

MEMORANDUM

Date: September 4, 2020 Project #: 24714

To: Wendy Farley-Campbell, Planning Director, City of Florence
Mike Miller, Public Works Director, City of Florence
City of Florence Public Works
250 Highway 101
Florence, OR 97439

Cc: James (Jim) Hanks, City of Florence Traffic Engineer Consultant

From: Diego Arguea, PE & Chris Brehmer, PE, & Amy Griffiths

Project: Florence Residential Subdivision

Subject: Traffic Impact Study – Planning Commission Response to Testimony

This memorandum addresses various transportation related considerations regarding the proposed Florence Residential Subdivision project located along Rhododendron Drive, north of 35th Street. A detailed traffic impact analysis was prepared for this site (hereinafter referred to as August 2020 TIA) that addressed applicable code criteria and was reviewed by the City of Florence Planning Commission prior to the August 25, 2020 hearing for the project. During the August 25 hearing, the Planning Commission requested the following additional traffic-related information:

- Updated intersection traffic volumes/capacity analysis at the Rhododendron Drive/35th Street intersection
- Assessment of a southbound left-turn lane at the Rhododendron Drive/35th Street intersection

Supplemental information addressing both of these topics has been prepared and is documented in detail in the following sections. Based on the additional information provided herein, we conclude that the findings and recommendations identified in the August 2020 TIA are substantiated and that the development can be constructed as proposed while maintaining acceptable traffic operations on the street system.

UPDATED TRAFFIC VOLUMES (AUGUST 2020)

As an outcome of the August 25th Planning Commission hearing, the applicant team was directed to provide updated traffic count volumes to reflect August traffic conditions. Additional traffic count volumes were obtained at the Rhododendron Drive/35th Street intersection in August 2020 that were subsequently adjusted and analyzed following the methodology described below.

Volume Adjustment Methodology

Per City of Florence Planning Commission direction, the applicant team consulted with City of Florence planning staff and also with City traffic consultant Jim Hanks to develop the following methodology to update the traffic volume data at the Rhododendron Drive/35th Street intersection:

1. Collect updated (August 2020) turning movement counts at the intersection during the weekday morning (7-9 AM) and evening (4-6 PM) commuter peak hours.
2. Obtain and review data from the Oregon Department of Transportation (ODOT) Automatic Traffic Recorder (ATR) 20-026¹ for the year 2019 and correlate to the volumes observed in 2020 at the same ATR. Develop a volume adjustment based on this information to account for potential reduced volumes as a result of the COVID-19 pandemic.
3. Apply the volume adjustment factor based on ODOT ATR methodology. Apply this factor to the updated, COVID-19-adjusted volumes to reflect the 30th Highest Hour Volumes (30HV).
4. Add anticipated future in-process traffic volumes from the City of Florence approved development *Sandpines Fairway Estates Residential Planned Development (August 2015)* and the County approved development *Fawn Ridge Development*.

The above methodology was confirmed by City staff and by Jim Hanks on August 26, 2020.

August 2020 Traffic Volume Counts

Updated turning movement counts were conducted during the weekday morning (7-9 AM) and weekday evening (4-6 PM) commuter peak hours, consistent with the time periods scoped for the analysis. Turning movement counts were conducted on a mid-week day in August 2020, and the unadjusted (raw) traffic volumes are provided in *Attachment A*.

ODOT ATR 20-026 COVID-19 Adjustment

The August 2020 raw traffic volumes were adjusted to compensate for the impact of the COVID-19 pandemic. The adjustment was based on data provided by ODOT for the Florence automatic traffic recorder (ATR 20-026). The 2020 traffic volumes were found to be 1.6 percent lower in August 2020 than in August 2019 and the August 2020 raw volumes were increased accordingly.

¹ ATR Florence (20-026) is located 0.77 miles north of Heceta Beach Road, and 2.21 miles north of the 35th Street/Highway 101 study intersection. Trends recorded at ATR 20-026 were judged to be reflective of those experienced at the August 2020 TIA study intersections given the close proximity of the ATR location.

Seasonal Adjustment Factor

The COVID-19 adjusted peak hour traffic volumes were further adjusted to reflect 30th highest hour design volumes based on the On-Site ATR Method summarized in the *ODOT Analysis Procedures Manual* (consistent with the method in the August 2020 TIA). The application of data from ATR 20-026 to seasonally adjust traffic volume data collected in August 2020 is summarized in Table 1.

Table 1. Seasonal Adjustment Factor Calculation (weekday daily data)

Year	2014	2015	2016	2017	2018	Average
Peak Month (July) % of ADT	136%	136%	134%	142%	140%	137%
Month of Data Collection (August) % of ADT	135%	134%	132%	142%	136%	135%

Notes:

ADT = Average Daily Traffic

Shaded values removed from average calculation per ODOT methodology.

Table 1 cells highlighted in grey reflect the highest and lowest values and were excluded from the average per ODOT guidelines. From this data, the seasonal factor can be computed as $137\% \div 135\% = 1.015$. The COVID-19 adjusted volumes were increased by the 1.015 factor to provide a base volume scenario that represents pre-COVID-19 and seasonally adjusted volumes. The traffic volume adjustment is further detailed in *Attachment B* to this memorandum.

In-Process Traffic Volume

Future trips associated with the *Sandpines Fairway Estates Residential Planned Development (August 2015)* and the County approved development *Fawn Ridge Development* were identified and incorporated into the updated intersection assessment².

Sandpines Fairway Estates Residential Planned Development Trips

Per conversations with City of Florence Planning staff, the Sandpines Fairview Estates development has been approved for Phase 1 (up to 40 single-family homes) but has not yet been constructed. The traffic impact analysis for Sandpines Fairview Estates did not provide traffic operations analysis information and, as such, Kittelson prepared a trip generation and distribution for the site to be included in this analysis. The analysis applied *Trip Generation Manual, 10th Edition* trip rates for single family homes (ITE 210) and distributed the trips through the Rhododendron Drive/35th Street intersection consistent with the trip distribution in the August 2020 TIA³.

² The in-process trip assessment methodology was confirmed with the City's traffic engineering consultant, Jim Hanks.

³ The trip assignment methodology resulted in 95% of the weekday AM and PM peak hour vehicle trips projected to and from the Sandpines Fairview Estates development to route through the 35th/Rhododendron intersection.

Fawn Ridge Development Trips

Per conversations with City of Florence Planning staff, the Fawn Ridge residential development was approved by Lane County prior to annexation into City of Florence. The site is located on Rhododendron Drive approximately one-half mile south of Heceta Beach Road and two miles north of 35th Street where 39 residential lots have not yet been constructed. Kittelson also prepared a trip generation and distribution for the site to be included in this analysis. The analysis applied *Trip Generation Manual, 10th Edition* trip rates for single family homes (ITE 210) and distributed the trips through the Rhododendron Drive/35th Street intersection consistent with the trip distribution in the August 2020 TIA.

The resulting trip generation and assignment for both in-process developments (Sandpines Fairway Estates and Fawn Ridge) are provided in further detail in *Attachment B* to this memorandum.

Supplemental Intersection Operations Analysis Findings

The revised traffic volumes were used to prepare updated peak hour operations analyses at the Rhododendron Drive/35th Street intersection. The operations analysis results are shown in Table 2 and demonstrate that the intersection will continue to satisfy City of Florence traffic operations standards during both the weekday AM and PM peak hours.

Table 2. Updated Analysis Summary (Rhododendron Drive/35th Street)

Performance Standard	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Existing (2020)	Background (2021)	With Site (2021)	Existing (2020)	Background (2021)	With Site (2021)
Intersection Capacity (v/c)	0.16	0.17	0.20	0.25	0.28	0.33
Level-of-Service (LOS, A-F)	B	B	B	B	B	B
Critical Movement Delay (seconds)	10.5	10.9	11.6	10.9	11.4	12.3
Southbound Left-turn Delay (seconds, LOS)	7.6 (A)	7.7 (A)	7.8 (A)	7.8 (A)	7.9 (A)	8.0 (A)

v/c: volume-to-capacity ratio

As summarized in Table 2, the stop controlled westbound (critical) movement at the Rhododendron Drive/35th Street intersection is forecast to operate at LOS B and at 33 percent of the potential vehicular capacity of the intersection during the critical weekday PM peak hour upon full site development. The southbound movement delay is also shown and operates at LOS A before and after the proposed project. The resulting 95th percentile queue for the southbound movement was estimated be one vehicle or less during both AM and PM peak hours. As shown, the southbound delay is forecast to increase a negligible amount as a result of the proposed development: 0.1 seconds during both the weekday AM and PM peak hours. The traffic operations output worksheets are included in *Attachment C* of this memorandum.

LEFT-TURN LANE ASSESSMENT

A left-turn lane assessment was prepared for the southbound approach of the Rhododendron Drive/35th Street intersection. The assessment includes a review of traffic operations, crash history, sight distance, and traffic volume-based turn lane guidance considering projected future peak hour traffic volumes. Each of these considerations is presented below along with findings.

Traffic Operations

The updated (August 2020) intersection operations analysis presented in Table 2 projects continued acceptable traffic operations, satisfying City performance standards for delay and capacity upon site buildout. The southbound left-turn movement delay was projected to increase by 0.1 seconds with the site traffic (not perceptible to most drivers) and is projected to continue to operate at a Level-of-Service (hereinafter referred to as, "LOS") "A" (the City LOS standard is LOS E for unsignalized intersections).

Crash History

Available crash data at the Rhododendron Drive/35th Street intersection was revisited and reviewed for a variety of factors including type, severity, general conditions, and location, to identify potential crash patterns or anomalies. No documented crash history has been reported in the most recent five years per ODOT records. Consequently, no crash patterns were identified that warrant mitigation as a result of the proposed development. Additional details and the raw crash data sheets are included in the August 2020 TIA document.

Sight Distance

The available stopping sight distance was reviewed along Rhododendron Drive for vehicles approaching 35th Street in the southbound direction⁴. For the analysis, stopping sight distance (hereinafter referred to as "SSD") was measured and then compared against design parameters from *A Policy on Geometric Design of Highways and Streets* (AASHTO, Reference 1). Based on a 40 MPH design speed (posted speed), the desired design SSD is 305 feet. The available SSD is over 450 feet, well in excess of the 305 foot minimum desired value, leading to the conclusion that stopping sight distance is sufficient as further detailed below.

Exhibits 1 and 2 below show the location and street view at which SSD was measured.

⁴ Per AASHTO guidelines (page 9-35), "If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions."

Exhibit 1 Stopping Sight Distance Southbound on Rhododendron Drive



Image Source: Google Earth

Exhibit 2 Southbound Street View from 490 Feet North of 35th Street



Image Source: Google Earth

Left-Turn Lane Needs Evaluation

The potential need for constructing a southbound left-turn lane at the Rhododendron Drive/35th Street intersection was evaluated using the updated peak hour intersection traffic volumes and the Harmelink volume-based criterion for left-turn lanes (Reference 2)⁵. The projected weekday AM and PM peak hour volumes with site development indicate that a southbound left-turn lane is not needed with site development. The Harmelink worksheets are included as *Attachment D* to this memorandum.

SUMMARY

The supplemental analyses documented in the report address each of the additional transportation considerations requested by the Planning Commission and were prepared in coordination with City staff. Key issues addressed include collection of additional turn movement count data, further operational

⁵ The Harmelink methodology was selected for application after consideration of multiple traffic volume-based assessment methodologies in consultation with the City of Florence traffic engineering consultant. The Harmelink methodology considers a combination of traffic volumes, available gaps, vehicle arrival rates, and operating speeds. While other turn lane assessment methodologies are available for rural and urban highways as published by ODOT and AASHTO, these methodologies do not consider operating speed of the roadway facilities, are predicated on opposing peak hour traffic volumes of 200 vehicles or higher whereas the volumes on Rhododendron Drive are forecast at 81 and 165 during the weekday AM and PM peak hours, respectively. As such, the ODOT and AASHTO methodologies are not considered reflective of the Rhododendron Drive roadway environment.

analysis incorporating the new traffic count data as well as additional in-process development data, crash history, sight distance, and southbound left-turn lane needs at the Rhododendron Drive/35th Street intersection. This supplemental analysis documents that the August 2020 TIA provided a reasonably conservative intersection operations analysis. Thus, the findings and recommendations of the August 2020 TIA remain appropriate. No additional recommendations have been identified through the supplemental review.

We appreciate the opportunity to provide this additional information and would be please to discuss any further questions or comments that you may have as you review this material.

REFERENCES

1. American Association of State Highway and Transportation Officials. *A Policy on Geometric Design of Highways and Streets*. 2018 Edition.
2. Harmelink, M.D. *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Intersections*. Department of Highways, Ontario.

ATTACHMENTS

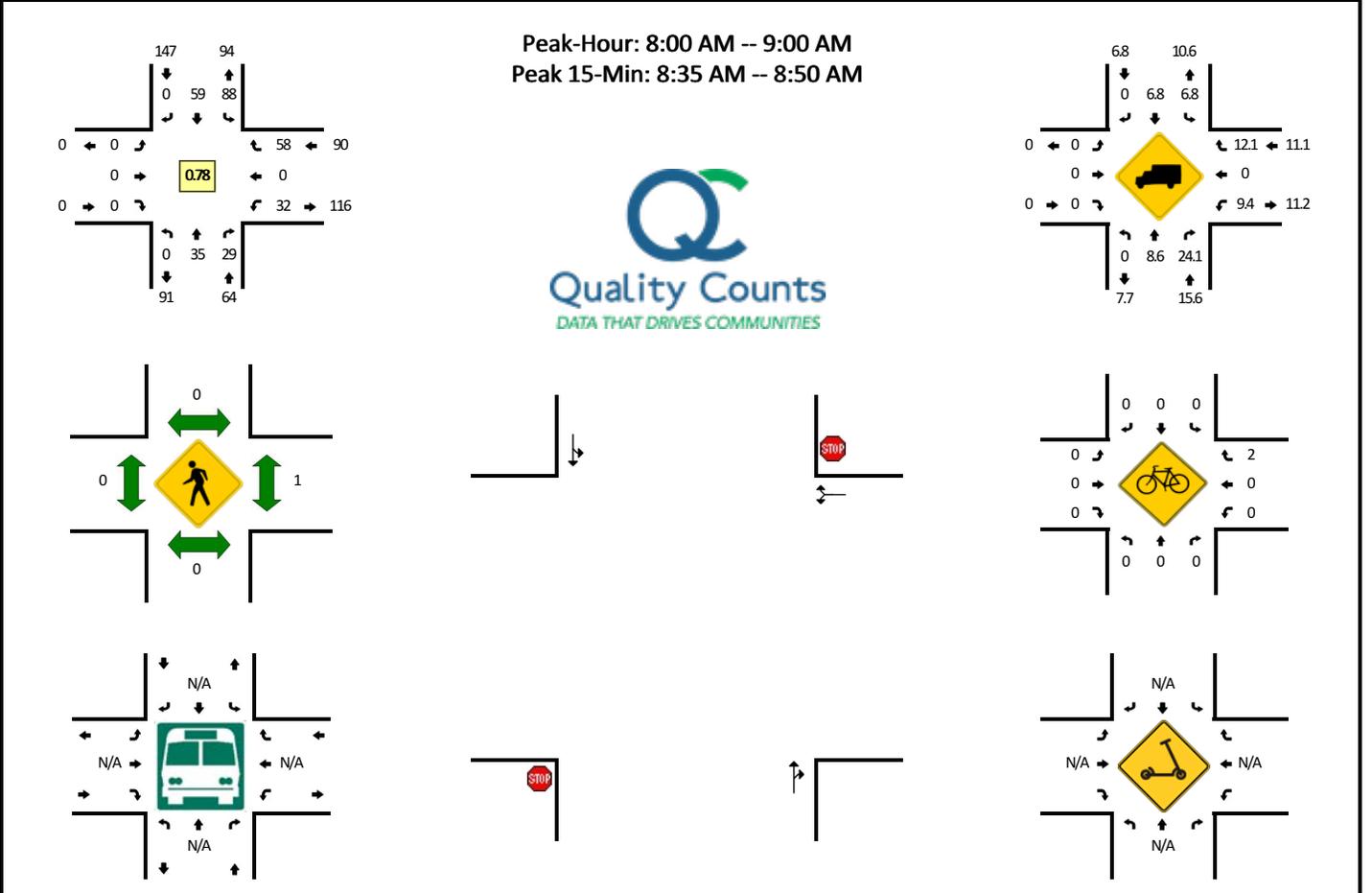
- A. Traffic Count Data (August 2020)
- B. Adjusted Traffic Count Volumes (August 2020)
- C. Traffic Operations Output Worksheets (August 2020)
- D. AASHTO Stopping Sight Distance
- E. Left-turn Lane Warrant Analysis Worksheets



Attachment A
Traffic Count Data
(August 2020)

LOCATION: Rhododendron Dr -- 35th St
CITY/STATE: Florence, OR

QC JOB #: 15273704
DATE: Thu, Aug 27 2020

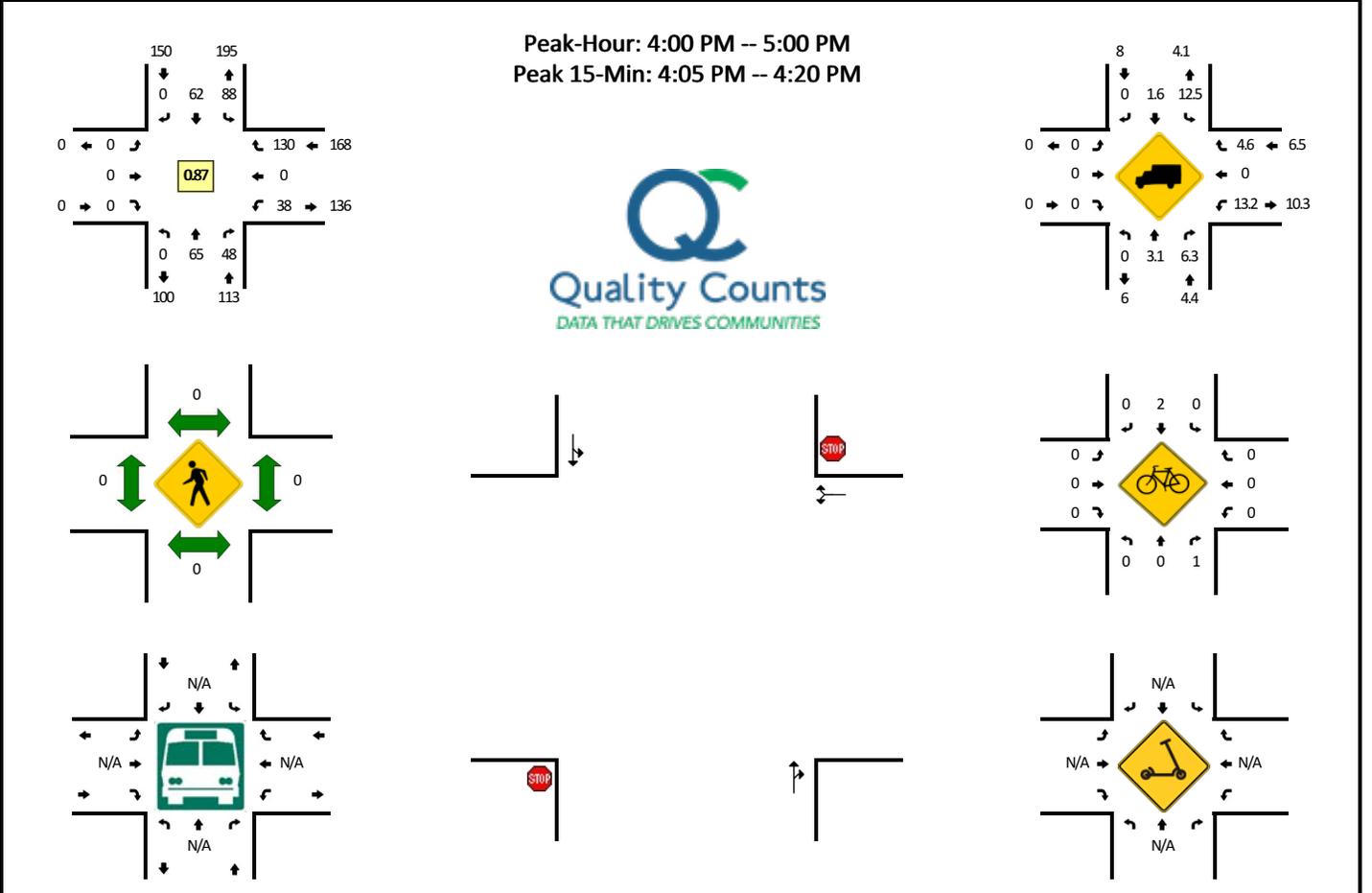


5-Min Count Period Beginning At	Rhododendron Dr (Northbound)				Rhododendron Dr (Southbound)				35th St (Eastbound)				35th St (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	2	1	0	3	1	0	0	0	0	0	0	1	0	7	0	15	
7:05 AM	0	0	1	0	4	1	0	0	0	0	0	0	2	0	1	0	9	
7:10 AM	0	1	0	0	3	2	0	0	0	0	0	0	1	0	4	0	11	
7:15 AM	0	2	0	0	8	2	0	0	0	0	0	0	3	0	2	0	17	
7:20 AM	0	1	2	0	1	2	0	0	0	0	0	0	1	0	4	0	11	
7:25 AM	0	4	0	0	7	4	0	0	0	0	0	0	0	0	3	0	18	
7:30 AM	0	0	1	0	2	2	0	0	0	0	0	0	2	0	3	0	10	
7:35 AM	0	1	3	0	8	6	0	0	0	0	0	0	1	0	6	0	25	
7:40 AM	0	1	1	0	9	6	0	0	0	0	0	0	0	0	3	0	20	
7:45 AM	0	2	2	0	4	6	0	0	0	0	0	0	4	0	5	0	23	
7:50 AM	0	2	2	0	9	3	0	0	0	0	0	0	1	0	6	0	23	
7:55 AM	0	4	3	0	6	6	0	0	0	0	0	0	1	0	3	0	23	205
8:00 AM	0	1	1	0	3	1	0	0	0	0	0	0	3	0	5	0	14	204
8:05 AM	0	2	0	0	3	4	0	0	0	0	0	0	2	0	6	0	17	212
8:10 AM	0	2	1	0	3	7	0	0	0	0	0	0	3	0	6	0	22	223
8:15 AM	0	3	3	0	11	4	0	0	0	0	0	0	2	0	3	0	26	232
8:20 AM	0	3	1	0	3	2	0	0	0	0	0	0	4	0	2	0	15	236
8:25 AM	0	5	1	0	8	4	0	1	0	0	0	0	2	0	7	0	28	246
8:30 AM	0	3	5	0	3	2	0	0	0	0	0	0	3	0	4	0	20	256
8:35 AM	0	2	3	0	17	5	0	0	0	0	0	0	1	0	9	0	37	268
8:40 AM	0	3	3	0	8	8	0	0	0	0	0	0	3	0	3	0	28	276
8:45 AM	0	2	3	0	11	9	0	0	0	0	0	0	4	0	3	0	32	285
8:50 AM	0	3	3	0	8	9	0	0	0	0	0	0	2	0	5	0	30	292
8:55 AM	0	6	5	0	9	4	0	0	0	0	0	0	3	0	5	0	32	301
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	28	36	0	144	88	0	0	0	0	0	0	32	0	60	0	388	
Heavy Trucks	0	0	0	0	12	8	0	0	0	0	0	0	4	0	4	0	28	
Buses																		
Pedestrians		0				0				0				0			0	
Bicycles	0	0	0		0	0	0			0	0	0	0	0	0		0	
Scoters																		

Comments:

LOCATION: Rhododendron Dr -- 35th St
CITY/STATE: Florence, OR

QC JOB #: 15273705
DATE: Thu, Aug 27 2020

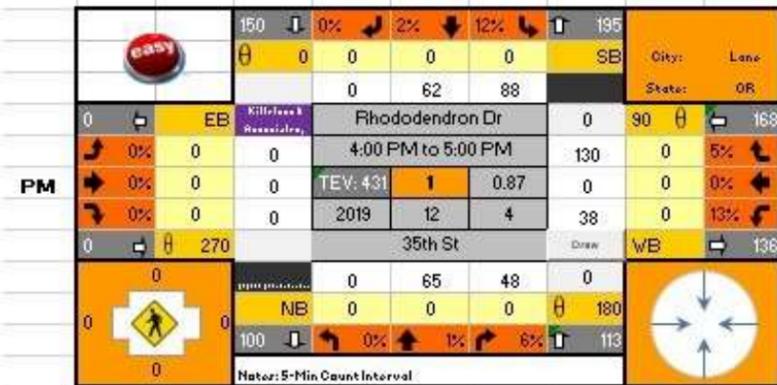
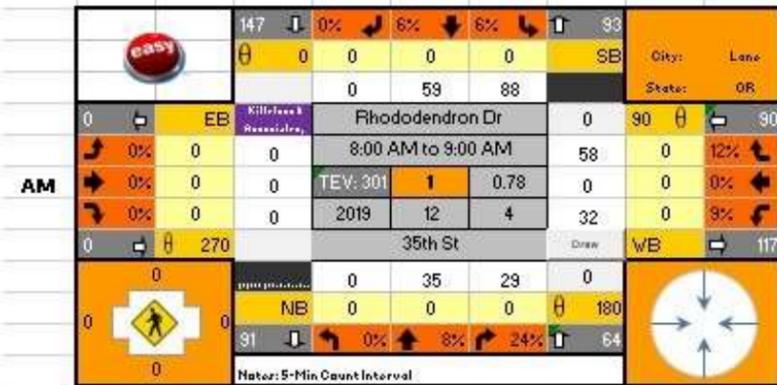


5-Min Count Period Beginning At	Rhododendron Dr (Northbound)				Rhododendron Dr (Southbound)				35th St (Eastbound)				35th St (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	0	6	11	0	6	4	0	0	0	0	0	0	1	0	9	0	37	
4:05 PM	0	6	3	0	8	9	0	0	0	0	0	0	6	0	13	0	45	
4:10 PM	0	6	3	0	6	5	0	0	0	0	0	0	4	0	11	0	35	
4:15 PM	0	7	3	0	12	9	0	0	0	0	0	0	1	0	12	0	44	
4:20 PM	0	2	2	0	11	6	0	0	0	0	0	0	2	0	11	0	34	
4:25 PM	0	5	8	0	7	2	0	0	0	0	0	0	2	0	5	0	29	
4:30 PM	0	4	2	0	5	4	0	0	0	0	0	0	6	0	9	0	30	
4:35 PM	0	5	8	0	8	7	0	0	0	0	0	0	4	0	15	0	47	
4:40 PM	0	7	3	0	5	6	0	0	0	0	0	0	4	0	8	0	33	
4:45 PM	0	4	2	0	7	6	0	0	0	0	0	0	3	0	9	0	31	
4:50 PM	0	3	3	0	8	4	0	0	0	0	0	0	3	0	12	0	33	
4:55 PM	0	10	0	0	5	0	0	0	0	0	0	0	2	0	16	0	33	431
5:00 PM	0	8	2	0	7	1	0	0	0	0	0	0	4	0	8	0	30	424
5:05 PM	0	3	3	0	5	5	0	0	0	0	0	0	2	0	12	0	30	409
5:10 PM	0	7	2	0	5	10	0	0	0	0	0	0	4	0	13	0	41	415
5:15 PM	0	7	2	0	9	9	0	0	0	0	0	0	0	0	8	0	35	406
5:20 PM	0	5	1	0	2	4	0	0	0	0	0	0	5	0	10	0	27	399
5:25 PM	0	6	2	0	7	5	0	0	0	0	0	0	3	0	8	0	31	401
5:30 PM	0	1	0	0	4	2	0	0	0	0	0	0	4	0	5	0	16	387
5:35 PM	0	4	0	0	5	1	0	0	0	0	0	0	0	0	10	0	20	360
5:40 PM	0	2	2	0	0	3	0	0	0	0	0	0	1	0	9	0	17	344
5:45 PM	0	3	3	0	4	5	0	0	0	0	0	0	0	0	5	0	20	333
5:50 PM	0	3	1	0	5	8	0	0	0	0	0	0	0	0	9	0	26	326
5:55 PM	0	1	0	0	5	5	0	0	0	0	0	0	0	0	8	0	19	312
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	76	36	0	104	92	0	0	0	0	0	0	44	0	144	0	496	
Heavy Trucks	0	4	8		20	0	0			0	0		8	0	4		44	
Buses																		
Pedestrians		0				0				0				0			0	
Bicycles	0	0	0		0	8	0			0	0	0	0	0	0		8	
Scoters																		

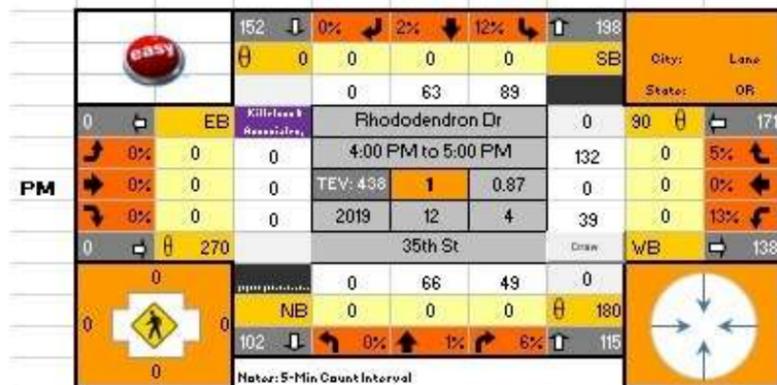
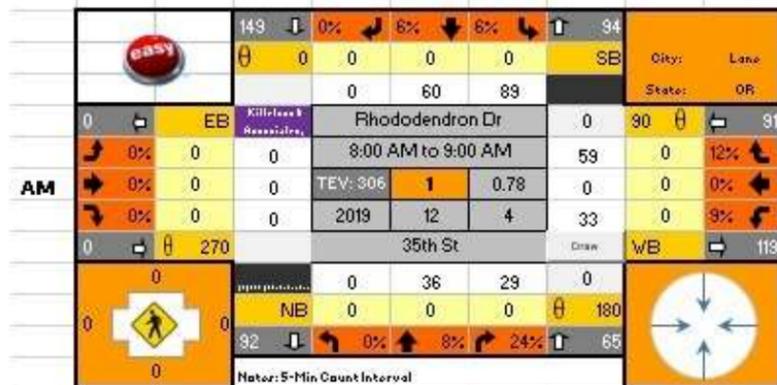
Comments:

Attachment B
Adjusted Traffic Count Volumes
(August 2020)

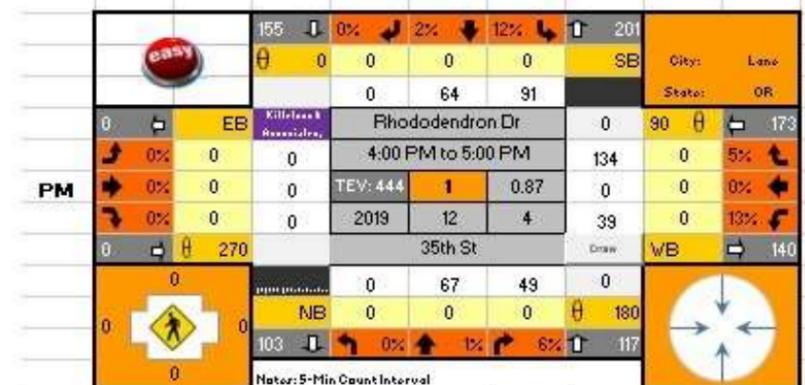
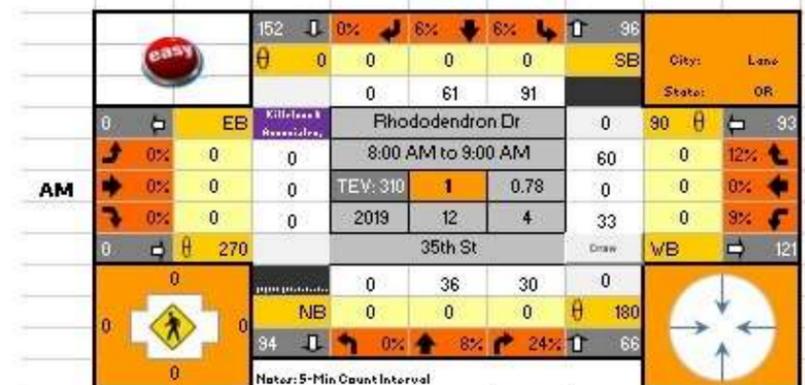
Raw Traffic Volumes (August 2020)



COVID-19 Adjusted Traffic Volumes (August 2020)



Seasonally Adjusted Traffic Volumes (August 2020)



Covid adjust factor:	1.016	Thursday average	Weekday average
confirmed - use weekday more conservative		2019	9489
		2020	9364
		Ratio	1.013

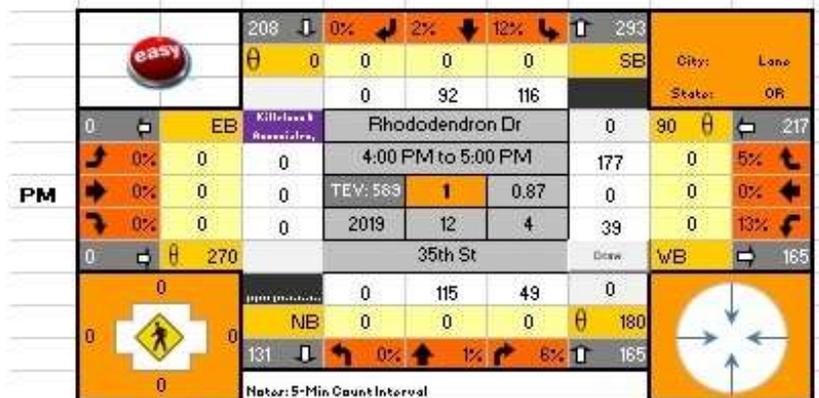
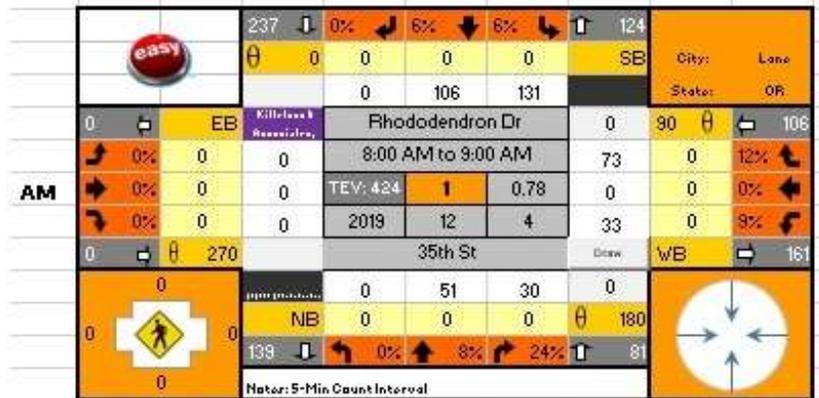
Seasonal adjust factor: 1.015 confirmed

Site Generated Added Traffic Volumes



confirmed		distribution	
	In	Out	
AM	18	57	north 5%
PM	53	34	south 50%
			east 45%

Total (with site) Traffic Volumes (updated for August 2020)



Attachment C
Traffic Operations Output
Worksheets (August 2020)

Intersection						
Int Delay, s/veh	5.4					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W	R	T	R	L	T
Traffic Vol, veh/h	33	60	36	30	91	61
Future Vol, veh/h	33	60	36	30	91	61
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	78	78	78	78	78	78
Heavy Vehicles, %	9	12	8	24	6	6
Mvmt Flow	42	77	46	38	117	78

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	377	65	0	0	84
Stage 1	65	-	-	-	-
Stage 2	312	-	-	-	-
Critical Hdwy	6.49	6.32	-	-	4.16
Critical Hdwy Stg 1	5.49	-	-	-	-
Critical Hdwy Stg 2	5.49	-	-	-	-
Follow-up Hdwy	3.581	3.408	-	-	2.254
Pot Cap-1 Maneuver	611	972	-	-	1488
Stage 1	940	-	-	-	-
Stage 2	727	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	561	972	-	-	1488
Mov Cap-2 Maneuver	561	-	-	-	-
Stage 1	940	-	-	-	-
Stage 2	667	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.5	0	4.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	771	1488
HCM Lane V/C Ratio	-	-	0.155	0.078
HCM Control Delay (s)	-	-	10.5	7.6
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.5	0.3

Intersection						
Int Delay, s/veh	5.9					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W		T			T
Traffic Vol, veh/h	39	134	67	49	91	64
Future Vol, veh/h	39	134	67	49	91	64
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	13	5	1	6	12	2
Mvmt Flow	45	154	77	56	105	74

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	389	105	0	0	133
Stage 1	105	-	-	-	-
Stage 2	284	-	-	-	-
Critical Hdwy	6.53	6.25	-	-	4.22
Critical Hdwy Stg 1	5.53	-	-	-	-
Critical Hdwy Stg 2	5.53	-	-	-	-
Follow-up Hdwy	3.617	3.345	-	-	2.308
Pot Cap-1 Maneuver	594	941	-	-	1392
Stage 1	893	-	-	-	-
Stage 2	740	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	547	941	-	-	1392
Mov Cap-2 Maneuver	547	-	-	-	-
Stage 1	893	-	-	-	-
Stage 2	682	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.9	0	4.6
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	810	1392
HCM Lane V/C Ratio	-	-	0.245	0.075
HCM Control Delay (s)	-	-	10.9	7.8
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	1	0.2

Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	33	65	42	30	106	77
Future Vol, veh/h	33	65	42	30	106	77
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	78	78	78	78	78	78
Heavy Vehicles, %	9	12	8	24	6	6
Mvmt Flow	42	83	54	38	136	99

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	444	73	0	0	92	0
Stage 1	73	-	-	-	-	-
Stage 2	371	-	-	-	-	-
Critical Hdwy	6.49	6.32	-	-	4.16	-
Critical Hdwy Stg 1	5.49	-	-	-	-	-
Critical Hdwy Stg 2	5.49	-	-	-	-	-
Follow-up Hdwy	3.581	3.408	-	-	2.254	-
Pot Cap-1 Maneuver	559	962	-	-	1478	-
Stage 1	932	-	-	-	-	-
Stage 2	683	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	505	962	-	-	1478	-
Mov Cap-2 Maneuver	505	-	-	-	-	-
Stage 1	932	-	-	-	-	-
Stage 2	617	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.9	0	4.4
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	737	1478
HCM Lane V/C Ratio	-	-	0.17	0.092
HCM Control Delay (s)	-	-	10.9	7.7
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.6	0.3

Intersection						
Int Delay, s/veh	5.9					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	T		T		T	
Traffic Vol, veh/h	39	151	86	49	101	75
Future Vol, veh/h	39	151	86	49	101	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	13	5	1	6	12	2
Mvmt Flow	45	174	99	56	116	86

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	445	127	0	0	155	0
Stage 1	127	-	-	-	-	-
Stage 2	318	-	-	-	-	-
Critical Hdwy	6.53	6.25	-	-	4.22	-
Critical Hdwy Stg 1	5.53	-	-	-	-	-
Critical Hdwy Stg 2	5.53	-	-	-	-	-
Follow-up Hdwy	3.617	3.345	-	-	2.308	-
Pot Cap-1 Maneuver	551	915	-	-	1366	-
Stage 1	872	-	-	-	-	-
Stage 2	713	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	502	915	-	-	1366	-
Mov Cap-2 Maneuver	502	-	-	-	-	-
Stage 1	872	-	-	-	-	-
Stage 2	650	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.4	0	4.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	783	1366
HCM Lane V/C Ratio	-	-	0.279	0.085
HCM Control Delay (s)	-	-	11.4	7.9
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	1.1	0.3

Intersection						
Int Delay, s/veh	5.3					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	33	73	51	30	131	106
Future Vol, veh/h	33	73	51	30	131	106
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	78	78	78	78	78	78
Heavy Vehicles, %	9	12	8	24	6	6
Mvmt Flow	42	94	65	38	168	136

Major/Minor	Minor1	Major1	Major2			
Conflicting Flow All	556	84	0	0	103	0
Stage 1	84	-	-	-	-	-
Stage 2	472	-	-	-	-	-
Critical Hdwy	6.49	6.32	-	-	4.16	-
Critical Hdwy Stg 1	5.49	-	-	-	-	-
Critical Hdwy Stg 2	5.49	-	-	-	-	-
Follow-up Hdwy	3.581	3.408	-	-	2.254	-
Pot Cap-1 Maneuver	480	948	-	-	1464	-
Stage 1	922	-	-	-	-	-
Stage 2	613	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	420	948	-	-	1464	-
Mov Cap-2 Maneuver	420	-	-	-	-	-
Stage 1	922	-	-	-	-	-
Stage 2	537	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.6	0	4.3
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	681	1464
HCM Lane V/C Ratio	-	-	0.2	0.115
HCM Control Delay (s)	-	-	11.6	7.8
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	0.7	0.4

Intersection						
Int Delay, s/veh	6.1					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	39	177	115	49	116	92
Future Vol, veh/h	39	177	115	49	116	92
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	13	5	1	6	12	2
Mvmt Flow	45	203	132	56	133	106

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	532	160	0	0	188
Stage 1	160	-	-	-	-
Stage 2	372	-	-	-	-
Critical Hdwy	6.53	6.25	-	-	4.22
Critical Hdwy Stg 1	5.53	-	-	-	-
Critical Hdwy Stg 2	5.53	-	-	-	-
Follow-up Hdwy	3.617	3.345	-	-	2.308
Pot Cap-1 Maneuver	490	877	-	-	1328
Stage 1	843	-	-	-	-
Stage 2	674	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	438	877	-	-	1328
Mov Cap-2 Maneuver	438	-	-	-	-
Stage 1	843	-	-	-	-
Stage 2	603	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.3	0	4.5
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	743	1328
HCM Lane V/C Ratio	-	-	0.334	0.1
HCM Control Delay (s)	-	-	12.3	8
HCM Lane LOS	-	-	B	A
HCM 95th %tile Q(veh)	-	-	1.5	0.3

Attachment D
AASHTO Stopping Sight
Distance

Metric					US Customary				
Design speed (km/h)	Brake reaction distance (m)	Braking distance on level (m)	Stopping sight distance		Design speed (mph)	Brake reaction distance (ft)	Braking distance on level (ft)	Stopping sight distance	
			Calculated (m)	Design (m)				Calculated (ft)	Design (ft)
20	13.9	4.6	18.5	20	15	55.1	21.6	76.7	80
30	20.9	10.3	31.2	35	20	73.5	38.4	111.9	115
40	27.8	18.4	46.2	50	25	91.9	60.0	151.9	155
50	34.8	28.7	63.5	65	30	110.3	86.4	196.7	200
60	41.7	41.3	83.0	85	35	128.6	117.6	246.2	250
70	48.7	56.2	104.9	105	40	147.0	153.6	300.6	305
80	55.6	73.4	129.0	130	45	165.4	194.4	359.8	360
90	62.6	92.9	155.5	160	50	183.8	240.0	423.8	425
100	69.5	114.7	184.2	185	55	202.1	290.3	492.4	495
110	76.5	138.8	215.3	220	60	220.5	345.5	566.0	570
120	83.4	165.2	248.6	250	65	238.9	405.5	644.4	645
130	90.4	193.8	284.2	285	70	257.3	470.3	727.6	730
					75	275.6	539.9	815.5	820
					80	294.0	614.3	908.3	910

Note: Brake reaction distance predicated on a time of 2.5 s; deceleration rate of 3.4 m/s² [11.2 ft/s²] used to determine calculated sight distance.

Exhibit 3-1. Stopping Sight Distance

Attachment E
Left-turn Lane Warrant Analysis
Worksheets

Left-Turn Lane Warrant Analysis

Project #: 25234
 Project Name: Florence Residential
 Analyst: DFA
 Intersection: Rhododendron/35th
 Scenario: Weekday AM Peak Hour
 Date: 9/3/2020
 File:



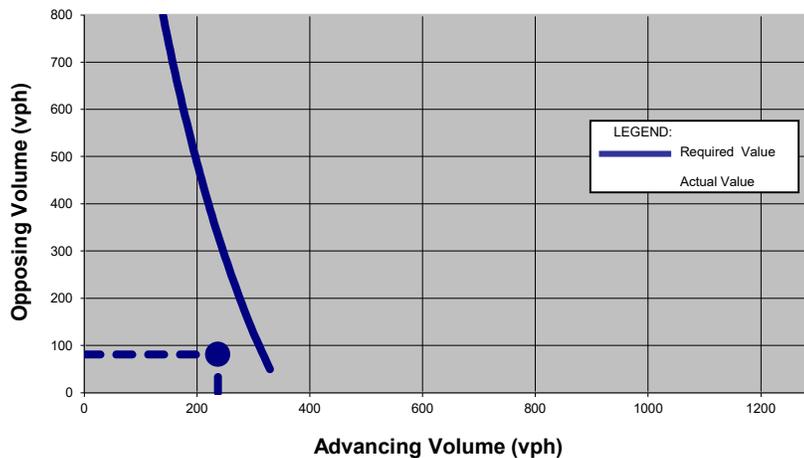
KITTELSON & ASSOCIATES, INC.
 610 SW Alder, Suite 700
 Portland, Oregon 97205
 (503) 228-5230
 Fax: (503) 273-8169

\\kittelson.com\fs\H_Projects\24\24714 - Florence Residential Subdivision\left turn lane analysis\[24714_left turn warrant_AM.xls]Main

Input Data:

Advancing Volume (vph) =	237
Left-turning Vehicles (vph) =	131
Opposing Volume (vph) =	81
Speed (mph) =	40
Number of Approach Lanes =	1 (not applicable for two lanes)
% Left-Turning Vehicles	55%
Critical Gap (sec) =	5
Maneuver Time (sec) =	3
Exit Time (sec) =	1.9
Utilization Factor =	0.02
Let-turn Lane Warranted?	No

Left-Turn Lane Warrant Analysis Results



* Based on *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections* (D. Harmelink)

Left-Turn Lane Warrant Analysis

Project #: 25234
 Project Name: Florence Residential
 Analyst: DFA
 Intersection: Rhododendron/35th
 Scenario: Weekday PM Peak Hour
 Date: 9/3/2020
 File:



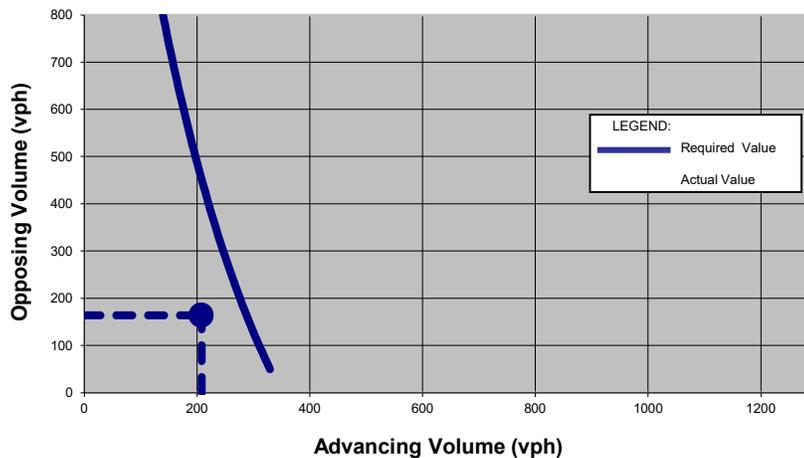
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Input Data:

Advancing Volume (vph) =	208
Left-turning Vehicles (vph) =	116
Opposing Volume (vph) =	164
Speed (mph) =	40
Number of Approach Lanes =	1 (not applicable for two lanes)
% Left-Turning Vehicles	56%
Critical Gap (sec) =	5
Maneuver Time (sec) =	3
Exit Time (sec) =	1.9
Utilization Factor =	0.02
Let-turn Lane Warranted?	No

Left-Turn Lane Warrant Analysis Results



* Based on *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections* (D. Harmelink)