Kirkwood Corridor
TRAFFIC STUDY

Memorial Drive to Britoak Lane

Prepared for:

The City of Houston, Texas

11-8-15

TBPE FIRM REGISTRATION F-9492

Submitted to:

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EXECUTIVE SUMMARY

Progressive Traffic & Transportation (PTT) was authorized by CivilTech Engineers, Inc. to conduct a traffic study for Kirkwood Road corridor between Memorial Drive and Britoak Lane, the very first street south of IH 10. The study is a part of the City of Houston Kirkwood Road drainage and paving project.

PURPOSE AND OBJECTIVE

The purpose of this study was to determine the levels of service for the study corridor and the study signalized intersections based on the existing 2015 and the projected 2035 traffic volume conditions. The study examined if the signalized intersections along the study corridor would be adequate to accommodate the projected 2035 traffic demand.

The objectives of the study include:

- Performing planning level roadway level of service (LOS)
- Performing signalized intersection capacity analysis, identifying existing deficiencies and providing recommendations for improvements.

The following study signalized intersections were included along the Kirkwood Road Corridor:

1. Memorial Drive at Kirkwood Road
2. Kimberley Lane at Kirkwood Road

The study analyses focused on the following three (3) conditions:

- Condition-1, Existing 2015 Traffic Conditions with Existing Lane Configurations
- Condition-2, Projected 2035 Traffic Condition with Existing Lane Configurations /No Build
- Condition-3, Proposed 2035 Traffic Conditions with Mitigation Measures/Four Alternatives

The following Four Alternatives considered for the Kirkwood study corridor:

ALTERNATIVE-1: ***Maintain Existing 4-Thru Lane Section on Kirkwood Road*** with turn lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-2: ***Proposed 6-Thru Lane Section on Kirkwood Road*** with Turn Lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-3: ***Proposed 6-Thru Lane Section on Kirkwood Road and 6-Thru Lane Section of 400' on Memorial Drive*** with Turn Lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-4: ***Existing 4-Thru Lane Section on Kirkwood Road with Proposed Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive and with Proposed 6-Thru Lane Section of 400' on EB and WB Memorial Drive Approaches*** with Turn Lane Improvements.

KEY FINDINGS

The following is concluded based on the findings of this report:

- ***For Existing 2014 condition***, both segments along the study corridor operate at LOS **"D"**.
- ***For 2035 No Build condition***, both segments along the study corridor would operate at LOS **"F"**.
- ***For Existing 2015 condition***, the intersection at Memorial Drive and Kirkwood Road operate at LOS **"C"** in the AM peak hours and LOS **"F"** in the PM peak hours. The intersection at Kimberley Lane and Kirkwood Road operates LOS **"A"** in both AM and PM peak hours.
- ***For 2035 No Build condition*****,** the intersection at Memorial Drive and Kirkwood Road will be operating at LOS **"E"** and **"F"** in the AM and PM peak hour, respectively. The results also reveal that the intersection of Kimberley Lane and Kirkwood Road will be operating at LOS **"B"** and **"E"** in the AM and PM peak hours, respectively.
- Due to unacceptable levels of service realized for 2035 No Build conditions for both study corridor and study intersections, mitigations were developed and analyzed. The results of the analysis are as follows:

Level-of-Service Analysis for Study Corridor

A. ROADWAY CAPACITY

Following **Tables** illustrate the level-of-service results under each condition analyzed for the study roadway segments as per the City's MTFP Policy Statement Criteria.

2014 Existing Conditions

Street	Segment	2014 ADT	Existing No. of Lanes	2014 V/C Ratio[1] NB	2014 V/C Ratio SB	2014 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	21,897	4	0.63	0.76	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	22,601	4	0.85	0.74	D

[1] 2014 Volume/Capacity (V/C) Ratio Given by the City of Houston

[2] 2014 Rdwy LOS with Existing No. of Lanes.

2035 No Build Conditions

Street	Segment	2035 ADT	Existing No. of Lanes	2035 V/C Ratio[1] NB	2035 V/C Ratio[1] SB	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	4	1.01	1.20	F
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	4	1.07	1.10	F

[1] 2035 Volume/Capacity (V/C) Ratio Given by the City w/Existing Lanes

[2] 2035 Rdwy LOS with Existing No. of Lanes.

2035 Build Conditions

Street	Segment	2035 ADT	Projected No. of Lanes (Total)[1]	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	6	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	6	D

[1] 2035 Rdwy LOS with Six Lanes.

[2] Subject to the City of Houston Approval due to right of constraints

Note: All Projected 2035 LOSs Calculated as Per COH MTFP Policy Statement Criteria.

These above results based on the three conditions considered for the study are explained below:

2014 Existing Conditions: For existing 2015 traffic condition with existing lane configurations, the respective **Table** illustrates that both segments of Kirkwood Road, Britoak Lane (IH 10) to Memorial Drive and Memorial Drive to Briar Forest Drive, are currently operating at level of service **"D"**.

2035 No Build Conditions: For projected 2035 traffic condition with existing lane configurations/No Build, the respective **Table** illustrates that both segments of Kirkwood Road will be operating at level of service **"F"**.

2035 Build Conditions: For proposed 2035 traffic condition with mitigation measures, consideration for the six-lane corridor, the respective **Table** shows that the Kirkwood Road corridor would be expected to operate at levels of service **"D"** (minimum acceptable level of service Per COH MTFP Policy Statement Criteria).

B. INTERSECTION CAPACITY

The intersection capacity analyses at the study intersections tested four alternatives. The results of intersection capacity analysis for all four alternatives are as follows:

Summary of LOS Results of Alternative Analyzed			
Condition Analyzed	Description	Intersection-1 Level-of-Service AM/Delay & PM/Delay	Intersection-2 Level-of-Service AM/Delay, PM/Delay
Existing 2015	Existing Condition	C/32.7 & F/191.2	A/7.4 & A/8.5
No Build 2035	Existing Condition	E/59.5 & F/344.4	B/15 & E/66.5
Alternative-1	Maintain Existing 4-Thru Lane Section w/turn lane improvements at the Study Signalized Intersections.	D/39.5, F/225.1	B/15.5 & C/21.3
Alternative-2	Proposed 6-Thru Lane Section on Kirkwood Road w/Turn Lane Improvements at the Study Signalized Intersections.	C/34.6 & F/220.7	A/9.4 & B/12.3
Alternative-3	Proposed 6-Thru Lane Section on Kirkwood Road and 6-Thru Lane Section of 400' on Memorial Drive w/Turn Lane Improvements at the Study Signalized Intersections.	C/31.4 & F/168.9	A/9.4 & B/12.3
Alternative-4	Proposed Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive with Maintaning the Rest of the Corridor with Existing 4-Thru Lane Section, Proposed 6-Thru Lane of 400' EB and WB Approaches along Memorial Drive and with Turnn Lane Improvements at the Study Signalized Intersections.	C/21.4 & D/48.8	B/15.5 & C/21.3
Note: The City of Houston minimum acceptable level-of-service is "D".			

Based on the intersection capacity and traffic operations analysis, **Alternative-4** that maintains four-lane cross section along Kirkwood Road with a compact interchange at Memorial Drive, satisfies the City's criteria for acceptable LOS "D" or better for the study signalized intersections.

FINAL RECOMMENDATIONS

Following are the recommendations to mitigate and/or improve the LOS along the Kirkwood study corridor and study intersections:

1) **Alternative-4** that maintains four-lane cross section along Kirkwood Road with a compact interchange at Memorial Drive, satisfies the City's criteria for acceptable LOS "D" or better for the study signalized intersections. As included with ***Alternate-4***, introduce a compact interchange at the intersection of Kirkwood Road and Memorial Drive with Kirkwood Road having two through lanes in each direction as underpass. The proposed Compact Interchange allowing more through traffic from the Kirkwood study corridor without stop control situation at the intersection of Kirkwood Road and Memorial Drive is expected to improve mobility and safety along the Kirkwood Corridor without widening to a six-lane section and also preserving the median area trees.

2) The proposed Compact Interchange is recommended to be minimum 1,000 ft. in length and/or as per the City's design guidelines.

3) A six-foot wide bike lane and a sidewalk in both directions along the Kirkwood study corridor are also recommended.

4) Provide turn lanes along the Kirkwood study corridor with a minimum of 100 ft. storage at all unsignalized cross street location. This will help preserve and/or improve the capacity of corridor and allow through traffic to flow at a better rate.

The recommendations 3 and 4 are common with each of the alternatives considered in the study, if the City decides to implement any alternative other than Alternative 4.

The alternative analyzed with the proposed roadway improvements and intersection levels-of-service are depicted in ***Exhibits A, B, C, and D*** of this report.

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I. INTRODUCTION

Progressive Traffic & Transportation (PTT) was authorized by CivilTech Engineers, Inc. to conduct a traffic study for Kirkwood Road corridor between Memorial Drive and Britoak Lane, the first street south of IH 10. The study is a part of the City of Houston Kirkwood Road drainage and paving project.

A. PURPOSE AND OBJECTIVE

The purpose of this study was to determine the levels of service for the study corridor and the study signalized intersections based on the existing 2015 and the projected 2035 traffic volume conditions. The study examined if the signalized intersections along the study corridor would be adequate to accommodate the projected 2035 traffic demand.

The objectives of the study include:

I. Performing planning level roadway level of service
II. Performing signalized intersection capacity analysis, identifying existing deficiencies and providing recommendations for safety and mobility improvements.

The following study signalized intersections were included along the Kirkwood Road Corridor:

1. Memorial Drive at Kirkwood Road
2. Kimberley Lane at Kirkwood Road

The study analyses focused on the following three (3) conditions:

- Condition-1, Existing 2015 Traffic Conditions with Existing Lane Configurations
- Condition-2, Projected 2035 Traffic No Build Condition with Existing Lane Configurations
- Condition-3, Proposed 2035 Traffic Build Conditions with Mitigation Measures/Four Alternatives

Synchro 8.0, an intersection capacity analysis software, was used to evaluate the current and future levels of service for the above listed intersections as listed above.

B. STUDY CORRIDOR

The Kirkwood study corridor is currently a four-lane divided roadway between IH 10 and Memorial Drive. Currently, the study corridor offers two signalized intersections.

C. EXISTING TRAFFIC FLOW AND LAND USE

Kirkwood Road is a north-south four lane divided boulevard between Britoak Lane and Memorial Drive. It serves as a major thoroughfare for the area people to commute to and from IH 10. Currently, the posted speed limit on Kirkwood Road within the project limit is **35** mph in both directions.

The land use along both sides of Kirkwood Road is predominantly residential with few commercial/retail developments. Along the study corridor, commercial /retail developments are located just south of IH 10.

There are following two study signalized intersections along Kirkwood Road:

1. Memorial Drive at Kirkwood Road
2. Kimberley Lane at Kirkwood Road

Currently, there is a bicycle lane along both sides of the study corridor.

EXISTING SIGNALIZED INTERSECTIONS

The following brief discussion provides an overview of characteristics of the study signalized intersections:

1) MEMORIAL DRIVE AT KIRKWOOD ROAD

At this span-wire signalized intersection, Kirkwood Road is a four-lane divided roadway with dedicated left turn lanes and shared through and right turn lanes on both northbound and southbound approaches. Similarly, Memorial Drive, at Kirkwood Road is a four-lane undivided roadway with dedicated left turn lanes and shared through and right turn lanes on both eastbound and westbound approaches. The posted speed limit on Memorial Drive is 35 mph.

Currently, the intersection does not comply with Chapter 15 requirements of COH Infrastructure Design Manual since the Audible Pedestrian Signals (APS) system is not present. The existing pedestrian ramps are not ADA compliant at some corners. Pavement markings need repainting at this intersection.

2) KIMBERLEY LANE AT KIRKWOOD ROAD

Kimberley Lane at Kirkwood Road has its eastbound and westbound approaches controlled by signal heads held by span wires. Both eastbound and westbound approaches have shared through, left and right turn lanes. The northbound and southbound approaches on Kirkwood Road have their signal heads held by mast arms. Kirkwood Road at Kimberley Lane has shared through and right turn lanes, and shared through and left turn lanes on both approaches. The posted speed limit on Kimberley Lane is assumed to be 30 mph.

Currently, the intersection does not comply with Chapter 15 requirements of COH Infrastructure Design Manual as Audible Pedestrian Signals (APS) system is not present. The pedestrian ramps are not the ADA compliant at some corners. Pavement markings need repainting at this intersection.

D. TRAFFIC VOLUMES

The traffic volumes were collected during the morning and evening peak periods at the study intersections for level of service/intersection capacity analysis. The turning movement counts data at the study intersections was collected on August 11, 2015 6:30 am to 8:30 am and 4:30 pm to 6:30 pm. This count data formed the basis for the operational analysis/intersection capacity analysis.

E. EXISTING 2014 AND PROJECTED 2035 AVERAGE DAILY TRAFFIC (ADTS)

The weekday Average Daily Traffic (ADTs) data for Kirkwood Road and Memorial Drive were provided by the City of Houston as shown in **Tables 1** and **2**.

Table 1 – EXISTING AND PROJECTED AVERAGE DAILY TRAFFIC

Kirkwood Drive (Britoak Lane, just south of IH 10, to Memorial Drive)

Street	Segment	2014 ADT	# of Lane	2035 ADT	# of Lane	2014 V/C Ratio	2035 V/C Ratio
Kirkwood	IH10 to Memorial	21,897	4	34,887	4	NB=0.63 , SB= 0.76	NB=1.01, SB= 1.2
	Memorial To Briar Forest	22,601	4	34,553	4	NB=0.85, SB= 0.74	NB=1.07, SB= 1.10

Source: City of Houston

According to the data provided by the City of Houston, the annual growth rates between 2014 and 2035 for the study segments are estimated to be as follows:

- The annual growth rate on Kirkwood Road, IH 10 to Memorial Drive = 2.24%
- The annual growth rate on Kirkwood Road, Memorial Drive to Briar Forest Drive = 2.04%

The existing 2014 and projected 2035 future average daily traffic (ADT's) counts data for Kirkwood Road from IH 10 to Memorial Drive and from Memorial Drive to Briar Forest Drive in terms of a bar chart is shown below in **Figure 1.**

Figure 1

2014 and 2035 Average Daily Traffic Volumes

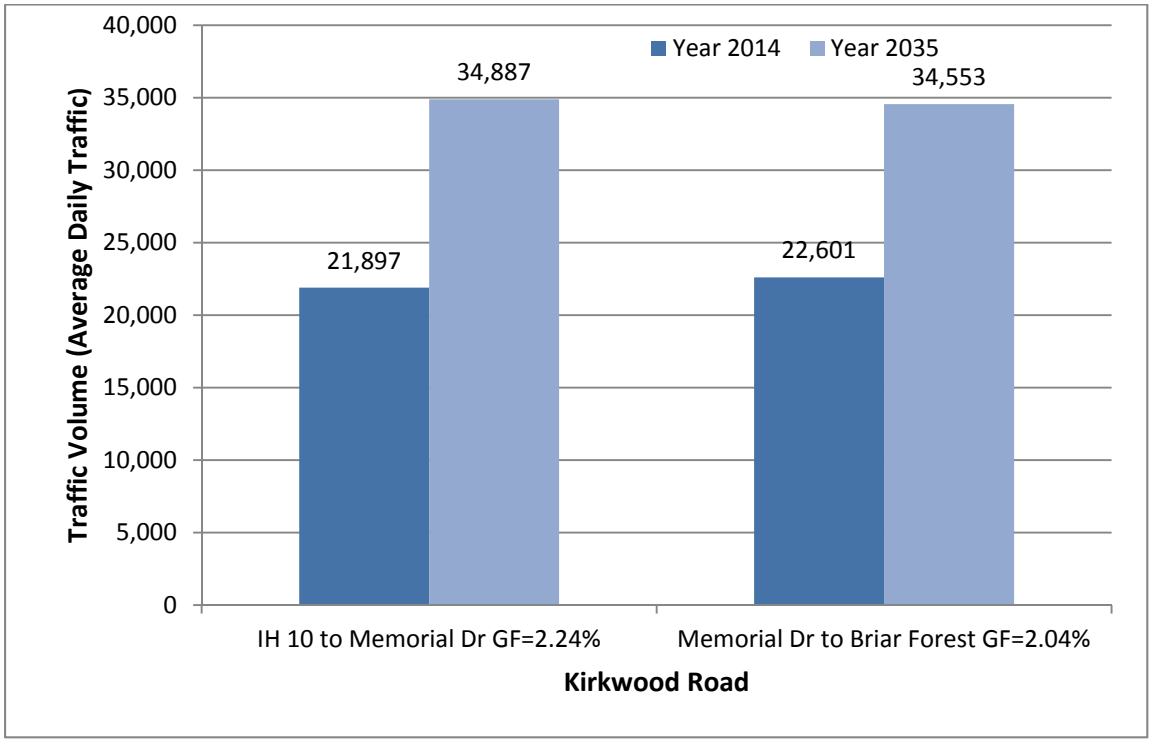


Table 2 – EXISTING AND PROJECTED AVERAGE DAILY TRAFFIC

Street	Segment	2014 ADT	2035 ADT
Memorial	Wilcrest to Kirkwood	23,543	32,377
	Kirkwood to Dairy Ashford	24,872	34,205

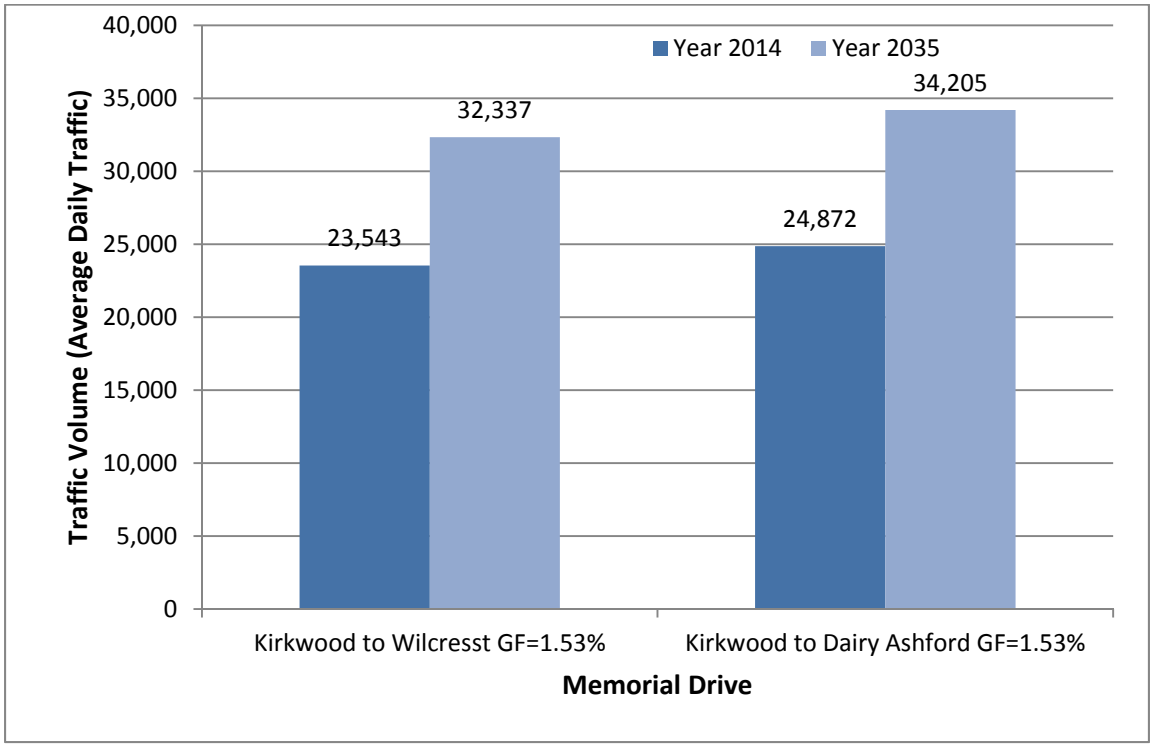
Source: City of Houston

According to the data provided by the City of Houston, the annual growth rates between 2014 and 2035 for the study segments are estimated to be as follows:

- The annual growth rate on Memorial Drive, Wilcrest Drive to Kirkwood Road = 1.53%
- The annual growth rate on Kirkwood Road, Kirkwood Road to Dairy Ashford Road = 1.53%

The existing 2014 and projected 2035 future average daily traffic (ADT's) counts data for Memorial Drive from Wilcrest Drive to Kirkwood Road and from Kirkwood Road to Dairy Ashford Road in terms of a bar chart is shown below in **Figure 2.**

Figure 2
2014 and 2035 Average Daily Traffic Volumes



II. ROADWAY CAPACITY & PROPOSED ALTERNATIVES

This study evaluated four alternatives along Kirkwood Road between Britoak Lane (just south of IH 10) and Memorial Forest Drive for capacity needs and traffic operations. Within each alternative, intersection improvements were considered for the intersections of Kirkwood Road at Memorial Drive and Kirkwood Road at Kimberley Lane, the study signalized intersections.

The following Four Alternatives considered for the Kirkwood study corridor:

ALTERNATIVE-1: ***Maintain Existing 4-Thru Lane Section on Kirkwood Road*** with turn lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-2: ***Proposed 6-Thru Lane Section on Kirkwood Road*** with Turn Lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-3: ***Proposed 6-Thru Lane Section on Kirkwood Road and 6-Thru Lane Section of 400' on Memorial Drive*** with Turn Lane Improvements at the Study Signalized Intersections.

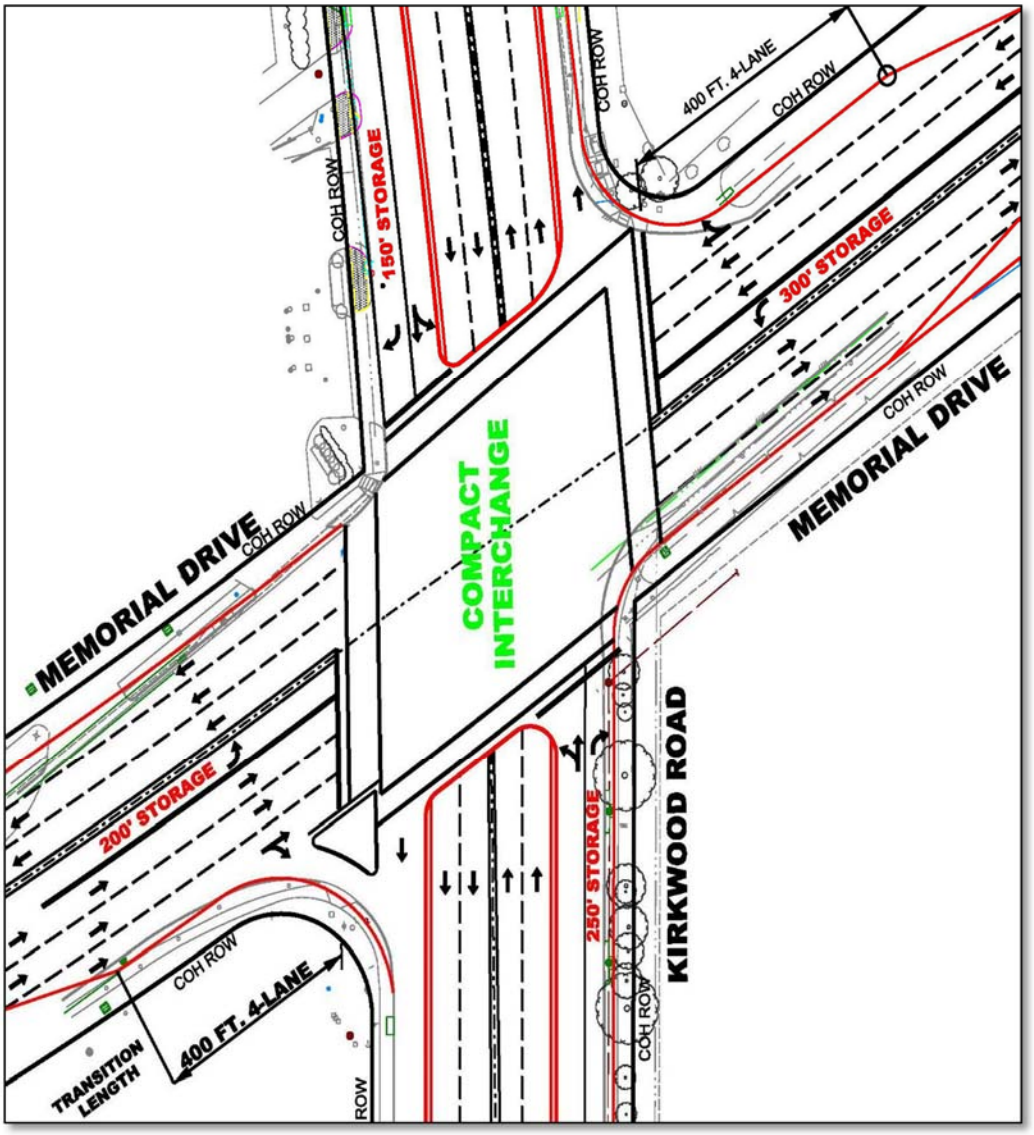
ALTERNATIVE-4: ***Existing 4-Thru Lane Section on Kirkwood Road with Proposed Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive and with Proposed 6-Thru Lane Section of 400' on EB and WB Memorial Drive Approaches*** with Turn Lane Improvements.

COMPACT INTERCHANGE:

Compact Interchange is a tight urban interchange with through lanes on the major roadway grade separated at the intersection. This type of interchange is more suitable for highly urbanized area with restricted right-of-way and it allows maximizing the intersection operation by making the heavy through traffic demand as free flow. In this case, it's the Kirkwood Road through traffic that will flow free of traffic control as illustrated in **Figure 3** on next page.

Figure 3

Compact Interchange at Kirkwood Road and Memorial Drive (Alternative-4)



COMPACT INTERCHANGE

This section also discusses the capacity analysis conducted for the study corridor to evaluate the existing 2015 and projected 2035 capacity needs and traffic operations.

ROADWAY CAPACITY ANALYSIS

Per the City MTFP Policy Statement criteria, the study Kirkwood corridor was analyzed for the AM and PM peak hours, which typically represent the heaviest traffic flows (maximum load on the transportation system) during the morning and evening periods. The peak hour generally constitutes about 8 to 12 percent of the total daily traffic, and it is common practice to use 10 percent of the average daily traffic volume to represent the peak hour traffic flow.

The effectiveness of the roadway in maintaining an acceptable standard of traffic flow, given its design capacity, is evaluated in terms of its level-of-service (LOS). Level-of-service ratings use an alphabetic scale with "A" as most free-flowing and "F" as having severe congestion. The LOS is calculated by taking the peak hour flow (10 percent of the daily total traffic) and divided by the number of lanes of the roadway, and then applying the result to the following scale to assign the roadway level-of-service. The relationship between the various LOS classifications and peak hour traffic flow is summarized in **Table 3**, given below:

Table 3 – ROADWAY LEVEL OF SERVICE CRITERIA

Vehicle Trips per Hour	LOS	Description
0 – 199	A	Primarily free flow operations at average travel speeds-90 percent or more of the free flow speed. Vehicles are completely unimpeded in their ability to maneuver within the traffic. Stopped delay at intersection is minimal.
200 – 349	B	Reasonably unimpeded operation at average travel speeds-usually about 70 percent of the free flow speed. The ability to maneuver in the traffic stream is only slightly restricted and stopped delays are not bothersome.
350 – 499	C	Stable operations. However, ability to maneuver and change lanes mid-block may be restricted more than LOS "B", and longer queues and/or adverse signal coordination may contribute to lower average travel speeds-about 50 percent of the free-flow speed
500 – 649	D	Small increases in flow may cause substantial increase in approach delay and decreases in arterial speed. Average travel speeds are about 40 percent of the free-flow speed.
650 – 799	E	Significant approach delays and average travel speeds are one-third of the free-flow speed or lower.
800 or more	F	Extremely low speeds below one-third of the free-flow speed. Intersection congestion is likely at critical intersections, with high approach delays resulting

Source: City of Houston MTFP Policy Statement

EXISTING 2014 AND PROJECTED FUTURE 2035 ROADWAY LEVEL OF SERVICE

The existing 2014 and the projected future 2035 Average Daily Traffic (ADT) data with volume to capacity ratios was provided for Kirkwood Road by the City of Houston. Based on this information, applying the City's MTFP Policy Statement Criteria, the roadway levels of service were calculated. A summary of these results is listed below in **Tables 4** through **6.**

Table 4 – 2014 EXISTING

Street	Segment	2014 ADT	Existing No. of Lanes	2014 V/C Ratio[1] NB	2014 V/C Ratio SB	2014 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	21,897	4	0.63	0.76	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	22,601	4	0.85	0.74	D

[1] *2014 Volume/Capacity (V/C) Ratio Given by the City of Houston*

[2] *2014 Rdwy LOS with existing no. of lanes.*

Table 5 – 2035 NO BUILD

Street	Segment	2035 ADT	Existing No. of Lanes	2035 V/C Ratio[1] NB	2035 V/C Ratio[1] SB	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	4	1.01	1.20	F
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	4	1.07	1.10	F

[1] 2035 Volume/Capacity (V/C) ratio given by the City w/existing lanes

[2] 2035 Rdwy LOS with existing no. of lanes.

Table 6 – 2035 BUILD

Street	Segment	2035 ADT	Projected No. of Lanes (Total)[1]	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	6	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	6	D

[1] 2035 Rdwy LOS with Six Lanes.

[2] Subject to the City of Houston approval due to right of constraints

Note: All Projected 2035 LOSs Calculated as Per COH MTFP Policy Statement Criteria.

According to 2014 traffic volumes as shown in Table 4, it is concluded that both segments of Kirkwood Road, IH 10 to Memorial Drive and Memorial Drive to Briar Forest Drive, are currently operating at acceptable level of service **"D"**.

Furthermore, according to 2035 projected traffic volumes with No Build condition as shown in Table 5, it is concluded that both segments of Kirkwood Road will be operating at failing level of service **"F"**.

According to 2035 projected traffic volumes with proposed six-lane cross section as shown in Table 6, the Kirkwood Road corridor is expected to operate at level of service **"D".**

III. INTERSECTION CAPACITY ANALYSIS

This section includes a discussion of the operational analysis for the study area signalized intersections. A traffic simulation model of the study intersection was developed using Synchro Version 8 traffic simulation software to assist in the analysis of existing conditions during the morning and evening peak hour. Based on the results of the simulation, a level of service analysis was completed.

Capacity analyses were conducted for the study intersection to evaluate existing and future traffic operating conditions. The Highway Capacity Manual (2010) defines capacity at an intersection as the maximum hourly rate at which vehicles can reasonably be expected to pass through the intersection under prevailing traffic roadway and signalization conditions. The primary measures of effectiveness (MOEs) used in evaluating the traffic operations at the intersection were peak hour intersection control delay (measured in units of seconds per vehicle) and level-of-service (LOS).

Control delay is defined as that component of total delay caused by decelerating and accelerating at a traffic signal or stop sign. Level-of-service is a qualitative measure of operating conditions at an intersection based on control delay. LOS is a given a letter designation from A to F, where LOS A represents free-flow conditions and LOS F represents heavy congestion.

The relationship between the various LOS classifications and control delay for signalized intersection is summarized on the next page in **Table 7.**

Table 7 – INTERSECTION LEVEL OF SERVICE CRITERIA

Level-of-Service (LOS)	Average Control Delay Per Vehicle (sec/veh)	Description
A	≤ 10	Very low vehicle delays, free traffic flow, signal progression extremely favorable, most vehicles arrive during given signal phase.
B	> 10 and ≤ 20	Good traffic flow, good signal progression, more vehicles stop and experience higher delays than for LOS A.
C	> 20 and ≤ 35	Stable traffic flow, fair signal progression, significant number of vehicles stop at signals.
D	> 35 and ≤ 55	Noticeable traffic congestion, longer delays and unfavorable signal progression, many vehicles stop at signals.
E	> 55 and ≤ 80	Unstable traffic flow, poor signal progression, significant congestion, traffic near roadway capacity, frequent traffic signal cycle failures.
F	> 80	Unacceptable delay, extremely unstable flow, heavy congestion, traffic exceeds roadway capacity, stop-and-go conditions.

Source: Highway Capacity Manual, Transportation Research Board, 2010

NOTE: The level of service criteria are defined as a measure of "control delay," which is the average delay, measured in seconds per vehicle, experienced by motorists at an intersection.

A. Intersection Capacity Analysis for 2015 Existing Traffic Condition

Traffic operations at study area intersections were analyzed using the existing 2015 turning movement volumes and assuming the existing roadway geometry and traffic control. The results of the traffic operations analysis for the study signalized intersections are summarized in **Table 8**.

Table 8 – Level of Service (LOS) Analysis Summary
Peak Hour Existing 2015

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	C	32.7	F	191.2
Kimberley Ln at Kirkwood Rd	A	7.4	A	8.5

LOS - Level of Service
Delay is represented in Seconds per Vehicle

Based on the existing 2015 condition analysis, the intersection at Memorial Drive and Kirkwood Road operate at LOS **"C"** in the AM peak hours and LOS **"F"** in the PM peak hours. The intersection at Kimberley Lane and Kirkwood Road operates LOS **"A"** in both AM and PM peak hours.

The detailed SYNCHRO reports are provided in **Appendix: Traffic Models - Synchro Output Results**.

B. Intersection Capacity Analysis for 2035 traffic for No Build Condition

The intersection capacity or level of service analysis was conducted for the study signalized intersections applying the 2035 projected turning movement volumes and assuming the existing roadway geometry and traffic control. The results of the traffic operations analysis for the study signalized intersections are summarized in **Table 9**.

Table 9 – Level of Service (LOS) Analysis Summary
Peak Hour 2035 No Build

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	E	59.5	F	344.4
Kimberley Ln at Kirkwood Rd	B	15	E	66.5

LOS - Level of Service
Delay is represented in Seconds per Vehicle

The above results reveal that the intersection at Memorial Drive and Kirkwood Road will be operating at LOS **"E"** and **"F"** in the AM and PM peak hour, respectively. The results also reveal that the intersection at Kimberley Lane and Kirkwood Road will be operating at LOS **"B"** and **"E"** in the AM and PM peak hours, respectively.

The detailed SYNCHRO reports are provided in **Appendix, Traffic Models - Synchro Output Results**.

C. Intersection Capacity Analysis for proposed 2035 traffic for build Condition,

Alternative 1 (Existing Four-lanes w/ Turn Lane Improvements)

The intersection capacity or level of service analysis was conducted for the study signalized intersections by applying the projected 2035 turning movement volumes, the recommended turn lanes and signal optimization for the intersection of Memorial Drive and Kirkwood Road. The proposed **Alternative 1** encompasses maintaining the existing four-lane section and addition of turn lanes.

The results of the traffic operations analysis for the study signalized intersections are summarized in below **Table 10**.

Table 10 - Level of Service (LOS) Analysis Summary
Peak Hour 2035 Alternative 1

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	D	39.5	F	225.1
Kimberley Ln at Kirkwood Rd	B	15.5	C	21.3

LOS - Level of Service
Delay is represented in Seconds per Vehicle

The detailed SYNCHRO reports are provided in **Appendix, Traffic Models - Synchro Output Results**.

D. Intersection Capacity Analysis for 2035 Proposed Condition

Alternative 2 (Widening Kirkwood to Six Lanes w/ Turn Lane Improvements)

The intersection capacity or level of service analysis was conducted for the study signalized intersections by applying the projected 2035 turning movement volumes, widening of Kirkwood Road to 6 lanes, and the recommended turn lanes and signal optimization for the intersections of Kirkwood Road at Memorial Drive and Kimberley Lane. The proposed **Alternative 2** encompasses widening the existing four-lane section to six lanes and addition of turn lanes.

The results of the traffic operations analysis for the study signalized intersections are summarized in below **Table 11**:

Table 11 - Level of Service (LOS) Analysis Summary
Peak Hour 2035 Alternative 2

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	C	34.6	F	220.7
Kimberley Ln at Kirkwood Rd	A	9.4	B	12.3

LOS - Level of Service
Delay is represented in Seconds per Vehicle

The detailed SYNCHRO reports are provided in **Appendix, Traffic Models - Synchro Output Results**.

E. Intersection Capacity Analysis for 2035 Proposed Condition

Alternative 3 (Widening Kirkwood to Six Lanes & Widening Memorial Drive to Six Lanes w/ Turn Lane Improvements)

The intersection capacity or level of service analysis was conducted for the study signalized intersections by applying the projected 2035 turning movement volumes, with compact interchange configuration, and the recommended turn lanes and signal optimization for the intersections of Kirkwood Road at Memorial Drive and Kimberley Lane. The proposed **Alternative-3** maintains the existing four-lane section with compact interchange at Kirkwood Road and Memorial.

The results of the traffic operations analysis for the study signalized intersections are summarized in below **Table 12**:

Table 12 - Level of Service (LOS) Analysis Summary
Peak Hour 2035 Alternative 3

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	C	31.4	F	168.9
Kimberley Ln at Kirkwood Rd	A	9.4	B	12.3

The detailed SYNCHRO reports are provided in **Appendix, Traffic Models - Synchro Output Results**.

F. Intersection Capacity Analysis for 2035 Proposed Condition

Alternative 4 (Maintain 4-lane section on Kirkwood Road with Urban Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive w/turn lane improvements)

The intersection capacity or level of service analysis was conducted for the study signalized intersections by applying the projected 2035 turning movement volumes, widening of Kirkwood Road to 6 lanes with compact interchange configuration, and the recommended turn lanes and signal optimization for the intersections of Kirkwood Road at Memorial Drive and Kimberley Lane. The proposed **Alternative-4** encompasses widening the existing four-lane section to six lanes with compact interchange at Kirkwood Road and Memorial.

The results of the traffic operations analysis for the study signalized intersections are summarized in below **Table 13**:

Table 13 - Level of Service (LOS) Analysis Summary
Peak Hour 2035 Alternative 4

INTERSECTION	AM Peak Hour		PM Peak Hour	
	LOS	Delay (Sec/Veh)	LOS	Delay (Sec/Veh)
Memorial Dr at Kirkwood Rd	C	21.4	D	48.8
Kimberley Ln at Kirkwood Rd	B	15.5	C	21.3

The detailed SYNCHRO reports are provided in **Appendix, Traffic Models - Synchro Output Results**.

G. SUMMARY OF INTERSECTION CAPACITY ANALYSIS

The traffic analysis for Year 2035 traffic conditions was conducted for the existing 2015 condition, 2035 No Build Condition and Proposed 2035 Alternatives 1 through 3 Conditions. The Year 2015 turning movement traffic volumes were projected to Year 2035 based on the 2014 traffic data the City provided.

The AM and PM peak traffic operations analysis results for the study signalized intersections are summarized in below **Tables 13** and **14**.

Table 14 – Intersection Level of Service - Summary
AM Peak Hour

INTERSECTION	Existing 2015		No Build 2035		Alternative 1 2035		Alternative 2 2035		Alternative 3 2035		Alternative 4 2035	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Memorial Dr at Kirkwood Rd	C	32.7	E	59.5	D	39.5	C	34.6	C	31.4	C	21.4
Kimberley Ln at Kirkwood Rd	A	7.4	B	15	B	15.5	A	9.4	A	9.4	B	15.5

Note: Delay is calculated in seconds per vehicle

Table 15 – Intersection Level of Service - Summary
PM Peak Hour

INTERSECTION	Existing 2015		No Build 2035		Alternative 1 2035		Alternative 2 2035		Alternative 3 2035		Alternative 4 2035	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Memorial Dr at Kirkwood Rd	F	191.2	F	344.4	F	225.1	F	220.7	F	168.9	D	48.8
Kimberley Ln at Kirkwood Rd	A	8.5	E	66.5	C	21.3	B	12.3	B	12.3	C	21.3

Note: Delay is calculated in seconds per vehicle

The above results are based on the projected 2035 turning movement volumes, the recommended turn lanes, the signal timing optimization for both study intersections, widening of Kirkwood Road and compact interchange at Kirkwood Road and Memorial Drive for various alternatives described above.

It is concluded that level of service at the study intersections improved to LOS **"D"** or better for Alternative-4.

IV. FINDINGS AND RECOMMENDATIONS

The following findings and recommendations are made based on our analyses:

This section summarizes the results of the roadway levels of service based on the three conditions analyzed for this study. The section also summarizes traffic signal improvements, intersection geometric improvements, and other considerations to improve the traffic operations and mobility along the Kirkwood study corridor.

The following Four Alternatives considered for the Kirkwood study corridor:

ALTERNATIVE-1: ***Maintain Existing 4-Thru Lane Section on Kirkwood Road*** with turn lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-2: ***Proposed 6-Thru Lane Section on Kirkwood Road*** with Turn Lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-3: ***Proposed 6-Thru Lane Section on Kirkwood Road and 6-Thru Lane Section of 400' on Memorial Drive*** with Turn Lane Improvements at the Study Signalized Intersections.

ALTERNATIVE-4: ***Existing 4-Thru Lane Section on Kirkwood Road with Proposed Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive and with Proposed 6-Thru Lane Section of 400' on EB and WB Memorial Drive Approaches*** with Turn Lane Improvements.

KEY FINDINGS

The following is concluded based on the findings of this report:

- ***For Existing 2014 condition***, both segments along the study corridor operate at LOS **"D"**.
- ***For 2035 No Build condition***, both segments along the study corridor would operate at LOS **"F"**.
- ***For Existing 2015 condition***, the intersection at Memorial Drive and Kirkwood Road operate at LOS **"C"** in the AM peak hours and LOS **"F"** in the PM peak hours. The intersection at Kimberley Lane and Kirkwood Road operates LOS **"A"** in both AM and PM peak hours.
- ***For 2035 No Build condition*****,** the intersection at Memorial Drive and Kirkwood Road will be operating at LOS **"E"** and **"F"** in the AM and PM peak hour, respectively. The results also reveal that the intersection of Kimberley Lane and Kirkwood Road will be operating at LOS **"B"** and **"E"** in the AM and PM peak hours, respectively.
- Due to unacceptable levels of service realized for 2035 No Build conditions for both study corridor and study intersections, mitigations were developed and analyzed. The results of the analysis are as follows:

Level-of-Service Analysis for Study Corridor

A. ROADWAY CAPACITY

Following **Tables** illustrate the level-of-service results under each condition analyzed for the study roadway segments as per the City's MTFP Policy Statement Criteria.

2014 Existing Conditions

Street	Segment	2014 ADT	Existing No. of Lanes	2014 V/C Ratio[1] NB	2014 V/C Ratio SB	2014 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	21,897	4	0.63	0.76	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	22,601	4	0.85	0.74	D

[1] 2014 Volume/Capacity (V/C) Ratio Given by the City of Houston

[2] 2014 Rdwy LOS with Existing No. of Lanes.

2035 No Build Conditions

Street	Segment	2035 ADT	Existing No. of Lanes	2035 V/C Ratio[1] NB	2035 V/C Ratio[1] SB	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	4	1.01	1.20	F
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	4	1.07	1.10	F

[1] 2035 Volume/Capacity (V/C) Ratio Given by the City w/Existing Lanes

[2] 2035 Rdwy LOS with Existing No. of Lanes.

2035 Build Conditions

Street	Segment	2035 ADT	Projected No. of Lanes (Total)[1]	2035 Roadway Level of Service[2]
Kirkwood Rd	IH 10 to Memorial Drive	34,887	6	D
Kirkwood Rd	Memorial Drive to Briar Forest Drive	34,553	6	D

[1] 2035 Rdwy LOS with Six Lanes.

[2] Subject to the City of Houston Approval due to right of constraints

Note: All Projected 2035 LOSs Calculated as Per COH MTFP Policy Statement Criteria.

These above results based on the three conditions considered for the study are explained below:

2014 Existing Conditions: For existing 2015 traffic condition with existing lane configurations, the respective **Table** illustrates that both segments of Kirkwood Road, Britoak Lane (IH 10) to Memorial Drive and Memorial Drive to Briar Forest Drive, are currently operating at level of service **"D"**.

2035 No Build Conditions: For projected 2035 traffic condition with existing lane configurations/No Build, the respective **Table** illustrates that both segments of Kirkwood Road will be operating at level of service **"F"**.

2035 Build Conditions: For proposed 2035 traffic condition with mitigation measures, consideration for the six-lane corridor, the respective **Table** shows that the Kirkwood Road corridor would be expected to operate at levels of service **"D"** (minimum acceptable level of service Per COH MTFP Policy Statement Criteria).

B. INTERSECTION CAPACITY

The intersection capacity analyses at the study intersections tested four alternatives. The results of intersection capacity analysis for all four alternatives are as follows:

Summary of LOS Results of Alternative Analyzed

Condition Analyzed	Description	Intersection-1 Level-of-Service AM/Delay & PM/Delay	Intersection-2 Level-of-Service AM/Delay, PM/Delay
Existing 2015	Existing Condition	C/32.7 & F/191.2	A/7.4 & A/8.5
No Build 2035	Existing Condition	E/59.5 & F/344.4	B/15 & E/66.5
Alternative-1	Maintain Existing 4-Thru Lane Section w/turn lane Improvements at the Study Signalized Intersections.	D/39.5, F/225.1	B/15.5 & C/21.3
Alternative-2	Proposed 6-Thru Lane Section on Kirkwood Road w/Turn Lane Improvements at the Study Signalized Intersections.	C/34.6 & F/220.7	A/9.4 & B/12.3
Alternative-3	Proposed 6-Thru Lane Section on Kirkwood Road and 6-Thru Lane Section of 400' on Memorial Drive w/Turn Lane Improvements at the Study Signalized Intersections.	C/31.4 & F/168.9	A/9.4 & B/12.3
Alternative-4	Proposed Compact Interchange at the Intersection of Kirkwood Road and Memorial Drive with Maintaning the Rest of the Corridor with Existing 4-Thru Lane Section, Proposed 6-Thru Lane of 400' EB and WB Approaches along Memorial Drive and with Turnn Lane Improvements at the Study Signalized Intersections.	C/21.4 & D/48.8	B/15.5 & C/21.3

Note: The City of Houston minimum acceptable level-of-service is "D".

Based on the intersection capacity and traffic operations analysis, **Alternative-4** that maintains four-lane cross section along Kirkwood Road with a compact interchange at Memorial Drive, satisfies the City's criteria for acceptable LOS "D" or better for the study signalized intersections.

FINAL RECOMMENDATIONS

Following are the recommendations to mitigate and/or improve the LOS along the Kirkwood study corridor and study intersections:

1) **Alternative-4** that maintains four-lane cross section along Kirkwood Road with a compact interchange at Memorial Drive, satisfies the City's criteria for acceptable LOS "D" or better for the study signalized intersections. As included with ***Alternate-4***, introduce a compact interchange at the intersection of Kirkwood Road and Memorial Drive with Kirkwood Road having two through lanes in each direction as underpass. The proposed Compact Interchange allowing more through traffic from the Kirkwood study corridor without stop control situation at the intersection of Kirkwood Road and Memorial Drive is expected to improve mobility and safety along the Kirkwood Corridor without widening to a six-lane section and also preserving the median area trees.

2) The proposed Compact Interchange is recommended to be minimum 1,000 ft. in length and/or as per the City's design guidelines.

3) A six-foot wide bike lane and a sidewalk in both directions along the Kirkwood study corridor are also recommended.

4) Provide turn lanes along the Kirkwood study corridor with a minimum of 100 ft. storage at all unsignalized cross street locations. This will help preserve and/or improve the capacity of corridor and allow through traffic to flow at a better rate.

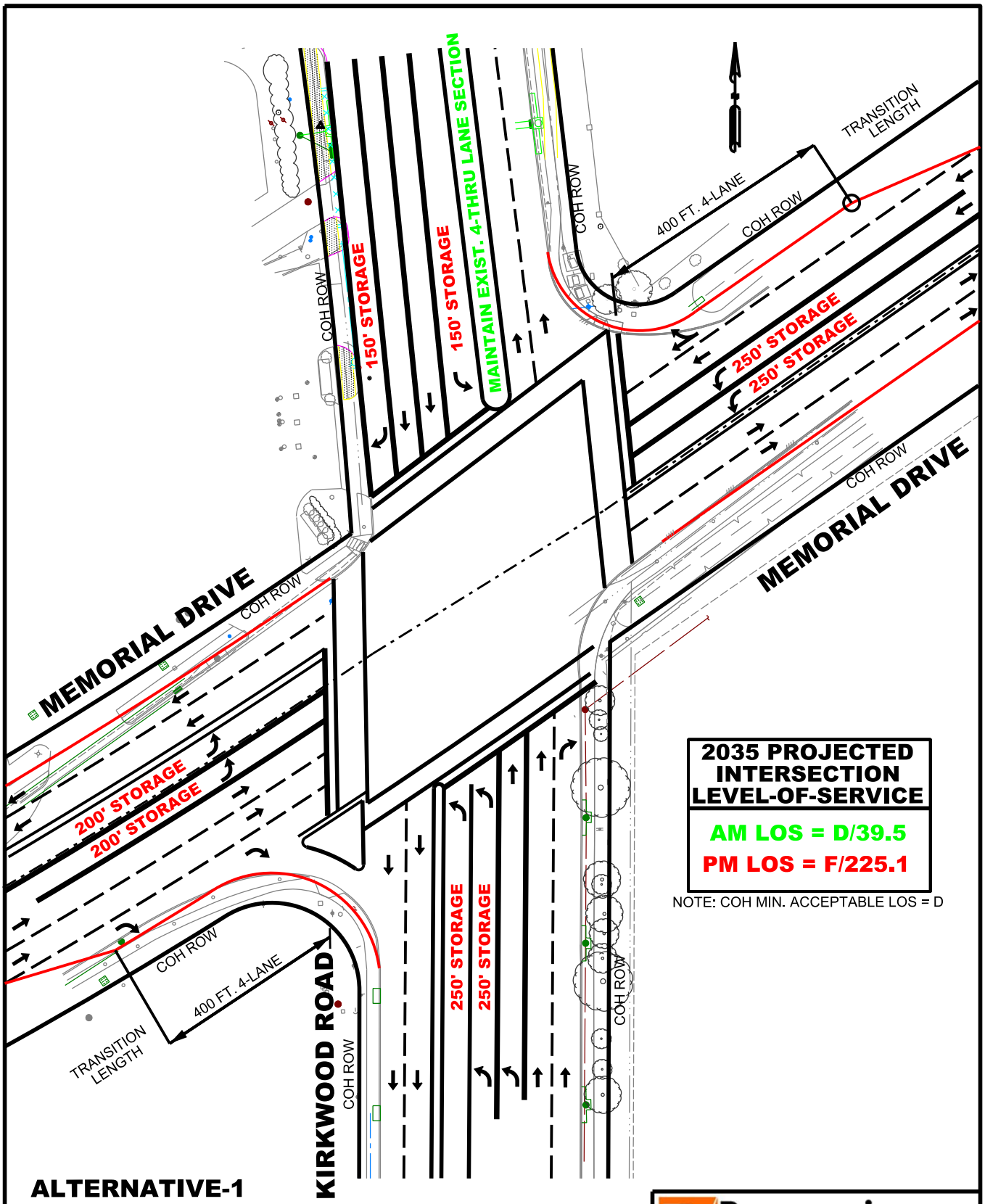
The recommendations 3 and 4 are common with each of the alternatives considered in the study, if the City decides to implement any alternative other than Alternative 4.

- **TRAFFIC SIGNAL IMPROVEMENTS**

Based on the deficiencies recorded during our field investigation, it is also recommended that the following strain pole signalized intersections with rustic poles and no audible pedestrian signals (APS) be replaced with the Mast-Arm Signal System to meet the current Chapter 15 requirements of the City of Houston Infrastructure Design Manual.

1) Kirkwood Road at Memorial Drive **(with the Mast-Arm Signal System)**
2) Kirkwood Road at Kimberley Lane **(with the Mast-Arm Signal**

The alternative analyzed with the proposed roadway improvements and intersection levels-of-service are depicted in ***Exhibits A, B, C, and D*** in the following pages.



2035 PROJECTED INTERSECTION LEVEL-OF-SERVICE

AM LOS = D/39.5

PM LOS = F/225.1

NOTE: COH MIN. ACCEPTABLE LOS = D

ALTERNATIVE-1

1) MAINTAIN EXISTING 4-THRU LANE SECTION ON KIRKWOOD ROAD
2) ADD TURN LANES AT THE INTERSECTION OF KIRKWODD ROAD AND MEMORIAL DRIVE
3) AM LOS = D/39.5 , PM LOS = F/225.1
4) EXISTING ROW = 100', ON KIRKWOOD ROAD AND MEMORIAL DRIVE
5) ADDITIONAL ROW IS NEEDED TO FACILITATE THE PROPOPOSED TURN LANES

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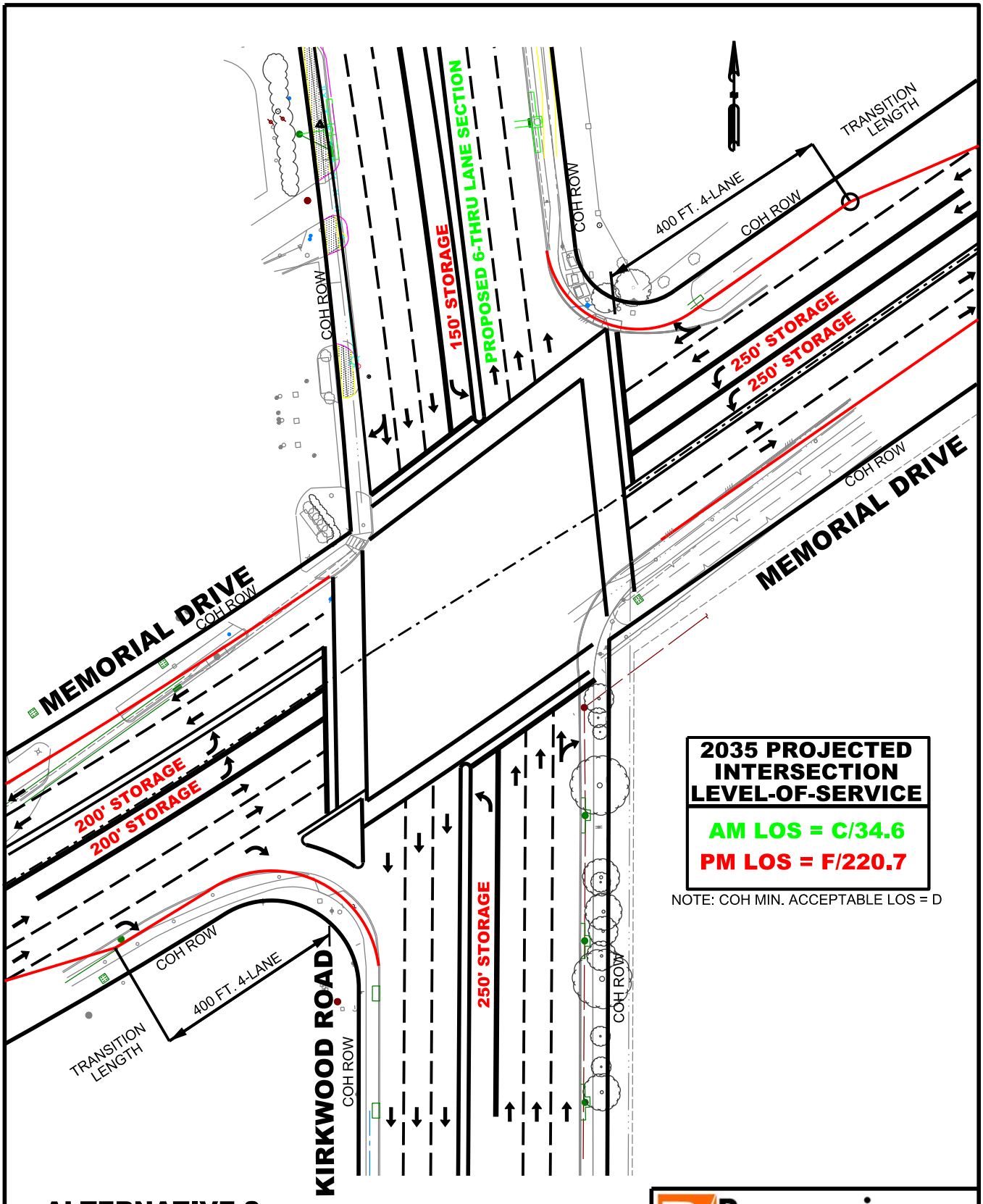
Engineers, Planners & Managers

EXHIBIT-A
ALTERNATIVE-1



2035 PROJECTED INTERSECTION LEVEL-OF-SERVICE

AM LOS = C/34.6

PM LOS = F/220.7

NOTE: COH MIN. ACCEPTABLE LOS = D

ALTERNATIVE-2

1) 6-THRU LANE SECTION ON KIRKWOOD RD W/TURN LANES
2) EXIST 4-THRU LANE SECTION ON MEMORIAL DR W/TURN LANES
3) AM LOS = C/34.6 , PM LOS = F/220.7
4) EXISTING ROW = 100', PROPOSED ROW = 120'

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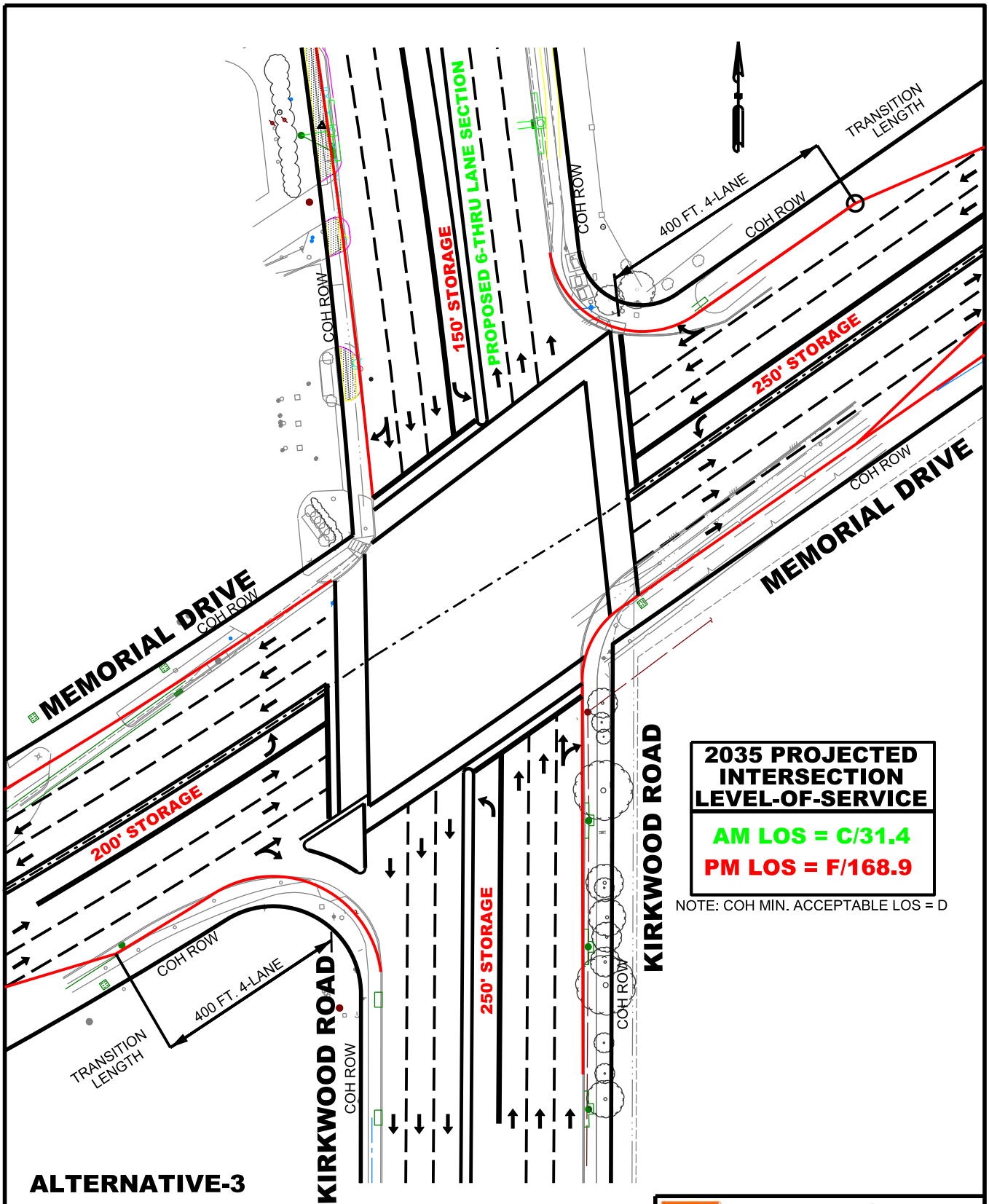
EXHIBIT-B
ALTERNATIVE-2



2035 PROJECTED INTERSECTION LEVEL-OF-SERVICE

AM LOS = C/31.4

PM LOS = F/168.9

NOTE: COH MIN. ACCEPTABLE LOS = D

ALTERNATIVE-3

1) PROP. 6-THRU LANE SECTION ON KIRKWOOD RD W/TURN LANES.
2) PROP. 6-THRU LANE 400' SEC, EB & WB MEMORIAL W/TURN LANES.
3) AM LOS = C/31.4 , PM LOS = F/168.9
4) KIRKWOOD RD EXIST. ROW= 100', PROP. ROW = 120'
5) KIRKWOOD EB & WB BIKE LANES W/PROP. ROW = 120'
6) MEMORIAL DR EXIST. ROW= 100', PROP. ROW = 110'
   TO ACCOMODATE TURN LANES

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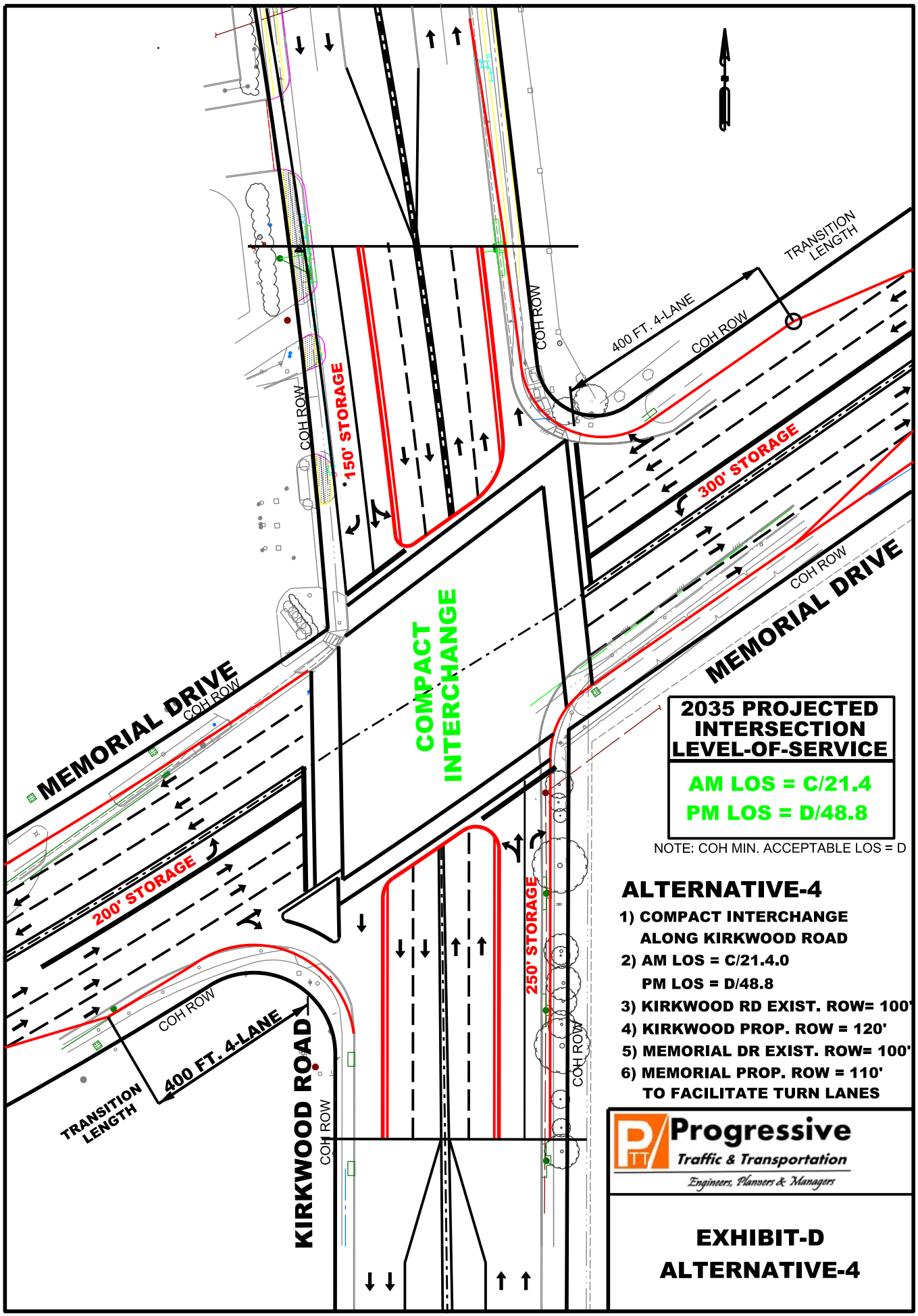
EXHIBIT-C
ALTERNATIVE-3



2035 PROJECTED INTERSECTION LEVEL-OF-SERVICE

AM LOS = C/21.4
PM LOS = D/48.8

NOTE: COH MIN. ACCEPTABLE LOS = D

ALTERNATIVE-4

1) COMPACT INTERCHANGE ALONG KIRKWOOD ROAD
2) AM LOS = C/21.4.0
   PM LOS = D/48.8
3) KIRKWOOD RD EXIST. ROW= 100'
4) KIRKWOOD PROP. ROW = 120'
5) MEMORIAL DR EXIST. ROW= 100'
6) MEMORIAL PROP. ROW = 110' TO FACILITATE TURN LANES

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Engineers, Planners & Managers

EXHIBIT-D
ALTERNATIVE-4

APPENDIX

TRAFFIC MODELS – SYNCHRO OUTPUT RESULTS

Progressive Traffic & Transportation
Engineers, Planners & Managers

APPENDIX

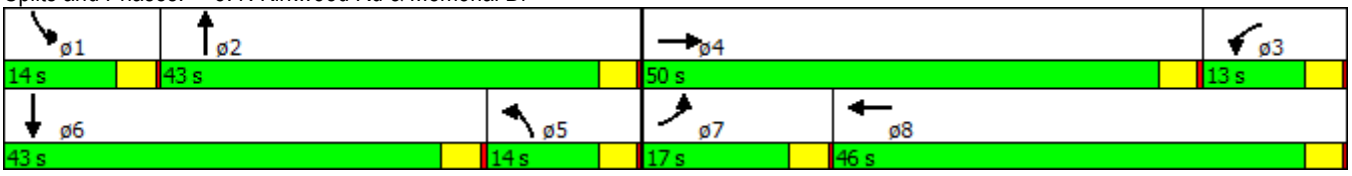
TRAFFIC MODEL

SYNCHRO PRINTOUTS

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	194	612	51	24	357	27	68	848	163	60	328	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	135		0	150		0	135		0	135		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	3500	0	1770	3504	0	1770	3454	0	1770	3387	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3500	0	1770	3504	0	1770	3454	0	1770	3387	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		8			7			20			52	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	211	665	55	26	388	29	74	922	177	65	357	142
Shared Lane Traffic (%)												
Lane Group Flow (vph)	211	720	0	26	417	0	74	1099	0	65	499	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	17.0	50.0		13.0	46.0		14.0	43.0		14.0	43.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	13.2	31.6		7.0	18.8		8.6	39.8		8.4	39.7	
Actuated g/C Ratio	0.14	0.34		0.07	0.20		0.09	0.42		0.09	0.42	
v/c Ratio	0.85	0.61		0.20	0.59		0.46	0.75		0.41	0.34	
Control Delay	72.2	29.8		48.2	37.1		53.3	28.6		51.9	19.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	72.2	29.8		48.2	37.1		53.3	28.6		51.9	19.1	
LOS	E	C		D	D		D	C		D	B	
Approach Delay		39.4			37.7			30.1			22.9	
Approach LOS		D			D			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 94			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.85			
Intersection Signal Delay: 32.7		Intersection LOS: C	
Intersection Capacity Utilization 67.2%		ICU Level of Service C	
Analysis Period (min) 15			

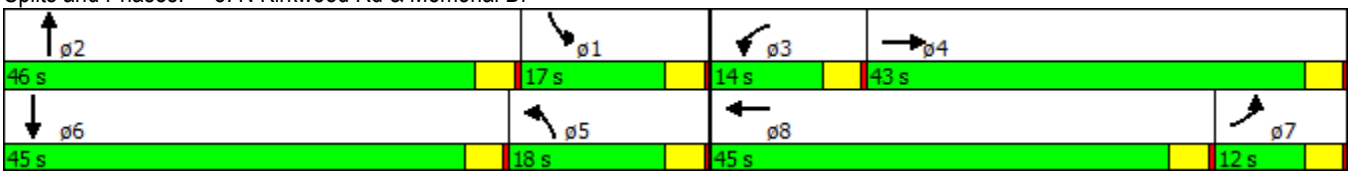
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	136	627	161	294	1574	60	182	368	71	39	1299	175
Satd. Flow (prot)	1770	3429	0	1770	3522	0	1770	3454	0	1770	3476	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3429	0	1770	3522	0	1770	3454	0	1770	3476	0
Satd. Flow (RTOR)		28			3			20			13	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	148	682	175	320	1711	65	198	400	77	42	1412	190
Shared Lane Traffic (%)												
Lane Group Flow (vph)	148	857	0	320	1776	0	198	477	0	42	1602	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	12.0	43.0		14.0	45.0		18.0	46.0		17.0	45.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	8.0	39.0		10.0	41.0		14.0	45.4		11.5	41.0	
Actuated g/C Ratio	0.07	0.32		0.08	0.34		0.12	0.38		0.10	0.34	
v/c Ratio	1.25	0.76		2.18	1.47		0.96	0.36		0.25	1.34	
Control Delay	211.6	40.1		577.8	249.0		106.5	27.7		53.0	191.6	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	211.6	40.1		577.8	249.0		106.5	27.7		53.0	191.6	
LOS	F	D		F	F		F	C		D	F	
Approach Delay		65.4			299.2			50.8			188.1	
Approach LOS		E			F			D			F	

Intersection Summary	
Cycle Length: 120	
Actuated Cycle Length: 120	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 2.18	
Intersection Signal Delay: 191.2	Intersection LOS: F
Intersection Capacity Utilization 117.9%	ICU Level of Service H
Analysis Period (min) 15	

Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	826	67	32	482	36	105	1314	253	93	508	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	135		0	150		0	135		0	135		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	3500	0	1770	3504	0	1770	3454	0	1770	3387	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3500	0	1770	3504	0	1770	3454	0	1770	3387	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		7			5			26			61	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	898	73	35	524	39	114	1428	275	101	552	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	285	971	0	35	563	0	114	1703	0	101	773	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	24.0	39.0		8.0	23.0		19.0	67.0		11.0	59.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	20.0	36.6		4.0	19.0		12.6	63.0		7.0	57.4	
Actuated g/C Ratio	0.16	0.29		0.03	0.15		0.10	0.50		0.06	0.46	
v/c Ratio	1.01	0.94		0.62	1.05		0.64	0.97		1.02	0.49	
Control Delay	107.6	60.8		102.8	103.0		70.3	45.7		153.7	23.1	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	107.6	60.8		102.8	103.0		70.3	45.7		153.7	23.1	
LOS	F	E		F	F		E	D		F	C	
Approach Delay		71.4			103.0			47.3			38.2	
Approach LOS		E			F			D			D	

Intersection Summary			
Area Type:	Other		
Cycle Length: 125			
Actuated Cycle Length: 125			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.05			
Intersection Signal Delay: 59.5		Intersection LOS: E	
Intersection Capacity Utilization 91.9%		ICU Level of Service F	
Analysis Period (min) 15			

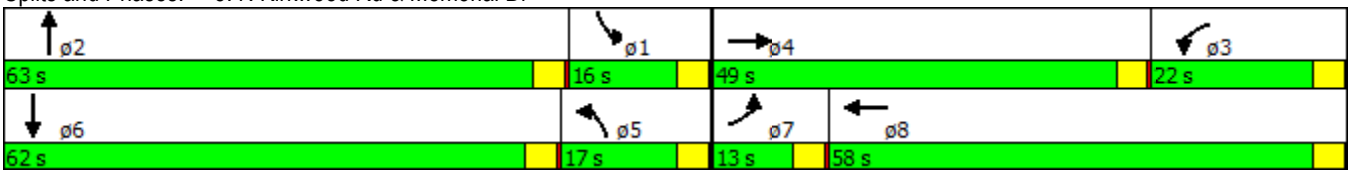
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	184	847	217	397	2125	81	282	570	110	61	2013	271
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	135		0	150		0	135		0	135		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	3429	0	1770	3518	0	1770	3454	0	1770	3476	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3429	0	1770	3518	0	1770	3454	0	1770	3476	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		22			3			18			11	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	200	921	236	432	2310	88	307	620	120	66	2188	295
Shared Lane Traffic (%)												
Lane Group Flow (vph)	200	1157	0	432	2398	0	307	740	0	66	2483	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	13.0	49.0		22.0	58.0		17.0	63.0		16.0	62.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	9.0	45.0		18.0	54.0		13.0	62.2		10.9	58.0	
Actuated g/C Ratio	0.06	0.30		0.12	0.36		0.09	0.41		0.07	0.39	
v/c Ratio	1.89	1.11		2.04	1.89		2.01	0.51		0.51	1.84	
Control Delay	467.1	109.4		514.0	432.3		507.3	34.1		80.8	408.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	467.1	109.4		514.0	432.3		507.3	34.1		80.8	408.9	
LOS	F	F		F	F		F	C		F	F	
Approach Delay		162.1			444.8			172.9			400.4	
Approach LOS		F			F			F			F	

Intersection Summary

Area Type: Other
Cycle Length: 150
Actuated Cycle Length: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 2.04
Intersection Signal Delay: 344.4 Intersection LOS: F
Intersection Capacity Utilization 164.7% ICU Level of Service H
Analysis Period (min) 15

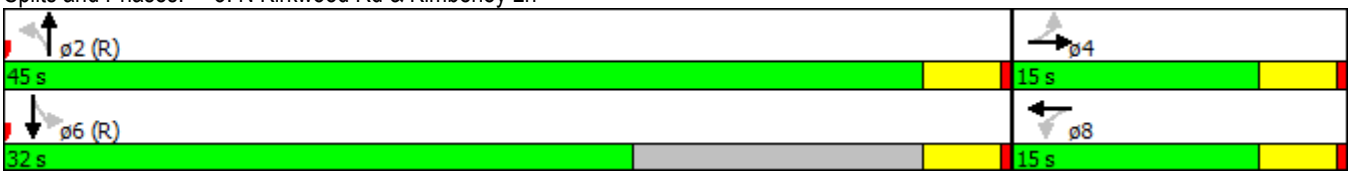
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	98	21	16	2	16	30	26	1130	5	9	484	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1699	0	0	3532	0	0	3507	0
Flt Permitted		0.752			0.990			0.937			0.934	
Satd. Flow (perm)	0	1378	0	0	1686	0	0	3313	0	0	3279	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10			33			1			21	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	107	23	17	2	17	33	28	1228	5	10	526	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	147	0	0	52	0	0	1261	0	0	565	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	15.0	15.0		15.0	15.0		45.0	45.0		32.0	32.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Act Effct Green (s)		11.0			11.0			41.0			41.0	
Actuated g/C Ratio		0.18			0.18			0.68			0.68	
v/c Ratio		0.57			0.15			0.56			0.25	
Control Delay		30.5			12.8			6.0			3.8	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		30.5			12.8			6.0			3.8	
LOS		C			B			A			A	
Approach Delay		30.5			12.8			6.0			3.8	
Approach LOS		C			B			A			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 0.57			
Intersection Signal Delay: 7.4		Intersection LOS: A	
Intersection Capacity Utilization 70.8%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	41	26	22	13	60	16	66	474	9	13	1209	138
Satd. Flow (prot)	0	1760	0	0	1805	0	0	3507	0	0	3486	0
Flt Permitted		0.840			0.957			0.703			0.949	
Satd. Flow (perm)	0	1513	0	0	1740	0	0	2481	0	0	3308	0
Satd. Flow (RTOR)		24			16			6			41	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	28	24	14	65	17	72	515	10	14	1314	150
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	97	0	0	96	0	0	597	0	0	1478	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	17.0	17.0		17.0	17.0		43.0	43.0		43.0	43.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Act Effct Green (s)		13.0			13.0			39.0			39.0	
Actuated g/C Ratio		0.22			0.22			0.65			0.65	
v/c Ratio		0.28			0.25			0.37			0.68	
Control Delay		18.1			18.8			5.6			8.4	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.1			18.8			5.6			8.4	
LOS		B			B			A			A	
Approach Delay		18.1			18.8			5.6			8.4	
Approach LOS		B			B			A			A	

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 60	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green	
Control Type: Pretimed	
Maximum v/c Ratio: 0.68	
Intersection Signal Delay: 8.5	Intersection LOS: A
Intersection Capacity Utilization 75.1%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	33	25	3	25	47	40	1752	8	14	750	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1701	0	0	3532	0	0	3507	0
Flt Permitted		0.803			0.989			0.920			0.905	
Satd. Flow (perm)	0	1472	0	0	1686	0	0	3253	0	0	3177	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10			22			2			20	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	36	27	3	27	51	43	1904	9	15	815	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	228	0	0	81	0	0	1956	0	0	876	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	16.0	16.0		16.0	16.0		44.0	44.0		44.0	44.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Act Effct Green (s)		12.0			12.0			40.0			40.0	
Actuated g/C Ratio		0.20			0.20			0.67			0.67	
v/c Ratio		0.75			0.23			0.90			0.41	
Control Delay		40.4			17.7			16.3			5.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		40.4			17.7			16.3			5.2	
LOS		D			B			B			A	
Approach Delay		40.4			17.7			16.3			5.2	
Approach LOS		D			B			B			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 0.90			
Intersection Signal Delay: 15.0		Intersection LOS: B	
Intersection Capacity Utilization 100.7%		ICU Level of Service G	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	40	34	20	93	25	102	735	14	20	1874	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1760	0	0	1805	0	0	3511	0	0	3486	0
Flt Permitted		0.840			0.949			0.526			0.942	
Satd. Flow (perm)	0	1513	0	0	1725	0	0	1858	0	0	3284	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		10			18			5			36	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	43	37	22	101	27	111	799	15	22	2037	233
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	150	0	0	150	0	0	925	0	0	2292	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Act Effct Green (s)		16.0			16.0			36.0			36.0	
Actuated g/C Ratio		0.27			0.27			0.60			0.60	
v/c Ratio		0.37			0.32			0.88dl			1.16	
Control Delay		19.8			17.7			18.2			92.3	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		19.8			17.7			18.2			92.3	
LOS		B			B			B			F	
Approach Delay		19.8			17.7			18.2			92.3	
Approach LOS		B			B			B			F	

Intersection Summary

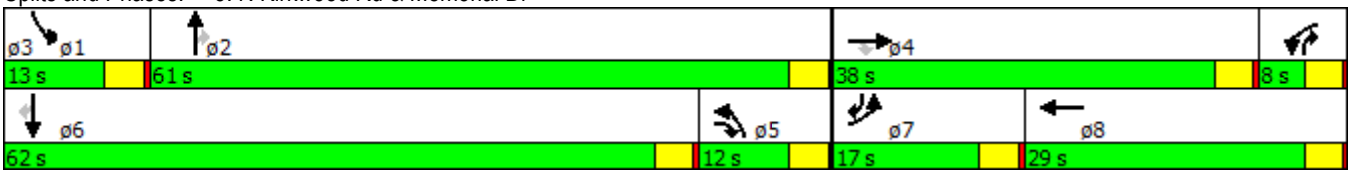
Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 1.16
Intersection Signal Delay: 66.5 Intersection LOS: E
Intersection Capacity Utilization 107.3% ICU Level of Service G
Analysis Period (min) 15
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	826	67	32	482	36	105	1314	253	93	508	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	250		0	250		250	150		150
Storage Lanes	2		1	2		0	2		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	3433	3539	1583	3433	3504	0	3433	3539	1583	1770	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3504	0	3433	3539	1583	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			82		6				82			82
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	898	73	35	524	39	114	1428	275	101	552	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	285	898	73	35	563	0	114	1428	275	101	552	221
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	4	5	3	8		5	2	3	1	6	7
Permitted Phases			4						2			6
Total Split (s)	17.0	38.0	12.0	8.0	29.0		12.0	61.0	8.0	13.0	62.0	17.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	12.6	33.2	45.0	4.0	24.5		7.8	57.0	61.0	8.8	58.0	70.6
Actuated g/C Ratio	0.11	0.28	0.38	0.03	0.21		0.07	0.48	0.51	0.07	0.49	0.59
v/c Ratio	0.78	0.91	0.11	0.30	0.78		0.51	0.84	0.32	0.77	0.32	0.23
Control Delay	67.8	55.7	4.7	63.7	52.5		62.2	33.0	10.1	89.8	19.3	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	67.8	55.7	4.7	63.7	52.5		62.2	33.0	10.1	89.8	19.3	4.5
LOS	E	E	A	E	D		E	C	B	F	B	A
Approach Delay		55.5			53.1			31.4			23.7	
Approach LOS		E			D			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 119			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.91			
Intersection Signal Delay: 39.5		Intersection LOS: D	
Intersection Capacity Utilization 81.0%		ICU Level of Service D	
Analysis Period (min) 15			

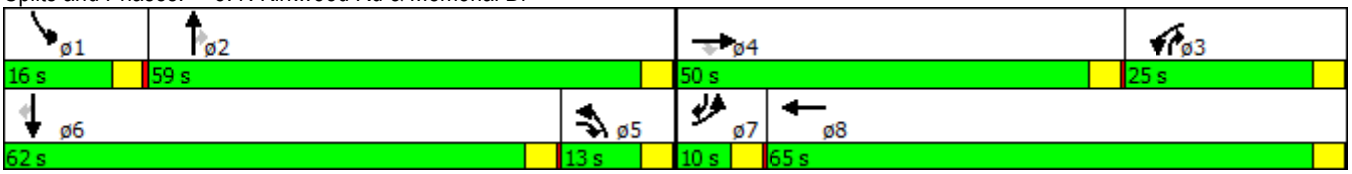
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	184	847	217	397	2125	81	282	570	110	61	2013	271
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	250		0	250		250	150		150
Storage Lanes	2		1	2		0	2		1	1		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	3433	3539	1583	3433	3518	0	3433	3539	1583	1770	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3518	0	3433	3539	1583	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			65		3				97			65
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	200	921	236	432	2310	88	307	620	120	66	2188	295
Shared Lane Traffic (%)												
Lane Group Flow (vph)	200	921	236	432	2398	0	307	620	120	66	2188	295
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	4	5	3	8		5	2	3	1	6	7
Permitted Phases			4						2			6
Total Split (s)	10.0	50.0	13.0	25.0	65.0		13.0	59.0	25.0	16.0	62.0	10.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Act Effct Green (s)	6.0	43.9	56.9	23.1	61.0		9.0	59.0	82.9	10.2	58.0	64.0
Actuated g/C Ratio	0.04	0.29	0.38	0.15	0.41		0.06	0.39	0.55	0.07	0.39	0.43
v/c Ratio	1.46	0.89	0.37	0.82	1.67		1.50	0.45	0.13	0.55	1.60	0.41
Control Delay	289.0	62.1	25.2	74.9	336.9		292.5	35.6	3.5	84.6	305.2	17.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	289.0	62.1	25.2	74.9	336.9		292.5	35.6	3.5	84.6	305.2	17.6
LOS	F	E	C	E	F		F	D	A	F	F	B
Approach Delay		89.1			296.9			107.3			266.2	
Approach LOS		F			F			F			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.67			
Intersection Signal Delay: 225.1		Intersection LOS: F	
Intersection Capacity Utilization 143.6%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	33	25	3	25	47	40	1752	8	14	750	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1701	0	1770	3536	0	1770	3511	0
Flt Permitted		0.778			0.990		0.292			0.111		
Satd. Flow (perm)	0	1426	0	0	1687	0	544	3536	0	207	3511	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		11			14			1			17	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	36	27	3	27	51	43	1904	9	15	815	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	228	0	0	81	0	43	1913	0	15	861	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		36.0	36.0		36.0	36.0	
Actuated g/C Ratio		0.27			0.27		0.60	0.60		0.60	0.60	
v/c Ratio		0.59			0.18		0.13	0.90		0.12	0.41	
Control Delay		25.4			15.8		6.5	18.4		8.0	6.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		25.4			15.8		6.5	18.4		8.0	6.9	
LOS		C			B		A	B		A	A	
Approach Delay		25.4			15.8			18.2			6.9	
Approach LOS		C			B			B			A	

Intersection Summary			
Area Type:	Other		
Cycle Length: 60			
Actuated Cycle Length: 60			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 0.90			
Intersection Signal Delay: 15.5		Intersection LOS: B	
Intersection Capacity Utilization 73.7%		ICU Level of Service D	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	40	34	20	93	25	102	735	14	20	1874	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1760	0	0	1805	0	1770	3529	0	1770	3486	0
Flt Permitted		0.703			0.953		0.061			0.326		
Satd. Flow (perm)	0	1266	0	0	1733	0	114	3529	0	607	3486	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		16			11			5			36	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	43	37	22	101	27	111	799	15	22	2037	233
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	150	0	0	150	0	111	814	0	22	2270	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		70.0	70.0		70.0	70.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		66.0	66.0		66.0	66.0	
Actuated g/C Ratio		0.18			0.18		0.73	0.73		0.73	0.73	
v/c Ratio		0.63			0.47		1.34	0.31		0.05	0.88	
Control Delay		43.7			36.3		234.6	4.5		3.6	14.6	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		43.7			36.3		234.6	4.5		3.6	14.6	
LOS		D			D		F	A		A	B	
Approach Delay		43.7			36.3			32.1			14.5	
Approach LOS		D			D			C			B	

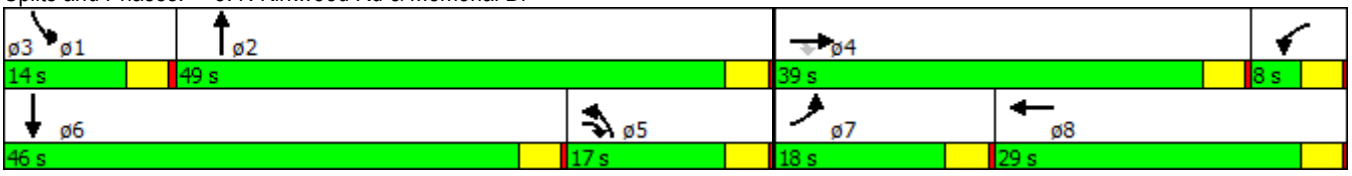
Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 1.34			
Intersection Signal Delay: 21.3		Intersection LOS: C	
Intersection Capacity Utilization 88.7%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	826	67	32	482	36	105	1314	253	93	508	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	250		0	250		0	150		0
Storage Lanes	2		1	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	3433	3539	1583	3433	3504	0	1770	4963	0	1770	4867	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3504	0	1770	4963	0	1770	4867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			89		6			44			106	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	898	73	35	524	39	114	1428	275	101	552	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	285	898	73	35	563	0	114	1703	0	101	773	0
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4									
Total Split (s)	18.0	39.0	17.0	8.0	29.0		17.0	49.0		14.0	46.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	12.7	33.9	50.3	4.0	21.8		12.3	45.2		9.3	42.2	
Actuated g/C Ratio	0.12	0.32	0.48	0.04	0.21		0.12	0.43		0.09	0.40	
v/c Ratio	0.69	0.79	0.09	0.27	0.77		0.55	0.79		0.65	0.38	
Control Delay	54.0	38.6	2.7	56.5	46.9		55.7	29.3		67.1	20.3	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	54.0	38.6	2.7	56.5	46.9		55.7	29.3		67.1	20.3	
LOS	D	D	A	E	D		E	C		E	C	
Approach Delay		40.0			47.4			30.9			25.7	
Approach LOS		D			D			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 110			
Actuated Cycle Length: 105.1			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.79			
Intersection Signal Delay: 34.6		Intersection LOS: C	
Intersection Capacity Utilization 75.7%		ICU Level of Service D	
Analysis Period (min) 15			

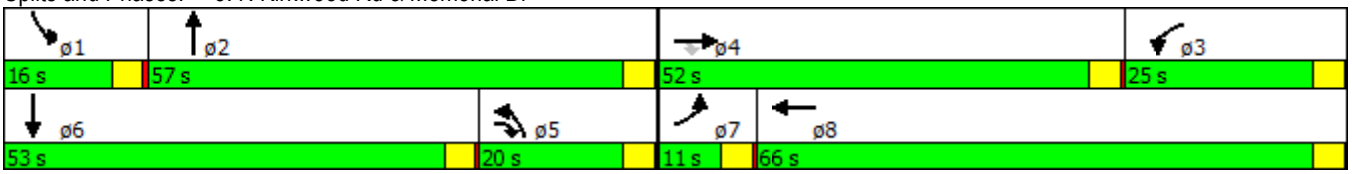
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	184	847	217	397	2125	81	282	570	110	61	2013	271
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	250		0	250		0	150		0
Storage Lanes	2		1	2		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	3433	3539	1583	3433	3518	0	1770	4963	0	1770	4994	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3518	0	1770	4963	0	1770	4994	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			65		3			29			17	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	200	921	236	432	2310	88	307	620	120	66	2188	295
Shared Lane Traffic (%)												
Lane Group Flow (vph)	200	921	236	432	2398	0	307	740	0	66	2483	0
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4									
Total Split (s)	11.0	52.0	20.0	25.0	66.0		20.0	57.0		16.0	53.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	7.0	44.7	64.7	24.3	62.0		16.0	57.0		10.2	49.0	
Actuated g/C Ratio	0.05	0.30	0.43	0.16	0.41		0.11	0.38		0.07	0.33	
v/c Ratio	1.25	0.87	0.33	0.78	1.65		1.63	0.39		0.55	1.51	
Control Delay	208.5	59.9	20.8	71.1	325.2		347.1	33.9		84.6	269.0	
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	208.5	59.9	20.8	71.1	325.2		347.1	33.9		84.6	269.0	
LOS	F	E	C	E	F		F	C		F	F	
Approach Delay		75.0			286.4			125.7			264.2	
Approach LOS		E			F			F			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.65			
Intersection Signal Delay: 220.7		Intersection LOS: F	
Intersection Capacity Utilization 140.5%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	33	25	3	25	47	40	1752	8	14	750	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1701	0	1770	5080	0	1770	5045	0
Flt Permitted		0.778			0.990		0.307			0.111		
Satd. Flow (perm)	0	1426	0	0	1687	0	572	5080	0	207	5045	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		11			14			2			26	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	36	27	3	27	51	43	1904	9	15	815	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	228	0	0	81	0	43	1913	0	15	861	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		36.0	36.0		36.0	36.0	
Actuated g/C Ratio		0.27			0.27		0.60	0.60		0.60	0.60	
v/c Ratio		0.59			0.18		0.13	0.63		0.12	0.28	
Control Delay		25.4			15.8		6.3	8.8		8.0	5.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		25.4			15.8		6.3	8.8		8.0	5.9	
LOS		C			B		A	A		A	A	
Approach Delay		25.4			15.8			8.8			5.9	
Approach LOS		C			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 9.4 Intersection LOS: A
Intersection Capacity Utilization 59.0% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	40	34	20	93	25	102	735	14	20	1874	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1760	0	0	1805	0	1770	5070	0	1770	5009	0
Flt Permitted		0.833			0.948		0.098			0.326		
Satd. Flow (perm)	0	1500	0	0	1724	0	183	5070	0	607	5009	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		13			16			8			58	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	70	43	37	22	101	27	111	799	15	22	2037	233
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	150	0	0	150	0	111	814	0	22	2270	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		45.0	45.0		45.0	45.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		41.0	41.0		41.0	41.0	
Actuated g/C Ratio		0.25			0.25		0.63	0.63		0.63	0.63	
v/c Ratio		0.40			0.34		0.97	0.25		0.06	0.71	
Control Delay		22.3			20.6		97.7	5.5		5.1	9.4	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		22.3			20.6		97.7	5.5		5.1	9.4	
LOS		C			C		F	A		A	A	
Approach Delay		22.3			20.6			16.5			9.4	
Approach LOS		C			C			B			A	

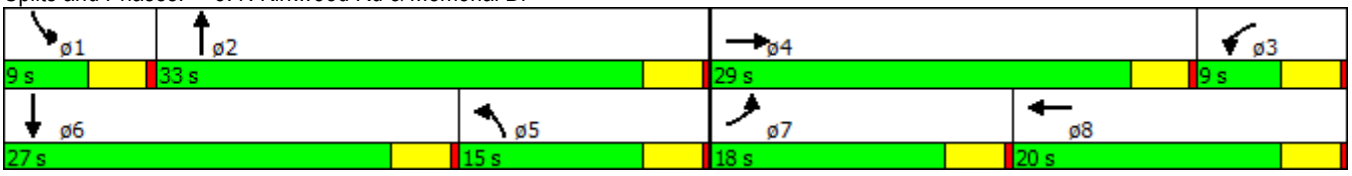
Intersection Summary			
Area Type:	Other		
Cycle Length: 65			
Actuated Cycle Length: 65			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 0.97			
Intersection Signal Delay: 12.3		Intersection LOS: B	
Intersection Capacity Utilization 71.0%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	826	67	32	482	36	105	1314	253	93	508	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		0	250		0	250		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	5029	0	1770	5034	0	1770	4963	0	1770	4867	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	5029	0	1770	5034	0	1770	4963	0	1770	4867	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		17			13			56			127	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	898	73	35	524	39	114	1428	275	101	552	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	285	971	0	35	563	0	114	1703	0	101	773	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	18.0	29.0		9.0	20.0		15.0	33.0		9.0	27.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	14.0	26.3		5.3	13.8		10.0	29.0		5.0	26.2	
Actuated g/C Ratio	0.18	0.34		0.07	0.18		0.13	0.37		0.06	0.34	
v/c Ratio	0.90	0.57		0.29	0.62		0.50	0.90		0.89	0.45	
Control Delay	64.3	23.0		42.2	32.1		39.8	31.1		101.1	19.0	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	64.3	23.0		42.2	32.1		39.8	31.1		101.1	19.0	
LOS	E	C		D	C		D	C		F	B	
Approach Delay		32.4			32.7			31.6			28.5	
Approach LOS		C			C			C			C	

Intersection Summary			
Area Type:	Other		
Cycle Length: 80			
Actuated Cycle Length: 77.9			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.90			
Intersection Signal Delay: 31.4		Intersection LOS: C	
Intersection Capacity Utilization 74.1%		ICU Level of Service D	
Analysis Period (min) 15			

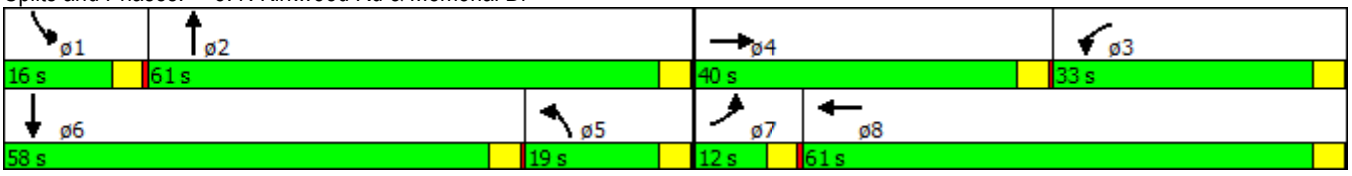
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	184	847	217	397	2125	81	282	570	110	61	2013	271
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		150	250		0	250		0	150		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	4928	0	1770	5055	0	1770	4963	0	1770	4994	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	4928	0	1770	5055	0	1770	4963	0	1770	4994	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		40			4			31			18	
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	200	921	236	432	2310	88	307	620	120	66	2188	295
Shared Lane Traffic (%)												
Lane Group Flow (vph)	200	1157	0	432	2398	0	307	740	0	66	2483	0
Turn Type	Prot	NA		Prot	NA		Prot	NA		Prot	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Total Split (s)	12.0	40.0		33.0	61.0		19.0	61.0		16.0	58.0	
Total Lost Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)	8.0	36.0		29.0	57.0		15.0	61.0		10.2	54.0	
Actuated g/C Ratio	0.05	0.24		0.19	0.38		0.10	0.41		0.07	0.36	
v/c Ratio	2.13	0.95		1.26	1.25		1.73	0.36		0.55	1.37	
Control Delay	571.9	70.9		187.4	155.0		390.1	31.0		84.6	208.3	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	571.9	70.9		187.4	155.0		390.1	31.0		84.6	208.3	
LOS	F	E		F	F		F	C		F	F	
Approach Delay		144.7			160.0			136.3			205.1	
Approach LOS		F			F			F			F	

Intersection Summary			
Area Type:	Other		
Cycle Length: 150			
Actuated Cycle Length: 150			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 2.13			
Intersection Signal Delay: 168.9		Intersection LOS: F	
Intersection Capacity Utilization 126.9%		ICU Level of Service H	
Analysis Period (min) 15			

Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	33	25	3	25	47	40	1752	8	14	750	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1701	0	1770	5080	0	1770	5045	0
Flt Permitted		0.778			0.990		0.307			0.111		
Satd. Flow (perm)	0	1426	0	0	1687	0	572	5080	0	207	5045	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		11			14			2			26	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	36	27	3	27	51	43	1904	9	15	815	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	228	0	0	81	0	43	1913	0	15	861	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		36.0	36.0		36.0	36.0	
Actuated g/C Ratio		0.27			0.27		0.60	0.60		0.60	0.60	
v/c Ratio		0.59			0.18		0.13	0.63		0.12	0.28	
Control Delay		25.4			15.8		6.3	8.8		8.0	5.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		25.4			15.8		6.3	8.8		8.0	5.9	
LOS		C			B		A	A		A	A	
Approach Delay		25.4			15.8			8.8			5.9	
Approach LOS		C			B			A			A	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 0.63
Intersection Signal Delay: 9.4 Intersection LOS: A
Intersection Capacity Utilization 59.0% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	40	34	20	93	25	102	735	14	20	1874	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.91	1.00	0.91	0.91
Frt		0.967			0.976			0.997			0.985	
Flt Protected		0.977			0.993		0.950			0.950		
Satd. Flow (prot)	0	1760	0	0	1805	0	1770	5070	0	1770	5009	0
Flt Permitted		0.833			0.948		0.098			0.326		
Satd. Flow (perm)	0	1500	0	0	1724	0	183	5070	0	607	5009	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		13			16			8			58	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Adj. Flow (vph)	70	43	37	22	101	27	111	799	15	22	2037	233
Lane Group Flow (vph)	0	150	0	0	150	0	111	814	0	22	2270	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		45.0	45.0		45.0	45.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		41.0	41.0		41.0	41.0	
Actuated g/C Ratio		0.25			0.25		0.63	0.63		0.63	0.63	
v/c Ratio		0.40			0.34		0.97	0.25		0.06	0.71	
Control Delay		22.3			20.6		97.7	5.5		5.1	9.4	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		22.3			20.6		97.7	5.5		5.1	9.4	
LOS		C			C		F	A		A	A	
Approach Delay		22.3			20.6			16.5			9.4	
Approach LOS		C			C			B			A	

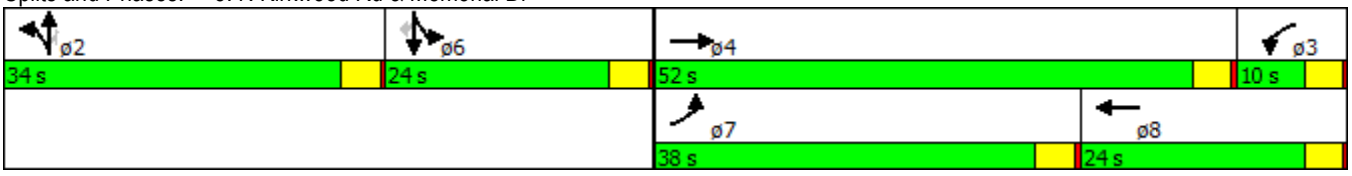
Intersection Summary			
Area Type:	Other		
Cycle Length: 65			
Actuated Cycle Length: 65			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 0.97			
Intersection Signal Delay: 12.3		Intersection LOS: B	
Intersection Capacity Utilization 71.0%		ICU Level of Service C	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	826	67	32	482	36	105	0	253	93	0	203
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		200	300		0	0		250	0		150
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Satd. Flow (prot)	1770	5029	0	1770	5034	0	0	1770	1583	0	1770	1583
Flt Permitted	0.950			0.950				0.950			0.950	
Satd. Flow (perm)	1770	5029	0	1770	5034	0	0	1770	1583	0	1770	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		13			8				270			221
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	285	898	73	35	524	39	114	0	275	101	0	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	285	971	0	35	563	0	0	114	275	0	101	221
Turn Type	Prot	NA		Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases									2			6
Total Split (s)	38.0	52.0		10.0	24.0		34.0	34.0	34.0	24.0	24.0	24.0
Total Lost Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	4.0
Act Effct Green (s)	17.4	30.5		8.3	14.3			10.8	10.8		10.0	10.0
Actuated g/C Ratio	0.25	0.44		0.12	0.21			0.16	0.16		0.14	0.14
v/c Ratio	0.64	0.44		0.17	0.54			0.42	0.58		0.39	0.53
Control Delay	32.1	16.6		33.4	27.9			34.8	10.3		35.6	10.3
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	32.1	16.6		33.4	27.9			34.8	10.3		35.6	10.3
LOS	C	B		C	C			C	B		D	B
Approach Delay		20.1			28.2			17.5			18.3	
Approach LOS		C			C			B			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 120			
Actuated Cycle Length: 69.4			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 0.64			
Intersection Signal Delay: 21.4		Intersection LOS: C	
Intersection Capacity Utilization 48.3%		ICU Level of Service A	
Analysis Period (min) 15			

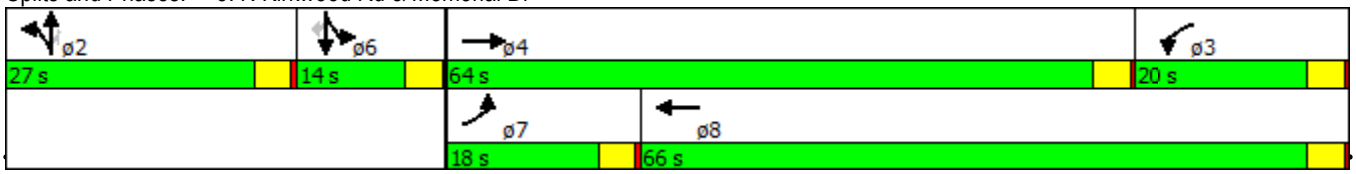
Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	184	847	217	397	2125	81	282	0	110	61	0	271
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	300		0	0		250	0		150
Storage Lanes	1		0	1		0	0		1	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	0.91	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.969			0.994				0.850			0.850
Flt Protected	0.950			0.950				0.950			0.950	
Satd. Flow (prot)	1770	4928	0	1770	5055	0	0	1770	1583	0	1770	1583
Flt Permitted	0.950			0.950				0.950			0.950	
Satd. Flow (perm)	1770	4928	0	1770	5055	0	0	1770	1583	0	1770	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		70			6				120			191
Link Speed (mph)		35			35			35			35	
Link Distance (ft)		907			814			1578			2002	
Travel Time (s)		17.7			15.9			30.7			39.0	
Adj. Flow (vph)	200	921	236	432	2310	88	307	0	120	66	0	295
Lane Group Flow (vph)	200	1157	0	432	2398	0	0	307	120	0	66	295
Turn Type	Prot	NA		Prot	NA		Split	NA	Perm	Split	NA	Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases									2			6
Total Split (s)	18.0	64.0		20.0	66.0		27.0	27.0	27.0	14.0	14.0	14.0
Total Lost Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	4.0
Act Effct Green (s)	14.0	38.6		37.4	62.0			22.9	22.9		10.0	10.0
Actuated g/C Ratio	0.11	0.31		0.30	0.50			0.18	0.18		0.08	0.08
v/c Ratio	1.01	0.74		0.82	0.95			0.95	0.31		0.47	0.98
Control Delay	121.3	38.8		55.2	40.4			89.4	9.8		66.4	67.2
Queue Delay	0.0	0.0		0.0	0.0			0.0	0.0		0.0	0.0
Total Delay	121.3	38.8		55.2	40.4			89.4	9.8		66.4	67.2
LOS	F	D		E	D			F	A		E	E
Approach Delay		50.9			42.6			67.0			67.0	
Approach LOS		D			D			E			E	

Intersection Summary			
Area Type:	Other		
Cycle Length: 125			
Actuated Cycle Length: 124.9			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.01			
Intersection Signal Delay: 48.8		Intersection LOS: D	
Intersection Capacity Utilization 85.3%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 8: N Kirkwood Rd & Memorial Dr



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	152	33	25	3	25	47	40	1752	8	14	750	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Satd. Flow (prot)	0	1769	0	0	1701	0	1770	3536	0	1770	3511	0
Flt Permitted		0.778			0.990		0.292			0.111		
Satd. Flow (perm)	0	1426	0	0	1687	0	544	3536	0	207	3511	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		11			14			1			17	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	165	36	27	3	27	51	43	1904	9	15	815	46
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	228	0	0	81	0	43	1913	0	15	861	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		40.0	40.0		40.0	40.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		36.0	36.0		36.0	36.0	
Actuated g/C Ratio		0.27			0.27		0.60	0.60		0.60	0.60	
v/c Ratio		0.59			0.18		0.13	0.90		0.12	0.41	
Control Delay		25.4			15.8		6.5	18.4		8.0	6.9	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		25.4			15.8		6.5	18.4		8.0	6.9	
LOS		C			B		A	B		A	A	
Approach Delay		25.4			15.8			18.2			6.9	
Approach LOS		C			B			B			A	

Intersection Summary

Area Type: Other
Cycle Length: 60
Actuated Cycle Length: 60
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green
Control Type: Pretimed
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 15.5 Intersection LOS: B
Intersection Capacity Utilization 73.7% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	64	40	34	20	93	25	102	735	14	20	1874	214
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	0.95
Frt		0.967			0.976			0.997			0.985	
Flt Protected		0.977			0.993		0.950			0.950		
Satd. Flow (prot)	0	1760	0	0	1805	0	1770	3529	0	1770	3486	0
Flt Permitted		0.703			0.953		0.061			0.326		
Satd. Flow (perm)	0	1266	0	0	1733	0	114	3529	0	607	3486	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		16			11			5			36	
Link Speed (mph)		30			30			35			35	
Link Distance (ft)		777			733			2002			518	
Travel Time (s)		17.7			16.7			39.0			10.1	
Adj. Flow (vph)	70	43	37	22	101	27	111	799	15	22	2037	233
Lane Group Flow (vph)	0	150	0	0	150	0	111	814	0	22	2270	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Total Split (s)	20.0	20.0		20.0	20.0		70.0	70.0		70.0	70.0	
Total Lost Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	
Act Effct Green (s)		16.0			16.0		66.0	66.0		66.0	66.0	
Actuated g/C Ratio		0.18			0.18		0.73	0.73		0.73	0.73	
v/c Ratio		0.63			0.47		1.34	0.31		0.05	0.88	
Control Delay		43.7			36.3		234.6	4.5		3.6	14.6	
Queue Delay		0.0			0.0		0.0	0.0		0.0	0.0	
Total Delay		43.7			36.3		234.6	4.5		3.6	14.6	
LOS		D			D		F	A		A	B	
Approach Delay		43.7			36.3			32.1			14.5	
Approach LOS		D			D			C			B	

Intersection Summary			
Area Type:	Other		
Cycle Length: 90			
Actuated Cycle Length: 90			
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green			
Control Type: Pretimed			
Maximum v/c Ratio: 1.34			
Intersection Signal Delay: 21.3		Intersection LOS: C	
Intersection Capacity Utilization 88.7%		ICU Level of Service E	
Analysis Period (min) 15			

Splits and Phases: 3: N Kirkwood Rd & Kimberley Ln