KD Anderson & Associates, Inc.
Transportation Engineers

February 16, 2018

Ms. Tiffany Wilson
**RSC Engineering, Inc.**
2250 Douglas Blvd., Suite 150
Roseville, CA 95661

**RE: REVISED ACCESS ASSESSMENT FOR PLACER CREEK APARTMENTS ON UNIVERSITY AVENUE, ROCKLIN, CA**

Dear Ms. Wilson:

Thank you for contacting our firm regarding access to the Placer Creek Apartments. As we have discussed, you are interested in confirming the feasibility of full signalized access and a second left-turn-in access on University Avenue in the area between Whitney Ranch Parkway and Larkspur Drive as shown in Figure 1. The area's General Development Plan includes retail commercial and office uses with potentially competing access requirements on the other side of University Avenue, including a northbound left turn lane that could share the space needed for a southbound left turn lane into the apartments at the signal. To evaluate feasibility this investigation of conditions accompanying buildout of the area was prepared to determine whether all movements can be accommodated.

**Approach.** The assessment involved these steps:

1. Identified "build out" p.m. peak hour trip generation for the parcels taking access to University Avenue in the area of the Placer Creek Apartments.

2. Reviewed long term p.m. peak hour traffic volumes for the University Avenue / Whitney Ranch Parkway intersection contained in the traffic study prepared for the Northwest Rocklin Area General Development Plan (NRAGDP)[1] to identify baseline future volumes with build out of the area.

3. Assigned locally generated traffic based on the travel characteristics in the NRAGDP study to create composite long term p.m. peak hour traffic volumes.

4. Calculated operating Levels of Service and estimated queue lengths at study access locations.

5. Identified the left turn lane storage requirements in left turn lanes based on anticipated queue lengths and deceleration requirements.

[1] Final Transportation Impact Analysis for the Northwest Rocklin Area General Development Plan, Fehr & Peers, May 5, 2016

6. Evaluated the sight distance assuming full signalized access based on the obstructions created by median landscaping and roadway curvature.

**Development Characteristics.** Figure 2 identifies the location of Placer Creek Apartments and the other properties west of University Avenue that will take access via the local area intersections. For the purposes of this analysis, the uses in these areas were assumed as noted in Table 1.

**TABLE 1**
**STUDY AREA LAND USES**

| Description | Quantity |
|---|---|
| Placer Creek Apartments | 242 apartment dwelling units |
| Westside Retail | 195 ksf of retail commercial buildings |
| Westside Hotel | 120 room hotel |
| Westside Office / Professional | 410 ksf of office space in areas 4, 5, 8 and 9 |

***Trip Generation Rates.*** Because the NRAGDP analysis is limited to the p.m. peak hour, a trip generation forecast for that period was conducted for study area land uses. Table 2 identifies applicable trip generation rates for these uses.

**TABLE 2**
**TRIP GENERATION RATES**

| Description | Unit | PM Peak Hour Trips per Unit | | |
|---|---|---|---|---|
| | | In | Out | Total |
| Apartments | du | 65% | 35% | 0.62 |
| Retail Commercial | Ksf | 48% | 52% | 3.71 |
| Hotel | Room | 51% | 49% | 0.60 |
| Office Park | 200 ksf | 12% | 88% | 1.49 |

***Trip Generation Forecasts.*** These rates were applied to the land use inventory to create the trip generation forecasts shown in Table 3.

| TABLE 3<br>TRIP GENERATION FORECASTS | | | | |
|---|---|---|---|---|
| **Description** | **Quantity** | **PM Peak Hour Trips per Unit** | | |
| | | **In** | **Out** | **Total** |
| Apartments | 242 du | 97 | 53 | 150 |
| Retail Commercial | 195 ksf | 347 | 376 | 723 |
| Pass-by Trips | | 104 | 113 | 217 |
| Net New Trips | | 243 | 263 | 506 |
| Hotel | 120 rooms | 37 | 35 | 72 |
| Office Park | 410 ksf | 73 | 538 | 611 |
| Gross Total Trips | | 554 | 1,002 | 1,556 |
| Pass-by Trips | | 104 | 113 | 217 |
| Net External Trips | | 550 | 889 | 1,339 |

***Trip Distribution.*** The identified local area trips were assigned to the study area intersections based on a general directional distribution that reflects the location of complimentary land uses and proximity to SR 65 via the Whitney Ranch Parkway interchange and is consistent with the results of the NRAGDP study.

| TABLE 4<br>TRIP DISTRIBUTION ASSUMPTIONS | | |
|---|---|---|
| **Direction** | **Percentage of Total External Trips** | |
| | **Apartments** | **Non-Residential** |
| West via Whitney Ranch Parkway towards SR 65 | 30% | 35% |
| North on University Avenue | 5% | 10% |
| East via Whitney Ranch Parkway | 25% | 35% |
| West into Retail Commercial / Office | 30% | 0% |
| South on University Avenue | 10% | 20% |
| Total | 100% | 100% |

Pass-by trips for the retail uses were assumed to be split equally between northbound and southbound traffic streams on University Avenue.

***Trip Assignment Assumptions for Retail.*** Locally generated trips were next assigned to the study area circulation system via the local intersections assuming anticipated access controls. Un-signalized midblock University Avenue access was assumed to be limited to left-turns-in-only. Because three points of access are available to the retail area, assumptions were made as to the relative use of each location, as noted in Table 5.

**TABLE 5**
**RETAIL TRIP ASSIGNMENT ASSUMPTIONS**

| Orientation | Direction | Route | Percentage of Total |
|---|---|---|---|
| West on Whitney Ranch Pky | inbound | Right at Whitney Ranch Pky driveway | 75% |
| | | Midblock right turn | 25% |
| | outbound | Right turn at midblock then southbound to northbound U-turn at signal | 25% |
| | | Left turn at signal | 75% |
| East on Whitney Ranch Pky | inbound | Midblock right turn | 50% |
| | | Right at signal | 50% |
| | outbound | Right turn at Whitney Ranch Pky driveway | 50% |
| | | Left turn at signal onto northbound University Ave | 25% |
| | | Right turn at midblock then southbound to northbound U-turn at signal | 25% |
| North on Whitney Ranch Pky | inbound | Midblock right turn | 50% |
| | | Right turn at signal | 50% |
| | outbound | Left turn at signal onto northbound University Ave | 75% |
| | | Right turn at midblock then southbound to northbound U-turn at signal | 25% |
| East to apartments | outbound | Eastbound at signal | 100% |
| | inbound | Westbound at signal | 50% |
| | | Right turn to midblock left turn | 50% |
| South on University Ave | inbound | Midblock left turn | 50% |
| | | Left turn at signal | 50% |
| | outbound | Midblock right turn | 50% |
| | | Right turn at signal | 50% |

**Cumulative Traffic Volume Forecasts.** Figure 3 identifies the long term p.m. peak hour traffic volume forecasts for study area intersections derived from the results of the NRAGDP traffic study and our local assignment. The intersection turning movements presented at the University Avenue / Whitney Ranch Parkway intersection are taken directly from that study, while the volumes at other intersections on University Avenue were balanced with through traffic to match the control volumes entering and exiting the Whitney Ranch Parkway intersections.

**Level of Service Analysis.** The operating Levels of Service at the signalized access intersection and at the midblock location were calculated using HCM 2010 methodology and Synchro software. This choice was made as an alternative to the City's normal approach (i.e., Circular No. 212) since that methodology does not yield estimates of vehicles queues.

Assumptions were made regarding the configuration of each intersection based on the nature of each land use and typical City of Rocklin policies for access to new four lane streets. Separate southbound right turn lanes were assumed at the two points of access to the retail area. A three lane approach to the University Avenue signal was assumed from the retail area, and based on the volume of left turning traffic this approach was assumed to be configured a left turn lane, a combined left plus thru and a separate right turn lane.

As noted, each location is projected to operate with Levels of Service that satisfy the City's minimum LOS C standard.

**TABLE 6**
**CUMULATIVE WITH PROJECT PM PEAK HOUR LEVELS OF SERVICE**

| Location | Control | PM Peak Hour | |
|---|---|---|---|
| | | Average Delay | Level of Service |
| Whitney Ranch Pky / University Ave | Signal | 34.2 | C |
| Apartment Midblock Access<br>(overall)<br>Southbound left turn<br>Westbound right turn | WB Stop | | |
| Retail Midblock Access<br>(overall)<br>Northbound left turn<br>Eastbound right turn | EB Stop | <br>(1.0)<br>8.5<br>10.8 | <br>(A)<br>A<br>C |
| Signalized Access from Apartments and Retail | Signal | 18.4 | B |

**Queueing / Left Turn Pocket Length**. The area between the Whitney Ranch Parkway intersection and the new signaled access will need to accommodate four separate left turn lanes under the proposed configuration. This total distance is 930 feet, and roughly 330 feet is available from the center of the midblock retail access to the crosswalk at the new traffic signal on University Avenue at the south end of the study area.

Desirable left turn pocket lengths can typically be determined from the standards presented in the Caltrans Highway Design Manual (HDM). Caltrans suggests that the combination of left turn lane and bay taper be long enough to hold waiting cars as well as deceleration outside of through travel lanes. If full deceleration from 40 mph is to be accommodated outside of the through travel lane, then the combination of bay taper and left turn lane would need to be 365 feet long to accommodate two waiting vehicles (i.e., 50 feet) plus deceleration to a stop from 40 mph (i.e., 315 feet). Assuming that 20 mph deceleration in advance of the turn pocket is acceptable, then these facilities would need to be at least 170 feet long to accommodate two waiting vehicles (i.e., 50 feet) plus deceleration to a stop from 20 mph (i.e., 120 feet).

While this approach is applicable to high speed roads, the City of Rocklin has typically employed a standard left turn lane length at intersections on new roadways. For example, all the left turn lanes at the signalized Whitney Ranch Parkway / Wildcat Blvd intersection are 220 to 250 feet long and preceded by 160 foot long bay tapers. Left turn lanes at un-signalized median openings can often be shorter, and the combination of turn lane and bay taper is 180 feet at locations on Lone Tree Blvd.

Peak period queue lengths were identified as a byproduct of the Level of Service analysis, and an alternative storage recommendation at un-signalized locations was identified from HDM Chapter 405.2. As noted in Table 7, the two northbound left turn lanes approaching Whitney Ranch Parkway are expected to carry 530 vph. The 95$^{th}$ percentile queue in these lanes would be 9 vehicles or 225 feet.

The northbound left turn at the midblock opening for the retail center is projected to handle 56 vph while 29 vph are expected at the apartment access. HCM 2010 calculation suggests that no appreciable queues will occur. Alternatively, HDM Chapter 405.2 suggests that un-signalized left turn lanes be designed to store a two minute accumulation of entering vehicles. The forecast traffic volumes would require storage for 2 vehicles under these criteria.

The forecast queue in the southbound left turn lane providing signalized access to Placer Creek Apartments has also been identified. A total of 116 vehicles turning left or making U-turns is projected, and a 95$^{th}$ percentile queue of 5 vehicles or 125 feet is anticipated.

**Recommended Left Turn Lane Lengths**. Table 7 also identifies the recommended left turn lane / bay taper lengths at each location based on the sum of minimum deceleration and storage requirements.

The minimum area between the new signal and the retail area's northbound left turn opening can be determined. The sum of the retail northbound left turn lane / bay taper requirement (170 feet) and the requirements at southbound left turn lane serving the apartments (245 feet) is 415 feet. This is slightly more than the distance between intersections in the conceptual area plan. This issue could be resolved by eliminating the landscaped median between intersections and creating "overlapping" bay tapers. A common 60 foot taper would allow the south end of the new opening to be 355 feet from to crosswalk of the apartment access intersection. Alternatively the midblock driveway could be moved to the north to provide separate lanes and bay tapers, and this could accommodate some landscaped median.

The requirements for the location of the midblock southbound left turn lane for the apartments can be determined in a similar manner. The dual NB left turn lanes approaching Whitney Ranch Parkway needed to be 225 feet long to accommodate 9 vehicle queues and to be preceded by a 120 foot taper. The southbound turn lane and taper should total 170 feet. To fit in these requirements the northbound and southbound lanes must share a common bay taper. This will likely eliminate the raised median in this area.

**TABLE 7**
**PROJECTED QUEUES AND LANE RECOMMENDATIONS**

| Location | Volume (vph) | HCM 2010 95th percentile queue | | HDM Storage Recommendation (2 minute accumulation) | | Sum of Turn Lane and Bay Taper | | |
|---|---|---|---|---|---|---|---|---|
| | | Vehicles | Length | Vehicles | Length | Storage | Deceleration | Total |
| Northbound dual left turn lanes at Whitney Blvd | 530 | 9 | 225 | - | - | 225 | 120 | 345 |
| Southbound left turn at Apartments midblock access | 29 | <1 | <25 | 2 | 50 | 50 | 120 | 170 |
| Northbound left turn lane at Retail midblock access | 56 | <1 | <25 | 2 | 50 | 50 | 120 | 170 |
| Southbound left turn at new signal | 116 | 5 | 125 | - | - | 125 | 120 | 245 |

Please feel free to contact me at (916) 660-1555 if you have any questions.

Sincerely yours,

**KD Anderson & Associates, Inc.**

Kenneth D. Anderson, P.E.
President

Attachments



KDA

VICINITY MAP

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Transportation Engineers

6260-22 RA 2/16/2018

figure 1

Overall Site Data

| | Site Area | Building Area | Building Height |
|---|---|---|---|
| Parcel 1: | ± 9.1 AC | * 210 Units | Varies |
| Parcel 2: | ± 21.4 AC | 195,000 S.F. | 1 Story |
| Parcel 3: | ± 3.9 AC | * 120 Rooms | 3 Story |
| Parcel 4: | ± 5.1 AC | 100,000 S.F. | 3 Story |
| Parcel 5: | ± 6.9 AC | 100,000 S.F. | 3 Story |
| Parcel 6: | ± 9.8 AC | 105,000 S.F. | 3 Story |
| Parcel 7: | ± 14.3 AC | - | 1 Story |
| Parcel 8: | ± 7.4 AC | 110,000 S.F. | 3 Story |
| Parcel 9: | ± 7.6 AC | 100,000 S.F. | 3 Story |
| Wetlands: | ± 3.8 AC | - | - |
| Roadway (University Ave.) | ± 7.5 AC | - | - |
| Total: | ± 96.8 AC | * 710,000 S.F. | |
| Total Parking Provided: | | | 5 / 1,000 S.F. |

* (Future Hotel Buildings, Apartments & Senior Living Not Included In Total Building Area - based on Room Quanity)

TRIP GENERATION AREA

NORTH

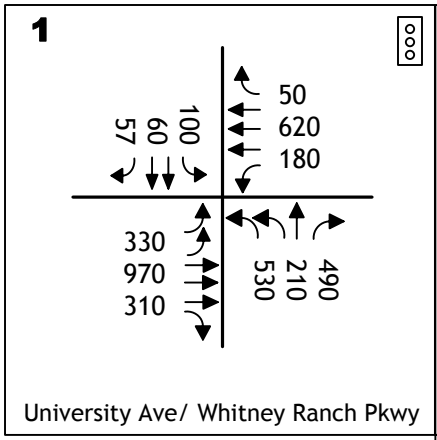
N.T.S.

**Legend**

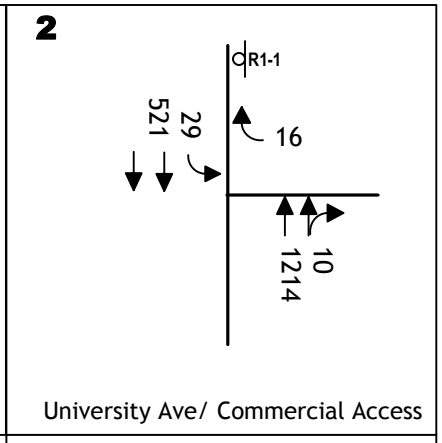
XX PM Peak Hour Volume

R1-1 Stop Sign

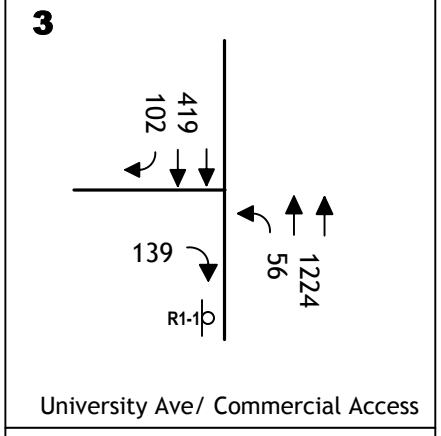
Signalized Intersection



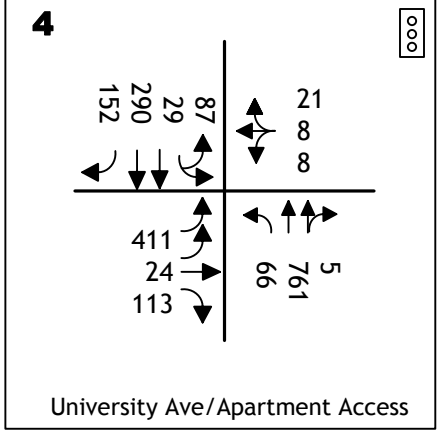

University Ave/ Whitney Ranch Pkwy




University Ave/ Commercial Access




University Ave/ Commercial Access




University Ave/Apartment Access

# CUMULATIVE PLUS PROJECT TRAFFIC VOLUMES AND LANE CONFIGURATIONS

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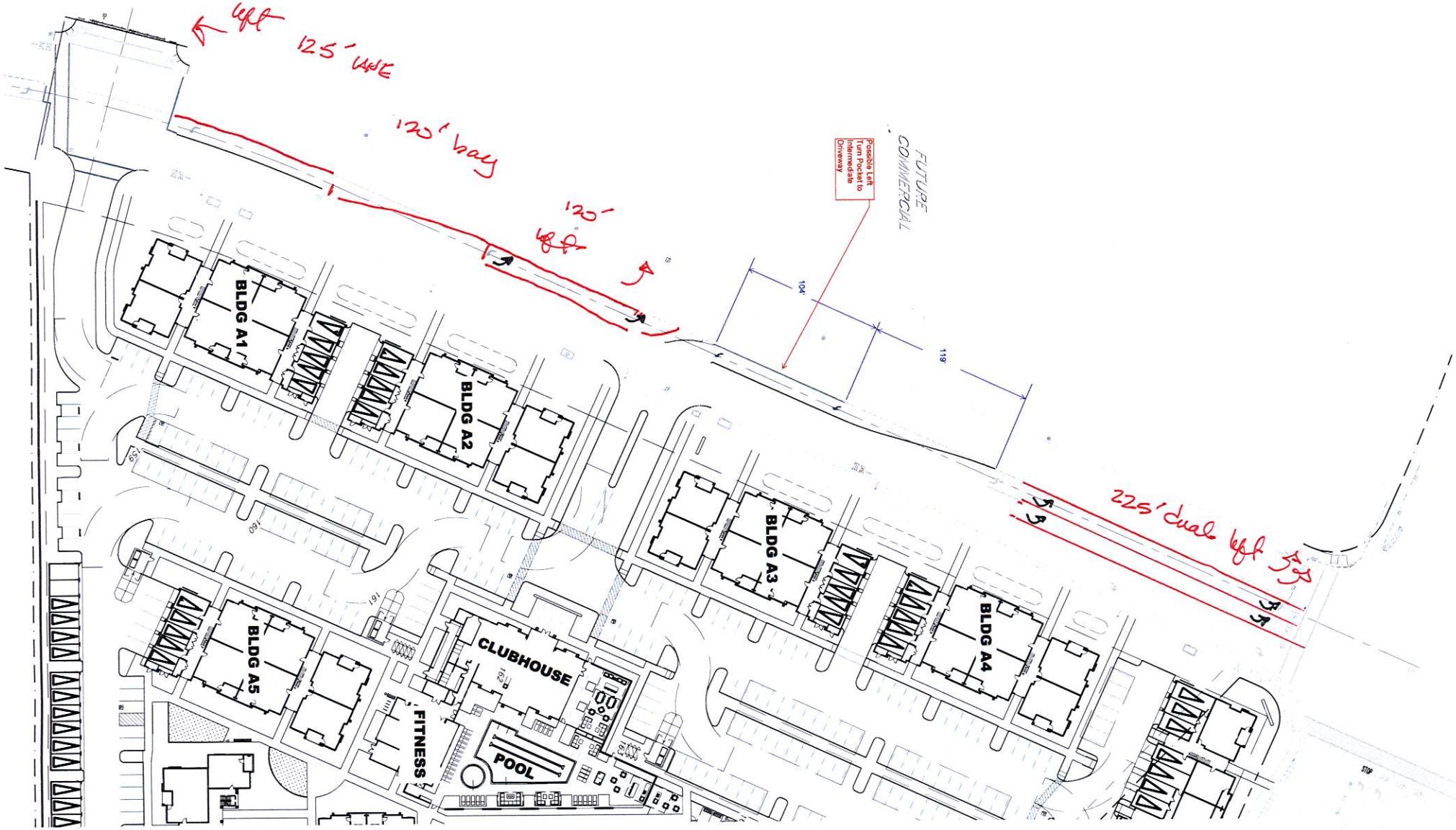
6260-22 RA 2/16/2018

figure 3




1" = 100'

LANE TREATMENT TO ACCOMODATE SOUTHBOUND LEFT TURN

KA

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 330 | 970 | 310 | 180 | 620 | 50 | 530 | 210 | 490 | 100 | 60 | 570 |
| Future Volume (veh/h) | 330 | 970 | 310 | 180 | 620 | 50 | 530 | 210 | 490 | 100 | 60 | 570 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow, veh/h/ln | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 | 1863 |
| Adj Flow Rate, veh/h | 359 | 1054 | 337 | 196 | 674 | 54 | 576 | 228 | 533 | 109 | 65 | 620 |
| Adj No. of Lanes | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 |
| 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 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 477 | 1555 | 797 | 282 | 1266 | 394 | 680 | 1251 | 690 | 178 | 735 | 549 |
| Arrive On Green | 0.14 | 0.31 | 0.31 | 0.08 | 0.25 | 0.25 | 0.20 | 0.35 | 0.35 | 0.05 | 0.21 | 0.21 |
| Sat Flow, veh/h | 3442 | 5085 | 1583 | 3442 | 5085 | 1583 | 3442 | 3539 | 1583 | 3442 | 3539 | 1583 |
| Grp Volume(v), veh/h | 359 | 1054 | 337 | 196 | 674 | 54 | 576 | 228 | 533 | 109 | 65 | 620 |
| Grp Sat Flow(s),veh/h/ln | 1721 | 1695 | 1583 | 1721 | 1695 | 1583 | 1721 | 1770 | 1583 | 1721 | 1770 | 1583 |
| Q Serve(g_s), s | 7.8 | 14.0 | 2.8 | 4.3 | 8.9 | 2.0 | 12.5 | 3.4 | 22.1 | 2.4 | 1.1 | 12.3 |
| Cycle Q Clear(g_c), s | 7.8 | 14.0 | 2.8 | 4.3 | 8.9 | 2.0 | 12.5 | 3.4 | 22.1 | 2.4 | 1.1 | 12.3 |
| Prop In Lane | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 477 | 1555 | 797 | 282 | 1266 | 394 | 680 | 1251 | 690 | 178 | 735 | 549 |
| V/C Ratio(X) | 0.75 | 0.68 | 0.42 | 0.69 | 0.53 | 0.14 | 0.85 | 0.18 | 0.77 | 0.61 | 0.09 | 1.13 |
| Avail Cap(c_a), veh/h | 980 | 1908 | 907 | 401 | 1266 | 394 | 680 | 1420 | 765 | 223 | 962 | 650 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 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 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 32.0 | 23.5 | 4.2 | 34.5 | 25.1 | 22.6 | 29.9 | 17.3 | 18.6 | 35.9 | 24.7 | 9.0 |
| Incr Delay (d2), s/veh | 2.4 | 0.7 | 0.4 | 3.1 | 0.4 | 0.2 | 9.8 | 0.1 | 4.5 | 3.4 | 0.1 | 78.4 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 3.8 | 6.6 | 2.3 | 2.2 | 4.2 | 0.9 | 6.8 | 1.7 | 10.4 | 1.2 | 0.6 | 17.2 |
| LnGrp Delay(d),s/veh | 34.4 | 24.2 | 4.5 | 37.6 | 25.6 | 22.7 | 39.7 | 17.3 | 23.0 | 39.3 | 24.8 | 87.4 |
| LnGrp LOS | C | C | A | D | C | C | D | B | C | D | C | F |
| Approach Vol, veh/h | | 1750 | | | 924 | | | 1337 | | | 794 | |
| Approach Delay, s/veh | | 22.5 | | | 27.9 | | | 29.2 | | | 75.7 | |
| Approach LOS | | C | | | C | | | C | | | E | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Phs Duration (G+Y+Rc), s | 8.0 | 31.3 | 10.3 | 27.6 | 19.3 | 20.1 | 14.7 | 23.2 |
| Change Period (Y+Rc), s | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 |
| Max Green Setting (Gmax), s | 5.0 | 31.0 | 9.0 | 29.0 | 15.0 | 21.0 | 22.0 | 16.0 |
| Max Q Clear Time (g_c+I1), s | 4.4 | 24.1 | 6.3 | 16.0 | 14.5 | 14.3 | 9.8 | 10.9 |
| Green Ext Time (p_c), s | 0.0 | 3.2 | 0.2 | 7.6 | 0.4 | 1.7 | 1.0 | 4.2 |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 34.2 |
| HCM 2010 LOS | C |

Notes

| Intersection | |
|---|---|
| Int Delay, s/veh | 1.3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vol, veh/h | 0 | 0 | 139 | 0 | 0 | 16 | 56 | 1214 | 10 | 29 | 521 | 102 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Stop | Stop | Stop | Stop | Free | Free | Free | Free | Free | Free |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | 0 | 150 | - | - | 150 | - | 200 |
| Veh in Median Storage, # | - | 1 | - | - | 1 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 0 | 151 | 0 | 0 | 17 | 61 | 1320 | 11 | 32 | 566 | 111 |

| Major/Minor | Minor2 | | | Minor1 | | | Major1 | | | Major2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 1411 | 2081 | 283 | 1793 | 2076 | 665 | 566 | 0 | 0 | 1330 | 0 | 0 |
| Stage 1 | 629 | 629 | - | 1447 | 1447 | - | - | - | - | - | - | - |
| Stage 2 | 782 | 1452 | - | 346 | 629 | - | - | - | - | - | - | - |
| Critical Hdwy | 7.54 | 6.54 | 6.94 | 7.54 | 6.54 | 6.94 | 4.14 | - | - | 4.14 | - | - |
| Critical Hdwy Stg 1 | 6.54 | 5.54 | - | 6.54 | 5.54 | - | - | - | - | - | - | - |
| Critical Hdwy Stg 2 | 6.54 | 5.54 | - | 6.54 | 5.54 | - | - | - | - | - | - | - |
| Follow-up Hdwy | 3.52 | 4.02 | 3.32 | 3.52 | 4.02 | 3.32 | 2.22 | - | - | 2.22 | - | - |
| Pot Cap-1 Maneuver | 98 | 53 | 714 | 51 | 53 | 403 | 1002 | - | - | 515 | - | - |
| Stage 1 | 437 | 474 | - | 138 | 195 | - | - | - | - | - | - | - |
| Stage 2 | 353 | 194 | - | 643 | 474 | - | - | - | - | - | - | - |
| Platoon blocked, % | | | | | | | | - | - | | - | - |
| Mov Cap-1 Maneuver | 85 | 47 | 714 | 37 | 47 | 403 | 1002 | - | - | 515 | - | - |
| Mov Cap-2 Maneuver | 191 | 118 | - | 102 | 131 | - | - | - | - | - | - | - |
| Stage 1 | 410 | 445 | - | 130 | 183 | - | - | - | - | - | - | - |
| Stage 2 | 317 | 182 | - | 475 | 445 | - | - | - | - | - | - | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 11.4 | 14.3 | 0.4 | 0.6 |
| HCM LOS | B | B | | |

| Minor Lane/Major Mvmt | NBL | NBT | NBR | EBLn1 | WBLn1 | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1002 | - | - | 714 | 403 | 515 | - | - |
| HCM Lane V/C Ratio | 0.061 | - | - | 0.212 | 0.043 | 0.061 | - | - |
| HCM Control Delay (s) | 8.8 | - | - | 11.4 | 14.3 | 12.4 | - | - |
| HCM Lane LOS | A | - | - | B | B | B | - | - |
| HCM 95th %tile Q(veh) | 0.2 | - | - | 0.8 | 0.1 | 0.2 | - | - |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (veh/h) | 411 | 24 | 113 | 8 | 8 | 21 | 66 | 761 | 5 | 116 | 290 | 152 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Adj Sat Flow, veh/h/ln | 1863 | 1863 | 1863 | 1900 | 1863 | 1900 | 1863 | 1863 | 1900 | 1863 | 1863 | 1863 |
| Adj Flow Rate, veh/h | 466 | 0 | 101 | 9 | 9 | 23 | 72 | 827 | 5 | 126 | 315 | 83 |
| Adj No. of Lanes | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 2 | 1 |
| 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 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 594 | 0 | 265 | 11 | 11 | 29 | 92 | 1928 | 12 | 159 | 2026 | 906 |
| Arrive On Green | 0.17 | 0.00 | 0.17 | 0.03 | 0.03 | 0.03 | 0.05 | 0.53 | 0.53 | 0.03 | 0.19 | 0.19 |
| Sat Flow, veh/h | 3548 | 0 | 1583 | 368 | 368 | 941 | 1774 | 3607 | 22 | 1774 | 3539 | 1583 |
| Grp Volume(v), veh/h | 466 | 0 | 101 | 41 | 0 | 0 | 72 | 406 | 426 | 126 | 315 | 83 |
| Grp Sat Flow(s),veh/h/ln | 1774 | 0 | 1583 | 1678 | 0 | 0 | 1774 | 1770 | 1859 | 1774 | 1770 | 1583 |
| Q Serve(g_s), s | 11.3 | 0.0 | 5.1 | 2.2 | 0.0 | 0.0 | 3.6 | 12.5 | 12.5 | 6.4 | 6.7 | 3.9 |
| Cycle Q Clear(g_c), s | 11.3 | 0.0 | 5.1 | 2.2 | 0.0 | 0.0 | 3.6 | 12.5 | 12.5 | 6.4 | 6.7 | 3.9 |
| Prop In Lane | 1.00 | | 1.00 | 0.22 | | 0.56 | 1.00 | | 0.01 | 1.00 | | 1.00 |
| Lane Grp Cap(c), veh/h | 594 | 0 | 265 | 51 | 0 | 0 | 92 | 946 | 994 | 159 | 2026 | 906 |
| V/C Ratio(X) | 0.78 | 0.00 | 0.38 | 0.80 | 0.00 | 0.00 | 0.78 | 0.43 | 0.43 | 0.79 | 0.16 | 0.09 |
| Avail Cap(c_a), veh/h | 1025 | 0 | 457 | 298 | 0 | 0 | 118 | 946 | 994 | 237 | 2026 | 906 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.33 | 0.33 | 0.33 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 35.9 | 0.0 | 33.3 | 43.4 | 0.0 | 0.0 | 42.1 | 12.6 | 12.6 | 42.8 | 18.3 | 17.2 |
| Incr Delay (d2), s/veh | 2.3 | 0.0 | 0.9 | 24.3 | 0.0 | 0.0 | 21.8 | 1.4 | 1.4 | 10.3 | 0.2 | 0.2 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 5.8 | 0.0 | 2.3 | 1.4 | 0.0 | 0.0 | 2.3 | 6.5 | 6.8 | 3.6 | 3.3 | 1.8 |
| LnGrp Delay(d),s/veh | 38.2 | 0.0 | 34.2 | 67.6 | 0.0 | 0.0 | 64.0 | 14.1 | 14.0 | 53.1 | 18.5 | 17.4 |
| LnGrp LOS | D | | C | E | | | E | B | B | D | B | B |
| Approach Vol, veh/h | | 567 | | | 41 | | | 904 | | | 524 | |
| Approach Delay, s/veh | | 37.5 | | | 67.6 | | | 18.0 | | | 26.6 | |
| Approach LOS | | D | | | E | | | B | | | C | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | 1 | 2 | | 4 | 5 | 6 | | 8 |
| Phs Duration (G+Y+Rc), s | 12.1 | 52.1 | | 19.1 | 8.7 | 55.5 | | 6.7 |
| Change Period (Y+Rc), s | 4.0 | 4.0 | | 4.0 | 4.0 | 4.0 | | 4.0 |
| Max Green Setting (Gmax), s | 12.0 | 20.0 | | 26.0 | 6.0 | 26.0 | | 16.0 |
| Max Q Clear Time (g_c+I1), s | 8.4 | 14.5 | | 13.3 | 5.6 | 8.7 | | 4.2 |
| Green Ext Time (p_c), s | 0.1 | 3.4 | | 1.7 | 0.0 | 7.3 | | 0.1 |

| Intersection Summary | | |
|---|---|---|
| HCM 2010 Ctrl Delay | | 26.7 |
| HCM 2010 LOS | | C |

**Notes**

User approved volume balancing among the lanes for turning movement.

| Lane Group | EBL | EBT | EBR | WBT | NBL | NBT | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group Flow (vph) | 237 | 236 | 123 | 41 | 72 | 832 | 126 | 315 | 165 |
| v/c Ratio | 0.68 | 0.67 | 0.27 | 0.28 | 0.40 | 0.52 | 0.55 | 0.18 | 0.19 |
| Control Delay | 42.0 | 41.6 | 3.7 | 27.1 | 43.6 | 23.4 | 50.1 | 13.2 | 2.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 42.0 | 41.6 | 3.7 | 27.1 | 43.6 | 23.4 | 50.1 | 13.2 | 2.2 |
| Queue Length 50th (ft) | 131 | 130 | 0 | 10 | 39 | 186 | 71 | 46 | 0 |
| Queue Length 95th (ft) | 192 | 191 | 23 | 40 | 78 | #359 | 126 | 77 | 16 |
| Internal Link Dist (ft) | | 445 | | 527 | | 690 | | 346 | |
| Turn Bay Length (ft) | 200 | | 200 | | 200 | | 200 | | 200 |
| Base Capacity (vph) | 485 | 489 | 569 | 321 | 181 | 1597 | 257 | 1771 | 874 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.49 | 0.48 | 0.22 | 0.13 | 0.40 | 0.52 | 0.49 | 0.18 | 0.19 |

Intersection Summary

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