Kimley»Horn

December 13, 2019

Bronce Stephenson, MPA
Director of Planning and Community Development
City of Winter Park
401 South Park Avenue
Winter Park, FL 32789

RE: Orange Avenue Technical Memorandum #3

Dear Mr. Stephenson:

Kimley-Horn conducted a transportation analysis associated with the proposed Orange Avenue Overlay District, between Orlando Avenue (US 17/92) and Fairbanks Avenue. This memorandum outlines the analysis, assumptions, and findings. Note that the Overlay District does not mandate specific modifications to Orange Avenue.

Roadway Segment Volumes:

Roadway segment counts and turning movement volume data were used to determine the existing and future roadway segment volumes. FDOT count station 75-5122, on Orange Avenue, was used to calculate an annual trend growth rate of 4.74%. The trend growth worksheet is attached. The growth rate calculation is based on 5 years of data from the count station and traffic counts that were taken in year 2019 along the corridor. Resulting future volumes in year 2025 are shown in **Table 1**.

Table 1: Existing Daily Volumes, Growth, And Future Volumes on Orange Avenue

Orange Avenue Segment		2019 Volume	Historic Trend	Growth	2025 AADT
From	To				
US 17/92 (Orlando Ave)	Cypress Ave	18,600	4.74%	5,300	23,900
Cypress Ave	Minnesota / Denning	18,200	4.74%	5,200	23,400
Minnesota / Denning	SR 426 (Fairbanks)	17,800	4.74%	5,100	22,900

As shown in Table 1, volumes on Orange Avenue are relatively high given the significant bottleneck intersections at each end of the corridor (US 17/92 in the southwest and Fairbanks Avenue in the northeast). Evaluation of existing conditions at intersections (as described in a previous technical memorandum) concluded that the existing lane configurations and signal timings at the boundary intersections have maximized the available peak-hour capacity. Therefore, the next evolution of improvements to the corridor should focus on safety and mobility options that better connect people with existing and future destinations along the corridor. Since traffic is effectively metered by the operations of the large intersections at both ends of the corridor (Orlando Ave and Fairbanks) it's reasonable to assume that a portion of any additional/future peak-hour traffic demand is likely to be absorbed by alternate travel routes and by travel modes other than single occupant vehicles.

Travel Patterns on Orange Avenue:

As detailed by MetroPlan Orlando, vehicles were measured as they enter/exit the corridor at points just beyond the study area on Orange Avenue southwest of Orlando Avenue, and east of the corridor on Fairbanks Avenue. At least 70% of the vehicles are cut-through trips that do not begin or end within the study area. Only 13% of the measured vehicles that pass control points (just outside of the corridor) begin or end within the study area. The remaining 17% of vehicles enter/exit the corridor at other side streets, and it isn't known whether they are cutting through or not. The relevant slide provided by MetroPlan is attached. If development patterns remain as they are, this relationship is anticipated to continue, with most vehicles on Orange Avenue making longer trips that do not start or end within the corridor.

When considering that the majority of vehicles on Orange Avenue are cutting through (and therefore have other travel options to choose) and the boundary intersections are already at capacity during the peak-hour, it is clear that significant diversion to more auto oriented routes will occur. Rather than encouraging more peak-hour traffic, the corridor can be enhanced to focus on safety, walkability, and multimodal options. Investment in these options has the added benefit of contributing positively to the creation of a cohesive corridor that integrates the aspirations for place making with a priority given to local (rather than) regional travel.

Potential Trip Generation:

Three key properties have the ability to develop/redevelop, and once developed, they will serve as catalyst sites for the area. These key properties will provide valuable benefits to other surrounding properties by including extra parking, stormwater collection and stormwater treatment.

Representative development programs for these sites have been provided for evaluation and include:

- Site 1 – Southern Portion of the corridor: 200 apartment units, 100 hotel rooms, 25,000 square feet of medical office, and 25,000 square feet of retail.
- Site 2 – Central Portion of the corridor: 120,000 square feet of office and 30,000 square feet of retail
- Site 3 – Northern portion of the corridor: 200 apartments units and 50,000 square feet of retail

Note that these sites currently have existing uses and could be redeveloped within the existing zoning requirements, though not with the mix of uses as considered herein. More importantly, redevelopment under existing zoning requirements would not result in the place making qualities offered by the proposed mixed-use overlay requirements.

Potential trip generation of the key properties is shown in **Table 2**, and internal capture worksheets are attached. Pass-by reductions were applied to the individual retail uses separately since they are located in different areas. Internal capture reductions were calculated in aggregate since several similar uses are located throughout the mixed-use corridor. This represents a relatively conservative internal capture reduction – it is more likely that the unconstrained internal capture rates for each use will be realized due to the proximity of compatible uses.

Table 2: Trip Generation of Key Properties along Corridor

Land Use	LUC	Size	Units	Daily	AM			PM		
					Total	In	Out	Total	In	Out
Apartment	221a	400	DU	1,036	80	10	70	66	48	18
Hotel	310a	100	Rooms	702	39	23	16	39	20	19
Office	710	120	KSF	1,266	108	93	15	108	18	90
Medical Office	720	25	KSF	873	65	51	14	87	24	63
Retail (Total Trips)	820	105	KSF	3,965	99	61	38	400	193	207
Pass-By Reduction (Retail Only)				34.0%	34.0%	17	17	53.8%	108	107
Retail (After Pass-By)				2,617	65	44	21	185	85	100
SubTotal				*6,494*	*357*	*221*	*136*	*485*	*195*	*290*
Internal Capture Reduction				21.7%	10.3%	18	19	24.2%	59	58
Net External Trips				**5,085**	**320**	**203**	**117**	**368**	**136**	**232**

As shown in the table, the trip generation potential (5,085 daily trips) for the major properties in the Overlay District is roughly equal to the anticipated daily volume growth for the corridor (5,200 vehicles per day). More importantly is the peak-hour demand for AM (320) and PM (368) periods. This is the 60 minutes in the morning and afternoon that experience the greatest amount of delay with the remainder of the 22 hours operating well within acceptable parameters.

Given the high percentage of vehicles that are using Orange Avenue as a cut-through corridor, it appears that future operating conditions will be similar, whether the new trips are associated with development along Orange Avenue, or with development in areas outside of the corridor (or outside of the City). However, decisions regarding the type and form of development as well as the types of corridor investments can influence the type of travel that absorbs this remaining travel capacity: local trips or regional trips.

Additional background / cut-through trips will gravitate to Orange Avenue to the extent that capacity is available if the route is more attractive than other vehicular options. Conversely, if the corridor takes on a more walkable design with mixed uses and quality placemaking features, the travel will absorb and prioritize local travel.

Future Traffic Impact Analyses

While this memorandum represents potential development intensities for the three large sites within the corridor, this does not represent a final development program. Additional properties will likely redevelop as opportunities become more feasible. Once the individual sites are ready to develop / redevelop, a Traffic Impact Analysis (TIA) will be required based on the City's development review requirements, just like TIA's are required for projects in any other area of the City.

It is recommended that the City's TIA requirements are reviewed to determine whether modifications are appropriate for developments that are proposed within the overlay district. Example modifications include the provision for increases in mode split assumptions, reduced trip lengths, and internal capture calculations.

Potential Strategies to Reduce Congestion on Orange Avenue

Several strategies could alleviate conditions on Orange Avenue. Potential examples include the following:

- Roundabouts
  - Denning Drive / Minnesota Avenue: This signalized intersection currently operates with a PM peak-hour maximum volume to capacity (v/c) ratio of 1.26, with considerable lost time due to the changing of multiple phases for the six approaches. If this intersection is converted to a roundabout, the degree of saturation (similar to a v/c ratio) reduces to 0.99 when analyzed as a 1-lane roundabout, with a lower degree of saturation as a 2-lane roundabout. Signalized analysis and analysis of a 1-lane roundabout are attached.
  - Fairbanks Avenue / Pennsylvania Avenue: This intersection currently operates with a PM peak-hour maximum v/c ratio of 1.26 (coincidentally the same v/c ratio as the Denning / Minnesota intersection), with an average vehicle delay of 65.7 seconds. If converted to a roundabout, the maximum degree of saturation would be 0.745, with an average vehicle delay of 16.9 seconds. Though this would be a significant improvement, there are several geometric challenges that need to be addressed when considering a roundabout. Signalized analysis and analysis of a roundabout are attached.
- Upgrades to US 17/92: FDOT will be implementing improvements to US 17/92 that are anticipated to be primarily bike / ped improvements. As bicycle travel on US 17/92 becomes more feasible and attractive, Orange Avenue will benefit as multi-modal mobility increases.
- Extension of the multi-use path adjacent to the railroad track: A path along the railroad track through Winter Park currently has a southern terminus at Fairbanks Avenue. If this trail is extended throughout the study area, it will allow longer-range, higher-speed cyclists to travel through the corridor in a protected alignment that does not conflict with slower pedestrians or faster cars along Orange Avenue. This alignment will also serve as a connection to bicycle facilities along Denning Drive.
- Completion of I-4 Ultimate project – Once improvements to I-4 are complete, traffic is anticipated to shift back to I-4 from several adjacent north / south roads. This shift will likely improve vehicular conditions on Orange Avenue, reducing the amount of cut-through traffic from longer trips.
- Turn lane at Fairbanks Avenue and Denning Drive: Installation of a dedicated westbound left-turn lane at this intersection will alleviate the existing westbound left-turn movement from Fairbanks Avenue to Orange Avenue.

Sincerely,

Mike Woodward, P.E.

Stephen M Stansbery, AICP

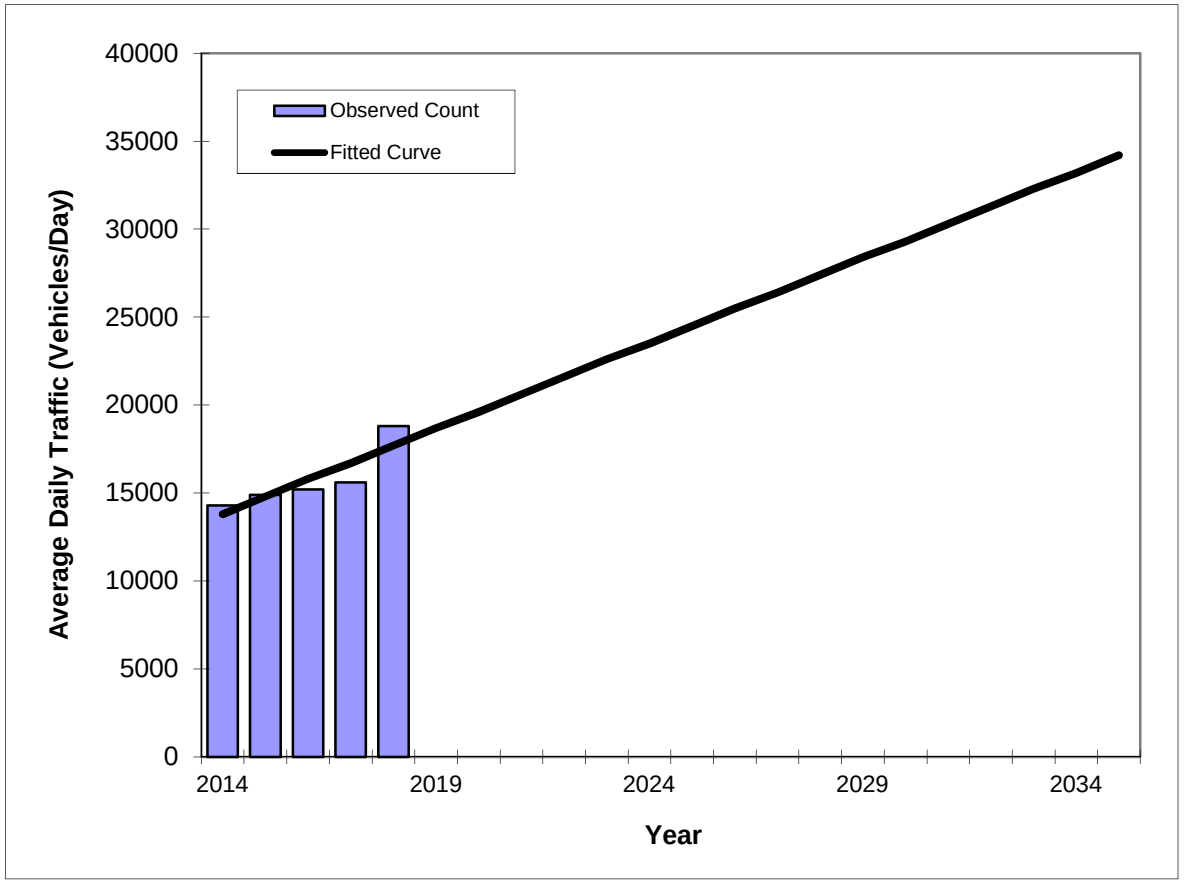
Attachments:
Trend Growth Worksheet
Excerpt from Streetlight Data Analysis by MetroPlan
Internal Capture Worksheets
Synchro and Sidra Analysis at Denning / Minnesota
Synchro and Sidra Analysis at Fairbanks / Pennsylvania

Traffic Trends - V2.0

ORANGE AVE --

PIN#	**12345**
Location	**1**

County:	Orange (75)
Station #:	5122
Highway:	ORANGE AVE

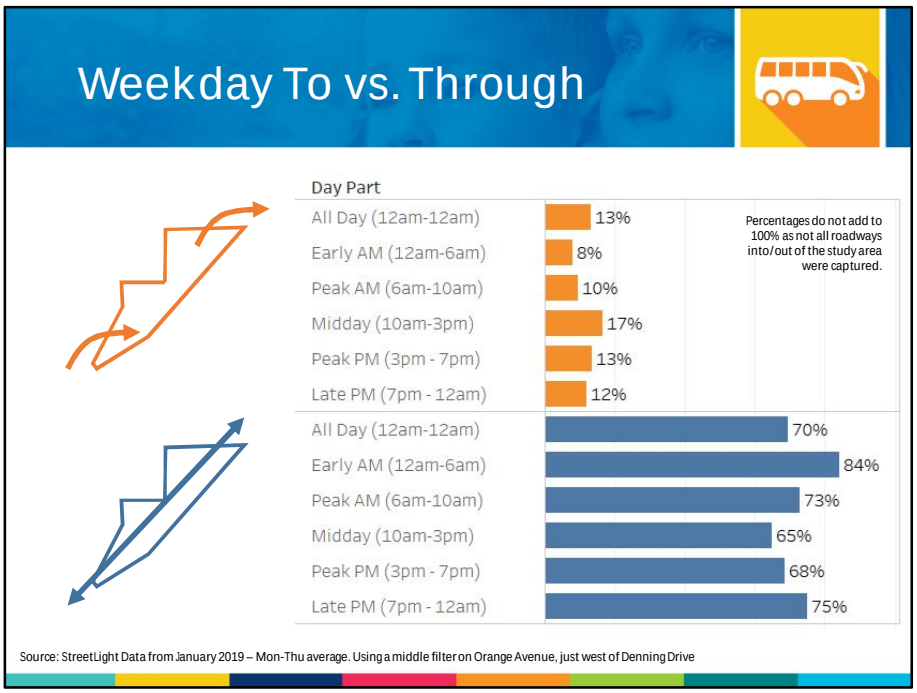


Year	Traffic (ADT/AADT) Count*	Trend**
2014	14300	13800
2015	14900	14800
2016	15200	15800
2017	15600	16700
2018	18800	17700
2019 Opening Year Trend		
2019	N/A	18700
2020 Mid-Year Trend		
2020	N/A	19600
2022 Design Year Trend		
2022	N/A	21600
TRANPLAN Forecasts/Trends		

** Annual Trend Increase:	970
Trend R-squared:	75.56%
Trend Annual Historic Growth Rate:	7.07%
Trend Growth Rate (2018 to Design Year):	5.51%
Printed:	10-Jul-19

Straight Line Growth Option

*Axle-Adjusted



On weekdays, 13 percent of traffic on Orange Avenue (west of Denning Dr) is starting or ending a trip on the study area. That number peaks at 17% during midday hours.

At least 70% of trips using Orange Avenue start and end their trips outside of the study area. In essence, they are cut-through trips from the point of view of the study area.

Weekends are similar.

Internal Capture Reduction Calculations

Methodology for A.M. Peak Hour and P.M. Peak Hour
based on the *Trip Generation Handbook* , 3rd Edition, published by the Institute of Transportation Engineers

Methodology for Daily
based on the average of the Unconstrained Rates for the A.M. Peak Hour and P.M. Peak Hour

SUMMARY

GROSS TRIP GENERATION

INPUT

Land Use	Daily		A.M. Peak Hour		P.M. Peak Hour	
	Enter	Exit	Enter	Exit	Enter	Exit
Office	633	633	93	15	18	90
Retail	1,309	1,309	44	21	85	100
Restaurant						
Cinema/Entertainment						
Residential	518	518	10	70	47	18
Hotel	351	351	23	16	20	19
	2,811	2,811	170	122	170	227

INTERNAL TRIPS

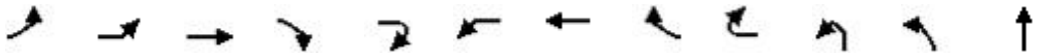
OUTPUT

Land Use	Daily		A.M. Peak Hour		P.M. Peak Hour	
	Enter	Exit	Enter	Exit	Enter	Exit
Office	136	161	8	4	3	9
Retail	302	265	7	4	17	27
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	133	135	0	2	24	10
Hotel	38	48	0	5	4	2
	609	609	15	15	48	48
% Reduction	21.7%		10.3%		24.2%	

EXTERNAL TRIPS

OUTPUT

Land Use	Daily		A.M. Peak Hour		P.M. Peak Hour	
	Enter	Exit	Enter	Exit	Enter	Exit
Office	497	472	85	11	15	81
Retail	1,007	1,044	37	17	68	73
Restaurant	0	0	0	0	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	385	383	10	68	23	8
Hotel	313	303	23	11	16	17
	2,202	2,202	155	107	122	179



Lane Group	EBL2	EBL	EBT	EBR	EBR2	WBL	WBT	WBR	WBR2	NBL2	NBL	NBT
Lane Configurations												
Traffic Volume (vph)	27	141	184	2	4	57	117	62	13	3	6	84
Future Volume (vph)	27	141	184	2	4	57	117	62	13	3	6	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0		0		0		0			0	
Storage Lanes		0		0		0		0			0	
Taper Length (ft)		25				25					25	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.998				0.959					0.943
Flt Protected			0.977				0.989					0.997
Satd. Flow (prot)	0	0	1816	0	0	0	1767	0	0	0	0	1751
Flt Permitted			0.661				0.814					0.974
Satd. Flow (perm)	0	0	1229	0	0	0	1454	0	0	0	0	1711
Right Turn on Red					Yes				Yes			
Satd. Flow (RTOR)							2					
Link Speed (mph)			25				25					25
Link Distance (ft)			1164				1248					619
Travel Time (s)			31.7				34.0					16.9
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.94	0.94	0.94	0.94	0.74	0.74	0.74
Adj. Flow (vph)	30	155	202	2	4	61	124	66	14	4	8	114
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	393	0	0	0	265	0	0	0	0	219
Turn Type	Perm	Perm	NA			Perm	NA			Perm	Perm	NA
Protected Phases			4				8					10
Permitted Phases	4	4				8				10	10	
Detector Phase	4	4	4			8	8			10	10	10
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0			5.0	5.0			5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0			11.0	11.0			11.0	11.0	11.0
Total Split (s)	25.0	25.0	25.0			25.0	25.0			20.0	20.0	20.0
Total Split (%)	23.8%	23.8%	23.8%			23.8%	23.8%			19.0%	19.0%	19.0%
Maximum Green (s)	19.0	19.0	19.0			19.0	19.0			14.0	14.0	14.0
Yellow Time (s)	4.0	4.0	4.0			4.0	4.0			4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0			2.0	2.0			2.0	2.0	2.0
Lost Time Adjust (s)			0.0				0.0					0.0
Total Lost Time (s)			6.0				6.0					6.0
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0			3.0	3.0			3.0	3.0	3.0
Recall Mode	None	None	None			None	None			None	None	None
Act Effct Green (s)			19.1				19.1					14.1
Actuated g/C Ratio			0.26				0.26					0.19
v/c Ratio			1.26				0.71					0.68
Control Delay			167.3				39.3					42.4
Queue Delay			0.0				0.0					0.0
Total Delay			167.3				39.3					42.4
LOS			F				D					D
Approach Delay			167.3				39.3					42.4
Approach LOS			F				D					D

Lane Group	NBR	NBR2	SBL2	SBL	SBT	SBR	SBR2	NEL2	NEL	NET	NER	SWL2
Lane Configurations												
Traffic Volume (vph)	68	1	8	74	37	107	18	2	27	625	43	10
Future Volume (vph)	68	1	8	74	37	107	18	2	27	625	43	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0			130		0			0		0	
Storage Lanes	0			1		0			0		0	
Taper Length (ft)				25					25			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	*1.00	*1.00	*1.00	*0.95
Frt					0.884					0.991		
Flt Protected				0.950						0.998		
Satd. Flow (prot)	0	0	0	1770	1647	0	0	0	0	3685	0	0
Flt Permitted				0.483						0.910		
Satd. Flow (perm)	0	0	0	900	1647	0	0	0	0	3360	0	0
Right Turn on Red		Yes					Yes					
Satd. Flow (RTOR)					5							
Link Speed (mph)					25					30		
Link Distance (ft)					768					925		
Travel Time (s)					20.9					21.0		
Peak Hour Factor	0.74	0.74	0.88	0.88	0.88	0.88	0.88	0.91	0.91	0.91	0.91	0.92
Adj. Flow (vph)	92	1	9	84	42	122	20	2	30	687	47	11
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	93	184	0	0	0	0	766	0	0
Turn Type			Perm	Perm	NA			Perm	Perm	NA		Perm
Protected Phases					10					2		
Permitted Phases			10	10				2	2			6
Detector Phase			10	10	10			2	2	2		6
Switch Phase												
Minimum Initial (s)			5.0	5.0	5.0			12.0	12.0	12.0		12.0
Minimum Split (s)			11.0	11.0	11.0			18.0	18.0	18.0		18.0
Total Split (s)			20.0	20.0	20.0			60.0	60.0	60.0		60.0
Total Split (%)			19.0%	19.0%	19.0%			57.1%	57.1%	57.1%		57.1%
Maximum Green (s)			14.0	14.0	14.0			54.0	54.0	54.0		54.0
Yellow Time (s)			4.0	4.0	4.0			4.0	4.0	4.0		4.0
All-Red Time (s)			2.0	2.0	2.0			2.0	2.0	2.0		2.0
Lost Time Adjust (s)				0.0	0.0					0.0		
Total Lost Time (s)				6.0	6.0					6.0		
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)			3.0	3.0	3.0			3.0	3.0	3.0		3.0
Recall Mode			None	None	None			None	None	None		None
Act Effct Green (s)				14.1	14.1					23.6		
Actuated g/C Ratio				0.19	0.19					0.32		
v/c Ratio				0.55	0.59					0.72		
Control Delay				44.0	37.2					26.8		
Queue Delay				0.0	0.0					0.0		
Total Delay				44.0	37.2					26.8		
LOS				D	D					C		
Approach Delay					39.5					26.8		
Approach LOS					D					C		

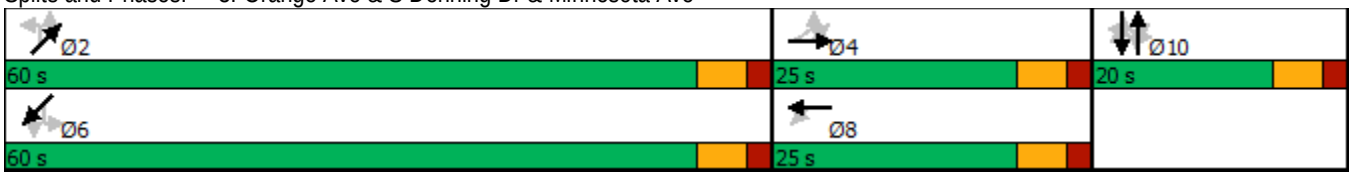
Lane Group	SWL	SWT	SWR	SWR2
Lane Configurations				
Traffic Volume (vph)	4	446	44	4
Future Volume (vph)	4	446	44	4
Ideal Flow (vphpl)	1900	1900	1900	1900
Storage Length (ft)	0		0	
Storage Lanes	0		0	
Taper Length (ft)	25			
Lane Util. Factor	*1.00	*1.00	*1.00	*0.95
Frt		0.986		
Flt Protected		0.999		
Satd. Flow (prot)	0	3670	0	0
Flt Permitted		0.924		
Satd. Flow (perm)	0	3394	0	0
Right Turn on Red				Yes
Satd. Flow (RTOR)		1		
Link Speed (mph)		30		
Link Distance (ft)		1865		
Travel Time (s)		42.4		
Peak Hour Factor	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	485	48	4
Shared Lane Traffic (%)				
Lane Group Flow (vph)	0	552	0	0
Turn Type	Perm	NA		
Protected Phases		6		
Permitted Phases	6			
Detector Phase	6	6		
Switch Phase				
Minimum Initial (s)	12.0	12.0		
Minimum Split (s)	18.0	18.0		
Total Split (s)	60.0	60.0		
Total Split (%)	57.1%	57.1%		
Maximum Green (s)	54.0	54.0		
Yellow Time (s)	4.0	4.0		
All-Red Time (s)	2.0	2.0		
Lost Time Adjust (s)		0.0		
Total Lost Time (s)		6.0		
Lead/Lag				
Lead-Lag Optimize?				
Vehicle Extension (s)	3.0	3.0		
Recall Mode	None	None		
Act Effct Green (s)		23.6		
Actuated g/C Ratio		0.32		
v/c Ratio		0.52		
Control Delay		22.4		
Queue Delay		0.0		
Total Delay		22.4		
LOS		C		
Approach Delay		22.4		
Approach LOS		C		

Lane Group	EBL2	EBL	EBT	EBR	EBR2	WBL	WBT	WBR	WBR2	NBL2	NBL	NBT
Queue Length 50th (ft)			~230				110					95
Queue Length 95th (ft)			#441				#250					145
Internal Link Dist (ft)			1084				1168					539
Turn Bay Length (ft)												
Base Capacity (vph)			313				372					321
Starvation Cap Reductn			0				0					0
Spillback Cap Reductn			0				0					0
Storage Cap Reductn			0				0					0
Reduced v/c Ratio			1.26				0.71					0.68

Intersection Summary			
Area Type:	Other		
Cycle Length: 105			
Actuated Cycle Length: 74.8			
Natural Cycle: 75			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.26			
Intersection Signal Delay: 52.3		Intersection LOS: D	
Intersection Capacity Utilization 114.2%		ICU Level of Service H	
Analysis Period (min) 15			

* User Entered Value
~ 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: 3: Orange Ave & S Denning Dr & Minnesota Ave



LANE SUMMARY

Site: 101 [Orange at Minnesota / Denning]

New Site
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: Denning													
Lane 1[d]	176	3.0	364	0.484	100	21.2	LOS C	2.2	57.4	Full	1600	0.0	0.0
Approach	176	3.0		0.484		21.2	LOS C	2.2	57.4				
East: Minnesota													
Lane 1[d]	272	3.0	432	0.629	100	24.6	LOS C	3.8	97.4	Full	1600	0.0	0.0
Approach	272	3.0		0.629		24.6	LOS C	3.8	97.4				
NorthEast: Orange Ave													
Lane 1[d]	552	3.0	862	0.640	100	14.5	LOS B	6.9	177.3	Full	1600	0.0	0.0
Approach	552	3.0		0.640		14.5	LOS B	6.9	177.3				
North: Denning													
Lane 1[d]	265	3.0	609	0.435	100	12.6	LOS B	2.3	60.1	Full	1600	0.0	0.0
Approach	265	3.0		0.435		12.6	LOS B	2.3	60.1				
West: Minnesota													
Lane 1[d]	389	3.0	571	0.682	100	22.1	LOS C	5.5	140.6	Full	1600	0.0	0.0
Approach	389	3.0		0.682		22.1	LOS C	5.5	140.6				
SouthWest: Orange Ave													
Lane 1[d]	759	3.0	767	0.989	100	52.8	LOS F	30.6	783.5	Full	1600	0.0	0.0
Approach	759	3.0		0.989		52.8	LOS F	30.6	783.5				
Intersection	2413	3.0		0.989		29.2	LOS D	30.6	783.5				

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Sign Control.
Lane LOS values are based on average delay and v/c ratio (degree of saturation) per lane.
LOS F will result if v/c > 1 irrespective of lane delay value (does not apply for approaches and intersection).
Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.
Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

d Dominant lane on roundabout approach

Lane Group	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL2	NBL	NBT	NBR	SBL
Lane Configurations												
Traffic Volume (vph)	649	25	10	3	434	770	33	8	31	157	30	19
Future Volume (vph)	649	25	10	3	434	770	33	8	31	157	30	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)		0			110		0		0		0	0
Storage Lanes		0			2		0		0		0	0
Taper Length (ft)					100				25			25
Lane Util. Factor	*1.00	*1.00	0.95	*1.00	*1.00	*1.00	0.95	1.00	1.00	1.00	1.00	1.00
Frt	0.992					0.994				0.982		
Flt Protected					0.950					0.991		
Satd. Flow (prot)	3696	0	0	0	3539	3703	0	0	0	1813	0	0
Flt Permitted					0.304					0.698		
Satd. Flow (perm)	3696	0	0	0	1133	3703	0	0	0	1277	0	0
Right Turn on Red			Yes				Yes				Yes	
Satd. Flow (RTOR)	1					5				5		
Link Speed (mph)	35					35				30		
Link Distance (ft)	1354					326				1141		
Travel Time (s)	26.4					6.4				25.9		
Peak Hour Factor	0.69	0.69	0.69	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.93	0.87
Adj. Flow (vph)	941	36	14	3	462	819	35	9	33	169	32	22
Shared Lane Traffic (%)												
Lane Group Flow (vph)	991	0	0	0	465	854	0	0	0	243	0	0
Turn Type	NA			custom	Prot	NA		Perm	Perm	NA		Perm
Protected Phases	2				1	6				4		
Permitted Phases				1				4	4			8
Detector Phase	2			1	1	6		4	4	4		8
Switch Phase												
Minimum Initial (s)	8.0			8.0	8.0	8.0		8.0	8.0	8.0		8.0
Minimum Split (s)	16.1			14.2	14.2	15.2		15.9	15.9	15.9		15.9
Total Split (s)	50.0			50.0	50.0	100.0		60.0	60.0	60.0		60.0
Total Split (%)	31.3%			31.3%	31.3%	62.5%		37.5%	37.5%	37.5%		37.5%
Maximum Green (s)	41.9			43.8	43.8	92.8		52.1	52.1	52.1		52.1
Yellow Time (s)	3.7			4.1	4.1	3.7		3.4	3.4	3.4		3.4
All-Red Time (s)	4.4			2.1	2.1	3.5		4.5	4.5	4.5		4.5
Lost Time Adjust (s)	0.0				0.0	0.0				0.0		
Total Lost Time (s)	8.1				6.2	7.2				7.9		
Lead/Lag	Lead			Lag	Lag							
Lead-Lag Optimize?	Yes			Yes	Yes							
Vehicle Extension (s)	3.0			3.0	3.0	3.0		3.0	3.0	3.0		3.0
Recall Mode	Max			None	None	Max		None	None	None		None
Act Effct Green (s)	42.0				43.9	93.0				26.2		
Actuated g/C Ratio	0.31				0.33	0.69				0.19		
v/c Ratio	0.86				1.26	0.33				0.96		
Control Delay	52.5				174.7	9.2				99.8		
Queue Delay	0.0				0.0	0.0				0.0		
Total Delay	52.5				174.7	9.2				99.8		
LOS	D				F	A				F		
Approach Delay	52.5					67.6				99.8		
Approach LOS	D					E				F		

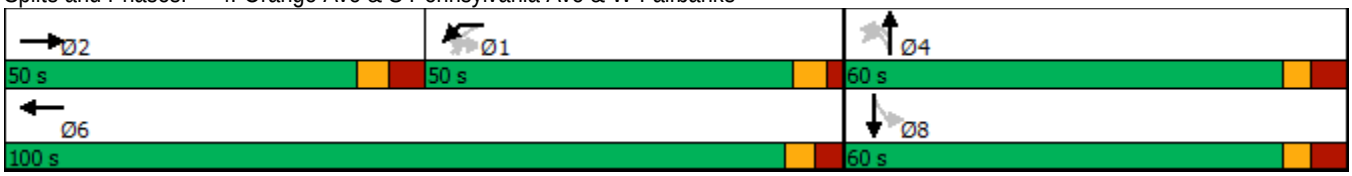
Lane Group	SBT	SBR	SBR2	NER
Lane Configurations				
Traffic Volume (vph)	143	53	22	3
Future Volume (vph)	143	53	22	3
Ideal Flow (vphpl)	1900	1900	1900	1900
Storage Length (ft)		0		0
Storage Lanes		0		2
Taper Length (ft)				
Lane Util. Factor	1.00	1.00	1.00	*1.00
Frt	0.957			0.850
Flt Protected	0.996			
Satd. Flow (prot)	1776	0	0	3167
Flt Permitted	0.918			
Satd. Flow (perm)	1636	0	0	3167
Right Turn on Red			Yes	
Satd. Flow (RTOR)	3			
Link Speed (mph)	30			
Link Distance (ft)	859			
Travel Time (s)	19.5			
Peak Hour Factor	0.87	0.87	0.87	0.95
Adj. Flow (vph)	164	61	25	3
Shared Lane Traffic (%)				
Lane Group Flow (vph)	272	0	0	3
Turn Type	NA			Perm
Protected Phases	8			
Permitted Phases				1
Detector Phase	8			1
Switch Phase				
Minimum Initial (s)	8.0			8.0
Minimum Split (s)	15.9			14.2
Total Split (s)	60.0			50.0
Total Split (%)	37.5%			31.3%
Maximum Green (s)	52.1			43.8
Yellow Time (s)	3.4			4.1
All-Red Time (s)	4.5			2.1
Lost Time Adjust (s)	0.0			0.0
Total Lost Time (s)	7.9			6.2
Lead/Lag				Lag
Lead-Lag Optimize?				Yes
Vehicle Extension (s)	3.0			3.0
Recall Mode	None			None
Act Effct Green (s)	26.2			43.9
Actuated g/C Ratio	0.19			0.33
v/c Ratio	0.85			0.00
Control Delay	74.6			33.3
Queue Delay	0.0			0.0
Total Delay	74.6			33.3
LOS	E			C
Approach Delay	74.6			
Approach LOS	E			

Lane Group	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL2	NBL	NBT	NBR	SBL
Queue Length 50th (ft)	405				~253	135				208		
Queue Length 95th (ft)	375				#394	209				#332		
Internal Link Dist (ft)	1274					246				1061		
Turn Bay Length (ft)					110							
Base Capacity (vph)	1155				370	2564				499		
Starvation Cap Reductn	0				0	0				0		
Spillback Cap Reductn	0				0	0				0		
Storage Cap Reductn	0				0	0				0		
Reduced v/c Ratio	0.86				1.26	0.33				0.49		

Intersection Summary			
Area Type:	Other		
Cycle Length: 160			
Actuated Cycle Length: 134.4			
Natural Cycle: 140			
Control Type: Actuated-Uncoordinated			
Maximum v/c Ratio: 1.26			
Intersection Signal Delay: 65.7		Intersection LOS: E	
Intersection Capacity Utilization 83.1%		ICU Level of Service E	
Analysis Period (min) 15			

* User Entered Value
~ 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: 4: Orange Ave & S Pennsylvania Ave & W Fairbanks



LANE SUMMARY

Site: 101 [Orange Ave/S Penn./W Fairbanks]

Orange Ave/W Fairbanks Ave/S Pennsylvania Ave
Site Category: (None)
Roundabout

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist ft	Lane Config	Lane Length ft	Cap. Adj. %	Prob. Block. %
South: S Pennsylvania Ave													
Lane 1[d]	246	1.0	366	0.670	100	31.0	LOS D	3.5	88.7	Full	1600	0.0	0.0
Approach	246	1.0		0.670		31.0	LOS D	3.5	88.7				
East: W Fairbanks Ave													
Lane 1	475	1.0	1097	0.433	58[5]	7.9	LOS A	2.4	60.5	Full	1600	0.0	0.0
Lane 2[d]	873	1.0	1171	0.745	100	15.2	LOS C	14.3	359.5	Full	1600	0.0	0.0
Approach	1348	1.0		0.745		12.6	LOS B	14.3	359.5				
North: S Pennsylvania Ave													
Lane 1[d]	258	1.0	440	0.586	100	22.1	LOS C	3.0	75.8	Full	1600	0.0	0.0
Approach	258	1.0		0.586		22.1	LOS C	3.0	75.8				
West: W Fairbanks Ave													
Lane 1	353	1.0	686	0.514	100	13.2	LOS B	3.2	80.8	Full	1600	0.0	0.0
Lane 2[d]	391	1.0	759	0.514	100	12.2	LOS B	3.2	81.8	Full	1600	0.0	0.0
Approach	743	1.0		0.514		12.7	LOS B	3.2	81.8				
SouthWest: N Orange Ave													
Lane 1	398	1.0	573	0.694	100	22.8	LOS C	5.4	135.0	Full	1600	0.0	0.0
Lane 2[d]	446	1.0	643	0.694	100	20.8	LOS C	5.5	139.8	Full	1600	0.0	0.0
Approach	843	1.0		0.694		21.7	LOS C	5.5	139.8				
Intersection	3438	1.0		0.745		16.9	LOS C	14.3	359.5				

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Intersection and Approach LOS values are based on average delay for all lanes (v/c not used as specified in HCM 6).
Roundabout Capacity Model: US HCM 6.
HCM Delay Formula option is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option applies.

Gap-Acceptance Capacity: Traditional M1.
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

5 Lane under-utilisation found by the program
d Dominant lane on roundabout approach

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