

2015

Intersection and  
Walkability

# Study

AND  
75<sup>th</sup>  
Wornall



Walkability | Traffic Flow | Streetscape



R&BC DESIGN GROUP

**MARC**  
MID AMERICA REGIONAL COUNCIL



Vireo  
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## A. INTRODUCTION

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The Vireo team worked with City of Kansas City staff, Mid-America Regional Council (MARC) representatives, and the Project Advisory Committee (the Committee) in a thorough analysis of the 75<sup>th</sup> Street and Wornall Road intersection. The analysis addressed traffic capacity, roadway safety and walkability of the intersection and surrounding area. The project goals were to improve the efficiency of traffic flow, most notably, the eastbound left-turn to northbound Wornall Road needs some capacity improvements and to maintain or enhance the walkability of the entire area, possibly making it more pedestrian-friendly. In addition, improvement impacts on the Trolley Track Trail crossing and the existing bus routes which stop at the adjacent park-and-ride facility were evaluated at every step of the analysis.

During a 3-day workshop in Waldo, our team worked with staff and the Committee to better understand the existing conditions of the intersection and surrounding area. The workshop consisted of daily discussions, a walking audit of the existing conditions, concept generation and development, and several public open houses to gather additional feedback. Components of the Streetscape Master Plan, which was recently adopted by the Community Improvement District (CID), were a part of our approach throughout.

The preparations and findings from this three-day workshop are presented below.

## B. DATA COLLECTION, INVENTORY AND ANALYSIS

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Prior to Day 1 of the workshop our team collected data for use in developing intersection options to present to staff and the Committee. This data included, but was not limited to, crash analysis, traffic volumes, capacity analysis, Operation Green Light signal timing, pedestrian counts, crash data, GIS and aerial mapping for the area, and exhibit images for design reference at the workshop. Refer to the Engineer's Report for all roadway data collected and analyzed.

On Day 1 of the workshop the Vireo team began by presenting existing data and site conditions to staff and Committee for feedback (Figure 1). In general it was conveyed that we are somewhat limited by data; that there are no sight distance issues; issues did include near misses, impatience, and cars passing buses; and there is a below average number of crashes at the intersection.



**Figure 1: One of the many staff and Committee work sessions.**

Following the presentation the Vireo team lead staff and the Committee on a Walking Audit of existing site conditions (Figure 2). The goals for the audit included educating people to experience and assess the physical conditions of existing infrastructure; to inspire people to understand what solutions could create a better walking environment; and to get everyone actively involved and allow an understanding of each other's opinion. See Figure 3 for a map of the area covered and field notes. In summary, staff and the Committee provided the following feedback:

- Consider the pedestrian first. There should be a walk signal regardless of cars.
- Evaluate pedestrian actuated push buttons.
- Slower speeds are ok.
- Delay cars, not pedestrians.
- Synchronize all signals.
- Clean up parking lots.
- Removing Broadway between 74th and 75th Street is an option.
- Removing westbound left-turn onto Broadway is an option.



Figure 2: Walking Audit stopped at Washington Street.



# WALKING AUDIT

08/11/2015

Figure 3: Walking Audit map and field notes.

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## C. PRELIMINARY OPTIONS AND RECOMMENDATIONS

On Day 1 of the workshop the Vireo team presented five intersection options for staff and Committee review and feedback.

The five options presented were the following (refer to Exhibits 10-14 in the Engineer's Report):

- Option 1 - a 4-lane section with left-turn lanes westbound and eastbound (Exhibit 11 - Traffic Engineer's Option).
- Option 2 - the existing 4-lane section "cleaned up"; no turn lanes added (Exhibit 10 - Clean Up Existing Option).
- Option 3 - added an eastbound left-turn lane at Wornall Road; westbound remains the same (Exhibit 12 - Urban Planner's Option).
- Option 4 - cleaned up the existing 4-lane section with 3 right turns at a relocated ATA lot; crossing of Trolley Track Trail would be grade separated (Exhibit 13 - 3 Rights Option).
- Option 5 - 3-lane section with turn lanes westbound and eastbound (Exhibit 14 - 3 Lane Option).

By the end of this presentation, staff and the Committee had selected 2 options for further study, Options 4 and 5. Day 2 consisted of the development of the 2 selected options and another presentation to staff and the Committee (Figure 4).



**Figure 4: Day 2 presentation and discussion with staff and Committee.**

Their comments are as follows:

- What are the associated costs with relocating the ATA stops?
- Consider interior and perimeter landscape requirements for parking.
- Wider sidewalk at shops on Broadway? Could lose parking. Promenade feel would be nice.
- 2 hour limit for on-street parking.
- Draw sections for trail relocation condition.
- Parking modifications on 75th Street would be controversial. Rather present "redistribution" of parking.
- #1 priority is safety. We can phase/implement over time.
- Owner of CVS is fine with people parking in their lot to go elsewhere.
- 74th Terrace crosswalks - show general intent with islands. This needs to be on the City's radar but the 75th Street intersection is the focus.
- Consider snow removal inside bulb-outs. City trucks will not plow this area. Will be on CID.
- Bus stops east of Wornall - can we pull bus into turn-out?

Following the public open house at the end of day 2, the Vireo team began day 3 by again meeting with staff and the Committee to discuss public comments and any additional thoughts or concerns, shown here:

- Continue road diet on 75th Street, State Line to Main. City studying this.
- Moving the ATA stop south should be considered a long-term possibility.
- We should target PIAC requests for August 31, 2015. Plans and estimates due in October.
- Mill and overlay (4-6") may not be possible. This area was constructed on a large boulder base, not granular.
- Need to understand landscape requirements for parking.
- Site furnishings may make pedestrian flow tight on the west side of Wornall.
- New criteria: parking "redistribution" and trail impacts.
- Trail crossings - could use green epoxy paint for new and existing crossings to call attention.
- ATA goal - use same corner for transfers and connections. Extra signal crossing at 75th is a concern.
- Locate new bike parking in reconfigured lot? Identify locations for a bike corral?
- Consider right in/right out at western CVS drive. No left turns onto 75th Street westbound.

Staff and the Committee also participated in completing a Criteria Matrix (Exhibit 15 in the Appendix), which ranked various criteria such as right-of-way impacts, parking impacts and enhanced streetscaping. A lower score was more desirable. The matrix provided additional support for the selection of a final option for further development and presentation to the public at the end of day 3.

## D. FINAL PLAN AND RECOMMENDATIONS

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By the completion of the 3-day workshop there was general consensus that Option 5 was the preferred option to move forward with. This option transforms 75th Street into a 3-lane section from Pennsylvania Avenue to Wyandotte Street (Figure 5). In summary, the recommendations include:

- Eastbound 75th Street traffic will drop a lane via right-turn only at Pennsylvania.
- East of Pennsylvania a continuous left-turn lane has been added (Figure 6).

- On the north side of 75th Street, between Pennsylvania and Wornall, bulb-outs and parallel parking have been added.
- A continuous left-turn lane has been added to 75th Street east of Wornall (Figure 8). This extends to Wyandotte Street.
- The current right-turn lane into the CVS parking lot has been extended west to also act as a bus turn-out (Figure 8).
- On the south side of 75th Street, between Wornall and Broadway, the 3-lane section allows for the curb line to be shifted north. This will reduce the crosswalk width across 75th Street and improve pedestrian safety (Figure 8).
- Access to northbound Broadway from 75th Street has been removed. In this location, if room is sufficient, a turn-out is shown for the relocation of the bus stop presently located further east.
- At Wyandotte Street eastbound lanes open back up from one through-lane to two through-lanes with a 10:1 straight line taper.
- On westbound 75th Street at Wyandotte the right lane is dropped as a right turn lane going north, and through traffic is diverted to the inside lane.
- Improvements to Wornall Road include bulb-outs along the west side to reduce crosswalk distances and better protect parallel parking. Several refuge islands are also proposed to slow traffic and improve pedestrian safety.
- Reconfigured ATA parking lots (60° parking and shifting to the east) allow for the Trolley Track Trail to be reconnected between 74th and 75th Streets (Figure 7).
- As a planning level parking study, existing parking within the project limits consists of +/- 176 spaces located on street and within the ATA parking lots. Based upon the proposed improvements listed above, there is a slight increase in parking to +/- 179 spaces.
- Sidewalk improvements throughout to enhance walkability and aesthetics.

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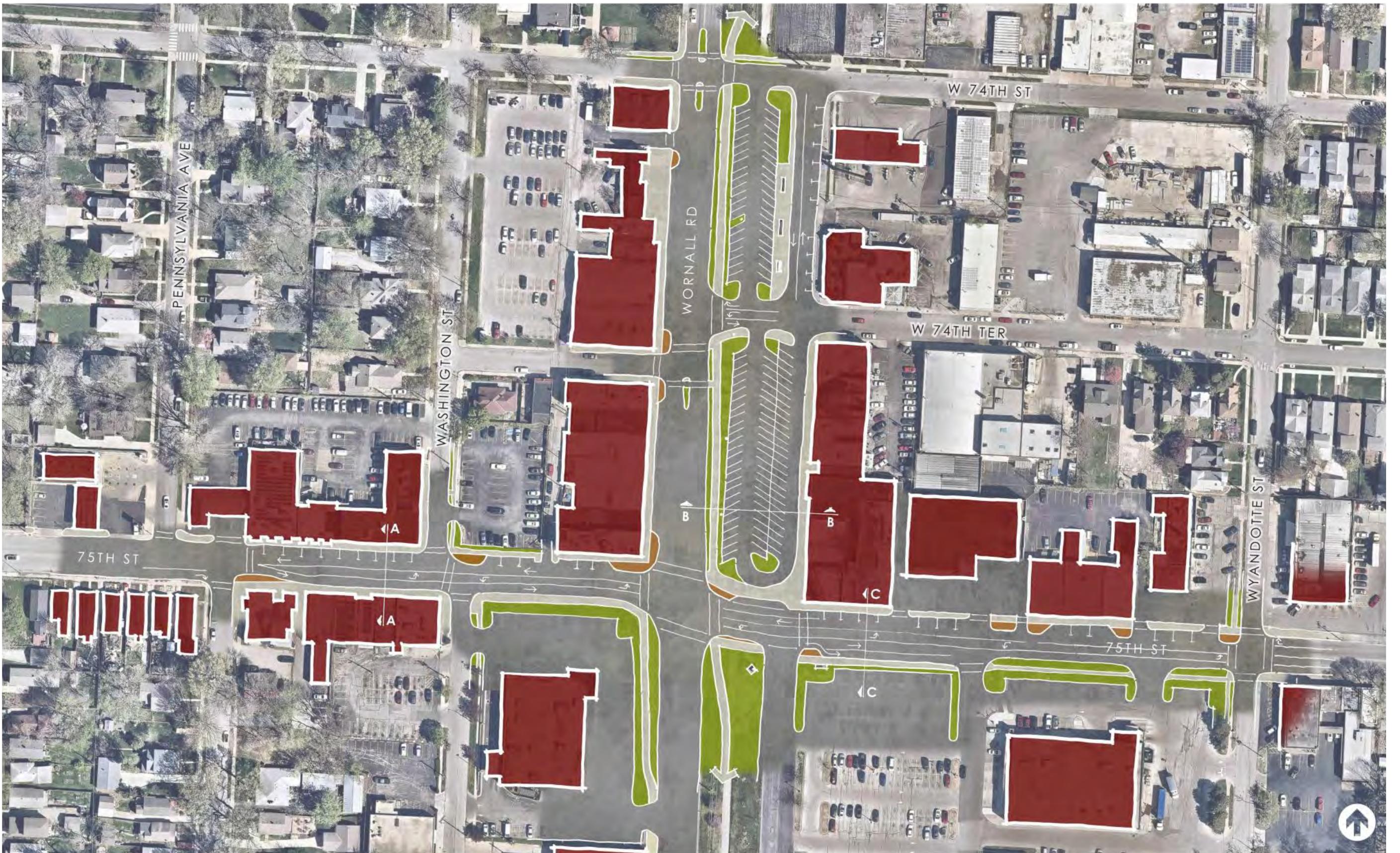


Figure 5: Site Plan.

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Figure 6 below shows a continuous left-turn lane between Pennsylvania Avenue and Wornall Road. Parallel parking will remain on the north side of the road while the south side becomes a thru-lane.

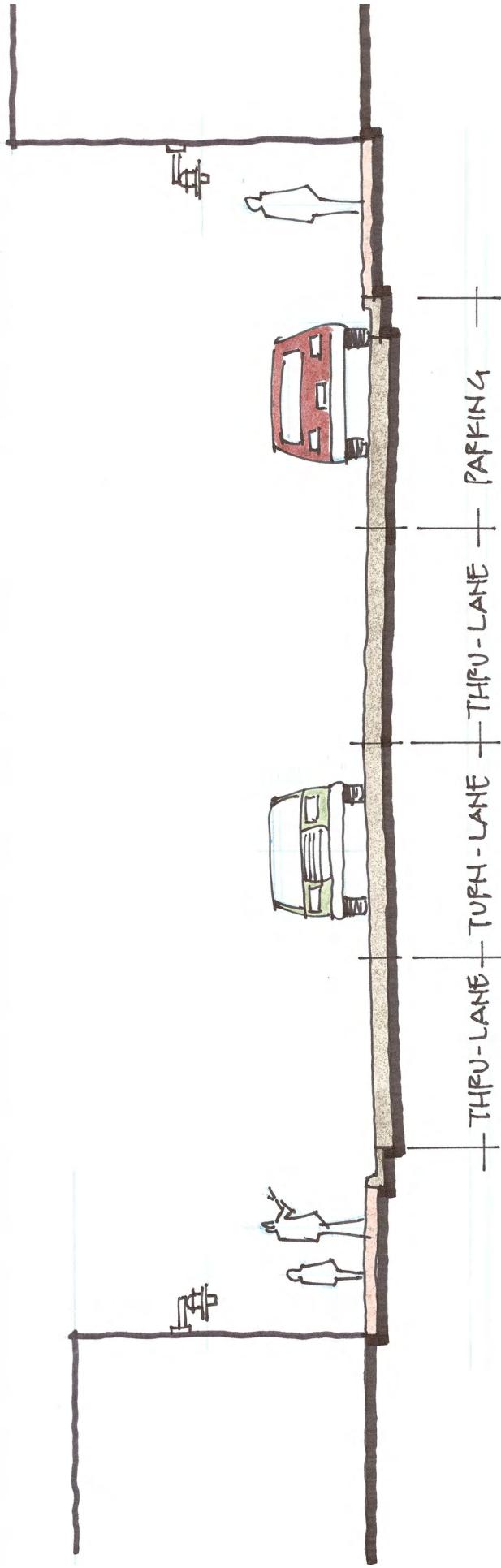


Figure 6: Section A (3-lane section).

Figure 7 below shows an east to west section through the existing ATA parking lots. The lots would be reconfigured from 90° parking to 60° parking and shifted to the east to allow for the Trolley Track Trail to be reconnected between 74th and 75th Streets.

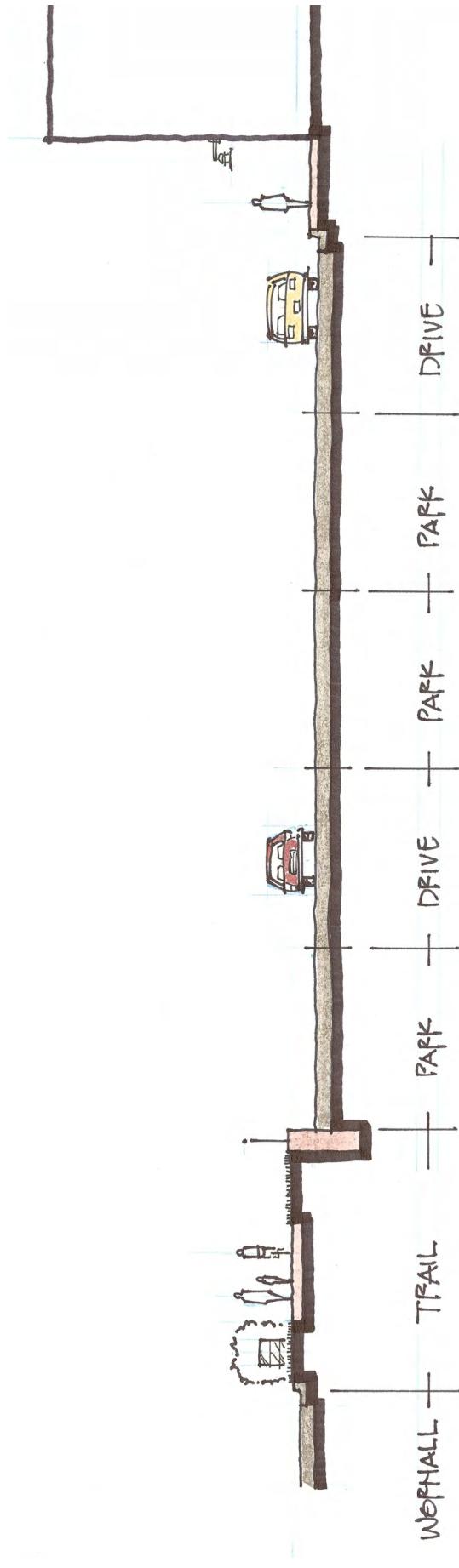


Figure 7: Section B (through trail and parking lot).

Figure 8 below is a section taken north to south just east of Broadway. A continuous left-turn lane has been added to 75th Street while parallel parking along the north side remains. The current right-turn lane into the CVS parking lot has been extended west to also act as a bus turn-out. Also, on the south side of 75th Street, between Wornall and Broadway, the 3-lane section allows for the curb line to be shifted north. This will reduce the crosswalk width across 75th Street and improve pedestrian safety.

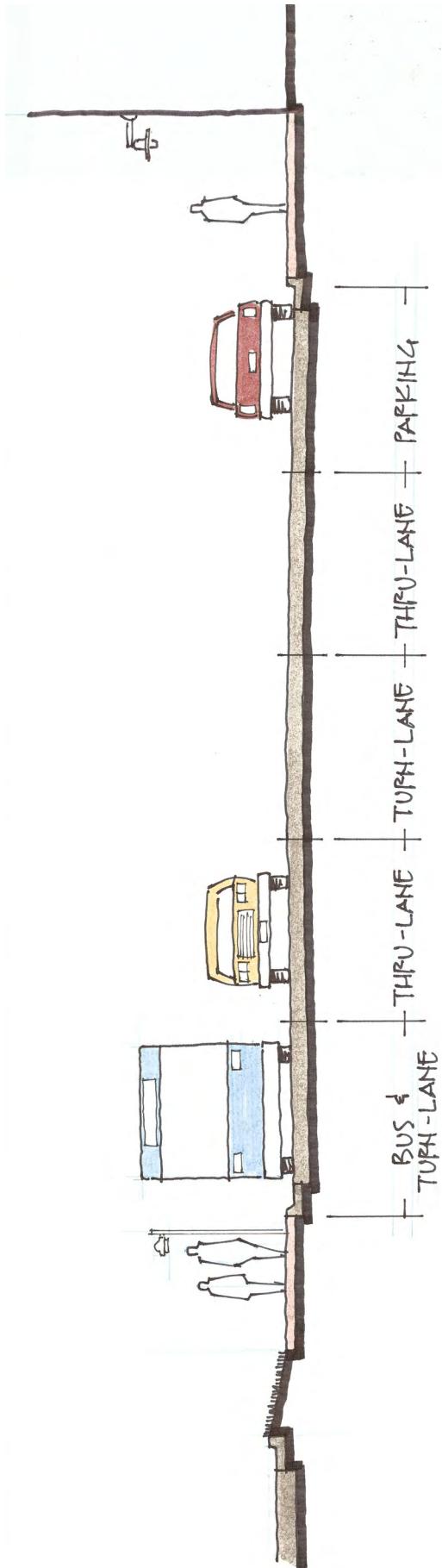


Figure 8: Section C (3-lane section with bus turn-out and parallel parking).

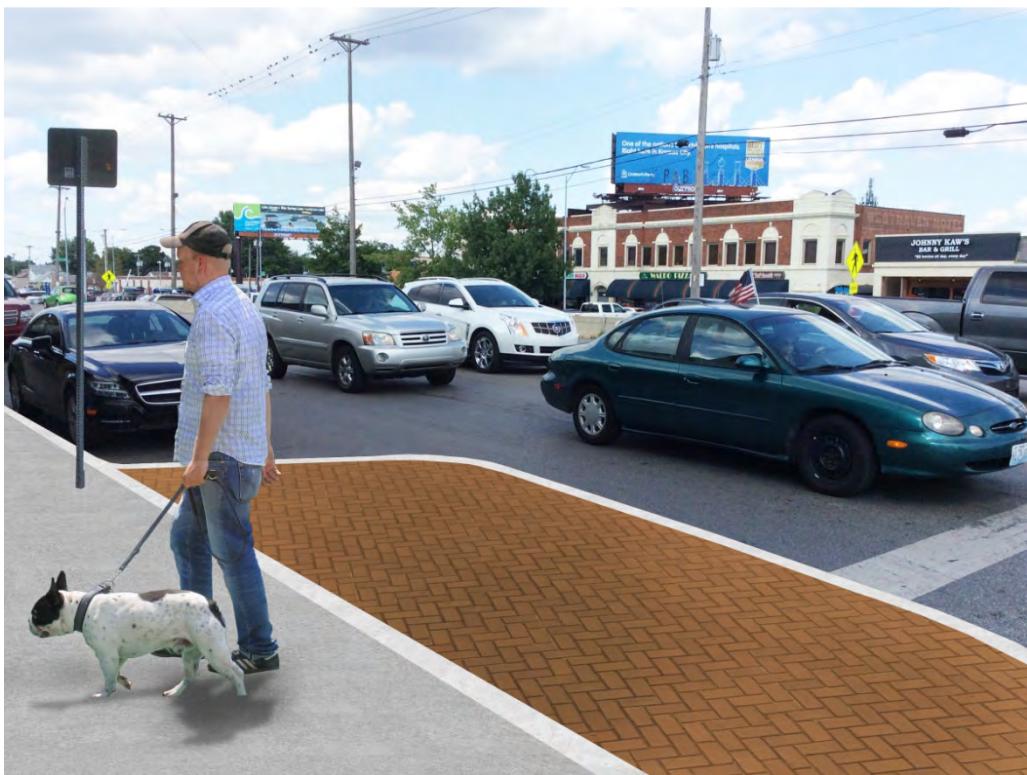
The following illustrations depict a number of the proposed improvements resulting from the workshop. They range from "bulb-outs" to refuge islands to enhanced pavement markings.



**Figure 9: A proposed bulb-out at 75th and Washington, looking west, would reduce the roadway crossing distance for pedestrians and result in improved safety and aesthetics. Bulb-outs also calm traffic due to reduced lane widths.**



**Figure 10:** A proposed bump-out at 75th and Wornall, looking south, would reduce the roadway crossing distance for pedestrians and result in improved safety and aesthetics. Bulb-outs also calm traffic due to reduced lane widths.



**Figure 11:** A proposed bump-out at 75th and Wornall, looking northeast, would reduce the roadway crossing distance for pedestrians and result in improved safety and aesthetics. Bulb-outs also calm traffic due to reduced lane widths.



**Figure 12: The proposed reconnection of Trolley Track Trail at 75th and Wornall, looking northwest, would provide a vital missing link between 74th and 75th Street. This would improve walkability and pedestrian safety, display the vitality and energy of the area, and potentially stimulate the economy for Waldo area businesses.**



**Figure 13:** A proposed bump-out and refuge island at 74th Terrace, looking west, would reduce the roadway crossing distance for pedestrians, provide an island of refuge for pedestrians "caught in the middle," and result in improved safety and aesthetics. The bulb-outs and islands will also calm traffic due to reduced lane widths.



**Figure 14: An enhanced Trolley Track Trail crossing at 74th Street, looking south, would better delineate the Trail and improve safety and aesthetics.**

## E. ANTICIPATED COSTS

<b>Anticipated costs for improvements on 75th Street</b>				
Item	Unit	Quantity	Unit Price	Cost
I. Anticipated construction items				
1. Mill, Overlay and restripe	Square yard (SY)	6,700	\$ 8.00	\$ 53,600.00
2. Signal upgrade	EA	1	\$ 200,000.00	\$ 200,000.00
3. Curb work, including bulb-outs	EA	6	\$ 15,000.00	\$ 90,000.00
<b>Sub-total construction</b>				<b>\$ 343,600.00</b>
II. Design	15%			\$ 51,540.00
<b>Sub-total construction + design</b>				<b>\$ 395,140.00</b>
III. Contingency	20%			\$ 79,028.00
<b>Sub-total</b>				<b>\$ 474,168.00</b>
IV. Project management	10%			\$ 47,416.80
<b>Total</b>				<b>\$ 521,584.80</b>

**Item 1 Notes:**

1. Limits from Pennsylvania to Wyandotte.

**Item 2 Notes:**

1. Cost includes ADA ramp upgrades.
2. Eastbound and Westbound movements get new signal pole and mast arm.
3. New conduit from signal poles to controller. New wiring to be installed.
4. APS and pedestrian requirements per KCMO standards.
5. Video pedestrian actuation.

<b>Anticipated costs for Trolley Track Trail Reconnection</b>				
Item	Unit	Quantity	Unit Price	Cost
I. 75th to 74th Terrace				
1. Mill, Overlay and restripe	Square yard (SY)	4,595	\$ 7.50	\$ 34,462.50
2. Curb work, including ADA ramps	LF	1,795	\$ 22.00	\$ 39,490.00
3. Retaining wall	SFF	775	\$ 45.00	\$ 34,875.00
4. Trail	SY	348	\$ 65.00	\$ 22,620.00
5. Decorative fence & posts and access control bollards	LS	1	\$ 55,600.00	\$ 55,600.00
Sub-total construction				\$ 187,047.50
II. 74th Terrace to 74th				
1. Mill, Overlay and restripe	Square yard (SY)	5,253	\$ 7.50	\$ 39,397.50
2. Curb work, including ADA ramps	LF	1,882	\$ 22.00	\$ 41,404.00
3. Retaining wall	SFF	650	\$ 45.00	\$ 29,250.00
4. Trail	SY	432	\$ 65.00	\$ 28,080.00
5. Decorative fence & posts and access control bollards	LS	1	\$ 53,800.00	\$ 53,800.00
Sub-total construction				\$ 191,931.50
Total construction				\$ 378,979.00
III. Design, including field survey	30%			\$ 113,693.70
Sub-total construction + design				\$ 492,672.70
IV. Contingency	15%			\$ 73,900.91
Sub-total construction + design + contingency				\$ 566,573.61
V. Project management	10%			\$ 56,657.36
<b>Total</b>				<b>\$ 623,230.97</b>
<b>Notes:</b>				
1. Costs include ADA ramp upgrades.				
2. The costs above do not include utility relocations.				

**F. ENGINEER'S REPORT AND APPENDICES**

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## 2 INTRODUCTION

A team consisting of Vireo and R^3C Design Group, LLC was selected to complete landscaping and intersection operation improvements at the 75<sup>th</sup> Street and Wornall Road intersection in the Waldo area of Kansas City, Missouri.

R^3C Engineers were tasked with developing an intersection solution that would primarily:

1. Enhance the walkability and pedestrian friendliness of the intersection
2. Provide either a left-turn lane or protected left-turn-signal phasing to move traffic more efficiently through the intersection

Exhibit 1 is a Google Earth snapshot showing the current configuration of the intersection. Important factors to note are:

1. The area is predominantly commercial/retail in nature.
2. The Trolley Track Trail on the east side of the intersection discontinues at 75<sup>th</sup> Street. It picks back up at 74<sup>th</sup> Street.
3. The Broadway intersection is approximately 50-feet east of the 75<sup>th</sup> and Wornall Road intersection.

Because both the Trolley Track Trail and Broadway Street intersections are close to Wornall Road, the design team included them in the study as any changes at 75<sup>th</sup> Street and Wornall Road would influence operations at both facilities.

This report documents the crash history at the intersections, the existing operations and the public outreach efforts to develop a solution that achieves the goals. The developed solution is tested for operations and a recommended solution is presented.

## 3 EXISTING CONDITIONS

As observed in Exhibit 1, the intersection is a skewed intersection. The east leg of 75<sup>th</sup> Street is offset from the west leg by about 40 feet. Sharp curves with radii of approximately 50 feet are used near the intersection to point drivers to the appropriate lanes. The 75<sup>th</sup> and Wornall Road intersection is signalized, while the Trolley Track Trail and Broadway Street intersection are two-way stop controlled intersections.

Wornall Road approaching 75<sup>th</sup> Street is a four-lane roadway with turn lanes at the intersection. 75<sup>th</sup> Street is also a four-lane roadway. However, there are no turn lanes available at the intersection. Even without turn lanes, the westbound left turn movement has a protected left turn



Looking west along 75<sup>th</sup> Street at the skew in the intersection

phase that allows a few left turning vehicles to clear the intersection without having to yield to the opposing eastbound traffic. Westbound through traffic is allowed to proceed through the intersection simultaneously.

Due to time restraints, a similar arrangement cannot be provided for the eastbound left-turning traffic. Since each opposing phase has to be given the approximately 3-second yellow plus 2-second all-red time, an additional five seconds of lost time is created for each cycle of the signal. This lost time could result in poor intersection operations and congestion.



Looking south along Wornall Road

In order to offset the split phasing, exclusive left-turn lanes will have to be provided so that the opposing left-turning traffic can go through the intersection simultaneously.

### 3.1 CRASH ANALYSIS

Crash data from May 5, 2012 to May 15, 2015 was obtained from the City of Kansas City, Missouri and analyzed to detect any unusual or unsafe conditions. The crash data included 75th Street at the intersections of Wornall Road and Broadway Street.

#### 3.1.1 75<sup>TH</sup> STREET AND WORNALL ROAD

The data is summarized in Exhibit 2. The following observations are made from the analysis:

- 25 of 58 total crashes (43%) were self-reported walk-in reports to the Police Department at the 75<sup>th</sup> Street and Wornall Road intersection.
- 2015 Vehicle 2 and Driver 2 totals are less than the total number of accidents classified as single-vehicle collisions.
- Crash analysis:
  - Type:
    - 86 percent of all crashes resulted in Property Damage Only.
    - 14 percent were injury accidents.
  - Vehicle Action:
    - Most of the crashes over the analysis time frame involved Motor Vehicles in Transport.
    - The largest significant vehicle action contributors (other than Unknown) are
      - Stopped in Traffic (5%)
      - Making a left turn (5%).
  - Driver Action:
    - None and Unknown contributed to 63% of all actions resulting in crashes.
    - Failure to yield resulted in 12% of the crashes.
    - Following too close resulted in 8% of the crashes.

- Light:
  - 72% of the crashes occurred during daylight.
  - 28% of the crashes were during dark or unknown conditions.
- Road Conditions:
  - 86% of the crashes occurred when the roadway was dry.

Interpretation:

1. Vehicles stopped in traffic prior to crashes could indicate congested conditions. It could also indicate sight distance restrictions primarily caused by the skew on 75<sup>th</sup> Street.
2. Making left- turn vehicle actions could be the result of no storage lane for the left-turning vehicles on 75<sup>th</sup> Street.
3. The failure-to- yield driver action could also be a result of the skew or inherent sight-distance restrictions at the intersection approaches.
4. Crashes due to following too close generally cannot be corrected by roadway geometrics. However, a small correlation between congestion, lack of turn bays and crashes from following too close could be assumed at this intersection.
5. While most of the crashes were during daytime, dark or unknown conditions contribute to about 28% of all crashes. This could suggest poor street lighting at the intersection.
6. Roadway condition does not appear to be a contributor to the crashes at the intersection.

### 3.1.2 75<sup>TH</sup> STREET AND BROADWAY INTERSECTION

Exhibit 3 summarizes the crash data at 75<sup>th</sup> Street and Broadway Street. The following observations are made from the exhibit.

- Data for 75<sup>th</sup> Street and Broadway Street ranges from August 18, 2012 to September 27, 2014. There are no recorded accidents for 2015.
- 5 of 8 total crashes (63%) were self-reported walk-in reports to the Police Department at the 75<sup>th</sup> Street and Broadway Street intersection.
- Crash analysis:
  - Type:
    - All crashes resulted in Property Damage Only.
  - Vehicle Action:
    - Most of the crashes over the analysis time frame involved Motor Vehicles in Transport.
    - The largest significant vehicle action contributors (other than Unknown) are
      - Parked (9%)
      - Making a left turn (6%).
  - Driver Action:
    - None, Unknown and Other contribute to 75% of all actions resulting in crashes.
    - Failure-to- yield results in 8% of the crashes.
  - Following too close, and improper lane use and/or changing lanes results in 8% of the crashes. Light:
    - 75% of the crashes were during daylight.
    - 25% of the crashes were during dark conditions.

- Road Conditions:
  - All crashes occurred when the roadway was dry.

Interpretation:

1. Vehicles stopped in traffic prior to crashes could indicate congested conditions. It could also indicate sight distance restrictions primarily resulting from the skew on 75<sup>th</sup> Street.
2. Left-turn-vehicle actions could be the result of no storage lane for the left-turning vehicles on 75<sup>th</sup> Street.
3. The failure-to- yield driver actions could also be a result of the skew or inherent sight-distance restrictions at the intersection approaches.
4. Crashes from following too close generally cannot be corrected by roadway geometrics. However, a small correlation between congestion, lack of turn bays and crashes from following too close could be assumed at this intersection.
5. While most of the crashes were during daytime, dark conditions contribute to about 25% of all crashes. This could suggest poor street lighting at the intersection.
6. Roadway condition does not appear to be a contributor to the crashes at the intersection.

While a significant number of crashes occur at the Wornall Road intersection, the intersection does not qualify as a high accident location in Kansas City, Missouri. The crash analysis indicates that the skew at the intersection combined with the lack of turn lanes on 75<sup>th</sup> Street are conditions that could be corrected to reduce the crash rate at the intersection.

### 3.2 TRAFFIC VOLUMES

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Traffic data for the study area was collected by TJ Brown and Associates on August 4, 2015. Data was collected at the following intersections:

1. 75<sup>th</sup> Street and Wornall Road – weekday morning and afternoon peak periods and Saturday noon hour. This data also included non-auto traffic on the Trolley Track Trail.
2. 75<sup>th</sup> Street and Broadway Boulevard – weekday morning and afternoon peak periods and Saturday noon hour
3. 75<sup>th</sup> Street and Washington Street – weekday afternoon peak period only
4. 74<sup>th</sup> Terrace and Wornall Road – weekday afternoon peak period only
5. 74<sup>th</sup> Street and Wornall Road – weekday afternoon peak period only

Heavy vehicle traffic (busses and trucks), non-auto traffic (pedestrians and bicyclists) and auto traffic data was collected at each of the intersections. The peak hour from the data collected at each of the locations was determined and is summarized in Exhibit 4 for the morning peak hour, Exhibit 5 for the afternoon peak hour and Exhibit 6 for the Saturday peak hour.

From the exhibits, we observe that traffic in the study area is directional in nature. During the morning peak hour, traffic is traveling either west, toward Ward Parkway, or north, toward downtown Kansas City. During the afternoon peak hour, traffic reverses direction and is traveling either south, toward Interstate 435 or east, toward US Highway 71. The traffic volumes are fairly balanced during the Saturday noon hour. Wornall Road tends to carry a larger volume of traffic on Saturday.

### 3.3 CAPACITY ANALYSIS

When evaluating modifications to an intersection, its operational level must be established. Based upon the delays experienced by its users, a baseline is set and improvement ideas are analyzed. All alternative considerations should exceed this baseline level of operations. The "Highway Capacity Manual", published by the Transportation Research Board (TRB), 2010 provides guidelines for completing an operational analysis at the intersection. The analysis results in a letter grade called the Level of Service (LOS). LOS ranges from A through F where LOS A implies drivers experience no delays while LOS F indicates a complete breakdown at the intersection. For signalized intersections, the criteria for the LOS grade are shown in the adjacent table.

Level of Service (LOS)	Delay (seconds per vehicle)	General description
A	≤ 10	Free flow
B	>10 to 20	Stable flow
C	>20 to 35	Stable flow
D	>35 to 55	Tolerable delay
E	>55 to 80	Intolerable delay
F	>80	Jammed conditions

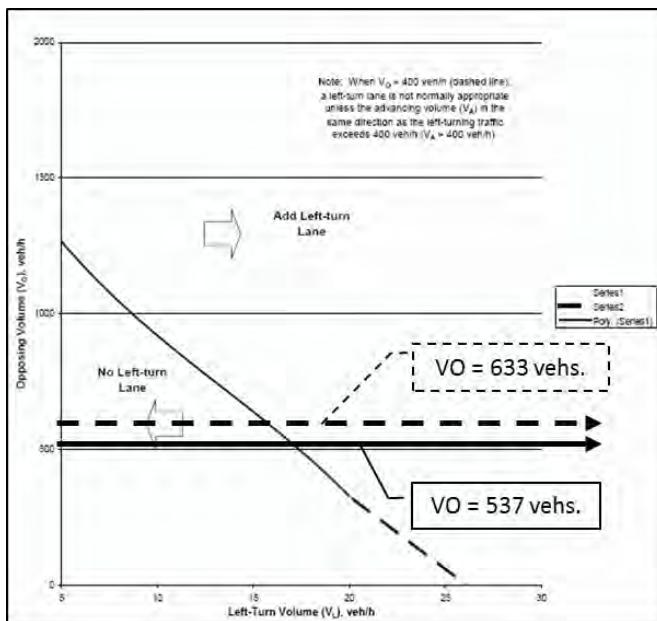
The analysis for the various intersections in the study area is completed using software called Synchro, released by Trafficware, version 9. Existing signal timing at the 75<sup>th</sup> and Wornall Road intersection was obtained from Kansas City, Missouri and used for the analysis. This intersection is on the 75<sup>th</sup> Street Operation Green Light (OGL) corridor.

The results of the analysis are shown in Exhibits 7, 8 and 9 for the morning, afternoon and Saturday peak hours respectively. Outputs from the software are included in the appendix. The Wornall Road and 75<sup>th</sup> Street intersection is currently operating at a LOS C during the morning and afternoon peak hours. However, during the Saturday peak hour, the LOS drops to D. Kansas City, Missouri considers LOS D as an acceptable LOS during any of the peak hours.

### 3.4 TURN LANE ADDITION CRITERIA

Because the project primarily involves a left-turn lane addition, R<sup>3</sup>C Designers performed the left turn lane addition guidelines check and the two-way left turn lane addition criteria. Kansas City, Missouri uses the Missouri Department of Transportation's (MoDOT) methodology for both types of lane additions.

### 3.4.1 LEFT TURN LANE GUIDELINES FOR FOUR LANE ROADWAYS



The guidelines are presented in MoDOT's Engineering Policy Guide (EPG) section 940.9.6<sup>1</sup>. The following data are required:

- Opposing Volume (veh/hr) - VO - The opposing volume is to include only the right-turn and through movements in the opposite direction of the left-turning vehicle.
  - For Eastbound left turn, VO = 448+89 = 537 vehicles
  - For Westbound left turn, VO = 575+58 = 633 vehicles
- Left-Turn Volume – VL
  - Eastbound left turn, VL = 92 vehicles
  - Westbound left turn, VL = 123 vehicles

If the opposing and left-turn volume

combination intersects above or to the right of the trend line, a left-turn lane is appropriate.

For the existing data, a left-turn lane for both the eastbound and westbound approaches is appropriate.

### 3.4.2 TWO-WAY LEFT-TURN LANE GUIDELINES

The guidelines for the addition of two-way left-turn lanes are presented in MoDOT's EPG section 232.3.1<sup>2</sup>. Criteria for use and design of TWLTLs includes the following:

Roadway/ Traffic Conditions	Two-Way Left-Turn Lanes (Five-Lane Facilities)	Two-Way Left-Turn Lanes (Three-Lane Facilities)
AADT	May be used where AADT in the design year is less than 28,000; otherwise use a raised median	May be used where AADT in the design year is less than 17,500
Driveway Spacing	May be used when driveway spacing is 12 or less per mile in each direction (Average spacing of 440 feet)	May be used when driveway spacing is 12 or less per mile in each direction (Average spacing of 440 feet)

- 75<sup>th</sup> Street Average Daily Traffic (ADT)
  - Assuming 10% of ADT is afternoon peak hour volume
  - Afternoon peak hour volume = eastbound volumes + westbound volumes
 
$$= (92+575+58) + (123+448+89)$$

$$= 725 + 660$$

<sup>1</sup> Available at:

[http://epg.modot.org/index.php?title=940.9\\_Auxiliary\\_Acceleration\\_and\\_Turning\\_Lanes#940.9.6\\_Left\\_Turn\\_Lane\\_Guidelines\\_for\\_Four-Lane\\_Roadways](http://epg.modot.org/index.php?title=940.9_Auxiliary_Acceleration_and_Turning_Lanes#940.9.6_Left_Turn_Lane_Guidelines_for_Four-Lane_Roadways)

<sup>2</sup> Available at: [http://epg.modot.org/index.php?title=232.3\\_Two\\_-Way\\_Left\\_-Turn\\_Lanes](http://epg.modot.org/index.php?title=232.3_Two_-Way_Left_-Turn_Lanes)

= 1, 385 vehicles

- ADT = 1385 \* 10 = 13,850 vehicles
- Driveway spacing =
  - Distance from Ward Parkway to Wornall = 0.5 miles = 2640 feet
  - Eastbound
    - Number of driveways = 14
    - Number of roadway intersections = 7
  - Westbound
    - Number of driveways = 14
    - Number of roadway intersections = 7
  - Total access points = 42
  - Driveway spacing =  $2640/42 = 63$  feet

Based on this analysis, the two-way left-turn lane addition meets the spacing criteria, but not ADT criteria.

## 4 FUTURE CONDITIONS

### 4.1 PUBLIC INPUT PROCESS

This project was completed using a very intense public participation process. A steering committee, consisting of local business owners, Kansas City Public Works staff, Mid-America Regional Council (MARC) staff, Kansas City Planning Department staff, and Kansas City Area Transit Authority (KCATA) staff, was overseeing project progress. The committee was updated on a daily basis during a three-day workshop held near the intersection. The following describes the process used.

1. August 11, 2015 - Development and presentation of options. A walking audit and feasibility analysis was also completed.
2. August 12, 2015 – Elimination of undesirable options Two preferred options were established.
3. August 13, 2015 – Recommendation selected



Steering Committee presentation and walking audit

Open house meetings were also held every day to gather input from Citizens and residents of the Waldo area. Detailed public workshop elements and comments received are presented in Chapter ??? of the final deliverable for this project.



## 4.2 OPTIONS DEVELOPED

Prior to and during the August 11, 2015

Public open house on August 11, 2015

workshop session, five different options were conceptualized and discussed. These include:

### 4.2.1 CLEAN UP EXISTING CURVES

This is shown in Exhibit 10. Field measurements indicate that a 50-foot radius was used on the west leg of the intersection. The American Public Works Association (APWA) suggests using 350-foot radii for a target speed of 35 miles per hour (mph). Therefore, this option flattens out the intersection approach radii to the desired 350-feet.

Advantages— There is minimal design or construction required for this option. Most of the restriping could be completed by maintenance crews. There is sufficient pavement width to accommodate the required lanes and the flatter radii. In addition, there are signal adjustments required with this option.

Disadvantages – The goals of the project are not met with this option. The walkability, or the lack of an eastbound left turn protected phase, are not addressed with this option.

### 4.2.2 TRAFFIC ENGINEER'S OPTION

This is shown in Exhibit 11. An eastbound left-turn lane was added to the intersection using recommended traffic engineering principles. Because of the closeness of the buildings on both the east and west legs of the intersections, pavement widening had to be limited to approximately 230 feet west and 375 feet east of Wornall Road. For the west leg, the resulting storage would be 10 feet. Typically, one car requires 25 feet of storage.

Advantages – A left-turn lane can be added at the intersection.

Disadvantages – This option would require design and construction. Utility relocation and right-of-way would have to be procured from the Walgreens located on the southwest corner of the intersection. The resulting cross-section on 75<sup>th</sup> Street would be about 55 feet wide, making it fairly unfriendly to pedestrians and could reduce the walkability of the intersection. Despite all the costs involved, the resulting storage bay is 10 feet. The steering committee did not see any benefit to this option and dismissed it.

### 4.2.3 URBAN PLANNER'S OPTION

This option is shown in Exhibit 12 and is a slight modification of the previous option. The traffic engineer's option provided a full shadow width for storing the left-turning vehicle. Instead of providing this full shadow, the urban planner's option looked at providing a 6-foot shadow for the left-turning vehicle. This reduces the transition length for building the left-turn lane. The resulting storage bay for

the eastbound left-turning traffic is approximately 90 feet. The 90-foot storage would remove three or four left-turning cars from the through lanes.

Advantages- A left-turn lane with approximately 90-foot storage can be added to the intersection on both sides of 75<sup>th</sup> Street. Exclusive left-turn phasing can be accommodated on the signal timing plan that could result in more efficient traffic flow.

Disadvantages – This option will also require design and construction work. Utility relocation and right-of-way costs could be high because of the pavement widening. Additionally, walkability and pedestrian friendliness would be sacrificed for improved traffic flow. The resulting width of 75<sup>th</sup> Street at the intersection would be 55 feet.

#### 4.2.4 3-RIGHTS OPTION

This option is also referred to as the “jug-handle” and is shown in Exhibit 13. The concept behind this option was that it takes three right turns to accomplish a left turn. Because Broadway Street is near Wornall Road, this option would take eastbound left-turning traffic through the Wornall Road intersection to Broadway Street. Drivers would then turn right onto Broadway Street, south of 75<sup>th</sup> Street, and then turn right again on a new connector to be constructed from Broadway Street to Wornall Road. A third right turn from the connector to Wornall Road would have completed their left turn movement.

Advantages – This option uses most of the existing pavement except for the short connector from Broadway Street to Wornall Road. The resulting “plaza” between the existing 75<sup>th</sup> Street and the new connector could be used as a KCATA bus terminus/exchange station.

Disadvantages – Broadway Street, south of 75<sup>th</sup> Street, is privately owned. Therefore, right-of-way costs would be incurred while pursuing this option. The connector between Broadway Street and Wornall Road would cross the Trolley Track Trail. While the anticipated volumes are not excessive, breaking access on the Trolley Track Trail is not desired by the community. Minimal signal adjustments would be required with this option.

#### 4.2.5 3-LANE SECTION (3-LANES) OPTION.

A concept plan is shown in Exhibit 14. The cross-section of 75<sup>th</sup> Street is dropped from a four-lane section to a three-lane section. The four-lane section does not have any turn lanes, while the three-lane section would have a through lane in each direction and a central two-way left-turn lane. This study area was limited to a section of 75<sup>th</sup> Street running from Washington Street to Wyandotte Street. City staff and community leaders were welcoming to the idea of expanding the exploration of this concept to include State Line Road to the west and The Paseo to the east.

Advantages – The three-lane section would very closely reflect the operations of a four-lane roadway. The resulting width of roadway at the intersection is 33-feet and presents the most pedestrian -friendly environment. Other advantages include 24-hour on-street parking facilities that cannot be provided with a four-lane section. Because of the closeness of driveways and cross streets on 75<sup>th</sup> Street, both east and west of the intersection, the three-lane option would benefit the whole corridor and not just the Wornall Road intersection. Finally, both goals of the project would be met. A left turn lane would be provided allowing simultaneous east and west turns and an improvement in the walkability of the intersection.

Disadvantages- There will be a minor loss in capacity at the intersection. Currently, two through lanes carry traffic across Wornall Road when the inner lane is not blocked by one or more left- turning vehicles. This second lane of through capacity would be lost with the three-lane option. The 3-lane option will also require costly signal adjustments at the 75<sup>th</sup> Street and Wornall Road intersection. Both the east and west leg signal poles and mast arms will need to be adjusted.

#### 4.2.5.1 City Resolution No. 140982

In December 2014, Mayor Sly James of Kansas City, Missouri passed City Resolution No. 140982 directing the City Manager to conduct a high-level road-diet analysis of certain existing streets. Each street was undivided and had four or more lanes. The purpose of the analysis was to determine the suitability of converting one or more of these streets into reduced-lane streets via a restriping and/or resurfacing program.

Further, the adopted Resolution stated that the Federal Highway Administration had found that road diets appeared to have minimal effects on vehicle capacity because left-turning vehicles were moved into a common two-way left turn lane. For road diets with annual average daily traffic under 20,000 vehicles, traffic congestion did not increase to the point of diverting traffic to alternative routes.

This Resolution is presented in Appendix B along with a spreadsheet showing the different roads that the city staff evaluated. In the spreadsheet, 75<sup>th</sup> Street between State Line Road and Main Street had an annual average daily traffic of 14,900 vehicles that is less than the 20,000 vehicles desired by the Resolution. However, 75<sup>th</sup> Street did not make the first cut through the selection process.

### 4.3 SELECTED OPTIONS

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On August 12, 2015 the steering committee eliminated the cleanup existing curves option, the traffic engineer's option and the urban planner's option primarily because they were not meeting the goals set for the project in terms of walkability and pedestrian friendliness.

The committee members realized that there is a balance to be achieved between pedestrian friendliness and moving traffic. When pedestrian friendliness is selected above traffic flow, traffic flow will be hindered. Correspondingly, if traffic flow was weighted higher, then pedestrian friendliness would suffer.

The committee members did not prefer the costs associated with right-of-way acquisition, utility relocation, design and construction with the turn-lane-addition options. Even though right-of-way would be required with the 3-rights option, it survived because the committee believed there would be significant benefits to creating a KCATA bus terminus/exchange station on the south side of 75<sup>th</sup> Street.

Therefore, at the end of August 13, 2015, the selected options for further analysis are:

1. 3-rights option and
2. 3-lanes option.

#### 4.4 CAPACITY ANALYSIS

The two selected options were then tested for operational efficiencies based on the methods prescribed in the 2010 edition of the Highway Capacity Manual. In addition to the two options, a no-build option was also tested. The no-build option does not change the existing roadways at the intersection. Instead, traffic volumes are increased by half-percent per year for 20 years to reflect growth. This analysis period of 20 years and increased volumes are used for all future capacity analyses.

Kansas City, Missouri typically considers LOS D as acceptable during peak hours. When the level drops to below LOS D, correctional measures are tested for implementation.

Results of the analysis are shown in Exhibits 4 through 6 for the different peak hours. Detailed outputs are provided in Appendix C. We observe the following from the exhibits:

Morning peak hour: Both the Wornall Road and Broadway Street intersections operate at LOS C or better with drivers experiencing average delays less than 35 seconds for all the future options, including the no-build option. Broadway Street intersection delays reduce between the no-build option, the 3-lanes and 3-rights options because the intersection is almost eliminated.

Afternoon peak hour: It is anticipated that the Wornall Road intersection will operate at a LOS C for the no-build option in 20 years. The two selected options for this intersection are projected to operate at a LOS D. LOS D is still acceptable per city standards.

In order to improve the intersection operations, two extra scenarios of adding either an eastbound right-turn lane or a westbound right-turn lane were tested at the intersection. The projected LOS does not change from the LOS D. However, average driver delays may reduce by a few seconds. Addition of the right-turn lanes for either the eastbound or westbound movements will require additional right-of-way and increase the costs of implementing the plan. Further, walkability and pedestrian friendliness may be sacrificed because of the extra width. Because the gain in operational LOS is not projected to be very large, the right turn lanes could be omitted from the desired solution.

Saturday peak hour: Similar to the morning peak hour, the operational efficiency between the no-build, and the two selected options does not change much. The Wornall Road intersection is anticipated to operate at a slightly better LOS for the 3-rights option during this peak hour.

## 5 RECOMMENDATION

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The capacity analysis results for the selected 3-rights and 3-lanes options were presented to the steering committee on the final day of the workshop, August 13, 2015. The results were discussed in detail and a criteria matrix was developed and discussed. This criteria matrix is shown as Exhibit 15. Upon completion of this exercise, the steering committee overwhelmingly selected the 3-lane option because of the benefits it presented. Kansas City staff, KCATA representatives, and MARC staff were all supportive of this option.

## 6 EXHIBITS

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Exhibit 1. STUDY AREA



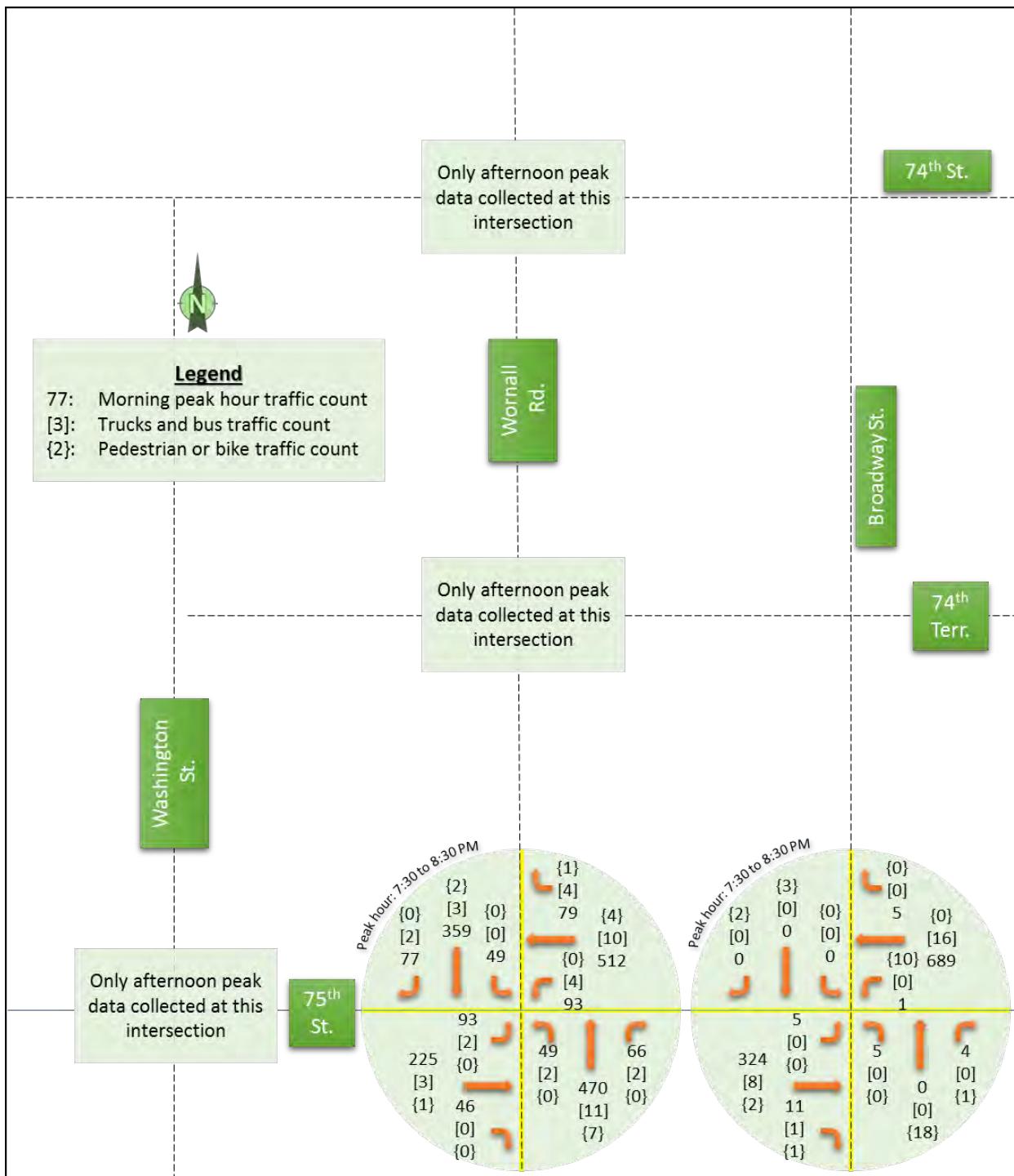
**Exhibit 2. CRASH HISTORY AT 75<sup>TH</sup> STREET AND WORNALL ROAD**

75th Street and Wornall Road Crash Analysis																
Year	2012			2013			2014			2015			All years			
Item	Number	Total	%	Number	Total	%	Number	Total	%	Number	Total	%	Total	%		
<b>Type</b>																
PDO	16	16	89%	11	11	79%	17	17	89%	6	6	86%	50	86%		
INJ	2	2	11%	3	3	21%	2	2	11%	1	1	14%	8	14%		
Fatality		0	0%		0	0%		0	0%		0	0%	0	0%		
Total	18	18	100%	14	14	100%	19	0	100%	7	7	100%	58	100%		
<b>Vehicle Action</b>																
MV in transport	6.81	7.49	44.3	40%	4.6	4.91	9.51	34%	6.99	6.9	13.89	37%	1.83	2.5	4.33	33% 42.03 37%
Going Straight	5.98	5.16	11.14	31%	3.15	2.16	5.31	19%	6.32	5.23	11.55	30%	1.83	2	3.83	29% 31.83 28%
Unknown			0	0%	2	2	4	14%	2		2	5%	2		2	15% 8 7%
Stopped in traffic		2	2	6%		1	1	4%	0.33	2.91	3.24	9%			0	0% 6.24 5%
Making left turn	1.83	0.66	2.49	7%	1.03	0.5	1.53	5%	1.33	0.33	1.66	4%	0.5		0.5	4% 6.18 5%
Parked	0.33	1.5	1.83	5%		0.75	0.75	3%		1	1	3%		1	1	8% 4.58 4%
Slowing/Stopping	0.33		0.33	1%	0.58	1.08	1.66	6%	0.66	1.24	1.9	5%			0	0% 3.89 3%
Collision with parked MV	1		1	3%		0	0%	0.83	0.83	1.66	4%		0.5	0.5	4% 3.16 3%	
Making right turn			0	0%	0.33	0.5	0.83	3%	0.5	0.5	1	3%			0	0% 1.83 2%
Changing Lane	0.99	0.5	1.49	4%		0	0%			0	0%	0.33		0.33	3%	1.82 2%
Backing	0.33	0.33	0.66	2%	0.75	0.25	1	4%			0	0%			0	0% 1.66 1%
Start in traffic		0.33	0.33	1%	0.33		0.33	1%			0	0%			0	0% 0.66 1%
Start from Parked			0	0%	0.58		0.58	2%			0	0%			0	0% 0.58 1%
Collision involving animal			0	0%		0.5	0.5	2%			0	0%			0	0% 0.5 0%
Collision involving other object			0	0%		0	0%			0	0%	0.5		0.5	4% 0.5 0%	
Airborne	0.33		0.33	1%		0	0%			0	0%			0	0% 0.33 0%	
Collision involving fixed object			0	0%	0.33	0.33	1%			0	0%			0	0% 0.33 0%	
Avoiding			0	0%	0.2		0.2	1%			0	0%			0	0% 0.2 0%
Cross Road			0	0%	0.2		0.2	1%			0	0%			0	0% 0.2 0%
Ran off Roadway - Left			0	0%	0.2		0.2	1%			0	0%			0	0% 0.2 0%
Total	18	18	36	100%	14	14	28	100%	19	19	38	100%	7	6	13	100% 115 100%
<b>Driver action</b>																
Drv. 1	Drv. 2			Drv. 1	Drv. 2		Drv. 1	Drv. 2		Drv. 1	Drv. 2		Drv. 1	Drv. 2		
None	2	13	15	42%	3	11	14	50%	1	14	15	39%	2	5	7	54% 51 44%
Unknown	3	3	6	17%	2	2	4	14%	6	4	10	26%	1.5	1.5	12% 21.5 19%	
Failed to yield	4	2	6	17%	2		2	7%	3	1	4	11%	1	1	2	15% 14 12%
Following too close	1		1	3%	1		1	4%	7		7	18%			0	0% 9 8%
Inattention	1		1	3%	3		3	11%	1		1	3%	0.5		0.5	4% 5.5 5%
Improper lane change	3.5		3.5	10%			0	0%			0	0%	1.5		1.5	12% 5 4%
Improper turn	0.5		0.5	1%	1		1	4%	1		1	3%			0	0% 2.5 2%
Violation signal/sign	1		1	3%		1	1	4%			0	0%			0	0% 2 2%
Too Fast for conditions	1		1	3%			0	0%			0	0%	0.5		0.5	4% 1.5 1%
Physical impairment	1		1	3%			0	0%			0	0%			0	0% 1 1%
<b>Driver action (Contd...)</b>																
Drv. 1	Drv. 2			Drv. 1	Drv. 2		Drv. 1	Drv. 2		Drv. 1	Drv. 2		Drv. 1	Drv. 2		
Improper Backing			0	0%	1		1	4%			0	0%			0	0% 1 1%
Other			0	0%	1		1	4%			0	0%			0	0% 1 1%
Parked			0	0%		0	0%			0	0%			0	0% 0 0%	
Stopped in traffic			0	0%		0	0%			0	0%			0	0% 0 0%	
Total	18	18	36	100%	14	14	28	100%	19	19	38	100%	7	6	13	100% 115 100%
<b>Light</b>																
Daylight	10	10	56%		11	11	79%		16	16	84%		5	5	71%	42 72%
Dark	7	7	39%		3	3	21%		1	1	5%		2	2	29%	13 22%
Unknown		0	0%			0	0%		2	2	11%		0	0%	2	3% 2 3%
Dark - unknown	1	1	6%			0	0%		0	0%			0	0%	1	2% 2 2%
Total	18	18	100%		14	14	100%		19	19	100%		7	7	100%	58 100%
<b>Road Conditions</b>																
Dry	16	16	89%		14	14	100%		15	15	79%		5	5	71%	50 86%
Snow	1	1	6%		0	0%	0.5		0.5	0.5	3%		1.5	1.5	21%	3 5%
Ice		0	0%		0	0%	1.5		1.5	1.5	8%		0.5	0.5	7%	2 3%
Unknown	1	1	6%			0	0%	1		1	5%			0	0%	2 3%
Wet		0	0%			0	0%	1		1	5%			0	0%	1 2%
Total	18	18	100%		14	14	100%		19	19	100%		7	7	100%	58 100%

**Exhibit 3. CRASH HISTORY AT 75<sup>TH</sup> STREET AND BROADWAY STREET**

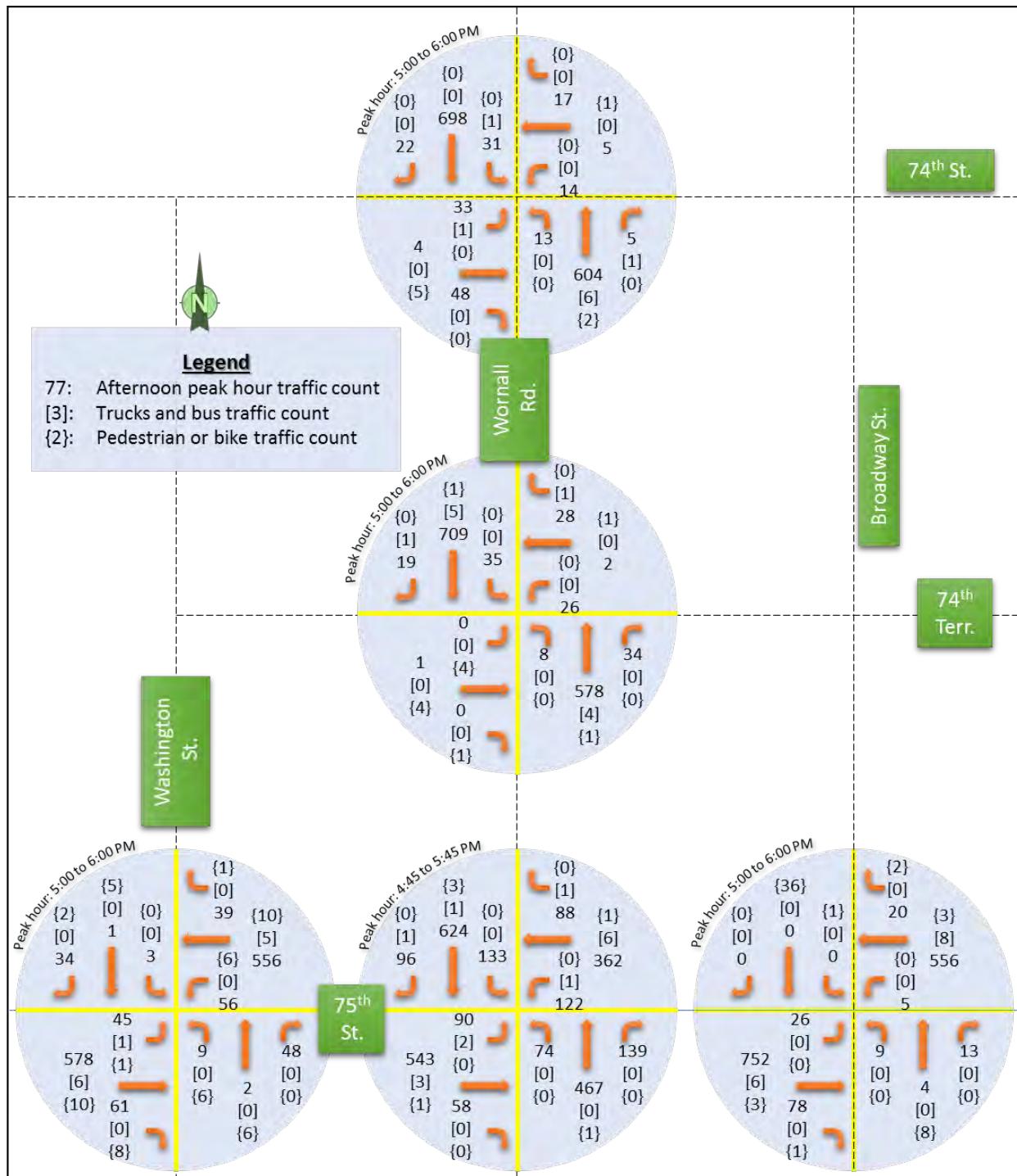
75th Street and Broadway Street Crash Analysis																
Year	2012			2013			2014			2015			All years			
Item	Number	Total	%	Number	Total	%	Number	Total	%	Number	Total	%	Total	%		
<b>Type</b>																
PDO	2	2	100%	5	5	100%	1	1	100%	0	0	0	8	100%		
INJ		0	0%		0	0%		0	0%		0	0	0	0%		
Fatality		0	0%		0	0%		0	0%		0	0	0	0%		
<b>Total</b>	<b>2</b>	<b>2</b>	<b>100%</b>	<b>5</b>	<b>5</b>	<b>100%</b>	<b>1</b>	<b>0</b>	<b>100%</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>100%</b>		
<b>Vehicle Action</b>																
MV in transport	0.83	1	1.83	46%	0.7	1	1.7	17%	0.34	0.34	0.68	34%				
Unknown		0	0%	2	2	4	40%			0	0%		0	4	25%	
Going Straight	0.33	1	1.33	33%	0.2	0.5	0.7	7%	0.33		0.33	17%		0	2.36	15%
Parked		0	0%	1	0.5	1.5	15%			0	0%		0	1.5	9%	
Making left turn		0	0%	0.2	0.5	0.7	7%		0.33	0.33	0.33	17%		0	1.03	6%
Making right turn		0	0%	0.5		0.5	5%			0	0%		0	0.5	3%	
Backing		0	0%		0.5	0.5	5%			0	0%		0	0.5	3%	
Start in traffic	0.5		0.5	13%			0	0%			0	0%		0	0.5	3%
Stopped in traffic		0	0%		0	0%			0.33	0.33	0.33	17%		0	0.33	2%
Changing Lane	0.33	0.33	8%			0	0%			0	0%		0	0.33	2%	
Skidding/Sliding		0	0%		0	0%	0.33			0.33	0.33	17%		0	0.33	2%
Slowing/Stopping		0	0%	0.2		0.2	2%			0	0%		0	0.2	1%	
Cross Road		0	0%	0.2		0.2	2%			0	0%		0	0.2	1%	
<b>Total</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>100%</b>	<b>5</b>	<b>5</b>	<b>100%</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>100%</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>100%</b>	
<b>Driver action</b>																
None		1	1	25%		3	3	30%	1		1	50%		0	5	31%
Unknown	1	1	2	50%	1	2	3	30%			0	0%		0	5	31%
Other		0	0%	2		2	20%			0	0%		0	2	13%	
Failed to yield		0	0%	0.33		0.33	3%		1	1	50%		0	1.33	8%	
Following too close		0	0%	1		1	10%			0	0%		0	1	6%	
Improper lane change	1		1	25%		0	0%			0	0%		0	1	6%	
Inattention		0	0%	0.34		0.34	3%			0	0%		0	0.34	2%	
Improper turn		0	0%	0.33		0.33	3%			0	0%		0	0.33	2%	
<b>Total</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>100%</b>	<b>5</b>	<b>5</b>	<b>100%</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>100%</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>100%</b>	
<b>Light</b>																
Daylight	1	1	50%	4	4	80%	1	1	100%			0	0	6	75%	
Dark - unknown		0	0%		0	0%			0	0%		0	0	0	0%	
<b>Total</b>	<b>2</b>	<b>2</b>	<b>100%</b>	<b>5</b>	<b>5</b>	<b>100%</b>	<b>1</b>	<b>1</b>	<b>100%</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>100%</b>		
<b>Road Conditions</b>																
Wet		0	0%		0	0%			0	0%		0	0	0	0%	
<b>Total</b>	<b>2</b>	<b>2</b>	<b>100%</b>	<b>5</b>	<b>5</b>	<b>100%</b>	<b>1</b>	<b>1</b>	<b>100%</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>100%</b>		

**Exhibit 4. MORNING PEAK HOUR TRAFFIC VOLUMES**



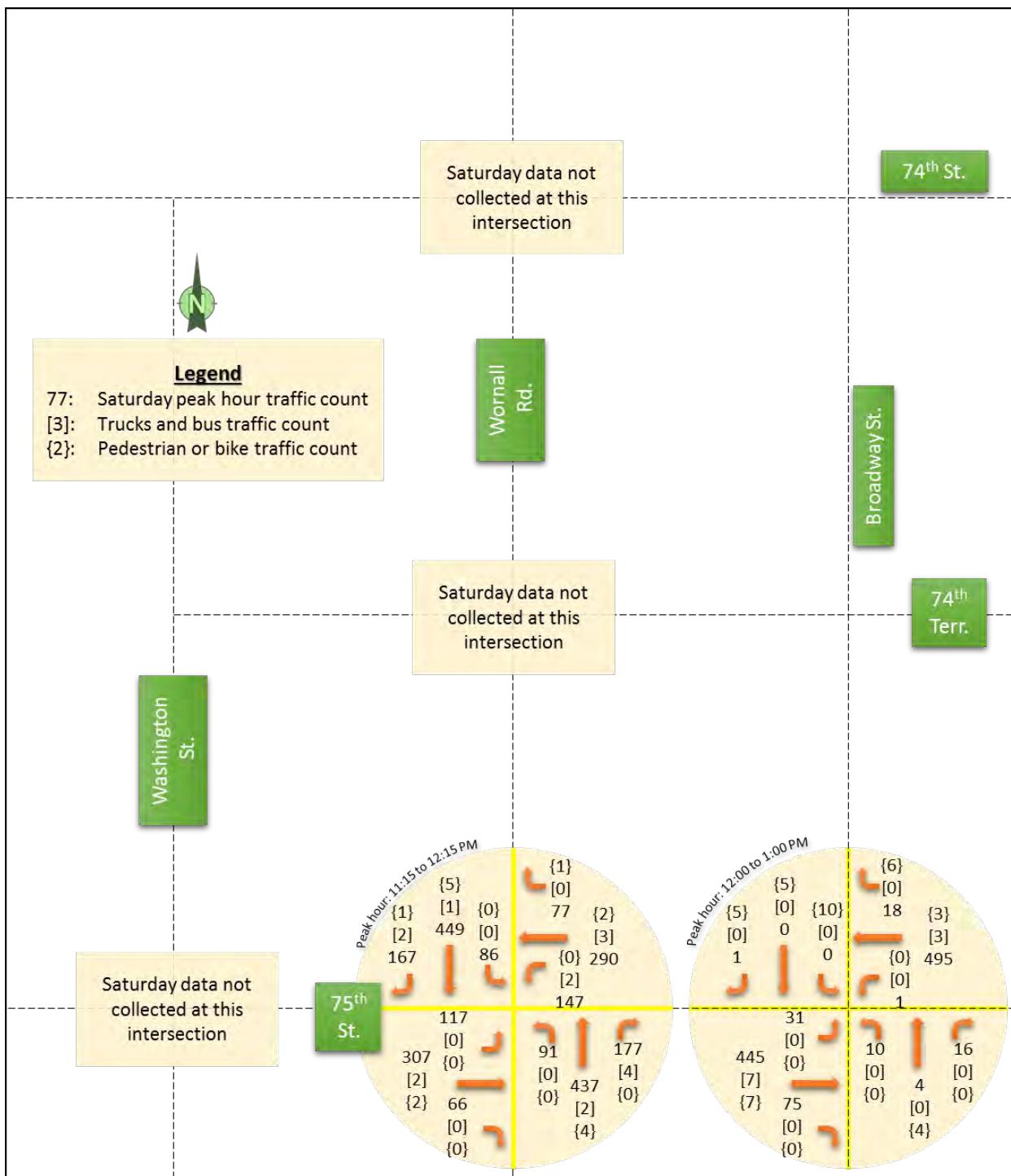
Data Source: TJ Brown Associates

**Exhibit 5. AFTERNOON PEAK HOUR TRAFFIC VOLUMES**



Data Source: TJ Brown Associates

**Exhibit 6. SATURDAY PEAK HOUR TRAFFIC VOLUMES**



Data Source: TJ Brown Associates

**Exhibit 7. CAPACITY ANALYSIS RESULTS FOR THE MORNING PEAK**

Int.	Scenario	Criteria	Eastbound			Westbound			Northbound			Southbound			Int.	
			LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
75th and Wornall	Existing AM	Delay	29.2		16.2			19.4	18.5	27.8	27.9	18.2	26.2	26.4	20.2	
		LOS	C		B			B	B	C	C	B	C	C	C	
	(1)	Delay	27.4		15.5			18.4	19.3	29.2	29.3	19.0	27.4	27.7	20.4	
		LOS	C		B			B	B	C	C	B	C	C	C	
	(1) (2)	Delay	24.2		20.6	15.3		33.1	28.9	41.7	41.9	28.3	38.6	39.0	32.9	
		LOS	C		C	B		C	C	D	D	C	D	D	C	
	(1) (2)	Delay		16.0	16.1			22.7	18.4	31.0	31.0	18.9	25.9	26.2	20.9	
		LOS		B	B			C	B	C	C	B	C	C	C	
75th and Broadway	Existing AM	Delay	9.3			8.2				10.4					0.1	
		LOS	A			A				B					*	
	(1)	Delay	9.3			8.2				13.7					0.1	
		LOS	A			A				B					*	
	(1) (2)	Delay								10.7					0.1	
		LOS								B					*	
	(1) (2)	Delay				8.6	0.0			15.5					0.1	
		LOS				A	A			C					*	
* = HCM 2010 does not calculate intersection LOS for two-way stop controlled intersections																
(1) = used 0.5% growth rate for 20 years. Factor = 1.10 Optimized signal length and splits																
(2) = Convert Broadway south leg to right-in, right-out intersection. Broadway north leg removed. Signal length and splits optimized																

**Exhibit 8. CAPACITY ANALYSIS RESULTS FOR THE AFTERNOON PEAK**

Int.	Scenario	Criteria	Eastbound			Westbound			Northbound			Southbound			Int.
			LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
75th and Wornall	Existing PM	Delay	24.7		18.6			18.3	22.8	34.2	34.8	22.5	38.2	38.2	26.8
		LOS	C		B			B	C	C	C	C	D	D	C
	(1)	Delay	33.3		20.6			20.1	27.1	33.8	34.1	29.1	44.5	44.5	30.2
		LOS	C		C			C	C	C	C	C	D	D	C
	(1) (2)	Delay	24.5		55.1	48.7		34.8	30.8	41.9	42.3	31.4	47.7	47.7	43.9
		LOS	C		E	D		C	C	D	D	C	D	D	D
	3-Lanes+ EBRT PM (1) (2)	Delay	32.7	49.6	24.8	36.5		35.3	28.6	39.0	39.3	26.6	41.1	41.1	39.4
		LOS	C	D	C	D		D	C	D	D	C	D	D	D
	3-Lanes+ WBRT PM (1) (2)	Delay	21.2		55.3	49.1	27.8	22.7	30.1	39.0	39.3	36.2	47.1	47.1	42.0
		LOS	C		E	D	C	C	C	D	D	D	D	D	D
	3-Rights PM (1) (2)	Delay		22.3	22.2			24.6	22.9	32.2	32.4	25.8	33.3	33.3	26.4
		LOS		C	C			C	C	C	C	C	C	C	C
75th and Broadway	Existing PM	Delay	8.9	0.3		10	0.1			21.4					0.7
		LOS	A	A		B	A		C						*
	(1)	Delay	9.2	0.3		10.5	0.1			25.3					0.8
		LOS	A	A		B	A		D						*
	(1) (2)	Delay								18.4					0.3
		LOS							C						*
	3-Rights PM (1) (2)	Delay			0.0					12.8					0.2
		LOS				A			B						*
	Existing PM	Delay	9.2	0.4		9.4	0.4			19.3		14.9			2.1
		LOS	A	A		A	A		C		B				*
75th and Washington	(1)	Delay	9.5	0.5		9.8	0.6			23.5		16.9			2.5
		LOS	A	A		A	A		C		C				*
	(1) (2)	Delay	9.5			9.8				35.0		22.8			2.7
		LOS	A			A			E		C				*
	(1) (2)	Delay	9.5	0.5		9.8	0.6			23.5		16.9			2.5
		LOS	A	A		A	A		C		C				*
	* = HCM 2010 does not calculate intersection LOS for two-way stop controlled intersections														
	(1) = used 0.5% growth rate for 20 years. Factor = 1.10 Optimized signal length and splits														
	(2) = Convert Broadway south leg to right-in, right-out intersection. Broadway north leg removed. Signal length and splits optimized														

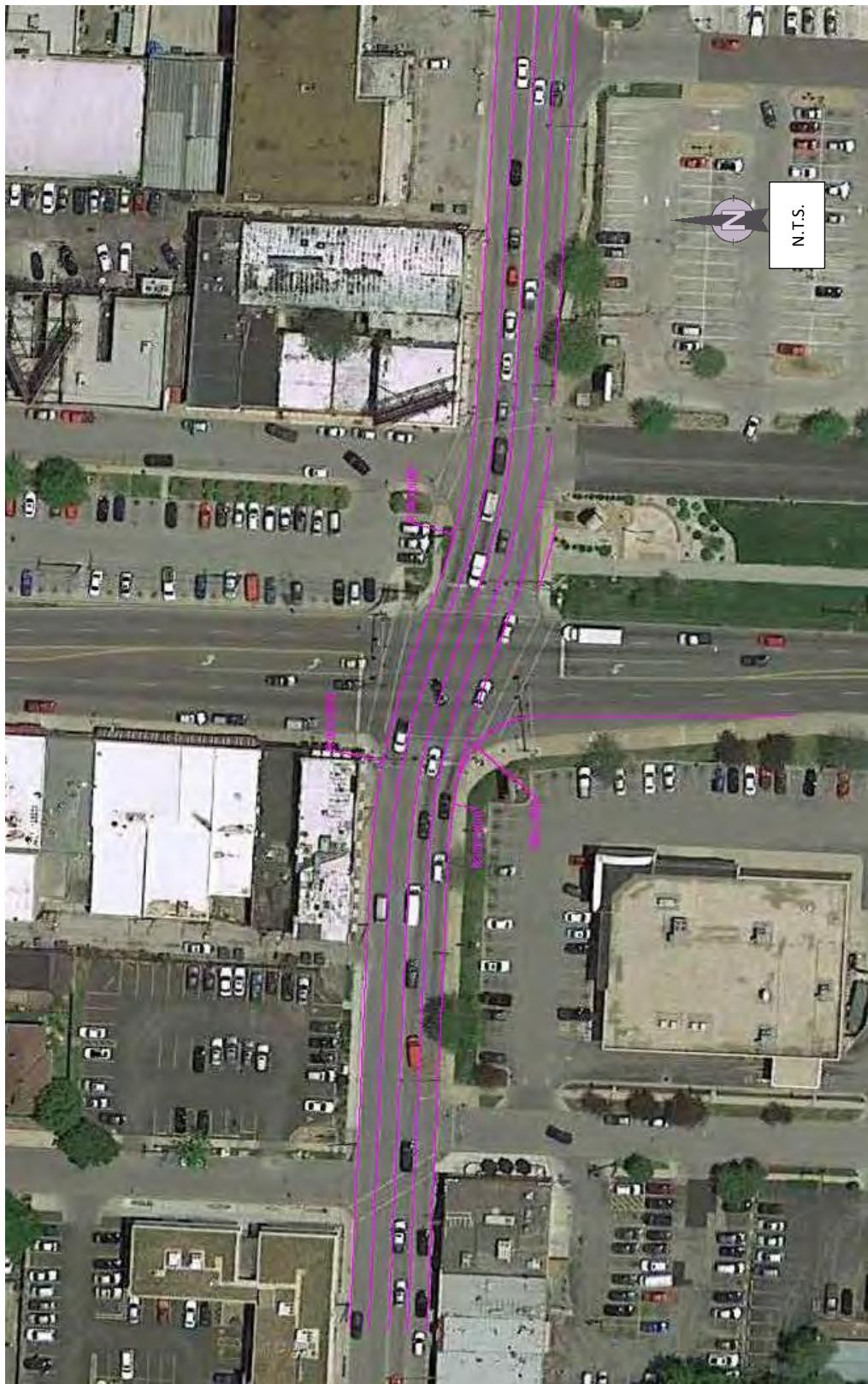
**Exhibit 9. CAPACITY ANALYSIS RESULTS FOR THE SATURDAY PEAK**

Int.	Scenario	Criteria	Eastbound			Westbound			Northbound			Southbound			Int.	
			LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
75th and Wornall	Existing Sat	Delay	304.7		34.8			31.5	12.2	17.7	17.9	12	18.4	18.6	48.2	
		LOS	F		C			C	B	B	B	B	B	B	D	
	No-build Sat (1)	Delay	294.8		31.1			29.0	14.6	21.5	21.7	14.2	22.3	22.6	48.3	
		LOS	F		F			C	B	C	C	B	C	C	D	
	3-Lanes Sat (1) (2)	Delay	21.7		42.2	42.3		32.7	25.7	41.7	42.6	25.0	46.6	47.8	39.7	
		LOS	C		D	D		C	C	D	D	C	D	D	D	
	3-Rights Sat (1) (2)	Delay		21.7	21.8			26.7	17.3	30.0	30.3	17.8	27.1	27.4	23.8	
		LOS		C	C			C	B	C	C	B	C	C	C	
75th and Broadway	Existing Sat	Delay	8.7	0.2		8.7	0			14.1					0.7	
		LOS	A	A		A	A			B					*	
	No-build Sat (1)	Delay	8.9	0.2		8.9	0.0			15.3					0.8	
		LOS	A	A		A	A			C					*	
	3-Lanes Sat (1) (2)	Delay								12.3					0.3	
		LOS								B					*	
	3-Rights Sat (1) (2)	Delay								10.5					0.3	
		LOS								B					*	
* = HCM 2010 does not calculate intersection LOS for two-way stop controlled intersections																
(1) = used 0.5% growth rate for 20 years. Factor = 1.10 Optimized signal length and splits																
(2) = Convert Broadway south leg to right-in, right-out intersection. Broadway north leg removed. Signal length and splits optimized																

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Exhibit 10. CLEAN UP EXISTING OPTION

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## **Exhibit 11. TRAFFIC ENGINEERS OPTION**



## **Exhibit 12. URBAN PLANNERS OPTION**

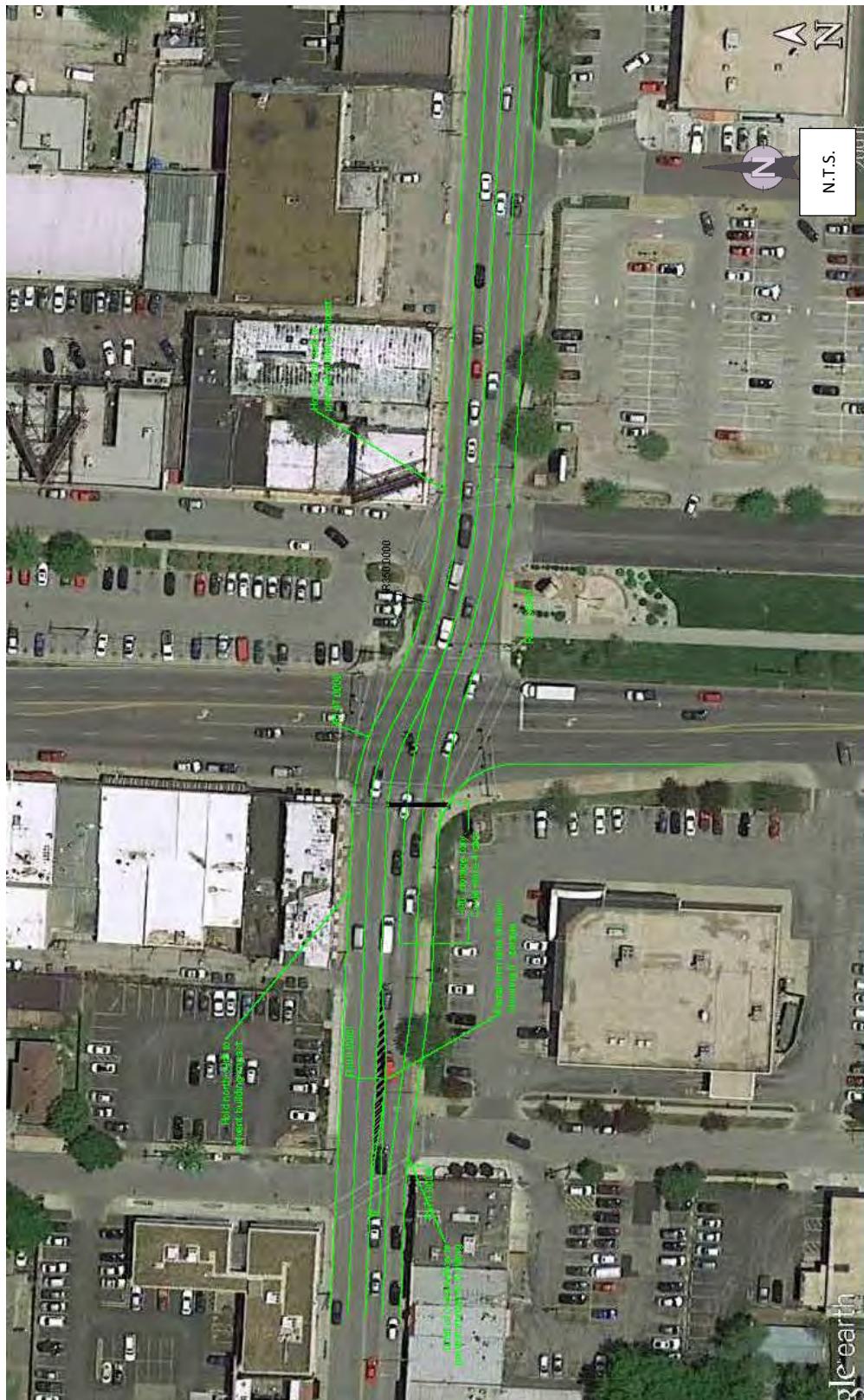


Exhibit 13. 3-RIGHTS OPTION

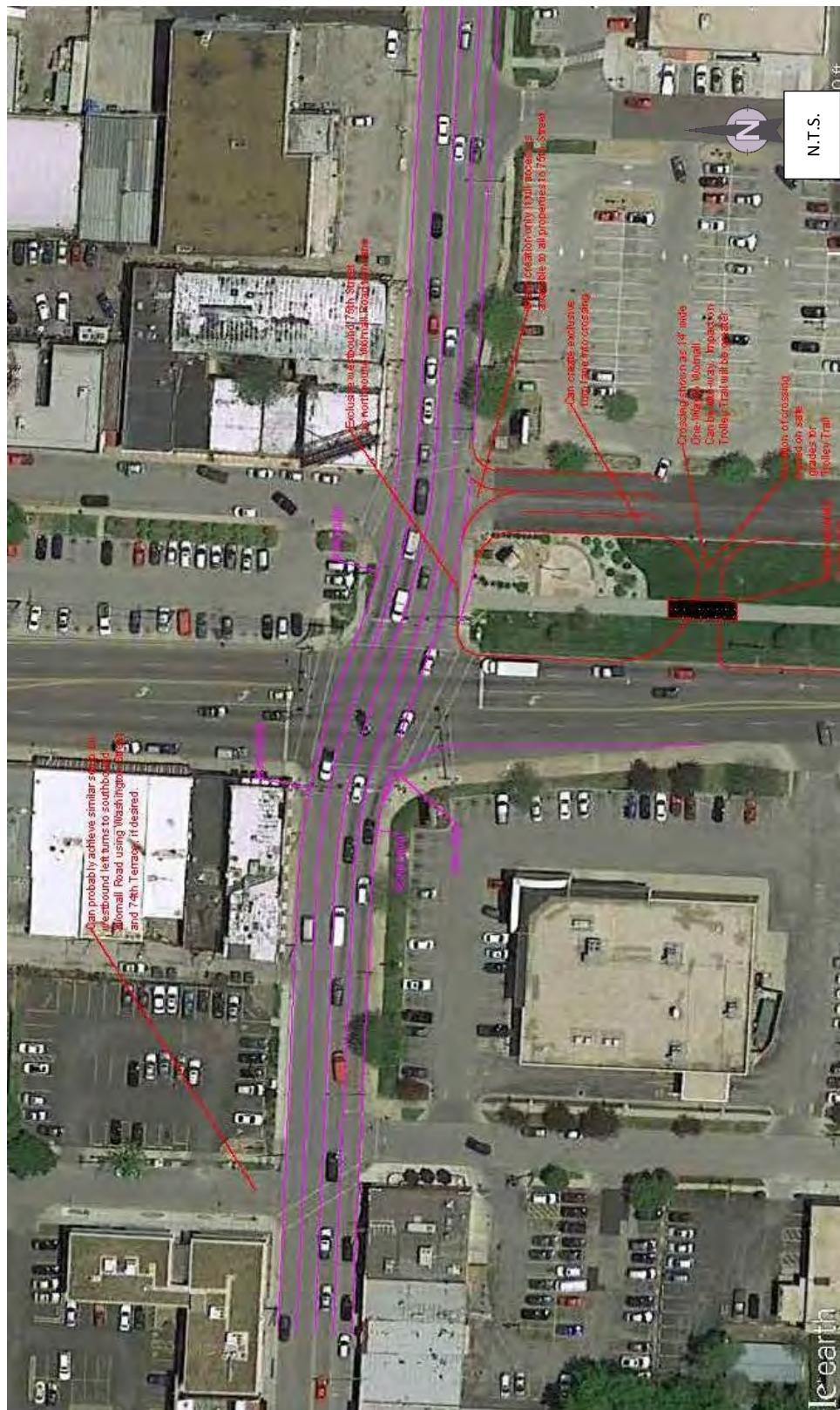
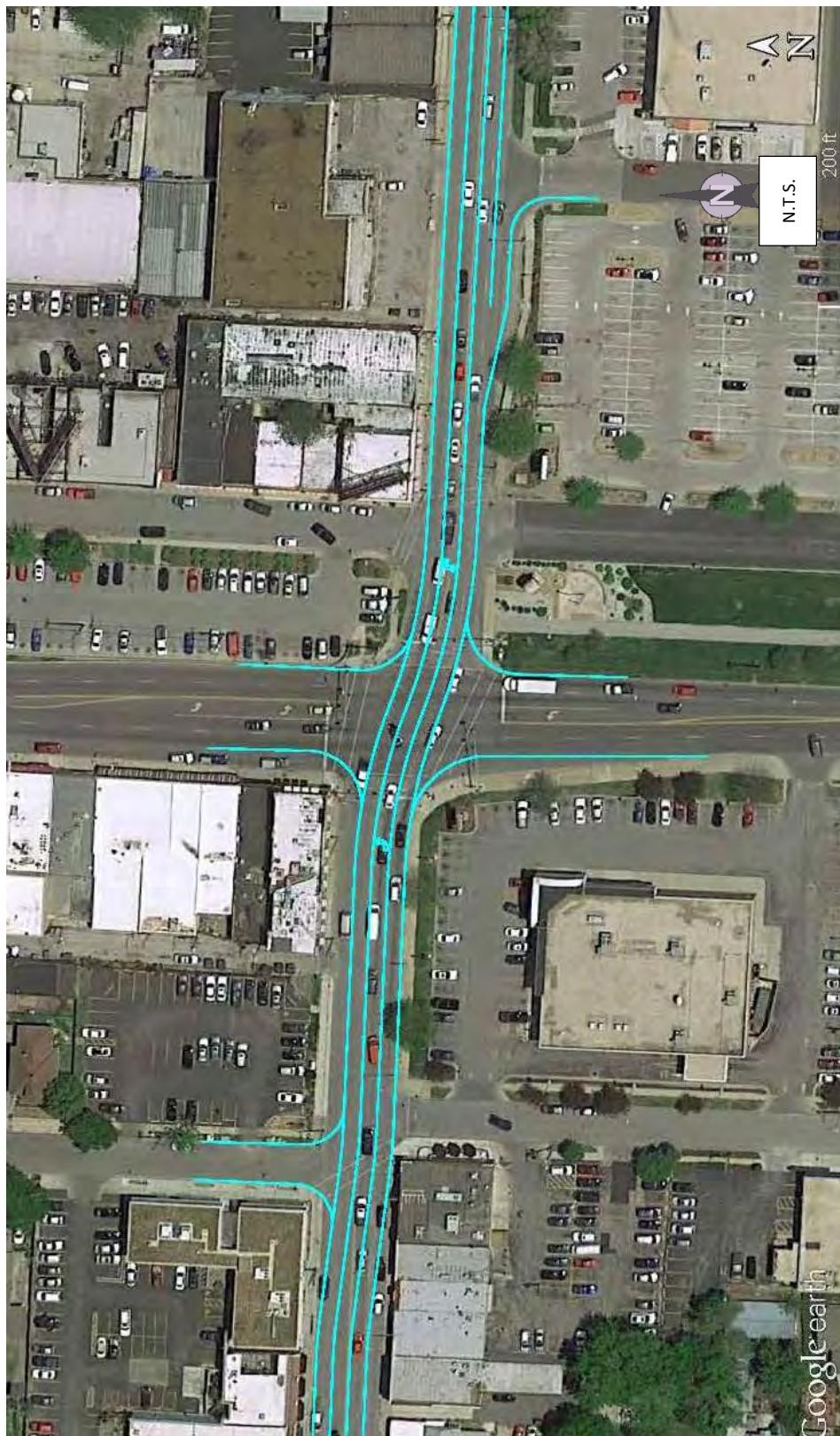


Exhibit 14. 3-LANE OPTION



**Exhibit 15. CRITERIA MATRIX**

Criteria	Ranking	No-build	3-rights	3-lane
Left turn lanes on 75th Street	Yes = 1 No = 2	2	2	1
Right-of-way impacts	Low = 1 Medium = 2 High = 3	1	3	1
Costs	Low = 1 Medium = 2 High = 3			
Street improvements	Low = 1 Medium = 2 High = 3			
Walkability improvements				
Bus turn-out improvements				
Bus routes management	High management = 1 Low management = 2	2	1	1
Enhanced streetscape	Possible = 1 Not possible = 2	2	1	1
Level-of-service				
Morning peak hour	LOS A, B = 1			
Noon hour	LOS C, D = 2			
Afternoon peak hour	LOS E, F = 3	3	2	2
Saturday peak hour				
Reduction of skew	Yes = 1 No = 2	2	2	1
Ease of implementation	Easy = 1	1	3	2
Constructability	Neutral = 2	1	3	2
Time for construction	Difficult = 3	1	3	2
Cost of construction				
Impact on Parking	Gain parking = 1 No gain/loss = 2 (within 5%) Lose parking = 3	2	2	2
Maintain entrance/access to adjacent properties	Maintain = 1 Loss of access = 2	1	1	1
Improved pedestrian flow	Improved = 1 Not improved = 2	2	1	1
Redistribution of parking	Low impact on current parking pattern = 1 Medium impact on current parking pattern = 2 High impact on current parking pattern = 3	1	1	2
Impact on trail	No trail crossing = 1 Trail crossing = 2	1	2	1
Total		22	27	20

## 7 APPENDIX

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### 7.1 APPENDIX A – EXISTING CAPACITY ANALYSIS RESULTS

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# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/28/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	228	46	97	522	83	51	481	68	49	364	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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		0.99	1.00	0.99
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	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	123	285	73	128	561	108	88	512	84	64	414	103
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.77	0.80	0.63	0.76	0.93	0.77	0.58	0.94	0.81	0.77	0.88	0.77
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	234	666	187	61	623	191	379	913	149	352	843	208
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.45	0.08	0.30	0.30	0.08	0.30	0.30
Sat Flow, veh/h	357	1480	416	2	1383	424	1774	3043	497	1774	2812	693
Grp Volume(v), veh/h	197	0	284	385	0	412	88	297	299	64	259	258
Grp Sat Flow(s),veh/h/ln	633	0	1620	190	0	1619	1774	1770	1771	1774	1770	1735
Q Serve(g_s), s	12.0	0.0	9.4	16.3	0.0	15.0	2.6	11.3	11.4	1.9	9.6	9.8
Cycle Q Clear(g_c), s	27.0	0.0	9.4	16.3	0.0	15.0	2.6	11.3	11.4	1.9	9.6	9.8
Prop In Lane	0.63			0.26	0.33		0.26	1.00		0.28	1.00	0.40
Lane Grp Cap(c), veh/h	358	0	729	0	0	729	379	531	531	352	531	520
V/C Ratio(X)	0.55	0.00	0.39	0.00	0.00	0.57	0.23	0.56	0.56	0.18	0.49	0.50
Avail Cap(c_a), veh/h	358	0	729	0	0	729	379	531	531	352	531	520
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.3	0.0	14.7	0.0	0.0	16.2	17.1	23.5	23.6	17.1	23.0	23.0
Incr Delay (d2), s/veh	5.9	0.0	1.6	0.0	0.0	3.2	1.4	4.2	4.3	1.1	3.2	3.3
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	4.4	0.0	4.5	0.0	0.0	7.3	1.4	6.1	6.2	1.0	5.1	5.1
LnGrp Delay(d),s/veh	29.2	0.0	16.2	0.0	0.0	19.4	18.5	27.8	27.9	18.2	26.2	26.4
LnGrp LOS	C		B			B	B	C	C	B	C	C
Approach Vol, veh/h		481			797			684			581	
Approach Delay, s/veh		21.6			10.0			26.6			25.4	
Approach LOS		C			B			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	41.0	10.0	29.0		41.0	10.0	29.0					
Change Period (Y+R <sub>c</sub> ), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	26.0	6.0	24.0		36.0	6.0	24.0					
Max Q Clear Time (g <sub>c+l1</sub> ), s	29.0	4.6	11.8		18.3	3.9	13.4					
Green Ext Time (p <sub>c</sub> ), s	0.0	0.0	5.3		8.6	0.0	4.8					
Intersection Summary												
HCM 2010 Ctrl Delay			20.2									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	5	342	12	1	705	5	5	0	4	0	0	0
Conflicting Peds, #/hr	0	0	2	2	0	0	3	0	28	28	0	3
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	5	372	13	1	766	5	5	0	4	0	0	0

Major/Minor	Major1	Major2			Minor1				
Conflicting Flow All	772	0	0	413	0	0	802	1191	222
Stage 1	-	-	-	-	-	-	417	417	-
Stage 2	-	-	-	-	-	-	385	774	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	839	-	-	1142	-	-	322	186	782
Stage 1	-	-	-	-	-	-	633	590	-
Stage 2	-	-	-	-	-	-	657	406	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	838	-	-	1140	-	-	311	0	762
Mov Cap-2 Maneuver	-	-	-	-	-	-	613	0	-
Stage 1	-	-	-	-	-	-	613	0	-
Stage 2	-	-	-	-	-	-	655	0	-

Approach	EB	WB			NB			
HCM Control Delay, s	0.1	0			10.4			
HCM LOS					B			

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	671	838	-	-	1140	-	-
HCM Lane V/C Ratio	0.015	0.006	-	-	0.001	-	-
HCM Control Delay (s)	10.4	9.3	0	-	8.2	0	-
HCM Lane LOS	B	A	A	-	A	A	-
HCM 95th %tile Q(veh)	0	0	-	-	0	-	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	92	546	58	123	368	89	74	467	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
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	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	108	575	70	137	391	98	89	502	170	148	727	128
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	180	999	132	71	578	192	272	715	241	344	902	159
Arrive On Green	0.45	0.45	0.45	0.45	0.45	0.45	0.08	0.28	0.28	0.10	0.30	0.30
Sat Flow, veh/h	269	2220	293	3	1284	427	1774	2599	875	1774	3008	529
Grp Volume(v), veh/h	360	0	393	254	0	372	89	341	331	148	428	427
Grp Sat Flow(s),veh/h/ln	1139	0	1643	93	0	1620	1774	1770	1705	1774	1770	1767
Q Serve(g_s), s	11.3	0.0	13.8	16.2	0.0	13.1	2.7	13.8	14.0	4.6	17.8	17.9
Cycle Q Clear(g_c), s	24.4	0.0	13.8	16.2	0.0	13.1	2.7	13.8	14.0	4.6	17.8	17.9
Prop In Lane	0.30			0.18	0.54		0.26	1.00		0.51	1.00	0.30
Lane Grp Cap(c), veh/h	571	0	739	0	0	729	272	487	469	344	531	530
V/C Ratio(X)	0.63	0.00	0.53	0.00	0.00	0.51	0.33	0.70	0.71	0.43	0.81	0.81
Avail Cap(c_a), veh/h	571	0	739	0	0	729	272	487	469	344	531	530
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.5	0.0	15.9	0.0	0.0	15.7	19.6	26.0	26.1	18.6	25.8	25.9
Incr Delay (d2), s/veh	5.2	0.0	2.7	0.0	0.0	2.5	3.2	8.2	8.7	3.9	12.3	12.4
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	7.6	0.0	6.8	0.0	0.0	6.3	1.6	7.8	7.7	2.6	10.5	10.5
LnGrp Delay(d),s/veh	24.7	0.0	18.6	0.0	0.0	18.3	22.8	34.2	34.8	22.5	38.2	38.2
LnGrp LOS	C		B			B	C	C	C	C	D	D
Approach Vol, veh/h		753			626			761			1003	
Approach Delay, s/veh		21.5			10.8			33.1			35.9	
Approach LOS		C			B			C			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s	41.0	10.0	29.0		41.0	12.0	27.0					
Change Period (Y+Rc), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	26.0	6.0	24.0		36.0	8.0	22.0					
Max Q Clear Time (g_c+l1), s	26.4	4.7	19.9		18.2	6.6	16.0					
Green Ext Time (p_c), s	0.0	0.0	3.0		8.9	0.1	4.2					
Intersection Summary												
HCM 2010 Ctrl Delay			26.8									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 2.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	46	584	61	56	561	39	9	2	48	3	1	34
Conflicting Peds, #/hr	10	0	16	16	0	10	6	0	12	12	0	6
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	50	635	66	61	610	42	10	2	52	3	1	37

Major/Minor	Major1	Major2		Minor1			Minor2					
Conflicting Flow All	664	0	0	713	0	0	1219	1566	379	1195	1578	354
Stage 1	-	-	-	-	-	-	780	780	-	765	765	-
Stage 2	-	-	-	-	-	-	439	786	-	430	813	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
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	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	921	-	-	883	-	-	136	110	619	142	108	642
Stage 1	-	-	-	-	-	-	354	404	-	362	410	-
Stage 2	-	-	-	-	-	-	567	401	-	574	390	-
Platoon blocked, %	-	-	-	-	-	-						
Mov Cap-1 Maneuver	909	-	-	871	-	-	106	87	605	106	86	627
Mov Cap-2 Maneuver	-	-	-	-	-	-	106	87	-	106	86	-
Stage 1	-	-	-	-	-	-	319	364	-	326	361	-
Stage 2	-	-	-	-	-	-	467	353	-	468	351	-

Approach	EB	WB			NB			SB		
HCM Control Delay, s	0.9	1.1			19.3			14.9		
HCM LOS					C			B		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	315	909	-	-	871	-	-	404
HCM Lane V/C Ratio	0.204	0.055	-	-	0.07	-	-	0.102
HCM Control Delay (s)	19.3	9.2	0.4	-	9.4	0.4	-	14.9
HCM Lane LOS	C	A	A	-	A	A	-	B
HCM 95th %tile Q(veh)	0.7	0.2	-	-	0.2	-	-	0.3

Intersection

Int Delay, s/veh 0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	26	758	78	5	564	20	9	4	13	0	0	0
Conflicting Peds, #/hr	4	0	3	3	0	4	36	0	8	8	0	36
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	28	824	85	5	613	22	10	4	14	0	0	0

Major/Minor	Major1	Major2			Minor1				
Conflicting Flow All	635	0	0	945	0	0	1276	1605	494
Stage 1	-	-	-	-	-	-	959	959	-
Stage 2	-	-	-	-	-	-	317	646	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	944	-	-	722	-	-	158	104	521
Stage 1	-	-	-	-	-	-	333	334	-
Stage 2	-	-	-	-	-	-	711	465	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	941	-	-	720	-	-	142	0	504
Mov Cap-2 Maneuver	-	-	-	-	-	-	142	0	-
Stage 1	-	-	-	-	-	-	303	0	-
Stage 2	-	-	-	-	-	-	701	0	-

Approach	EB	WB			NB			
HCM Control Delay, s	0.5	0.2			21.4			
HCM LOS					C			

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	247	941	-	-	720	-	-
HCM Lane V/C Ratio	0.114	0.03	-	-	0.008	-	-
HCM Control Delay (s)	21.4	8.9	0.3	-	10	0.1	-
HCM Lane LOS	C	A	A	-	B	A	-
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0	-	-

# HCM 2010 Signalized Intersection Summary

541: Wornal/Wornall & 75th

8/30/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	117	309	66	149	293	77	91	439	181	86	450	169
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1910	1872	1910	1881	1844	1881	1872	1872	1910	1863	1863	1900
Adj Flow Rate, veh/h	136	386	92	175	329	100	118	488	199	97	484	194
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.86	0.80	0.72	0.85	0.89	0.77	0.77	0.90	0.91	0.89	0.93	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	110	389	120	77	329	125	431	1077	437	430	1051	419
Arrive On Green	0.27	0.27	0.27	0.27	0.27	0.27	0.07	0.44	0.44	0.07	0.43	0.43
Sat Flow, veh/h	160	1440	445	6	1217	464	1783	2469	1001	1774	2471	984
Grp Volume(v), veh/h	279	0	335	260	0	344	118	351	336	97	346	332
Grp Sat Flow(s),veh/h/ln	422	0	1624	92	0	1596	1783	1778	1691	1774	1770	1685
Q Serve(g_s), s	5.6	0.0	15.2	17.2	0.0	16.0	2.9	11.1	11.2	2.4	11.2	11.3
Cycle Q Clear(g_c), s	21.6	0.0	15.2	17.2	0.0	16.0	2.9	11.1	11.2	2.4	11.2	11.3
Prop In Lane	0.49			0.27	0.67		0.29	1.00		0.59	1.00	0.58
Lane Grp Cap(c), veh/h	181	0	438	0	0	431	431	776	738	430	753	717
V/C Ratio(X)	1.54	0.00	0.77	0.00	0.00	0.80	0.27	0.45	0.46	0.23	0.46	0.46
Avail Cap(c_a), veh/h	181	0	438	0	0	640	456	776	738	475	753	717
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.7	0.0	26.9	0.0	0.0	27.2	11.9	15.8	15.9	11.7	16.4	16.4
Incr Delay (d2), s/veh	269.0	0.0	7.9	0.0	0.0	4.3	0.3	1.9	2.0	0.3	2.0	2.1
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	17.5	0.0	7.8	0.0	0.0	7.6	1.4	5.8	5.6	1.1	5.8	5.7
LnGrp Delay(d),s/veh	304.7	0.0	34.8	0.0	0.0	31.5	12.2	17.7	17.9	12.0	18.4	18.6
LnGrp LOS	F		C			C	B	B	B	B	B	B
Approach Vol, veh/h		614			604			805			775	
Approach Delay, s/veh		157.2			17.9			17.0			17.7	
Approach LOS		F			B			B			B	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	27.8	11.9	40.3		27.8	11.0	41.2					
Change Period (Y+R <sub>c</sub> ), s	* 6.2	* 6.3	* 6.3		* 6.2	5.7	* 6.3					
Max Green Setting (Gmax), s	* 20	* 6.7	* 23		* 32	7.3	* 23					
Max Q Clear Time (g <sub>c+l1</sub> ), s	23.6	4.9	13.3		19.2	4.4	13.2					
Green Ext Time (p <sub>c</sub> ), s	0.0	0.0	3.7		2.4	0.1	3.6					
<b>Intersection Summary</b>												
HCM 2010 Ctrl Delay		48.2										
HCM 2010 LOS		D										
<b>Notes</b>												

\* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Intersection

Int Delay, s/veh 0.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	31	452	75	1	498	18	10	4	16	0	0	0
Conflicting Peds, #/hr	13	0	7	7	0	13	5	0	4	4	0	5
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	2	-	-	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	34	491	82	1	541	20	11	4	17	0	0	0

Major/Minor	Major1	Major2			Minor1				
Conflicting Flow All	561	0	0	578	0	0	877	1167	304
Stage 1	-	-	-	-	-	-	604	604	-
Stage 2	-	-	-	-	-	-	273	563	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	1006	-	-	992	-	-	288	192	692
Stage 1	-	-	-	-	-	-	508	486	-
Stage 2	-	-	-	-	-	-	748	507	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	995	-	-	981	-	-	269	0	682
Mov Cap-2 Maneuver	-	-	-	-	-	-	269	0	-
Stage 1	-	-	-	-	-	-	480	0	-
Stage 2	-	-	-	-	-	-	739	0	-

Approach	EB	WB			NB			
HCM Control Delay, s	0.6	0			14.1			
HCM LOS					B			

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	429	995	-	-	981	-	-
HCM Lane V/C Ratio	0.076	0.034	-	-	0.001	-	-
HCM Control Delay (s)	14.1	8.7	0.2	-	8.7	0	-
HCM Lane LOS	B	A	A	-	A	A	-
HCM 95th %tile Q(veh)	0.2	0.1	-	-	0	-	-

## 7.2 APPENDIX B – KANSAS CITY, MISSOURI RESOLUTION No. 140982

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COMMITTEE SUBSTITUTE FOR RESOLUTION NO. 140982

Directing the City Manager to conduct a high level road diet analysis of existing undivided four or more lane streets to determine the suitability of converting one or more of these streets into reduced lane streets via a restriping and/or resurfacing program.

WHEREAS, Resolution No. 110069 expressed the Council's support for the concept of "Livable Streets" as a means to promote great neighborhoods, healthy and active people, and a thriving community; and

WHEREAS, the City has updated its Major Street Plan with a citywide traffic model which can be used to determine the feasibility of road diets; and

WHEREAS, a road diet is a vehicle lane reduction that often involves adding a bike lane and that can lead to improved roadway safety with no or minimal loss of service to users; and

WHEREAS, the Federal Highway Administration has found that road diets appeared to have minimal effects on vehicle capacity because left-turning vehicles were moved into a common two-way left-turn lane, and, for road diets with annual average daily traffic under 20,000 vehicles, traffic congestion will not increase to the point of diverting traffic to alternative routes; and

WHEREAS, the City of Kansas City has numerous four or more lane undivided streets that may be good candidates for a road diet conversion with bike lanes; and

WHEREAS, the City continues to resurface streets leaving in place current lane configurations; and

WHEREAS, the Council desires a plan of action to convert, where appropriate, four or more lanes undivided streets to improve safety and to not miss opportunities to improve transportation options for non-motorized users; and

WHEREAS, the City Manager's Office has the expertise to select the priority of undivided four or more lane streets for analysis; and

WHEREAS, the Council desires a record of the streets to undergo road diets so that future street resurfacing efforts result in more "Livable Streets;" NOW, THEREFORE,

BE IT RESOLVED BY THE COUNCIL OF KANSAS CITY:

That the City Manager is hereby directed to provide a high level road diet analysis of existing undivided four or more lane streets within the City to determine the suitability of converting one or more of these streets into reduced lane streets via a restriping and/or

COMMITTEE SUBSTITUTE FOR RESOLUTION NO. 140982

resurfacing program and to report the findings, including an explanation of interdepartmental and public participation, to the Council within 120 days.



Authenticated as Passed

Sly James, Mayor

Marilyn Sanders, City Clerk

DEC 04 2014

Date Passed

STREETNAME	Qualified Road Diet Routes by Continuous Segments with 4 or More Lanes			ESTIMATED ADT NO. OF LANES	Existing Pavement Markings Conditions	On Street Parking	Comments	2015 Resurfacing Program		AM PEAK HOUR VOLUMES		PM PEAK HOUR VOLUMES		Road Diet Feasibility					
	Begin	End	Best Condition Observed					Any Part of the Corridor		North or East Leg		South or West Leg							
								Proposed - Cleaver II to Stadium Dr	170	99	366	148							
Leeds Tfwy	280 feet east of Emanuel Cleaver II N Stadium Dr	N Stadium Dr	4	3700	Fair	No	Not in 2015 List			606	791	57	57	Yes					
Highland Ave	NE 48th Street	NE 46th Street	4	8000	Poor	No	Not in 2015 List			14				Yes					
Southern Rd	Stillwell St	Front St	4	600			Not in 2015 List							Yes					
McGee Tfwy	250 feet south of 28th St	30th St	4	1000	Fair	Yes	Not in 2015 List			66	93			Yes					
W 89th St	State Line Rd	Ward Pkwy	4	1300	Fair	Yes	Not in 2015 List			95	12	122	39	Yes					
NW 64th St	N London	N Gower	4	1500	Fair	Yes	Not in 2015 List							Yes					
Ararat Dr	48th Terrace	Eastwood Tfwy	4	1600	Fair	No	Not in 2015 List							Yes					
American Royal Dr	Gennesse St	23rd Street	4	2300	Fair	No	Not in 2015 List							Yes					
Searcy Creek Pkwy	702 feet north of NE 33rd St	Mo Re 210	4	2400	Fair	Yes	Not in 2015 List							Yes					
N Wyandotte St	NW Metro North Dr	185 feet north of NE Barry Road	4	2400	Fair	Yes	Not in 2015 List							Yes					
NE 85th Ter	N Wyandotte	N Dak Tfwy	4	2500	Fair	Yes	Not in 2015 List			134	145	293	241	Yes					
Longview Rd	Spring Valley Rd	Raytown Rd	4	2600	Poor	Yes	Not in 2015 List			251	226	224	156	Yes					
N Madison Ave	NW 88th St	NW Barry Rd	4	2600	Poor	Yes	Not in 2015 List			59			254	Yes					
NW Tiffany Springs Rd	210 feet west of N Helena	320 feet west of N Hull	4	3500	Fair	Yes	Not in 2015 List							Yes					
W 23rd St	Stateline 1060 feet west of American Royal Dr	Allen Street	4	3900	Fair	No	Not in 2015 List			278	224	384	333	Yes					
Deramus Ave	Chouteau Tfwy	N Topping	4	3900	Fair	Yes	Not in 2015 List							Yes					
E 19th St	Baltimore	McGee	4	3900	Fair	Yes	Not in 2015 List			290	288	381	385	Yes					
E Meyer Blvd	Main St	Holmes	4	4000	Fair	Yes	Not in 2015 List			246	274	338	395	Yes					
W 19th St	Baltimore/Southwest Blvd	Main St	4	4100	Fair	Yes	Not in 2015 List			401		394		Yes					
E 95th Ter	Bannister Rd	325 feet east of Euclid Ave	5	4300	Fair	No	Not in 2015 List			100	424	108	400	Yes					
Holmes St	14th St	Truman Rd	4	4700	Poor	No	Not in 2015 List							Yes					
N Ambassador Dr	325 feet south of NW Plaza Circle	N Ponoma	4	4800	Poor	Yes	Not in 2015 List			457	429	455	476	Yes					
N Corrington Ave	3000 feet north of Front St	Front St	4	5000	Fair	Yes	Not in 2015 List			491	116	354	54	Yes					
Benton Blvd	46th St	Blue Pkwy	4	5200	Fair	Yes	Not in 2015 List			258	322	452	517	Yes					
Gardner Ave	N Agnes	N Chouteau Tfwy	4	5300	Fair	Yes	Not in 2015 List			54	483	21	530	Yes					
NW 68th St	NW Evelyn St	N Holly St	5	5500	Excellent	No	Not in 2015 List			203	377	446	550	Yes					
McGee St	20th St	Pershing Rd	4.5	5600	Excellent	No	Not in 2015 List			406		555		Yes					
Marion Ridge Dr	62.5 feet south of Bannister Road	155 feet south of E 96th Place	4	5600	Fair	Yes	Not in 2015 List			266	418	552	515	Yes					
W 13th St	Central	Wyandotte	4	5800	Fair	No	Not in 2015 List			163			578	Yes					
N Chestnut Tfwy	N Kansas Ave	380 feet south of Guinotte Via	4	5800	Poor	Yes	Not in 2015 List			365	363	577	573	Yes					
Paseo Blvd (SB)	250 feet south of 18th Street	E 21st	4.6	6000	Fair	Yes	Not in 2015 List			388	382	572	591	Yes					
NE 48th St	N Brighton	N Beacon Ave	4	6300	Fair	No	Not in 2015 List			628	584	617	607	Yes					
E Armour Blvd	Main St	The Paseo	4	6400	Excellent	Yes	Not in 2015 List			490	412	622	637	Yes					
Carondelet Dr	State Line Rd	Wornall	4	6700	Excellent	No	Not in 2015 List			297	563	501	665	Yes					
Front St	620 feet east of N Corrington	N Century Ave	4	6900	Poor	No	Not in 2015 List			686	603	520	539	Yes					
E Gregory Blvd	Oak St	Prospect Ave	4	6900	Fair	Yes	Not in 2015 List			418	709	160	348	Yes					
Hickman Mills Dr	77th St	750 feet north of 85th St	4	7100	Fair	Yes	Not in 2015 List			488	559	563	716	Yes					
E Red Bridge Rd	Hickman Mills Dr	Hillcrest Rd	5	7200	Fair	Yes	Not in 2015 List			287	381	456	737	Yes					
N St Clair Ave	270 feet north of N Cosby Ave	N Cosby Ave	4	7400	Fair	No	Not in 2015 List							Yes					

STREETNAME	Qualified Road Diet Routes by Continuous Segments with 4 or More Lanes			ESTIMATED ADT Best Condition Observed	Existing Pavement Markings Conditions	On Street Parking	2015 Resurfacing Program		AM PEAK HOUR VOLUMES		PM PEAK HOUR VOLUMES		Road Diet Feasibility				
	Begin	End	NO. OF LANES				Comments	North or East Leg		South or West Leg		North or East Leg	South or West Leg				
								North or East Leg	South or West Leg	North or East Leg	South or West Leg	North or East Leg	South or West Leg				
W 39th St	State Line Rd	Main St	4	7400	Fair	Yes	Not in 2015 List	517	522	740	737	737	737	Yes			
Elmwood Ave	Emanuel Cleaver II	Blue Pkwy	4	7500	Excellent	No	Not in 2015 List	424	424	744	744	744	744	Yes			
N Gower Ave	N 64th St	N Gower Dr	4	7700	Excellent	Yes	Not in 2015 List	694	694	761	761	761	761	Yes			
E 12th St	Michigan	Van Brunt Blvd	4.5	7900	Excellent	Yes	Not in 2015 List	209	638	324	790	790	790	Yes			
James A Reed Rd	190 feet south of 93rd Terrace	107th St	4	8000	Fair	Yes	Not in 2015 List	288	236	792	692	692	692	Yes			
Grand Ave	Independence	Pershing	4.5,6,7	14000	Fair	Yes	Proposed by Wes - 8th to 12th	1060	1063	1392	1385	1385	1385	Yes			
Stadium Dr	US 40 Hwy	Manchester Tfkwy	4	9400	Fair	Yes	Proposed	720	720	931	931	931	931	Further Investigation			
Gregory Blvd	Cleveland Ave	Lakeside Dr	4	9600	Fair	No	Proposed	742	742	951	951	951	951	Further Investigation			
Sterling Ave	380 feet south of 43rd St	47th St	4	5900	Fair	Yes	Not in 2015 List	551	383	896	587	587	587	Further Investigation			
Swope Pkwy	Meyer Blvd	67th St	4	8300	Excellent	Yes	Not in 2015 List	573	420	955	823	823	823	Further Investigation			
Washington St	43rd Street	44th Street	4	8500	Fair	No	Not in 2015 List	44	713	53	845	845	845	Further Investigation			
Belmont Blvd	Scarritt Ave	Smart Ave	4	8600	Fair	No	Not in 2015 List	470	285	857	581	581	581	Further Investigation			
Prospect Ave	12th St	280 feet north of 20th St	4	8800	Fair	Yes	Not in 2015 List	470	377	878	605	605	605	Further Investigation			
E 63rd St	Main	E Meyer Blvd	4.5	9000	Fair	No	Not in 2015 List	632	638	898	820	820	820	Further Investigation			
W 43rd St	Pennsylvania	Wornall	4	9800	Fair	No	Not in 2015 List	791	606	976	746	746	746	Further Investigation			
Independence Blvd	Charlotte	1440 feet east of Cambridge Ave	4.5	13200	Fair	Yes	Proposed - Forest to Paseo, Only Four Blocks	919	741	1316	1294	1294	1294	No			
E 85th St	560 feet east of Wornall Rd	Campbell St	4.5	10700	Fair	No	Add On - Wornall to Holmes	981	842	1066	922	922	922	No			
Eastwood Hwy	Blue Pkwy	225 feet east of Bristol Ave	4	10900	Fair	No	Add On - Blue Pkwy to 1435 Hwy	1012	991	1087	1055	1055	1055	No			
Wornall Rd	77th St	79th St	4	16300	Fair	No	Add On - 77th to 79th, Only 2 Blocks	901	901	1624	1624	1624	1624	No			
Holmes Rd	Rockhill Rd	150 feet north of E 86th Terrace	4.5	12400	Fair	Yes	Add On - 75th to 79th, Only Four Blocks	970	1195	1071	1233	1233	1233	No			
Southwest Blvd	19th St	31st St (Sateline)	4.5	10100	Excellent	Yes	Not in 2015 List	546	888	758	1093	1093	1093	No			
Blue Ridge Cutoff	C.I. E 35th St	E 38th Terrace	4.5,6,8	10300	Excellent	No	Not in 2015 List	641	482	1023	829	829	829	No			
Admiral Blvd	Locust	The Paseo	4.5	10300	Fair	Yes	Not in 2015 List	632	610	1027	709	709	709	No			
E 13th St	Oak	Charlotte	4	10300	Excellent	Yes	Not in 2015 List	1024	1030	349	468	468	468	No			
W 39th St	Wyoming	Main St	4	10800	Fair	Yes	Not in 2015 List	642	557	1076	1007	1007	1007	No			
Lei's Summit Rd	US 40	475 feet south of US 40	4	10800	Fair	Yes	Not in 2015 List	856	835	1079	1043	1043	1043	No			
W 31st St	Southwest Blvd	Main St	4.5	11100	Excellent	No	Not in 2015 List	581	731	1103	519	519	519	No			
NW 112th St	540 feet west of N Ambassador Dr	N Congress Ave	4	11100	Fair	Yes	Not in 2015 List	489	1104	323	668	668	668	No			
E 31st St	Main	Woodland	4	11500	Fair	Yes	Not in 2015 List	1102	1093	1165	1141	1141	1141	No			
West Pennway	Southwest Blvd	W 26th St	5	11600	Excellent	No	Not in 2015 List	872	599	1152	883	883	883	No			
Pershing Rd	W Pennway St	Broadway	6	12100	Excellent	No	Not in 2015 List	866	968	1108	1205	1205	1205	No			
E 87th St	510 feet west of Hillcrest Rd	Eastern Ave	5	12400	Fair	No	Not in 2015 List	1054	1036	1238	1205	1205	1205	No			
E 23rd St	Askew	Manchester Tfkwy	4	12400	Fair	Yes	Not in 2015 List	855	863	1233	1230	1230	1230	No			
E Linwood Blvd	Main St	Woodland	4.5	12500	Excellent	No	Not in 2015 List	1211	1241	1150	1244	1244	1244	No			
W 12th St	E ramps to I-35	Broadway	4	12500	Fair	No	Not in 2015 List	867	1247	814	1185	1185	1185	No			
Gillham Rd	400 feet NW of 39th St	260 feet south of 41st St	4	13600	Fair	Yes	Not in 2015 List	1146	1104	1328	1351	1351	1351	No			
NE Barry Rd	410 feet east of N Oak Tfkwy	N Wayne	4.5	14100	Excellent	No	Not in 2015 List	482	544	1196	1401	1401	1401	No			
N Executive Hills Blvd	N Pomona	250 feet south of 61st & Pomona	4	13200	Fair	Yes	Not in 2015 List	940	1414	1414	1414	1414	1414	No			
W 75th St	Stateline Rd	Main St	4	14900	Fair	Yes	Not in 2015 List	1111	873	1489	1046	1046	1046	No			

STREETNAME	Qualified Road Diet Routes by Continuous Segments with 4 or More lanes			ESTIMATED ADT NO. OF LANES	Existing Pavement Markings Conditions	On Street Parking	Comments	AM PEAK HOUR VOLUMES			PM PEAK HOUR VOLUMES			Road Diet Feasibility
	Begin	End	Best Condition Observed					North or East Leg	South or West Leg	North or East Leg	South or West Leg	North or East Leg	South or West Leg	
Trost Ave	340 feet south of E 68th St	Bannister Rd	4.5	15000	Fair	Yes	Not in 2015 List	1241	1166	1493	1459	No	No	
E Bannister Rd	Bristol	James A. Reed	5	15000	Fair	No	Not in 2015 List	648	704	1495	1355	No	No	
W 103rd St	State Line Rd	880 feet east of State Line Rd	5	15100	Fair	No	Not in 2015 List	868		1504		No	No	
E 22nd St	Holmes St	Campbell St	5	15300	Fair	No	Not in 2015 List	1217	1044	1522	1281	No	No	
Broadway Blvd	31st Street	43rd Street	5	15400	Fair	Yes	Not in 2015 List	1057	970	1536	1419	No	No	
N Brighton Ave	N Vivion Rd	NE Parvin Rd	4	15400	Fair	Yes	Not in 2015 List	681	495	1533	1279	No	No	
E Truman Rd	Charlotte	Winchester	4,5,6,7,8	15600	Fair	Yes	Not in 2015 List	845	900	1556	1435	No	No	
Rockhill Rd	E 48th Street	Holmes St	4.5	15600	Fair	No	Not in 2015 List	856	912	1185	1056	No	No	
N Chouteau Hwy	500 feet south of N Vivion Rd	EB ramps to I-35	4	15600	Fair	No	Not in 2015 List	738	1009	1434	1552	No	No	
Brookside Blvd	500 feet north of E 51st St	290 feet south of E 58th St	4	15600	Fair	Yes	Not in 2015 List	1382	1331	1536	1549	No	No	
Blue Ridge Blvd	E 103rd St	Cambridge Ave	4.5	17200	Fair	No	Not in 2015 List	545	596	1573	1719	No	No	
Womail Rd	96th St	103rd St	5.7	18100	Fair	No	Not in 2015 List	1576	1651	1712	1801	No	No	
N Church Rd	SR 152	NE 81st Terrace Cl.	4.5	18700	Excellent	No	Not in 2015 List	525	739	1451	1870	No	No	
Westport Rd	State Line Rd	Roanoke	4.5	19800	Excellent	Yes	Not in 2015 List	1692	1973	1377	1693	No	No	

## 7.3 APPENDIX C – FUTURE CAPACITY ANALYSIS RESULTS

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### 7.3.1 No-BUILD OPTION

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/28/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	95	228	46	97	522	83	51	481	68	49	364	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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		0.99	1.00	0.99
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	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	123	285	73	128	561	108	88	512	84	64	414	103
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.77	0.80	0.63	0.76	0.93	0.77	0.58	0.94	0.81	0.77	0.88	0.77
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	244	688	193	61	641	196	366	875	143	340	808	199
Arrive On Green	0.46	0.46	0.46	0.46	0.46	0.46	0.08	0.29	0.29	0.08	0.29	0.29
Sat Flow, veh/h	370	1487	416	2	1386	424	1774	3043	497	1774	2811	693
Grp Volume(v), veh/h	197	0	284	384	0	413	88	297	299	64	259	258
Grp Sat Flow(s),veh/h/ln	652	0	1620	192	0	1619	1774	1770	1771	1774	1770	1734
Q Serve(g_s), s	11.6	0.0	9.1	16.0	0.0	14.7	2.7	11.5	11.6	1.9	9.8	10.0
Cycle Q Clear(g_c), s	26.3	0.0	9.1	16.0	0.0	14.7	2.7	11.5	11.6	1.9	9.8	10.0
Prop In Lane	0.62		0.26	0.33		0.26	1.00		0.28	1.00		0.40
Lane Grp Cap(c), veh/h	375	0	749	0	0	749	366	509	509	340	509	499
V/C Ratio(X)	0.53	0.00	0.38	0.00	0.00	0.55	0.24	0.58	0.59	0.19	0.51	0.52
Avail Cap(c_a), veh/h	375	0	749	0	0	749	366	509	509	340	509	499
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.2	0.0	14.0	0.0	0.0	15.5	17.8	24.4	24.4	17.8	23.8	23.9
Incr Delay (d2), s/veh	5.2	0.0	1.5	0.0	0.0	2.9	1.5	4.8	4.9	1.2	3.6	3.8
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	4.3	0.0	4.3	0.0	0.0	7.1	1.4	6.3	6.3	1.0	5.3	5.3
LnGrp Delay(d),s/veh	27.4	0.0	15.5	0.0	0.0	18.4	19.3	29.2	29.3	19.0	27.4	27.7
LnGrp LOS	C		B			B	B	C	C	B	C	C
Approach Vol, veh/h		481			797			684			581	
Approach Delay, s/veh		20.3			9.5			28.0			26.6	
Approach LOS		C			A			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	42.0	10.0	28.0		42.0	10.0	28.0					
Change Period (Y+R <sub>c</sub> ), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	27.0	6.0	23.0		37.0	6.0	23.0					
Max Q Clear Time (g <sub>c+l1</sub> ), s	28.3	4.7	12.0		18.0	3.9	13.6					
Green Ext Time (p <sub>c</sub> ), s	0.0	0.0	5.0		9.0	0.0	4.5					
Intersection Summary												
HCM 2010 Ctrl Delay			20.4									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 0.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	5	342	12	1	705	5	5	0	4	0	0	0
Conflicting Peds, #/hr	0	0	2	2	0	0	3	0	28	28	0	3
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	5	372	13	1	766	5	5	0	4	0	0	0

Major/Minor	Major1	Major2			Minor1				
Conflicting Flow All	772	0	0	413	0	0	802	1191	222
Stage 1	-	-	-	-	-	-	417	417	-
Stage 2	-	-	-	-	-	-	385	774	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	839	-	-	1142	-	-	322	186	782
Stage 1	-	-	-	-	-	-	633	590	-
Stage 2	-	-	-	-	-	-	657	406	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	838	-	-	1140	-	-	311	0	762
Mov Cap-2 Maneuver	-	-	-	-	-	-	311	0	-
Stage 1	-	-	-	-	-	-	613	0	-
Stage 2	-	-	-	-	-	-	655	0	-

Approach	EB	WB			NB			
HCM Control Delay, s	0.1	0			13.7			
HCM LOS					B			

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	422	838	-	-	1140	-	-
HCM Lane V/C Ratio	0.023	0.006	-	-	0.001	-	-
HCM Control Delay (s)	13.7	9.3	0	-	8.2	0	-
HCM Lane LOS	B	A	A	-	A	A	-
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	92	546	58	123	368	89	74	467	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1900	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	119	632	77	150	431	108	98	552	186	163	799	140
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	988	134	63	595	197	235	809	272	288	936	164
Arrive On Green	0.47	0.47	0.47	0.47	0.47	0.47	0.07	0.31	0.31	0.07	0.31	0.31
Sat Flow, veh/h	256	2117	288	2	1274	422	1774	2602	874	1774	3010	527
Grp Volume(v), veh/h	389	0	439	274	0	415	98	375	363	163	470	469
Grp Sat Flow(s),veh/h/ln	1017	0	1644	78	0	1621	1774	1770	1706	1774	1770	1768
Q Serve(g_s), s	17.7	0.0	17.5	21.4	0.0	16.5	3.3	16.7	16.8	5.7	22.4	22.4
Cycle Q Clear(g_c), s	34.2	0.0	17.5	21.4	0.0	16.5	3.3	16.7	16.8	5.7	22.4	22.4
Prop In Lane	0.31			0.18	0.55		0.26	1.00		0.51	1.00	0.30
Lane Grp Cap(c), veh/h	527	0	767	0	0	756	235	551	531	288	551	550
V/C Ratio(X)	0.74	0.00	0.57	0.00	0.00	0.55	0.42	0.68	0.68	0.57	0.85	0.85
Avail Cap(c_a), veh/h	527	0	767	0	0	756	235	551	531	288	551	550
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.3	0.0	17.5	0.0	0.0	17.2	21.8	27.1	27.1	21.2	29.1	29.1
Incr Delay (d2), s/veh	8.9	0.0	3.1	0.0	0.0	2.8	5.4	6.7	7.0	7.9	15.4	15.4
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	10.1	0.0	8.6	0.0	0.0	8.0	1.9	9.1	8.9	3.3	13.3	13.3
LnGrp Delay(d),s/veh	33.3	0.0	20.6	0.0	0.0	20.1	27.1	33.8	34.1	29.1	44.5	44.5
LnGrp LOS	C		C			C	C	C	C	D	D	
Approach Vol, veh/h		828			689			836			1102	
Approach Delay, s/veh		26.5			12.1			33.2			42.2	
Approach LOS		C			B			C			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	47.0	10.0	33.0		47.0	10.0	33.0					
Change Period (Y+R <sub>c</sub> ), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	32.0	6.0	28.0		42.0	6.0	28.0					
Max Q Clear Time (g <sub>c+l1</sub> ), s	36.2	5.3	24.4		23.4	7.7	18.8					
Green Ext Time (p <sub>c</sub> ), s	0.0	0.0	2.8		10.2	0.0	6.3					
Intersection Summary												
HCM 2010 Ctrl Delay			30.2									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	46	584	61	56	561	39	9	2	48	3	1	34
Conflicting Peds, #/hr	10	0	16	16	0	10	6	0	12	12	0	6
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	55	698	73	67	671	47	11	2	57	4	1	41

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	729	0	0	783	0	0	1339	1720	414	1312	1733	387
Stage 1	-	-	-	-	-	-	857	857	-	840	840	-
Stage 2	-	-	-	-	-	-	482	863	-	472	893	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
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	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	871	-	-	831	-	-	111	89	587	116	87	611
Stage 1	-	-	-	-	-	-	318	372	-	326	379	-
Stage 2	-	-	-	-	-	-	534	370	-	542	358	-
Platoon blocked, %	-	-	-	-	-	-						
Mov Cap-1 Maneuver	859	-	-	820	-	-	82	67	573	81	65	597
Mov Cap-2 Maneuver	-	-	-	-	-	-	82	67	-	81	65	-
Stage 1	-	-	-	-	-	-	279	326	-	286	324	-
Stage 2	-	-	-	-	-	-	422	316	-	423	314	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	1.1			1.3			23.5			16.9		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	264	859	-	-	820	-	-	347
HCM Lane V/C Ratio	0.267	0.064	-	-	0.082	-	-	0.131
HCM Control Delay (s)	23.5	9.5	0.5	-	9.8	0.6	-	16.9
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	1	0.2	-	-	0.3	-	-	0.4

Intersection

Int Delay, s/veh 0.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	26	758	78	5	564	20	9	4	13	0	0	0
Conflicting Peds, #/hr	4	0	3	3	0	4	36	0	8	8	0	36
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	31	906	93	6	674	24	11	5	16	0	0	0

Major/Minor	Major1	Major2			Minor1				
Conflicting Flow All	698	0	0	1036	0	0	1400	1761	540
Stage 1	-	-	-	-	-	-	1051	1051	-
Stage 2	-	-	-	-	-	-	349	710	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	894	-	-	667	-	-	131	84	486
Stage 1	-	-	-	-	-	-	298	302	-
Stage 2	-	-	-	-	-	-	685	435	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	891	-	-	665	-	-	115	0	470
Mov Cap-2 Maneuver	-	-	-	-	-	-	115	0	-
Stage 1	-	-	-	-	-	-	266	0	-
Stage 2	-	-	-	-	-	-	672	0	-

Approach	EB	WB			NB			
HCM Control Delay, s	0.5	0.2			25.3			
HCM LOS					D			

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	208	891	-	-	665	-	-
HCM Lane V/C Ratio	0.149	0.035	-	-	0.009	-	-
HCM Control Delay (s)	25.3	9.2	0.3	-	10.5	0.1	-
HCM Lane LOS	D	A	A	-	B	A	-
HCM 95th %tile Q(veh)	0.5	0.1	-	-	0	-	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/30/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	117	309	66	149	293	77	91	439	181	86	450	169
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1910	1872	1910	1881	1844	1881	1872	1872	1910	1863	1863	1900
Adj Flow Rate, veh/h	150	425	101	193	362	110	130	537	219	106	532	214
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.86	0.80	0.72	0.85	0.89	0.77	0.77	0.90	0.91	0.89	0.93	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	121	441	135	77	369	140	373	982	399	373	956	383
Arrive On Green	0.31	0.31	0.31	0.31	0.31	0.31	0.07	0.40	0.40	0.07	0.39	0.39
Sat Flow, veh/h	174	1441	441	5	1204	458	1783	2467	1002	1774	2465	988
Grp Volume(v), veh/h	304	0	372	282	0	383	130	387	369	106	381	365
Grp Sat Flow(s),veh/h/ln	432	0	1625	71	0	1597	1783	1778	1691	1774	1770	1684
Q Serve(g_s), s	7.0	0.0	16.5	19.3	0.0	17.5	3.4	13.4	13.5	2.8	13.4	13.5
Cycle Q Clear(g_c), s	24.5	0.0	16.5	19.3	0.0	17.5	3.4	13.4	13.5	2.8	13.4	13.5
Prop In Lane	0.49			0.27	0.69		0.29	1.00		0.59	1.00	
Lane Grp Cap(c), veh/h	200	0	498	0	0	489	373	708	673	373	686	653
V/C Ratio(X)	1.52	0.00	0.75	0.00	0.00	0.78	0.35	0.55	0.55	0.28	0.56	0.56
Avail Cap(c_a), veh/h	200	0	498	0	0	701	396	708	673	392	686	653
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	35.2	0.0	25.0	0.0	0.0	25.3	14.0	18.5	18.5	13.8	19.1	19.1
Incr Delay (d2), s/veh	259.6	0.0	6.1	0.0	0.0	3.7	0.6	3.0	3.2	0.4	3.2	3.4
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	18.8	0.0	8.2	0.0	0.0	8.2	1.7	7.1	6.9	1.4	7.2	6.9
LnGrp Delay(d),s/veh	294.8	0.0	31.1	0.0	0.0	29.0	14.6	21.5	21.7	14.2	22.3	22.6
LnGrp LOS	F		C			C	B	C	C	B	C	C
Approach Vol, veh/h		676			665			886			852	
Approach Delay, s/veh		149.7			16.7			20.6			21.4	
Approach LOS		F			B			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	30.7	12.0	37.3		30.7	11.1	38.2					
Change Period (Y+R <sub>c</sub> ), s	* 6.2	* 6.3	* 6.3		* 6.2	5.7	* 6.3					
Max Green Setting (Gmax), s	* 23	* 6.7	* 20		* 35	6.3	* 21					
Max Q Clear Time (g <sub>c+l1</sub> ), s	26.5	5.4	15.5		21.3	4.8	15.5					
Green Ext Time (p <sub>c</sub> ), s	0.0	0.0	2.5		3.2	0.0	2.7					

## Intersection Summary

HCM 2010 Ctrl Delay	48.3
HCM 2010 LOS	D

## Notes

\* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Intersection

Int Delay, s/veh 0.8

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	31	452	75	1	498	18	10	4	16	0	0	0
Conflicting Peds, #/hr	13	0	7	7	0	13	5	0	4	4	0	5
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	2	-	-	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	37	540	90	1	595	22	12	5	19	0	0	0

Major/Minor	Major1	Major2		Minor1					
Conflicting Flow All	617	0	0	635	0	0	964	1283	333
Stage 1	-	-	-	-	-	-	664	664	-
Stage 2	-	-	-	-	-	-	300	619	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	959	-	-	944	-	-	253	164	663
Stage 1	-	-	-	-	-	-	474	456	-
Stage 2	-	-	-	-	-	-	725	478	-
Platoon blocked, %	-	-	-	-	-	-			
Mov Cap-1 Maneuver	949	-	-	934	-	-	234	0	653
Mov Cap-2 Maneuver	-	-	-	-	-	-	234	0	-
Stage 1	-	-	-	-	-	-	443	0	-
Stage 2	-	-	-	-	-	-	716	0	-

Approach	EB	WB			NB		
HCM Control Delay, s	0.7	0			15.3		
HCM LOS					C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	387	949	-	-	934	-	-
HCM Lane V/C Ratio	0.093	0.039	-	-	0.001	-	-
HCM Control Delay (s)	15.3	8.9	0.2	-	8.9	0	-
HCM Lane LOS	C	A	A	-	A	A	-
HCM 95th %tile Q(veh)	0.3	0.1	-	-	0	-	-

7.3.2 3-RIGHTS OPTION

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	323	46	97	522	88	51	576	68	49	364	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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		0.99	1.00	0.99
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	0	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	0	444	80	140	617	126	97	674	92	70	455	113
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.77	0.80	0.63	0.76	0.93	0.77	0.58	0.94	0.81	0.77	0.88	0.77
Percent Heavy Veh, %	0	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	0	1313	235	61	584	190	373	977	133	309	879	217
Arrive On Green	0.00	0.44	0.44	0.44	0.44	0.44	0.08	0.31	0.31	0.08	0.31	0.31
Sat Flow, veh/h	0	3093	537	2	1334	435	1774	3127	426	1774	2812	693
Grp Volume(v), veh/h	0	261	263	414	0	469	97	381	385	70	285	283
Grp Sat Flow(s),veh/h/ln	0	1770	1768	153	0	1617	1774	1770	1784	1774	1770	1735
Q Serve(g_s), s	0.0	7.8	7.9	21.4	0.0	18.4	2.8	15.1	15.1	2.0	10.6	10.7
Cycle Q Clear(g_c), s	0.0	7.8	7.9	21.4	0.0	18.4	2.8	15.1	15.1	2.0	10.6	10.7
Prop In Lane	0.00			0.30	0.34		0.27	1.00		0.24	1.00	0.40
Lane Grp Cap(c), veh/h	0	774	773	0	0	708	373	553	558	309	553	542
V/C Ratio(X)	0.00	0.34	0.34	0.00	0.00	0.66	0.26	0.69	0.69	0.23	0.52	0.52
Avail Cap(c_a), veh/h	0	774	773	0	0	708	373	553	558	309	553	542
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()	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	14.8	14.9	0.0	0.0	17.8	16.7	24.1	24.1	17.2	22.5	22.6
Incr Delay (d2), s/veh	0.0	1.2	1.2	0.0	0.0	4.8	1.7	6.9	6.9	1.7	3.4	3.6
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	0.0	4.0	4.1	0.0	0.0	9.0	1.5	8.4	8.4	1.1	5.7	5.6
LnGrp Delay(d),s/veh	0.0	16.0	16.1	0.0	0.0	22.7	18.4	31.0	31.0	18.9	25.9	26.2
LnGrp LOS	B	B				C	B	C	C	B	C	C
Approach Vol, veh/h	524				883			863			638	
Approach Delay, s/veh	16.0				12.0			29.6			25.3	
Approach LOS	B				B			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	40.0	10.0	30.0		40.0	10.0	30.0					
Change Period (Y+R <sub>c</sub> ), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	25.0	6.0	25.0		35.0	6.0	25.0					
Max Q Clear Time (g <sub>c+l1</sub> ), s	9.9	4.8	12.7		23.4	4.0	17.1					
Green Ext Time (p <sub>c</sub> ), s	8.3	0.0	6.3		7.0	0.0	4.6					
Intersection Summary												
HCM 2010 Ctrl Delay			20.9									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 0.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	347	107	1	710	5	4
Conflicting Peds, #/hr	0	2	2	0	3	28
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	415	128	1	849	6	5

Major/Minor	Major1	Major2		Minor1	
Conflicting Flow All	0	0	571	0	934
Stage 1	-	-	-	-	507
Stage 2	-	-	-	-	427
Critical Hdwy	-	-	4.14	-	6.84
Critical Hdwy Stg 1	-	-	-	-	5.84
Critical Hdwy Stg 2	-	-	-	-	5.84
Follow-up Hdwy	-	-	2.22	-	3.52
Pot Cap-1 Maneuver	-	-	998	-	264
Stage 1	-	-	-	-	570
Stage 2	-	-	-	-	626
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	996	-	257
Mov Cap-2 Maneuver	-	-	-	-	557
Stage 1	-	-	-	-	557
Stage 2	-	-	-	-	624

Approach	EB	WB	NB
HCM Control Delay, s	0	0	11.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	605	-	-	996	-
HCM Lane V/C Ratio	0.018	-	-	0.001	-
HCM Control Delay (s)	11.1	-	-	8.6	0
HCM Lane LOS	B	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑		↑	↑↑		↑	↑↑	
Volume (veh/h)	0	638	58	123	368	89	74	559	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	0	1863	1900	1900	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	0	739	77	150	431	108	98	661	186	163	799	140
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	0	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	0	1366	142	64	543	174	271	940	264	305	1070	188
Arrive On Green	0.00	0.42	0.42	0.42	0.42	0.42	0.07	0.34	0.34	0.08	0.36	0.36
Sat Flow, veh/h	0	3329	337	3	1287	412	1774	2728	767	1774	3010	527
Grp Volume(v), veh/h	0	404	412	263	0	426	98	429	418	163	470	469
Grp Sat Flow(s), veh/h/ln	0	1770	1803	79	0	1623	1774	1770	1725	1774	1770	1768
Q Serve(g_s), s	0.0	15.4	15.4	25.5	0.0	18.5	3.1	18.9	18.9	5.3	21.0	21.0
Cycle Q Clear(g_c), s	0.0	15.4	15.4	25.5	0.0	18.5	3.1	18.9	18.9	5.3	21.0	21.0
Prop In Lane	0.00		0.19	0.57		0.25	1.00		0.44	1.00		0.30
Lane Grp Cap(c), veh/h	0	747	761	0	0	685	271	610	594	305	629	629
V/C Ratio(X)	0.00	0.54	0.54	0.00	0.00	0.62	0.36	0.70	0.70	0.53	0.75	0.75
Avail Cap(c_a), veh/h	0	747	761	0	0	685	271	610	594	305	629	629
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()	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	19.5	19.5	0.0	0.0	20.4	19.2	25.5	25.5	19.2	25.4	25.4
Incr Delay (d2), s/veh	0.0	2.8	2.8	0.0	0.0	4.2	3.7	6.7	6.9	6.6	7.9	7.9
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	0.0	8.1	8.2	0.0	0.0	9.1	1.8	10.3	10.1	3.1	11.6	11.5
LnGrp Delay(d), s/veh	0.0	22.3	22.2	0.0	0.0	24.6	22.9	32.2	32.4	25.8	33.3	33.3
LnGrp LOS		C	C			C	C	C	C	C	C	C
Approach Vol, veh/h		816			689			945			1102	
Approach Delay, s/veh		22.2			15.2			31.3			32.2	
Approach LOS		C			B			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	43.0	10.0	37.0		43.0	11.0	36.0					
Change Period (Y+R <sub>c</sub> ), s	5.0	4.0	5.0		5.0	4.0	5.0					
Max Green Setting (Gmax), s	28.0	6.0	32.0		38.0	7.0	31.0					
Max Q Clear Time (g <sub>c+l1</sub> ), s	17.4	5.1	23.0		27.5	7.3	20.9					
Green Ext Time (p <sub>c</sub> ), s	6.8	0.0	6.5		6.7	0.0	7.1					
Intersection Summary												
HCM 2010 Ctrl Delay			26.4									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 2.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	46	584	61	56	561	39	9	2	48	3	1	34
Conflicting Peds, #/hr	10	0	16	16	0	10	6	0	12	12	0	6
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	55	698	73	67	671	47	11	2	57	4	1	41

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	729	0	0	783	0	0	1339	1720	414	1312	1733	387
Stage 1	-	-	-	-	-	-	857	857	-	840	840	-
Stage 2	-	-	-	-	-	-	482	863	-	472	893	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.54	6.54	6.94	7.54	6.54	6.94
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	2.22	-	-	2.22	-	-	3.52	4.02	3.32	3.52	4.02	3.32
Pot Cap-1 Maneuver	871	-	-	831	-	-	111	89	587	116	87	611
Stage 1	-	-	-	-	-	-	318	372	-	326	379	-
Stage 2	-	-	-	-	-	-	534	370	-	542	358	-
Platoon blocked, %	-	-	-	-	-	-						
Mov Cap-1 Maneuver	859	-	-	820	-	-	82	67	573	81	65	597
Mov Cap-2 Maneuver	-	-	-	-	-	-	82	67	-	81	65	-
Stage 1	-	-	-	-	-	-	279	326	-	286	324	-
Stage 2	-	-	-	-	-	-	422	316	-	423	314	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	1.1			1.3			23.5			16.9		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	264	859	-	-	820	-	-	347
HCM Lane V/C Ratio	0.267	0.064	-	-	0.082	-	-	0.131
HCM Control Delay (s)	23.5	9.5	0.5	-	9.8	0.6	-	16.9
HCM Lane LOS	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	1	0.2	-	-	0.3	-	-	0.4

Intersection

Int Delay, s/veh 0.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	784	170	0	589	0	26
Conflicting Peds, #/hr	0	3	3	0	36	8
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	Free	-	None	-	Stop
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	937	203	0	704	0	31

Major/Minor	Major1	Major2		Minor1	
Conflicting Flow All	0	-	973	0	1325 508
Stage 1	-	-	-	-	973 -
Stage 2	-	-	-	-	352 -
Critical Hdwy	-	-	4.14	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	-	-	2.22	-	3.52 3.32
Pot Cap-1 Maneuver	-	0	704	-	147 510
Stage 1	-	0	-	-	327 -
Stage 2	-	0	-	-	683 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	702	-	143 493
Mov Cap-2 Maneuver	-	-	-	-	317 -
Stage 1	-	-	-	-	317 -
Stage 2	-	-	-	-	683 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0	12.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	WBL	WBT
Capacity (veh/h)	493	-	702	-
HCM Lane V/C Ratio	0.063	-	-	-
HCM Control Delay (s)	12.8	-	0	-
HCM Lane LOS	B	-	A	-
HCM 95th %tile Q(veh)	0.2	-	0	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/30/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑		↑	↑↑		↑	↑↑	
Volume (veh/h)	0	426	66	150	293	95	91	556	181	86	450	169
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	0	1872	1910	1881	1844	1881	1872	1872	1910	1863	1863	1900
Adj Flow Rate, veh/h	0	586	101	194	362	136	130	680	219	106	532	214
Adj No. of Lanes	0	2	0	0	2	0	1	2	0	1	2	0
Peak Hour Factor	0.86	0.80	0.72	0.85	0.89	0.77	0.77	0.90	0.91	0.89	0.93	0.87
Percent Heavy Veh, %	0	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	0	1072	184	78	394	182	330	930	299	289	841	337
Arrive On Green	0.00	0.35	0.35	0.35	0.35	0.35	0.07	0.35	0.35	0.07	0.34	0.34
Sat Flow, veh/h	0	3129	522	4	1115	516	1783	2645	851	1774	2465	988
Grp Volume(v), veh/h	0	343	344	274	0	418	130	457	442	106	381	365
Grp Sat Flow(s), veh/h/ln	0	1778	1779	49	0	1587	1783	1778	1718	1774	1770	1683
Q Serve(g_s), s	0.0	12.4	12.4	24.6	0.0	18.5	3.7	18.0	18.0	3.0	14.5	14.6
Cycle Q Clear(g_c), s	0.0	12.4	12.4	24.6	0.0	18.5	3.7	18.0	18.0	3.0	14.5	14.6
Prop In Lane	0.00		0.29	0.71		0.33	1.00		0.50	1.00		0.59
Lane Grp Cap(c), veh/h	0	628	628	0	0	560	330	625	604	289	604	574
V/C Ratio(X)	0.00	0.55	0.55	0.00	0.00	0.75	0.39	0.73	0.73	0.37	0.63	0.63
Avail Cap(c_a), veh/h	0	628	628	0	0	656	353	625	604	330	604	574
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()	0.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	0.0	20.7	20.8	0.0	0.0	22.7	16.5	22.6	22.6	17.1	22.1	22.2
Incr Delay (d2), s/veh	0.0	1.0	1.0	0.0	0.0	4.0	0.8	7.4	7.6	0.8	5.0	5.3
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	0.0	6.2	6.2	0.0	0.0	8.6	1.9	10.0	9.7	1.5	7.9	7.6
LnGrp Delay(d), s/veh	0.0	21.7	21.8	0.0	0.0	26.7	17.3	30.0	30.3	17.8	27.1	27.4
LnGrp LOS		C	C			C	B	C	C	B	C	C
Approach Vol, veh/h		687			692			1029			852	
Approach Delay, s/veh		21.8			16.1			28.5			26.1	
Approach LOS		C			B			C			C	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	34.4	12.0	33.6		34.4	11.1	34.4					
Change Period (Y+R <sub>c</sub> ), s	* 6.2	* 6.3	* 6.3		* 6.2	5.7	* 6.3					
Max Green Setting (Gmax), s	* 20	* 6.7	* 22		* 33	7.3	* 22					
Max Q Clear Time (g <sub>c+l1</sub> ), s	14.4	5.7	16.6		26.6	5.0	20.0					
Green Ext Time (p <sub>c</sub> ), s	2.8	0.0	3.1		1.6	0.0	1.1					

## Intersection Summary

HCM 2010 Ctrl Delay	23.8
HCM 2010 LOS	C

## Notes

\* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Intersection

Int Delay, s/veh 0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	483	192	0	517	0	26
Conflicting Peds, #/hr	0	7	7	0	5	4
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	Free	-	None	-	Stop
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	2	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	578	230	0	618	0	31

Major/Minor	Major1	Major2	Minor1	
Conflicting Flow All	0	-	583	0
Stage 1	-	-	-	583
Stage 2	-	-	-	309
Critical Hdwy	-	-	4.14	-
Critical Hdwy Stg 1	-	-	-	5.84
Critical Hdwy Stg 2	-	-	-	5.84
Follow-up Hdwy	-	-	2.22	-
Pot Cap-1 Maneuver	-	0	987	-
Stage 1	-	0	-	521
Stage 2	-	0	-	718
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	981	-
Mov Cap-2 Maneuver	-	-	-	519
Stage 1	-	-	-	519
Stage 2	-	-	-	718

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

Minor Lane/Major Mvmt	NBLn1	EBT	WBL	WBT
Capacity (veh/h)	688	-	981	-
HCM Lane V/C Ratio	0.045	-	-	-
HCM Control Delay (s)	10.5	-	0	-
HCM Lane LOS	B	-	A	-
HCM 95th %tile Q(veh)	0.1	-	0	-

### 7.3.3 3-LANES OPTION

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/28/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↘											
Volume (veh/h)	95	228	46	97	522	83	51	481	68	49	364	79
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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		0.99	1.00	0.99
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	1900	1863	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	123	285	73	128	561	108	88	512	84	64	414	103
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.77	0.80	0.63	0.76	0.93	0.77	0.58	0.94	0.81	0.77	0.88	0.77
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	276	644	165	497	683	132	283	760	124	258	702	173
Arrive On Green	0.06	0.45	0.45	0.06	0.45	0.45	0.06	0.25	0.25	0.06	0.25	0.25
Sat Flow, veh/h	1774	1431	366	1774	1518	292	1774	3040	496	1774	2807	691
Grp Volume(v), veh/h	123	0	358	128	0	669	88	297	299	64	259	258
Grp Sat Flow(s), veh/h/ln	1774	0	1797	1774	0	1810	1774	1770	1767	1774	1770	1729
Q Serve(g_s), s	3.7	0.0	13.7	3.8	0.0	32.2	3.6	15.1	15.3	2.6	12.9	13.1
Cycle Q Clear(g_c), s	3.7	0.0	13.7	3.8	0.0	32.2	3.6	15.1	15.3	2.6	12.9	13.1
Prop In Lane	1.00			0.20	1.00		0.16	1.00		0.28	1.00	0.40
Lane Grp Cap(c), veh/h	276	0	809	497	0	815	283	442	442	258	442	432
V/C Ratio(X)	0.45	0.00	0.44	0.26	0.00	0.82	0.31	0.67	0.68	0.25	0.59	0.60
Avail Cap(c_a), veh/h	276	0	809	497	0	815	283	442	442	258	442	432
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	0.0	18.9	14.0	0.0	24.0	26.0	33.8	33.9	26.0	33.0	33.0
Incr Delay (d2), s/veh	5.1	0.0	1.8	1.2	0.0	9.1	2.9	7.9	8.1	2.3	5.6	5.9
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	2.1	0.0	7.2	2.0	0.0	18.0	2.0	8.3	8.5	1.4	7.0	6.9
LnGrp Delay(d), s/veh	24.2	0.0	20.6	15.3	0.0	33.1	28.9	41.7	41.9	28.3	38.6	39.0
LnGrp LOS	C	C	B		C	C	D	D	C	D	D	
Approach Vol, veh/h		481			797			684			581	
Approach Delay, s/veh		21.6			30.2			40.1			37.6	
Approach LOS		C			C			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	10.0	50.0	10.0	30.0	10.0	50.0	10.0	30.0				
Change Period (Y+R <sub>c</sub> ), s	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0				
Max Green Setting (Gmax), s	6.0	45.0	6.0	25.0	6.0	45.0	6.0	25.0				
Max Q Clear Time (g <sub>c+l1</sub> ), s	5.8	15.7	5.6	15.1	5.7	34.2	4.6	17.3				
Green Ext Time (p <sub>c</sub> ), s	0.0	7.8	0.0	4.6	0.0	4.9	0.0	3.9				
Intersection Summary												
HCM 2010 Ctrl Delay			32.9									
HCM 2010 LOS			C									

Intersection

Int Delay, s/veh 0.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	337	12	0	711	0	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	Free	-	None	-	Stop
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	403	14	0	850	0	11

Major/Minor	Major1	Major2	Minor1	
Conflicting Flow All	0	-	403	0
Stage 1	-	-	-	403
Stage 2	-	-	-	425
Critical Hdwy	-	-	4.12	-
Critical Hdwy Stg 1	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	5.83
Follow-up Hdwy	-	-	2.218	-
Pot Cap-1 Maneuver	-	0	1156	-
Stage 1	-	0	-	674
Stage 2	-	0	-	628
Platoon blocked, %	-	-	-	-
Mov Cap-1 Maneuver	-	-	1156	-
Mov Cap-2 Maneuver	-	-	-	325
Stage 1	-	-	-	674
Stage 2	-	-	-	628

Approach	EB	WB	NB
HCM Control Delay, s	0	0	10.7
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	WBL	WBT
Capacity (veh/h)	647	-	1156	-
HCM Lane V/C Ratio	0.017	-	-	-
HCM Control Delay (s)	10.7	-	0	-
HCM Lane LOS	B	-	A	-
HCM 95th %tile Q(veh)	0.1	-	0	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖											
Volume (veh/h)	92	546	58	123	368	109	74	467	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1900	1863	1863	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	119	632	77	150	431	132	98	552	186	163	799	140
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	277	666	81	189	566	173	205	822	276	272	995	174
Arrive On Green	0.05	0.41	0.41	0.06	0.41	0.41	0.05	0.32	0.32	0.07	0.33	0.33
Sat Flow, veh/h	1774	1629	198	1774	1369	419	1774	2600	873	1774	3009	527
Grp Volume(v), veh/h	119	0	709	150	0	563	98	375	363	163	470	469
Grp Sat Flow(s),veh/h/ln	1774	0	1828	1774	0	1788	1774	1770	1704	1774	1770	1767
Q Serve(g_s), s	4.6	0.0	45.0	5.9	0.0	32.4	4.4	22.1	22.2	7.5	29.0	29.0
Cycle Q Clear(g_c), s	4.6	0.0	45.0	5.9	0.0	32.4	4.4	22.1	22.2	7.5	29.0	29.0
Prop In Lane	1.00			0.11	1.00		0.23	1.00		0.51	1.00	0.30
Lane Grp Cap(c), veh/h	277	0	748	189	0	739	205	559	538	272	585	585
V/C Ratio(X)	0.43	0.00	0.95	0.79	0.00	0.76	0.48	0.67	0.67	0.60	0.80	0.80
Avail Cap(c_a), veh/h	285	0	761	189	0	745	231	559	538	272	585	585
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	23.5	0.0	34.2	28.3	0.0	30.2	29.1	35.6	35.7	27.8	36.6	36.6
Incr Delay (d2), s/veh	1.0	0.0	20.8	20.4	0.0	4.6	1.7	6.3	6.6	3.6	11.1	11.1
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	2.3	0.0	27.0	3.9	0.0	16.9	2.2	11.7	11.5	3.9	16.0	16.0
LnGrp Delay(d),s/veh	24.5	0.0	55.1	48.7	0.0	34.8	30.8	41.9	42.3	31.4	47.7	47.7
LnGrp LOS	C	E	D		C	C	D	D	C	D	D	
Approach Vol, veh/h		828			713			836			1102	
Approach Delay, s/veh		50.7			37.7			40.8			45.3	
Approach LOS		D			D			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	11.0	54.1	10.2	44.7	10.5	54.6	12.0	42.9				
Change Period (Y+R <sub>c</sub> ), s	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0				
Max Green Setting (Gmax), s	7.0	50.0	8.0	37.0	7.0	50.0	8.0	37.0				
Max Q Clear Time (g <sub>c+l1</sub> ), s	7.9	47.0	6.4	31.0	6.6	34.4	9.5	24.2				
Green Ext Time (p <sub>c</sub> ), s	0.0	2.1	0.0	4.4	0.0	7.7	0.0	8.1				
Intersection Summary												
HCM 2010 Ctrl Delay		43.9										
HCM 2010 LOS		D										

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖											
Volume (veh/h)	92	546	58	123	368	109	74	467	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1900	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	119	632	77	150	431	132	98	552	186	163	799	140
Adj No. of Lanes	1	1	1	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	234	698	593	217	558	171	224	866	291	304	1080	189
Arrive On Green	0.03	0.37	0.37	0.07	0.41	0.41	0.05	0.33	0.33	0.08	0.36	0.36
Sat Flow, veh/h	1774	1863	1582	1774	1369	419	1774	2600	873	1774	3009	527
Grp Volume(v), veh/h	119	632	77	150	0	563	98	375	363	163	470	469
Grp Sat Flow(s),veh/h/ln	1774	1863	1582	1774	0	1788	1774	1770	1704	1774	1770	1767
Q Serve(g_s), s	4.0	38.5	3.8	6.0	0.0	32.7	4.3	21.5	21.7	7.1	27.8	27.8
Cycle Q Clear(g_c), s	4.0	38.5	3.8	6.0	0.0	32.7	4.3	21.5	21.7	7.1	27.8	27.8
Prop In Lane	1.00			1.00		0.23	1.00		0.51	1.00		0.30
Lane Grp Cap(c), veh/h	234	698	593	217	0	729	224	589	568	304	635	634
V/C Ratio(X)	0.51	0.91	0.13	0.69	0.00	0.77	0.44	0.64	0.64	0.54	0.74	0.74
Avail Cap(c_a), veh/h	234	745	633	218	0	775	224	589	568	332	635	634
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()	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	30.9	35.5	24.7	27.6	0.0	30.7	27.2	33.9	33.9	25.2	33.6	33.6
Incr Delay (d2), s/veh	1.8	14.1	0.1	8.9	0.0	4.6	1.3	5.2	5.4	1.5	7.6	7.6
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	1.8	22.6	1.7	3.5	0.0	17.0	2.2	11.4	11.0	3.5	14.9	14.9
LnGrp Delay(d),s/veh	32.7	49.6	24.8	36.5	0.0	35.3	28.6	39.0	39.3	26.6	41.1	41.1
LnGrp LOS	C	D	C	D		D	C	D	D	C	D	D
Approach Vol, veh/h		828			713			836			1102	
Approach Delay, s/veh		44.9			35.6			37.9			39.0	
Approach LOS		D			D			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	12.0	50.0	10.0	48.1	8.0	53.9	13.1	45.0				
Change Period (Y+R <sub>c</sub> ), s	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0				
Max Green Setting (Gmax), s	8.0	48.0	6.0	40.0	4.0	52.0	11.0	35.0				
Max Q Clear Time (g <sub>c+l1</sub> ), s	8.0	40.5	6.3	29.8	6.0	34.7	9.1	23.7				
Green Ext Time (p <sub>c</sub> ), s	0.0	4.4	0.0	6.8	0.0	7.8	0.1	7.4				
Intersection Summary												
HCM 2010 Ctrl Delay		39.4										
HCM 2010 LOS		D										

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/29/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↑ ↗	↗ ↘	↖ ↙	↖ ↙	↑ ↗	↗ ↘	↖ ↙	↑ ↗	↖ ↙	↖ ↙	↑ ↗	↖ ↙
Volume (veh/h)	92	546	58	123	368	109	74	467	139	133	625	97
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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	1900	1863	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	119	632	77	150	431	132	98	552	186	163	799	140
Adj No. of Lanes	1	1	0	1	1	1	1	2	0	1	2	0
Peak Hour Factor	0.85	0.95	0.83	0.90	0.94	0.91	0.83	0.93	0.82	0.90	0.86	0.76
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	355	666	81	188	768	653	203	866	291	258	1002	176
Arrive On Green	0.05	0.41	0.41	0.06	0.41	0.41	0.05	0.33	0.33	0.05	0.33	0.33
Sat Flow, veh/h	1774	1629	198	1774	1863	1582	1774	2600	873	1774	3009	527
Grp Volume(v), veh/h	119	0	709	150	431	132	98	375	363	163	470	469
Grp Sat Flow(s), veh/h/ln	1774	0	1828	1774	1863	1582	1774	1770	1704	1774	1770	1767
Q Serve(g_s), s	4.6	0.0	45.0	5.9	21.2	6.4	4.3	21.5	21.7	6.0	28.9	28.9
Cycle Q Clear(g_c), s	4.6	0.0	45.0	5.9	21.2	6.4	4.3	21.5	21.7	6.0	28.9	28.9
Prop In Lane	1.00			0.11	1.00		1.00	1.00		0.51	1.00	0.30
Lane Grp Cap(c), veh/h	355	0	747	188	768	653	203	590	568	258	590	589
V/C Ratio(X)	0.33	0.00	0.95	0.80	0.56	0.20	0.48	0.64	0.64	0.63	0.80	0.80
Avail Cap(c_a), veh/h	362	0	761	188	776	659	203	590	568	258	590	589
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()	1.00	0.00	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	20.6	0.0	34.3	28.3	26.9	22.6	28.3	33.9	33.9	31.3	36.3	36.3
Incr Delay (d2), s/veh	0.6	0.0	21.0	20.8	0.9	0.2	1.8	5.2	5.4	4.9	10.7	10.7
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	2.3	0.0	27.0	3.9	11.1	2.8	2.2	11.4	11.0	2.5	15.9	15.8
LnGrp Delay(d), s/veh	21.2	0.0	55.3	49.1	27.8	22.7	30.1	39.0	39.3	36.2	47.1	47.1
LnGrp LOS	C	E	D	C	C	C	D	D	D	D	D	D
Approach Vol, veh/h		828			713			836			1102	
Approach Delay, s/veh		50.4			31.4			38.1			45.5	
Approach LOS		D			C			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	11.0	54.0	10.0	45.0	10.5	54.5	10.0	45.0				
Change Period (Y+R <sub>c</sub> ), s	4.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0				
Max Green Setting (Gmax), s	7.0	50.0	6.0	39.0	7.0	50.0	6.0	39.0				
Max Q Clear Time (g <sub>c+l1</sub> ), s	7.9	47.0	6.3	30.9	6.6	23.2	8.0	23.7				
Green Ext Time (p <sub>c</sub> ), s	0.0	2.0	0.0	5.7	0.0	9.2	0.0	9.2				
Intersection Summary												
HCM 2010 Ctrl Delay		42.0										
HCM 2010 LOS		D										

Intersection

Int Delay, s/veh 2.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	46	584	61	56	561	39	9	2	48	3	1	34
Conflicting Peds, #/hr	10	0	16	16	0	10	6	0	12	12	0	6
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None									
Storage Length	0	-	-	50	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	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	55	698	73	67	671	47	11	2	57	4	1	41

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	729	0	0	783	0	0	1718	1720	763	1727	1733	722
Stage 1	-	-	-	-	-	-	857	857	-	840	840	-
Stage 2	-	-	-	-	-	-	861	863	-	887	893	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	875	-	-	835	-	-	71	89	404	70	88	427
Stage 1	-	-	-	-	-	-	352	374	-	360	381	-
Stage 2	-	-	-	-	-	-	350	372	-	339	360	-
Platoon blocked, %	-	-	-	-	-	-						
Mov Cap-1 Maneuver	863	-	-	824	-	-	55	75	395	51	74	417
Mov Cap-2 Maneuver	-	-	-	-	-	-	55	75	-	51	74	-
Stage 1	-	-	-	-	-	-	326	347	-	334	347	-
Stage 2	-	-	-	-	-	-	285	338	-	266	334	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.6			0.8			35			22.8		
HCM LOS							E			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	189	863	-	-	824	-	-	247
HCM Lane V/C Ratio	0.373	0.064	-	-	0.081	-	-	0.184
HCM Control Delay (s)	35	9.5	-	-	9.8	-	-	22.8
HCM Lane LOS	E	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	1.6	0.2	-	-	0.3	-	-	0.7

Intersection

Int Delay, s/veh 0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	782	78	0	589	0	22
Conflicting Peds, #/hr	0	3	3	0	36	8
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	Free	-	None	-	Stop
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	935	93	0	704	0	26

Major/Minor	Major1	Major2		Minor1	
Conflicting Flow All	0	-	971	0	1323 974
Stage 1	-	-	-	-	971 -
Stage 2	-	-	-	-	352 -
Critical Hdwy	-	-	4.12	-	6.63 6.23
Critical Hdwy Stg 1	-	-	-	-	5.43 -
Critical Hdwy Stg 2	-	-	-	-	5.83 -
Follow-up Hdwy	-	-	2.218	-	3.519 3.319
Pot Cap-1 Maneuver	-	0	710	-	159 305
Stage 1	-	0	-	-	366 -
Stage 2	-	0	-	-	684 -
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	708	-	154 295
Mov Cap-2 Maneuver	-	-	-	-	274 -
Stage 1	-	-	-	-	355 -
Stage 2	-	-	-	-	684 -

Approach	EB	WB	NB
HCM Control Delay, s	0	0	18.4
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	EBT	WBL	WBT
Capacity (veh/h)	295	-	708	-
HCM Lane V/C Ratio	0.089	-	-	-
HCM Control Delay (s)	18.4	-	0	-
HCM Lane LOS	C	-	A	-
HCM 95th %tile Q(veh)	0.3	-	0	-

Intersection

Int Delay, s/veh 0.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	452	75	0	499	0	26
Conflicting Peds, #/hr	0	7	7	0	5	4
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	Free	-	None	-	Stop
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	2	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	540	90	0	597	0	31

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	-	545	0	843
Stage 1	-	-	-	-	545
Stage 2	-	-	-	-	298
Critical Hdwy	-	-	4.12	-	6.63
Critical Hdwy Stg 1	-	-	-	-	5.43
Critical Hdwy Stg 2	-	-	-	-	5.83
Follow-up Hdwy	-	-	2.218	-	3.519
Pot Cap-1 Maneuver	-	0	1024	-	318
Stage 1	-	0	-	-	580
Stage 2	-	0	-	-	728
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1018	-	317
Mov Cap-2 Maneuver	-	-	-	-	317
Stage 1	-	-	-	-	578
Stage 2	-	-	-	-	728

Approach	EB	WB	NB
HCM Control Delay, s	0	0	12.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	EBT	WBL	WBT
Capacity (veh/h)	527	-	1018	-
HCM Lane V/C Ratio	0.059	-	-	-
HCM Control Delay (s)	12.3	-	0	-
HCM Lane LOS	B	-	A	-
HCM 95th %tile Q(veh)	0.2	-	0	-

# HCM 2010 Signalized Intersection Summary

541: Wornall & 75th

8/30/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖ ↗ ↘ ↙ ↖											
Volume (veh/h)	117	309	66	149	293	77	91	439	181	86	450	169
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Q <sub>b</sub> ), 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		0.99	1.00	0.99
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	1872	1872	1910	1844	1844	1881	1872	1872	1910	1863	1863	1900
Adj Flow Rate, veh/h	150	425	101	193	362	110	130	537	219	106	532	214
Adj No. of Lanes	1	1	0	1	1	0	1	2	0	1	2	0
Peak Hour Factor	0.86	0.80	0.72	0.85	0.89	0.77	0.77	0.90	0.91	0.89	0.93	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	304	474	113	240	458	139	249	685	278	243	644	258
Arrive On Green	0.08	0.32	0.32	0.07	0.34	0.34	0.07	0.28	0.28	0.06	0.26	0.26
Sat Flow, veh/h	1783	1462	348	1756	1358	413	1783	2463	1001	1774	2461	986
Grp Volume(v), veh/h	150	0	526	193	0	472	130	387	369	106	382	364
Grp Sat Flow(s),veh/h/ln	1783	0	1810	1756	0	1770	1783	1778	1685	1774	1770	1678
Q Serve(g_s), s	5.0	0.0	24.9	6.1	0.0	21.7	4.7	18.1	18.2	3.9	18.3	18.4
Cycle Q Clear(g_c), s	5.0	0.0	24.9	6.1	0.0	21.7	4.7	18.1	18.2	3.9	18.3	18.4
Prop In Lane	1.00			0.19	1.00		0.23	1.00		0.59	1.00	0.59
Lane Grp Cap(c), veh/h	304	0	587	240	0	597	249	495	469	243	463	439
V/C Ratio(X)	0.49	0.00	0.90	0.80	0.00	0.79	0.52	0.78	0.79	0.44	0.82	0.83
Avail Cap(c_a), veh/h	327	0	680	240	0	671	253	495	469	277	463	439
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()	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.5	0.0	29.0	24.7	0.0	26.9	23.9	30.0	30.0	23.7	31.3	31.3
Incr Delay (d2), s/veh	1.2	0.0	13.3	17.7	0.0	5.7	1.9	11.7	12.5	1.2	15.3	16.4
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	2.5	0.0	14.6	3.0	0.0	11.6	2.4	10.4	10.0	2.0	10.9	10.5
LnGrp Delay(d),s/veh	21.7	0.0	42.2	42.3	0.0	32.7	25.7	41.7	42.6	25.0	46.6	47.8
LnGrp LOS	C		D	D		C	C	D	D	C	D	D
Approach Vol, veh/h		676			665			886			852	
Approach Delay, s/veh		37.7			35.5			39.7			44.4	
Approach LOS		D			D			D			D	
Timer	1	2	3	4	5	6	7	8				
Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+R <sub>c</sub> ), s	12.0	35.4	12.8	29.8	10.8	36.6	11.3	31.3				
Change Period (Y+R <sub>c</sub> ), s	5.9	* 6.2	* 6.3	* 6.3	4.0	* 6.2	5.7	* 6.3				
Max Green Setting (Gmax), s	6.1	* 34	* 6.7	* 19	8.0	* 34	7.3	* 19				
Max Q Clear Time (g <sub>c+l1</sub> ), s	8.1	26.9	6.7	20.4	7.0	23.7	5.9	20.2				
Green Ext Time (p <sub>c</sub> ), s	0.0	2.3	0.0	0.0	0.0	2.9	0.0	0.0				

## Intersection Summary

HCM 2010 Ctrl Delay	39.7
HCM 2010 LOS	D

## Notes

\* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.