

July 14, 2021

NEX-2020283.00

Mr. Michael Durant
Nouria Energy Corp
326 Clark Street
Worcester, Massachusetts 01606

SUBJECT: Response to VHB Comments – 6/2/2021
Proposed Retail Motor Fuel Outlet
158 Epping Road – Exeter, New Hampshire

Dear Mr. Durant:

Greenman-Pedersen, Inc. (GPI) has prepared this Response to Comments (RTC) letter to respond to the traffic comments provided in a letter from Vanasse Hangen Brustlin, Inc. (VHB) dated June 2, 2021 regarding the *Traffic Impact and Access Study* prepared for the proposed retail motor fuel outlet to be located at 158 Epping Road (NH Route 27) in Exeter, New Hampshire. We have reviewed the comments and this letter has been prepared to summarize our responses to the comments. A copy of the VHB letter is attached for reference.

Study Area

Comment 1: *Based on the trip-generation and distribution projections detailed within the Traffic Impact and Access Study and as reflected on Figure 6 and 7, the proposed development is estimated to increase traffic volumes between 62 and 66 vehicles per hour along Epping Road north of Continental Drive and between 42 and 52 vehicles per hour to the south of the Epping Road site driveway during the weekday AM and weekday PM peak hours. Therefore, the study area appears to be reasonable unless there are increases in the trip-generation estimates or changes in the trip-distribution patterns that would increase the site trips to exceed the 100 vehicles per hour threshold (see Comments 3 and 8).*

Response 1: Comment acknowledged. As part of this response letter, the trip generation estimates have been updated and are provided in the attachments. Although the number of total trips has increased as a result of changing the independent variable for LUC 960 (Super Convenience Market/Gas Station), the number of new trips has decreased by 22 new trips during the weekday AM peak hour and 37 new trips in the weekday PM peak hour as a result of the significant increase in pass-by for LUC 960 (see response 8 for more detail). Accordingly, the increase in site trips beyond the study area do not exceed the 100 vehicles per hour threshold and the study area remains reasonable.

Traffic Volumes

Existing Conditions

Comment 2: *VHB concurs with the methodology used in developing the 2021 Existing traffic volumes. Based on a review of NHDOT historical traffic volumes, traffic volumes in the area have generally experienced a negative growth rate between 2015 and 2019. Therefore, VHB finds the rationale to be acceptable that the 2020 Base traffic volumes from the Corridor Study may be representative of 2021 Existing traffic volumes. The Applicant should confirm with the Exeter Town Planner that no land development projects have been constructed in the area that would have increased traffic volumes subsequent to the Corridor Study's traffic counts (i.e., March 2020).*

Response 2: The following developments from the Corridor Study dated December 2020 were considered and included in the 2030 future traffic volumes provided in the TIAS:

- **Ray Farm Exeter** – A 55+ active adult residential community with 116 total units located at 183 Epping Road was in construction at the time of the counts. The anticipated traffic for the remaining units were added to the traffic volume networks.
- **Gateway at Exeter** – The Gateway at Exeter development is proposed on the west side of Epping Road (NH Route 27), south of the NH Route 101 interchange. This mixed-use development includes 11,225 SF of retail space, 17,295 SF of office space, a 20,040 SF daycare facility, and 224 residential dwelling units. The anticipated traffic associated with this project was added to the traffic volume networks.
- **Unitil Corporation** – This 60,000 SF Unitil facility was under construction at 27 Gourmet Place at the time of the counts, and therefore the anticipated traffic associated this project was added to the traffic volume networks.
- **Primrose Daycare School** – A 13,000 SF Daycare School was being considered to replace the previously approved mixed-use development at the end of McKay Drive. Traffic was generated for the daycare using ITE and was added to the traffic volume networks.

GPI has reached out to the Exeter Town Planner and the following projects were identified with an updated status:

- **Ray Farm Exeter** – This project is still ongoing and therefore will not be added to the 2021 Existing traffic volume networks. It is included in the 2030 future traffic-volume networks.
- **5-Lot Subdivision** – This development has been constructed and is located off Spruce Street and Brentwood Road. Due to the scale of the project, this traffic was not added to the 2021 Existing traffic volumes but is expected to have a negligible impact on the study area intersections.
- **Unitil Corporation** – This 60,000 SF Unitil facility has been constructed. It was already included in the 2030 future traffic volumes, but now has been added to the 2021 Existing traffic volumes as well. The project's site-generated traffic volumes are attached to this letter. The Updated 2021 Existing Peak Hour Traffic Volume networks and analysis are also attached.

Comment 3: *Based on the trip-generation methodology for the existing Jaguar automobile dealership, however, the ITE trips for the weekday PM peak hour were developed using the regression equation. In accordance with ITE guidelines, the average rate should be used in calculating the site trips for this dealership during the weekday PM peak hour. In the absence of traffic counts for the existing driveways, the Applicant should therefore update the trip-generation estimates for the existing automobile dealership. This methodology would reduce the existing site trips by approximately 14 trips during the weekday PM peak hour. Combined with potential modifications to the trip-generation methodology for the proposed development (see Comment 8), the Applicant should confirm that the difference in the existing and proposed site trips would not require an expansion to the study area (see Comment 1).*

Response 3: Based on *Figure 4.2 Process for Selecting Average Rate or Equation in Trip Generation Manual Data* from the ITE Trip General Handbook,¹ if there are 20 or more data points, the fitted curve equation should be used. For LUC 840 (Automobile Sales [New]), the data for the weekday PM peak hour of adjacent street traffic is based on 49 data points. Accordingly, we do not agree with the use of the average rate, and therefore no changes were made to the trip-generation estimates for the existing Jaguar automobile dealership.

¹ *Trip Generation Handbook*; 3rd Edition; Institute of Transportation Engineers; Washington, DC; September 2017.

Comment 4: *Based on ITE guidelines, "The time period(s) that provide the highest cumulative directional traffic demands should be used to assess the impact of site traffic on adjacent street system and define roadway configurations and traffic control measure changes needed in the study area...In general, the critical traffic time period for a given project is directly associated with the peaking characteristics of both the project-related travel and area transportation system." Upon review of the trip-generation calculations provided in the Appendix of the Traffic Impact and Access Study, the proposed development is shown to generate more site trips during the Saturday midday peak hour than during the weekday PM peak hour. Therefore, the Applicant should provide support that the Saturday midday peak hour should not be evaluated (i.e., is not a critical time period) for the proposed development and along the Epping Road corridor.*

Response 4: NHDOT traffic volume data on Epping Road was reviewed and a summary is provided in an attachment to this letter. Saturday daily volumes on Epping Road appear to be consistently $\pm 3,000$ vehicles per day (vpd) less than the weekday. Based on the trip generation estimates provided in the TIAS, the Saturday daily total trips were about 700 vpd more than the weekday daily total trips. Accordingly, the traffic volumes on Epping Road are higher on a weekday than a Saturday with and without the proposed development in place.

Additionally, when you base the trip generation on the size of the convenience store as opposed to vehicle fueling positions, as suggested in Comment #8, the proposed site is expected to generate more traffic on a weekday than a Saturday further supporting the evaluation of the weekday conditions versus the Saturday condition.

Lastly, in review of the peak hours in particular, the weekday PM peak hour has more traffic than the Saturday midday peak hour at both NHDOT count locations, north and south of the project site.

Future Conditions

2030 No-Build Traffic Conditions

Comment 5: *VHB concurs with the methodology used in developing the 2030 No-Build traffic volumes. The Applicant should confirm with the Exeter Town Planner that no land development projects are planned to be constructed and occupied by 2030 that would increase traffic volumes in the area.*

Response 5: The following developments from the Corridor Study dated December 2020 were considered and included in the 2030 future traffic volumes provided in the TIAS:

- **Ray Farm Exeter** – A 55+ active adult residential community with 116 total units located at 183 Epping Road was in construction at the time of the counts. The anticipated traffic for the remaining units were added to the traffic volume networks.
- **Gateway at Exeter** – The Gateway at Exeter development is proposed on the west side of Epping Road (NH Route 27), south of the NH Route 101 interchange. This mixed-use development includes 11,225 SF of retail space, 17,295 SF of office space, a 20,040 SF daycare facility, and 224 residential dwelling units. The anticipated traffic associated with this project was added to the traffic volume networks.
- **Unitil Corporation** – This 60,000 SF Unitil facility was under construction at 27 Gourmet Place at the time of the counts, and therefore the anticipated traffic associated this project was added to the traffic volume networks.
- **Primrose Daycare School** – A 13,000 SF Daycare School was being considered to replace the previously approved mixed-use development at the end of McKay Drive. Traffic was generated for the daycare using ITE and was added to the traffic volume networks.

GPI has reached out to the Exeter Town Planner and the following additional projects were identified:

- **Light Industrial / Distribution Facility** – This ±116,000 SF building is proposed to be located at 24 Continental Drive. The anticipated traffic associated with this development was obtained from the Traffic Impact Assessment² prepared for the project and added to the 2030 future traffic-volume networks. The project's site-generated traffic volumes are attached to this letter.
- **Public Safety Complex** – This project is in the conceptual stages and is proposed to be located on Continental Drive at the intersection with Jillian Lane. The facilities to be included in the Complex are still undetermined as well. Accordingly, no traffic associated with this development have been included in the traffic-volume projections.

Comment 6: *The Applicant should provide anticipated timeframes for these identified planned roadway improvements to confirm that construction of such measures would occur within the 2030 design horizon.*

Response 6: Based on discussions with the Town, there are no anticipated timeframes for the Epping Road roadway improvements, for either Mid-Term or Full Build-Out. Accordingly, the 2030 design horizon has been evaluated both with and without the two-way left-turn lane (TWLTL) on Epping Road for comparison purposes.

Comment 7: *As documented within the Epping Road (NH Route 27) Corridor Study, different levels of improvements were identified along the Epping Road corridor for planning purposes. The roadway and traffic-volume conditions in which these recommendations were based may change as future development occurs along the corridor and as transportation improvements are implemented. Therefore, the Corridor Study states that the Epping Road corridor should be reevaluated in the future as vacant parcels are developed and as current land uses are redeveloped because the improvements are subject to revision as the Epping Road corridor evolves. The redevelopment of the Jaguar automobile dealership parcel was not included within the Corridor Study and there are no commitments to implement the Mid-Term improvements evaluated within the Corridor Study. Therefore, the Applicant should evaluate the traffic impacts of the proposed retail motor fuel outlet without the improvements identified within the Corridor Study (i.e., without the potential TWLTL along Epping Road adjacent to the site).*

Response 7: The 2030 No-Build and 2030 Build capacity analysis without the Mid-Term improvements identified within the Corridor Study are attached to this letter and summarized in Table A-1 which include the updated trip generation estimates prepared as part of this response letter.

2030 Build Traffic Conditions

Comment 8 *VHB generally concurs with the methodology used in developing the site trips. The Applicant should, however, revisit the calculations based on the following:*

- *The Traffic Impact and Access Study used Land Use Code 960 (Super Convenience Market/Gas Station) to estimate the proposed site trips for the convenience market and fueling dispensers. The independent variable selected was the number of fueling positions (i.e., 12 vfps) and not the size of the convenience market (i.e., 5,500 square feet). Based on a review of the ITE data for this land use, the size of the convenience market should be considered instead of the number of fueling positions because this variable shows a stronger*

² Stephen G. Pernaw, Inc.; Traffic Impact Assessment, Proposed Light Industry / Distribution Facility, Exeter, New Hampshire, August 4, 2017.

relationship in trip making. The changes in the site trips would then require a modification to the internal trip calculations.

- *The Traffic Impact and Access Study used ITE pass-by data for Land Use Code 945 (Gasoline/Service Station with Convenience Market). ITE issued an erratum subsequent to the publication of the ITE Trip Generation Handbook 3rd edition that provided pass-by data specific to Land Use Code 960 (Super Convenience Market/Gas Station). Since the proposed site trips were estimated using Land Use Code 960 (Super Convenience Market/Gas Station) for the convenience market and fueling dispensers, the Applicant should update the trip-generation characteristic estimates accordingly (i.e., new and pass-by trips).*

Due to the changes in the trip-generation estimates and trip characteristics for the proposed development, the Applicant should revise the proposed 2030 Build traffic volumes and intersection analyses.

Response 8: Although it is common to use the number of fueling positions as the independent variable for LUC 960, the trip generation has been updated using the size of the convenience market. This resulted in 120 more total trips during the weekday AM peak hour and 105 more total trips in the weekday PM peak hour.

The ITE erratum was reviewed for updated pass-by data, specific to LUC 960. The new trips were recalculated based on a pass-by rate of 76 percent during the peak hours as opposed to 62 percent during the weekday AM peak hour and 56 during the weekday PM peak hour.

As a result of the updated number of total trips and the new pass-by rate, the number of new trips reduced from the estimates provided in the original TIAS by 22 new trips during the weekday AM peak hour and 37 new trips in the weekday PM peak hour. The updated Trip Generation details and the following figures are attached to this letter:

- Updated Figure 4 – 2030 No-Build Weekday AM Peak Hour Traffic Volumes
- Updated Figure 5 – 2030 No-Build Weekday PM Peak Hour Traffic Volumes
- Updated Figure 6 – Site Generated Weekday AM Peak Hour Traffic Volumes
- Updated Figure 7 – Site Generated Weekday PM Peak Hour Traffic Volumes
- Updated Figure 8 – 2030 Build Weekday AM Peak Hour Traffic Volumes
- Updated Figure 9 – 2030 Build Weekday PM Peak Hour Traffic Volumes

Comment 9 *Since the Traffic Impact and Access Study has stated that vehicle speeds are important in determining sufficient sight lines to and from a driveway but the speed measurements obtained in the field along Continental Drive are being disregarded for use in determining the required sight lines, then the Applicant should either collect vehicle speeds at the approximate location of this proposed site driveway or base the required sight lines on the posted speed limit. In addition, the Applicant should provide the sight distance calculations for review as well as sight line profile plans.*

Response 9: Vehicle speeds were collected on July 6, 2021 at the location of the proposed site driveway on Continental Drive. The required sight lines have been re-evaluated and the speed data, sight distance calculations, Updated Table 4 – Sight Distance Summary, and Sight Distance Plans are attached to this letter. Based on the updated speed data, available sight distances at the proposed site driveway on Continental Drive exceed the minimum SSD and ISD requirements for safe operation.

Comment 10 *Based on a preliminary review of the proposed site driveways reflected on the site plans, the access easement between the site and Al's Automotive & Truck Service Center does not appear to be large enough (i.e., east-west) to accommodate motorists exiting the proposed retail motor fuel outlet's western internal driveway onto the shared driveway (destined for Epping Road) without crossing into the abutting private property. Therefore, the Applicant should consider extending the existing access easement further to the west.*

Response 10: As shown on the updated Site Plan, the area between the two parcels where the access easement exists has been modified. In making this revision, it directs on-site traffic to the access easement and there is no longer a need to extend the easement further into the site.

Comment 11 *As shown on the Truck Turn Plan submitted with the site plans, fuel tankers would enter the site from Epping Road southbound by turning right into the site driveway. The truck path is shown to cross into both of the exiting lanes on the shared driveway approach at Epping Road (i.e., the exclusive left-turn lane and the exclusive right-turn lane). After entering the site, traveling northbound, and stopping at the underground fuel tanks, the truck path is shown to cross into the internal curbing and grassed area between the underground tanks and the Continental Drive driveway. In addition, the truck path is shown to exit the western internal site driveway, cross into Al's Automotive & Truck Service Center parking spaces (approximately 5 spaces), and use the exclusive right-turn lane on the site driveway to turn left and exit onto Epping Road northbound. The Applicant should provide traffic engineering support to justify these conflicts or modify the site layout to accommodate fuel tankers.*

Response 11: The Epping Road driveway has been modified and shifted slightly to the north to accommodate the truck turn movements. In addition, as mentioned in Response #10, internal modifications have been made near the access easement between the two parcels. The truck turn plan has been updated to eliminate the concerns noted in Comment #11.

Comment 12: *As shown on the site plans, there are several conflicting maneuvers at and within 140 feet of the Epping Road site driveway. The Applicant should provide traffic engineering support for the close proximity of these three intersections, the conflicts that would occur within a short decision distance, and any proposed internal signage and pavement markings that would help signify which motorist as the right of way and improve safety.*

Response 12: As noted in Response #10 and #11, internal modifications have been made to this area. The updated Site Plan reflects the revised layout.

Comment 13 *The drive-through area for the convenience market was not described within the Traffic Impact and Access Study. The Applicant should provide information related to the proposed drive-through window with respect to the use (convenience items, doughnut shop, coffee, etc.) and detail the expected operations to ensure there is an adequate stacking area to accommodate vehicle queues. In addition, the Applicant should provide information related to the proposed automated car wash to ensure that there is adequate storage space available to accommodate vehicle queues.*

Response 13: The drive-through area for the convenience market is proposed to be a coffee shop. The drive-through provides one lane for customers with an 11-foot bypass lane. The drive-through is proposed to be 11 feet wide and striped to provide approximately 200 feet of storage. Based on an average length vehicle of 20 feet, the drive-through lane provides storage for about 10 vehicles

without impacting on-site circulation. In addition to the striped drive-through window lane, the site provides approximately 80 additional feet (4 vehicles) of storage on-site without disrupting flow on Continental Drive.

Empirical vehicle queue observations were reviewed at the following Dunkin' Donuts facilities located within a gas station during the weekday AM peak period:

- 124 Rockingham Road (NH Route 28), Londonderry, NH on Tuesday, April 17, 2014
Located within the convenience store of an Irving Oil gas station.
Average Queue = 5 vehicles Maximum Queue = 10 vehicles
- 295 Federal Street, Greenfield, MA on Thursday, June 9, 2016
Located within the convenience store of a Sunoco gas station.
Average Queue = 4 vehicles Maximum Queue = 10 vehicles
- 420 Newbury Street, Danvers, MA on Thursday, October 31, 2013
Located within the convenience store of Mobil gas station.
Average Queue = 6 vehicles Maximum Queue = 9 vehicles

The average queues were between 4 and 6 vehicles and the maximum queues were between 9 and 10 vehicles. Based on the vehicle queue observation data, it is anticipated that the vehicle queue for the proposed drive-through window can be accommodated on site. The drive-through window observation data is attached to this letter.

The automated car wash provides storage for approximately 17 vehicles. Based on data from the *ITE Summer E-Newsletter from the Traffic Engineering Council* in Summer 2012, which references data collected by CountingCars.com and includes 12 data points, the average maximum queue for car washes is 5 vehicles and the 85th percentile maximum queue is 7 vehicles. Accordingly, the proposed car wash is expected to provide adequate storage to accommodate the vehicle queues. The relevant pages from the report are attached to this letter for reference.

Intersection Analyses

Comment 14 *Based on previous comments within this traffic peer review letter, the Applicant should reevaluate the 2030 No-Build traffic volumes, the 2030 Build traffic volumes, and the project's impacts at the study area intersections.*

Response 14: The following analysis has been updated and attached to this letter:

- 2021 Existing – Updated based on the inclusion of Unitil Corporation
- 2030 No-Build – Updated based on the inclusion of the Light Industrial / Distribution Facility at 24 Continental Drive, with and without the Mid-Term Improvements.
- 2030 Build – Updated based on the updated Trip Generation estimates provided in this letter, with and without the Mid-Term Improvements.

It should be noted that the 2030 No-Build and 2030 Build analysis with the Mid-Term improvements (Updated Table 6 attached to this letter) was also updated specifically at the intersection of Epping Road at Brentwood Road. The two-way left-turn lane on Epping Road which was added as part of the Mid-Term improvements was inadvertently carried through to the intersection of Epping Road and Brentwood Road rather than ending just north of the intersection. Accordingly, the results were accounting for a two-stage left turn from Brentwood Road onto Epping Road, which is incorrect. Updated Table 6 accounts for this correction.

As shown in Updated Table 6, at the intersection of Epping Road at Brentwood Road, the Brentwood Road eastbound left-turn operates with long delays (LOS F) with and without the redevelopment project. The project is expected to add five to six additional vehicles to the eastbound left-turn movement during the weekday peak hours, increasing the queue by one to two vehicles. As a result of the Unifil Corporation in the Existing analysis, the Industrial/Distribution Facility in the future analyses, and the updated trip generation in the Build analysis, the changes in the operations were minimal which can be seen at the remainder of the study area intersections:

- Epping Road at Continental Drive
- Epping Road at Columbus Avenue
- Brentwood Road at Columbus Avenue
- Epping Road at Site Driveway
- Continental Drive at Site Driveway

As shown in Table A-1, with the removal of the Mid-Term improvements (two-way left-turn lane on Epping Road), the site driveway on Epping Road is expected to operate with long delays (LOS F), however, the volume-to capacity (v/c) ratios are all expected to be below 1.00 and the on-site queuing is expected to be three vehicle or less which can be accommodated on-site.

Comment 15 *Upon review of Table 6 of the Traffic Impact and Access Study, the Epping Road driveway would be blocked by vehicles extending southerly from the Continental Drive signalized intersection during the weekday PM peak hour (distance = 195 feet, average queue = 262 feet, 95th percentile queue = 410 feet). In addition, the proposed Continental Drive driveway would be blocked by vehicles extending westerly from the Epping Road signalized intersection during the weekday PM peak hour (distance = 115 feet, average queue = 116 feet, 95th percentile queue = 255 feet). These projected vehicle queues will likely change due to the modification of the 2030 Build traffic volumes and with the current geometry along Epping Road (i.e., no TWLTL).*

The reported Epping Road vehicle queues suggest that motorists would have long delays turning left from the site onto Epping Road northbound. In addition, the Epping Road northbound left-turns entering the site may block access for Epping Road northbound vehicles destined for Continental Drive. Further, the Continental Drive vehicle queues suggest that vehicles would have difficulty entering the site from Continental Drive that may result in stacking along Continental Drive easterly to the Epping Road intersection. As the site is located on a corner lot and has access to a signalized intersection, consideration may be given to restricting left turns to and from the site via the Epping Road site driveway (right-turn in/right-turn out only) and restricting left turns into the site from Continental Drive westbound (right-turns in, left-turns out, and right-turns out).

Response 15: The 2030 traffic volume networks and capacity and queue analyses have been updated based on comments provided in the VHB peer review letter. For the Epping Road driveway, there is a 300-foot long northbound left-turn lane that extends from the traffic signal at Continental past the existing/proposed site driveway. The Epping Road northbound through average queue is not expected to block access to the left-turn lane. Although the Epping Road northbound through lane 95th percentile queue will block access to the left-turn lane, based on the 90 second cycle length of the traffic signal, that is only expected to occur approximately two times during the peak hour. Delays for the left-turns exiting the Epping Road driveway are expected to be long, however, the v/c ratios are all expected to be below 1.00 and the on-site queuing is expected to be three vehicle or less which can be accommodated on-site.

As noted on the Site Plan, there is an access easement between the two adjacent properties. The property to the south (156 Epping Road) has no turn restrictions on any of their wide-open curb cuts. If full access and egress is not allowed at the Epping Road proposed driveway, it is expected

that motorists may use the cross connection to enter and exit from the adjacent property. The proposed island to the south of the Epping Road driveway is to narrow up the curb-cut to provide separation from vehicles using the abutting driveways to the south in an effort to provide more control to movements entering and exiting the proposed site. In addition, as shown on the truck turn plan, the fuel delivery truck uses this driveway to enter and exit the site. With the presence of the northbound left-turn lane and a queue that can be accommodated on-site, we would like to request that no turn restrictions are placed on the Epping Road driveway. The proposed driveways will be self-regulating. Motorists will use whatever driveway is easiest for them to get out of depending on the time of day they are visiting the site. If a motorist is not comfortable taking a left turn out of the Epping Road driveway during the peak hours, they always have the opportunity to use the Continental Drive driveway and get access to the traffic signal. During non-peak hours, however; when traffic volumes along Epping Road are lower, motorists may find it easy to make a left turn out of the Epping Road driveway.

For the Continental Drive driveway, with the updated traffic volumes along Continental Drive, the queues from the traffic signal have increased and even the average queues extending from the traffic signal are expected to block the driveway during the weekday PM peak hour when employees are leaving the business along Continental Drive for the day. Accordingly, as shown on the Site Plan, DO NOT BLOCK INTERSECTION pavement markings and signage are proposed in the Continental Drive eastbound approach to allow left-turn movements into the site. Since Continental Drive is a dead-end roadway, the proposed pavement markings and signage are expected to be adhered to because the motorists using Continental Drive use it on a regular basis and are familiar with the area.

Pedestrian Accommodations

Comment 16 *Based on a review of the Traffic Impact and Access Study, pedestrian safety, circulation, and facilities were not addressed. Therefore, the Applicant should engage the traffic engineering consultant in evaluating existing and proposed pedestrian accommodations associated with the proposed development within the site and along Epping Road in the vicinity of the site due to the proximity of existing commercial uses in the area. In addition, the Applicant should coordinate with the Exeter Town Planner with regard to any potential sidewalk projects or improvements along Epping Road adjacent to the site.*

Response 16: ADA compliant pedestrian accommodations are provided around the convenience store, including sidewalks and ADA parking spaces. A contribution to the Town's sidewalk fund will be provided which can be incorporated into future sidewalk and roadway construction improvement plans. We look forward to discussing this with the Planning Board at the upcoming meeting.

Off-Street Parking and Loading

Comment 17 *Upon review of the Traffic Impact and Access Study, off-street parking, loading, and emergency vehicle access were not addressed. Therefore, the Applicant should engage the traffic engineering consultant to evaluate these items.*

Response 17: As shown on the Site Plan, a total of 19 off-street parking spaces are required to meet the Town of Exeter Zoning Regulations. A total of 22 off-street parking spaces are provided, which does not include the 12 spaces at each of the vehicle-fueling positions. A loading zone is provided on-site on the south side of the convenience store building. The delivery vehicles can access this space through the by-pass lane around the convenience store building. Vehicles using the loading zone

are not expected to impact on-site circulation. As shown on the Truck Turn Plans for the site, emergency vehicles are expected to enter the site via the Epping Road driveway since the police and fire departments are south of the site and they are able to exit through the Continental Drive driveway. In addition, there is adequate room on site, the emergency vehicles to circulate around the site.

Should you have any questions or require additional information, please feel free to contact me at (978) 570-2968.

Sincerely,

GREENMAN-PEDERSEN, INC.

A handwritten signature in cursive script that reads "Heather Monticup".

Heather L. Monticup, P.E.
Assistant Vice President / Director of Traffic Engineering – Land Development

enclosure(s)

- ATTACHMENTS

- *VHB Peer Review Letter*
- *Updated Trip Generation*
- *Updated Traffic-Volume Networks (Updated Figures 2 through 9)*
 - *Other Development Traffic-Volume Networks*
- *Updated Capacity & Queue Analysis Tables (Updated Table 6 & Table A-1)*
 - *Updated Capacity & Queue Analysis Worksheets*
 - *NHDOT Traffic Volumes on Epping Road*
 - *Updated Sight Distance Data (Updated Table 4)*
 - *Drive-Through Data*

VHB PEER REVIEW LETTER



June 2, 2021

Ref: 52785.00

Mr. David Sharples
Exeter Town Planner
10 Front Street
Exeter, NH 03833

Re: Traffic Engineer Peer Review
Proposed Retail Motor Fuel Outlet

Dear Mr. Sharples,

Vanasse Hangen Brustlin, Inc. (VHB) has conducted a peer review of the April 2021 Traffic Impact and Access Study prepared by Greenman-Pedersen, Inc. (GPI) for the proposed retail motor fuel outlet to be located at 158 Epping Road (NH Route 27) in Exeter, New Hampshire. The development would be constructed on the southwest quadrant of the Epping Road (NH Route 27) and Continental Drive signalized intersection. As proposed, the build program includes replacing the existing Jaguar automobile dealership with a retail motor fuel outlet that would consist of a 5,500 square foot convenience store, a gasoline station with 6 multi-product dispensers (12 vehicles fueling positions [vfps]), and a 4,182 square foot automated car wash.

Access is currently provided via a full access driveway on Epping Road and a full access driveway on Continental Drive. The Epping Road driveway is located approximately 195 feet south of Continental Drive and provides shared access with AI's Automotive & Truck Service Center. The Continental Drive driveway is located approximately 345 feet west of Epping Road and provides shared access with storage structures to the west of the Jaguar automobile dealership building (a partial fence signifies a separation of the uses). As proposed, the Epping Road driveway would be modified to provide a more defined access point that would continue to provide shared access with AI's Automotive & Truck Service Center. The existing Continental Drive driveway would remain and provide access only to the storage structures west of the proposed retail motor fuel outlet (i.e., no connection to the proposed uses). In addition, a new driveway would be constructed on Continental Drive approximately 115 feet west of Epping Road for access only for the proposed retail motor fuel outlet.

VHB has reviewed the traffic study for consistency with standard traffic engineering practice and methodologies, including Town of Exeter guidelines and requirements, as applicable. This peer review letter has been prepared to outline our findings, comments, and recommendations on the traffic study.

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Engineers | Scientists | Planners | Designers



Study Area

The traffic impacts of the proposed development were evaluated at the following 'study area' intersections:

- Epping Road and Continental Drive
- Epping Road, Brentwood Road (NH Route 111 A), and Columbus Avenue
- Epping Road and existing/proposed site driveway
- Continental Drive and proposed site driveway

Institute of Transportation Engineers (ITE) methodologies¹ and New Hampshire Department of Transportation (NHDOT) guidelines² suggest that an intersection should be evaluated when site trips are projected to experience a noticeable increase in peak hour traffic volumes (i.e., ≥ 100 vehicles). The rationale is that an increase of 100 vehicles per hour could impact the vehicular operations on an intersection approach. A safety or capacity deficiency may require the study of a project's impacts at an intersection even if that intersection is projected to experience less than 100 peak hour site trips.

Comment 1. Based on the trip-generation and distribution projections detailed within the Traffic Impact and Access Study and as reflected on Figure 6 and 7, the proposed development is estimated to increase traffic volumes between 62 and 66 vehicles per hour along Epping Road north of Continental Drive and between 42 and 52 vehicles per hour to the south of the Epping Road site driveway during the weekday AM and weekday PM peak hours. Therefore, the study area appears to be reasonable unless there are increases in the trip-generation estimates or changes in the trip-distribution patterns that would increase the site trips to exceed the 100 vehicles per hour threshold (see Comments 3 and 8).

Traffic Volumes

Existing Conditions

In coordination with Town of Exeter officials, VHB prepared a planning study for the Epping Road corridor between Beech Hill Road to the north and Brentwood Road to the south.³ As part of the overall study, VHB conducted traffic engineering and transportation efforts with the primary focus on identifying operational and safety deficiencies along the Epping Road corridor. In addition, VHB developed

¹ Institute of Transportation Engineers. Transportation Impact Analyses for Site Development: An ITE Proposed Recommended Practice. Washington, DC. 2010.

² Bollinger, Robert E. Inter-Department Communication. New Hampshire Department of Transportation, Bureau of Traffic. 17 Feb. 2010.

³ Vanasse Hangen Brustlin, Inc. Epping Road (NH Route 27) Corridor Study. Dec. 2020.



preliminary engineering and design recommendations to be considered in addressing congestion and safety concerns related to existing and potential future deficiencies along the corridor.

As part of the Corridor Study, VHB developed 2020 Base weekday AM and weekday PM peak hour traffic volumes. Due to the current coronavirus disease 2019 (COVID-19) pandemic, traffic volumes are not representative of typical travel conditions on New Hampshire roadways. Therefore, GPI obtained the 2020 Base traffic volumes from the Epping Road (NH Route 27) Corridor Study and assumed that traffic volumes did not grow between 2020 and 2021 within the study area (i.e., the 2020 Base traffic volumes are reflective of 2021 Existing traffic volumes).

Comment 2. VHB concurs with the methodology used in developing the 2021 Existing traffic volumes. Based on a review of NHDOT historical traffic volumes, traffic volumes in the area have generally experienced a negative growth rate between 2015 and 2019. Therefore, VHB finds the rationale to be acceptable that the 2020 Base traffic volumes from the Corridor Study may be representative of 2021 Existing traffic volumes. The Applicant should confirm with the Exeter Town Planner that no land development projects have been constructed in the area that would have increased traffic volumes subsequent to the Corridor Study's traffic counts (i.e., March 2020).

Comment 3. Although turning movement counts were not collected at the Jaguar automobile dealership driveways as part of the Corridor Study, the dealership was in operation at the time of the traffic counts. It appears that GPI estimated the existing site trips based on ITE trip-generation methodologies,⁴ distributed the site trips along the adjacent roadway network, and included these site trips on the 2021 Existing traffic-volume networks within the Traffic Impact and Access Study (Figures 2 and 3). Since the Jaguar automobile dealership was operational at the time of the traffic counts for the Corridor Study, VHB finds this approach to be reasonable.

Based on the trip-generation methodology for the existing Jaguar automobile dealership, however, the ITE trips for the weekday PM peak hour were developed using the regression equation. In accordance with ITE guidelines, the average rate should be used in calculating the site trips for this dealership during the weekday PM peak hour.⁵ In the absence of traffic counts for the existing driveways, the Applicant should therefore update the trip-generation estimates for the existing automobile dealership. This methodology would reduce the existing site trips by approximately 14 trips during the weekday PM peak hour. Combined with potential modifications to the trip-generation methodology for the proposed development (see Comment 8), the Applicant should

⁴ Institute of Transportation Engineers. Trip Generation Manual, 10th ed. Washington, D.C. 2017.

⁵ Since the coefficient of determination (R^2) is <0.75 (suggesting that the fitted curve equation does not fit with the data) and the line corresponding to the fitted curve equation is not within the cluster of data points at the size of the development (12,187 square feet), a different methodology should be considered (e.g., the average rate).



confirm that the difference in the existing and proposed site trips would not require an expansion to the study area (see Comment 1).

Comment 4. Based on ITE guidelines, “The time period(s) that provide the highest cumulative directional traffic demands should be used to assess the impact of site traffic on adjacent street system and define roadway configurations and traffic control measure changes needed in the study area . . . In general, the critical traffic time period for a given project is directly associated with the peaking characteristics of both the project-related travel and area transportation system.”⁶ Upon review of the trip-generation calculations provided in the Appendix of the Traffic Impact and Access Study, the proposed development is shown to generate more site trips during the Saturday midday peak hour than during the weekday PM peak hour. Therefore, the Applicant should provide support that the Saturday midday peak hour should not be evaluated (i.e., is not a critical time period) for the proposed development and along the Epping Road corridor.

Future Conditions

2030 No-Build Traffic Conditions

Similar to establishing existing traffic volumes within the study area, GPI obtained the 2030 Mid-Term Build traffic volumes developed as part of the Epping Road (NH Route 27) Corridor Study. The 2030 Mid-Term Build traffic volumes were developed by applying a 0.5% compounded annual traffic growth rate (or 5.1% over 10 years) to the 2020 Base volumes and adding vehicle trips associated with the full build-out of Ray Farm Exeter, Gateway at Exeter, Unitol Corporation, and Primrose Daycare School developments. This Mid-Term condition omits the development of the vacant parcels along the corridor and cross easements between abutting properties. As part of the Traffic Impact and Access Study, GPI used the 2030 Mid-Term Build traffic volumes from the Corridor Study to reflect 2030 No-Build traffic volumes for the proposed retail motor fuel outlet development.

Comment 5. VHB concurs with the methodology used in developing the 2030 No-Build traffic volumes. The Applicant should confirm with the Exeter Town Planner that no land development projects are planned to be constructed and occupied by 2030 that would increase traffic volumes in the area.

As detailed within the Traffic Impact and Access Study, the following roadway improvement projects by others were assumed to be in place by the 2030 design year.

- **NHDOT Project #41372:** construct sidewalks along Epping Road, Brentwood Road, Winter Street, and Spring Street.
- **Transportation Alternatives Transportation Alternatives Program (TAP) Grant for the Epping Road, Brentwood Road, and Columbus Avenue Intersection:** the Town of Exeter is addressing pedestrian safety by eliminating the northwest intersection, restricting Columbus Avenue to allow

⁶ Ibid. 1.



right-turns in/right-turns out only, striping a crosswalk across the Epping Road and Brentwood Road intersection (northeast), and constructing a median island along Brentwood Road to restrict left turns at Columbus Avenue and serve as a pedestrian refuge area for the crosswalk. These improvements are intended to improve safety but not increase vehicular capacity.

- **Mid-Term Improvements as Part of the Corridor Study:** a Two-Way Left-Turn Lane (TWLTL) (aka, center turn lane) would be constructed along the Epping Road corridor segments from north of Cronin Road to Continental Drive and from south of Continental Drive to south of Brookside Drive.

Comment 6. The Applicant should provide anticipated timeframes for these identified planned roadway improvements to confirm that construction of such measures would occur within the 2030 design horizon.

Comment 7. As documented within the Epping Road (NH Route 27) Corridor Study, different levels of improvements were identified along the Epping Road corridor for planning purposes. The roadway and traffic-volume conditions in which these recommendations were based may change as future development occurs along the corridor and as transportation improvements are implemented. Therefore, the Corridor Study states that the Epping Road corridor should be reevaluated in the future as vacant parcels are developed and as current land uses are redeveloped because the improvements are subject to revision as the Epping Road corridor evolves. The redevelopment of the Jaguar automobile dealership parcel was not included within the Corridor Study and there are no commitments to implement the Mid-Term improvements evaluated within the Corridor Study. Therefore, the Applicant should evaluate the traffic impacts of the proposed retail motor fuel outlet without the improvements identified within the Corridor Study (i.e., without the potential TWLTL along Epping Road adjacent to the site).

2030 Build Traffic Conditions

Site trips for the proposed retail motor fuel outlet development were estimated using data provided in the ITE Trip Generation Manual.⁷ The site trips were then distributed along the adjacent roadway network with 55% of site traffic originating from/destined to the north on Epping Road, 30% from/to the south on Epping Road (south of Brentwood Road), and 15% from/to the west on Brentwood Road. These trip percentages were noted to have been based on existing travel patterns.

The vehicle trips calculated for each of the proposed uses represent single-use trips at the site on the study area system. Based on ITE methodologies, some patrons of mixed-use or multi-use developments could visit more than one of the uses on the site (internal trips).⁸ In addition, not all of the vehicle trips expected to be generated by the proposed development represent new trips on the study area roadway system. A portion of the vehicles visiting the proposed retail uses may already be present in the adjacent

⁷ Ibid. 4.

⁸ Institute of Transportation Engineers. Trip Generation Handbook, 3rd ed. Washington, DC. Sept. 2017.



passing traffic stream (pass-by trips) or are diverted from another route to the subject site (i.e., diverted trips).

Comment 8. VHB generally concurs with the methodology used in developing the site trips. The Applicant should, however, revisit the calculations based on the following:

- The Traffic Impact and Access Study used Land Use Code 960 (Super Convenience Market/Gas Station) to estimate the proposed site trips for the convenience market and fueling dispensers. The independent variable selected was the number of fueling positions (i.e., 12 vfps) and not the size of the convenience market (i.e., 5,500 square feet). Based on a review of the ITE data for this land use, the size of the convenience market should be considered instead of the number of fueling positions because this variable shows a stronger relationship in trip making.⁹ The changes in the site trips would then require a modification to the internal trip calculations.
- The Traffic Impact and Access Study used ITE pass-by data for Land Use Code 945 (Gasoline/Service Station with Convenience Market). ITE issued an erratum subsequent to the publication of the ITE Trip Generation Handbook 3rd edition that provided pass-by data specific to Land Use Code 960 (Super Convenience Market/Gas Station).¹⁰ Since the proposed site trips were estimated using Land Use Code 960 (Super Convenience Market/Gas Station) for the convenience market and fueling dispensers, the Applicant should update the trip-generation characteristic estimates accordingly (i.e., new and pass-by trips).

Due to the changes in the trip-generation estimates and trip characteristics for the proposed development, the Applicant should revise the proposed 2030 Build traffic volumes and intersection analyses.

Access is proposed to be provided via the existing shared driveway on Epping Road and a new driveway on Continental Drive. To determine if available sight lines are sufficient for vehicles to enter and exit the site driveways, vehicle speed observations and sight distance measurements were collected.

Comment 9. As presented in Table 3 of the Traffic Impact and Access Study, vehicles were measured to be traveling at 85th percentile speeds between 40 and 42 miles per hour (mph) along Epping Road south of Continental Drive and between 34 and 36 mph along Continental Drive west of Epping Road. The 85th percentile speed indicates the speed that most drivers consider safe and reasonable under ideal conditions. Since this speed more

⁹ The size of the proposed convenience market is closer to the ITE average size than the number of fueling positions (5,000 square feet vs. 14 vfps) and the proposed convenience market falls within the cluster of the ITE data points for the size of the convenience market.

¹⁰ Institute of Transportation Engineers. Trip Generation Handbook, 3rd ed, Errata. Washington, DC. 06 Feb. 2018.



accurately represents the overall travel speed on a roadway, 85th percentile speeds are typically used to verify speeding concerns. These observations indicate that most motorists travel faster than the posted speed limits along Epping Road and Continental Drive (i.e., 30 mph).

As documented within the Traffic Impact and Access Study, “[the] primary use of [the vehicle speed] information is explained in the Sight Distance section where the speeds are correlated to sight distance measurements and taken at the location of the site driveways to assure adequate sight distances exist at the driveways to provide safe operation.” As noted in the Sight Distance section of the traffic study, however, “[due] to the proximity of the [Epping Road] intersection, it is not likely that vehicles traveling in the westbound direction will be traveling greater than 22 mph on Continental Drive between Epping Road and the site driveway as they are entering onto Continental Drive from a turning movement . . . The speed measurements collected along Continental Drive were captured further west closer to Jillian Lane.”

Since the Traffic Impact and Access Study has stated that vehicle speeds are important in determining sufficient sight lines to and from a driveway but the speed measurements obtained in the field along Continental Drive are being disregarded for use in determining the required sight lines, then the Applicant should either collect vehicle speeds at the approximate location of this proposed site driveway or base the required sight lines on the posted speed limit. In addition, the Applicant should provide the sight distance calculations for review as well as sight line profile plans.¹¹

The Epping Road shared driveway is located approximately 195 feet south of Continental Drive and is approximately 235 feet in width. As shown on the April 20, 2021 Proposed Site Re-Development Plans Access prepared by GPI, this shared driveway would be reduced to 44 feet in width with the northern edge of the driveway to generally remain in the same location and a new island to be constructed at the southern end of the driveway.

Comment 10. Based on a preliminary review of the proposed site driveways reflected on the site plans, the access easement between the site and AI’s Automotive & Truck Service Center does not appear to be large enough (i.e., east-west) to accommodate motorists exiting the proposed retail motor fuel outlet’s western internal driveway onto the shared driveway (destined for Epping Road) without crossing into the abutting private property. Therefore, the Applicant should consider extending the existing access easement further to the west.

Comment 11. As shown on the Truck Turn Plan submitted with the site plans, fuel tankers would enter the site from Epping Road southbound by turning right into the site driveway. The truck path is shown to cross into both of the exiting lanes on the shared driveway approach at Epping Road (i.e., the exclusive left-turn lane and the exclusive right-turn lane). After

¹¹ As per the Town of Exeter’s Site Plan Review and Subdivision Regulations (Section 8.7.3).



entering the site, traveling northbound, and stopping at the underground fuel tanks, the truck path is shown to cross into the internal curbing and grassed area between the underground tanks and the Continental Drive driveway. In addition, the truck path is shown to exit the western internal site driveway, cross into Al's Automotive & Truck Service Center parking spaces (approximately 5 spaces), and use the exclusive right-turn lane on the site driveway to turn left and exit onto Epping Road northbound. The Applicant should provide traffic engineering support to justify these conflicts or modify the site layout to accommodate fuel tankers.

Comment 12. As shown on the site plans, there are several conflicting maneuvers at and within 140 feet of the Epping Road site driveway.¹² The Applicant should provide traffic engineering support for the close proximity of these three intersections, the conflicts that would occur within a short decision distance, and any proposed internal signage and pavement markings that would help signify which motorist as the right of way and improve safety.

As shown on the April 20, 2021 Proposed Site Re-Development Plans Access prepared by GPI, the proposed development would include a drive-through window for the convenience market. The layout would provide for up to 10 vehicles to queue within the drive-through storage area. In addition, the proposed automated car wash would provide for up to 17 vehicles to queue within the storage area.

Comment 13. The drive-through area for the convenience market was not described within the Traffic Impact and Access Study. The Applicant should provide information related to the proposed drive-through window with respect to the use (convenience items, doughnut shop, coffee, etc.) and detail the expected operations to ensure there is an adequate stacking area to accommodate vehicle queues.¹³ In addition, the Applicant should provide information related to the proposed automated car wash to ensure that there is adequate storage space available to accommodate vehicle queues.

Intersection Analyses

As presented in Table 6 of the Traffic Impact and Access Study, the traffic operations at the study area intersections were evaluated under 2021 Existing, 2030 No-Build, and 2030 Build traffic-volume conditions for the weekday AM and weekday PM peak hours.

¹² At the western internal driveway, at the eastern internal driveway, and at Epping Road.

¹³ For example, calculations using Kendall's Notation on the mathematical theory of probability and Andrey Markov's Queue Theory (M/M/1 Queuing System – Poisson arrival process, an exponential service time distribution, and one server).



Comment 14. Based on previous comments within this traffic peer review letter, the Applicant should reevaluate the 2030 No-Build traffic volumes,¹⁴ the 2030 Build traffic volumes,¹⁵ and the project's impacts at the study area intersections.¹⁶

Comment 15. Upon review of Table 6 of the Traffic Impact and Access Study, the Epping Road driveway would be blocked by vehicles extending southerly from the Continental Drive signalized intersection during the weekday PM peak hour (distance = 195 feet, average queue = 262 feet, 95th percentile queue = 410 feet). In addition, the proposed Continental Drive driveway would be blocked by vehicles extending westerly from the Epping Road signalized intersection during the weekday PM peak hour (distance = 115 feet, average queue = 116 feet, 95th percentile queue = 255 feet). These projected vehicle queues will likely change due to the modification of the 2030 Build traffic volumes and with the current geometry along Epping Road (i.e., no TWLTL).

The reported Epping Road vehicle queues suggest that motorists would have long delays turning left from the site onto Epping Road northbound. In addition, the Epping Road northbound left-turns entering the site may block access for Epping Road northbound vehicles destined for Continental Drive. Further, the Continental Drive vehicle queues suggest that vehicles would have difficulty entering the site from Continental Drive that may result in stacking along Continental Drive easterly to the Epping Road intersection. As the site is located on a corner lot and has access to a signalized intersection, consideration may be given to restricting left turns to and from the site via the Epping Road site driveway (right-turn in/right-turn out only) and restricting left turns into the site from Continental Drive westbound (right-turns in, left-turns out, and right-turns out).¹⁷

Pedestrian Accommodations

In compliance with the Town of Exeter's Site Plan Review and Subdivision Regulations (Section 7.14.4.2), traffic studies for land development projects are required to address pedestrian safety, circulation, access, and egress.

Comment 16. Based on a review of the Traffic Impact and Access Study, pedestrian safety, circulation, and facilities were not addressed. Therefore, the Applicant should engage the traffic

¹⁴ No TWLTL and updated trip generation estimates for the existing Jaguar automobile dealership.

¹⁵ No TWLTL and updated trip generation for the proposed convenience market and fueling dispensers.

¹⁶ Traffic-volume increases, confirm that the 100 vehicle per hour threshold on any approach is not exceeded, and revised intersection analyses.

¹⁷ Exiting motorists destined to Epping Road north could turn right from the site onto Continental Drive eastbound and then turn left at the Epping Road signalized intersection. Entering motorists from Continental Drive westbound could instead enter the site via the Epping Road driveway.



engineering consultant in evaluating existing and proposed pedestrian accommodations associated with the proposed development within the site and along Epping Road in the vicinity of the site due to the proximity of existing commercial uses in the area. In addition, the Applicant should coordinate with the Exeter Town Planner with regard to any potential sidewalk projects or improvements along Epping Road adjacent to the site.

Off-Street Parking and Loading

In accordance with the Town of Exeter's Site Plan Review and Subdivision Regulations (Section 7.14.4.3), traffic studies for land development projects are required to address off-street parking, loading, and emergency vehicle access.

Comment 17. Upon review of the Traffic Impact and Access Study, off-street parking, loading, and emergency vehicle access were not addressed. Therefore, the Applicant should engage the traffic engineering consultant to evaluate these items.

Findings

In general, concerns have been identified within this traffic peer review letter on the traffic study prepared for the proposed retail motor fuel outlet. The trip-generation estimates for the proposed project should be recalculated, the future traffic-volume analyses at the study area intersections should be reevaluated, changes to the location and/or turning restrictions at the site driveways should be considered, internal circulation and turning paths should be reassessed, an updated sight distance study should be conducted, and missing information from the Town of Exeter's Site Plan Review and Subdivision Regulations should be provided.

Please do not hesitate to contact us if you have any questions or if we can be of any further assistance.

Sincerely,

Vanasse Hangen Brustlin, Inc.

A handwritten signature in blue ink that reads "Jason R. Plourde". The signature is written in a cursive, flowing style.

Jason R. Plourde, P.E., PTP

Transportation Systems Team Leader
JPlourde@vhb.com

UPDATED TRIP GENERATION

		<u>Existing</u> LUC 840	<u>Total</u>	<u>Proposed</u> LUC 960	<u>New</u>
				<u>Pass-By</u>	
Weekday Daily	In	160	2,303	1750	553
	<u>Out</u>	<u>160</u>	<u>2,303</u>	<u>1750</u>	<u>553</u>
	Total	320	4,606	3500	1,106
Weekday AM	In	17	247	187	60
	<u>Out</u>	<u>6</u>	<u>246</u>	<u>187</u>	<u>59</u>
	Total	23	493	374	119
Weekday PM	In	18	209	158	51
	<u>Out</u>	<u>26</u>	<u>208</u>	<u>158</u>	<u>50</u>
	Total	44	417	316	101
Saturday Daily	In	318	1,925	1463	462
	<u>Out</u>	<u>318</u>	<u>1,925</u>	<u>1463</u>	<u>462</u>
	Total	636	3,850	2926	924
Saturday Midday	In	4	214	162	52
	<u>Out</u>	<u>5</u>	<u>212</u>	<u>162</u>	<u>50</u>
	Total	9	426	324	102

	<u>Pass-By</u>
Wkday Daily	76%
AM	76%
PM	76%
Saturday	76%
SAT	76%

No daily Car Wash trip estimates available.

Institute of Transportation Engineers (ITE)
Land Use Code (LUC) 840 - Automobile Sales (New)
General Urban/Suburban

Average Vehicle Trips Ends v: 1000 Sq. Feet Gross Floor Area
Independent Variable (X): 12.187

AVERAGE WEEKDAY DAILY

$$T = 28.65 (X) - 29.45$$

$$T = 28.65 * 12.187 - 29.45$$

$$T = 319.71$$

$$T = 320 \text{ vehicle trips}$$

with 50% (160 vph) entering and 50% (160 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 1.87 * (X)$$

$$T = 1.87 * 12.187$$

$$T = 22.79$$

$$T = 23 \text{ vehicle trips}$$

with 73% (17 vph) entering and 27% (6 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 1.80 (X) + 21.60$$

$$T = 1.80 * 12.187 + 21.60$$

$$T = 43.54$$

$$T = 44 \text{ vehicle trips}$$

with 40% (18 vph) entering and 60% (26 vph) exiting.

SATURDAY DAILY

$$T = 52.24 * (X)$$

$$T = 52.24 * 12.187$$

$$T = 636.65$$

$$T = 636 \text{ vehicle trips}$$

with 50% (318 vpd) entering and 50% (318 vpd) exiting.

SATURDAY PEAK HOUR OF GENERATOR

$$T = 8.56 (X) - 95.19$$

$$T = 8.56 * 12.187 - 95.19$$

$$T = 9.13$$

$$T = 9 \text{ vehicle trips}$$

with 50% (4 vph) entering and 50% (5 vph) exiting.

Institute of Transportation Engineers (ITE)
Land Use Code (LUC) 960 - Super Convenience Market/Gas Station
General Urban/Suburban

Average Vehicle Trips Ends vs: 1,000 Sq. Feet Gross Floor Area
Independent Variable (X): 5.500

AVERAGE WEEKDAY DAILY

$T = 837.58 * (X)$
 $T = 837.58 * 5.500$
 $T = 4606.69$
 $T = 4,606$ vehicle trips
with 50% (2,303 vpd) entering and 50% (2,303 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 83.14 * (X)$
 $T = 83.14 * 5.500$
 $T = 457.27$
 $T = 457$ vehicle trips
with 50% (229 vph) entering and 50% (228 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 69.28 * (X)$
 $T = 69.28 * 5.500$
 $T = 381.04$
 $T = 381$ vehicle trips
with 50% (191 vph) entering and 50% (190 vph) exiting.

SATURDAY DAILY

$T = 700.00 * (X)$
 $T = 700.00 * 5.500$
 $T = 3850.00$
 $T = 3,850$ vehicle trips
with 50% (1,925 vpd) entering and 50% (1,925 vpd) exiting.

SATURDAY PEAK HOUR OF GENERATOR

$T = 63.80 * (X)$
 $T = 63.80 * 5.500$
 $T = 350.90$
 $T = 351$ vehicle trips
with 50% (176 vph) entering and 50% (175 vph) exiting.

Institute of Transportation Engineers (ITE)

Land Use Code (LUC) 948 - Automated Car Wash

General Urban/Suburban

Average Vehicle Trips Ends vs: 1,000 Sq. Ft. Gross Floor Area

Independent Variable (X): 4.182

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 14.20 * (X)$$

$$T = 14.20 * 4.182$$

$$T = 59.38$$

$$T = 60 \text{ vehicle trips}$$

with 50% (30 vpd) entering and 50% (30 vpd) exiting.

** No weekday morning peak hour data available, weekday evening trips were assumed.*

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 14.20 * (X)$$

$$T = 14.20 * 4.182$$

$$T = 59.38$$

$$T = 60 \text{ vehicle trips}$$

with 50% (30 vpd) entering and 50% (30 vpd) exiting.

SATURDAY PEAK HOUR OF GENERATOR

$$T = 30.40 * (X)$$

$$T = 30.40 * 4.182$$

$$T = 127.13$$

$$T = 127 \text{ vehicle trips}$$

with 50% (64 vph) entering and 50% (63 vph) exiting.

**MULTI-USE DEVELOPMENT
TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY**

Analyst: Susannah E. Theriault
Date: March 16, 2021

Name of Dvlp: Retail Motor Fuel Outlet
Time Period: Weekday Daily

LAND USE A Retail

ITE LUC 960		Size <u>12</u> VFPS	
Enter	2,303	Internal	0
Exit	2,303	External	2,303
Total	4,606	Total	4,606
Percent	100%	Percent	100%

LAND USE B Retail

ITE LUC 948		Size <u>4,182</u> SF	
Enter	0	Internal	0
Exit	0	External	0
Total	0	Total	0
Percent	100%	Percent	100%

Exit to External 2303

Enter from External 2303

Demand 28% | 645

Balanced 0

Demand 30% | 0

Enter from External 0

Exit to External 0

Net External Trips for Multi-Use Development

	Enter	Exit	Total	Single-Use Trip Gen Est.
Land Use A	2303	2303	4606	4606
Land Use B	0	0	0	0
TOTAL	2303	2303	4606	4606
				Internal Capture 0%

Based on ITE Trip Generation Handbook, June 2004.

**MULTI-USE DEVELOPMENT
TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY**

Analyst: Susannah E. Theriault
Date: March 16, 2021

Name of Dvlp: Retail Motor Fuel Outlet
Time Period: Weekday AM

LAND USE A Retail

ITE LUC 960		Size <u>12</u> SF	
Enter	229	Internal	6
Exit	228	External	222
Total	457	Total	445
Percent	100%	Internal Capture	97%

LAND USE B Retail

ITE LUC 948		Size <u>4,182</u> Units	
Enter	30	Internal	6
Exit	30	External	24
Total	60	Total	48
Percent	100%	Internal Capture	20%

Exit to External
222

Enter from External
223

Demand
20% | 46

Balanced
6

Demand
20% | 6

Enter from External
24

Exit to External
24

Net External Trips for Multi-Use Development

	Enter	Exit	Total	Single-Use Trip Gen Est.
Land Use A	223	222	445	457
Land Use B	24	24	48	60
TOTAL	247	246	493	517

Based on ITE Trip Generation Handbook, June 2004.

**MULTI-USE DEVELOPMENT
TRIP GENERATION
AND INTERNAL CAPTURE SUMMARY**

Analyst: Susannah E. Theriault
Date: March 16, 2021

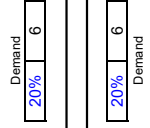
Name of Dvlp: Retail Motor Fuel Outlet
Time Period: Weekday PM

LAND USE A Retail

ITE LUC 960		Size <u>12</u> SF	
Enter	191	Internal	6
Exit	190	External	184
Total	381	Total	369
Percent	100%	Percent	97%

LAND USE B Retail

ITE LUC 948		Size <u>4,182</u> Units	
Enter	30	Internal	6
Exit	30	External	24
Total	60	Total	48
Percent	100%	Percent	80%



Net External Trips for Multi-Use Development

	Enter	Exit	Total	Single-Use Trip Gen Est.
Land Use A	185	184	369	361
Land Use B	24	24	48	60
TOTAL	209	208	417	441
				5%

Based on ITE Trip Generation Handbook, June 2004.

**Table E.39
Pass-By and Non-Pass-By Trips
Weekday, AM Peak Period**

Land Use 960 — Super Convenience Market/Gas Station

SIZE (1,000 SQ. FT. GFA)	VEHICLE FUELING POSITIONS	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PASS-BY TRIP (%)	NON-PASS-BY TRIPS (%)			ADJ. STREET PEAK HOUR VOLUME	SOURCE
							PRIMARY	DIVERTED	TOTAL		
5.500	12	East Lampeter, PA	2000	—	7:00-10:00 a.m.	85	—	—	15	2,975	Traffic Planning & Design
5.060	12	Ephrata, PA	2000	—	7:00-10:00 a.m.	84	—	—	16	3,219	Traffic Planning & Design
5.543	16	East Vincent, PA	2000	—	7:00-10:00 a.m.	84	—	—	16	1,933	Traffic Planning & Design
5.565	16	Upper Macungie, PA	2000	—	7:00-10:00 a.m.	77	—	—	23	2,262	Traffic Planning & Design
5.500	16	West Sadsbury, PA	2000	—	7:00-10:00 a.m.	82	—	—	18	1,570	Traffic Planning & Design
4.993	16	Muhlenberg, PA	2000	—	7:00-10:00 a.m.	75	—	—	25	1,991	Traffic Planning & Design
5.488	12	Millsboro, DE	2000	—	7:00-10:00 a.m.	80	—	—	20	—	Traffic Planning & Design
5.565	16	Bristol, PA	2000	—	7:00-10:00 a.m.	68	—	—	32	2,854	Traffic Planning & Design
4.694	12	Bel Air, MD	2000	—	7:00-10:00 a.m.	72	—	—	28	2,440	Traffic Planning & Design
4.694	16	Frederick, MD	2000	—	7:00-10:00 a.m.	90	—	—	10	2,278	Traffic Planning & Design
4.694	12	Salisbury, MD	2000	—	7:00-10:00 a.m.	78	—	—	22	1,561	Traffic Planning & Design
4.694	12	Salisbury, MD	2000	—	7:00-10:00 a.m.	79	—	—	21	2,764	Traffic Planning & Design
4.848	12	Fredericksburg, VA	2000	—	7:00-10:00 a.m.	55	—	—	45	1,398	Traffic Planning & Design
4.848	16	Woodbridge, VA	2000	—	7:00-10:00 a.m.	68	—	—	32	2,106	Traffic Planning & Design
5.242	12	Woodbridge, VA	2000	—	7:00-10:00 a.m.	74	—	—	26	1,160	Traffic Planning & Design
4.848	16	Spotsylvania, VA	2000	—	7:00-10:00 a.m.	85	—	—	15	2,676	Traffic Planning & Design
4.848	16	Spotsylvania, VA	2000	—	7:00-10:00 a.m.	75	—	—	25	3,244	Traffic Planning & Design
4.848	16	Stafford, VA	2000	—	7:00-10:00 a.m.	71	—	—	29	1,663	Traffic Planning & Design
5.242	12	Fredericksburg, VA	2000	—	7:00-10:00 a.m.	71	—	—	29	548	Traffic Planning & Design
4.694	20	New Castle, DE	2000	—	7:00-10:00 a.m.	84	—	—	16	3,864	Traffic Planning & Design
4.694	16	New Castle, DE	2000	—	7:00-10:00 a.m.	74	—	—	26	2,185	Traffic Planning & Design

4.694	16	Middletown, DE	2000	—	7:00-10:00 a.m.	58	—	—	42	962	Traffic Planning & Design
4.694	16	Newark, DE	2000	—	7:00-10:00 a.m.	84	—	—	16	2,956	Traffic Planning & Design
5.094	16	Lanoka, NJ	2000	—	7:00-10:00 a.m.	86	—	—	14	1,260	Traffic Planning & Design
5.565	16	Cream Ridge, NJ	2000	—	7:00-10:00 a.m.	58	—	—	42	1,253	Traffic Planning & Design
5.565	16	Medford, NJ	2000	—	7:00-10:00 a.m.	79	—	—	21	1,928	Traffic Planning & Design
4.694	16	Egg Harbor, NJ	2000	—	7:00-10:00 a.m.	79	—	—	21	1,859	Traffic Planning & Design
5.565	16	Florence, NJ	2000	---	7:00-10:00 a.m.	84	---	---	16	1,953	Traffic Planning & Design

Average Pass-By Trip Percentage: 76

“—” means no data

Table E.40
Pass-By and Non-Pass-By Trips
Weekday, PM Peak Period

Land Use 960 — Super Convenience Market/Gas Station

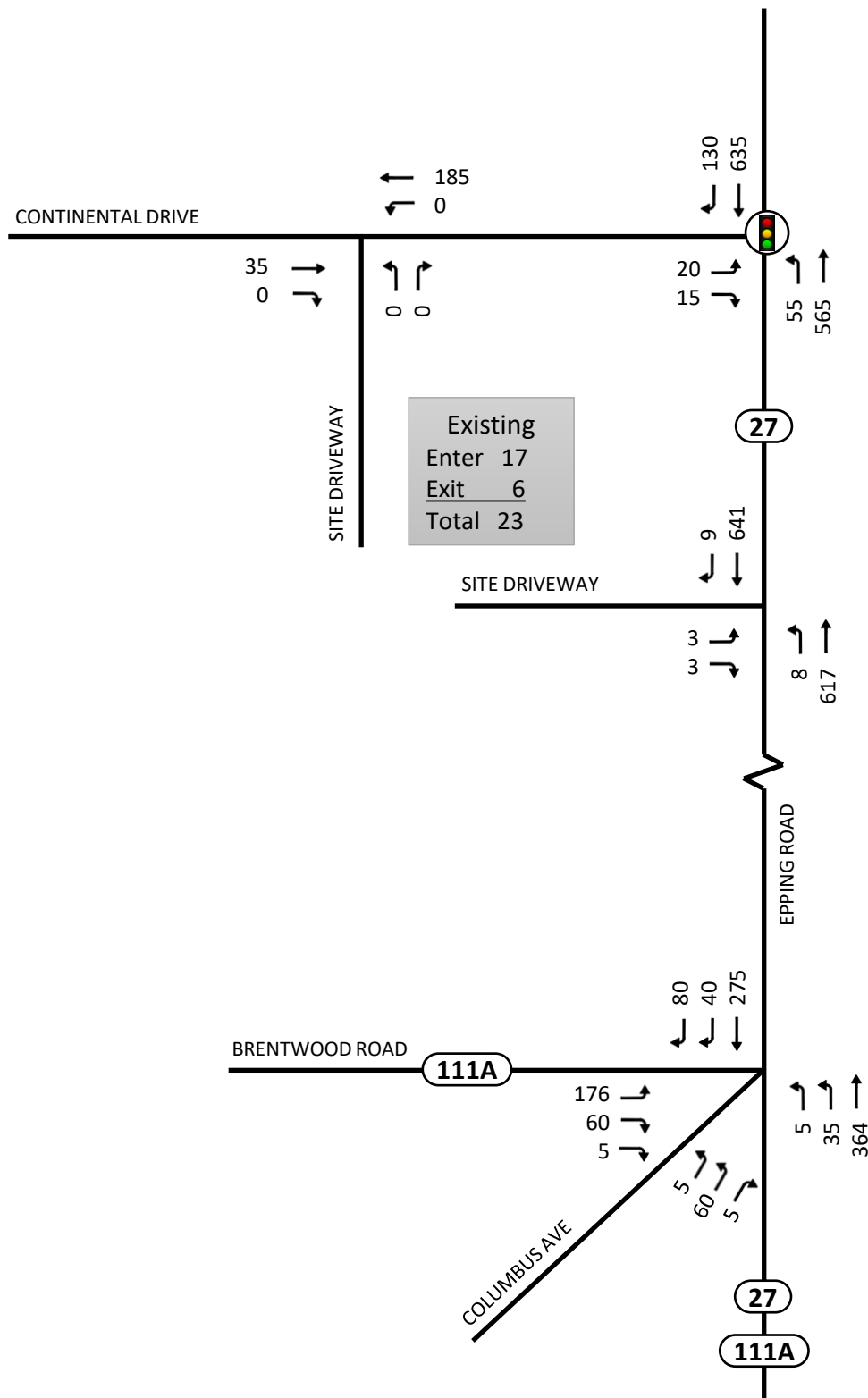
SIZE (1,000 SQ. FT. GFA)	VEHICLE FUELING POSITIONS	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PASS-BY TRIP (%)	NON-PASS-BY TRIPS (%)			ADJ. STREET PEAK HOUR VOLUME	SOURCE
							PRIMARY	DIVERTED	TOTAL		
5.500	12	East Lampeter, PA	2000	—	3:00–6:00 p.m.	84	—	—	16	4,025	Traffic Planning & Design
5.060	12	Ephrata, PA	2000	—	3:00–6:00 p.m.	91	—	—	9	4,181	Traffic Planning & Design
5.543	16	East Vincent, PA	2000	—	3:00–6:00 p.m.	87	—	—	13	2,363	Traffic Planning & Design
5.565	16	Upper Macungie, PA	2000	—	3:00–6:00 p.m.	81	—	—	19	2,770	Traffic Planning & Design
5.500	16	West Sadsbury, PA	2000	—	3:00–6:00 p.m.	90	—	—	10	2,616	Traffic Planning & Design
4.993	16	Muhlenberg, PA	2000	—	3:00–6:00 p.m.	72	—	—	28	2,917	Traffic Planning & Design
5.488	12	Millsboro, DE	2000	—	3:00–6:00 p.m.	73	—	—	27	—	Traffic Planning & Design
5.565	16	Bristol, PA	2000	—	3:00–6:00 p.m.	76	—	—	24	3,362	Traffic Planning & Design
4.694	12	Bel Air, MD	2000	—	3:00–6:00 p.m.	78	—	—	22	3,549	Traffic Planning & Design
4.694	16	Frederick, MD	2000	—	3:00–6:00 p.m.	89	—	—	11	2,755	Traffic Planning & Design
4.694	12	Salisbury, MD	2000	—	3:00–6:00 p.m.	67	—	—	33	2,272	Traffic Planning & Design
4.694	12	Salisbury, MD	2000	—	3:00–6:00 p.m.	66	—	—	34	3,514	Traffic Planning & Design
4.848	12	Fredericksburg, VA	2000	—	3:00–6:00 p.m.	71	—	—	29	2,350	Traffic Planning & Design
4.848	16	Woodbridge, VA	2000	—	3:00–6:00 p.m.	67	—	—	33	2,954	Traffic Planning & Design
5.242	12	Woodbridge, VA	2000	—	3:00–6:00 p.m.	70	—	—	30	2,445	Traffic Planning & Design
4.848	16	Spotsylvania, VA	2000	—	3:00–6:00 p.m.	78	—	—	22	3,086	Traffic Planning & Design
4.848	16	Spotsylvania, VA	2000	—	3:00–6:00 p.m.	83	—	—	17	4,143	Traffic Planning & Design
4.848	16	Stafford, VA	2000	—	3:00–6:00 p.m.	73	—	—	27	2,534	Traffic Planning & Design
5.242	12	Fredericksburg, VA	2000	—	3:00–6:00 p.m.	56	—	—	44	950	Traffic Planning & Design
4.694	20	New Castle, DE	2000	—	3:00–6:00 p.m.	76	—	—	24	1,616	Traffic Planning & Design
4.694	16	New Castle, DE	2000	—	3:00–6:00 p.m.	73	—	—	27	1,858	Traffic Planning & Design

4.694	16	Middletown, DE	2000	—	3:00–6:00 p.m.	59	—	—	41	1,344	Traffic Planning & Design
4.694	16	Newark, DE	2000	—	3:00–6:00 p.m.	72	—	—	28	3,434	Traffic Planning & Design
5.094	16	Lanoka, NJ	2000	—	3:00–6:00 p.m.	86	—	—	14	1,730	Traffic Planning & Design
5.565	16	Cream Ridge, NJ	2000	—	3:00–6:00 p.m.	61	—	—	39	1,713	Traffic Planning & Design
5.565	16	Medford, NJ	2000	—	3:00–6:00 p.m.	86	—	—	14	1,721	Traffic Planning & Design
4.694	16	Egg Harbor, NJ	2000	—	3:00–6:00 p.m.	81	—	—	19	1,734	Traffic Planning & Design
5.565	16	Florence, NJ	2000	---	3:00–6:00 p.m.	81	---	---	19	2,227	Traffic Planning & Design

Average Pass-By Trip Percentage: 76

“—” means no data were provided

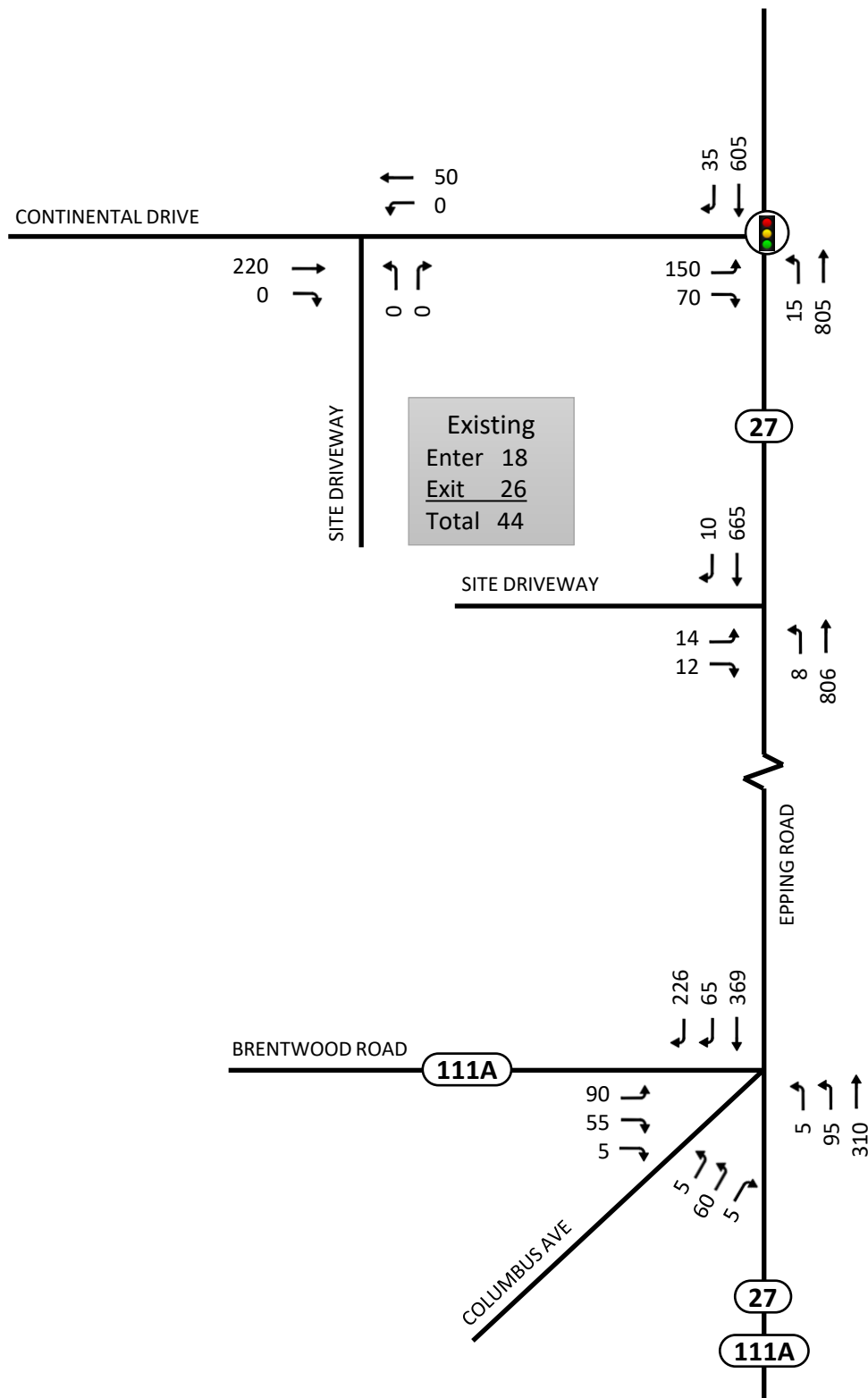
UPDATED TRFFIC-VOLUME NETWORKS



Existing
 Enter 17
 Exit 6
 Total 23

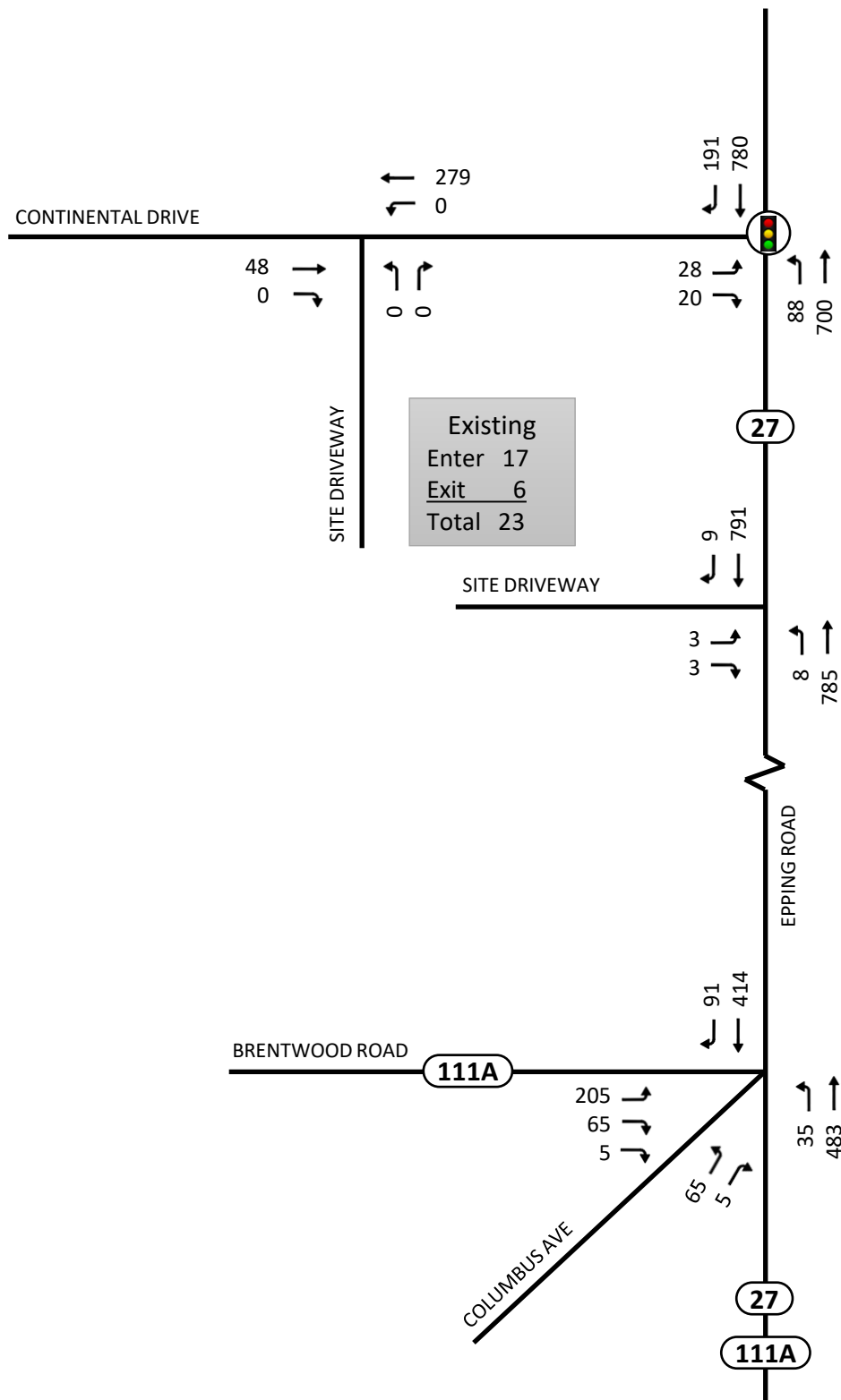
INTERSECTIONS DO NOT BALANCE

UPDATED FIGURE 2
 2021 EXISTING WEEKDAY AM
 PEAK HOUR TRAFFIC VOLUMES



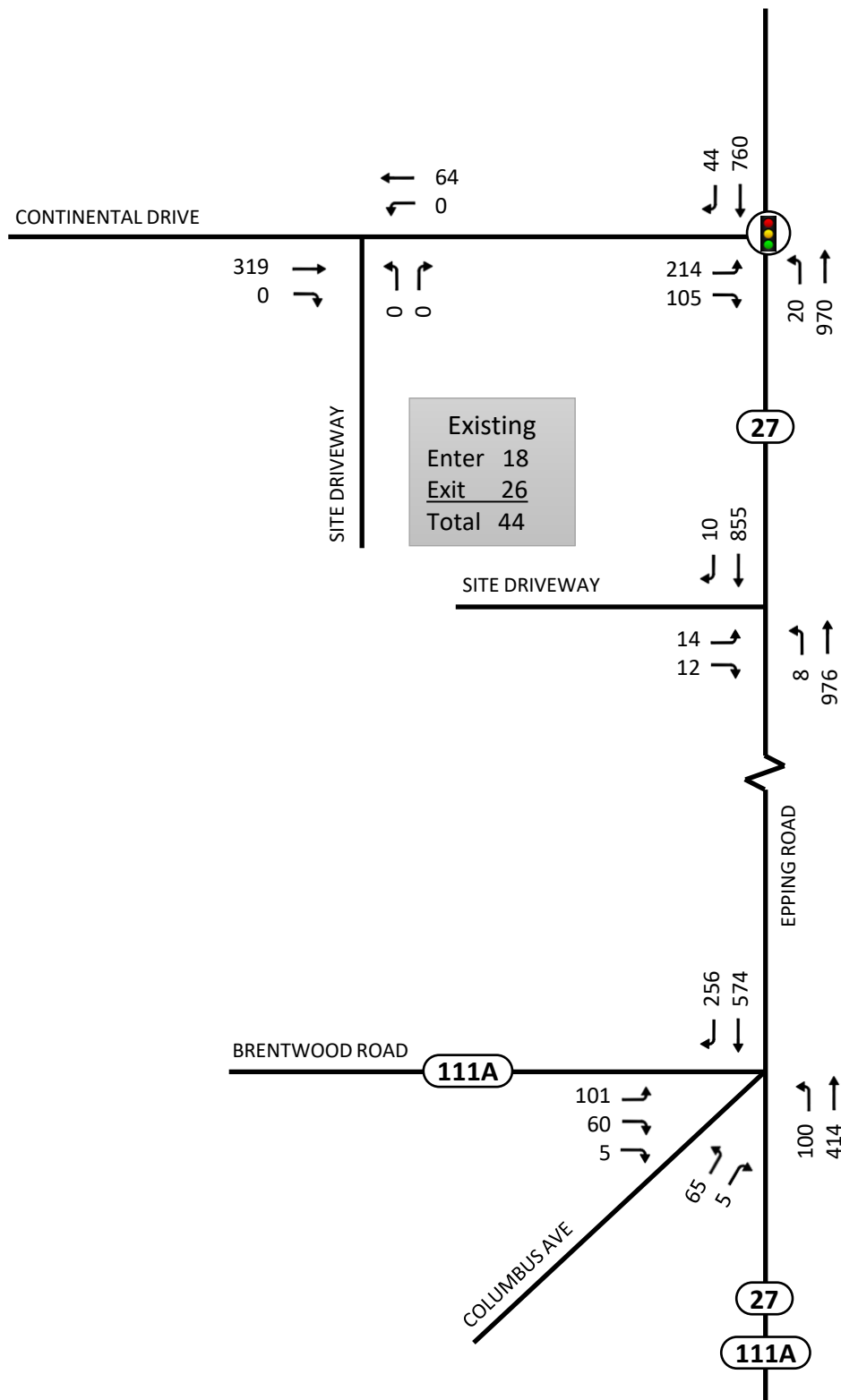
INTERSECTIONS DO NOT BALANCE

UPDATED FIGURE 3
 2021 EXISTING WEEKDAY PM
 PEAK HOUR TRAFFIC VOLUMES



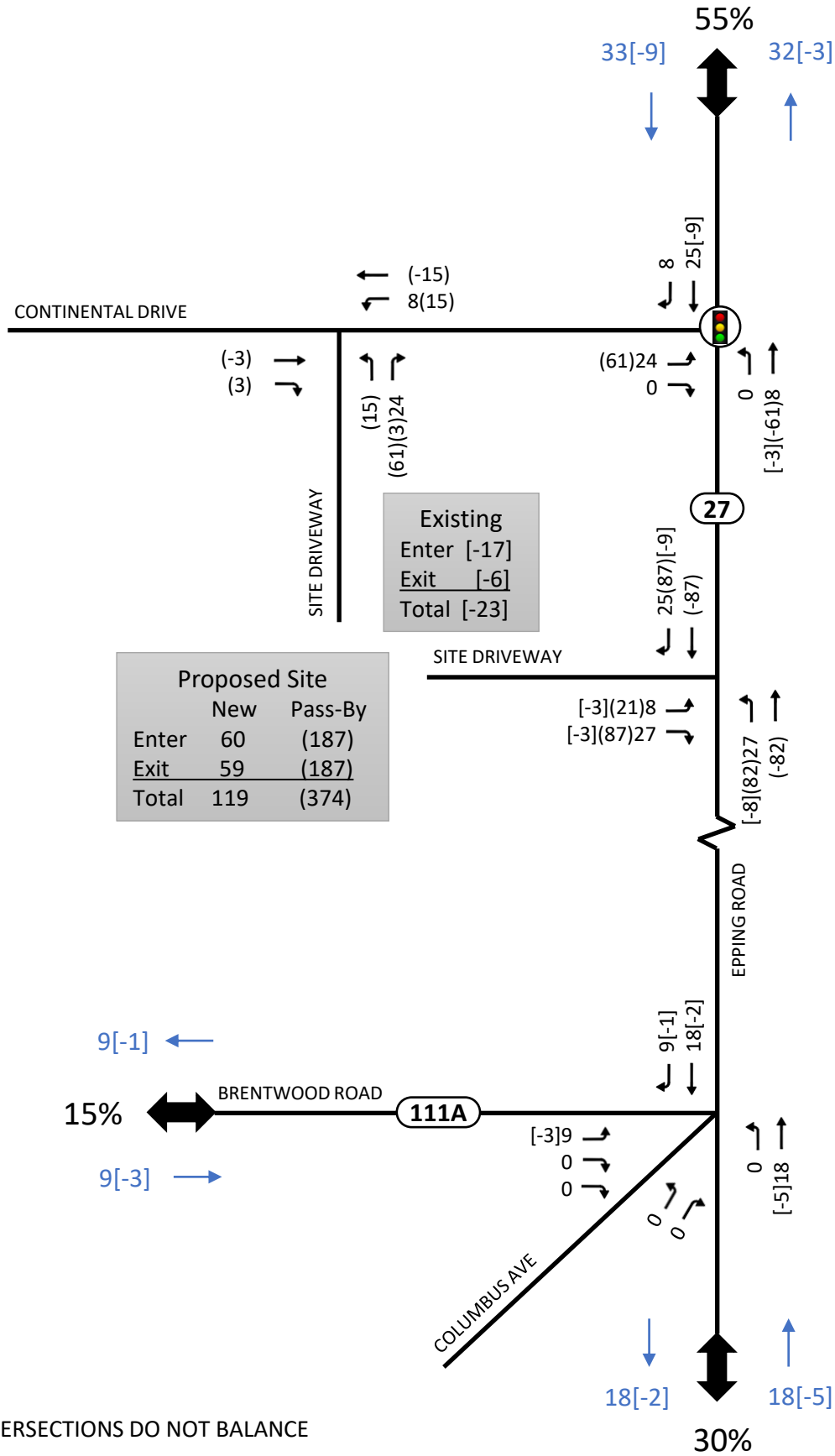
INTERSECTIONS DO NOT BALANCE

UPDATED FIGURE 4
 2030 NO-BUILD WEEKDAY AM
 PEAK HOUR TRAFFIC VOLUMES



INTERSECTIONS DO NOT BALANCE

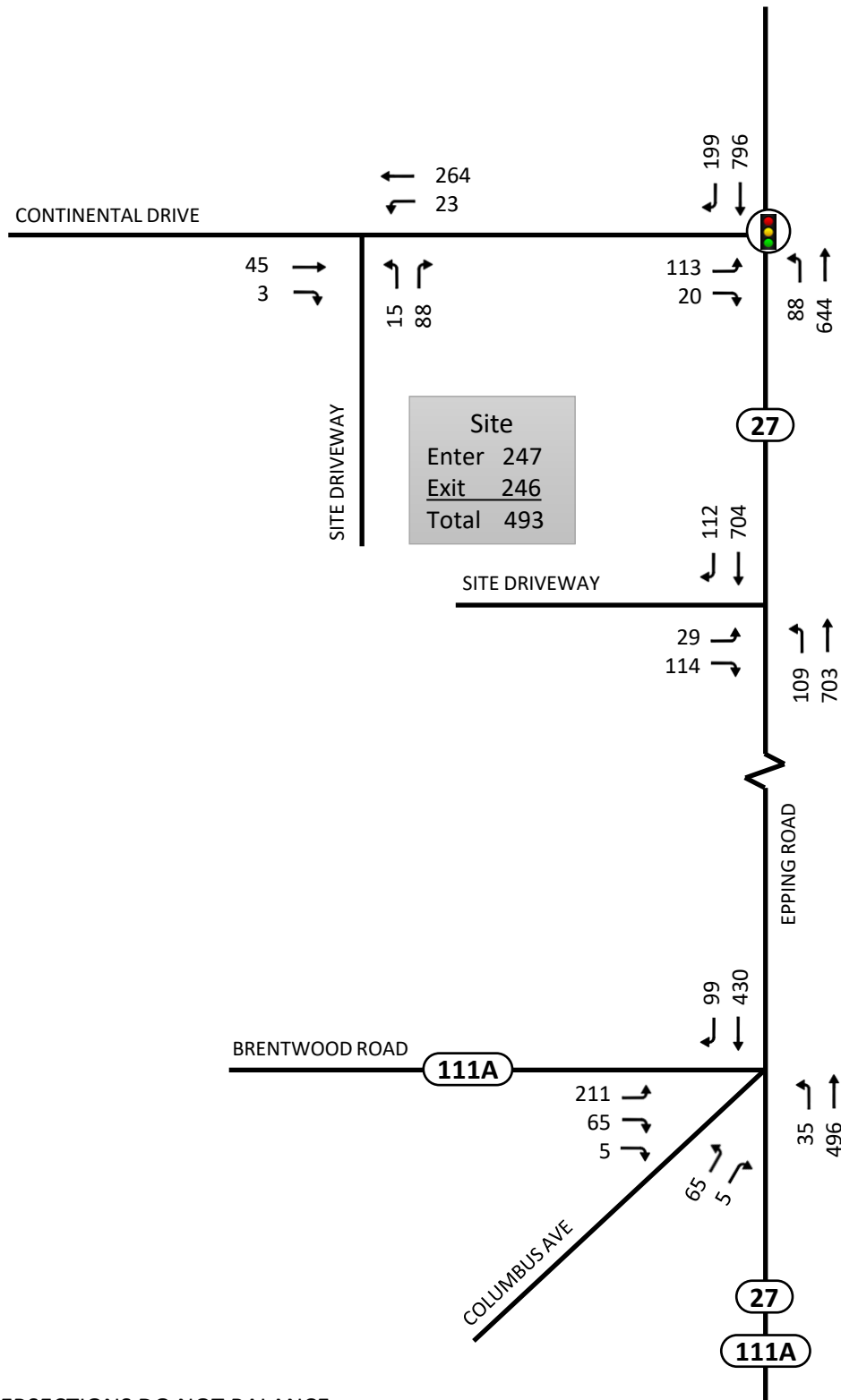
UPDATED FIGURE 5
 2030 NO-BUILD WEEKDAY PM
 PEAK HOUR TRAFFIC VOLUMES



INTERSECTIONS DO NOT BALANCE

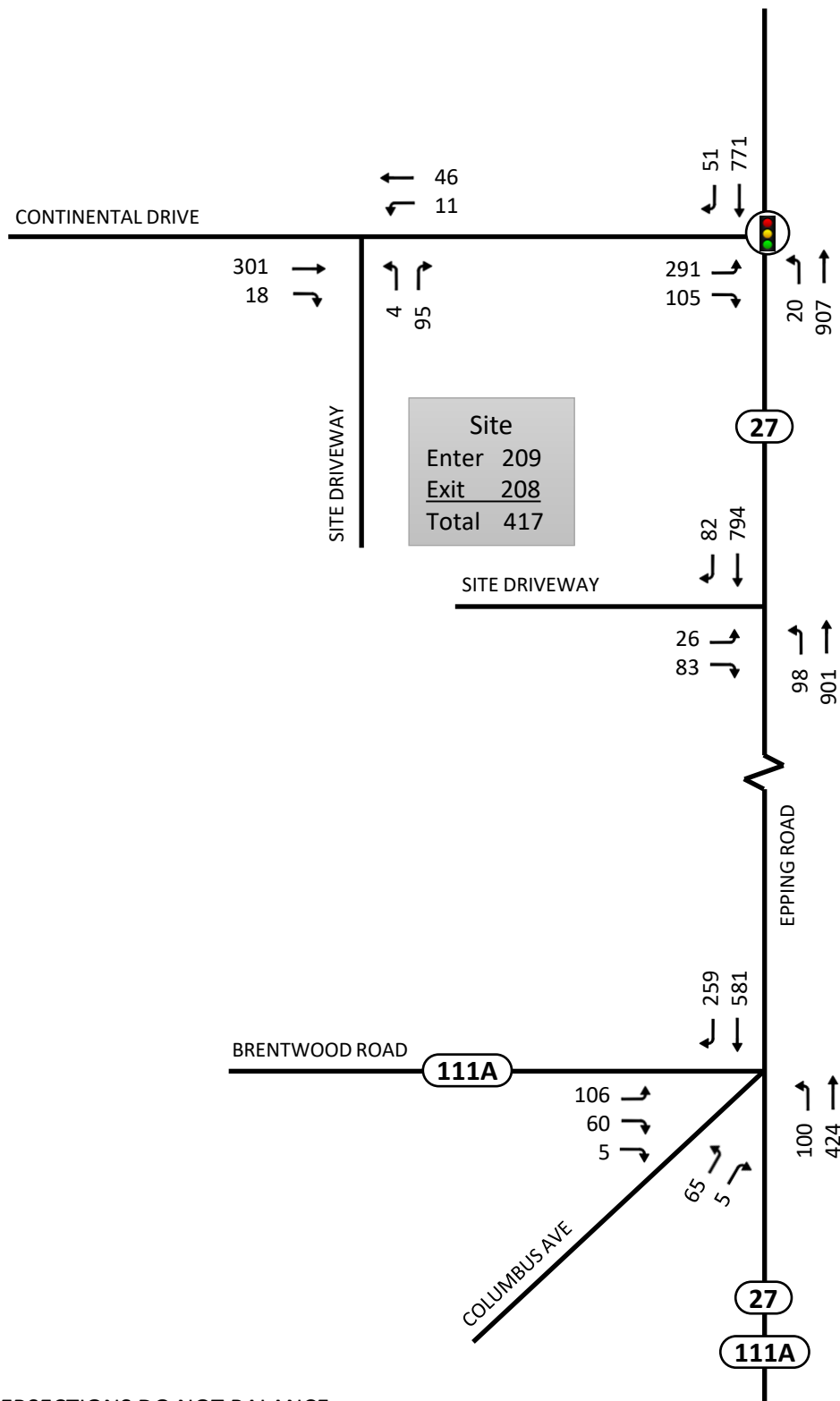
UPDATED FIGURE 6
 SITE GENERATED WEEKDAY AM
 PEAK HOUR TRAFFIC VOLUMES





INTERSECTIONS DO NOT BALANCE

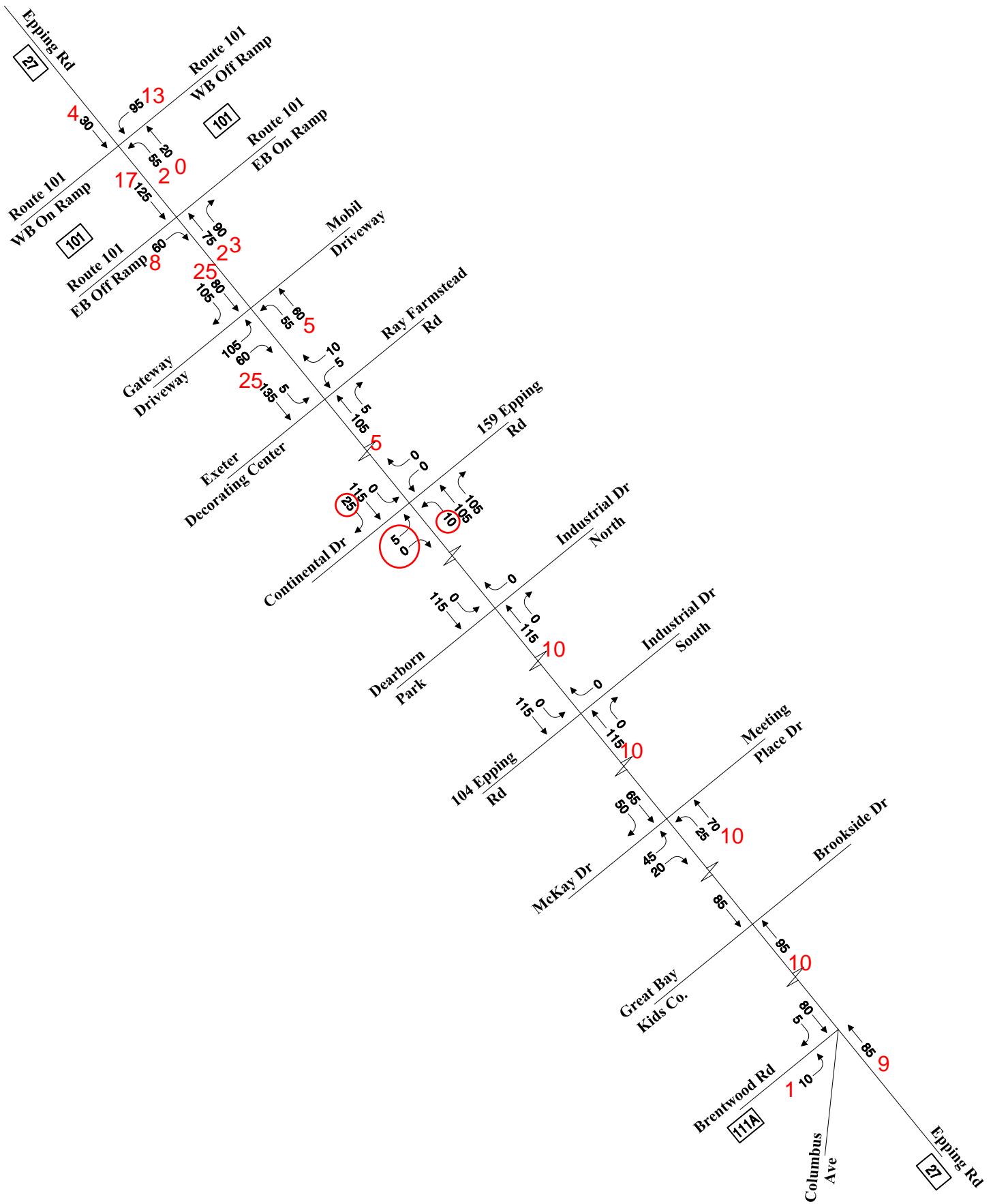
UPDATED FIGURE 8
 2030 BUILD WEEKDAY AM
 PEAK HOUR TRAFFIC VOLUMES



INTERSECTIONS DO NOT BALANCE

UPDATED FIGURE 9
 2030 BUILD WEEKDAY PM
 PEAK HOUR TRAFFIC VOLUMES

OTHER DEVELOPMENT TRAFFIC-VOLUME NETWORKS



↑
Not to Scale



Unitil Corporation
Known Developments
Site-Generated Traffic Volumes
Weekday Morning

Figure A-3

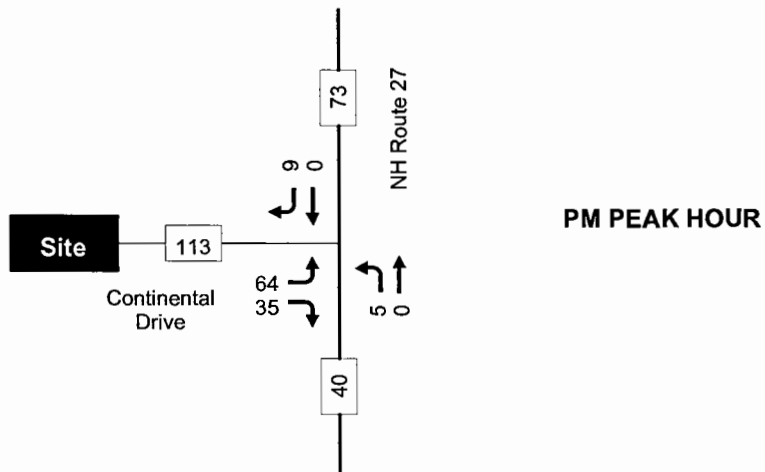
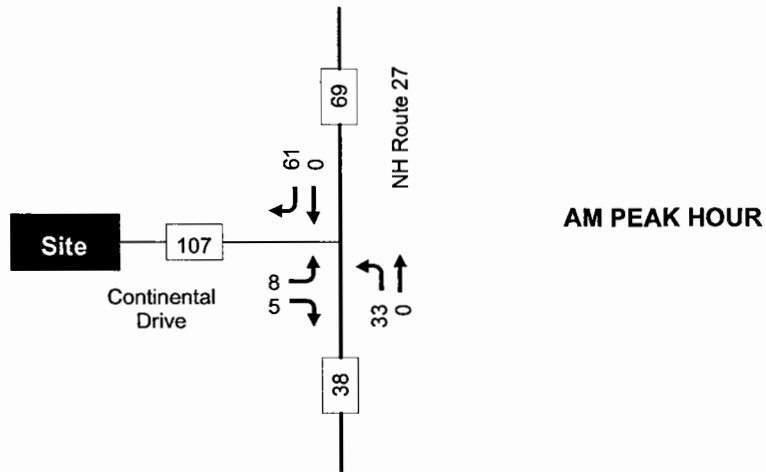


↑
Not to Scale



Unitil Corporation
Known Developments
Site-Generated Traffic Volumes
Weekday Evening

Figure A-4



UPDATED CAPACITY & QUEUE ANALYSIS TABLES

UPDATED TABLE 6
Intersection Capacity Analysis Summary

Intersection/Peak Hour/Lane Group	2021 Existing				2030 No-Build				2030 Build			
	V/C ^a	Del. ^b	LOS ^c	Queue ^d	V/C	Del.	LOS	Queue	V/C	Del.	LOS	Queue
Epping Road (NH Route 27) at Continental Drive												
<i>Weekday AM:</i>												
Continental Drive EB left turn	0.11	19.3	B	7/33	0.16	25.9	C	14/42	0.51	29.3	C	65/129
Continental Drive EB right turn	0.04	13.8	B	0/14	0.06	18.3	B	0/16	0.05	19.0	B	0/16
Epping Road NB left turn	0.25	18.9	B	21/65	0.41	26.0	C	46/95	0.43	29.2	C	49/95
Epping Road NB through	0.45	3.0	A	77/118	0.54	3.3	A	112/180	0.51	3.9	A	105/156
Epping Road SB through	0.73	10.4	B	198/337	0.82	13.6	B	316/560	0.84	16.4	B	340/607
Epping Road SB right turn	0.15	4.0	A	0/11	0.20	4.0	A	0/16	0.20	3.7	A	0/16
Overall Intersection	--	7.3	A	--/--	--	9.4	A	--/--	--	12.1	B	--/--
<i>Weekday PM:</i>												
Continental Drive EB left turn	0.46	17.9	B	60/142	0.70	29.0	C	115/265	0.88	47.4	D	186/384
Continental Drive EB right turn	0.17	13.5	B	0/28	0.28	19.2	B	0/37	0.27	19.6	B	0/37
Epping Road NB left turn	0.12	21.3	C	6/26	0.17	28.6	C	10/34	0.18	30.5	C	10/34
Epping Road NB through	0.74	7.0	A	178/315	0.84	9.6	A	285/453	0.80	9.2	A	245/379
Epping Road SB through	0.74	11.4	B	209/339	0.82	13.9	B	322/482	0.84	15.7	B	331/497
Epping Road SB right turn	0.04	2.6	A	0/5	0.04	2.2	A	0/5	0.05	2.1	A	0/6
Overall Intersection	--	9.9	A	--/--	--	13.6	B	--/--	--	17.3	B	--/--

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.

^c Level of service.

^d Average/95th percentile queue length in feet per lane (assuming 25 feet per vehicle).

UPDATED TABLE 6 (continued)
Intersection Capacity Analysis Summary

Intersection/Peak Hour/Lane Group	2021 Existing				2030 No-Build				2030 Build			
	V/C ^a	Del. ^b	LOS ^c	Queue ^d	V/C	Del.	LOS	Queue	V/C	Del.	LOS	Queue
Epping Road (NH Route 27) at Columbus Avenue												
<i>Weekday AM:</i>												
Columbus Avenue NE approach	0.69	33.2	D	--/123	--	--	--	--/--	--	--	--	--/--
Epping Road NB left turn	0.00	0.0	A	--/<25	--	--	--	--/--	--	--	--	--/--
<i>Weekday PM:</i>												
Columbus Avenue NE approach	0.52	28.7	D	--/73	--	--	--	--/--	--	--	--	--/--
Epping Road NB left turn	0.00	0.0	A	--/<25	--	--	--	--/--	--	--	--	--/--
Epping Road (NH Route 27) at Brentwood Road (NH Route 111A)												
<i>Weekday AM:</i>												
Epping Road NB left turn	0.03	8.0	A	--/<25	0.04	8.4	A	--/<25	0.04	8.4	A	--/<25
Brentwood Road EB approach	0.10	10.4	B	--/<25	--	--	--	--/--	--	--	--	--/--
Brentwood Road EB left turn	--	--	--	--/--	1.06	123.7	F	--/250	1.14	155.3	F	--/285
Brentwood Road EB right turn	--	--	--	--/--	0.14	12.4	B	--/<25	0.14	12.7	B	--/<25
<i>Weekday PM:</i>												
Epping Road NB left turn	0.09	8.4	A	--/<25	0.12	9.3	A	--/<25	0.12	9.3	A	--/<25
Brentwood Road EB approach	0.10	11.2	B	--/<25	--	--	--	--/--	--	--	--	--/--
Brentwood Road EB left turn	--	--	--	--/--	0.94	133.7	F	--/150	1.02	158.6	F	--/170
Brentwood Road EB right turn	--	--	--	--/--	0.18	16.1	C	--/<25	0.19	16.3	C	--/<25
Brentwood Road (NH Route 111A) at Columbus Avenue												
<i>Weekday AM:</i>												
Columbus Avenue NB approach	0.10	8.4	A	--/<25	0.11	10.5	B	--/<25	0.11	10.5	B	--/<25
Brentwood Road EB approach	0.33	9.9	A	--/38	0.00	0.0	A	--/<25	0.00	0.0	A	--/<25
Brentwood Road WB approach	0.06	8.1	A	--/<25	0.00	0.0	A	--/<25	0.00	0.0	A	--/<25
Columbus Avenue SB approach	0.16	8.2	A	--/<25	--	--	--	--/--	--	--	--	--/--
<i>Weekday PM:</i>												
Columbus Avenue NB approach	0.11	8.6	A	--/<25	0.09	9.6	A	--/<25	0.09	9.6	A	--/<25
Brentwood Road EB approach	0.23	9.6	A	--/<25	0.00	0.0	A	--/<25	0.00	0.0	A	--/<25
Brentwood Road WB approach	0.15	9.0	A	--/<25	0.00	0.0	A	--/<25	0.00	0.0	A	--/<25
Columbus Avenue SB approach	0.37	9.8	A	--/43	--	--	--	--/--	--	--	--	--/--

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.

^c Level of service.

^d Average/95th percentile queue length in feet per lane (assuming 25 feet per vehicle).

UPDATED TABLE 6 (continued)
Intersection Capacity Analysis Summary

Intersection/Peak Hour/Lane Group	2021 Existing				2030 No-Build				2030 Build			
	V/C ^a	Del. ^b	LOS ^c	Queue ^d	V/C	Del.	LOS	Queue	V/C	Del.	LOS	Queue
Epping Road (NH Route 27) at Site Driveway												
<i>Weekday AM:</i>												
Epping Road NB left turn	0.01	9.1	A	--/<25	0.01	9.8	A	--/<25	0.16	10.7	B	--/<25
Site Driveway EB approach	0.03	22.0	C	--/<25	0.03	18.7	C	--/<25	--	--	--	--/--
Site Driveway EB left turn	--	--	--	--/--	--	--	--	--/--	0.19	30.5	D	--/<25
Site Driveway EB right turn	--	--	--	--/--	--	--	--	--/--	0.35	20.1	C	--/38
<i>Weekday PM:</i>												
Epping Road NB left turn	0.01	9.2	A	--/<25	0.01	10.1	B	--/<25	0.15	11.0	B	--/<25
Site Driveway EB approach	0.18	32.4	D	--/<25	0.13	23.3	C	--/<25	--	--	--	--/--
Site Driveway EB left turn	--	--	--	--/--	--	--	--	--/--	0.21	38.2	E	--/<25
Site Driveway EB right turn	--	--	--	--/--	--	--	--	--/--	0.28	20.4	C	--/28
Continental Drive at Site Driveway												
<i>Weekday AM:</i>												
Site Driveway NB approach	--	--	--	--/--	--	--	--	--/--	0.12	9.5	A	--/<25
Continental Drive WB left turn	--	--	--	--/--	--	--	--	--/--	0.02	7.4	A	--/<25
<i>Weekday PM:</i>												
Site Driveway NB approach	--	--	--	--/--	--	--	--	--/--	0.16	11.2	B	--/<25
Continental Drive WB left turn	--	--	--	--/--	--	--	--	--/--	0.01	8.0	A	--/<25

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.

^c Level of service.

^d Average/95th percentile queue length in feet per lane (assuming 25 feet per vehicle).

TABLE A-1
Intersection Capacity Analysis Summary – No Mid-Term Improvements

Intersection/Peak Hour/Lane Group	2021 Existing				2030 No-Build				2030 Build			
	V/C ^a	Del. ^b	LOS ^c	Queue ^d	V/C	Del.	LOS	Queue	V/C	Del.	LOS	Queue
Epping Road (NH Route 27) at Site Driveway												
<i>Weekday AM:</i>												
Epping Road NB left turn	0.01	9.1	A	--/<25	0.01	9.8	A	--/<25	0.16	10.7	B	--/<25
Site Driveway EB approach	0.03	22.0	C	--/<25	0.05	31.8	D	--/<25	--	--	--	--/--
Site Driveway EB left turn	--	--	--	--/--	--	--	--	--/--	0.57	130.5	F	--/58
Site Driveway EB right turn	--	--	--	--/--	--	--	--	--/--	0.35	20.1	C	--/38
<i>Weekday PM:</i>												
Epping Road NB left turn	0.01	9.2	A	--/<25	0.01	10.1	B	--/<25	0.15	11.0	B	--/<25
Site Driveway EB approach	0.18	32.4	D	--/<25	0.31	59.5	F	--/30	--	--	--	--/--
Site Driveway EB left turn	--	--	--	--/--	--	--	--	--/--	0.83	267.9	F	--/73
Site Driveway EB right turn	--	--	--	--/--	--	--	--	--/--	0.28	20.4	C	--/28

^a Volume-to-capacity ratio.

^b Average control delay in seconds per vehicle.













^c Level of service.

^d Average/95th percentile queue length in feet per lane (assuming 25 feet per vehicle).

UPDATED CAPACITY & QUEUE ANALYSIS WORKSHEETS

3: Epping Road (NH 27) & Continental Drive Timings

2021 Existing
Timing Plan: Weekday AM

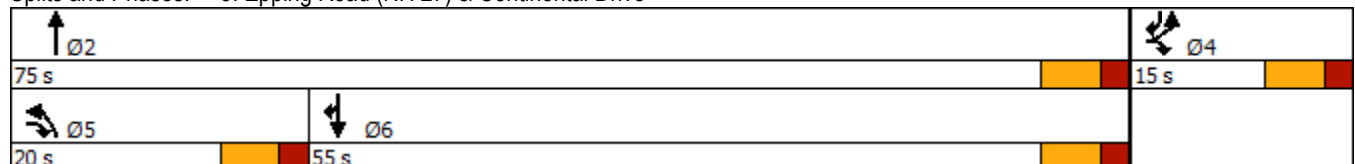
Lane Group						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	20	15	55	565	635	130
Future Volume (vph)	20	15	55	565	635	130
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	15.0		20.0	75.0	55.0	
Total Split (%)	16.7%		22.2%	83.3%	61.1%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	11.1	22.4	11.7	47.2	39.5	51.2
Actuated g/C Ratio	0.18	0.37	0.19	0.78	0.65	0.84
v/c Ratio	0.07	0.03	0.18	0.43	0.57	0.10
Control Delay	30.6	9.5	29.1	4.3	12.5	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.6	9.5	29.1	4.3	12.5	0.8
LOS	C	A	C	A	B	A
Approach Delay	21.7			6.5	10.5	
Approach LOS	C			A	B	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 60.9
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.57
 Intersection Signal Delay: 9.0
 Intersection Capacity Utilization 56.8%
 Analysis Period (min) 15







Intersection LOS: A
 ICU Level of Service B

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive















3: Epping Road (NH 27) & Continental Drive Queues

2021 Existing
Timing Plan: Weekday AM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	22	16	60	614	690	141
v/c Ratio	0.07	0.03	0.18	0.43	0.57	0.10
Control Delay	30.6	9.5	29.1	4.3	12.5	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.6	9.5	29.1	4.3	12.5	0.8
Queue Length 50th (ft)	7	0	21	77	198	0
Queue Length 95th (ft)	33	14	65	118	337	11
Internal Link Dist (ft)	2747			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	353	687	514	1793	1527	1383
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.02	0.12	0.34	0.45	0.10
Intersection Summary						

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2021 Existing
Timing Plan: Weekday AM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	15	55	565	635	130
Future Volume (veh/h)	20	15	55	565	635	130
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	22	16	60	614	690	141
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	194	385	239	1351	942	971
Arrive On Green	0.11	0.11	0.13	0.72	0.50	0.50
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	22	16	60	614	690	141
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	0.5	0.4	1.4	6.4	13.7	1.8
Cycle Q Clear(g_c), s	0.5	0.4	1.4	6.4	13.7	1.8
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	194	385	239	1351	942	971
V/C Ratio(X)	0.11	0.04	0.25	0.45	0.73	0.15
Avail Cap(c_a), veh/h	414	581	601	2803	2013	1878
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	13.7	18.4	2.7	9.2	3.9
Incr Delay (d2), s/veh	0.3	0.0	0.5	0.2	1.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.4	0.6	0.8	4.3	0.6
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	19.3	13.8	18.9	3.0	10.4	4.0
LnGrp LOS	B	B	B	A	B	A
Approach Vol, veh/h	38			674	831	
Approach Delay, s/veh	17.0			4.4	9.3	
Approach LOS	B			A	A	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		38.2		9.1	10.4	27.9
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		69.0		9.0	14.0	49.0
Max Q Clear Time (g_c+I1), s		8.4		2.5	3.4	15.7
Green Ext Time (p_c), s		4.9		0.0	0.1	6.1
Intersection Summary						
HCM 6th Ctrl Delay			7.3			
HCM 6th LOS			A			

8: Columbus Avenue & Epping Road (NH 27)
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 7.9

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	0	364	275	120	236	0
Future Vol, veh/h	0	364	275	120	236	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	396	299	130	257	0

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	429	0	0
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	4.12	-	-
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	2.218	-	-
Pot Cap-1 Maneuver	1130	-	-
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1130	-	-
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	NB	SB	NE
HCM Control Delay, s	0	0	33.2
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
Capacity (veh/h)	374	1130	-	-	-
HCM Lane V/C Ratio	0.686	-	-	-	-
HCM Control Delay (s)	33.2	0	-	-	-
HCM Lane LOS	D	A	-	-	-
HCM 95th %tile Q(veh)	4.9	0	-	-	-

9: Epping Road (NH 27) & Brentwood Road (NH 111A)
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 1.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
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Lane Configurations						
Traffic Vol, veh/h	0	65	40	364	275	0
Future Vol, veh/h	0	65	40	364	275	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	71	43	396	299	0

Major/Minor	Minor2	Major1	Major2
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Conflicting Flow All	781	299	299	0	-	0
Stage 1	299	-	-	-	-	-
Stage 2	482	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	363	741	1262	-	-	-
Stage 1	752	-	-	-	-	-
Stage 2	621	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	347	741	1262	-	-	-
Mov Cap-2 Maneuver	347	-	-	-	-	-
Stage 1	719	-	-	-	-	-
Stage 2	621	-	-	-	-	-

Approach	EB	NB	SB
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HCM Control Delay, s	10.4	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
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Capacity (veh/h)	1262	-	741	-	-
HCM Lane V/C Ratio	0.034	-	0.095	-	-
HCM Control Delay (s)	8	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-

10: Columbus Avenue & Brentwood Road (NH 111A)
 HCM 6th AWSC

2021 Existing
 Timing Plan: Weekday AM

Intersection

Intersection Delay, s/veh	9.1
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	176	60	5	5	35	0	5	60	5	0	40	80
Future Vol, veh/h	176	60	5	5	35	0	5	60	5	0	40	80
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	191	65	5	5	38	0	5	65	5	0	43	87
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Approach	EB			WB			NB			SB		
Opposing Approach	WB			EB			SB			NB		
Opposing Lanes	1			1			1			1		
Conflicting Approach Left	SB			NB			EB			WB		
Conflicting Lanes Left	1			1			1			1		
Conflicting Approach Right	NB			SB			WB			EB		
Conflicting Lanes Right	1			1			1			1		
HCM Control Delay	9.9			8.1			8.4			8.2		
HCM LOS	A			A			A			A		

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	7%	73%	12%	0%
Vol Thru, %	86%	25%	88%	33%
Vol Right, %	7%	2%	0%	67%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	70	241	40	120
LT Vol	5	176	5	0
Through Vol	60	60	35	40
RT Vol	5	5	0	80
Lane Flow Rate	76	262	43	130
Geometry Grp	1	1	1	1
Degree of Util (X)	0.101	0.334	0.057	0.158
Departure Headway (Hd)	4.787	4.591	4.739	4.359
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	748	783	754	822
Service Time	2.82	2.62	2.777	2.388
HCM Lane V/C Ratio	0.102	0.335	0.057	0.158
HCM Control Delay	8.4	9.9	8.1	8.2
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.3	1.5	0.2	0.6

15: Epping Road (NH 27) & Site Driveway
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	3	8	617	641	9
Future Vol, veh/h	3	3	8	617	641	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	3	9	686	712	10













Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1421	717	722	0	-	0
Stage 1	717	-	-	-	-	-
Stage 2	704	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	150	430	880	-	-	-
Stage 1	484	-	-	-	-	-
Stage 2	490	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	147	430	880	-	-	-
Mov Cap-2 Maneuver	147	-	-	-	-	-
Stage 1	476	-	-	-	-	-
Stage 2	490	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	880	-	219	-	-
HCM Lane V/C Ratio	0.01	-	0.03	-	-
HCM Control Delay (s)	9.1	0	22	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

3: Epping Road (NH 27) & Continental Drive Timings

2021 Existing
Timing Plan: Weekday PM

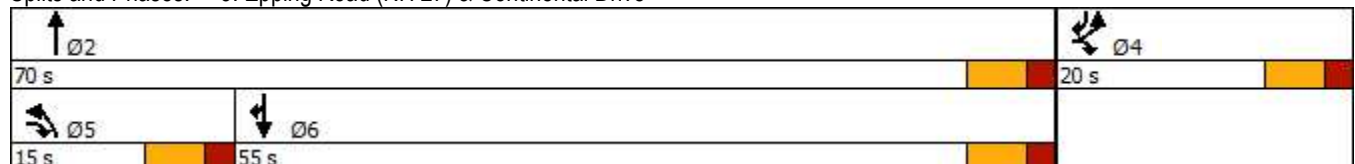
						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	150	70	15	805	605	35
Future Volume (vph)	150	70	15	805	605	35
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	20.0		15.0	70.0	55.0	
Total Split (%)	22.2%		16.7%	77.8%	61.1%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	13.4	27.8	10.3	47.3	36.5	55.0
Actuated g/C Ratio	0.19	0.40	0.15	0.69	0.53	0.80
v/c Ratio	0.48	0.11	0.06	0.68	0.67	0.03
Control Delay	32.2	5.3	31.8	9.8	17.2	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.2	5.3	31.8	9.8	17.2	0.8
LOS	C	A	C	A	B	A
Approach Delay	23.6			10.2	16.3	
Approach LOS	C			B	B	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 68.9
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.68
 Intersection Signal Delay: 14.3
 Intersection Capacity Utilization 57.3%
 Analysis Period (min) 15







Intersection LOS: B
 ICU Level of Service B

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive















3: Epping Road (NH 27) & Continental Drive
Queues

2021 Existing
Timing Plan: Weekday PM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	163	76	16	875	658	38
v/c Ratio	0.48	0.11	0.06	0.68	0.67	0.03
Control Delay	32.2	5.3	31.8	9.8	17.2	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.2	5.3	31.8	9.8	17.2	0.8
Queue Length 50th (ft)	60	0	6	178	209	0
Queue Length 95th (ft)	142	28	26	315	339	5
Internal Link Dist (ft)	2747			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	422	698	290	1713	1418	1326
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.11	0.06	0.51	0.46	0.03
Intersection Summary						

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2021 Existing
Timing Plan: Weekday PM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	150	70	15	805	605	35
Future Volume (veh/h)	150	70	15	805	605	35
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	163	76	16	875	658	38
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	357	434	131	1185	892	1074
Arrive On Green	0.20	0.20	0.07	0.63	0.48	0.48
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	163	76	16	875	658	38
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	3.9	1.8	0.4	15.5	13.7	0.4
Cycle Q Clear(g_c), s	3.9	1.8	0.4	15.5	13.7	0.4
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	357	434	131	1185	892	1074
V/C Ratio(X)	0.46	0.17	0.12	0.74	0.74	0.04
Avail Cap(c_a), veh/h	591	642	406	2559	1978	1994
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	17.0	13.3	20.9	6.1	10.2	2.6
Incr Delay (d2), s/veh	0.9	0.2	0.4	0.9	1.2	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.2	3.6	4.5	0.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	17.9	13.5	21.3	7.0	11.4	2.6
LnGrp LOS	B	B	C	A	B	A
Approach Vol, veh/h	239			891	696	
Approach Delay, s/veh	16.5			7.3	10.9	
Approach LOS	B			A	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		34.6		13.7	7.5	27.0
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		64.0		14.0	9.0	49.0
Max Q Clear Time (g_c+I1), s		17.5		5.9	2.4	15.7
Green Ext Time (p_c), s		8.7		0.4	0.0	5.3
Intersection Summary						
HCM 6th Ctrl Delay			9.9			
HCM 6th LOS			A			

8: Columbus Avenue & Epping Road (NH 27)
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 3.8

Movement	NBL	NBT	SBT	SBR	NEL	NER
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Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	0	310	369	291	150	0
Future Vol, veh/h	0	310	369	291	150	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	337	401	316	163	0

Major/Minor	Major1	Major2	Minor2
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Conflicting Flow All	717	0	0	896	559
Stage 1	-	-	-	559	-
Stage 2	-	-	-	337	-
Critical Hdwy	4.12	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	3.518	3.318
Pot Cap-1 Maneuver	884	-	-	311	529
Stage 1	-	-	-	572	-
Stage 2	-	-	-	723	-
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	884	-	-	311	529
Mov Cap-2 Maneuver	-	-	-	311	-
Stage 1	-	-	-	572	-
Stage 2	-	-	-	723	-

Approach	NB	SB	NE
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HCM Control Delay, s	0	0	28.7
HCM LOS			D

Minor Lane/Major Mvmt	NELn1	NBL	NBT	SBT	SBR
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Capacity (veh/h)	311	884	-	-	-
HCM Lane V/C Ratio	0.524	-	-	-	-
HCM Control Delay (s)	28.7	0	-	-	-
HCM Lane LOS	D	A	-	-	-
HCM 95th %tile Q(veh)	2.9	0	-	-	-

9: Epping Road (NH 27) & Brentwood Road (NH 111A)
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 1.8

Movement	EBL	EBR	NBL	NBT	SBT	SBR
----------	-----	-----	-----	-----	-----	-----

Lane Configurations						
Traffic Vol, veh/h	0	60	100	310	369	0
Future Vol, veh/h	0	60	100	310	369	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	65	109	337	401	0

Major/Minor	Minor2	Major1	Major2
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Conflicting Flow All	956	401	401	0	-	0
Stage 1	401	-	-	-	-	-
Stage 2	555	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	286	649	1158	-	-	-
Stage 1	676	-	-	-	-	-
Stage 2	575	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	253	649	1158	-	-	-
Mov Cap-2 Maneuver	253	-	-	-	-	-
Stage 1	598	-	-	-	-	-
Stage 2	575	-	-	-	-	-

Approach	EB	NB	SB
----------	----	----	----

HCM Control Delay, s	11.2	2.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
-----------------------	-----	-----	-------	-----	-----

Capacity (veh/h)	1158	-	649	-	-
HCM Lane V/C Ratio	0.094	-	0.1	-	-
HCM Control Delay (s)	8.4	0	11.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.3	-	0.3	-	-

Intersection

Intersection Delay, s/veh	9.5
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	90	55	5	5	95	0	5	60	5	0	65	226
Future Vol, veh/h	90	55	5	5	95	0	5	60	5	0	65	226
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	98	60	5	5	103	0	5	65	5	0	71	246
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	9.6	9	8.6	9.8
HCM LOS	A	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	7%	60%	5%	0%
Vol Thru, %	86%	37%	95%	22%
Vol Right, %	7%	3%	0%	78%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	70	150	100	291
LT Vol	5	90	5	0
Through Vol	60	55	95	65
RT Vol	5	5	0	226
Lane Flow Rate	76	163	109	316
Geometry Grp	1	1	1	1
Degree of Util (X)	0.105	0.228	0.152	0.374
Departure Headway (Hd)	4.952	5.044	5.032	4.253
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	720	708	708	845
Service Time	3.012	3.111	3.102	2.294
HCM Lane V/C Ratio	0.106	0.23	0.154	0.374
HCM Control Delay	8.6	9.6	9	9.8
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.4	0.9	0.5	1.7

15: Epping Road (NH 27) & Site Driveway
 HCM 6th TWSC

2021 Existing
 Timing Plan: Weekday PM

Intersection

Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	12	8	806	665	10
Future Vol, veh/h	14	12	8	806	665	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	13	9	896	739	11













Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	1659	745	750	0	0
Stage 1	745	-	-	-	-
Stage 2	914	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	107	414	859	-	-
Stage 1	469	-	-	-	-
Stage 2	391	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	105	414	859	-	-
Mov Cap-2 Maneuver	105	-	-	-	-
Stage 1	459	-	-	-	-
Stage 2	391	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	32.4	0.1	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	859	-	160	-	-
HCM Lane V/C Ratio	0.01	-	0.181	-	-
HCM Control Delay (s)	9.2	0	32.4	-	-
HCM Lane LOS	A	A	D	-	-
HCM 95th %tile Q(veh)	0	-	0.6	-	-

3: Epping Road (NH 27) & Continental Drive Timings

2030 No-Build
Timing Plan: Weekday AM

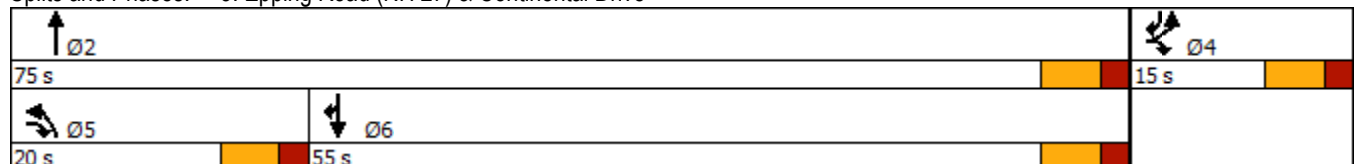
						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	28	20	88	700	780	191
Future Volume (vph)	28	20	88	700	780	191
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	15.0		20.0	75.0	55.0	
Total Split (%)	16.7%		22.2%	83.3%	61.1%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	10.8	27.6	12.6	55.7	43.3	59.6
Actuated g/C Ratio	0.14	0.37	0.17	0.74	0.58	0.80
v/c Ratio	0.12	0.04	0.33	0.56	0.80	0.16
Control Delay	35.4	8.8	35.1	5.5	21.0	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.4	8.8	35.1	5.5	21.0	0.8
LOS	D	A	D	A	C	A
Approach Delay	24.3			8.8	17.0	
Approach LOS	C			A	B	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 74.9
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 13.7
 Intersection Capacity Utilization 64.4%
 Analysis Period (min) 15







Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive



3: Epping Road (NH 27) & Continental Drive Queues

2030 No-Build
Timing Plan: Weekday AM













						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	31	22	98	778	867	212
v/c Ratio	0.12	0.04	0.33	0.56	0.80	0.16
Control Delay	35.4	8.8	35.1	5.5	21.0	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.4	8.8	35.1	5.5	21.0	0.8
Queue Length 50th (ft)	14	0	46	112	316	0
Queue Length 95th (ft)	42	16	95	180	#560	16
Internal Link Dist (ft)	2747			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	275	631	400	1670	1306	1313
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.11	0.03	0.24	0.47	0.66	0.16

Intersection Summary

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

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2030 No-Build
Timing Plan: Weekday AM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	28	20	88	700	780	191
Future Volume (veh/h)	28	20	88	700	780	191
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	31	22	98	778	867	212
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	193	387	242	1430	1058	1068
Arrive On Green	0.11	0.11	0.14	0.76	0.57	0.57
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	31	22	98	778	867	212
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	1.0	0.7	3.2	10.6	23.7	3.2
Cycle Q Clear(g_c), s	1.0	0.7	3.2	10.6	23.7	3.2
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	193	387	242	1430	1058	1068
V/C Ratio(X)	0.16	0.06	0.41	0.54	0.82	0.20
Avail Cap(c_a), veh/h	311	491	452	2105	1512	1453
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	25.5	18.3	24.9	3.0	11.1	3.9
Incr Delay (d2), s/veh	0.4	0.1	1.1	0.3	2.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	0.0	1.3	1.8	8.4	1.2
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	25.9	18.3	26.0	3.3	13.6	4.0
LnGrp LOS	C	B	C	A	B	A
Approach Vol, veh/h	53			876	1079	
Approach Delay, s/veh	22.8			5.9	11.7	
Approach LOS	C			A	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		52.3		10.8	12.6	39.7
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		69.0		9.0	14.0	49.0
Max Q Clear Time (g_c+I1), s		12.6		3.0	5.2	25.7
Green Ext Time (p_c), s		7.1		0.0	0.1	8.0
Intersection Summary						
HCM 6th Ctrl Delay			9.4			
HCM 6th LOS			A			

Intersection

Int Delay, s/veh	20.5					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	205	70	35	483	414	91
Future Vol, veh/h	205	70	35	483	414	91
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	Stop
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	228	78	39	537	460	101

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	1126	511	460	0	0
Stage 1	511	-	-	-	-
Stage 2	615	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	~ 227	563	1101	-	-
Stage 1	602	-	-	-	-
Stage 2	539	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	~ 216	563	1101	-	-
Mov Cap-2 Maneuver	~ 216	-	-	-	-
Stage 1	572	-	-	-	-
Stage 2	539	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	95.4	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1101	-	216	563	-	-
HCM Lane V/C Ratio	0.035	-	1.055	0.138	-	-
HCM Control Delay (s)	8.4	0	123.7	12.4	-	-
HCM Lane LOS	A	A	F	B	-	-
HCM 95th %tile Q(veh)	0.1	-	10	0.5	-	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh 1.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	270	5	0	126	0	70
Future Vol, veh/h	270	5	0	126	0	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	300	6	0	140	0	78

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	306
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.12
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.218
Pot Cap-1 Maneuver	-	-	1255
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1255
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	737	-	-	1255	-
HCM Lane V/C Ratio	0.106	-	-	-	-
HCM Control Delay (s)	10.5	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

Intersection

Int Delay, s/veh	0.1					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	3	3	8	785	791	9
Future Vol, veh/h	3	3	8	785	791	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	3	9	872	879	10













Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1774	884	889	0	-	0
Stage 1	884	-	-	-	-	-
Stage 2	890	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	91	344	762	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	401	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	89	344	762	-	-	-
Mov Cap-2 Maneuver	222	-	-	-	-	-
Stage 1	395	-	-	-	-	-
Stage 2	401	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	18.7	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	762	-	270	-	-
HCM Lane V/C Ratio	0.012	-	0.025	-	-
HCM Control Delay (s)	9.8	0	18.7	-	-
HCM Lane LOS	A	A	C	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

3: Epping Road (NH 27) & Continental Drive Timings

2030 No-Build
Timing Plan: Weekday PM

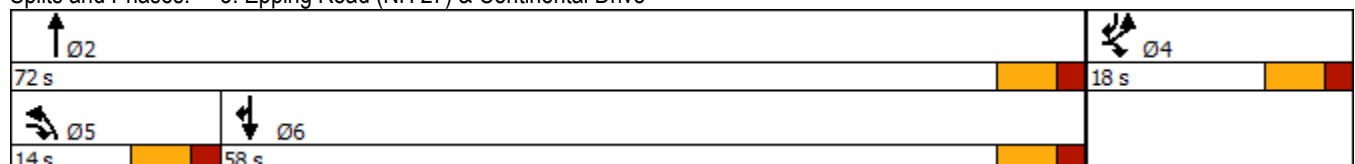
						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	214	105	20	970	760	44
Future Volume (vph)	214	105	20	970	760	44
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	18.0		14.0	72.0	58.0	
Total Split (%)	20.0%		15.6%	80.0%	64.4%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	14.1	28.7	10.4	54.7	44.3	63.7
Actuated g/C Ratio	0.18	0.37	0.13	0.71	0.57	0.83
v/c Ratio	0.74	0.18	0.09	0.82	0.79	0.04
Control Delay	49.4	5.6	36.0	13.3	20.1	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.4	5.6	36.0	13.3	20.1	0.6
LOS	D	A	D	B	C	A
Approach Delay	34.9			13.8	19.0	
Approach LOS	C			B	B	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 77.1
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.82
 Intersection Signal Delay: 19.0
 Intersection Capacity Utilization 69.6%
 Analysis Period (min) 15







Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive



3: Epping Road (NH 27) & Continental Drive Queues

2030 No-Build
Timing Plan: Weekday PM













						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	238	117	22	1078	844	49
v/c Ratio	0.74	0.18	0.09	0.82	0.79	0.04
Control Delay	49.4	5.6	36.0	13.3	20.1	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	49.4	5.6	36.0	13.3	20.1	0.6
Queue Length 50th (ft)	115	0	10	285	322	0
Queue Length 95th (ft)	#265	37	34	453	482	5
Internal Link Dist (ft)	2747			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	334	649	239	1597	1345	1303
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.18	0.09	0.68	0.63	0.04

Intersection Summary

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

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2030 No-Build
Timing Plan: Weekday PM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	214	105	20	970	760	44
Future Volume (veh/h)	214	105	20	970	760	44
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	238	117	22	1078	844	49
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	340	416	128	1281	1030	1175
Arrive On Green	0.19	0.19	0.07	0.68	0.55	0.55
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	238	117	22	1078	844	49
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	8.0	3.8	0.7	27.5	23.7	0.5
Cycle Q Clear(g_c), s	8.0	3.8	0.7	27.5	23.7	0.5
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	340	416	128	1281	1030	1175
V/C Ratio(X)	0.70	0.28	0.17	0.84	0.82	0.04
Avail Cap(c_a), veh/h	389	459	278	1982	1574	1636
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.3	18.9	28.0	7.5	11.8	2.2
Incr Delay (d2), s/veh	4.7	0.4	0.6	2.1	2.1	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.6	3.7	0.3	7.7	8.5	0.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	29.0	19.2	28.6	9.6	13.9	2.2
LnGrp LOS	C	B	C	A	B	A
Approach Vol, veh/h	355			1100	893	
Approach Delay, s/veh	25.7			10.0	13.3	
Approach LOS	C			A	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		47.9		16.2	8.6	39.3
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		66.0		12.0	8.0	52.0
Max Q Clear Time (g_c+I1), s		29.5		10.0	2.7	25.7
Green Ext Time (p_c), s		12.4		0.2	0.0	7.4
Intersection Summary						
HCM 6th Ctrl Delay			13.6			
HCM 6th LOS			B			

Intersection

Int Delay, s/veh	10.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	101	65	100	414	574	256
Future Vol, veh/h	101	65	100	414	574	256
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	Stop
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	112	72	111	460	638	284

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	1462	780	638	0	0
Stage 1	780	-	-	-	-
Stage 2	682	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	142	395	946	-	-
Stage 1	452	-	-	-	-
Stage 2	502	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	120	395	946	-	-
Mov Cap-2 Maneuver	120	-	-	-	-
Stage 1	381	-	-	-	-
Stage 2	502	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	87.7	1.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	946	-	120	395	-	-
HCM Lane V/C Ratio	0.117	-	0.935	0.183	-	-
HCM Control Delay (s)	9.3	0	133.7	16.1	-	-
HCM Lane LOS	A	A	F	C	-	-
HCM 95th %tile Q(veh)	0.4	-	6	0.7	-	-

Intersection

Int Delay, s/veh	1.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	161	5	0	356	0	70
Future Vol, veh/h	161	5	0	356	0	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	179	6	0	396	0	78

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	185	0	578 182
Stage 1	-	-	-	-	182 -
Stage 2	-	-	-	-	396 -
Critical Hdwy	-	-	4.12	-	6.42 6.22
Critical Hdwy Stg 1	-	-	-	-	5.42 -
Critical Hdwy Stg 2	-	-	-	-	5.42 -
Follow-up Hdwy	-	-	2.218	-	3.518 3.318
Pot Cap-1 Maneuver	-	-	1390	-	478 861
Stage 1	-	-	-	-	849 -
Stage 2	-	-	-	-	680 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1390	-	478 861
Mov Cap-2 Maneuver	-	-	-	-	478 -
Stage 1	-	-	-	-	849 -
Stage 2	-	-	-	-	680 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	861	-	-	1390	-
HCM Lane V/C Ratio	0.09	-	-	-	-
HCM Control Delay (s)	9.6	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.3	-	-	0	-

Intersection

Int Delay, s/veh	0.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	12	8	976	855	10
Future Vol, veh/h	14	12	8	976	855	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	13	9	1084	950	11













Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	2058	956	961	0	0
Stage 1	956	-	-	-	-
Stage 2	1102	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	61	313	716	-	-
Stage 1	373	-	-	-	-
Stage 2	318	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	59	313	716	-	-
Mov Cap-2 Maneuver	181	-	-	-	-
Stage 1	361	-	-	-	-
Stage 2	318	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	23.3	0.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	716	-	225	-	-
HCM Lane V/C Ratio	0.012	-	0.128	-	-
HCM Control Delay (s)	10.1	0	23.3	-	-
HCM Lane LOS	B	A	C	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

3: Epping Road (NH 27) & Continental Drive Timings

2030 Build
Timing Plan: Weekday AM

						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	113	20	88	644	796	199
Future Volume (vph)	113	20	88	644	796	199
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.950		0.950			
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Satd. Flow (RTOR)		22				221
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	15.0		20.0	75.0	55.0	
Total Split (%)	16.7%		22.2%	83.3%	61.1%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	11.6	29.0	13.0	55.3	43.2	60.6
Actuated g/C Ratio	0.15	0.38	0.17	0.73	0.57	0.80
v/c Ratio	0.46	0.04	0.32	0.53	0.83	0.17
Control Delay	41.8	8.7	35.8	5.3	22.9	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.8	8.7	35.8	5.3	22.9	0.8
LOS	D	A	D	A	C	A
Approach Delay	36.9			9.0	18.5	
Approach LOS	D			A	B	

Intersection Summary

Cycle Length: 90

Actuated Cycle Length: 75.7

Natural Cycle: 65

Control Type: Actuated-Uncoordinated

Maximum v/c Ratio: 0.83

Intersection Signal Delay: 16.1

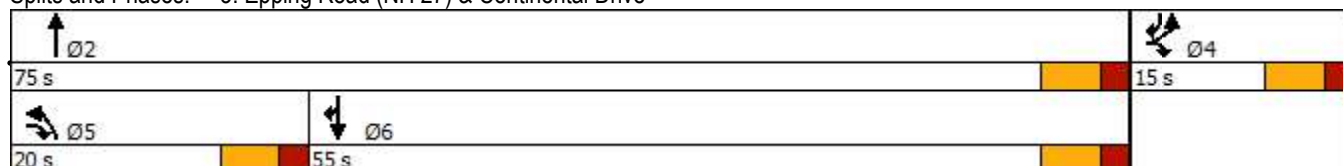
Intersection LOS: B

Intersection Capacity Utilization 65.2%

ICU Level of Service C







Analysis Period (min) 15

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive



3: Epping Road (NH 27) & Continental Drive Queues

2030 Build
Timing Plan: Weekday AM













						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	126	22	98	716	884	221
v/c Ratio	0.46	0.04	0.32	0.53	0.83	0.17
Control Delay	41.8	8.7	35.8	5.3	22.9	0.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.8	8.7	35.8	5.3	22.9	0.8
Queue Length 50th (ft)	65	0	49	105	340	0
Queue Length 95th (ft)	#129	16	95	156	#607	16
Internal Link Dist (ft)	208			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	280	689	408	1635	1279	1299
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.03	0.24	0.44	0.69	0.17

Intersection Summary

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

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2030 Build
Timing Plan: Weekday AM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	113	20	88	644	796	199
Future Volume (veh/h)	113	20	88	644	796	199
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	126	22	98	716	884	221
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	245	420	226	1396	1051	1109
Arrive On Green	0.14	0.14	0.13	0.75	0.56	0.56
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	126	22	98	716	884	221
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	4.5	0.7	3.5	10.9	27.2	3.4
Cycle Q Clear(g_c), s	4.5	0.7	3.5	10.9	27.2	3.4
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	245	420	226	1396	1051	1109
V/C Ratio(X)	0.51	0.05	0.43	0.51	0.84	0.20
Avail Cap(c_a), veh/h	283	453	412	1919	1378	1386
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	27.7	19.0	27.9	3.6	12.6	3.6
Incr Delay (d2), s/veh	1.7	0.1	1.3	0.3	3.8	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	1.5	2.4	10.4	1.5
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	29.3	19.0	29.2	3.9	16.4	3.7
LnGrp LOS	C	B	C	A	B	A
Approach Vol, veh/h	148			814	1105	
Approach Delay, s/veh	27.8			6.9	13.8	
Approach LOS	C			A	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		55.7		13.5	12.8	42.9
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		69.0		9.0	14.0	49.0
Max Q Clear Time (g_c+I1), s		12.9		6.5	5.5	29.2
Green Ext Time (p_c), s		6.2		0.1	0.1	7.7
Intersection Summary						
HCM 6th Ctrl Delay			12.1			
HCM 6th LOS			B			

Intersection

Int Delay, s/veh 25.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	211	70	35	496	430	99
Future Vol, veh/h	211	70	35	496	430	99
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	Stop
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	234	78	39	551	478	110

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1162	533	478	0	-	0
Stage 1	533	-	-	-	-	-
Stage 2	629	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 216	547	1084	-	-	-
Stage 1	588	-	-	-	-	-
Stage 2	531	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 205	547	1084	-	-	-
Mov Cap-2 Maneuver	~ 205	-	-	-	-	-
Stage 1	557	-	-	-	-	-
Stage 2	531	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	119.8	0.6	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1084	-	205	547	-	-
HCM Lane V/C Ratio	0.036	-	1.144	0.142	-	-
HCM Control Delay (s)	8.4	0	155.3	12.7	-	-
HCM Lane LOS	A	A	F	B	-	-
HCM 95th %tile Q(veh)	0.1	-	11.4	0.5	-	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh 1.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	276	5	0	134	0	70
Future Vol, veh/h	276	5	0	134	0	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	307	6	0	149	0	78

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	313	0	459
Stage 1	-	-	-	-	310
Stage 2	-	-	-	-	149
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1247	-	560
Stage 1	-	-	-	-	744
Stage 2	-	-	-	-	879
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1247	-	560
Mov Cap-2 Maneuver	-	-	-	-	560
Stage 1	-	-	-	-	744
Stage 2	-	-	-	-	879

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	730	-	-	1247	-
HCM Lane V/C Ratio	0.107	-	-	-	-
HCM Control Delay (s)	10.5	-	-	0	-
HCM Lane LOS	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	-	-	0	-

15: Epping Road (NH 27) & Site Driveway
 HCM 6th TWSC

2030 Build
 Timing Plan: Weekday AM

Intersection

Int Delay, s/veh 2.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	29	114	109	703	704	112
Future Vol, veh/h	29	114	109	703	704	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	32	127	121	781	782	124

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1867	844	906	0	-	0
Stage 1	844	-	-	-	-	-
Stage 2	1023	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	80	363	751	-	-	-
Stage 1	422	-	-	-	-	-
Stage 2	347	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	57	363	751	-	-	-
Mov Cap-2 Maneuver	173	-	-	-	-	-
Stage 1	302	-	-	-	-	-
Stage 2	347	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	22.2	1.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	751	-	173	363	-	-
HCM Lane V/C Ratio	0.161	-	0.186	0.349	-	-
HCM Control Delay (s)	10.7	0	30.5	20.1	-	-
HCM Lane LOS	B	A	D	C	-	-
HCM 95th %tile Q(veh)	0.6	-	0.7	1.5	-	-

Intersection

Int Delay, s/veh 2.6

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	45	3	23	264	15	88
Future Vol, veh/h	45	3	23	264	15	88
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	50	3	26	293	17	98

Major/Minor	Major1	Major2	Minor1	Minor2	Minor3
Conflicting Flow All	0	0	53	0	397
Stage 1	-	-	-	-	52
Stage 2	-	-	-	-	345
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1553	-	608
Stage 1	-	-	-	-	970
Stage 2	-	-	-	-	717
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1553	-	596
Mov Cap-2 Maneuver	-	-	-	-	596
Stage 1	-	-	-	-	970
Stage 2	-	-	-	-	703

Approach	EB	WB	NB
HCM Control Delay, s	0	0.6	9.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	921	-	-	1553	-
HCM Lane V/C Ratio	0.124	-	-	0.016	-
HCM Control Delay (s)	9.5	-	-	7.4	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.4	-	-	0.1	-

3: Epping Road (NH 27) & Continental Drive Timings

2030 Build
Timing Plan: Weekday PM

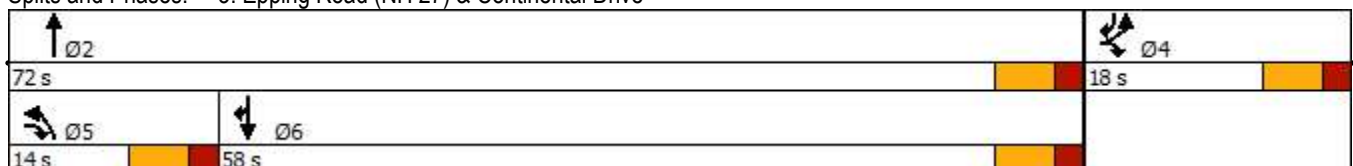
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	291	105	20	907	771	51
Future Volume (vph)	291	105	20	907	771	51
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor						
Frt		0.850				0.850
Flt Protected	0.950		0.950			
Satd. Flow (prot)	1770	1583	1770	1863	1863	1583
Flt Permitted	0.950		0.950			
Satd. Flow (perm)	1770	1583	1770	1863	1863	1583
Satd. Flow (RTOR)		117				57
Turn Type	Prot	pt+ov	Prot	NA	NA	pt+ov
Protected Phases	4	4 5	5	2	6	4 6
Permitted Phases						
Detector Phase	4	4 5	5	2	6	4 6
Switch Phase						
Minimum Initial (s)	8.0		8.0	10.0	10.0	
Minimum Split (s)	14.0		14.0	16.0	16.0	
Total Split (s)	18.0		14.0	72.0	58.0	
Total Split (%)	20.0%		15.6%	80.0%	64.4%	
Yellow Time (s)	4.0		4.0	4.0	4.0	
All-Red Time (s)	2.0		2.0	2.0	2.0	
Lost Time Adjust (s)	-2.0		-2.0	-2.0	-2.0	
Total Lost Time (s)	4.0		4.0	4.0	4.0	
Lead/Lag			Lead		Lag	
Lead-Lag Optimize?			Yes		Yes	
Recall Mode	None		None	Min	Min	
Act Effct Green (s)	14.7	29.4	10.5	54.0	43.7	63.8
Actuated g/C Ratio	0.19	0.38	0.14	0.70	0.57	0.83
v/c Ratio	0.96	0.17	0.09	0.77	0.81	0.04
Control Delay	77.5	5.6	36.2	11.6	21.2	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.5	5.6	36.2	11.6	21.2	0.6
LOS	E	A	D	B	C	A
Approach Delay	58.4			12.1	20.0	
Approach LOS	E			B	B	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 77.1
 Natural Cycle: 80
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 23.7
 Intersection Capacity Utilization 70.5%
 Analysis Period (min) 15







Intersection LOS: C
 ICU Level of Service C

Splits and Phases: 3: Epping Road (NH 27) & Continental Drive



3: Epping Road (NH 27) & Continental Drive Queues

2030 Build
Timing Plan: Weekday PM













						
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	323	117	22	1008	857	57
v/c Ratio	0.96	0.17	0.09	0.77	0.81	0.04
Control Delay	77.5	5.6	36.2	11.6	21.2	0.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	77.5	5.6	36.2	11.6	21.2	0.6
Queue Length 50th (ft)	~186	0	10	245	331	0
Queue Length 95th (ft)	#384	37	34	379	497	6
Internal Link Dist (ft)	208			332	2112	
Turn Bay Length (ft)		125	225			225
Base Capacity (vph)	337	676	241	1585	1335	1320
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.17	0.09	0.64	0.64	0.04

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

3: Epping Road (NH 27) & Continental Drive HCM 6th Signalized Intersection Summary

2030 Build
Timing Plan: Weekday PM

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	291	105	20	907	771	51
Future Volume (veh/h)	291	105	20	907	771	51
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00	1.00			1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No	No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	323	117	22	1008	857	57
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	367	436	124	1266	1026	1196
Arrive On Green	0.21	0.21	0.07	0.68	0.55	0.55
Sat Flow, veh/h	1781	1585	1781	1870	1870	1585
Grp Volume(v), veh/h	323	117	22	1008	857	57
Grp Sat Flow(s),veh/h/ln	1781	1585	1781	1870	1870	1585
Q Serve(g_s), s	12.0	3.9	0.8	25.7	26.0	0.6
Cycle Q Clear(g_c), s	12.0	3.9	0.8	25.7	26.0	0.6
Prop In Lane	1.00	1.00	1.00			1.00
Lane Grp Cap(c), veh/h	367	436	124	1266	1026	1196
V/C Ratio(X)	0.88	0.27	0.18	0.80	0.84	0.05
Avail Cap(c_a), veh/h	367	436	262	1869	1484	1584
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.2	19.3	29.8	7.7	12.8	2.1
Incr Delay (d2), s/veh	21.2	0.3	0.7	1.5	2.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	6.9	0.0	0.4	7.6	9.8	0.3
Unsig. Movement Delay, s/veh						
LnGrp Delay(d),s/veh	47.4	19.6	30.5	9.2	15.7	2.1
LnGrp LOS	D	B	C	A	B	A
Approach Vol, veh/h	440			1030	914	
Approach Delay, s/veh	40.0			9.7	14.8	
Approach LOS	D			A	B	
Timer - Assigned Phs		2		4	5	6
Phs Duration (G+Y+Rc), s		50.0		18.0	8.7	41.3
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0
Max Green Setting (Gmax), s		66.0		12.0	8.0	52.0
Max Q Clear Time (g_c+I1), s		27.7		14.0	2.8	28.0
Green Ext Time (p_c), s		11.0		0.0	0.0	7.3
Intersection Summary						
HCM 6th Ctrl Delay			17.3			
HCM 6th LOS			B			

Intersection

Int Delay, s/veh	12.3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	106	65	100	424	581	259
Future Vol, veh/h	106	65	100	424	581	259
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	Stop
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	118	72	111	471	646	288

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	1483	790	646	0	0
Stage 1	790	-	-	-	-
Stage 2	693	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	138	390	939	-	-
Stage 1	447	-	-	-	-
Stage 2	496	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	~ 116	390	939	-	-
Mov Cap-2 Maneuver	~ 116	-	-	-	-
Stage 1	375	-	-	-	-
Stage 2	496	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	104.5	1.8	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	939	-	116	390	-	-
HCM Lane V/C Ratio	0.118	-	1.015	0.185	-	-
HCM Control Delay (s)	9.3	0	158.6	16.3	-	-
HCM Lane LOS	A	A	F	C	-	-
HCM 95th %tile Q(veh)	0.4	-	6.8	0.7	-	-

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh	1.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	166	5	0	359	0	70
Future Vol, veh/h	166	5	0	359	0	70
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	184	6	0	399	0	78

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	190	0	586
Stage 1	-	-	-	-	187
Stage 2	-	-	-	-	399
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1384	-	473
Stage 1	-	-	-	-	845
Stage 2	-	-	-	-	678
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1384	-	473
Mov Cap-2 Maneuver	-	-	-	-	473
Stage 1	-	-	-	-	845
Stage 2	-	-	-	-	678

Approach	EB	WB	NB
HCM Control Delay, s	0	0	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	855	-	-	1384	-
HCM Lane V/C Ratio	0.091	-	-	-	-
HCM Control Delay (s)	9.6	-	-	0	-
HCM Lane LOS	A	-	-	A	-
HCM 95th %tile Q(veh)	0.3	-	-	0	-

15: Epping Road (NH 27) & Site Driveway
 HCM 6th TWSC

2030 Build
 Timing Plan: Weekday PM

Intersection

Int Delay, s/veh 1.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	26	83	98	901	794	82
Future Vol, veh/h	26	83	98	901	794	82
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	29	92	109	1001	882	91

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	2147	928	973	0	-	0
Stage 1	928	-	-	-	-	-
Stage 2	1219	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	53	325	709	-	-	-
Stage 1	385	-	-	-	-	-
Stage 2	279	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	35	325	709	-	-	-
Mov Cap-2 Maneuver	137	-	-	-	-	-
Stage 1	252	-	-	-	-	-
Stage 2	279	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	24.6	1.1	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	709	-	137	325	-	-
HCM Lane V/C Ratio	0.154	-	0.211	0.284	-	-
HCM Control Delay (s)	11	0	38.2	20.4	-	-
HCM Lane LOS	B	A	E	C	-	-
HCM 95th %tile Q(veh)	0.5	-	0.8	1.1	-	-

Intersection

Int Delay, s/veh 2.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	301	18	11	46	4	95
Future Vol, veh/h	301	18	11	46	4	95
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	334	20	12	51	4	106

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	354
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	4.12
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	2.218
Pot Cap-1 Maneuver	-	-	1205
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	-	-	1205
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	694	-	-	1205	-
HCM Lane V/C Ratio	0.159	-	-	0.01	-
HCM Control Delay (s)	11.2	-	-	8	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0	-

Intersection

Int Delay, s/veh 0.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
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Lane Configurations						
Traffic Vol, veh/h	3	3	8	785	791	9
Future Vol, veh/h	3	3	8	785	791	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	3	9	872	879	10

Major/Minor	Minor2	Major1	Major2
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Conflicting Flow All	1774	884	889	0	-	0
Stage 1	884	-	-	-	-	-
Stage 2	890	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	91	344	762	-	-	-
Stage 1	404	-	-	-	-	-
Stage 2	401	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	89	344	762	-	-	-
Mov Cap-2 Maneuver	89	-	-	-	-	-
Stage 1	395	-	-	-	-	-
Stage 2	401	-	-	-	-	-

Approach	EB	NB	SB
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HCM Control Delay, s	31.8	0.1	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
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Capacity (veh/h)	762	-	141	-	-
HCM Lane V/C Ratio	0.012	-	0.047	-	-
HCM Control Delay (s)	9.8	0	31.8	-	-
HCM Lane LOS	A	A	D	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection

Int Delay, s/veh	0.9					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	12	8	976	855	10
Future Vol, veh/h	14	12	8	976	855	10
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	16	13	9	1084	950	11

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	2058	956	961	0	0
Stage 1	956	-	-	-	-
Stage 2	1102	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	61	313	716	-	-
Stage 1	373	-	-	-	-
Stage 2	318	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	59	313	716	-	-
Mov Cap-2 Maneuver	59	-	-	-	-
Stage 1	361	-	-	-	-
Stage 2	318	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	59.5	0.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	716	-	94	-	-
HCM Lane V/C Ratio	0.012	-	0.307	-	-
HCM Control Delay (s)	10.1	0	59.5	-	-
HCM Lane LOS	B	A	F	-	-
HCM 95th %tile Q(veh)	0	-	1.2	-	-

Intersection

Int Delay, s/veh 4.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	29	114	109	703	704	112
Future Vol, veh/h	29	114	109	703	704	112
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	32	127	121	781	782	124

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1867	844	906	0	-	0
Stage 1	844	-	-	-	-	-
Stage 2	1023	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	80	363	751	-	-	-
Stage 1	422	-	-	-	-	-
Stage 2	347	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	57	363	751	-	-	-
Mov Cap-2 Maneuver	57	-	-	-	-	-
Stage 1	302	-	-	-	-	-
Stage 2	347	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	42.5	1.4	0
HCM LOS	E		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	751	-	57	363	-	-
HCM Lane V/C Ratio	0.161	-	0.565	0.349	-	-
HCM Control Delay (s)	10.7	0	130.5	20.1	-	-
HCM Lane LOS	B	A	F	C	-	-
HCM 95th %tile Q(veh)	0.6	-	2.3	1.5	-	-

Intersection

Int Delay, s/veh	4.9					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	26	83	98	901	794	82
Future Vol, veh/h	26	83	98	901	794	82
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	0	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	29	92	109	1001	882	91

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	2147	928	973	0	0
Stage 1	928	-	-	-	-
Stage 2	1219	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	53	325	709	-	-
Stage 1	385	-	-	-	-
Stage 2	279	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	35	325	709	-	-
Mov Cap-2 Maneuver	35	-	-	-	-
Stage 1	252	-	-	-	-
Stage 2	279	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	79.4	1.1	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	709	-	35	325	-	-
HCM Lane V/C Ratio	0.154	-	0.825	0.284	-	-
HCM Control Delay (s)	11	0	267.9	20.4	-	-
HCM Lane LOS	B	A	F	C	-	-
HCM 95th %tile Q(veh)	0.5	-	2.9	1.1	-	-

NHDOT TRAFFIC VOLUMES ON EPPING ROAD

NHDOT Traffic Volumes on Epping Road

Location ID: 82153064

Epping Road, south of NH 101 Exit 9 (North of project site)

Saturday 7/21/2012 – 10,769 vpd

SAT Midday Peak Period (12-1pm) – 937 vehicles

Thursday 7/19/2012 – 14,644 vpd

AM Peak Period (7-8am) – 1,007 vehicles

PM Peak Period (4-5pm) – 1,237 vehicles

Location ID: 82153103

Epping Road, north of NH 111A (South of project site)

Saturday 7/24/2010 – 8,101 vpd

SAT Midday Peak Period (12-1pm) – 767 vehicles

Monday 7/26/2010 – 11,081 vpd

AM Peak Period (8-9am) – 731 vehicles

PM Peak Period (4-5pm) – 920 vehicles

Friday 7/23/2010 – 11,259 vpd

AM Peak Period (8-9am) – 687 vehicles

PM Peak Period (4-5pm) – 901 vehicles

UPDATED SIGHT DISTANCE DATA

UPDATED TABLE 4
Sight Distance Summary

Location/Direction	Stopping Sight Distance (feet)		Intersection Sight Distance (feet)		
	Measured	Minimum Required ^a	Measured	Minimum Required ^b	Desirable ^c
Epping Road at Site Driveway:					
<i>North of intersection (SB)</i>	500+	305	500+	305	290
<i>South of intersection (NB)</i>	500+	325	500+	325	355
Continental Dr at Site Driveway:					
<i>East of intersection (WB)</i>	125 ^d	120	125 ^d	120	355
<i>West of intersection (EB)</i>	450	140	365	140	290

^a Values based on AASHTO requirements for minimum SSD based on 85th percentile speeds; 40 mph (SB) and 42 mph (NB) on Epping Road and 21 mph (WB) and 23 mph (EB) on Continental Drive.

^b Values based on AASHTO requirements for SSD.

^c Values based on AASHTO requirements for ISD for posted speed of 30 mph on Epping Road and Continental Drive.

^d Measurement to end of roadway.

VEHICLE SPEED CALCULATION WORKSHEET

Location: Continental Drive, west of Epping Road
 Project: Retail Motor Fuel Outlet - Exeter, NH
 Weather: Sunny/Cloudy - 80's

Date: 7/6/2021
 Time: 12:00 PM
 Job #: NEX-2020283.00

Eastbound Speed (mph)	Westbound Speed (mph)
22	13
23	20
16	23
17	14
18	19
18	19
23	18
25	16
18	18
15	16
17	18
11	20
18	23
22	20
21	17
23	21
24	21
17	15
15	17
15	18
14	18
17	11
16	14
15	22
23	15
20	18
23	17
14	17
15	17
13	19
22	16
17	17
19	16
18	21
15	21
20	18
24	17
21	20
17	19
15	15
20	16
17	17
14	20
20	18
15	15
19	22
15	
16	
21	
20	

<u>18</u>	<u>18</u>	= Average Speeds
23	21	= 85th Percentile Speeds

AASHTO Recommended Sight Distance Summary (Passenger Vehicles)

LOCATION: Continental Drive at Site Driveway

Side Street Direction: NB
 Number of Lanes on Mainline = 3
 Median Width (Feet) = 0

STOPPING SIGHT DISTANCE

Mainline Direction: EB
 85th Percentile Speed (V) = 23 MPH
 Grade (G) = -2.0%
 Apply Grade Adjustment Yes
 Brake Reaction Time (T) = 2.5 seconds
 Deceleration Rate (A) = 11.2 ft/s²
 SSD = 1.47 V * T + 1.075 V²/A = 139 FT

SSD =	140 FT
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Mainline Direction: WB
 85th Percentile Speed (V) = 21 MPH
 Grade (G) = 2.0%
 Apply Grade Adjustment Yes
 Brake Reaction Time (T) = 2.5 seconds
 Deceleration Rate (A) = 11.2 ft/s²
 SSD = 1.47 V * T + 1.075 V²/A = 118 FT

SSD =	120 FT
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INTERSECTION SIGHT DISTANCE

RIGHT TURN FROM STOP: West of Driveway
 Posted Speed (V) = 30 MPH
 Minor Street Approach Grade (G) = 0.0%
 Apply Grade Adjustment No
 Time Gap (t_g) = 6.5 seconds
 ISD (Right Turn from Stop) = 1.47 * t_g * V = 287 FT

ISD (Right Turn from Stop) =	290 FT
-------------------------------------	---------------

LEFT TURN FROM STOP: East of Driveway
 Posted Speed (V) = 30 MPH
 Minor Street Approach Grade (G) = 0.0%
 Apply Grade Adjustment No
 Time Gap (t_g) = 8 seconds
 ISD (Left Turn from Stop) = 1.47 * t_g * V = 353 FT

ISD (Left Turn from Stop) =	355 FT
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AASHTO Recommended Sight Distance Summary (Passenger Vehicles)

LOCATION: Epping Road at Site Driveway

Side Street Direction: EB
 Number of Lanes on Mainline = 3
 Median Width (Feet) = 0

STOPPING SIGHT DISTANCE

Mainline Direction: SB
 85th Percentile Speed (V) = 40 MPH
 Grade (G) = 0.2%
 Apply Grade Adjustment No
 Brake Reaction Time (T) = 2.5 seconds
 Deceleration Rate (A) = 11.2 ft/s²
 SSD = 1.47 V * T + 1.075 V²/A = 301 FT

SSD =	305 FT
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Mainline Direction: NB
 85th Percentile Speed (V) = 42 MPH
 Grade (G) = -0.2%
 Apply Grade Adjustment No
 Brake Reaction Time (T) = 2.5 seconds
 Deceleration Rate (A) = 11.2 ft/s²
 SSD = 1.47 V * T + 1.075 V²/A = 325 FT

SSD =	325 FT
--------------	---------------

INTERSECTION SIGHT DISTANCE

RIGHT TURN FROM STOP: North of Driveway
 Posted Speed (V) = 30 MPH
 Minor Street Approach Grade (G) = 0.0%
 Apply Grade Adjustment No
 Time Gap (t_g) = 6.5 seconds
 ISD (Right Turn from Stop) = 1.47 * t_g * V = 287 FT

ISD (Right Turn from Stop) =	290 FT
-------------------------------------	---------------

LEFT TURN FROM STOP: South of Driveway
 Posted Speed (V) = 30 MPH
 Minor Street Approach Grade (G) = 0.0%
 Apply Grade Adjustment No
 Time Gap (t_g) = 8 seconds
 ISD (Left Turn from Stop) = 1.47 * t_g * V = 353 FT

ISD (Left Turn from Stop) =	355 FT
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RESPONSE TO COMMENTS

Retail Motor Fuel Outlet – Exeter, New Hampshire

DRIVE-THROUGH DATA

GPI Project #:
 Londonderry, NH
 Client: John DeBarros



Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-443-5636
F: 617-801-3300
www.tsetraffic.com

File Name : Rockingham
 Site Code : 124Rocki
 Start Date : 4/17/2014
 Page No : 1

L n.	No.	Joined Queue	Released From Queue	Delay
1	4	7:00:31 AM	7:02:46 AM	135
1	5	7:00:31 AM	7:02:59 AM	148
1	6	7:00:47 AM	7:03:22 AM	155
1	7	7:01:59 AM	7:03:38 AM	99
1	8	7:02:26 AM	7:04:08 AM	102
1	9	7:02:26 AM	7:05:05 AM	159
1	10	7:02:57 AM	7:05:35 AM	158
1	11	7:03:06 AM	7:06:05 AM	179
1	12	7:03:39 AM	7:06:32 AM	173
1	13	7:04:39 AM	7:07:22 AM	163
1	14	7:05:32 AM	7:07:36 AM	124
1	15	7:05:51 AM	7:08:36 AM	165
1	16	7:06:19 AM	7:08:58 AM	159
1	17	7:06:45 AM	7:09:11 AM	146
1	18	7:07:34 AM	7:09:39 AM	125
1	19	7:07:38 AM	7:10:02 AM	144
1	20	7:08:24 AM	7:10:22 AM	118
1	21	7:09:21 AM	7:12:03 AM	162
1	22	7:10:41 AM	7:12:20 AM	99
1	23	7:10:47 AM	7:12:29 AM	102
1	24	7:10:51 AM	7:13:16 AM	145
1	25	7:11:17 AM	7:13:45 AM	148
1	26	7:11:46 AM	7:13:54 AM	128
1	27	7:11:57 AM	7:15:00 AM	183
1	28	7:12:09 AM	7:16:33 AM	264
1	29	7:13:50 AM	7:17:12 AM	202

Summary Information:

7:00:00 AM - 7:15:00 AM	Drive-Thru
Total Vehicle Count:	26
Delayed Vehicle Count:	26
Through Vehicle Count:	0
Average Stopped Time:	149.42
Maximum Stopped Time:	264
Min. Secs. for Delay:	0
Average Queue:	3.88
Queue Density:	3.88
Maximum Queue:	7
Delay in Vehicle Hour:	3.88
Total Delay:	3885

L n.	No.	Joined Queue	Released From Queue	Delay
1	30	7:15:03 AM	7:17:44 AM	161
1	31	7:15:30 AM	7:18:01 AM	151
1	32	7:15:56 AM	7:18:47 AM	171
1	33	7:16:05 AM	7:18:58 AM	173
1	34	7:16:08 AM	7:19:29 AM	201
1	35	7:17:22 AM	7:22:04 AM	282
1	36	7:17:23 AM	7:22:16 AM	293
1	37	7:17:59 AM	7:22:49 AM	290
1	38	7:18:54 AM	7:23:33 AM	279
1	39	7:19:14 AM	7:24:08 AM	294
1	40	7:19:38 AM	7:24:29 AM	291
1	41	7:20:27 AM	7:25:17 AM	290
1	42	7:21:41 AM	7:25:49 AM	248
1	43	7:22:15 AM	7:26:21 AM	246
1	44	7:22:22 AM	7:26:31 AM	249
1	45	7:24:22 AM	7:27:14 AM	172
1	46	7:24:39 AM	7:27:45 AM	186
1	47	7:25:25 AM	7:28:28 AM	183
1	48	7:25:26 AM	7:29:05 AM	219
1	49	7:26:46 AM	7:29:42 AM	176
1	50	7:26:56 AM	7:30:05 AM	189
1	51	7:26:59 AM	7:30:43 AM	224
1	52	7:27:17 AM	7:31:10 AM	233
1	53	7:28:23 AM	7:32:01 AM	218
1	54	7:29:15 AM	7:32:21 AM	186



L n.	No.	Joined Queue	Released From Queue	Delay
1	55	7:29:52 AM	7:32:56 AM	184
1	56	7:29:53 AM	7:33:22 AM	209

Summary Information:

7:15:00 AM - 7:30:00 AM	Drive-Thru
Total Vehicle Count:	27
Delayed Vehicle Count:	27
Through Vehicle Count:	0
Average Stopped Time:	222.15
Maximum Stopped Time:	294
Min. Secs. for Delay:	0
Average Queue:	5.46
Queue Density:	5.46
Maximum Queue:	8
Delay in Vehicle Hour:	5.46
Total Delay:	5998

L n.	No.	Joined Queue	Released From Queue	Delay
1	57	7:30:52 AM	7:34:02 AM	190
1	58	7:31:23 AM	7:34:35 AM	192
1	59	7:31:42 AM	7:34:54 AM	192
1	60	7:32:12 AM	7:36:03 AM	231
1	61	7:33:29 AM	7:36:38 AM	189
1	62	7:34:27 AM	7:37:30 AM	183
1	63	7:34:48 AM	7:38:41 AM	233
1	64	7:35:21 AM	7:40:13 AM	292
1	65	7:36:09 AM	7:40:54 AM	285
1	66	7:37:11 AM	7:41:51 AM	280
1	67	7:38:12 AM	7:42:54 AM	282
1	68	7:38:16 AM	7:43:04 AM	288
1	69	7:39:21 AM	7:43:33 AM	252
1	70	7:40:20 AM	7:43:52 AM	212
1	71	7:41:04 AM	7:45:54 AM	290
1	72	7:41:05 AM	7:46:52 AM	347
1	73	7:42:41 AM	7:47:05 AM	264
1	74	7:44:03 AM	7:48:09 AM	246
1	75	7:44:04 AM	7:49:11 AM	307
1	76	7:44:06 AM	7:49:44 AM	338

Summary Information:

7:30:00 AM - 7:45:00 AM	Drive-Thru
Total Vehicle Count:	20
Delayed Vehicle Count:	20
Through Vehicle Count:	0
Average Stopped Time:	254.65
Maximum Stopped Time:	347
Min. Secs. for Delay:	0
Average Queue:	4.50
Queue Density:	4.50
Maximum Queue:	7
Delay in Vehicle Hour:	4.50
Total Delay:	5093

L n.	No.	Joined Queue	Released From Queue	Delay
1	77	7:45:32 AM	7:50:33 AM	301
1	78	7:47:09 AM	7:50:41 AM	212
1	79	7:48:25 AM	7:51:54 AM	209
1	80	7:48:45 AM	7:52:29 AM	224
1	81	7:49:14 AM	7:52:47 AM	213
1	82	7:49:55 AM	7:53:20 AM	205
1	83	7:50:37 AM	7:54:04 AM	207
1	84	7:50:57 AM	7:55:26 AM	269
1	85	7:51:34 AM	7:56:17 AM	283
1	86	7:52:21 AM	7:56:31 AM	250
1	87	7:52:34 AM	7:57:02 AM	268
1	88	7:53:59 AM	7:57:34 AM	215
1	89	7:54:25 AM	7:57:55 AM	210



Traffic Survey Expedition
106 Sharon Road
N. Quincy, MA 02171
P: 617-448-5686
F: 617-301-3800
www.tsetraffic.com

File Name : Rockingham
 Site Code : 124Rocki
 Start Date : 4/17/2014
 Page No : 3

L n.	No.	Joined Queue	Released From Queue	Delay
1	90	7:54:26 AM	7:59:26 AM	300
1	91	7:56:47 AM	8:00:07 AM	200
1	92	7:57:29 AM	8:01:11 AM	222
1	93	7:57:49 AM	8:01:49 AM	240
1	94	7:58:18 AM	8:02:33 AM	255
1	95	7:59:32 AM	8:05:07 AM	335

Summary Information:

7:45:00 AM - 8:00:00 AM	Drive-Thru
Total Vehicle Count:	19
Delayed Vehicle Count:	19
Through Vehicle Count:	0
Average Stopped Time:	243.05
Maximum Stopped Time:	335
Min. Secs. for Delay:	0
Average Queue:	3.93
Queue Density:	3.93
Maximum Queue:	7
Delay in Vehicle Hour:	3.93
Total Delay:	4618

L n.	No.	Joined Queue	Released From Queue	Delay
1	96	8:01:56 AM	8:05:25 AM	209
1	97	8:02:00 AM	8:05:34 AM	214
1	98	8:02:04 AM	8:06:43 AM	279
1	99	8:03:01 AM	8:07:03 AM	242
1	100	8:03:23 AM	8:07:24 AM	241
1	101	8:04:30 AM	8:08:21 AM	231
1	102	8:05:32 AM	8:08:50 AM	198
1	103	8:06:11 AM	8:09:36 AM	205
1	104	8:06:12 AM	8:09:55 AM	223
1	105	8:06:22 AM	8:10:21 AM	239
1	106	8:07:29 AM	8:10:50 AM	201
1	107	8:07:30 AM	8:11:09 AM	219
1	108	8:08:11 AM	8:11:57 AM	226
1	109	8:08:34 AM	8:12:31 AM	237
1	110	8:09:45 AM	8:13:00 AM	195
1	111	8:10:05 AM	8:13:08 AM	183
1	112	8:10:33 AM	8:13:44 AM	191
1	113	8:10:47 AM	8:14:33 AM	226
1	114	8:12:07 AM	8:16:41 AM	274
1	115	8:12:07 AM	8:17:16 AM	309
1	116	8:12:57 AM	8:17:58 AM	301
1	117	8:13:15 AM	8:20:04 AM	409
1	118	8:14:11 AM	8:21:49 AM	458
1	119	8:14:12 AM	8:22:04 AM	472

Summary Information:

8:00:00 AM - 8:15:00 AM	Drive-Thru
Total Vehicle Count:	24
Delayed Vehicle Count:	24
Through Vehicle Count:	0
Average Stopped Time:	257.58
Maximum Stopped Time:	472
Min. Secs. for Delay:	0
Average Queue:	5.12
Queue Density:	5.12
Maximum Queue:	8
Delay in Vehicle Hour:	5.12
Total Delay:	6182

L n.	No.	Joined Queue	Released From Queue	Delay
1	120	8:15:06 AM	8:22:20 AM	434
1	121	8:15:57 AM	8:22:49 AM	412
1	122	8:16:58 AM	8:24:46 AM	468
1	123	8:17:34 AM	8:25:14 AM	460
1	124	8:17:51 AM	8:25:38 AM	467



L n.	No.	Joined Queue	Released From Queue	Delay
1	125	8:19:20 AM	8:26:25 AM	425
1	126	8:19:56 AM	8:27:12 AM	436
1	127	8:21:57 AM	8:27:29 AM	332
1	128	8:22:29 AM	8:28:09 AM	340
1	129	8:23:40 AM	8:28:34 AM	294
1	130	8:24:19 AM	8:29:14 AM	295
1	131	8:26:31 AM	8:30:02 AM	211
1	132	8:29:38 AM	8:30:38 AM	60

Summary Information:

8:15:00 AM - 8:30:00 AM	Drive-Thru
Total Vehicle Count:	13
Delayed Vehicle Count:	13
Through Vehicle Count:	0
Average Stopped Time:	356.46
Maximum Stopped Time:	468
Min. Secs. for Delay:	0
Average Queue:	4.97
Queue Density:	4.98
Maximum Queue:	9
Delay in Vehicle Hour:	4.97
Total Delay:	4634

L n.	No.	Joined Queue	Released From Queue	Delay
1	133	8:30:01 AM	8:31:22 AM	81
1	134	8:30:08 AM	8:32:08 AM	120
1	135	8:30:44 AM	8:33:01 AM	137
1	136	8:31:35 AM	8:33:22 AM	107
1	137	8:31:42 AM	8:33:38 AM	116
1	138	8:32:02 AM	8:33:57 AM	115
1	139	8:33:37 AM	8:36:06 AM	149
1	140	8:33:54 AM	8:36:22 AM	148
1	141	8:34:49 AM	8:36:32 AM	103
1	142	8:34:54 AM	8:37:49 AM	175
1	143	8:34:58 AM	8:40:04 AM	306
1	144	8:35:32 AM	8:41:44 AM	372
1	145	8:37:11 AM	8:43:07 AM	356
1	146	8:38:31 AM	8:43:36 AM	305
1	147	8:39:28 AM	8:43:57 AM	269
1	148	8:40:19 AM	8:44:15 AM	236
1	149	8:40:32 AM	8:44:43 AM	251
1	150	8:41:52 AM	8:45:14 AM	202
1	151	8:42:08 AM	8:45:47 AM	219
1	152	8:43:06 AM	8:46:14 AM	188
1	153	8:43:51 AM	8:46:43 AM	172
1	154	8:44:13 AM	8:47:06 AM	173

Summary Information:

8:30:00 AM - 8:45:00 AM	Drive-Thru
Total Vehicle Count:	22
Delayed Vehicle Count:	22
Through Vehicle Count:	0
Average Stopped Time:	195.45
Maximum Stopped Time:	372
Min. Secs. for Delay:	0
Average Queue:	4.19
Queue Density:	4.20
Maximum Queue:	8
Delay in Vehicle Hour:	4.20
Total Delay:	4300

L n.	No.	Joined Queue	Released From Queue	Delay
1	155	8:45:32 AM	8:47:28 AM	116
1	156	8:45:37 AM	8:48:14 AM	157
1	157	8:46:26 AM	8:48:27 AM	121
1	158	8:46:39 AM	8:48:58 AM	139
1	159	8:49:52 AM	8:51:35 AM	103



Traffic Survey Expedition
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File Name : Rockingham
 Site Code : 124Rocki
 Start Date : 4/17/2014
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L n.	No.	Joined Queue	Released From Queue	Delay
1	160	8:50:08 AM	8:51:44 AM	96
1	161	8:50:35 AM	8:52:55 AM	140
1	162	8:50:49 AM	8:53:41 AM	172
1	163	8:52:25 AM	8:56:07 AM	222
1	164	8:52:33 AM	8:56:38 AM	245
1	165	8:54:25 AM	8:57:53 AM	208

Summary Information:

8:45:00 AM - 9:00:00 AM	Drive-Thru
Total Vehicle Count:	12
Delayed Vehicle Count:	12
Through Vehicle Count:	0
Average Stopped Time:	157.08
Maximum Stopped Time:	245
Min. Secs. for Delay:	0
Average Queue:	2.12
Queue Density:	2.26
Maximum Queue:	4
Delay in Vehicle Hour:	2.13
Total Delay:	1885

Summary Information:

7:00:00 AM - 9:00:00 AM	Drive-Thru
Total Vehicle Count:	163
Delayed Vehicle Count:	163
Through Vehicle Count:	0
Average Stopped Time:	224.51
Maximum Stopped Time:	472
Min. Secs. for Delay:	0
Average Queue:	5.09
Queue Density:	5.13
Maximum Queue:	10
Delay in Vehicle Hour:	5.09
Total Delay:	36595



INNOVATIVE DATA, LLC.
50 ALDEN AVENUE
BELCHERTOWN, MA 01007

Summary of Dunkin Donuts
Drive Thru Queue Study –
Greenfield, Massachusetts

Dates: Tuesday 5.31.16
Thursday 6.9.16
AM Peak: 7 am to 9 am

Summary of Queue Activity @ 295 Federal Street (within Sunoco facility)
Thursday, June 9, 2016

Interval Start Time	Vehicle Count	Average Delay	Max Delay	Min Delay	Total Delay (in seconds)	Average Queue	Max Queue	Min Queue
7:00	18	190.67	278	77	3432	3.89	6	1
7:15	18	195.11	378	43	3512	3.39	6	2
7:30	13	285.15	400	203	3707	5.23	7	3
7:45	18	243.28	380	64	4379	6.28	10	1
8:00	13	171.23	247	49	2226	3.23	5	1
8:15	14	155.14	227	92	2172	3.14	7	1
8:30	14	120.57	205	70	1688	2.29	4	1
8:45	9	177.22	269	130	1595	3.78	6	1
Total	117	194.11	400	43	22711	3.97	10	1



INNOVATIVE DATA, LLC.
50 ALDEN AVENUE
BELCHERTOWN, MA 01007

Summary of Dunkin Donuts
 Drive Thru Queue Study –
 Greenfield, Massachusetts

Dates: Tuesday 5.31.16
 Thursday 6.9.16
 AM Peak: 7 am to 9 am

Raw Data for Queue Activity @ 295 Federal Street (within Sunoco facility)
Thursday, June 9, 2016

Vehicle Count	Arrival Time			Departure Time			Delay (in sec)	Queue
	Hour	Min	Sec	Hour	Min	Sec		
1	7	0	10	7	2	50	160	1
2	7	0	18	7	3	31	193	2
3	7	0	42	7	3	57	195	3
4	7	0	52	7	4	55	243	4
5	7	2	33	7	6	9	216	5
6	7	2	40	7	7	18	278	6
7	7	3	15	7	7	48	273	6
8	7	4	8	7	8	30	262	5
9	7	6	3	7	8	56	173	5
10	7	6	9	7	9	16	187	6
11	7	6	12	7	9	45	213	6
12	7	8	50	7	10	7	77	4
13	7	10	7	7	11	34	87	2
14	7	10	10	7	12	39	149	2
15	7	10	23	7	14	4	221	3
16	7	11	47	7	15	15	208	3
17	7	12	23	7	15	40	197	4
18	7	14	40	7	16	20	100	3
19	7	15	53	7	17	35	102	2
20	7	16	0	7	18	20	140	3
21	7	16	5	7	19	36	211	4
22	7	18	41	7	20	0	79	2
23	7	18	45	7	20	45	120	3
24	7	18	50	7	21	12	142	4
25	7	20	44	7	21	52	68	3
26	7	21	39	7	22	22	43	2
27	7	21	42	7	23	37	115	3
28	7	21	45	7	24	25	160	4
29	7	22	17	7	25	1	164	4
30	7	24	34	7	26	45	131	2
31	7	24	38	7	29	35	297	3
32	7	25	15	7	31	2	347	3
33	7	25	47	7	32	5	378	4
34	7	27	15	7	32	38	323	4
35	7	27	17	7	33	27	370	5
36	7	28	42	7	34	4	322	6

37	7	30	36	7	37	3	387	6
38	7	33	27	7	38	12	285	4
39	7	34	21	7	39	3	282	3
40	7	35	18	7	39	29	251	4
41	7	36	10	7	40	2	232	5
42	7	37	1	7	41	1	240	6
43	7	38	41	7	42	4	203	5
44	7	39	1	7	42	30	209	6
45	7	39	18	7	43	27	249	6
46	7	40	41	7	45	3	262	5
47	7	41	15	7	47	2	347	5
48	7	41	41	7	47	41	360	6
49	7	41	45	7	48	25	400	7
50	7	45	20	7	48	55	215	4
51	7	45	22	7	50	31	309	5
52	7	45	27	7	50	48	321	6
53	7	45	32	7	51	24	352	7
54	7	45	37	7	51	57	380	8
55	7	46	30	7	52	21	351	9
56	7	47	45	7	52	35	290	8
57	7	49	10	7	52	59	229	7
58	7	49	33	7	53	31	238	8
59	7	49	45	7	53	55	250	9
60	7	49	55	7	55	19	324	10
61	7	50	32	7	55	43	311	10
62	7	50	58	7	56	2	304	10
63	7	55	37	7	56	41	64	3
64	7	55	49	7	57	30	101	3
65	7	58	21	7	59	35	74	1
66	7	59	23	8	1	25	122	2
67	7	59	28	8	1	52	144	3
68	8	0	6	8	2	55	169	3
69	8	1	17	8	5	22	245	4
70	8	1	54	8	5	52	238	3
71	8	2	59	8	6	11	192	3
72	8	3	8	8	6	40	212	4
73	8	4	48	8	8	55	247	5
74	8	7	5	8	9	41	156	2
75	8	7	11	8	10	21	190	3
76	8	8	48	8	10	53	125	4
77	8	9	3	8	11	34	151	4
78	8	10	52	8	12	29	97	3
79	8	11	4	8	13	39	155	3
80	8	14	27	8	15	16	49	1
81	8	16	27	8	17	59	92	1
82	8	17	8	8	18	54	106	2
83	8	18	27	8	20	24	117	2
84	8	18	50	8	20	41	111	3

85	8	19	30	8	22	36	186	3
86	8	20	48	8	23	9	141	2
87	8	20	54	8	23	45	171	3
88	8	21	10	8	24	21	191	4
89	8	21	18	8	24	47	209	5
90	8	22	1	8	25	15	194	6
91	8	22	6	8	25	53	227	7
92	8	28	50	8	30	41	111	1
93	8	29	31	8	32	6	155	2
94	8	29	57	8	32	38	161	3
95	8	31	21	8	32	59	98	3
96	8	33	3	8	34	49	106	1
97	8	33	33	8	35	43	130	2
98	8	33	51	8	36	40	169	3
99	8	35	32	8	37	20	108	3
100	8	38	14	8	39	38	84	1
101	8	38	21	8	39	55	94	2
102	8	38	26	8	40	51	145	3
103	8	40	15	8	41	45	90	2
104	8	41	4	8	42	14	70	2
105	8	43	25	8	44	44	79	1
106	8	44	22	8	46	48	146	2
107	8	44	35	8	47	19	164	3
108	8	44	38	8	48	3	205	4
109	8	46	34	8	48	52	138	4
110	8	46	48	8	49	18	150	5
111	8	46	57	8	50	15	198	5
112	8	47	55	8	51	50	235	5
113	8	47	59	8	52	28	269	6
114	8	51	31	8	53	41	130	3
115	8	51	33	8	54	2	149	4
116	8	54	37	8	57	38	181	1
117	8	57	43	9	0	8	145	1

420 Newbury St (Route 1), Danvers MA - Queue

10/31/13

7:00	5
7:05	0
7:10	3
7:13	6
7:15	8
7:17	6
7:18	7
7:19	8
7:20	7
7:22	4
7:24	4
7:25	5
7:26	5
7:28	7
7:29	4
7:30	3
7:31	4

8:12	8
8:14	8
8:15	9
8:17	7
8:19	6
8:20	6
8:22	4
8:24	1
8:26	4
8:27	5
8:28	3
8:29	4
8:30	6
8:33	5
8:35	5
8:36	6
8:38	6
8:40	6
8:42	4
8:43	7
8:44	5
8:45	3
8:46	5

3.2 Car Washes

Data collection was done at six car washes with drive-through services (including one full-service car wash) in February 2012. Twelve days of data were collected. The car washes were located in the cities of Falcon Heights, Hopkins, Minneapolis, Roseville and St. Louis Park, MN. Five of the six car washes (excluding the full-service car wash) were located at gas stations. Only the vehicles waiting in line were counted; vehicles being washed were not added to the queue.

Table 3.2 – Drive-Through Car Wash Maximum Queue Statistics

Number of Data Points	12
Average Maximum Queue (Vehicles)	4.42
Standard Deviation (Vehicles)	2.31
Coefficient of Variation	52%
Range (Vehicles)	1 to 10
85 th Percentile (Vehicles)	6.20
33 rd Percentile (Vehicles)	3.00

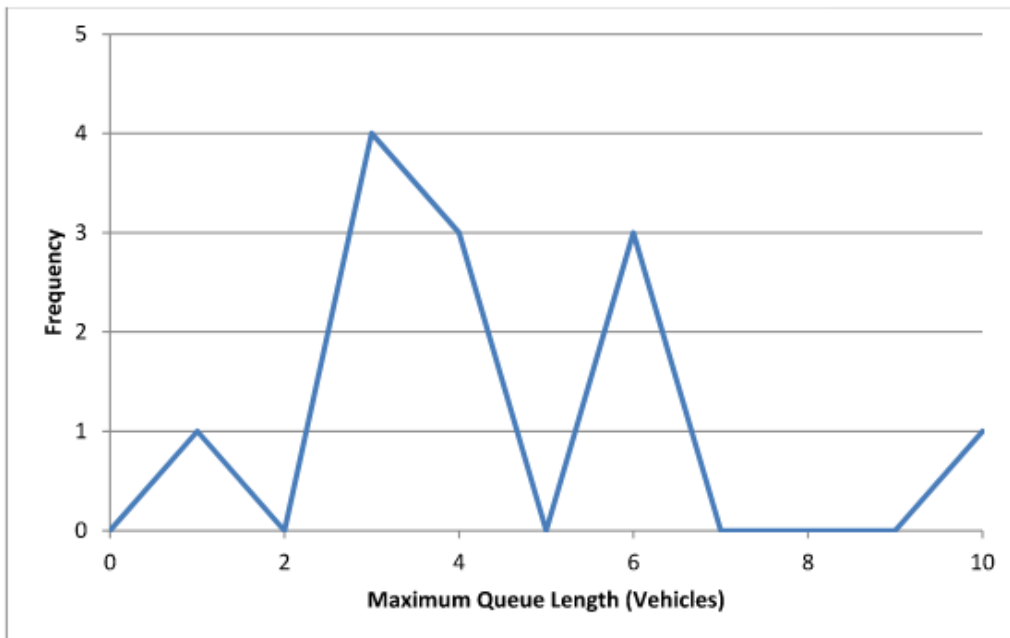


Figure 3.2 – Drive-Through Car Wash Maximum Queue Frequency

Two of the car washes had two lanes while the other four were one lane car washes. The full-service car wash had two lanes and also produced the highest maximum queue of 10 vehicles. The maximum queues for car washes were spread throughout the afternoon from 12:30pm to 8:30pm. With an 85th percentile maximum queue of more than six vehicles, the data suggests that car washes with drive-through lanes should be able to accommodate 140 feet of vehicle stacking throughout the day.