

TECHNICAL MEMORANDUM

Date:	April 28, 2016	TG:	15461.00
To:	Min Luo, P.E., PTOE – City of Redmond		
From:	Ryan Peterson, P.E., PTOE – Transpo Group		
cc:	Brenda Fodge – BMC Rose Hill, LLC		
Subject:	Rose Hill Preliminary Plat, Phase 2 Traffic Impact Analysis		

This memorandum describes UCP Rose Hill’s proposed Rose Hill Preliminary Plat project. The scope of this analysis has been previously approved by City of Redmond staff and includes a review of trip generation estimates, pipeline and with-project traffic volumes, traffic operations at both NE 100th Street/132nd Avenue NE and site accesses, signal warrant analysis, and mitigation measures.

Project Description

The proposed project includes the construction of 29 single-family residential units located east of 138th Avenue NE and south of NE 100th Street. Two access points are proposed via 138th Avenue NE. The project site is currently undeveloped. Figure 1 shows the project site and surrounding vicinity and Figure 2 shows the preliminary site plan. It is anticipated the development would be completed and occupied by 2019.



Figure 1. Site Vicinity

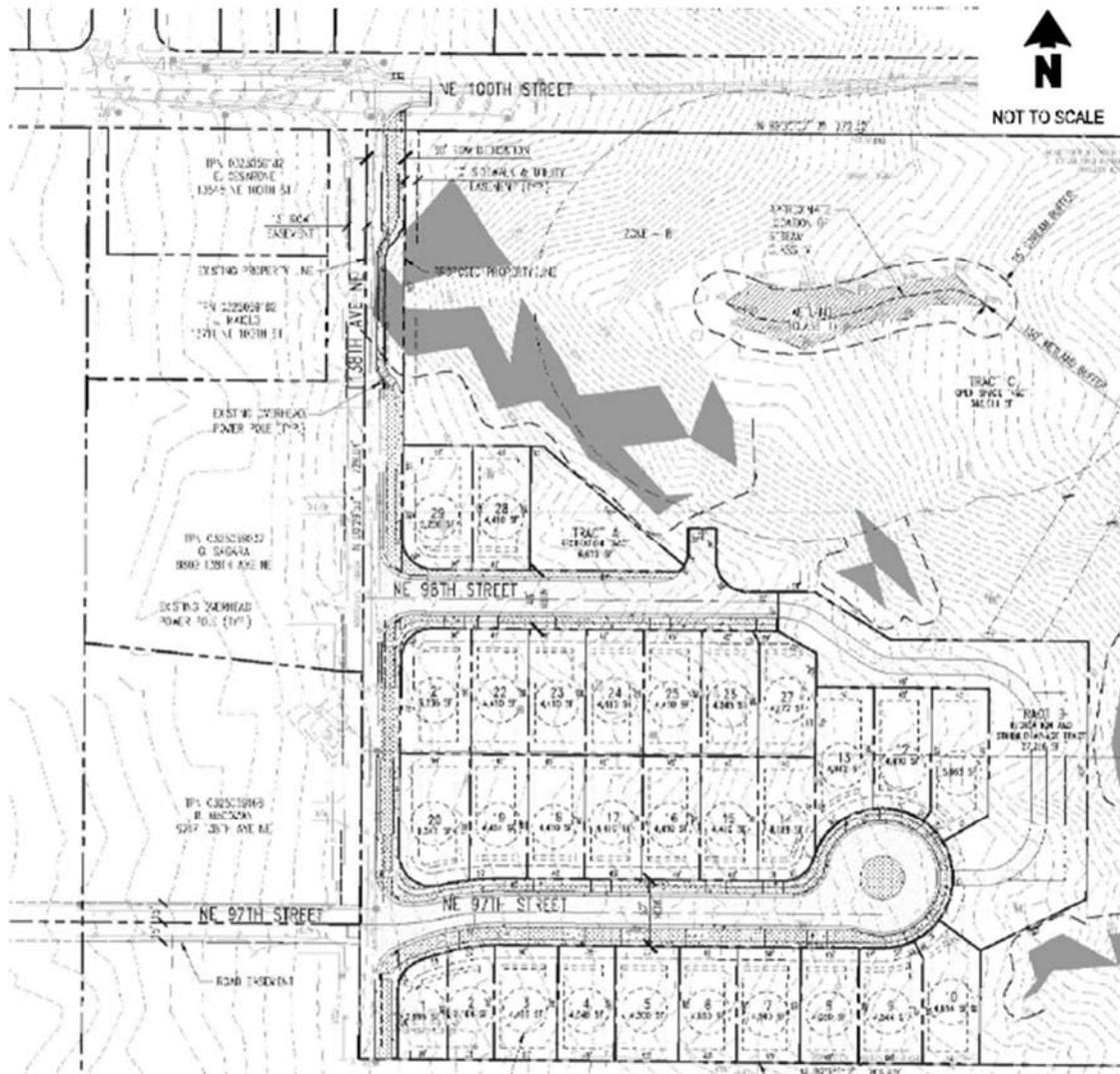


Figure 2. Preliminary Site Plan

Trip Generation

The following table illustrates the anticipated number of new daily, AM peak hour, and PM peak hour vehicle trips the proposed development would likely generate. These estimates were derived by multiplying the proposed number of units (29) by the average daily and peak hour trip generation rates for Land Use Code No. 210 ("Single-Family Detached Housing") published by the Institute of Transportation Engineers (ITE) in the *Trip Generation Manual* (9th Edition, 2012).

Table 1. Trip Generation Summary

Land Use (ITE Code)	Size	Trip Rate ¹	Project Trips		
			In	Out	Total
Single-Family Detached Housing (LU 210)	29 units				
Weekday Daily		9.52	138	138	276
Weekday AM Peak Hour		0.75	6	16	22
Weekday PM Peak Hour		1.00	18	11	29

1. Average trips rates from ITE *Trip Generation Manual*, 9th Edition, 2012

As illustrated above, the proposed development is anticipated to generate approximately 276 new daily vehicle trips with 22 new trips generated during the AM peak hour and 29 new trips generated during the PM peak hour.

Traffic Volumes

AM and PM peak period traffic counts were collected at NE 100th Street/132nd Avenue NE in March 2016. In addition, 12-hour vehicle volumes were collected in April 2016 on each approach of the NE 100th Street/132nd Avenue NE intersection. Detailed intersection traffic counts are provided in Attachment A.

Future horizon year (2019) without-project AM and PM peak hour traffic volumes were estimated at NE 100th Street/132nd Avenue NE by increasing existing through traffic by an annual growth rate of 2 percent and adding project trips from other developments in the project vicinity (“pipeline projects”). Anticipated traffic volumes from the following 7 developments were identified via City of Redmond’s Project Viewer and were used to develop the future without-project traffic volumes:

- North Rose Hill Short Plat
- Willow Hill – Lot 9
- Fu Short Plat
- Short Tom-Duplex
- Benjamin Estates
- Gabarino Property
- Heather’s Ridge

A total of 7 developments (either permitted or under construction) were identified in the site vicinity with sizes ranging from 1 single-family home to 41 single family homes (Heather’s Ridge).

It should be noted that for the developments east of 132nd Avenue NE and north of NE 100th Street, it was assumed that half of the estimated trips travelling to/from the north would use NE 100th Street to access 132nd Avenue NE and half would use NE 104th Street to the north. As a conservative assumption, it was assumed approximately 9 single family homes located south of NE 100th Street could use 138th Avenue NE to access NE 100th Street and would act as through movements at the proposed project’s site access locations.

Pipeline traffic and project-generated traffic were assigned to the roadway network based on separate AM and PM distributions. These distributions, shown in Figures 3 and 4, were based on existing counts at NE 100th Street/132nd Avenue NE.



Figure 3. AM Peak Hour Distribution and Assignment

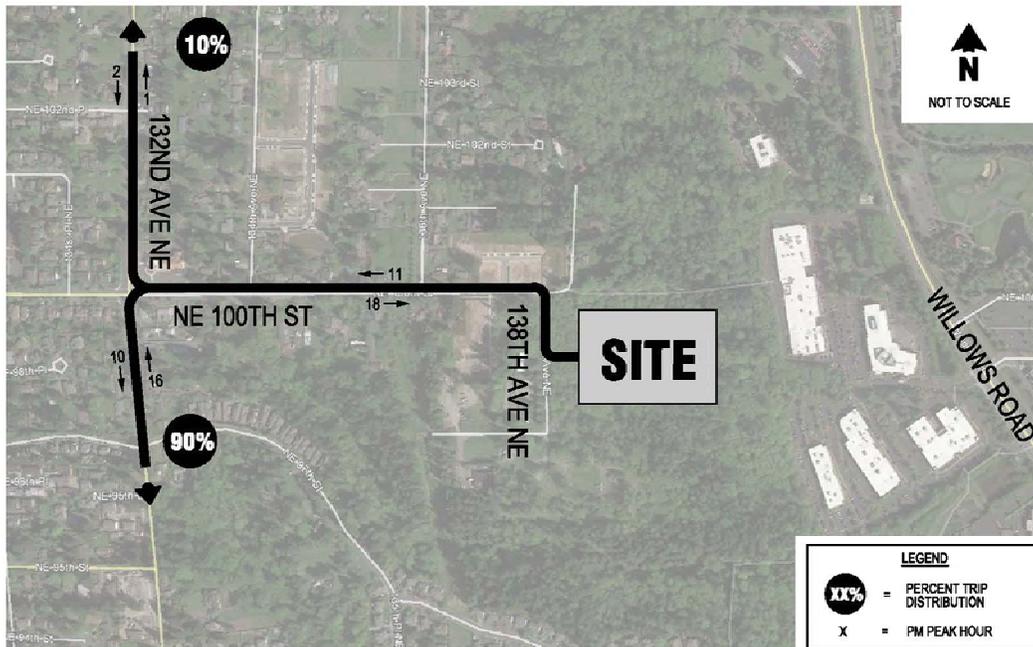


Figure 4. PM Peak Hour Distribution and Assignment

Most project traffic is anticipated to access the site via 132nd Avenue NE (60 percent from the south and 35 percent from the north, respectively) during the AM peak hour. During the PM peak hour, 90 percent of the project trips are expected to access the site from the south while the remaining 10 percent would access from the north. It is anticipated that 5 percent of the project

trips would access the site via NE 100th Street during the AM peak hour only. Existing (2016), future (2019) without-project, and future (2019) with-project traffic volumes are summarized in Figure 5.

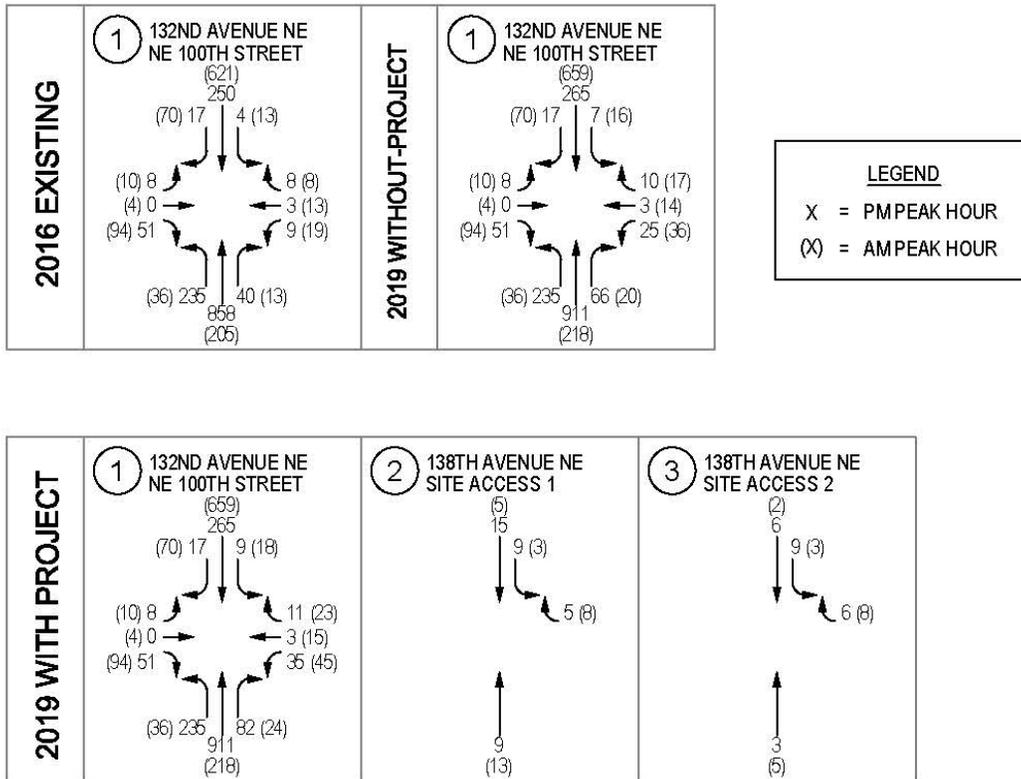


Figure 5. Existing (2016), Future (2019) Without-Project, and Future (2019) With-Project Peak Hour Traffic Volumes

Traffic Operations

Intersection level of service (LOS) for existing, future without-, and with-project conditions were evaluated at the 132nd Avenue NE/ NE 100th Street intersection along with the site accesses using the *Synchro 9* software program based on procedures identified in the *Highway Capacity Manual* (HCM, 2010). All intersection parameters such as channelization and intersection control were consistent through all analysis scenarios. At side-street stop-controlled intersections, LOS is measured in average delay per vehicle during the peak hour of traffic and is reported for the worst operating movement of the intersection. Attachment B provides a detailed explanation of LOS criteria and definitions. Detailed LOS worksheets are provided in Attachment C.

Table 2. Estimated Weekday AM and PM Peak Hour Traffic Operations

Intersection	Existing (2016)			2019 Without-Project			2019 With-Project		
	LOS ¹	Delay ²	WM ³	LOS	Delay	WM	LOS	Delay	WM
<i>AM Peak Hour</i>									
132nd Avenue NE/ NE 100th Street	D	27.7	WB	E	37.1	WB	E	41.9	WB
138th Avenue NE/ Site Access 1	-	-	-	-	-	-	A	8.4	WB
138th Avenue NE/ Site Access 2	-	-	-	-	-	-	A	8.4	WB
<i>PM Peak Hour</i>									
132nd Avenue NE/ NE 100th Street	F	74.5	WB	F	>180	WB	F	>180	WB
138th Avenue NE/ Site Access 1	-	-	-	-	-	-	A	8.5	WB
138th Avenue NE/ Site Access 2	-	-	-	-	-	-	A	8.3	WB

Note: WB = westbound approach

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM), Transportation Research Board.

2. Average delay per vehicle in seconds.

3. Worst movement reported for unsignalized intersections.

The City of Redmond operations standard is LOS D or better. As shown in Table 2, during the AM peak hour, 132nd Avenue NE/ NE 100th Street operates at LOS D under existing conditions and would operate at LOS E during both future (2019) without-project and future with-project conditions. It should be noted that the proposed project would only increase the delay at the intersection by about 5 seconds between without-project and with-project conditions during the AM peak hour. Additionally, westbound vehicle queues are not anticipated to exceed 3 vehicles under with-project conditions.

During the PM peak hour, NE 100th Street/132nd Avenue NE is anticipated to operate at LOS F under all three analysis conditions. It should be noted that the westbound approach would only see an increase in 11 trips with the development of the proposed project. Westbound queues are not anticipated to exceed 5 vehicles at the study intersection under with-project conditions; this would be an increase of about 2 vehicles compared to without-project conditions.

Under both AM and PM peak hour periods, the site access intersections are anticipated to operate at LOS A with less than 10 seconds of delay. Maximum queues at the site accesses are anticipated to be no more than 1 vehicle.

Signal Warrant Analysis

A signal warrant² analysis was conducted for the 132nd Avenue NE/ NE 100th Street intersection under with-project conditions. The following presents the data (geometry and traffic volumes) used to perform the signal warrant analysis, as well as the findings.

Intersection Geometry and Traffic Volumes

The existing 132nd Avenue NE/ NE 100th Street intersection is a 4-way intersection and is stop-controlled for the eastbound and westbound approaches. The future (2019) with-project weekday AM and PM peak hour traffic volumes at the intersection, as previously mentioned, are shown in Figure 3. In addition, 12-hour vehicle counts were collected at the intersection in April 2016; these volumes were also used for the signal warrant analysis. The following sections provide a summary of the methodology for the signal warrants evaluated for the 132nd Avenue NE/ NE 100th Street intersection (Warrants 1,2, and 3).

² *Manual on Uniform Traffic Control Devices* (MUTCD), Federal Highways Administration (2009).

Warrant 1 – Eight Hour Vehicular Volume

Warrant 1 consists of two conditions that independently assess whether a traffic signal is warranted based on traffic volumes. The first condition (Condition A) determines if traffic volumes at an intersection are consistently high enough throughout an average weekday to warrant the installation of a signal. The second condition (Condition B) is considered when Condition A is not met, and assesses whether traffic on the minor street experiences excessive delay due to high traffic volumes on the major street throughout an average weekday. These two conditions are combined such that fulfilling either of the two conditions would meet the warrant for installation of a signal.

Detailed volume threshold criteria are identified for these conditions in the warrant methodology, and if traffic volumes exceed these thresholds for 8 or more hours on an average weekday, the signal warrant is satisfied. Alternatively, if neither of Conditions A or B are met, the volume criteria for both conditions can be reduced to 80 percent of their values such that if both conditions are then met, then installation of a traffic signal could be warranted.

Based on the future with-project traffic volumes shown in Attachment D, Warrant 1 would **not** be satisfied as documented in the traffic volume signal warrant worksheet also provided in Attachment D.

Warrant 2 – Four Hour Vehicular Volume

Signal Warrant 2 is applied where the volume of intersecting traffic is the primary reason for considering installation of a traffic signal. The warrant is satisfied by comparing the traffic volumes on the major street and minor street with a chart included in the MUTCD. If the major and minor street traffic volumes intersect above the MUTCD chart threshold for four or more one-hour periods, then the signal warrant would be satisfied.

Based on the future with-project traffic volumes shown in Attachment D, Warrant 2 would **not** be satisfied as documented in the traffic volume signal warrant worksheet provided in Attachment D.

Warrant 3 – Peak Hour

Signal Warrant 3 is applied when, for a minimum of one-hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. The warrant is satisfied by one of two categories are met:

- If all three of the following conditions exist for four consecutive 15 minute periods:
 - The total stopped time delay by traffic on one of the minor street approaches controlled by a stop sign exceeds 4 vehicle hours for a one lane road; and
 - The volume on the same minor street approach (one direction only) exceeds 100 vehicles per hour for one moving lane; and
 - The total entering volume serviced for during the hour equals or exceeds 800 vehicles per hour for four or more approaches.
- Comparing the traffic volumes on the major street and minor street with a chart included in the MUTCD. If the major street traffic volume and the highest minor street approach volume intersect above the MUTCD chart threshold for four or more one-hour periods, then the signal warrant would be satisfied.

It should be considered that MUTCD notes that this particular signal warrant “shall only be applied in unusual cases such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time” (MUTCD, 2009)). It is unclear as to whether the intersection of 132nd Avenue NE/ NE 100th Street meets this criterion. Regardless, based on the future with-project traffic volumes shown in Attachment D, Warrant 3 would **not** be satisfied as documented in the traffic volume signal warrant worksheet provided in Attachment D.

Mitigation

Mitigation measures have been identified to reduce potential transportation-related project impacts. All site accesses operate at LOS C or better and NE 100th Street/132nd Avenue NE operates at the same LOS during both AM and PM peak hours with or without the addition of project-generated traffic. Therefore mitigation beyond the City’s transportation impact fees is not necessary.

Transportation Impact Fees

The project would be required to pay the City’s Transportation Impact Fee. Per the City of Redmond Impact Fee⁵, the single family dwelling unit fee is \$4,430.66 per unit, resulting in an impact fee of \$128,490 for the 29-unit project. This fee is a preliminary calculation and the final impact fee would be calculated by the City of Redmond at the time of building permit issuance.

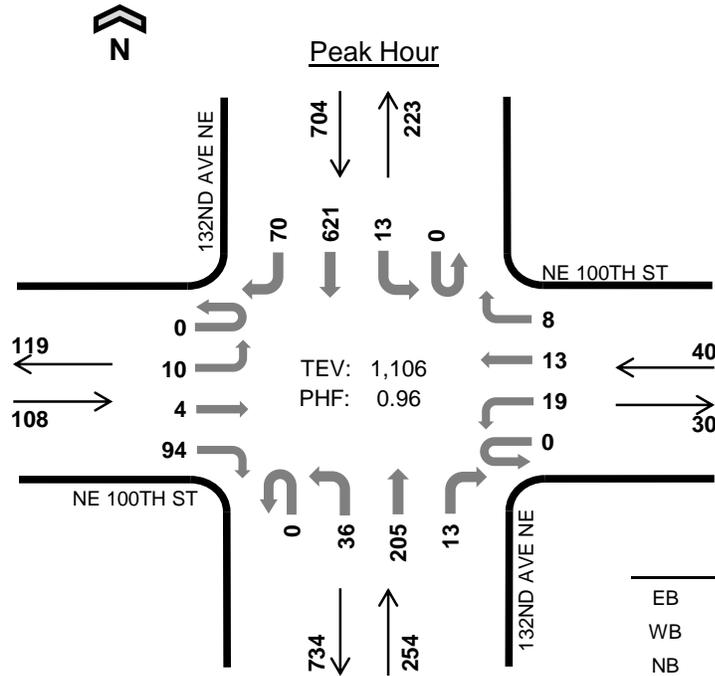
⁵ City of Redmond Impact Fees Schedule



Attachment A: Traffic Counts

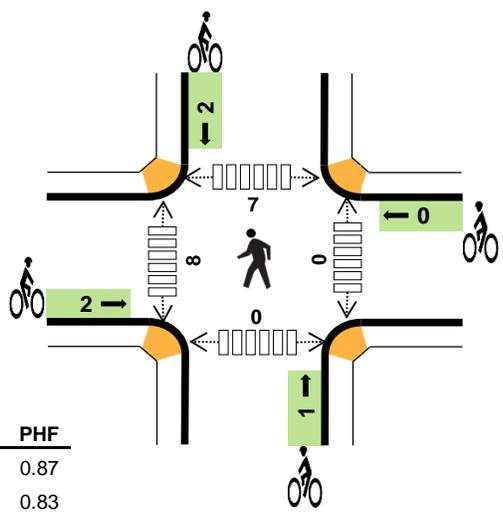


132ND AVE NE NE 100TH ST



Date: Wed, Mar 09, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 8:00 AM to 9:00 AM

	HV %:	PHF
EB	0.0%	0.87
WB	7.5%	0.83
NB	2.8%	0.72
SB	1.6%	0.84
TOTAL	1.9%	0.96



Two-Hour Count Summaries

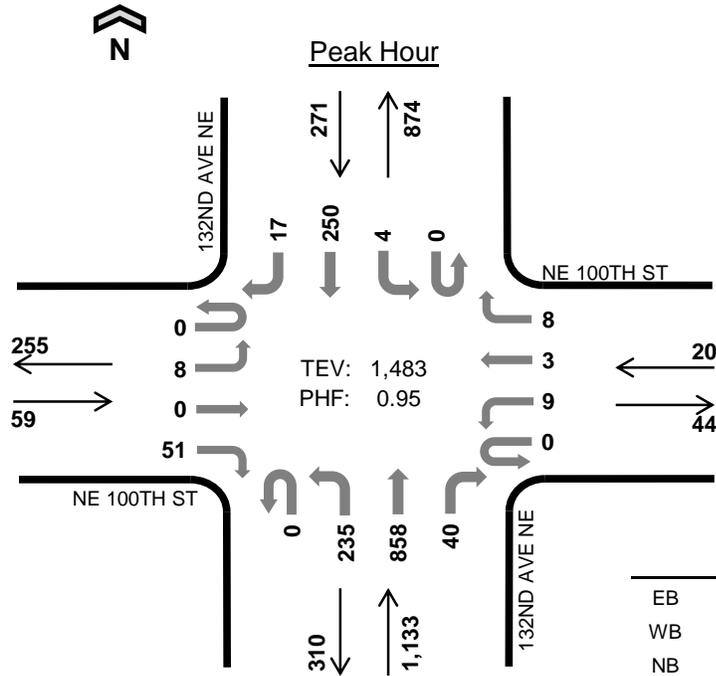
Interval Start	NE 100TH ST Eastbound				NE 100TH ST Westbound				132ND AVE NE Northbound				132ND AVE NE Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	29	0	6	1	0	0	5	40	8	0	3	124	2	218	0
7:15 AM	0	1	0	28	0	8	1	2	0	5	38	3	0	6	142	13	247	0
7:30 AM	0	1	4	22	0	8	7	1	0	12	64	6	0	2	152	8	287	0
7:45 AM	0	0	0	28	0	6	3	0	0	11	56	4	0	1	156	5	270	1,022
8:00 AM	0	1	0	18	0	6	2	1	0	8	52	6	0	6	148	11	259	1,063
8:15 AM	0	5	0	24	0	7	2	0	0	3	30	5	0	3	185	22	286	1,102
8:30 AM	0	4	0	27	0	3	5	4	0	11	50	1	0	3	161	20	289	1,104
8:45 AM	0	0	4	25	0	3	4	3	0	14	73	1	0	1	127	17	272	1,106
Count Total	0	12	8	201	0	47	25	11	0	69	403	34	0	25	1,195	98	2,128	0
Peak Hour	0	10	4	94	0	19	13	8	0	36	205	13	0	13	621	70	1,106	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	1	0	3	4	0	0	0	0	0	0	1	1	0	2
7:15 AM	1	1	0	7	9	0	0	0	0	0	0	1	0	0	1
7:30 AM	1	1	5	2	9	0	0	0	1	1	0	0	1	0	1
7:45 AM	0	4	5	2	11	1	0	0	0	1	0	1	3	0	4
8:00 AM	0	0	2	4	6	1	0	1	1	3	0	6	1	0	7
8:15 AM	0	0	1	2	3	1	0	0	0	1	0	1	1	0	2
8:30 AM	0	2	1	3	6	0	0	0	0	0	0	1	4	0	5
8:45 AM	0	1	3	2	6	0	0	0	1	1	0	0	1	0	1
Count Total	2	10	17	25	54	3	0	1	3	7	0	11	12	0	23
Peak Hour	0	3	7	11	21	2	0	1	2	5	0	8	7	0	15

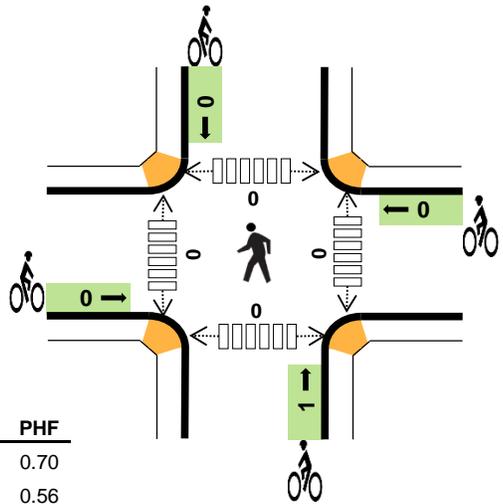


132ND AVE NE NE 100TH ST



Date: Wed, Mar 09, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:15 PM to 5:15 PM

	HV %:	PHF
EB	1.7%	0.70
WB	5.0%	0.56
NB	0.5%	0.95
SB	2.2%	0.85
TOTAL	0.9%	0.95



Two-Hour Count Summaries

Interval Start	NE 100TH ST Eastbound				NE 100TH ST Westbound				132ND AVE NE Northbound				132ND AVE NE Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	3	0	17	0	2	2	5	0	46	168	10	0	0	59	6	318	0
4:15 PM	0	2	0	9	0	1	0	2	0	73	211	4	0	1	52	3	358	0
4:30 PM	0	1	0	13	0	0	0	1	0	56	207	11	0	0	73	7	369	0
4:45 PM	0	3	0	10	0	2	1	4	0	56	228	14	0	3	64	6	391	1,436
5:00 PM	0	2	0	19	0	6	2	1	0	50	212	11	0	0	61	1	365	1,483
5:15 PM	0	2	0	15	0	3	2	2	0	54	178	6	0	0	61	3	326	1,451
5:30 PM	0	4	1	12	0	1	1	2	0	40	212	7	0	0	53	7	340	1,422
5:45 PM	0	6	1	15	0	0	1	3	0	55	211	7	0	1	76	6	382	1,413
Count Total	0	23	2	110	0	15	9	20	0	430	1,627	70	0	5	499	39	2,849	0
Peak Hour	0	8	0	51	0	9	3	8	0	235	858	40	0	4	250	17	1,483	0

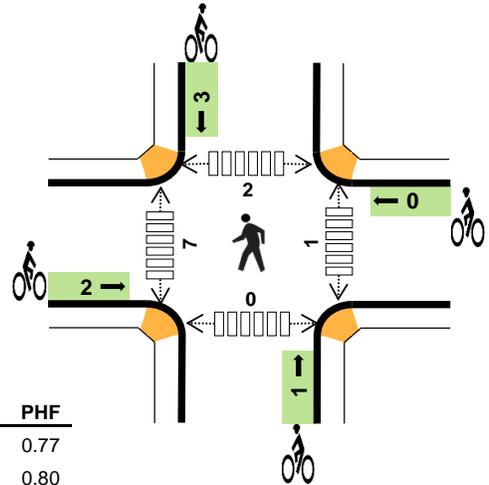
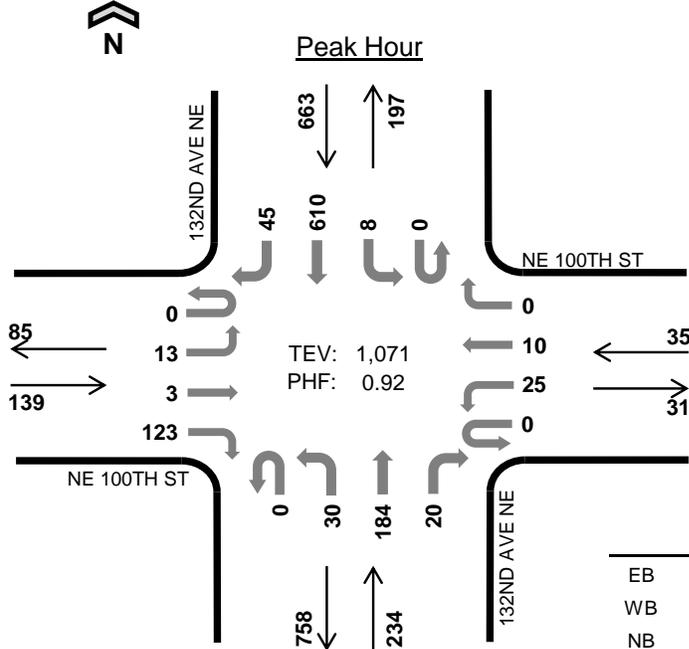
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	1	2	2	5	0	0	0	0	0	0	0	0	0	0
4:15 PM	1	0	2	2	5	0	0	0	0	0	0	0	0	0	0
4:30 PM	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0
4:45 PM	0	1	0	2	3	0	0	0	0	0	0	0	0	0	0
5:00 PM	0	0	3	1	4	0	0	1	0	1	0	0	0	0	0
5:15 PM	0	0	0	1	1	1	0	0	0	1	0	0	1	0	1
5:30 PM	0	0	2	0	2	0	0	1	0	1	0	0	1	0	1
5:45 PM	0	0	1	1	2	0	0	1	0	1	0	1	1	0	2
Count Total	1	2	11	10	24	1	0	3	0	4	0	1	3	0	4
Peak Hour	1	1	6	6	14	0	0	1	0	1	0	0	0	0	0

132ND AVE NE NE 100TH ST



Date: Tue, Apr 12, 2016
 Count Period: 7:00 AM to 1:00 PM
 Peak Hour: 7:30 AM to 8:30 AM



	HV %:	PHF
EB	0.0%	0.77
WB	17.1%	0.80
NB	4.3%	0.85
SB	1.5%	0.88
TOTAL	2.4%	0.92

Six-Hour Count Summaries

Interval Start	NE 100TH ST				NE 100TH ST				132ND AVE NE				132ND AVE NE				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:30 AM	0	0	0	34	0	8	3	0	0	12	51	6	0	2	151	6	273	0
7:45 AM	0	0	1	35	0	8	2	0	0	7	46	8	0	2	153	6	268	0
8:00 AM	0	1	1	22	0	7	1	0	0	8	38	6	0	4	140	11	239	0
8:15 AM	0	12	1	32	0	2	4	0	0	3	49	0	0	0	166	22	291	1,071
Peak Hour	0	13	3	123	0	25	10	0	0	30	184	20	0	8	610	45	1,071	0

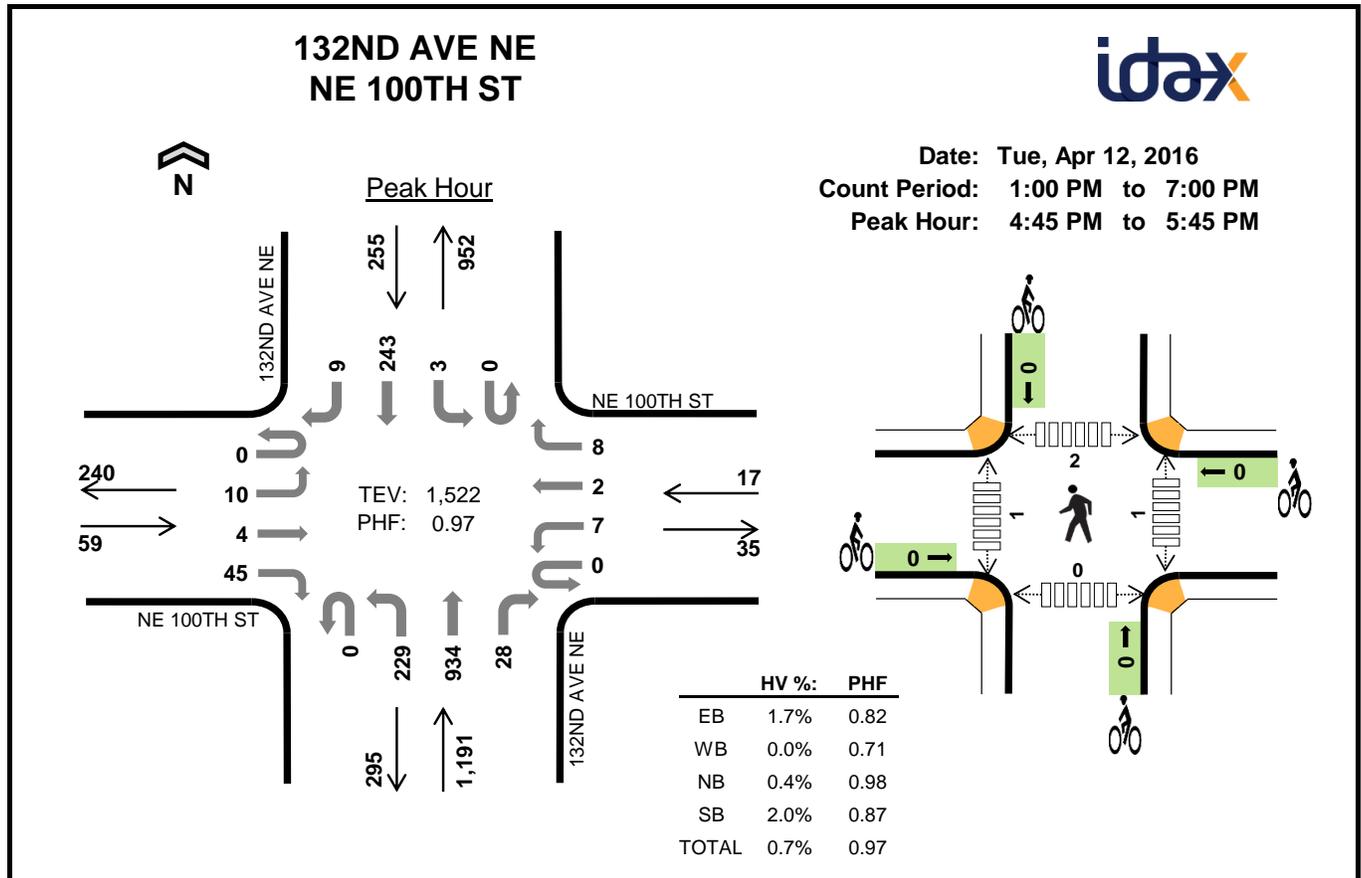
Note: For all three-hour count summary, see next page.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:30 AM	0	2	1	5	8	0	0	0	0	0	1	0	1	0	2
7:45 AM	0	0	6	2	8	0	0	0	1	1	0	0	0	0	0
8:00 AM	0	3	1	2	6	1	0	1	1	3	0	5	1	0	6
8:15 AM	0	1	2	1	4	1	0	0	1	2	0	2	0	0	2
Peak Hour	0	6	10	10	26	2	0	1	3	6	1	7	2	0	10

Six-Hour Count Summaries																		
Interval Start	NE 100TH ST				NE 100TH ST				132ND AVE NE				132ND AVE NE				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	1	0	24	0	12	1	0	0	3	35	4	0	2	126	3	211	0
7:15 AM	0	0	0	30	0	3	1	1	0	14	42	5	0	6	111	7	220	0
7:30 AM	0	0	0	34	0	8	3	0	0	12	51	6	0	2	151	6	273	0
7:45 AM	0	0	1	35	0	8	2	0	0	7	46	8	0	2	153	6	268	972
8:00 AM	0	1	1	22	0	7	1	0	0	8	38	6	0	4	140	11	239	1,000
8:15 AM	0	12	1	32	0	2	4	0	0	3	49	0	0	0	166	22	291	1,071
8:30 AM	0	0	1	26	0	3	3	1	0	6	62	2	0	1	134	5	244	1,042
8:45 AM	0	3	1	29	0	3	10	0	0	10	68	0	0	0	150	5	279	1,053
9:00 AM	0	1	1	33	0	4	1	4	0	7	56	3	0	2	109	8	229	1,043
9:15 AM	0	3	2	30	0	4	0	1	0	10	36	6	0	1	119	8	220	972
9:30 AM	0	0	1	25	0	6	4	1	0	6	31	5	0	1	101	6	187	915
9:45 AM	0	0	0	21	0	2	5	2	0	5	28	2	0	2	76	1	144	780
10:00 AM	0	0	1	17	0	4	3	1	0	5	35	5	0	2	38	2	113	664
10:15 AM	0	0	0	8	0	8	3	1	0	5	53	4	0	2	53	2	139	583
10:30 AM	0	3	0	10	0	5	2	2	0	5	39	7	0	1	61	2	137	533
10:45 AM	0	0	0	9	0	7	1	3	0	6	34	4	0	1	56	0	121	510
11:00 AM	0	1	1	6	0	2	2	1	0	9	36	4	0	0	46	6	114	511
11:15 AM	0	0	1	11	0	3	1	1	0	14	48	1	0	1	47	3	131	503
11:30 AM	0	1	2	13	0	7	1	3	0	8	37	4	0	1	75	2	154	520
11:45 AM	0	3	0	12	0	5	2	1	0	15	56	2	0	4	91	6	197	596
12:00 PM	0	3	0	13	0	4	2	2	0	10	49	6	0	1	58	5	153	635
12:15 PM	0	0	1	10	0	3	1	4	0	15	56	4	0	0	40	1	135	639
12:30 PM	0	3	0	3	0	3	2	1	0	11	54	4	0	1	47	1	130	615
12:45 PM	0	4	1	9	0	1	0	1	0	15	54	7	0	4	41	1	138	556
Count Total	0	39	16	462	0	114	55	31	0	209	1,093	99	0	41	2,189	119	4,467	0
Peak Hour	0	13	3	123	0	25	10	0	0	30	184	20	0	8	610	45	1,071	0

Note: Six-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	2	1	1	4	0	0	0	2	2	2	3	2	0	7
7:15 AM	0	0	2	7	9	0	1	1	2	4	0	3	2	0	5
7:30 AM	0	2	1	5	8	0	0	0	0	0	1	0	1	0	2
7:45 AM	0	0	6	2	8	0	0	0	1	1	0	0	0	0	0
8:00 AM	0	3	1	2	6	1	0	1	1	3	0	5	1	0	6
8:15 AM	0	1	2	1	4	1	0	0	1	2	0	2	0	0	2
8:30 AM	0	0	1	4	5	1	0	0	1	2	0	1	1	0	2
8:45 AM	1	0	1	1	3	0	0	1	0	1	0	0	0	0	0
9:00 AM	1	1	2	1	5	0	0	0	0	0	0	1	1	0	2
9:15 AM	1	0	2	1	4	0	0	0	0	0	0	2	2	0	4
9:30 AM	1	1	0	4	6	0	0	1	0	1	0	0	0	0	0
9:45 AM	0	0	2	0	2	0	0	0	0	0	0	1	0	0	1
10:00 AM	0	0	2	0	2	0	0	0	0	0	1	0	1	0	2
10:15 AM	0	1	2	1	4	0	0	1	1	2	2	1	2	0	5
10:30 AM	1	2	2	2	7	0	0	1	0	1	0	0	2	0	2
10:45 AM	0	3	3	0	6	1	0	0	1	2	0	0	0	0	0
11:00 AM	0	2	2	0	4	0	0	0	0	0	0	2	0	0	2
11:15 AM	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0
11:30 AM	0	0	3	1	4	0	0	1	0	1	0	0	0	0	0
11:45 AM	0	0	3	1	4	0	0	0	0	0	0	1	0	0	1
12:00 PM	0	1	3	3	7	0	0	0	1	1	0	3	1	0	4
12:15 PM	2	1	2	0	5	0	0	0	1	1	1	0	0	0	1
12:30 PM	0	0	3	1	4	0	0	0	0	0	0	2	1	0	3
12:45 PM	0	0	2	2	4	0	0	0	0	0	0	0	0	0	0
Count Total	7	20	50	40	117	4	1	7	12	24	7	27	17	0	51
Peak Hour	0	6	10	10	26	2	0	1	3	6	1	7	2	0	10



Six-Hour Count Summaries

Interval Start	NE 100TH ST				NE 100TH ST				132ND AVE NE				132ND AVE NE				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:45 PM	0	3	2	8	0	1	0	0	0	56	243	5	0	2	68	3	391	0
5:00 PM	0	1	1	12	0	1	1	4	0	60	229	14	0	0	64	1	388	0
5:15 PM	0	2	1	11	0	3	1	0	0	55	227	3	0	1	56	2	362	0
5:30 PM	0	4	0	14	0	2	0	4	0	58	235	6	0	0	55	3	381	1,522
Peak Hour	0	10	4	45	0	7	2	8	0	229	934	28	0	3	243	9	1,522	0

Note: For all three-hour count summary, see next page.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:45 PM	0	0	2	2	4	0	0	0	0	0	1	0	1	0	2
5:00 PM	1	0	1	1	3	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	2	1	3	0	0	0	0	0	0	1	1	0	2
5:30 PM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Peak Hour	1	0	5	5	11	0	0	0	0	0	1	1	2	0	4

Six-Hour Count Summaries																		
Interval Start	NE 100TH ST				NE 100TH ST				132ND AVE NE				132ND AVE NE				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
1:00 PM	0	0	3	10	0	1	1	1	0	9	65	4	0	2	36	4	136	0
1:15 PM	0	2	0	7	0	2	5	2	0	15	47	2	0	1	34	4	121	0
1:30 PM	0	3	3	8	0	4	1	2	0	3	44	4	0	3	47	4	126	0
1:45 PM	0	1	0	5	0	2	3	0	0	13	42	8	0	1	49	4	128	511
2:00 PM	0	1	2	7	0	2	1	2	0	22	43	2	0	2	56	3	143	518
2:15 PM	0	3	1	9	0	4	2	1	0	14	68	8	0	0	39	2	151	548
2:30 PM	0	2	1	5	0	5	4	0	0	14	87	8	0	0	76	3	205	627
2:45 PM	0	2	1	11	0	7	2	0	0	22	82	7	0	0	56	6	196	695
3:00 PM	0	13	2	10	0	2	2	3	0	29	120	5	0	0	49	7	242	794
3:15 PM	0	5	3	14	0	2	1	1	0	34	124	4	0	0	49	4	241	884
3:30 PM	0	5	3	10	0	2	3	1	0	31	111	6	0	0	65	4	241	920
3:45 PM	0	3	2	8	0	3	1	3	0	42	171	4	0	0	65	3	305	1,029
4:00 PM	0	2	1	5	0	2	0	1	0	43	186	5	0	2	58	3	308	1,095
4:15 PM	0	4	0	3	0	2	1	0	0	66	194	3	0	0	68	7	348	1,202
4:30 PM	0	1	2	9	0	4	0	4	0	53	221	12	0	0	60	4	370	1,331
4:45 PM	0	3	2	8	0	1	0	0	0	56	243	5	0	2	68	3	391	1,417
5:00 PM	0	1	1	12	0	1	1	4	0	60	229	14	0	0	64	1	388	1,497
5:15 PM	0	2	1	11	0	3	1	0	0	55	227	3	0	1	56	2	362	1,511
5:30 PM	0	4	0	14	0	2	0	4	0	58	235	6	0	0	55	3	381	1,522
5:45 PM	0	4	0	9	0	1	2	1	0	59	223	9	0	0	40	3	351	1,482
6:00 PM	0	2	1	10	0	1	0	0	0	52	219	3	0	0	60	3	351	1,445
6:15 PM	0	1	1	7	0	1	2	2	0	56	224	8	0	1	48	4	355	1,438
6:30 PM	0	2	0	13	0	0	2	1	0	57	182	5	0	0	47	4	313	1,370
6:45 PM	0	1	0	7	0	6	3	1	0	43	142	5	0	0	29	1	238	1,257
Count Total	0	67	30	212	0	60	38	34	0	906	3,529	140	0	15	1,274	86	6,391	0
Peak Hour	0	10	4	45	0	7	2	8	0	229	934	28	0	3	243	9	1,522	0

Note: Six-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
1:00 PM	0	0	1	1	2	0	0	0	1	1	0	0	0	0	0
1:15 PM	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0
1:30 PM	1	0	0	1	2	0	0	1	0	1	0	0	0	0	0
1:45 PM	0	0	2	4	6	0	0	0	0	0	0	0	0	0	0
2:00 PM	0	0	2	1	3	0	0	0	0	0	0	0	1	0	1
2:15 PM	1	2	2	1	6	0	0	1	0	1	0	0	0	0	0
2:30 PM	0	0	3	2	5	0	0	1	0	1	0	0	1	0	1
2:45 PM	0	0	1	1	2	0	0	0	0	0	0	0	3	0	3
3:00 PM	2	0	9	3	14	0	0	1	0	1	0	0	2	0	2
3:15 PM	2	1	2	0	5	0	1	0	0	1	0	1	1	0	2
3:30 PM	2	0	1	1	4	0	0	1	0	1	0	0	0	0	0
3:45 PM	1	1	3	3	8	0	0	0	0	0	0	1	0	0	1
4:00 PM	1	0	3	1	5	0	0	0	1	1	1	0	1	0	2
4:15 PM	0	0	1	0	1	0	0	0	0	0	0	0	1	0	1
4:30 PM	0	0	3	1	4	0	0	2	0	2	0	0	2	0	2
4:45 PM	0	0	2	2	4	0	0	0	0	0	1	0	1	0	2
5:00 PM	1	0	1	1	3	0	0	0	0	0	0	0	0	0	0
5:15 PM	0	0	2	1	3	0	0	0	0	0	0	1	1	0	2
5:30 PM	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
5:45 PM	0	0	1	1	2	0	0	1	1	2	1	0	0	0	1
6:00 PM	1	0	0	0	1	0	1	1	0	2	0	0	0	0	0
6:15 PM	0	1	4	1	6	0	0	0	0	0	0	0	0	0	0
6:30 PM	0	0	4	1	5	0	0	0	0	0	1	0	0	0	1
6:45 PM	0	0	0	1	1	0	0	0	0	0	0	1	1	0	2
Count Total	12	5	48	29	94	0	2	9	4	15	4	4	15	0	23
Peak Hour	1	0	5	5	11	0	0	0	0	0	1	1	2	0	4

Attachment B: LOS Definitions



Highway Capacity Manual 2010

Signalized intersection level of service (LOS) is defined in terms of a weighted average control delay for the entire intersection. Control delay quantifies the increase in travel time that a vehicle experiences due to the traffic signal control as well as provides a surrogate measure for driver discomfort and fuel consumption. Signalized intersection LOS is stated in terms of average control delay per vehicle (in seconds) during a specified time period (e.g., weekday PM peak hour). Control delay is a complex measure based on many variables, including signal phasing and coordination (i.e., progression of movements through the intersection and along the corridor), signal cycle length, and traffic volumes with respect to intersection capacity and resulting queues. Table 1 summarizes the LOS criteria for signalized intersections, as described in the *Highway Capacity Manual 2010* (Transportation Research Board, 2010).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)	General Description
A	≤10	Free Flow
B	>10 – 20	Stable Flow (slight delays)
C	>20 – 35	Stable flow (acceptable delays)
D	>35 – 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 – 80	Unstable flow (intolerable delay)
F ¹	>80	Forced flow (congested and queues fail to clear)

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio for a lane group exceeds 1.0 LOS F is assigned to the individual lane group. LOS for overall approach or intersection is determined solely by the control delay.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop and two-way stop control. All-way stop control intersection LOS is expressed in terms of the weighted average control delay of the overall intersection or by approach. Two-way stop-controlled intersection LOS is defined in terms of the average control delay for each minor-street movement (or shared movement) as well as major-street left-turns. This approach is because major-street through vehicles are assumed to experience zero delay, a weighted average of all movements results in very low overall average delay, and this calculated low delay could mask deficiencies of minor movements. Table 2 shows LOS criteria for unsignalized intersections.

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F ¹	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio exceeds 1.0, LOS F is assigned an individual lane group for all unsignalized intersections, or minor street approach at two-way stop-controlled intersections. Overall intersection LOS is determined solely by control delay.

Attachment C: LOS Worksheets



Intersection												
Int Delay, s/veh	3.1											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	10	4	94	19	13	8	36	205	13	13	621	70
Future Vol, veh/h	10	4	94	19	13	8	36	205	13	13	621	70
Conflicting Peds, #/hr	15	0	8	0	0	7	8	0	0	7	0	15
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	0	8	8	8	3	3	3	2	2	2
Mvmt Flow	10	4	98	20	14	8	38	214	14	14	647	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1002	998	670	1042	991	242	662	0	0	234	0	0
Stage 1	689	689	-	302	302	-	-	-	-	-	-	-
Stage 2	313	309	-	740	689	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.18	6.58	6.28	4.13	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.572	4.072	3.372	2.227	-	-	2.218	-	-
Pot Cap-1 Maneuver	223	246	460	202	240	782	922	-	-	1333	-	-
Stage 1	439	450	-	695	654	-	-	-	-	-	-	-
Stage 2	702	663	-	399	438	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	194	225	450	146	220	766	915	-	-	1314	-	-
Mov Cap-2 Maneuver	194	225	-	146	220	-	-	-	-	-	-	-
Stage 1	412	436	-	657	618	-	-	-	-	-	-	-
Stage 2	637	627	-	301	424	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	18	27.7	1.3	0.1
HCM LOS	C	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	915	-	-	388	200	1314	-
HCM Lane V/C Ratio	0.041	-	-	0.29	0.208	0.01	-
HCM Control Delay (s)	9.1	0	-	18	27.7	7.8	0
HCM Lane LOS	A	A	-	C	D	A	A
HCM 95th %tile Q(veh)	0.1	-	-	1.2	0.8	0	-

Intersection												
Int Delay, s/veh	4.2											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	10	4	94	36	14	17	36	218	20	16	659	70
Future Vol, veh/h	10	4	94	36	14	17	36	218	20	16	659	70
Conflicting Peds, #/hr	15	0	8	0	0	7	8	0	0	7	0	15
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	0	8	8	8	3	3	3	2	2	2
Mvmt Flow	10	4	98	38	15	18	38	227	21	17	686	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1071	1065	709	1106	1055	260	701	0	0	255	0	0
Stage 1	735	735	-	320	320	-	-	-	-	-	-	-
Stage 2	336	330	-	786	735	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.18	6.58	6.28	4.13	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.572	4.072	3.372	2.227	-	-	2.218	-	-
Pot Cap-1 Maneuver	200	224	438	183	220	764	891	-	-	1310	-	-
Stage 1	414	428	-	679	642	-	-	-	-	-	-	-
Stage 2	682	649	-	377	417	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	169	204	428	129	200	748	884	-	-	1291	-	-
Mov Cap-2 Maneuver	169	204	-	129	200	-	-	-	-	-	-	-
Stage 1	388	412	-	641	606	-	-	-	-	-	-	-
Stage 2	609	612	-	279	402	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.4	37.1	1.2	0.2
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	884	-	-	362	180	1291	-
HCM Lane V/C Ratio	0.042	-	-	0.311	0.388	0.013	-
HCM Control Delay (s)	9.3	0	-	19.4	37.1	7.8	0
HCM Lane LOS	A	A	-	C	E	A	A
HCM 95th %tile Q(veh)	0.1	-	-	1.3	1.7	0	-

Intersection

Int Delay, s/veh 5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	10	4	94	45	15	23	36	218	24	18	659	70
Future Vol, veh/h	10	4	94	45	15	23	36	218	24	18	659	70
Conflicting Peds, #/hr	15	0	8	0	0	7	8	0	0	7	0	15
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	0	0	0	8	8	8	3	3	3	2	2	2
Mvmt Flow	10	4	98	47	16	24	38	227	25	19	686	73

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1080	1073	709	1112	1061	262	701	0	0	259	0	0
Stage 1	739	739	-	322	322	-	-	-	-	-	-	-
Stage 2	341	334	-	790	739	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.18	6.58	6.28	4.13	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.18	5.58	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.572	4.072	3.372	2.227	-	-	2.218	-	-
Pot Cap-1 Maneuver	197	222	438	181	218	762	891	-	-	1306	-	-
Stage 1	412	427	-	677	640	-	-	-	-	-	-	-
Stage 2	678	647	-	375	415	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	164	201	428	128	198	746	884	-	-	1287	-	-
Mov Cap-2 Maneuver	164	201	-	128	198	-	-	-	-	-	-	-
Stage 1	386	410	-	639	604	-	-	-	-	-	-	-
Stage 2	599	611	-	277	398	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	19.5	41.9	1.2	0.2
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	884	-	-	359	181	1287	-	-
HCM Lane V/C Ratio	0.042	-	-	0.313	0.478	0.015	-	-
HCM Control Delay (s)	9.3	0	-	19.5	41.9	7.8	0	-
HCM Lane LOS	A	A	-	C	E	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.3	2.3	0	-	-

Intersection

Int Delay, s/veh 3.1

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	0	8	13	0	3	5
Future Vol, veh/h	0	8	13	0	3	5
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	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	8	14	0	3	5

Major/Minor	Minor1	Minor2	Major1	Major2	Major3	Major4
Conflicting Flow All	25	14	0	0	14	0
Stage 1	14	-	-	-	-	-
Stage 2	11	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	991	1066	-	-	1604	-
Stage 1	1009	-	-	-	-	-
Stage 2	1012	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	989	1066	-	-	1604	-
Mov Cap-2 Maneuver	989	-	-	-	-	-
Stage 1	1009	-	-	-	-	-
Stage 2	1010	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.4	0	2.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	1066	1604	-
HCM Lane V/C Ratio	-	-	0.008	0.002	-
HCM Control Delay (s)	-	-	8.4	7.2	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Intersection

Int Delay, s/veh 4.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	0	8	5	0	3	2
Future Vol, veh/h	0	8	5	0	3	2
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	96	96	96	96	96	96
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	8	5	0	3	2

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	13	5	0
Stage 1	5	-	-
Stage 2	8	-	-
Critical Hdwy	6.42	6.22	4.12
Critical Hdwy Stg 1	5.42	-	-
Critical Hdwy Stg 2	5.42	-	-
Follow-up Hdwy	3.518	3.318	2.218
Pot Cap-1 Maneuver	1006	1078	1616
Stage 1	1018	-	-
Stage 2	1015	-	-
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1004	1078	1616
Mov Cap-2 Maneuver	1004	-	-
Stage 1	1018	-	-
Stage 2	1013	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.4	0	4.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 1078	1616	-
HCM Lane V/C Ratio	-	- 0.008	0.002	-
HCM Control Delay (s)	-	- 8.4	7.2	0
HCM Lane LOS	-	- A	A	A
HCM 95th %tile Q(veh)	-	- 0	0	-

Intersection												
Int Delay, s/veh	3.3											

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	8	0	51	9	3	8	235	858	40	4	250	17
Future Vol, veh/h	8	0	51	9	3	8	235	858	40	4	250	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	5	5	5	1	1	1	2	2	2
Mvmt Flow	8	0	54	9	3	8	247	903	42	4	263	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1697	1712	263	1717	1691	924	263	0	0	945	0	0
Stage 1	272	272	-	1419	1419	-	-	-	-	-	-	-
Stage 2	1425	1440	-	298	272	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.15	6.55	6.25	4.11	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.545	4.045	3.345	2.209	-	-	2.218	-	-
Pot Cap-1 Maneuver	73	90	776	70	92	322	1307	-	-	726	-	-
Stage 1	734	685	-	167	200	-	-	-	-	-	-	-
Stage 2	168	198	-	704	679	-	-	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	47	53	776	45	55	322	1307	-	-	726	-	-
Mov Cap-2 Maneuver	47	53	-	45	55	-	-	-	-	-	-	-
Stage 1	439	680	-	100	120	-	-	-	-	-	-	-
Stage 2	95	118	-	651	674	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24.1	74.5	1.7	0.1
HCM LOS	C	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1307	-	-	250	72	726	-	-
HCM Lane V/C Ratio	0.189	-	-	0.248	0.292	0.006	-	-
HCM Control Delay (s)	8.4	0	-	24.1	74.5	10	0	-
HCM Lane LOS	A	A	-	C	F	A	A	-
HCM 95th %tile Q(veh)	0.7	-	-	1	1.1	0	-	-

Intersection

Int Delay, s/veh 7.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	8	0	51	25	3	10	235	911	66	7	265	17
Future Vol, veh/h	8	0	51	25	3	10	235	911	66	7	265	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	5	5	5	1	1	1	2	2	2
Mvmt Flow	8	0	54	26	3	11	247	959	69	7	279	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1789	1817	279	1809	1782	994	279	0	0	1028	0	0
Stage 1	294	294	-	1488	1488	-	-	-	-	-	-	-
Stage 2	1495	1523	-	321	294	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.15	6.55	6.25	4.11	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.545	4.045	3.345	2.209	-	-	2.218	-	-
Pot Cap-1 Maneuver	63	78	760	60	81	294	1289	-	-	676	-	-
Stage 1	714	670	-	152	185	-	-	-	-	-	-	-
Stage 2	153	180	-	684	664	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	37	42	760	36	44	294	1289	-	-	676	-	-
Mov Cap-2 Maneuver	37	42	-	36	44	-	-	-	-	-	-	-
Stage 1	389	662	-	83	101	-	-	-	-	-	-	-
Stage 2	78	98	-	628	656	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	29.5	214.3	1.6	0.3
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1289	-	-	208	48	676	-	-
HCM Lane V/C Ratio	0.192	-	-	0.299	0.833	0.011	-	-
HCM Control Delay (s)	8.5	0	-	29.5	214.3	10.4	0	-
HCM Lane LOS	A	A	-	D	F	B	A	-
HCM 95th %tile Q(veh)	0.7	-	-	1.2	3.4	0	-	-

Intersection

Int Delay, s/veh 12.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Traffic Vol, veh/h	8	0	51	35	3	11	235	911	82	9	265	17
Future Vol, veh/h	8	0	51	35	3	11	235	911	82	9	265	17
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	200
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	5	5	5	1	1	1	2	2	2
Mvmt Flow	8	0	54	37	3	12	247	959	86	9	279	18

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1802	1838	279	1822	1795	1002	279	0	0	1045	0	0
Stage 1	298	298	-	1497	1497	-	-	-	-	-	-	-
Stage 2	1504	1540	-	325	298	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.15	6.55	6.25	4.11	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.15	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.545	4.045	3.345	2.209	-	-	2.218	-	-
Pot Cap-1 Maneuver	62	76	760	59	79	290	1289	-	-	666	-	-
Stage 1	711	667	-	150	183	-	-	-	-	-	-	-
Stage 2	151	177	-	681	662	-	-	-	-	-	-	-
Platoon blocked, %												
Mov Cap-1 Maneuver	35	40	760	~ 34	41	290	1289	-	-	666	-	-
Mov Cap-2 Maneuver	35	40	-	~ 34	41	-	-	-	-	-	-	-
Stage 1	378	656	-	80	97	-	-	-	-	-	-	-
Stage 2	75	94	-	623	651	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	30.9	\$ 350.9	1.6	0.3
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1289	-	-	200	43	666	-
HCM Lane V/C Ratio	0.192	-	-	0.311	1.2	0.014	-
HCM Control Delay (s)	8.5	0	-	30.9	\$ 350.9	10.5	0
HCM Lane LOS	A	A	-	D	F	B	A
HCM 95th %tile Q(veh)	0.7	-	-	1.3	5	0	-

Notes

-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Intersection

Int Delay, s/veh 2.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	0	5	9	0	9	15
Future Vol, veh/h	0	5	9	0	9	15
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	25	25	25	25	25	25
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	20	36	0	36	60

Major/Minor	Minor1	Major1	Major2
Conflicting Flow All	168	36	0
Stage 1	36	-	-
Stage 2	132	-	-
Critical Hdwy	6.4	6.2	4.1
Critical Hdwy Stg 1	5.4	-	-
Critical Hdwy Stg 2	5.4	-	-
Follow-up Hdwy	3.5	3.3	2.2
Pot Cap-1 Maneuver	827	1042	1588
Stage 1	992	-	-
Stage 2	899	-	-
Platoon blocked, %			
Mov Cap-1 Maneuver	808	1042	1588
Mov Cap-2 Maneuver	808	-	-
Stage 1	992	-	-
Stage 2	878	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.5	0	2.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	- 1042	1588	-
HCM Lane V/C Ratio	-	- 0.019	0.023	-
HCM Control Delay (s)	-	- 8.5	7.3	0
HCM Lane LOS	-	- A	A	A
HCM 95th %tile Q(veh)	-	- 0.1	0.1	-

Intersection

Int Delay, s/veh 4.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Traffic Vol, veh/h	0	6	3	0	9	6
Future Vol, veh/h	0	6	3	0	9	6
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	95	95	95	95	95	95
Heavy Vehicles, %	0	0	0	0	0	0
Mvmt Flow	0	6	3	0	9	6

Major/Minor	Minor1	Minor2	Major1	Major2	Major3	Major4
Conflicting Flow All	28	3	0	0	3	0
Stage 1	3	-	-	-	-	-
Stage 2	25	-	-	-	-	-
Critical Hdwy	6.4	6.2	-	-	4.1	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	-	-	2.2	-
Pot Cap-1 Maneuver	992	1087	-	-	1632	-
Stage 1	1025	-	-	-	-	-
Stage 2	1003	-	-	-	-	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	986	1087	-	-	1632	-
Mov Cap-2 Maneuver	986	-	-	-	-	-
Stage 1	1025	-	-	-	-	-
Stage 2	997	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.3	0	4.3
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	1087	1632	-
HCM Lane V/C Ratio	-	-	0.006	0.006	-
HCM Control Delay (s)	-	-	8.3	7.2	0
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	0	-

Attachment D: Signal Warrants



Warrants Summary												
Information												
Analyst	Matthew Thomas					Intersection	132nd Ave NE/ NE 100th St					
Agency/Co	Transpo Group					Jurisdiction	Redmond					
Date Performed	3/14/2016					Units	U.S. Customary					
Project ID	Rose Hill Preliminary Plat					Time Period Analyzed	PM Peak Period					
East/West Street	NE 100th Street					North/South Street	132nd Avenue NE					
File Name	12-Hour Warrant					Major Street	North-South					
Project Description <i>Rose Hill Preliminary Plat</i>												
General						Roadway Network						
Major Street Speed (mph)	35	<input type="checkbox"/>	Population < 10,000				Two Major Routes				<input type="checkbox"/>	
Nearest Signal (ft)	3600	<input type="checkbox"/>	Coordinated Signal System				Weekend Count				<input type="checkbox"/>	
Crashes (per year)	0	<input type="checkbox"/>	Adequate Trials of Alternatives				5-yr Growth Factor				0	
Geometry and Traffic	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of lanes, N	0	1	0	0	1	0	0	1	0	0	1	1
Lane usage	LTR			LTR			LTR			LT R		
Vehicle Volume Averages (vph)	8	3	56	14	7	5	92	385	19	4	288	17
Peds (ped/h) / Gaps (gaps/h)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--
Delay (s/veh) / (veh-hr)	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--	--	0 / 0	--
Warrant 1: Eight-Hour Vehicular Volume												<input type="checkbox"/>
1 A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>
1 B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--												<input type="checkbox"/>
1 (80%) Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 2: Four-Hour Vehicular Volume												<input type="checkbox"/>
2 A. Four-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 3: Peak Hour												<input type="checkbox"/>
3 A. Peak-Hour Conditions (Minor delay --and-- minor volume --and-- total volume) --or--												<input type="checkbox"/>
3 B. Peak- Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)												<input type="checkbox"/>
Warrant 4: Pedestrian Volume												<input type="checkbox"/>
4 A. Four Hour Volumes --or--												<input type="checkbox"/>
4 B. One-Hour Volumes												<input type="checkbox"/>
Warrant 5: School Crossing												<input type="checkbox"/>
5. Student Volumes --and--												<input type="checkbox"/>
5. Gaps Same Period												<input type="checkbox"/>
Warrant 6: Coordinated Signal System												<input type="checkbox"/>
6. Degree of Platooning (Predominant direction or both directions)												<input type="checkbox"/>
Warrant 7: Crash Experience												<input type="checkbox"/>
7 A. Adequate trials of alternatives, observance and enforcement failed --and--												<input type="checkbox"/>
7 B. Reported crashes susceptible to correction by signal (12-month period) --and--												<input type="checkbox"/>
7 C. (80%) Volumes for Warrants 1A, 1B --or-- 4 are satisfied												<input type="checkbox"/>
Warrant 8: Roadway Network												<input type="checkbox"/>
8 A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2 or 3) --or--												<input type="checkbox"/>
8 B. Weekend Volume (Five hours total)												<input type="checkbox"/>
Warrant 9: Grade Crossing												<input type="checkbox"/>
9 A. Grade Crossing within 140 ft --and--												<input type="checkbox"/>
9 B. Peak-Hour Vehicular Volumes												<input type="checkbox"/>

Warrants Volume

Information			
Analyst	Matthew Thomas	Intersection	132nd Ave NE/ NE 100th St
Agency/Co	Transpo Group	Jurisdiction	Redmond
Date Performed	3/14/2016	Units	U.S. Customary
Project ID	Rose Hill Preliminary Plat	Time Period Analyzed	PM Peak Period
East/West Street	NE 100th Street	North/South Street	132nd Avenue NE
File Name	12-Hour Warrant	Major Street	North-South

Project Description *Rose Hill Preliminary Plat*

Warrant 1

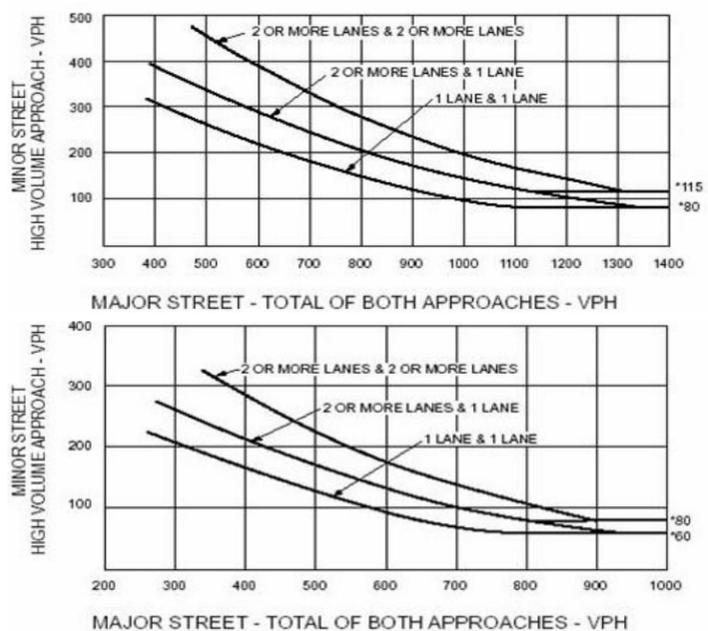
Condition A—Minimum Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

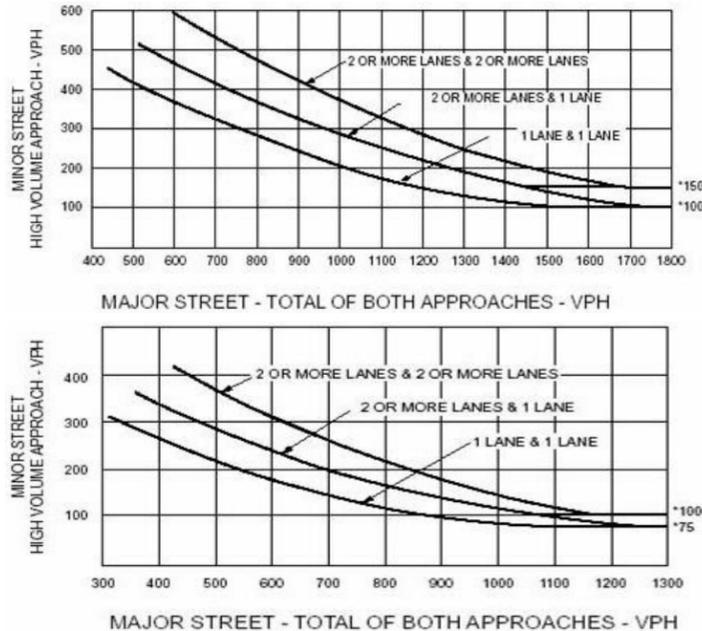
Condition B—Interruption of Continuous Traffic

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

Warrant 2



Warrant 3



Volume Summary

Hours	Major Street Lanes 2+			Minor Street Lanes 1		Speed		Population		
	Major Volume	Minor Volume	Total Volume	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (100%)
07-08	808	125	972	No	Yes	No	Yes	No	No	No
08-09	890	129	1053	No	Yes	No	Yes	No	No	No
09-10	629	117	780	No	No	No	No	No	No	No
10-11	422	48	510	No	No	No	No	No	No	No
11-12	516	51	596	No	No	No	No	No	No	No
12-13	485	47	556	No	No	No	No	No	No	No
13-14	445	42	511	No	No	No	No	No	No	No
14-15	620	45	695	No	No	No	No	No	No	No
15-16	927	78	1029	No	No	Yes	Yes	No	No	No
16-17	1362	40	1417	No	No	No	No	No	No	No
17-18	1403	59	1482	No	No	No	No	No	No	No
18-19	1193	45	1257	No	No	No	No	No	No	No
Totals	9700	826	10858	0	2	1	3	0	0	0