons, and new wheelchair ramps with detectable warning panels. At the Long Pond Road channelized southbound right-turn lane, pedestrian warning signs will be installed to warn motorists of the uncontrolled pedestrian crossing at this location. A conceptual plan showing these improvements is provided on Figure 15.

Home Depot Drive

The prior factory outlet center project proposed to widen Home Depot Drive to provide essentially a four-lane cross section along the entire length of Home Depot Drive. This was necessitated by the significantly higher traffic generated by such a use. This widening is no longer required for the proposed apartment and medical office project.

The first internal intersection on Home Depot Drive that provides access to the Honda dealership and the 99 Restaurant to the north and the Hilton Garden Inn hotel and retail shops to the south is currently an all-way stop controlled intersection. With the exception of the Home Depot Drive westbound approach, all approaches provide single lanes. The westbound approach provides two approach lanes with the left lane signed as a left-only lane. During field investigation, it was

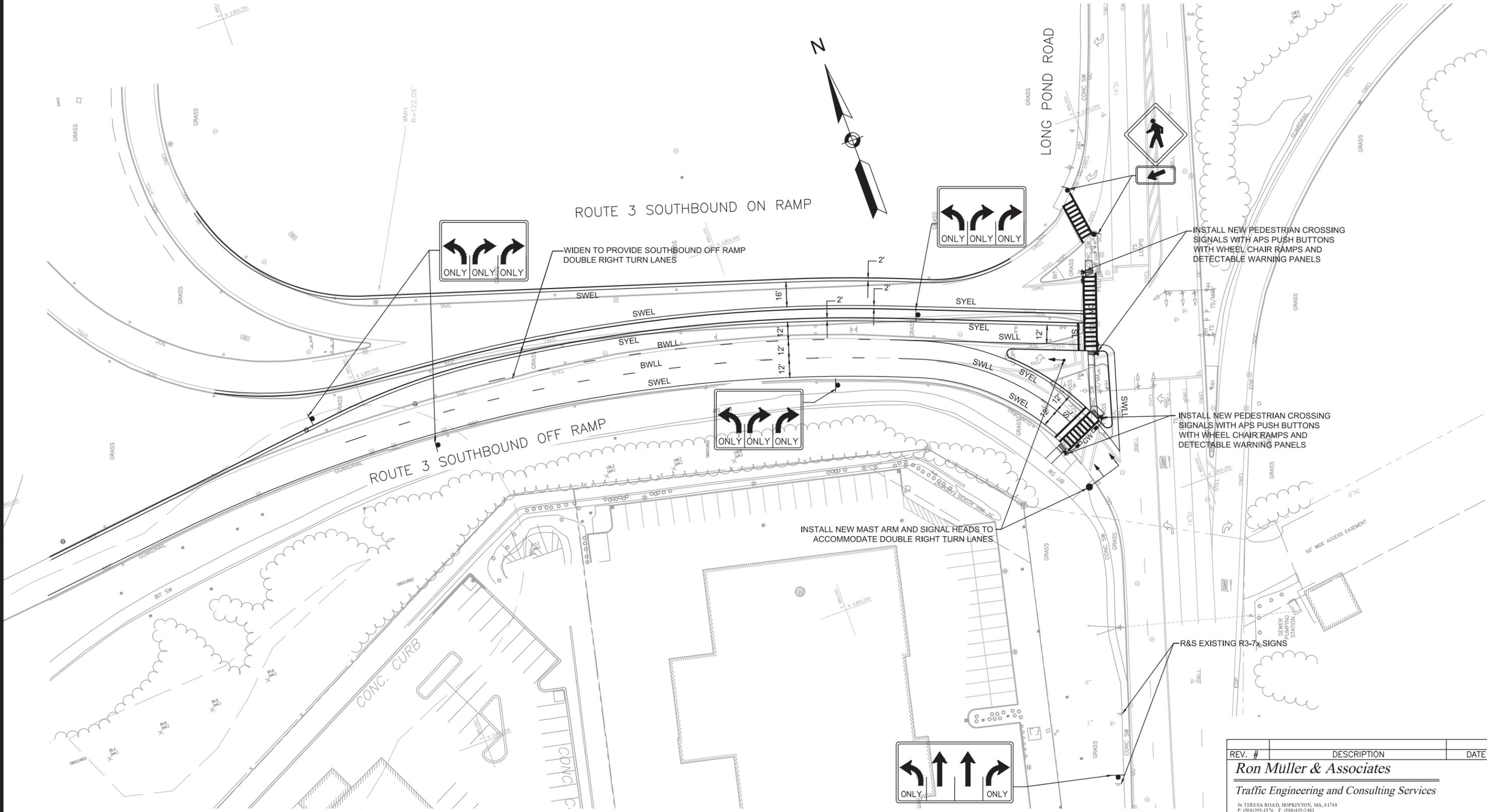


PAVEMENT MARKING LEGEND	
DYCL	DOUBLE YELLOW CENTER LINE
DWGL	DASHED WHITE GUIDE LINE
DWLL	DOTTED WHITE LANE LINE
SWEL	SOLID WHITE EDGE LINE
SWLL	SOLID WHITE LANE LINE
SYEL	SOLID YELLOW EDGE LINE
SL	STOP LINE
CW	CROSSWALK

NOTES:
 ALL PROPOSED SIGNAL HEADS TO HAVE RETROREFLECTIVE BACKPLATES.
 REPLACE ALL PEDESTRIAN SIGNAL HEADS WITH NEW COUNTDOWN HEADS AND INSTALL NEW APS PUSH BUTTONS.



REV. #	DESCRIPTION	DATE
Ron Muller & Associates Traffic Engineering and Consulting Services <small>56 TERESA ROAD, BOPKINTON, MA, 01748 P: (508)395-1576 F: (508)435-2481</small>		
HOME DEPOT DRIVE AT LONG POND ROAD PLYMOUTH, MASSACHUSETTS		
FIGURE 14		
CONCEPTUAL IMPROVEMENT PLAN		
DATE:	12/6/18	SHEET 1 OF 1



PAVEMENT MARKING LEGEND	
DYCL	DOUBLE YELLOW CENTER LINE
DWLL	DOTTED WHITE LANE LINE
SWEL	SOLID WHITE EDGE LINE
SWLL	SOLID WHITE LANE LINE
SYEL	SOLID YELLOW EDGE LINE
SL	STOP LINE
CW	CROSSWALK

NOTES:
 ALL PROPOSED SIGNAL HEADS TO HAVE RETROREFLECTIVE BACKPLATES.
 ALL PEDESTRIAN SIGNAL HEADS TO BE COUNTDOWN HEADS AND PROVIDE NEW APS PUSH BUTTONS.

REV. #	DESCRIPTION	DATE
Ron Muller & Associates Traffic Engineering and Consulting Services <small>56 TERESA ROAD, HOPKINTON, MA, 01748 P: (508)395-1576 F: (508)435-2481</small>		
ROUTE 3 SB RAMPS AT LONG POND ROAD PLYMOUTH, MASSACHUSETTS		
FIGURE 15		
CONCEPTUAL IMPROVEMENT PLAN		
DATE:	12/7/18	SHEET 1 OF 1

observed that the through lane does not align with the receiving lane west of the intersection. The capacity analyses indicate acceptable traffic operations and queues during the weekday AM and PM peak hours. However, during the Saturday peak hour with the added development traffic, long delays are projected on the westbound approach with 95th percentile vehicle queues extending to, but not onto Long Pond Road. Accurate measurements of delays and queues on this approach are difficult to model as approaching vehicles are metered by the traffic signal on Long Pond Road. Actual delays and queues may therefore be better than modeled.

It was considered to modify the lane use on this approach to a shared left/through lane and an exclusive right-turn lane so that the through lane would properly align with the receiving lane. However, this would result in about 90 percent of the approach volume in a single lane. Capacity analyses revealed that this lane configuration would result in excessive queues on the westbound approach that could extend onto Long Pond Road and affect the operation of the signalized intersection. This lane configuration is accordingly not recommended at this time.

Home Depot Drive is a privately-owned and maintained driveway and any improvements to this intersection require the approval of the property owner. The project proponent is therefore committed to monitoring this intersection to determine actual traffic operations after occupancy of the development. If the monitoring shows that vehicle queues affect the operation of the Long Pond Road and Home Depot Drive intersection, then corrective measures will be taken. These measures could include a widening of Home Depot Drive to properly align the westbound through lane with the receiving lane, eliminating the stop control on the Home Depot Drive approaches, installation of a traffic signal (if warranted), or construction of a mini roundabout. It is recommended that monitoring of the intersection be conducted on the following schedule:

- after occupancy of half of the residential apartments (160 units);
- after occupancy of all of the residential apartments (320 units); and
- after occupancy of the medical office space

Monitoring of the intersection should include traffic counts during the Saturday midday peak period (11:00 AM to 2:00 PM); intersection capacity analyses to determine levels of service and queues; and actual observations of traffic operations to determine whether vehicle queues affect Long Pond Road traffic operations. If the monitoring studies reveal operational impacts to Long Pond Road, then corrective measures should be evaluated in the monitoring study and implemented by the appropriate parties.

In the interim, the proponent will add lane striping and arrow pavement markings on the westbound approach to reinforce the current lane arrangement and add dashed white guide lines through the intersection to guide westbound through vehicles through the intersection. In addition, it was observed that the stop signs on each of the approaches lack the “ALL WAY” plaques under the stop signs that are now required for all-way stop controlled intersections and that the end of the median on Home Depot Drive at this intersection lacks a “KEEP RIGHT” sign. The proponent will accordingly install these signs and the recommended improvements are shown on the conceptual plan provided on Figure 14.

Coordinated Signal System along Long Pond Road

As a result of the project and improvements being made at study area intersections, signal timing and coordination changes are proposed as part of the project. The measures are intended to reallocate signal green times as a result of the added capacity from the physical improvements discussed above to improve traffic progression and traffic operations for individual lane groups. The signal timing modifications will also include updated signal clearance times in an effort to reduce rear-end collisions, consistent with the recommendations of the RSA. The signal coordination changes are also consistent with the requirements of the MOU.

The results of the improved coordination patterns at coordinated traffic signals along Long Pond Road are provided in Table 7 and all analysis worksheets are provided in the Appendix. As shown, all intersections will operate at acceptable levels (LOS B to C) with the exception of the Home Depot Drive intersection where overall LOS D operations are expected during the Weekday PM and Saturday peak hours.

Signage

The widening of Home Depot Drive to provide a double left-turn lane onto Long Pond Road northbound will necessitate the installation of directional signs on Home Depot Drive to guide motorists into the proper lane before exiting the Home Depot Plaza. It is recommended that signs be posted on Home Depot Drive directing motorists destined to Route 3 to use the center lane.

As discussed in the RSA, there are numerous lane utilization signs (R3-7X) on Long Pond Road southbound approaching Home Depot Drive and on Long Pond Road northbound approaching the Route 3 southbound ramps. The RSA recommended replacing these signs with lane designation signs (R3-8 Series) to reduce sign clutter and provide better advance notice to motorists. The proponent has agreed to install the recommended signs, which are also shown on the conceptual plans provided on Figures 14 and 15.

Table 7
Mitigated Level-of-Service Analysis Summary

Location/Peak Hour Movement	2025 No-Build				2025 Build				2025 Build Mitigated			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Route 3 Northbound Ramps												
<i>Weekday AM Peak</i>												
WB Left	0.93	58.0	E	210/346	0.98	69.3	E	221/395	0.93	54.6	D	227/390
NB Thru	0.45	28.0	C	194/265	0.47	28.5	C	231/265	0.48	29.5	C	174/250
SB Left	0.67	14.2	B	106/155	0.33	15.9	B	116/155	0.70	16.2	B	114/151
SB Thru	0.37	14.4	B	185/215	0.33	22.1	C	179/231	0.42	15.9	B	176/270
Overall	--	29.1	C	--	--	34.0	C	--	--	29.8	C	--
<i>Weekday PM Peak</i>												
WB Left	0.91	52.7	D	189/279	0.92	54.6	D	189/342	0.92	54.6	D	189/342
NB Thru	0.45	6.6	A	172/175	0.50	13.0	B	178/185	0.50	29.8	C	145/243
SB Left	0.69	11.1	B	55/281	0.76	15.6	B	112/320	0.84	23.6	C	112/320
SB Thru	0.58	10.2	B	79/402	0.61	11.4	B	328/412	0.61	11.4	B	328/412
Overall	--	16.0	B	--	--	19.8	B	--	--	26.9	C	--
<i>Saturday Peak Hour</i>												
WB Left	0.89	24.0	C	195/385	0.91	29.7	C	226/440	0.93	46.6	D	261/369
NB Thru	0.61	17.0	B	164/252	0.65	18.6	B	189/267	0.51	4.5	A	124/207
SB Left	0.56	11.4	B	58/127	0.59	12.8	B	65/135	0.48	11.1	B	89/134
SB Thru	0.60	9.9	A	181/316	0.66	11.6	B	232/357	0.60	14.3	B	339/360
Overall	--	15.8	B	--	--	18.4	B	--	--	17.8	B	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 7 (continued)
Mitigated Level-of-Service Analysis Summary

Location/Peak Hour Movement	2025 No-Build				2025 Build				2025 Build Mitigated			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Route 3 Southbound Ramps												
<i>Weekday AM Peak</i>												
EB Left	1.09	107.6	F	212/275	1.09	107.6	F	162/291	0.83	33.2	C	218286
EB Right	1.89	446.0	F	158/301	2.10	538.9	F	203/499	0.84	31.6	C	142/163
NB Left	0.05	7.8	A	4/16	0.05	8.2	A	7/12	0.06	10.5	B	7/7
NB Thru	0.35	12.4	B	176/282	0.39	19.8	B	243/291	0.43	0.5	A	189/337
SB Thru	0.32	21.0	C	122/194	0.35	21.7	C	141/198	0.40	25.3	C	121/190
SB Right	0.17	18.2	B	15/42	0.17	18.2	B	16/36	0.19	21.5	C	16/28
Overall	--	134.4	F	--	--	160.8	F	--	--	20.3	C	--
<i>Weekday PM Peak</i>												
EB Left	0.67	35.6	D	113/214	0.67	35.6	D	124/223	0.45	23.8	C	127/188
EB Right	2.34	645.1	F	381/738	2.55	740.5	F	583/875	0.92	40.7	D	198/259
NB Left	0.04	6.0	A	2/3	0.04	6.0	A	3/3	0.06	11.6	B	3/4
NB Thru	0.54	0.6	A	114/114	0.61	0.4	A	122/122	0.72	0.7	A	182/458
SB Thru	0.37	0.3	A	202/204	0.40	0.4	A	200/211	0.49	16.4	B	210/287
SB Right	0.30	0.6	A	31/34	0.30	0.5	A	20/37	0.37	15.5	B	13/61
Overall	--	156.1	F	--	--	180.4	F	--	--	16.6	B	--
<i>Saturday Peak Hour</i>												
EB Left	0.78	42.2	D	122/228	0.78	42.2	D	130/241	0.49	23.3	C	137/213
EB Right	2.41	677.6	F	394/761	2.71	813.8	F	628/951	0.92	39.9	D	214/301
NB Left	0.05	7.2	A	3/3	0.05	7.5	A	3/3	0.05	11.6	B	4/6
NB Thru	0.48	0.3	A	209/209	0.53	0.2	A	255/255	0.66	30.2	C	260/297
SB Thru	0.43	10.5	B	229/248	0.48	10.8	B	246/260	0.61	3.1	A	247/272
SB Right	0.19	8.7	A	0/34	0.19	8.7	A	0/32	0.25	2.4	A	12/27
Overall	--	177.2	F	--	--	216.0	F	--	--	23.4	C	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 7 (continued)
Mitigated Level-of-Service Analysis Summary

Location/Peak Hour Movement	2025 No-Build				2025 Build				2025 Build Mitigated			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Home Depot Drive/County Drive												
<i>Weekday AM Peak</i>												
EB Left	0.70	41.6	D	116/177	1.11	121.9	F	177/335	0.81	43.9	D	104/198
EB Thru/Right	0.28	24.8	C	14/53	0.30	25.0	C	12/55	0.36	31.8	C	106/201
WB Left/Thru	0.19	27.6	C	34/65	0.19	27.9	C	30/65	0.47	46.9	D	41/101
WB Right	0.29	21.2	C	32/60	0.28	20.9	C	27/60	0.31	31.1	C	4/29
NB Left	0.33	17.7	B	17/94	0.40	17.8	B	22/113	0.62	16.0	B	17/61
NB Thru/Right	0.64	17.5	B	98/271	0.64	17.6	B	90/271	0.62	15.9	B	200/200
SB Left	0.72	21.4	C	40/147	0.71	21.1	C	54/174	0.67	15.7	B	127/210
SB Thru	0.54	32.3	C	140/250	0.55	32.4	C	185/251	0.52	14.0	B	191/192
Overall	--	25.5	C	--	--	36.4	D	--	--	19.0	B	--
<i>Weekday PM Peak</i>												
EB Left	0.99	82.6	F	170/283	1.67	352.9	F	355/548	0.88	48.6	D	162/322
EB Thru/Right	0.30	21.7	C	12/55	0.35	22.1	C	12/58	0.44	29.6	C	0/43
WB Left/Thru	0.19	23.1	C	37/70	0.20	23.8	C	34/70	0.39	36.8	D	47/93
WB Right	0.50	20.0	C	85/146	0.49	19.8	B	85/146	0.91	60.7	E	49/98
NB Left	0.43	19.0	B	3/3	0.54	21.0	C	3/3	0.60	24.6	C	45/82
NB Thru/Right	0.85	25.4	C	322/408	0.85	25.3	C	322/408	0.96	45.2	D	277/426
SB Left	0.75	24.2	C	75/144	0.75	24.8	C	79/114	0.82	37.4	D	75/177
SB Thru	0.83	15.6	B	284/326	0.84	30.1	C	284/273	0.91	48.4	D	320/430
Overall	--	26.8	C	--	--	74.0	E	--	--	45.8	D	--
<i>Saturday Peak</i>												
EB Left	1.82	427.1	F	246/422	2.84	885.5	F	455/655	0.89	48.8	D	177/344
EB Thru/Right	0.53	26.8	C	28/90	0.58	27.7	C	37/106	0.64	32.7	C	47/124
WB Left/Thru	0.28	30.4	C	36/75	0.30	31.3	C	37/76	0.70	54.5	D	48/124
WB Right	0.36	19.1	B	56/104	0.36	19.1	B	56/104	0.87	61.2	E	25/64
NB Left	0.69	24.3	C	83/158	0.80	34.4	C	98/201	0.90	54.9	D	80/189
NB Thru/Right	0.79	18.6	B	318/383	0.79	18.5	B	318/384	0.86	50.4	D	242/395
SB Left	0.64	19.3	B	81/135	0.64	18.7	B	76/115	0.79	31.6	C	81/169
SB Thru	0.79	26.5	C	318/351	0.79	25.6	C	305/305	0.85	42.4	D	254/415
Overall	--	69.0	E	--	--	156.4	F	--	--	46.4	D	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 7 (continued)
Mitigated Level-of-Service Analysis Summary

Location/Peak Hour Movement	2025 No-Build				2025 Build				2025 Build Mitigated			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Shops at 5/Shops at Long Pond												
<i>Weekday AM Peak</i>												
EB Left	0.11	39.9	D	7/23	0.11	39.9	D	7/23	0.11	39.9	D	7/24
EB Left/Thru/Rt	0.05	39.5	D	3/13	0.05	39.5	D	3/13	0.05	39.5	D	3/14
WB Left/Thru	0.09	39.8	D	5/20	0.09	39.8	D	5/20	0.09	39.8	D	5/21
WB Right	0.17	29.2	C	18/30	0.17	29.2	C	18/30	0.23	33.7	C	22/42
NB Left	0.01	36.8	D	2/6	0.01	36.8	D	2/6	0.02	39.5	D	2/5
NB Thru/Right	0.41	26.7	C	164/224	0.42	27.1	C	173/233	0.42	27.1	C	146/204
SB Left	0.60	37.6	D	53/86	0.60	37.4	D	52/85	0.60	40.1	D	50/85
SB Thru/Right	1.05	48.2	D	170/667	1.06	51.1	D	184/668	0.96	34.1	C	372/480
Overall	--	38.1	D	--	--	39.4	D	--	--	32.0	C	--
<i>Weekday PM Peak</i>												
EB Left	0.36	43.2	D	30/67	0.46	43.2	D	30/67	0.46	43.2	D	30/75
EB Left/Thru/Rt	0.21	41.2	D	17/43	0.27	41.2	D	17/43	0.27	41.2	D	17/46
WB Left/Thru	0.40	45.4	D	36/89	0.54	45.4	D	37/89	0.54	45.4	D	37/89
WB Right	0.48	29.7	C	64/96	0.61	33.4	C	65/96	0.55	30.9	C	90/131
NB Left	0.17	30.1	C	11/28	0.07	32.8	C	11/29	0.09	35.2	D	10/29
NB Thru/Right	0.73	23.0	C	275/318	0.61	23.3	C	279/326	0.62	23.9	C	253/331
SB Left	0.77	36.6	D	158/212	0.88	33.9	C	158/194	0.84	39.5	D	158/183
SB Thru/Right	0.75	42.1	D	86/581	0.99	21.7	C	128/593	0.92	31.4	C	252/442
Overall	--	33.0	C	--	--	27.2	C	--	--	30.9	C	--
<i>Saturday Peak</i>												
EB Left	0.60	47.2	D	33/71	0.60	47.2	D	33/71	0.52	44.0	D	33/73
EB Left/Thru/Rt	0.35	43.1	D	18/46	0.35	43.1	D	18/46	0.30	41.5	D	18/47
WB Left/Thru	0.66	53.1	D	41/112	0.66	53.1	D	41/112	0.44	39.8	D	43/88
WB Right	0.54	26.0	C	71/122	0.56	27.0	C	72/122	0.59	28.5	C	105/151
NB Left	0.05	25.8	C	13/36	0.05	26.5	C	13/34	0.07	29.6	C	13/37
NB Thru/Right	0.48	20.7	C	211/238	0.50	21.1	C	221/250	0.56	25.4	C	206/284
SB Left	0.90	35.1	D	181/242	0.90	35.1	D	181/243	0.87	31.5	C	65/118
SB Thru/Right	0.95	25.7	C	63/237	0.95	25.2	C	75/248	0.95	26.2	C	42/253
Overall	--	28.0	C	--	--	28.0	C	--	--	28.6	C	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Table 7 (continued)
Mitigated Level-of-Service Analysis Summary

Location/Peak Hour Movement	2025 No-Build				2025 Build				2025 Build Mitigated			
	v/c ^a	Del. ^b	LOS ^c	Queue ^d	v/c	Del.	LOS	Queue	v/c	Del.	LOS	Queue
Long Pond Road at Camelot Drive												
<i>Weekday AM Peak</i>												
WB Left/Right	0.85	48.6	D	21/84	0.85	48.6	D	21/84	0.85	48.6	D	21/84
NB Thru/Right	0.34	13.7	B	82/160	0.35	13.8	B	86/166	0.35	14.0	B	86/166
SB Left	0.85	46.6	D	81/81	0.85	46.6	D	76/77	0.82	53.1	D	71/86
SB Thru	0.20	0.2	A	0/1	0.21	0.2	A	0/1	0.21	14.5	B	24/49
Overall	--	18.0	B	--	--	17.9	B	--	--	23.5	C	--
<i>Weekday PM Peak</i>												
WB Left/Right	0.90	56.7	E	112/185	0.90	56.7	E	112/185	0.89	54.4	D	112/185
NB Thru/Right	0.35	15.3	B	103/186	0.36	15.4	B	107/192	0.36	15.4	B	107/193
SB Left	0.80	48.5	D	69/75	0.80	48.5	D	65/71	0.80	48.5	D	58/79
SB Thru	0.24	6.7	A	14/68	0.25	6.7	A	14/76	0.26	6.8	A	14/144
Overall	--	23.4	C	--	--	23.1	C	--	--	22.7	C	--
<i>Saturday Peak</i>												
WB Left/Right	0.86	51.2	D	73/141	0.86	51.2	D	73/141	0.85	46.5	D	73/141
NB Thru/Right	0.32	12.7	B	91/167	0.34	12.9	B	97/177	0.34	13.0	B	97/178
SB Left	0.79	49.2	B	65/93	0.79	49.2	D	64/87	0.79	49.2	D	48/82
SB Thru	0.20	5.2	D	17/39	0.20	5.3	A	18/42	0.20	5.4	A	35/126
Overall	--	19.9	B	--	--	19.6	B	--	--	18.9	B	--

^a Volume-to-capacity ratio

^b Average control delay in seconds per vehicle

^c Level of service

^d Average/95th percentile queue in feet, assuming 25 feet per vehicle

Transportation Demand Management Program

The proponent is committed to implementing a number of Transportation Demand Management (TDM) measures aimed at reducing vehicular traffic to and from the site. The proponent will implement the following measures in an effort to minimize the dependency on the private automobile.

Pedestrian Linkages

The proponent has committed to constructing new sidewalks from the current terminus of Home Depot Drive to each of the residential buildings to provide pedestrian linkages to the Home Depot Plaza. This will encourage walking between the residential and retail uses and reduce automobile emissions.

Bicycle Accommodation

Each of the residential buildings will provide safe storage for bicycles within the buildings to encourage this mode of transportation. Once the commercial component of the project is constructed, installation of secure bicycle racks will be incorporated into the design.

Public Transportation

The proponent will reach out to the Greater Attleboro Taunton Regional Transit Authority (GATRA) to explore the feasibility of providing a bus stop and shelter within the site for the Mayflower Link bus route. This bus route currently connects area businesses and the adjacent visitor's center with downtown Plymouth, where additional bus routes provide access to the Plymouth and Kingston commuter rail stations. Such a bus stop would encourage residents and employees/patients of the medical office use to use public transportation to/from work as well as draw customers to the Home Depot Plaza from the significant tourist population in Plymouth. If successful, the proponent will post bus route schedules and fares within the proposed clubhouse to encourage residents to make use of this service.

Carpooling Program

The proponent will encourage residents to make use of ride matching, carpooling and other greener modes of transportation through the active promotion of NuRide, the Commonwealth's web based trip planning and ride matching system that allows users to earn rewards for taking greener trips. Promotional materials for NuRide will be posted in the proposed clubhouse.

Direct Deposit

Tenants of the medical office use will be encouraged to offer direct deposit of employee paychecks to minimize the need for separate trips to employees' banks.

CONCLUSIONS

Existing and future conditions at the study area intersections have been described and analyzed with respect to traffic operations and the impact of the proposed site development. Conclusions of this effort and recommendations are presented below:

- The proposed Oasis at Plymouth mixed-use development consists of 320 apartment units and up to 70,000 square feet of medical office space. The project replaces the previously proposed and MEPA-approved 396,000 square foot factory outlet center and will be an expansion of the existing Home Depot Plaza and use the same access drive (Home Depot Drive) to Long Pond Road.
- After making conservative adjustments for internal capture trips and no pass-by trip credit, the proposed mixed-use development is expected to generate 270 new vehicle trips during the weekday AM peak hour, 351 new vehicle trips during the weekday PM peak hour, and 410 new vehicle trips during the Saturday midday peak hour.
- The development will require an indirect Highway Access Permit from MassDOT as well as a Notice of Project Change (NPC) through the MEPA office. However, the expansion project will not exceed any thresholds for further environmental review including the need for a Supplement Environmental Impact Report (EIR). In fact, the project will generate less than half of the weekday daily traffic than the previously-approved factory outlet center.
- When compared with the trip thresholds established in the Memorandum of Understanding (MOU) between the Town of Plymouth and the land owner, the proposed project will generate between 44 and 59 percent fewer trips than allowed in the MOU.
- The largest increase in traffic from the development will be experienced on Route 3. On the local roadways, traffic-volume increases beyond the study area are expected in the range of 22 to 56 vehicles during the peak hours. These increases represent approximately one additional vehicle every one to three minutes, on average.
- Traffic operational constraints currently exist at the Long Pond Road intersections with Home Depot Drive and with the Route 3 southbound ramps and site-generated traffic will exacerbate these conditions. Mitigation measures are therefore proposed including widening Home Depot Drive to provide a double left-turn lane onto Long Pond Road, split-phasing the Home Depot Drive and County Way approaches, and widening the Route 3 southbound off ramp to provide a double right-turn lane under signal control. Additional safety-related improvements are also proposed as recommended in the Road Safety Audit (RSA) prepared on behalf of the project. These improvements will add significant capacity to offset the project's impacts and also improve safety at these locations. The project proponent has committed to implement these measures.