RAMEY KEMP ASSOCIATES
Moving forward.

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4343 Cox Road
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October 6, 2020

Mr. Kevin McDermott, AICP
Albemarle County
401 McIntire Road
Charlottesville, Virginia 22902
Phone: (434) 296-5832

Reference: **Ashwood Boulevard Residential** – Revised Traffic Impact Analysis (TIA)

Dear Mr. McDermott,

Ramey Kemp & Associates, Inc. (RKA) prepared the Traffic Impact Analysis (TIA) for this proposed neighborhood on December 27, 2019. VDOT reviewed the TIA and provided comments in a letter dated July 22, 2020, which are detailed below and following is a brief response to each.

VDOT Traffic Engineering

1) Page 1: The counts and collection dates do not match and will be corrected.

   - The traffic count date has been corrected in the revised TIA

2) Page 6: TE recommends 100-ft storage and 100-ft taper for Ashwood @ Archer Ave. The construction of the left turn lane may lead to the closure of the existing median break. TE recommends 200-ft taper to comply with the VDOT access management for turning lane length of taper and storage for US 29 @ RIRO Driveway.

   - RKA agrees with these recommendations, which were included in the original TIA

Synchro Files

3) AM and PM existing models do not have the correct existing total split timing, yellow timings, all red timings. Considering this intersection is coordinated with other intersection along US 29, the existing timings need to be used throughout all scenarios. If signal-timing modification is deemed necessary to accommodate the development, the modified signal timings should be added to the recommendation section for review. Furthermore, any signal timing modification to this intersection may require updating the entire coordination system along US 29. Obtain the correct existing timings from VDOT / TOC and update synchro accordingly.

   - The existing VDOT signal timings have been included in this revised analysis for the existing conditions and maintained for the no-build and build conditions.

4) Lost time adjustment is coded incorrectly throughout all scenarios (Existing, No-Build and Build). Use the default value of "0". Side note: VDOT / TE commented in this practice from RKA several times at different occasions. Refer to Synchro guide for information in regards to the lost time adjustment.

   - Lost time has two components – start-up lost time (perception / reaction time when the light turns green, which is 2.0 seconds), and the clearance lost time (the amount of clearance time that is not used by drivers – typically assumed to be 2.0 seconds). This results in a total lost time of 4.0 seconds per phase. Synchro calculates lost time as the clearance time (yellow plus all-red), which is incorrect. The U.S. 29 at Ashwood Boulevard intersection has clearance times of 5.9 to 8.5 seconds per phase. Start-up lost time is fixed at 2.0 seconds, so this means that drivers are not using the last 3.9 to 6.5 seconds of clearance time, which is overly conservative. In Table 2, the LOS results are reported with and without the lost time adjustment.

5) The existing condition has a pedestrian phase, which was not coded into Synchro. Add the pedestrian phase for all scenarios.

   - The pedestrian phase for the crosswalk across the east leg of the intersection has been included in all scenarios. This crosswalk runs with northbound U.S. 29, so it receives plenty of walk time with every cycle, so has no impact to the Synchro analysis.

6) Level of Service Summary tables uses Synchro output values, however, per TOSAM "HCM 2010 should be used for reporting Synchro analyses. If HCM 2010 reports are not generated because of the operation of the intersection, HCM 2000 should be used". Revise all the summary tables to include the HCM values and all attached reports are to be HCM 2010 / HCM 2000 reports.

   - The HCM 2010 reports have been utilized for all unsignalized intersections in the revised TIA. HCM 2000 reports were utilized to report LOS and delay for the signalized intersection because HCM 2010 is unable to analyze U-turns, and the Synchro intersection reports have been included for lane queues.

7) Southbound left-turn lane is coded incorrectly throughout all scenarios (Existing, No-Build, and Build). SBL is coded as a protected permissive; however, SBL is in a protected only mode. Revise Synchro models to match the existing condition of the SBL operation. VDOT TE performed internal analysis for the PM Build model using existing timing. The Synchro queue length is #313-ft. As a result, TE recommends that the SBL storage needs to be extended an additional 150-ft to accommodate the long queue during the PM peak.

   - The southbound left-turn movement has been corrected to protected-only operation, and the applicant has agreed to extend the storage in the southbound left-turn lane from 200 feet to 350 feet.

8) Note that the final plan must show conformance with the VDOT Road Design Manual Appendices B(1) and F, as well as any other applicable standards, regulations or other requirements.

   - Understood

Ramey Kemp & Associates, Inc. (RKA) has performed a Traffic Impact Analysis (TIA) for the proposed neighborhood in the northeast quadrant of the U.S. 29 at Ashwood Boulevard intersection. The development plan includes up to 250 apartments and 108 two-over-two (2+2) townhome units with one full-movement driveway on Ashwood Boulevard and one right-in / right-out driveway on U.S. 29. If approved, the neighborhood is expected to be built-out in 2023. Figure 1 shows the site location and study intersections, and Figure 2 shows the preliminary site plan.

Based on our TIA scoping meeting with you and VDOT on December 6, the purpose of this letter report is to provide the following:

- Trip generation calculations
- Evaluation of turn lane warrants for the proposed site driveways
- Capacity and queueing analysis of the study intersections

Existing Roadway Conditions

U.S. 29 (Seminole Trail) is a six-lane Principal Arterial with a current average daily traffic (ADT) volume of approximately 45,000 vehicles per day (vpd), and a posted speed limit of 45 miles per hour (mph) in the vicinity of the site.

Ashwood Boulevard is a two-lane collector with a current ADT volume of approximately 5,100 vpd, and a posted speed limit of 35 mph.

The existing roadway configuration is shown in Figure 3.

Existing Traffic Volumes

The AM peak hour (7:00 to 9:00 AM) and PM peak hour (4:00 to 6:00 PM) turning movement counts were conducted by Peggy Malone & Associates, Inc. at the intersection of U.S. 29 at Ashwood Boulevard on December 12, which was during University of Virginia (UVA) exam week, and months before the Covid-19 pandemic. Based on discussion with you at the time, we agreed that traffic counts during UVA exam week were acceptable. In fact, the traffic volumes on U.S. 29 were likely elevated due to holiday shopping at the retail centers on the U.S. 29 corridor. The traffic count data are enclosed, and the existing 2019 volumes are shown in Figure 4.

Approved Development
Based on discussion with the County and VDOT, one approved development is included in this TIA. Brookhill is a mixed-use development in the southeast quadrant of the U.S. 29 at Ashwood Boulevard intersection. The approved development trips were based on Figure 12 from the RKA TIA dated February 2016. The trips for the Brookhill neighborhood are shown in Figure 5.

Background Traffic Growth
The 2019 peak hour traffic volumes were grown by an annual rate of 1.15% for four years to estimate the 2023 peak hour traffic volumes. The grown volumes were combined with the approved development trips to estimate the no-build 2023 volumes, which are shown in Figure 6.

Trip Generation
The trip generation potential of the proposed neighborhood during a typical weekday, AM peak hour, and PM peak hour was estimated using the methodologies published by the ITE *Trip Generation Manual – 10th Edition*. Table 1 summarizes the trip generation calculations.

Table 1
ITE Trip Generation – Weekday – 10th Edition

Land Use (ITE Land Use Code)	Size	Weekday Daily Traffic (vpd)		AM Peak Hour (vph)		PM Peak Hour (vph)	
		Enter	Exit	Enter	Exit	Enter	Exit
Multifamily Housing – Mid-Rise (221)	375 units	1,021	1,021	35	100	101	64

The development plan includes 358 units, but the analysis is based on the trip potential of 375 units to be conservative.

Site Traffic Distribution
The following site traffic distribution was applied based on a review of the existing traffic volumes, the adjacent roadway network, and engineering judgement:

- 67% to / from the south on U.S. 29
- 15% to / from the south on Archer Avenue
- 13% to / from the north on U.S. 29
- 5% to / from the east on Ashwood Boulevard

Figure 7 shows the site trip distribution, Figure 8 shows the site trip assignment, and Figure 9 shows the projected 2023 build-out peak hour traffic volumes.

VDOT Turn Lane Warrant Analysis

The projected build-out AM and PM peak hour traffic volumes at the proposed site driveways were compared to the turn lane warrants in the Virginia Department of Transportation (VDOT) *Access Management Design Standards for Entrances and Intersections*.

U.S. 29 at Right-in / Right-out Driveway:

- A northbound right-turn taper on U.S. 29 is barely warranted in the PM peak hour only

Ashwood Boulevard at Archer Avenue / Site Driveway:

- A westbound right-turn lane on Ashwood Boulevard is not warranted
- An eastbound left-turn lane on Ashwood Boulevard is nearly warranted in the PM peak hour only

Figure 10 shows the recommended roadway laneage at the proposed driveways.

Intersection Spacing Standards

VDOT requires at least 305 feet of separation between partial access driveways on Principal Arterial roadways posted 45 mph. The proposed right-in / right-out driveway on U.S. 29 is approximately 500 feet north of the U.S. 29 at Ashwood Boulevard intersection which exceeds the VDOT minimum spacing standards.

Traffic Capacity Analysis

Traffic capacity analysis for the study intersections was performed using Synchro 10, which is a comprehensive software package that allows the user to model signalized and unsignalized intersections to determine levels-of-service based on the thresholds specified in the Highway Capacity Manual (HCM) – 6th Edition.

Table 2 summarizes the capacity analysis results for the signalized intersection of U.S. 29 at Ashwood Boulevard, and the Synchro outputs are enclosed for reference. HCM 2010 is unable to analyze U-turn movements, so HCM 2000 methodology was utilized for LOS and delay. Synchro intersection reports are included in the analysis to provide queue lengths, which are not provided with HCM 2000 signalized reports.

Table 2
Level-of-Service Summary for U.S. 29 at Ashwood Boulevard

CONDITION	LANE GROUP	AM PEAK HOUR				PM PEAK HOUR			
		Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)	Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)
Existing (2019) Traffic Conditions	WBL	D	50.1	188	B (17.7 sec)	E	59.1	88	B (12.1 sec)
	WBR	D	40.7	36		E	55.6	35	
	NBU	E	57.6	6		E	65.5	7	
	NBT	B	11.9	274		B	11.9	449	
	NBR	A	8.6	23		A	7.3	30	
	SBL	E	58.3	30		E	62.9	91	
	SBT	B	15.1	549		A	7.2	286	
No-Build (2023) Traffic Conditions	WBL	D	50.7	221	C (25.4 sec)	E	62.4	117	C (20.3 sec)
	WBR	D	39.4	45		D	55.0	47	
	NBU	E	58.2	97		E	63.6	97	
	NBT	B	16.1	314		B	16.7	511	
	NBR	B	11.2	24		A	9.5	30	
	SBL	E	72.2	125		F	115.2	302	
	SBT	C	23.9	658		B	11.4	368	
Build (2023) Traffic Conditions	WBL	D	53.2	257	C (27.3 sec)	E	69.2	154	C (22.7 sec)
	WBR	D	38.3	46		D	54.5	48	
	NBU	E	58.2	97		E	63.6	97	
	NBT	B	17.8	317		B	16.9	522	
	NBR	B	12.4	26		A	9.8	32	
	SBL	E	64.6	136		F	152.9	332	
	SBT	C	25.6	658		B	11.6	368	
Build (2023) Traffic Conditions ***With Lost Time Adjustment***	WBL	D	43.0	243	C (23.8 sec)	E	55.4	138	B (18.2 sec)
	WBR	C	34.8	43		D	50.6	46	
	NBU	D	50.2	93		E	57.1	94	
	NBT	B	15.6	305		B	15.5	497	
	NBR	B	10.9	25		A	9.0	31	
	SBL	D	53.0	113		E	79.7	289	
	SBT	C	23.2	630		B	10.5	349	

Capacity analysis indicates that the intersection currently operates at LOS B during the AM and PM peak hours. Under no-build conditions, the intersection is expected to operate at LOS C during the AM and PM peak hours.

Under build conditions, the intersection is expected to continue to operate at LOS C during the AM and PM peak hours.

Lost time has two components – start-up lost time (perception / reaction time when the light turns green, which is 2.0 seconds), and the clearance lost time (the amount of clearance time that is not used by drivers – typically assumed to be 2.0 seconds). This gives us a total lost time of 4.0 seconds.

With the appropriate lost time adjustment factored into the analysis for build conditions, the intersection is expected to operate at LOS C during the AM peak hour and LOS B during the PM peak hour.

The following improvement is recommended to accommodate the site trips:

- Extend the storage in the southbound left-turn lane on U.S. 29 from 200 feet to 350 feet

Table 3 summarizes the capacity analysis results for the intersection of Ashwood Boulevard at Archer Avenue / Site Driveway, and the Synchro outputs are enclosed for reference. HCM 2010 methodology was utilized for this analysis.

Table 3
Level-of-Service Summary for Ashwood Boulevard at Archer Avenue / Site Driveway

CONDITION	LANE GROUP	AM PEAK HOUR				PM PEAK HOUR			
		Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)	Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)
No-Build (2023) Traffic Conditions	EBT	-	-	-	N/A[3]	-	-	-	N/A[3]
	EBR	-	-	-		-	-	-	
	WBL[2]	A	7.6	3		A	8.4	3	
	WBT	-	-	-		-	-	-	
	NBL[1]	C	15.4	18		B	14.9	15	
	NBR[1]	A	9.0	3		B	10.4	5	
Build (2023) Traffic Conditions	EBL[2]	A	8.4	3	N/A[3]	A	7.7	3	N/A[3]
	EBT	-	-	-		-	-	-	
	EBR	-	-	-		-	-	-	
	WBL[2]	A	7.6	3		A	8.4	3	
	WBT/R	-	-	-		-	-	-	
	NBL[1]	C	24.0	30		C	22.3	25	
	NBT/R[1]	A	9.9	5		B	12.7	8	
	SBL/T[1]	C	17.1	5		C	18.8	5	
	SBR[1]	B	12.2	13		A	9.4	5	

1. Level of service for minor approach
2. Level of service for major street left-turn movement
3. HCM methodology does not provide lane group or overall LOS, delay, and queue lengths for major street through movements or right turns at unsignalized intersections.

Under no-build conditions, capacity analysis indicates that the minor street left-turn movement is expected to operate with short delays (less than 25 seconds) during the AM and PM peak hours with queue lengths less than one vehicle.

Under build conditions, capacity analysis indicates that the minor street left-turn movement is expected to continue to operate with short delays (less than 25 seconds) during the AM and PM peak hour with queue lengths of one vehicle or less.

Table 4 summarizes the capacity analysis results for the intersection of U.S. 29 at Right-in / Right-out Driveway, and the Synchro outputs are enclosed for reference. HCM 2010 methodology was utilized for this analysis.

Table 4
Level-of-Service Summary for U.S. 29 at Right-in / Right-out Driveway

CONDITION	LANE GROUP	AM PEAK HOUR				PM PEAK HOUR			
		Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)	Lane LOS	Lane Delay (sec)	Queue (ft)	Overall LOS (Delay)
Build (2023) Traffic Conditions	WBR[1]	C	19.1	5	N/A[2]	D	32.0	5	N/A[2]
	NBT	-	-	-		-	-	-	
	NBR	-	-	-		-	-	-	
	SBT	-	-	-		-	-	-	

1. Level of service for minor approach
2. HCM methodology does not provide lane group or overall LOS, delay, and queue lengths for major street through movements or right turns at unsignalized intersections.

Under build conditions, capacity analysis indicates that the minor street right-turn movement is expected to operate with short delays (less than 25 seconds) during the AM peak hour and with moderate delays (between 25 and 50 seconds) during the PM peak hour, with queue lengths of less than one vehicle.

Recommendations

Based on the trip generation potential of the proposed neighborhood, the following improvements are recommended:

U.S. 29 at Ashwood Boulevard:

- Extend the storage in the southbound left-turn lane on U.S. 29 from 200 feet to 350 feet

Ashwood Boulevard at Archer Avenue / Site Driveway:

- Construct site driveway with one ingress lane and two egress lanes
- Construct one eastbound left-turn lane on Ashwood Boulevard with 100 feet of storage

U.S. 29 at Right-in / Right-out Driveway:

- Construct site driveway with one ingress lane and one egress lane
- Construct one northbound right-turn lane on U.S. 29 with 200 feet of storage

We appreciate your attention to this matter. Please contact me at (804) 217-8560 if you have any questions about this report.

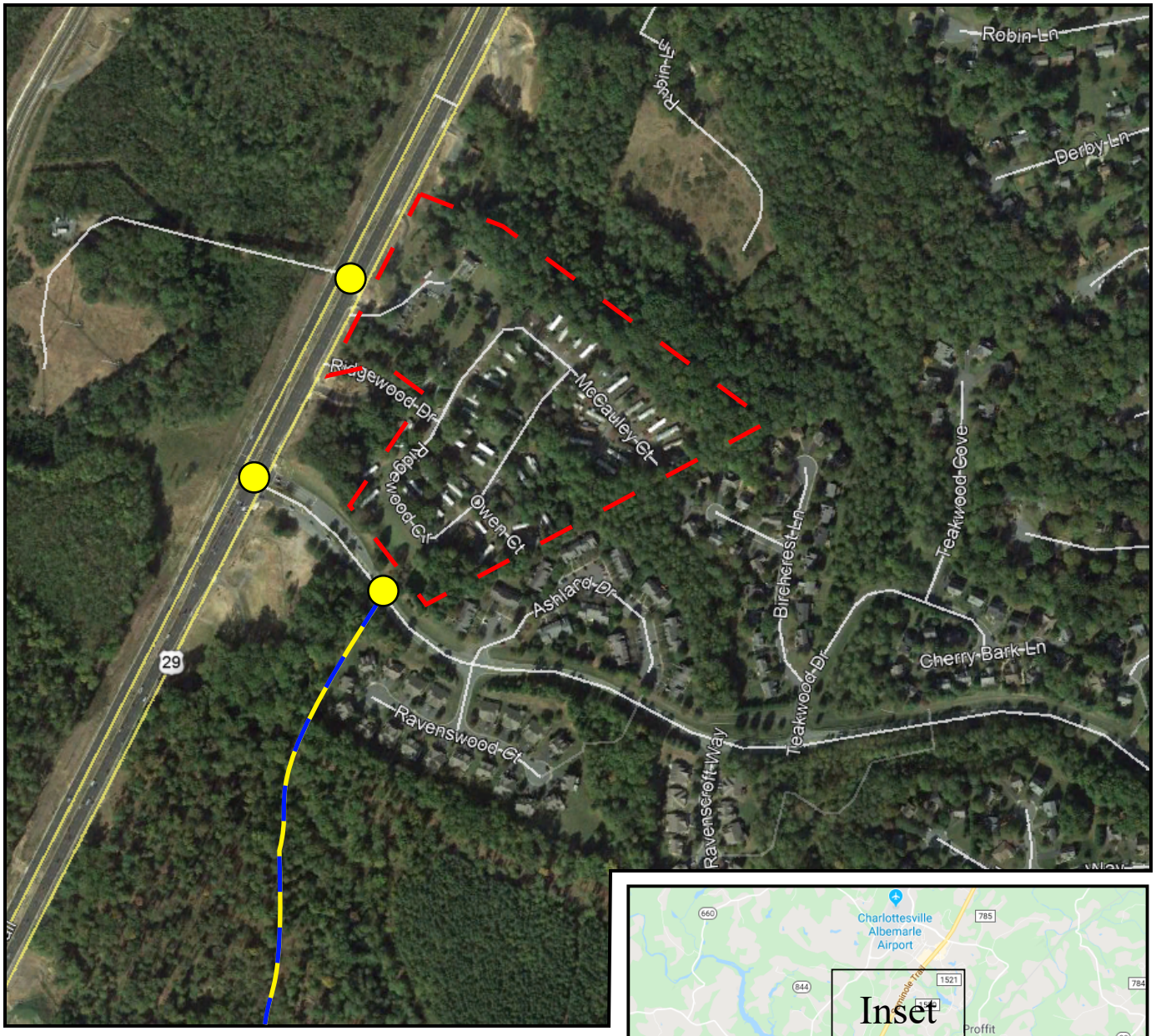
Sincerely yours,
Ramey Kemp & Associates, Inc.



Carl Hultgren, P.E., PTOE
State Traffic Engineering Lead

Enclosures: Figures, Traffic count data, Synchro output, VDOT turn lane warrant diagrams

Copy to: Mr. Adam Moore, P.E., VDOT
Mr. Scott Copeland, RST Development, LLC
Mr. Alex Mays, RST Development, LLC
Ms. Valerie Long, Williams Mullen
Mr. Charles Alvis, Williams Mullen
Mr. Ryan Yauger, P.E., Bohler Engineering



Inset



Overview

LEGEND

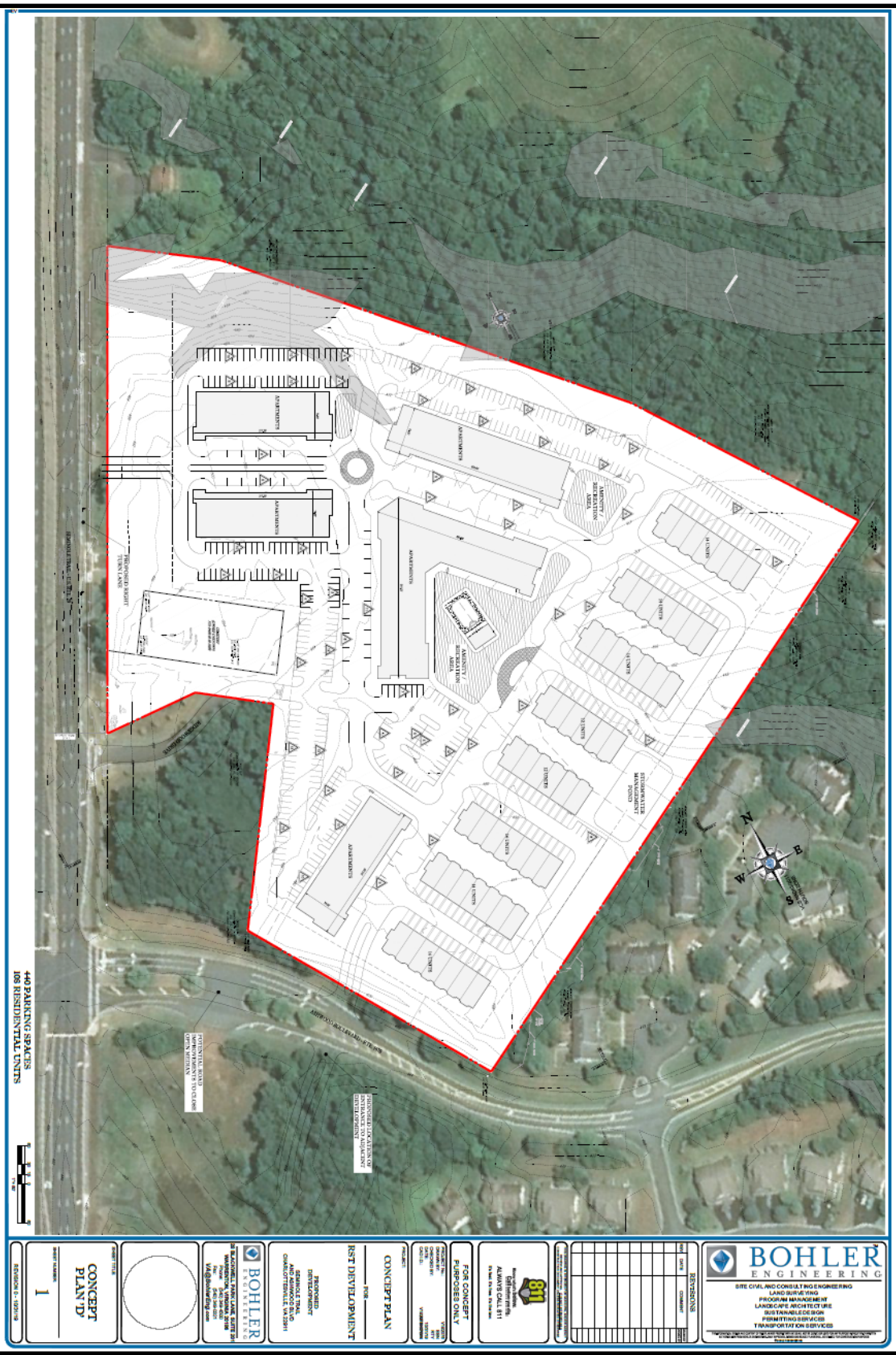
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Study Intersection

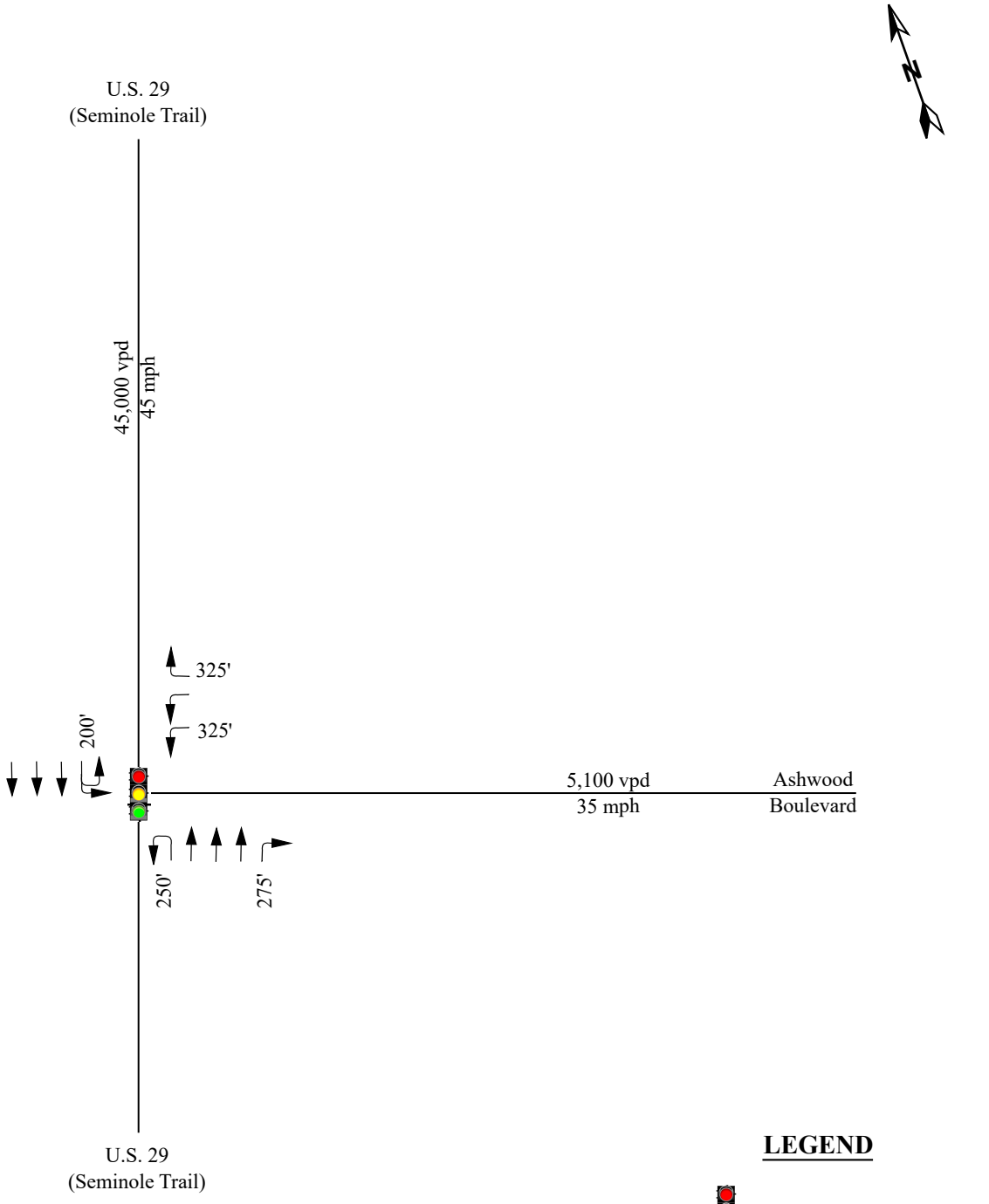
Site Boundary

Future Archer Avenue

Moving forward. RKA RAMEY KEMP ASSOCIATES	Ashwood Boulevard Residential Albemarle County, Virginia	Site Location and Study Intersections Scale: Not to Scale | Figure 1



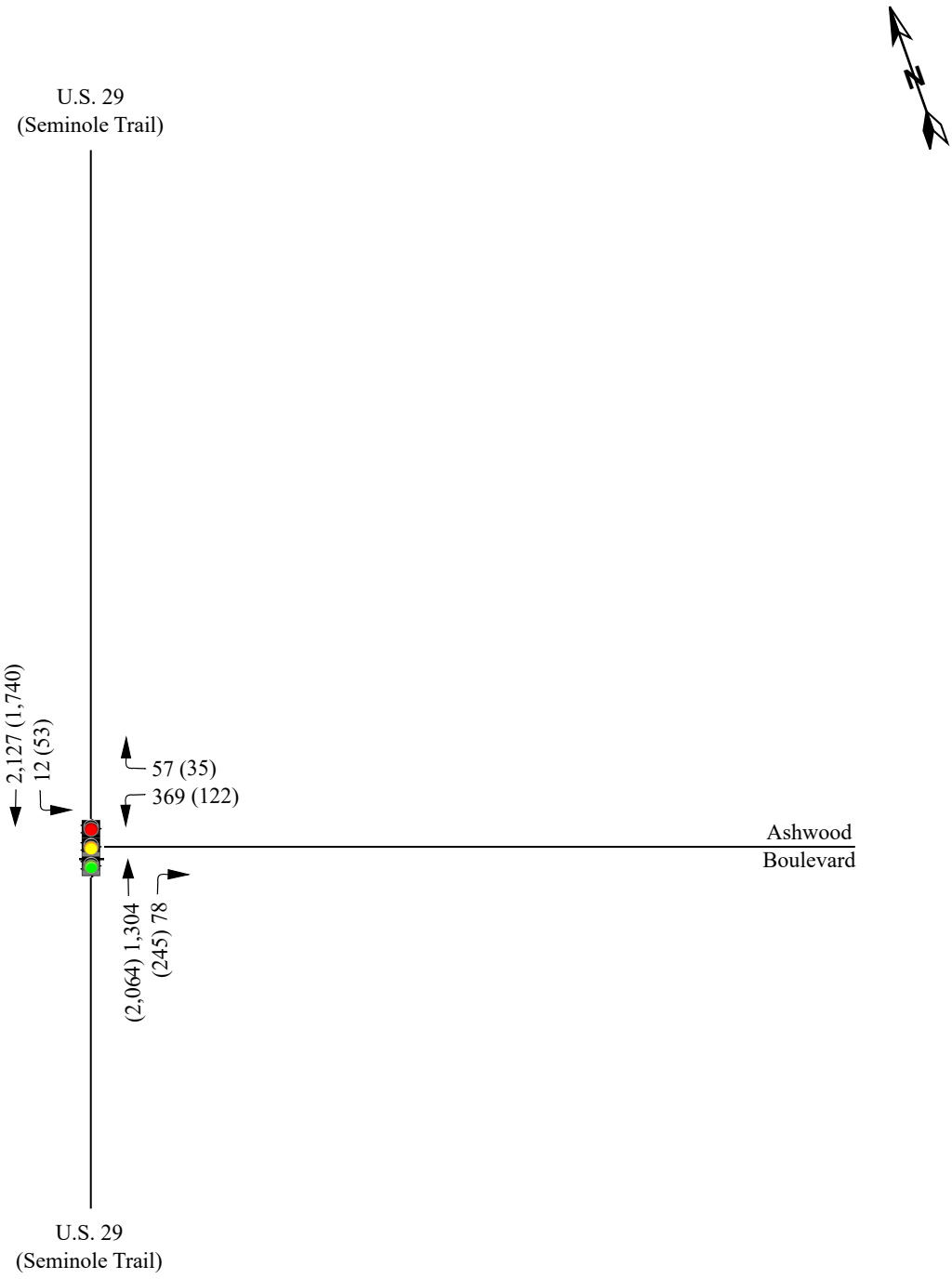
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LEGEND

- Existing Traffic Signal
- Existing Lane
- X' Storage (In Feet)

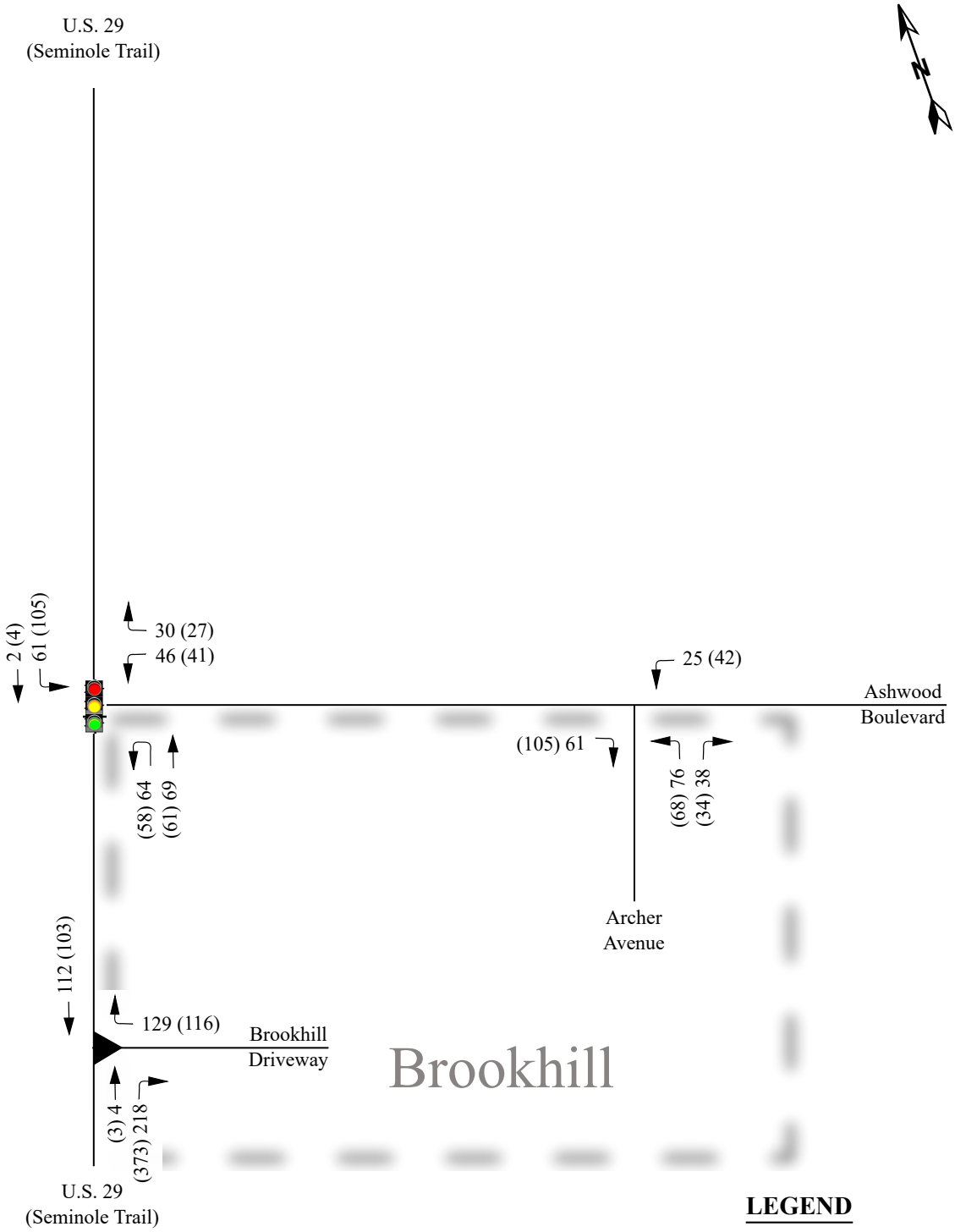
Moving forward. RKA RAMEY KEMP ASSOCIATES	Ashwood Boulevard Residential Albemarle County, Virginia	Existing Lane Configuration Scale: Not to Scale | Figure 3



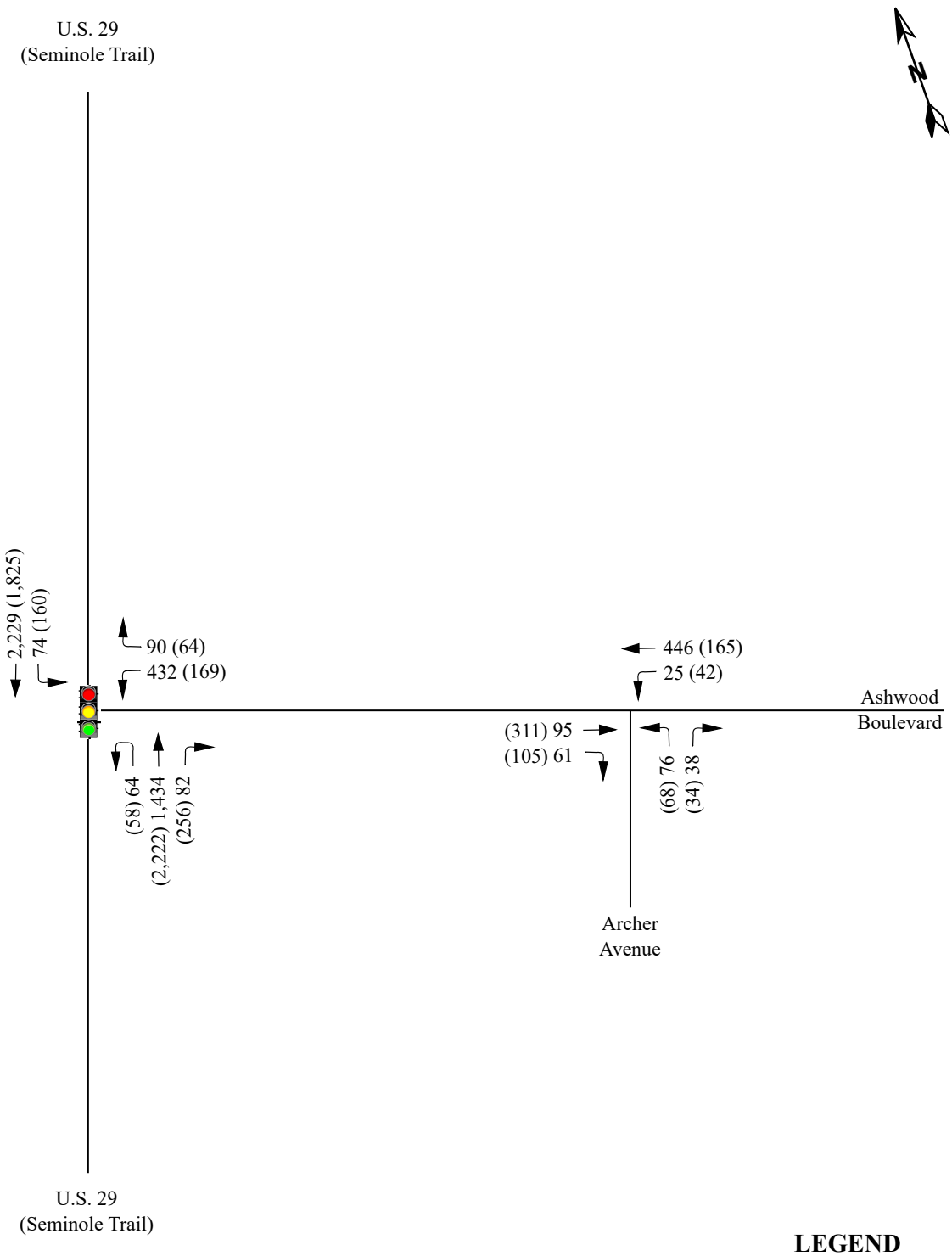
LEGEND

X (Y) AM (PM) Peak Hour

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Moving forward. RKA RAMEY KEMP ASSOCIATES	Ashwood Boulevard Residential Albemarle County, Virginia	Approved Development Trips Scale: Not to Scale | Figure 5



LEGEND

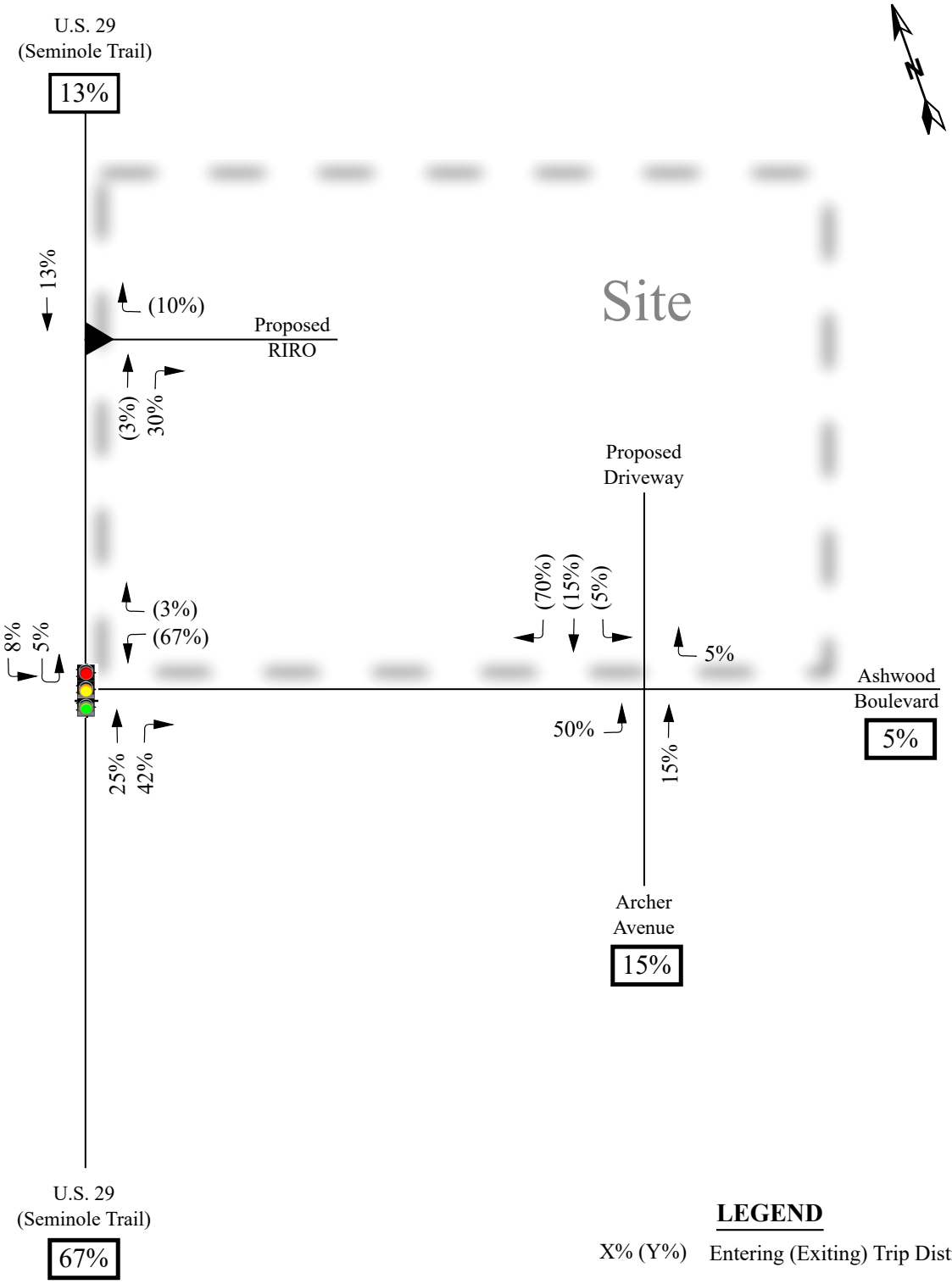
X (Y) AM (PM) Peak Hour

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RKA
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Ashwood Boulevard Residential
Albemarle County, Virginia

No-Build (2023) Peak Hour Traffic Volumes

Scale: Not to Scale | Figure 6

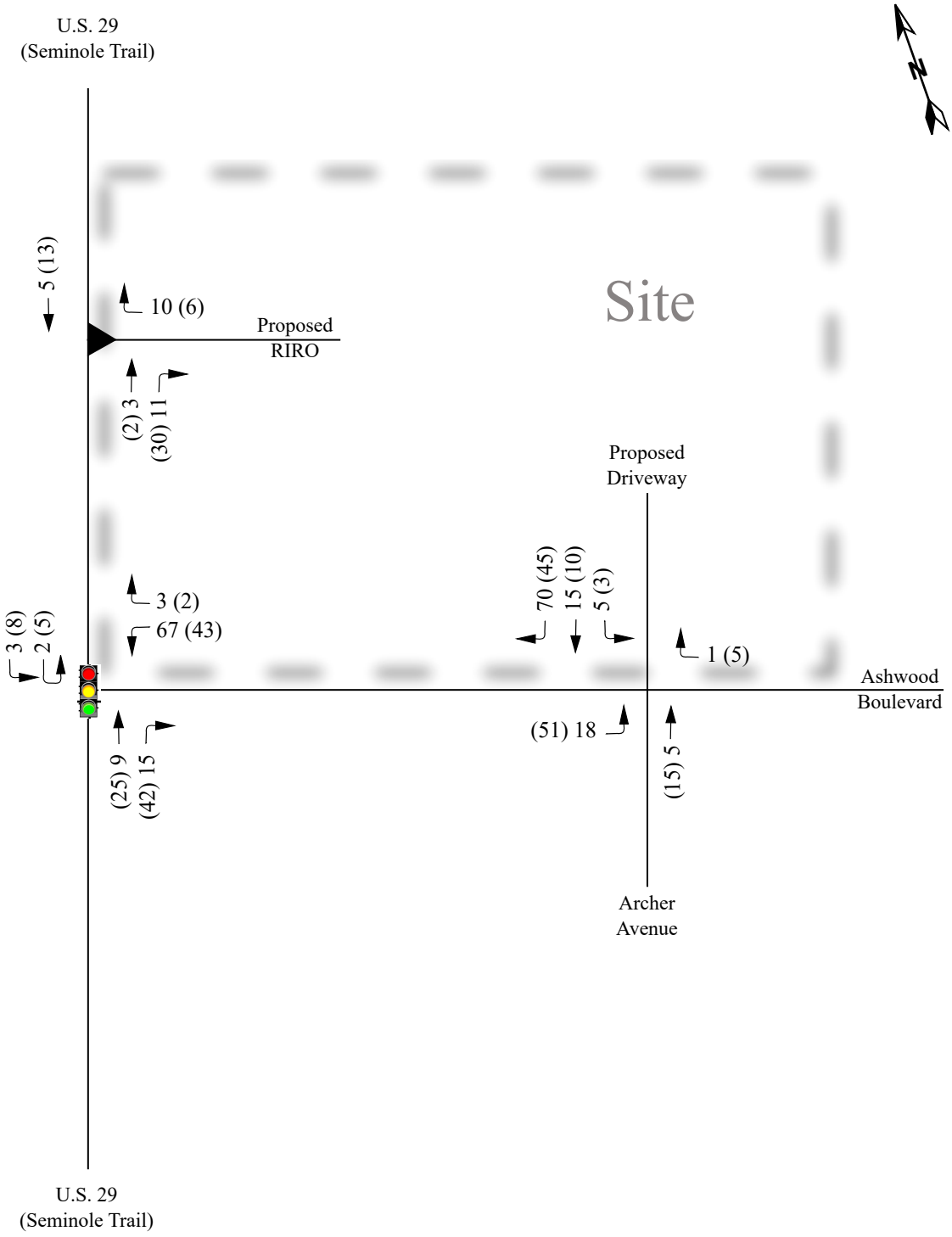


LEGEND

X% (Y%) Entering (Exiting) Trip Distribution

XX% Regional Trip Distribution

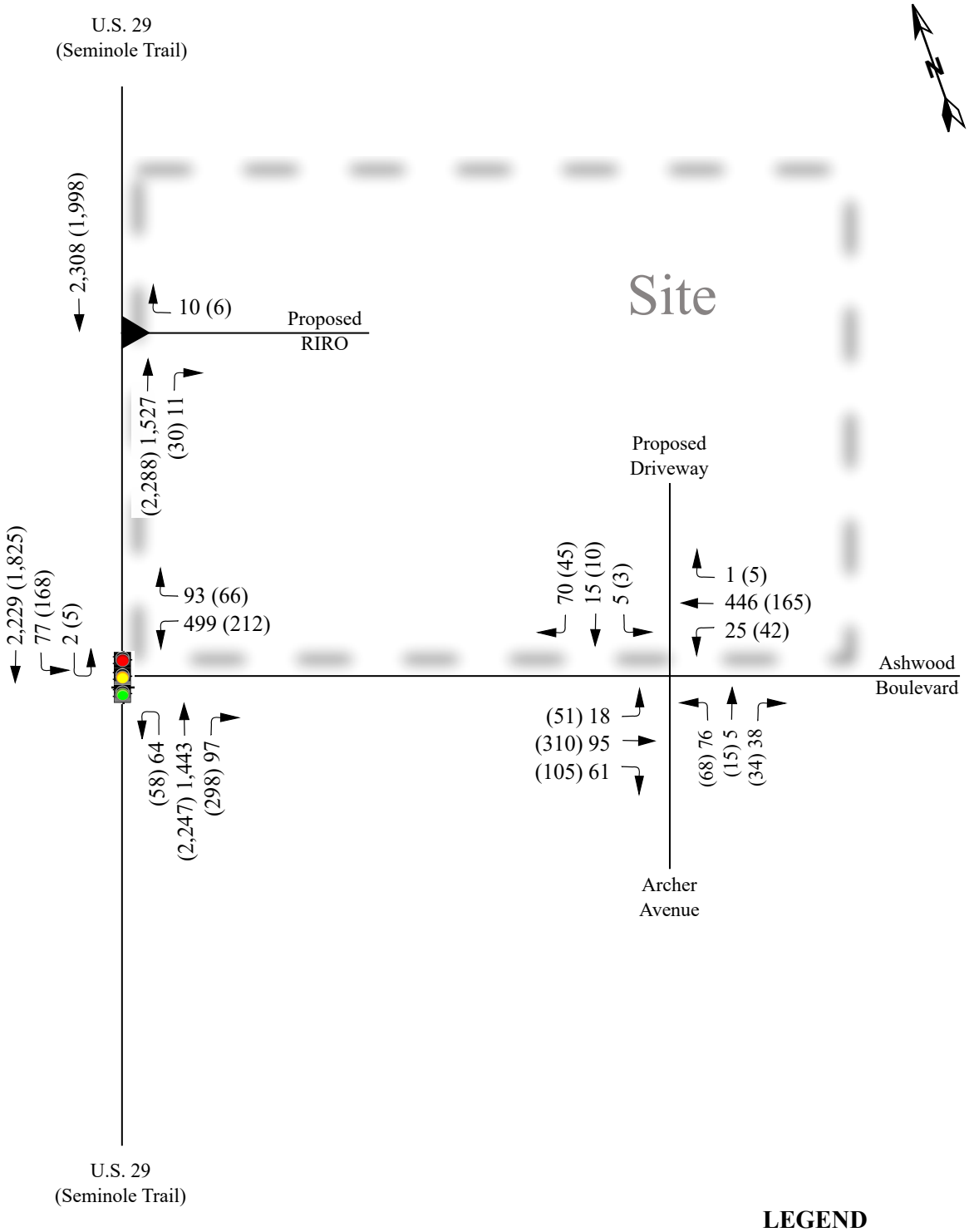
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LEGEND

X (Y) AM (PM) Peak Hour

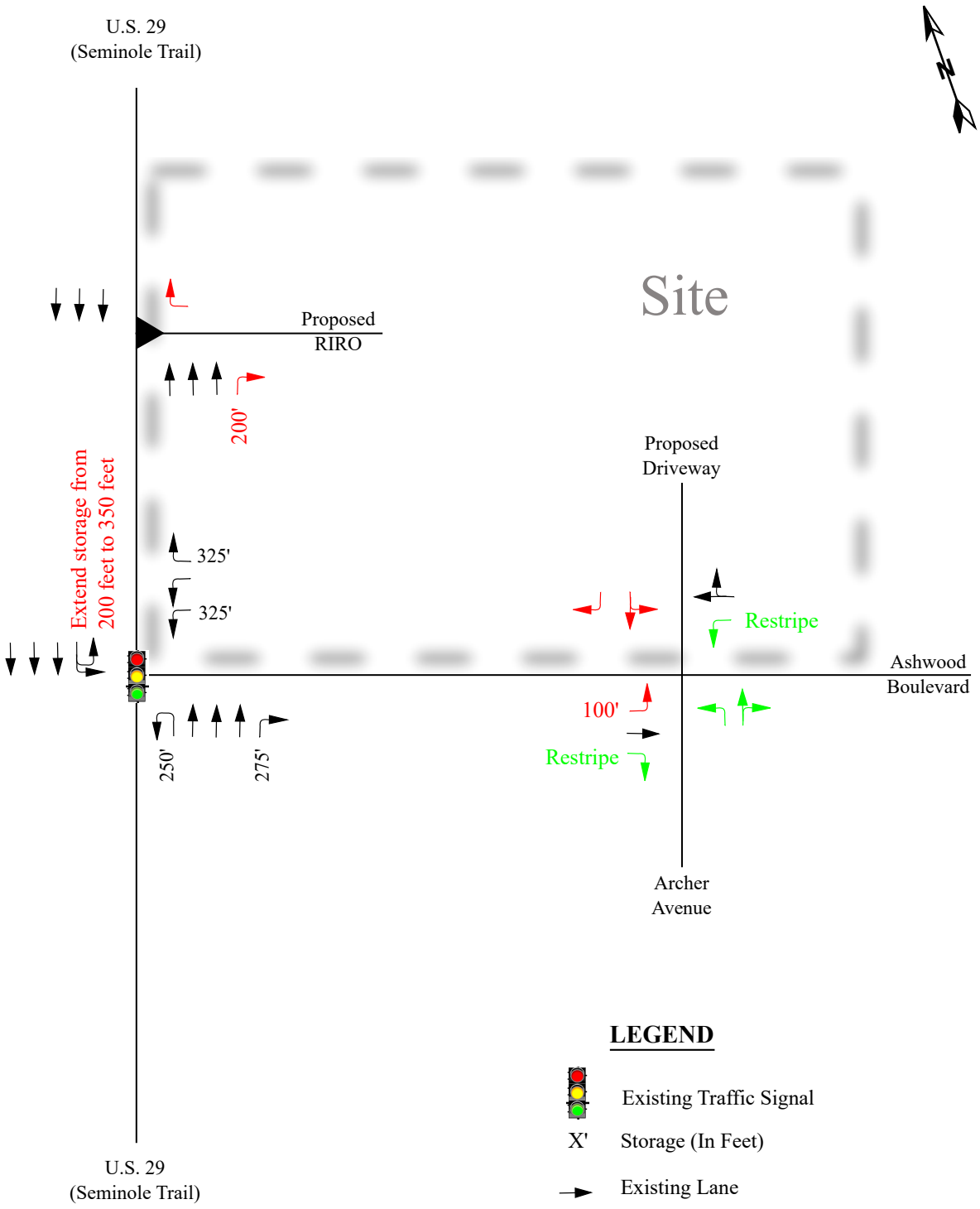
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LEGEND

X (Y) AM (PM) Peak Hour Traffic

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LEGEND

- Existing Traffic Signal
- X' Storage (In Feet)
- Existing Lane
- Recommended Lane
- Lane to be constructed by Brookhill development

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Peggy Malone & Associates, Inc.
(888) 247-8602

File Name : US 29 and Ashwood Blvd. AM
Site Code :
Start Date : 12/12/2019
Page No : 1

Groups Printed- Combined

	US 29 Southbound				Ashwood Blvd Westbound				US 29 Northbound					
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	381	1	0	382	8	30	0	38	10	255	0	0	265	685
07:15 AM	514	7	0	521	17	44	0	61	16	296	0	0	312	894
07:30 AM	562	3	0	565	15	70	0	85	21	314	0	0	335	985
07:45 AM	570	4	0	574	16	97	0	113	24	352	0	0	376	1063
Total	2027	15	0	2042	56	241	0	297	71	1217	0	0	1288	3627
08:00 AM	519	3	0	522	18	93	0	111	18	308	0	0	326	959
08:15 AM	476	2	0	478	8	109	0	117	15	330	0	0	345	940
08:30 AM	403	4	0	407	16	99	0	115	24	301	1	0	326	848
08:45 AM	454	4	0	458	15	64	0	79	32	297	0	0	329	866
Total	1852	13	0	1865	57	365	0	422	89	1236	1	0	1326	3613
Grand Total	3879	28	0	3907	113	606	0	719	160	2453	1	0	2614	7240
Apprch %	99.3	0.7	0		15.7	84.3	0		6.1	93.8	0	0		
Total %	53.6	0.4	0	54	1.6	8.4	0	9.9	2.2	33.9	0	0	36.1	

	US 29 Southbound			Ashwood Blvd Westbound			US 29 Northbound				
Start Time	Thru	Left	App. Total	Right	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1											
Peak Hour for Entire Intersection Begins at 07:30 AM											
07:30 AM	562	3	565	15	70	85	21	314	0	335	985
07:45 AM	**570**	**4**	**574**	16	97	113	**24**	**352**	0	**376**	**1063**
08:00 AM	519	3	522	**18**	93	111	18	308	0	326	959
08:15 AM	476	2	478	8	**109**	**117**	15	330	0	345	940
Total Volume	2127	12	2139	57	369	426	78	1304	0	1382	3947
% App. Total	99.4	0.6		13.4	86.6		5.6	94.4	0		
PHF	.933	.750	.932	.792	.846	.910	.813	.926	.000	.919	.928

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File Name : US 29 and Ashwood Blvd. PM
Site Code :
Start Date : 12/12/2019
Page No : 1

Groups Printed- Combined

	US 29 Southbound				Ashwood Blvd Westbound				US 29 Northbound					
Start Time	Thru	Left	Peds	App. Total	Right	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	393	8	0	401	3	37	0	40	43	503	0	0	546	987
04:15 PM	405	9	0	414	15	57	0	72	55	558	1	0	614	1100
04:30 PM	437	13	0	450	14	30	0	44	52	476	0	0	528	1022
04:45 PM	419	8	0	427	9	33	0	42	67	470	0	0	537	1006
Total	1654	38	0	1692	41	157	0	198	217	2007	1	0	2225	4115
05:00 PM	474	15	0	489	9	24	0	33	53	538	0	0	591	1113
05:15 PM	433	19	0	452	7	31	0	38	64	523	0	0	587	1077
05:30 PM	414	11	0	425	10	34	0	44	61	533	0	0	594	1063
05:45 PM	401	12	0	413	7	27	0	34	74	485	0	0	559	1006
Total	1722	57	0	1779	33	116	0	149	252	2079	0	0	2331	4259
Grand Total	3376	95	0	3471	74	273	0	347	469	4086	1	0	4556	8374
Apprch %	97.3	2.7	0		21.3	78.7	0		10.3	89.7	0	0		
Total %	40.3	1.1	0	41.4	0.9	3.3	0	4.1	5.6	48.8	0	0	54.4	

	US 29 Southbound			Ashwood Blvd Westbound			US 29 Northbound				
Start Time	Thru	Left	App. Total	Right	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1											
Peak Hour for Entire Intersection Begins at 04:45 PM											
04:45 PM	419	8	427	9	33	42	**67**	470	0	537	1006
05:00 PM	**474**	15	**489**	9	24	33	53	**538**	0	591	**1113**
05:15 PM	433	**19**	452	7	31	38	64	523	0	587	1077
05:30 PM	414	11	425	**10**	**34**	**44**	61	533	0	**594**	1063
Total Volume	1740	53	1793	35	122	157	245	2064	0	2309	4259
% App. Total	97	3		22.3	77.7		10.6	89.4	0		
PHF	.918	.697	.917	.875	.897	.892	.914	.959	.000	.972	.957

Movement	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	369	57	1	1304	78	12	2127
Future Volume (vph)	369	57	1	1304	78	12	2127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	397	61	1	1402	84	13	2287
RTOR Reduction (vph)	0	51	0	0	32	0	0
Lane Group Flow (vph)	397	10	1	1402	52	13	2287
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Actuated Green, G (s)	18.6	18.6	1.2	71.4	71.4	3.0	73.2
Effective Green, g (s)	18.6	18.6	1.2	71.4	71.4	3.0	73.2
Actuated g/C Ratio	0.16	0.16	0.01	0.62	0.62	0.03	0.64
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	555	256	18	3157	982	46	3236
v/s Ratio Prot	c0.12		0.00	0.28		c0.01	c0.45
v/s Ratio Perm		0.01			0.03		
v/c Ratio	0.72	0.04	0.06	0.44	0.05	0.28	0.71
Uniform Delay, d1	45.7	40.7	56.3	11.4	8.5	54.9	13.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.4	0.1	1.3	0.5	0.1	3.4	1.3
Delay (s)	50.1	40.7	57.6	11.9	8.6	58.3	15.1
Level of Service	D	D	E	B	A	E	B
Approach Delay (s)	48.8			11.7			15.4
Approach LOS	D			B			B

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	369	57	1	1304	78	12	2127
Future Volume (vph)	369	57	1	1304	78	12	2127
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275	200	
Storage Lanes	2	1	1		1	1	
Taper Length (ft)	100		100			100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.950		0.950			0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Right Turn on Red		Yes			Yes		
Satd. Flow (RTOR)		61			84		
Link Speed (mph)	35			45			45
Link Distance (ft)	454			863			808
Travel Time (s)	8.8			13.1			12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Shared Lane Traffic (%)							
Lane Group Flow (vph)	397	61	1	1402	84	13	2287
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Detector Phase	4	4	5	2	2	1	6
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	20.0
Minimum Split (s)	16.0	16.0	14.4	49.9	49.9	13.0	28.5
Total Split (s)	32.0	32.0	18.0	67.0	67.0	16.0	65.0
Total Split (%)	27.8%	27.8%	15.7%	58.3%	58.3%	13.9%	56.5%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	C-Min
Act Effct Green (s)	18.6	18.6	5.6	76.0	76.0	6.5	79.2
Actuated g/C Ratio	0.16	0.16	0.05	0.66	0.66	0.06	0.69
v/c Ratio	0.72	0.20	0.01	0.42	0.08	0.13	0.65
Control Delay	53.1	11.4	52.0	11.1	2.9	54.0	12.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.1	11.4	52.0	11.1	2.9	54.0	12.7
LOS	D	B	D	B	A	D	B
Approach Delay	47.5			10.7			12.9
Approach LOS	D			B			B
Queue Length 50th (ft)	145	0	1	132	0	9	287
Queue Length 95th (ft)	188	36	6	274	23	30	549
Internal Link Dist (ft)	374			783			728
Turn Bay Length (ft)			250		275	200	
Base Capacity (vph)	701	372	163	3361	1074	129	3500
Starvation Cap Reductn	0	0	0	0	0	0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.16	0.01	0.42	0.08	0.10	0.65

Intersection Summary

Area Type: Other
Cycle Length: 115
Actuated Cycle Length: 115
Offset: 47 (41%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.72
Intersection Signal Delay: 15.9 Intersection LOS: B
Intersection Capacity Utilization 63.8% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Movement	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	122	35	1	2064	245	53	1740
Future Volume (vph)	122	35	1	2064	245	53	1740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	131	38	1	2219	263	57	1871
RTOR Reduction (vph)	0	35	0	0	81	0	0
Lane Group Flow (vph)	131	3	1	2219	182	57	1871
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Actuated Green, G (s)	10.0	10.0	1.2	89.8	89.8	8.2	96.8
Effective Green, g (s)	10.0	10.0	1.2	89.8	89.8	8.2	96.8
Actuated g/C Ratio	0.08	0.08	0.01	0.69	0.69	0.06	0.74
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	264	121	16	3512	1093	111	3786
v/s Ratio Prot	c0.04		0.00	c0.44		c0.03	c0.37
v/s Ratio Perm		0.00			0.11		
v/c Ratio	0.50	0.02	0.06	0.63	0.17	0.51	0.49
Uniform Delay, d1	57.6	55.5	63.8	11.0	7.0	59.0	6.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	0.1	1.6	0.9	0.3	4.0	0.5
Delay (s)	59.1	55.6	65.5	11.9	7.3	62.9	7.2
Level of Service	E	E	E	B	A	E	A
Approach Delay (s)	58.3			11.4			8.8
Approach LOS	E			B			A

Intersection Summary

HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	122	35	1	2064	245	53	1740
Future Volume (vph)	122	35	1	2064	245	53	1740
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275	200	
Storage Lanes	2	1	1		1	1	
Taper Length (ft)	100		100			100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.950		0.950			0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Right Turn on Red		Yes			Yes		
Satd. Flow (RTOR)		38			263		
Link Speed (mph)	35			45			45
Link Distance (ft)	454			863			808
Travel Time (s)	8.8			13.1			12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Shared Lane Traffic (%)							
Lane Group Flow (vph)	131	38	1	2219	263	57	1871
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Detector Phase	4	4	5	2	2	1	6
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	27.1
Total Split (s)	20.0	20.0	20.0	90.0	90.0	20.0	90.0
Total Split (%)	15.4%	15.4%	15.4%	69.2%	69.2%	15.4%	69.2%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	C-Min
Act Effct Green (s)	10.0	10.0	5.6	91.4	91.4	9.4	102.8
Actuated g/C Ratio	0.08	0.08	0.04	0.70	0.70	0.07	0.79
v/c Ratio	0.50	0.24	0.01	0.62	0.22	0.45	0.47
Control Delay	64.0	20.5	60.0	12.3	1.4	68.2	5.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.0	20.5	60.0	12.3	1.4	68.2	5.5
LOS	E	C	E	B	A	E	A
Approach Delay	54.2			11.2			7.4
Approach LOS	D			B			A
Queue Length 50th (ft)	55	0	1	358	0	47	142
Queue Length 95th (ft)	88	35	7	449	30	91	286
Internal Link Dist (ft)	374			783			728
Turn Bay Length (ft)			250		275	200	
Base Capacity (vph)	303	174	171	3573	1190	168	4019
Starvation Cap Reductn	0	0	0	0	0	0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.43	0.22	0.01	0.62	0.22	0.34	0.47

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 79 (61%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.62
Intersection Signal Delay: 11.2 Intersection LOS: B
Intersection Capacity Utilization 60.4% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Movement	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	432	90	64	1434	82	74	2229
Future Volume (vph)	432	90	64	1434	82	74	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	465	97	69	1542	88	80	2397
RTOR Reduction (vph)	0	80	0	0	38	0	0
Lane Group Flow (vph)	465	17	69	1542	50	80	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Actuated Green, G (s)	20.4	20.4	7.9	65.3	65.3	7.3	64.7
Effective Green, g (s)	20.4	20.4	7.9	65.3	65.3	7.3	64.7
Actuated g/C Ratio	0.18	0.18	0.07	0.57	0.57	0.06	0.56
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	608	280	121	2887	898	112	2860
v/s Ratio Prot	c0.14		0.04	0.30		c0.05	c0.47
v/s Ratio Perm		0.01			0.03		
v/c Ratio	0.76	0.06	0.57	0.53	0.06	0.71	0.84
Uniform Delay, d1	45.0	39.3	51.9	15.4	11.1	52.8	20.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.7	0.1	6.3	0.7	0.1	19.3	3.1
Delay (s)	50.7	39.4	58.2	16.1	11.2	72.2	23.9
Level of Service	D	D	E	B	B	E	C
Approach Delay (s)	48.8			17.6			25.5
Approach LOS	D			B			C

Intersection Summary

HCM 2000 Control Delay	25.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	432	90	64	1434	82	74	2229
Future Volume (vph)	432	90	64	1434	82	74	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275	200	
Storage Lanes	2	1	1		1	1	
Taper Length (ft)	100		100			100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.950		0.950			0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Right Turn on Red		Yes			Yes		
Satd. Flow (RTOR)		97			88		
Link Speed (mph)	35			45			45
Link Distance (ft)	454			863			808
Travel Time (s)	8.8			13.1			12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Shared Lane Traffic (%)							
Lane Group Flow (vph)	465	97	69	1542	88	80	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Detector Phase	4	4	5	2	2	1	6
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	27.1
Total Split (s)	32.0	32.0	18.0	67.0	67.0	16.0	65.0
Total Split (%)	27.8%	27.8%	15.7%	58.3%	58.3%	13.9%	56.5%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	C-Min
Act Effct Green (s)	20.4	20.4	9.1	66.8	66.8	8.7	66.2
Actuated g/C Ratio	0.18	0.18	0.08	0.58	0.58	0.08	0.58
v/c Ratio	0.76	0.27	0.50	0.52	0.09	0.60	0.82
Control Delay	53.6	9.6	62.7	16.5	3.0	70.4	24.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.6	9.6	62.7	16.5	3.0	70.4	24.5
LOS	D	A	E	B	A	E	C
Approach Delay	46.0			17.7			26.0
Approach LOS	D			B			C
Queue Length 50th (ft)	170	0	49	267	0	57	536
Queue Length 95th (ft)	221	45	97	314	24	#125	658
Internal Link Dist (ft)	374			783			728
Turn Bay Length (ft)			250		275	200	
Base Capacity (vph)	701	400	163	2952	956	139	2928
Starvation Cap Reductn	0	0	0	0	0	0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.66	0.24	0.42	0.52	0.09	0.58	0.82

Intersection Summary

Area Type: Other
Cycle Length: 115
Actuated Cycle Length: 115
Offset: 47 (41%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 25.4 Intersection LOS: C
Intersection Capacity Utilization 77.9% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Intersection						
Int Delay, s/veh	2.3					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	95	61	25	446	76	38
Future Vol, veh/h	95	61	25	446	76	38
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	200	200	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	103	66	27	485	83	41

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	169	0	642	103
Stage 1	-	-	-	-	103	-
Stage 2	-	-	-	-	539	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1409	-	438	952
Stage 1	-	-	-	-	921	-
Stage 2	-	-	-	-	585	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1409	-	430	952
Mov Cap-2 Maneuver	-	-	-	-	430	-
Stage 1	-	-	-	-	921	-
Stage 2	-	-	-	-	574	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.4	13.3
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	430	952	-	-	1409	-
HCM Lane V/C Ratio	0.192	0.043	-	-	0.019	-
HCM Control Delay (s)	15.4	9	-	-	7.6	-
HCM Lane LOS	C	A	-	-	A	-
HCM 95th %tile Q(veh)	0.7	0.1	-	-	0.1	-

Movement	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	169	64	58	2222	256	160	1825
Future Volume (vph)	169	64	58	2222	256	160	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00	1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00	0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	182	69	62	2389	275	172	1962
RTOR Reduction (vph)	0	63	0	0	97	0	0
Lane Group Flow (vph)	182	6	62	2389	178	172	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Actuated Green, G (s)	10.8	10.8	8.5	84.1	84.1	13.1	88.7
Effective Green, g (s)	10.8	10.8	8.5	84.1	84.1	13.1	88.7
Actuated g/C Ratio	0.08	0.08	0.07	0.65	0.65	0.10	0.68
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	285	131	115	3289	1024	178	3469
v/s Ratio Prot	c0.05		0.04	c0.47		c0.10	c0.39
v/s Ratio Perm		0.00			0.11		
v/c Ratio	0.64	0.04	0.54	0.73	0.17	0.97	0.57
Uniform Delay, d1	57.7	54.8	58.9	15.3	9.1	58.2	10.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.6	0.1	4.8	1.4	0.4	57.0	0.7
Delay (s)	62.4	55.0	63.6	16.7	9.5	115.2	11.4
Level of Service	E	D	E	B	A	F	B
Approach Delay (s)	60.3			17.1			19.7
Approach LOS	E			B			B

Intersection Summary

HCM 2000 Control Delay	20.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Lane Configurations							
Traffic Volume (vph)	169	64	58	2222	256	160	1825
Future Volume (vph)	169	64	58	2222	256	160	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275	200	
Storage Lanes	2	1	1		1	1	
Taper Length (ft)	100		100			100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	1770	5085
Flt Permitted	0.950		0.950			0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	1770	5085
Right Turn on Red		Yes			Yes		
Satd. Flow (RTOR)		69			275		
Link Speed (mph)	35			45			45
Link Distance (ft)	454			863			808
Travel Time (s)	8.8			13.1			12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Shared Lane Traffic (%)							
Lane Group Flow (vph)	182	69	62	2389	275	172	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	NA
Protected Phases	4		5	2		1	6
Permitted Phases		4			2		
Detector Phase	4	4	5	2	2	1	6
Switch Phase							
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	27.1
Total Split (s)	20.0	20.0	20.0	90.0	90.0	20.0	90.0
Total Split (%)	15.4%	15.4%	15.4%	69.2%	69.2%	15.4%	69.2%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9	7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	C-Min
Act Effct Green (s)	10.8	10.8	9.7	84.1	84.1	13.1	90.2
Actuated g/C Ratio	0.08	0.08	0.07	0.65	0.65	0.10	0.69
v/c Ratio	0.64	0.36	0.47	0.73	0.25	0.97	0.56
Control Delay	68.2	17.8	68.8	16.9	1.5	118.2	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.2	17.8	68.8	16.9	1.5	118.2	11.6
LOS	E	B	E	B	A	F	B
Approach Delay	54.4			16.6			20.2
Approach LOS	D			B			C
Queue Length 50th (ft)	77	0	51	457	0	~153	304
Queue Length 95th (ft)	117	47	97	511	30	#302	368
Internal Link Dist (ft)	374			783			728
Turn Bay Length (ft)			250		275	200	
Base Capacity (vph)	303	202	171	3289	1121	177	3528
Starvation Cap Reductn	0	0	0	0	0	0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.34	0.36	0.73	0.25	0.97	0.56

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 79 (61%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 19.9 Intersection LOS: B
Intersection Capacity Utilization 75.0% ICU Level of Service D
Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

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

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Intersection						
Int Delay, s/veh	2.4					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	311	105	42	165	68	34
Future Vol, veh/h	311	105	42	165	68	34
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	200	200	-	0	0
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	338	114	46	179	74	37

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	452	0	609	338
Stage 1	-	-	-	-	338	-
Stage 2	-	-	-	-	271	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1109	-	458	704
Stage 1	-	-	-	-	722	-
Stage 2	-	-	-	-	775	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1109	-	439	704
Mov Cap-2 Maneuver	-	-	-	-	439	-
Stage 1	-	-	-	-	722	-
Stage 2	-	-	-	-	743	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.7	13.4
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	439	704	-	-	1109	-
HCM Lane V/C Ratio	0.168	0.052	-	-	0.041	-
HCM Control Delay (s)	14.9	10.4	-	-	8.4	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.6	0.2	-	-	0.1	-

Movement	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	499	93	64	1443	97	2	77	2229
Future Volume (vph)	499	93	64	1443	97	2	77	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00		1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85		1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583		1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583		1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Adj. Flow (vph)	537	100	69	1552	104	2	83	2397
RTOR Reduction (vph)	0	81	0	0	47	0	0	0
Lane Group Flow (vph)	537	19	69	1552	57	0	85	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Actuated Green, G (s)	21.8	21.8	7.9	62.9	62.9		8.3	63.3
Effective Green, g (s)	21.8	21.8	7.9	62.9	62.9		8.3	63.3
Actuated g/C Ratio	0.19	0.19	0.07	0.55	0.55		0.07	0.55
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	650	300	121	2781	865		127	2798
v/s Ratio Prot	c0.16		0.04	0.31			c0.05	c0.47
v/s Ratio Perm		0.01			0.04			
v/c Ratio	0.83	0.06	0.57	0.56	0.07		0.67	0.86
Uniform Delay, d1	44.8	38.2	51.9	17.0	12.2		52.0	22.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	8.5	0.1	6.3	0.8	0.1		12.6	3.6
Delay (s)	53.2	38.3	58.2	17.8	12.4		64.6	25.6
Level of Service	D	D	E	B	B		E	C
Approach Delay (s)	50.9			19.1				27.0
Approach LOS	D			B				C

Intersection Summary

HCM 2000 Control Delay	27.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	79.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	499	93	64	1443	97	2	77	2229
Future Volume (vph)	499	93	64	1443	97	2	77	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275		350	
Storage Lanes	2	1	1		1		1	
Taper Length (ft)	100		100				100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	0	1770	5085
Flt Permitted	0.950		0.950				0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	0	1770	5085
Right Turn on Red		Yes			Yes			
Satd. Flow (RTOR)		100			104			
Link Speed (mph)	35			45				45
Link Distance (ft)	454			863				808
Travel Time (s)	8.8			13.1				12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Shared Lane Traffic (%)								
Lane Group Flow (vph)	537	100	69	1552	104	0	85	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Detector Phase	4	4	5	2	2	1	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	13.0	27.1
Total Split (s)	32.0	32.0	18.0	67.0	67.0	16.0	16.0	65.0
Total Split (%)	27.8%	27.8%	15.7%	58.3%	58.3%	13.9%	13.9%	56.5%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	None	C-Min
Act Effct Green (s)	21.8	21.8	9.1	62.9	62.9		8.3	64.8
Actuated g/C Ratio	0.19	0.19	0.08	0.55	0.55		0.07	0.56
v/c Ratio	0.83	0.26	0.50	0.56	0.11		0.66	0.84
Control Delay	56.2	9.3	62.7	18.3	2.9		76.6	25.8
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	56.2	9.3	62.7	18.3	2.9		76.6	25.8
LOS	E	A	E	B	A		E	C
Approach Delay	48.8			19.1				27.6
Approach LOS	D			B				C
Queue Length 50th (ft)	194	0	49	272	0		62	569
Queue Length 95th (ft)	257	46	97	317	26		#136	658
Internal Link Dist (ft)	374			783				728
Turn Bay Length (ft)			250		275		350	
Base Capacity (vph)	701	403	163	2779	912		132	2866
Starvation Cap Reductn	0	0	0	0	0		0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0		0	0
Reduced v/c Ratio	0.77	0.25	0.42	0.56	0.11		0.64	0.84

Intersection Summary

Area Type: Other
Cycle Length: 115
Actuated Cycle Length: 115
Offset: 47 (41%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 27.4 Intersection LOS: C
Intersection Capacity Utilization 79.8% ICU Level of Service D
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Intersection	
Int Delay, s/veh	4.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	18	95	61	25	446	1	76	5	38	5	15	70
Future Vol, veh/h	18	95	61	25	446	1	76	5	38	5	15	70
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	15	0	5
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	100	-	200	200	-	-	0	-	-	-	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	20	103	66	27	485	1	83	5	41	5	16	76

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	486	0	0	169	0	0	734	683	118	754	749	491
Stage 1	-	-	-	-	-	-	143	143	-	540	540	-
Stage 2	-	-	-	-	-	-	591	540	-	214	209	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1077	-	-	1409	-	-	336	372	934	326	341	578
Stage 1	-	-	-	-	-	-	860	779	-	526	521	-
Stage 2	-	-	-	-	-	-	493	521	-	788	729	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1077	-	-	1409	-	-	271	358	921	295	328	575
Mov Cap-2 Maneuver	-	-	-	-	-	-	271	358	-	295	328	-
Stage 1	-	-	-	-	-	-	844	764	-	516	511	-
Stage 2	-	-	-	-	-	-	404	511	-	723	715	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.9	0.4	18.9	13.3
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	271	779	1077	-	-	1409	-	-	319	575
HCM Lane V/C Ratio	0.305	0.06	0.018	-	-	0.019	-	-	0.068	0.132
HCM Control Delay (s)	24	9.9	8.4	-	-	7.6	-	-	17.1	12.2
HCM Lane LOS	C	A	A	-	-	A	-	-	C	B
HCM 95th %tile Q(veh)	1.2	0.2	0.1	-	-	0.1	-	-	0.2	0.5

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	13	1527	11	0	2308
Future Vol, veh/h	0	13	1527	11	0	2308
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	200	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	14	1660	12	0	2509

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	830	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.14	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.92	-	-	-	-
Pot Cap-1 Maneuver	0	269	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	269	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	19.1	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	269	-
HCM Lane V/C Ratio	-	-	0.053	-
HCM Control Delay (s)	-	-	19.1	-
HCM Lane LOS	-	-	C	-
HCM 95th %tile Q(veh)	-	-	0.2	-

Movement	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	212	66	58	2247	298	5	168	1825
Future Volume (vph)	212	66	58	2247	298	5	168	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00		1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85		1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583		1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583		1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Adj. Flow (vph)	228	71	62	2416	320	5	181	1962
RTOR Reduction (vph)	0	65	0	0	113	0	0	0
Lane Group Flow (vph)	228	6	62	2416	207	0	186	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Actuated Green, G (s)	11.3	11.3	8.5	84.1	84.1		12.6	88.2
Effective Green, g (s)	11.3	11.3	8.5	84.1	84.1		12.6	88.2
Actuated g/C Ratio	0.09	0.09	0.07	0.65	0.65		0.10	0.68
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	298	137	115	3289	1024		171	3449
v/s Ratio Prot	c0.07		0.04	c0.48			c0.11	c0.39
v/s Ratio Perm		0.00			0.13			
v/c Ratio	0.77	0.05	0.54	0.73	0.20		1.09	0.57
Uniform Delay, d1	58.1	54.4	58.9	15.4	9.3		58.7	10.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	11.1	0.1	4.8	1.5	0.4		94.2	0.7
Delay (s)	69.2	54.5	63.6	16.9	9.8		152.9	11.6
Level of Service	E	D	E	B	A		F	B
Approach Delay (s)	65.7			17.2				23.9
Approach LOS	E			B				C

Intersection Summary

HCM 2000 Control Delay	22.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	212	66	58	2247	298	5	168	1825
Future Volume (vph)	212	66	58	2247	298	5	168	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275		350	
Storage Lanes	2	1	1		1		1	
Taper Length (ft)	100		100				100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	0	1770	5085
Flt Permitted	0.950		0.950				0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	0	1770	5085
Right Turn on Red		Yes			Yes			
Satd. Flow (RTOR)		71			320			
Link Speed (mph)	35			45				45
Link Distance (ft)	454			863				808
Travel Time (s)	8.8			13.1				12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Shared Lane Traffic (%)								
Lane Group Flow (vph)	228	71	62	2416	320	0	186	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Detector Phase	4	4	5	2	2	1	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	13.0	27.1
Total Split (s)	20.0	20.0	20.0	90.0	90.0	20.0	20.0	90.0
Total Split (%)	15.4%	15.4%	15.4%	69.2%	69.2%	15.4%	15.4%	69.2%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	3.5	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Lead/Lag			Lead	Lag	Lag	Lead	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	None	C-Min
Act Effct Green (s)	11.3	11.3	9.7	84.1	84.1		12.6	89.7
Actuated g/C Ratio	0.09	0.09	0.07	0.65	0.65		0.10	0.69
v/c Ratio	0.77	0.35	0.47	0.73	0.28		1.09	0.56
Control Delay	75.4	17.3	68.8	17.2	1.6		148.0	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	75.4	17.3	68.8	17.2	1.6		148.0	11.8
LOS	E	B	E	B	A		F	B
Approach Delay	61.6			16.5				23.6
Approach LOS	E			B				C
Queue Length 50th (ft)	98	0	51	468	0		~178	304
Queue Length 95th (ft)	#154	48	97	522	32		#332	368
Internal Link Dist (ft)	374			783				728
Turn Bay Length (ft)			250		275		350	
Base Capacity (vph)	303	204	171	3289	1137		171	3510
Starvation Cap Reductn	0	0	0	0	0		0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0		0	0
Reduced v/c Ratio	0.75	0.35	0.36	0.73	0.28		1.09	0.56

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 79 (61%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 1.09
Intersection Signal Delay: 22.0 Intersection LOS: C
Intersection Capacity Utilization 77.4% ICU Level of Service D
Analysis Period (min) 15
~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Intersection												
Int Delay, s/veh	4.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	51	310	105	42	165	5	68	15	34	3	10	45
Future Vol, veh/h	51	310	105	42	165	5	68	15	34	3	10	45
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	100	-	200	200	-	-	0	-	-	-	-	0
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	55	337	114	46	179	5	74	16	37	3	11	49

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	184	0	0	451	0	0	751	723	337	805	835	182
Stage 1	-	-	-	-	-	-	447	447	-	274	274	-
Stage 2	-	-	-	-	-	-	304	276	-	531	561	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1391	-	-	1109	-	-	327	352	705	301	304	861
Stage 1	-	-	-	-	-	-	591	573	-	732	683	-
Stage 2	-	-	-	-	-	-	705	682	-	532	510	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1391	-	-	1109	-	-	281	324	705	258	280	861
Mov Cap-2 Maneuver	-	-	-	-	-	-	281	324	-	258	280	-
Stage 1	-	-	-	-	-	-	567	550	-	703	655	-
Stage 2	-	-	-	-	-	-	627	654	-	470	490	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.8	1.7	18.3	11.5
HCM LOS			C	B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1	SBLn2
Capacity (veh/h)	281	518	1391	-	-	1109	-	-	275	861
HCM Lane V/C Ratio	0.263	0.103	0.04	-	-	0.041	-	-	0.051	0.057
HCM Control Delay (s)	22.3	12.7	7.7	-	-	8.4	-	-	18.8	9.4
HCM Lane LOS	C	B	A	-	-	A	-	-	C	A
HCM 95th %tile Q(veh)	1	0.3	0.1	-	-	0.1	-	-	0.2	0.2

Intersection	
Int Delay, s/veh	0.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	0	8	2288	30	0	1998
Future Vol, veh/h	0	8	2288	30	0	1998
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	200	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	9	2487	33	0	2172

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	-	1244	0	0	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	7.14	-	-	-	-
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	3.92	-	-	-	-
Pot Cap-1 Maneuver	0	142	-	-	0	-
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	-	142	-	-	-	-
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	32	0	0
HCM LOS	D		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBT
Capacity (veh/h)	-	-	142	-
HCM Lane V/C Ratio	-	-	0.061	-
HCM Control Delay (s)	-	-	32	-
HCM Lane LOS	-	-	D	-
HCM 95th %tile Q(veh)	-	-	0.2	-

Movement	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	499	93	64	1443	97	2	77	2229
Future Volume (vph)	499	93	64	1443	97	2	77	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00		1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85		1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583		1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583		1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Adj. Flow (vph)	537	100	69	1552	104	2	83	2397
RTOR Reduction (vph)	0	77	0	0	44	0	0	0
Lane Group Flow (vph)	537	23	69	1552	60	0	85	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Actuated Green, G (s)	21.8	21.8	7.9	64.3	64.3		6.9	63.3
Effective Green, g (s)	26.3	26.3	11.3	66.2	66.2		10.5	65.4
Actuated g/C Ratio	0.23	0.23	0.10	0.58	0.58		0.09	0.57
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	785	362	173	2927	911		161	2891
v/s Ratio Prot	c0.16		0.04	0.31			c0.05	c0.47
v/s Ratio Perm		0.01			0.04			
v/c Ratio	0.68	0.06	0.40	0.53	0.07		0.53	0.83
Uniform Delay, d1	40.6	34.7	48.7	14.9	10.8		49.9	20.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.5	0.1	1.5	0.7	0.1		3.1	2.9
Delay (s)	43.0	34.8	50.2	15.6	10.9		53.0	23.2
Level of Service	D	C	D	B	B		D	C
Approach Delay (s)	41.7			16.7				24.2
Approach LOS	D			B				C

Intersection Summary

HCM 2000 Control Delay	23.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	15.6
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	499	93	64	1443	97	2	77	2229
Future Volume (vph)	499	93	64	1443	97	2	77	2229
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275		350	
Storage Lanes	2	1	1		1		1	
Taper Length (ft)	100		100				100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	0	1770	5085
Flt Permitted	0.950		0.950				0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	0	1770	5085
Right Turn on Red		Yes			Yes			
Satd. Flow (RTOR)		100			104			
Link Speed (mph)	35			45				45
Link Distance (ft)	454			863				808
Travel Time (s)	8.8			13.1				12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Shared Lane Traffic (%)								
Lane Group Flow (vph)	537	100	69	1552	104	0	85	2397
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Detector Phase	4	4	5	2	2	1	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	13.0	27.1
Total Split (s)	32.0	32.0	18.0	67.0	67.0	16.0	16.0	65.0
Total Split (%)	27.8%	27.8%	15.7%	58.3%	58.3%	13.9%	13.9%	56.5%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	3.5	1.0
Lost Time Adjust (s)	-4.5	-4.5	-3.4	-1.9	-1.9		-3.6	-2.1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Lead/Lag			Lead	Lag	Lag	Lead	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	None	C-Min
Act Effct Green (s)	26.3	26.3	12.5	67.8	67.8		11.8	66.9
Actuated g/C Ratio	0.23	0.23	0.11	0.59	0.59		0.10	0.58
v/c Ratio	0.68	0.23	0.36	0.52	0.11		0.47	0.81
Control Delay	45.3	8.1	52.5	15.8	2.6		57.6	23.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	45.3	8.1	52.5	15.8	2.6		57.6	23.5
LOS	D	A	D	B	A		E	C
Approach Delay	39.5			16.5				24.7
Approach LOS	D			B				C
Queue Length 50th (ft)	184	0	48	261	0		60	544
Queue Length 95th (ft)	243	43	93	305	25		113	630
Internal Link Dist (ft)	374			783				728
Turn Bay Length (ft)			250		275		350	
Base Capacity (vph)	835	461	215	2996	975		186	2959
Starvation Cap Reductn	0	0	0	0	0		0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0		0	0
Reduced v/c Ratio	0.64	0.22	0.32	0.52	0.11		0.46	0.81

Intersection Summary

Area Type: Other
Cycle Length: 115
Actuated Cycle Length: 115
Offset: 47 (41%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 23.7 — Intersection LOS: C
Intersection Capacity Utilization 71.5% — ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



Movement	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	212	66	58	2247	298	5	168	1825
Future Volume (vph)	212	66	58	2247	298	5	168	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	1.00	1.00	0.91	1.00		1.00	0.91
Frt	1.00	0.85	1.00	1.00	0.85		1.00	1.00
Flt Protected	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3433	1583	1770	5085	1583		1770	5085
Flt Permitted	0.95	1.00	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3433	1583	1770	5085	1583		1770	5085
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Adj. Flow (vph)	228	71	62	2416	320	5	181	1962
RTOR Reduction (vph)	0	62	0	0	108	0	0	0
Lane Group Flow (vph)	228	9	62	2416	212	0	186	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Actuated Green, G (s)	11.2	11.2	8.5	84.1	84.1		12.7	88.3
Effective Green, g (s)	15.7	15.7	11.9	86.0	86.0		16.3	90.4
Actuated g/C Ratio	0.12	0.12	0.09	0.66	0.66		0.13	0.70
Clearance Time (s)	8.5	8.5	7.4	5.9	5.9		7.6	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	414	191	162	3363	1047		221	3536
v/s Ratio Prot	c0.07		0.04	c0.48			c0.11	0.39
v/s Ratio Perm		0.01			0.13			
v/c Ratio	0.55	0.04	0.38	0.72	0.20		0.84	0.55
Uniform Delay, d1	53.8	50.5	55.6	14.2	8.6		55.6	9.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.6	0.1	1.5	1.4	0.4		24.1	0.6
Delay (s)	55.4	50.6	57.1	15.5	9.0		79.7	10.5
Level of Service	E	D	E	B	A		E	B
Approach Delay (s)	54.3			15.7				16.4
Approach LOS	D			B				B

Intersection Summary

HCM 2000 Control Delay	18.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	15.6
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Lane Configurations								
Traffic Volume (vph)	212	66	58	2247	298	5	168	1825
Future Volume (vph)	212	66	58	2247	298	5	168	1825
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0	0	250		275		350	
Storage Lanes	2	1	1		1		1	
Taper Length (ft)	100		100				100	
Satd. Flow (prot)	3433	1583	1770	5085	1583	0	1770	5085
Flt Permitted	0.950		0.950				0.950	
Satd. Flow (perm)	3433	1583	1770	5085	1583	0	1770	5085
Right Turn on Red		Yes			Yes			
Satd. Flow (RTOR)		71			320			
Link Speed (mph)	35			45				45
Link Distance (ft)	454			863				808
Travel Time (s)	8.8			13.1				12.2
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93
Shared Lane Traffic (%)								
Lane Group Flow (vph)	228	71	62	2416	320	0	186	1962
Turn Type	Prot	Perm	Prot	NA	Perm	Prot	Prot	NA
Protected Phases	4		5	2		1	1	6
Permitted Phases		4			2			
Detector Phase	4	4	5	2	2	1	1	6
Switch Phase								
Minimum Initial (s)	5.0	5.0	5.0	20.0	20.0	5.0	5.0	20.0
Minimum Split (s)	16.0	16.0	13.0	49.9	49.9	13.0	13.0	27.1
Total Split (s)	20.0	20.0	20.0	90.0	90.0	20.0	20.0	90.0
Total Split (%)	15.4%	15.4%	15.4%	69.2%	69.2%	15.4%	15.4%	69.2%
Yellow Time (s)	3.1	3.1	4.0	4.9	4.9	4.1	4.1	5.1
All-Red Time (s)	5.4	5.4	3.4	1.0	1.0	3.5	3.5	1.0
Lost Time Adjust (s)	-4.5	-4.5	-3.4	-1.9	-1.9		-3.6	-2.1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0
Lead/Lag			Lead	Lag	Lag	Lead	Lead	Lag
Lead-Lag Optimize?			Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	C-Min	C-Min	None	None	C-Min
Act Effct Green (s)	15.7	15.7	13.1	86.0	86.0		16.3	91.9
Actuated g/C Ratio	0.12	0.12	0.10	0.66	0.66		0.13	0.71
v/c Ratio	0.55	0.28	0.35	0.72	0.28		0.84	0.55
Control Delay	59.2	14.4	59.2	15.7	1.5		86.5	10.6
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Total Delay	59.2	14.4	59.2	15.7	1.5		86.5	10.6
LOS	E	B	E	B	A		F	B
Approach Delay	48.6			15.1				17.2
Approach LOS	D			B				B
Queue Length 50th (ft)	94	0	49	445	0		156	287
Queue Length 95th (ft)	138	46	94	497	31		#289	349
Internal Link Dist (ft)	374			783				728
Turn Bay Length (ft)			250		275		350	
Base Capacity (vph)	422	257	217	3363	1155		221	3594
Starvation Cap Reductn	0	0	0	0	0		0	0

Lane Group	WBL	WBR	NBU	NBT	NBR	SBU	SBL	SBT
Spillback Cap Reductn	0	0	0	0	0		0	0
Storage Cap Reductn	0	0	0	0	0		0	0
Reduced v/c Ratio	0.54	0.28	0.29	0.72	0.28		0.84	0.55

Intersection Summary

Area Type: Other
Cycle Length: 130
Actuated Cycle Length: 130
Offset: 79 (61%), Referenced to phase 2:NBT and 6:SBT, Start of Green
Natural Cycle: 80
Control Type: Actuated-Coordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 17.9 Intersection LOS: B
Intersection Capacity Utilization 69.0% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: U.S. 29 & Ashwood Boulevard



WARRANT FOR LEFT-TURN STORAGE LANES ON TWO-LANE HIGHWAY

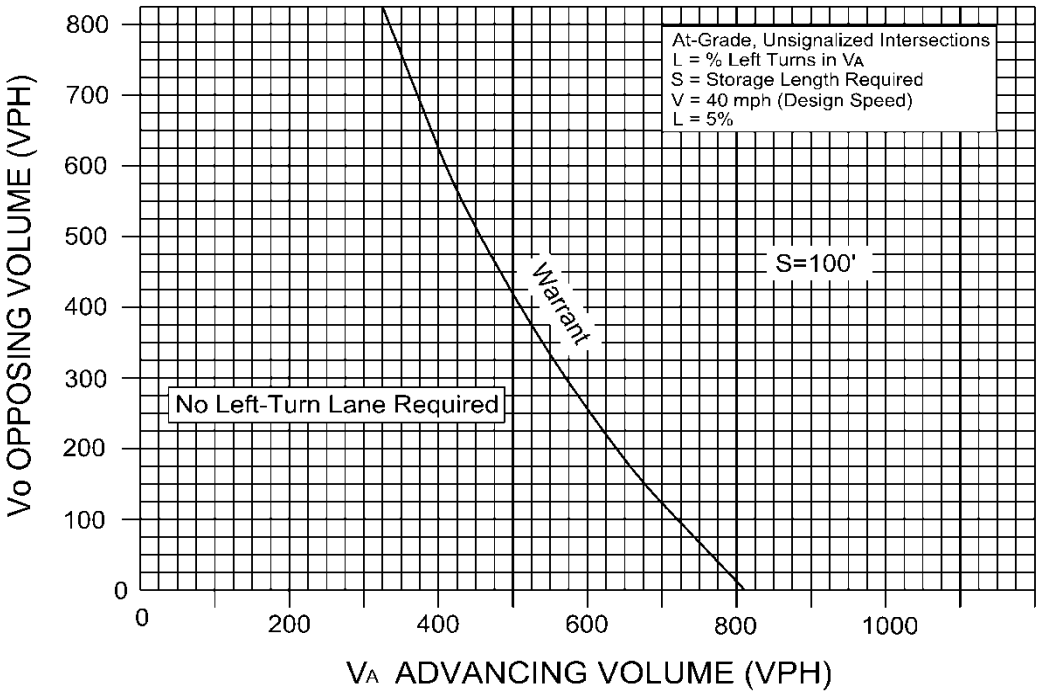


FIGURE 3-5

AM Peak 472

PM Peak 212

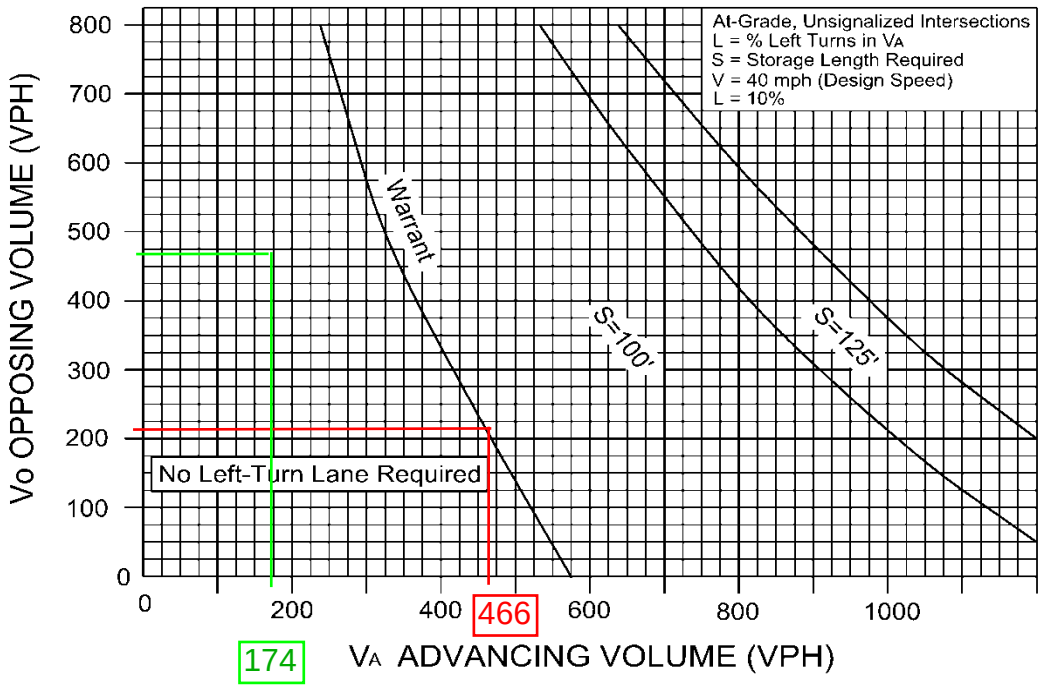
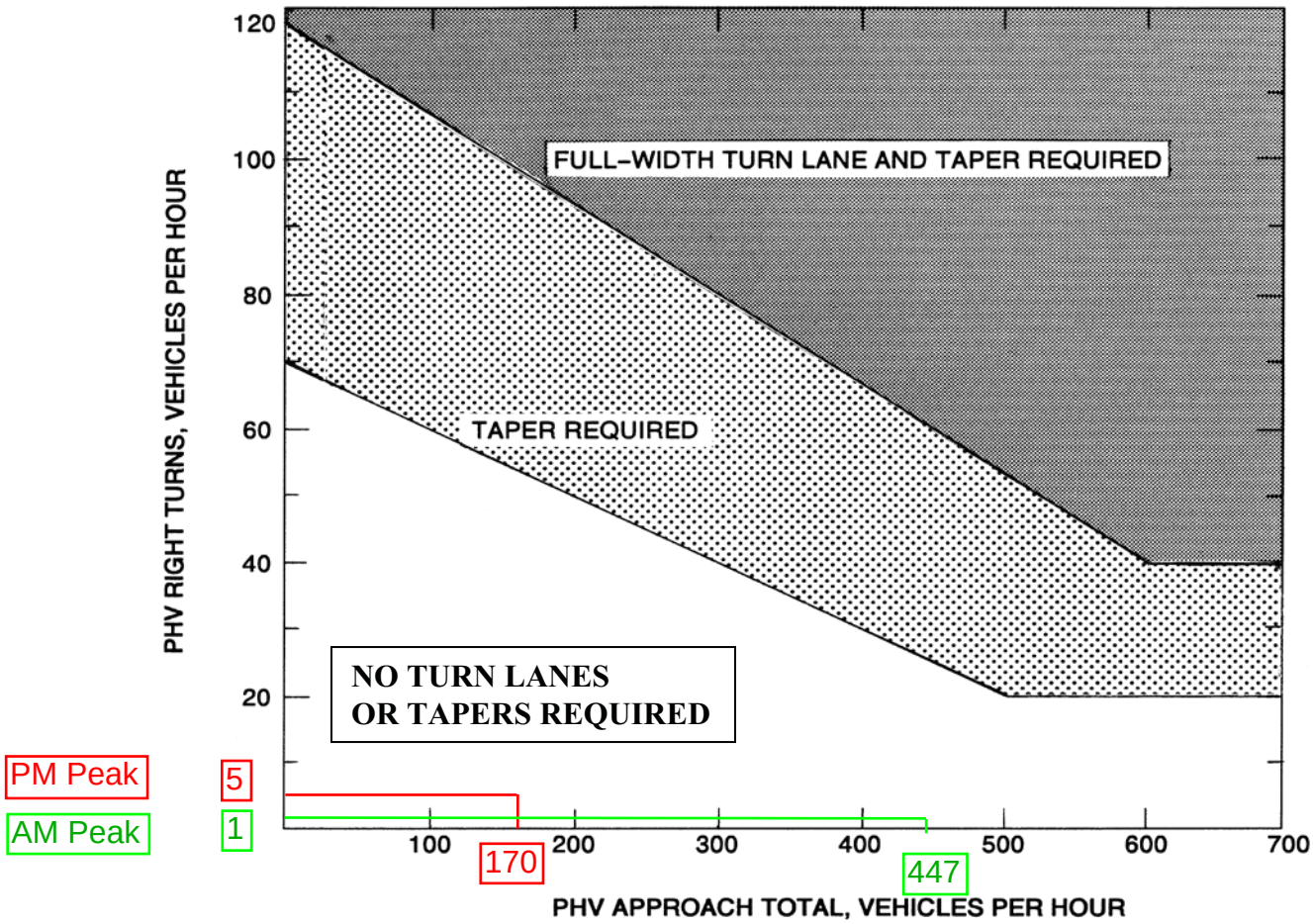


FIGURE 3-6



Appropriate Radius required at all Intersections and Entrances (Commercial or Private).

LEGEND

PHV - Peak Hour Volume (also Design Hourly Volume equivalent)

Adjustment for Right Turns

For posted speeds at or under 45 mph, PHV right turns > 40, and PHV total < 300.
Adjusted right turns = PHV Right Turns - 20
If PHV is not known use formula: PHV = ADT x K x D

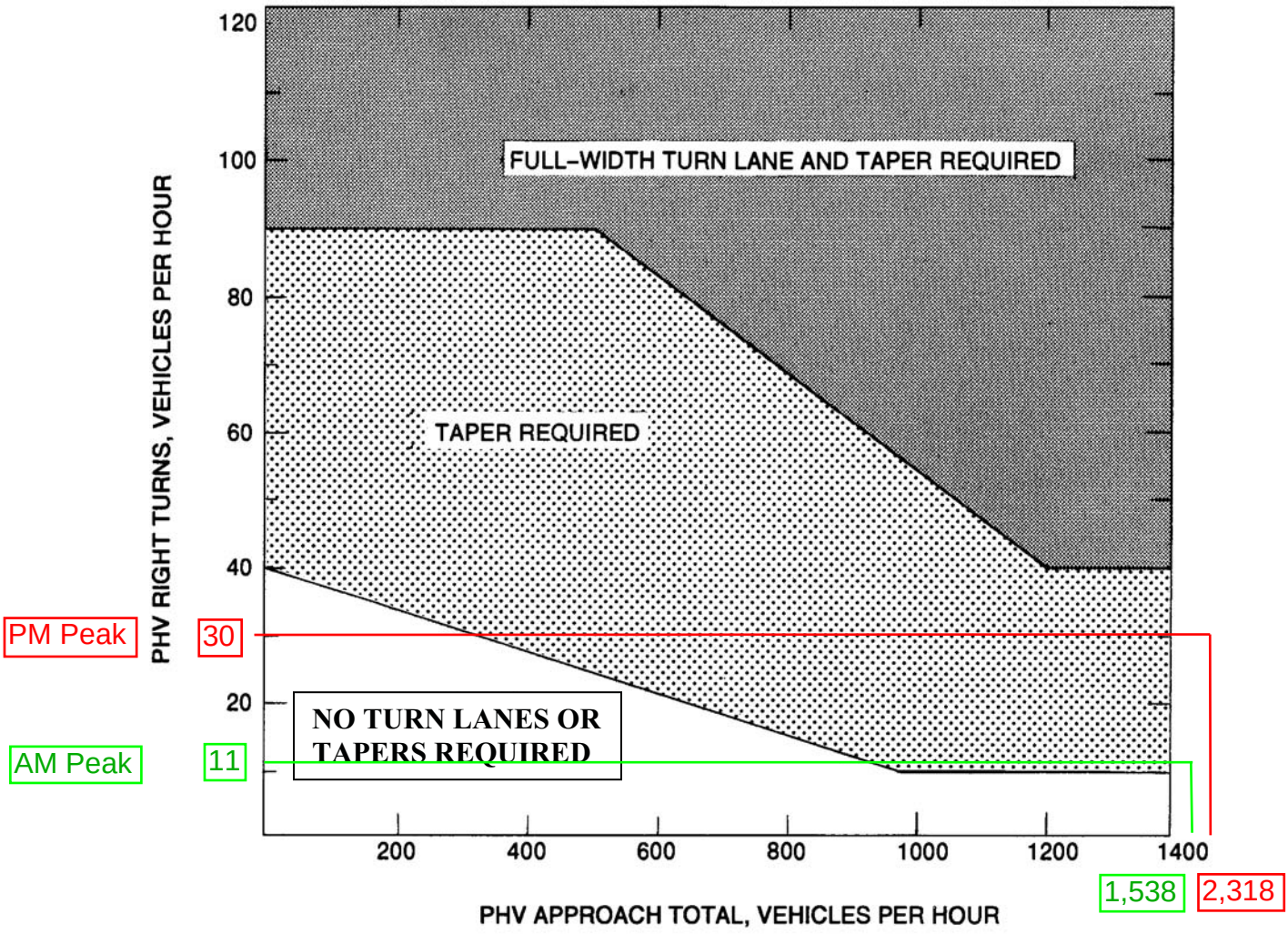
K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow

Note: An average of 11% for K x D will suffice.

When right turn facilities are warranted, see Figure 3-1 for design criteria.*

FIGURE 3-26 WARRANTS FOR RIGHT TURN TREATMENT (2-LANE HIGHWAY)

* Rev. 1/15



Appropriate Radius required at all Intersections and Entrances (Commercial or Private).

LEGEND

PHV- - Peak Hour Volume (also Design Hourly Volume equivalent)

Adjustment for Right Turns

If PHV is not known use formula: PHV = ADT x K x D

K = the percent of AADT occurring in the peak hour
D = the percent of traffic in the peak direction of flow

Note: An average of 11% for K x D will suffice.

When right turn facilities are warranted, see Figure 3-1 for design criteria.*

FIGURE 3-27 WARRANTS FOR RIGHT TURN TREATMENT (4-LANE HIGHWAY)

* Rev. 1/15