KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING
610 SW Alder Street, Suite 700, Portland, OR 97205 P 503.228.5230 F 503.273.8169

MEMORANDUM

Date: October 14, 2015 Project #: 17808.0

To: Mike Peebles, PE, OTAK

From: Anais Malinge and Marc Butorac, PE, PTOE

Project: South Cooper Mountain Heights PUD

Subject: Supplemental Analysis

The supplemental analysis provided herein addresses completeness review comments for the South Cooper Mountain Heights Traffic Impact Analysis (May 2015) received from City of Beaverton staff on September 25, 2015. The two completeness review comments addressed herein include:

1. *Phasing plan for the street improvements. The traffic analysis will need to show how the internal and external circulation system will perform at each stage of development.*
2. *For any local street not designed to the L1 standard, that applicant's traffic engineer will have to show that the expected traffic volumes will be below the 500 trip threshold*.

In addition to addressing the above completeness review comments, this supplemental analysis also provides an updated 2016 total traffic conditions analysis assuming an updated trip generation estimate per the final South Cooper Mountain Heights site plan.

PHASING PLAN

The following section summarizes the assumed site access phasing, recommended improvements under 2016 full build-out, and the proposed phased development scheme.

Site Access Phasing

The proposed South Cooper Mountain Heights development assumes two new site access points along SW 175th Avenue upon full build-out in year 2016. Site access for the proposed South Cooper Mountain Heights development will ultimately be provided via three access points upon full build-out of the South Cooper Mountain Concept Plan area, as described below.

- SW 175th Avenue/Planned Collector 6b, 6c – the planned collector provides full access to the proposed South Cooper Mountain Heights development and is stop-controlled in the near-term build-out year 2016. This intersection is anticipated to be signalized in the longer

term as the South Cooper Mountain Concept Plan area develops, particularly to the west of SW 175th Avenue, and when a connection to SW Loon Drive is realized. The warrants for this signal will not be met without future development to the west of SW 175th Avenue.

- SW 175th Avenue/High School Site Access – South Site Access – the proposed South Cooper Mountain Heights south site access provides full signalized access and shares access with the proposed Beaverton High School. The South Cooper Mountain Heights development will necessitate the activation of the westbound approach to the signal. In the near-term build-out year 2016, a majority of trips bound for the SW Roy Rogers Road/SW Scholls Ferry Road intersection travel through this intersection; however, vehicles will be more evenly distributed to the other two site-access points (SW 175th Avenue/Planned Collector 6b, 6c and SW Loon Drive/Planned Collector 6b, 6c) in the longer term.
- SW Loon Drive/Planned Collector 6b, 6c – the City of Beaverton is currently evaluating options to construct the portion of the Planned Collector 6b, 6c that lies east of the proposed South Cooper Mountain Heights development. Upon construction, an additional site access will be provided via the SW Loon Drive/Planned Collector 6b, 6c.[1]

Figures 1 through 4 show the trip distribution and assignment for both the weekday AM and PM peak hours, with and without access to SW Loon Drive. The trip assignment assumes a cumulative approach to the phased development, assuming Phase 1 is constructed first.

Recommended Improvements

Per the May 2015 Transportation Impact Analysis, the following improvements are proposed upon 2016 full build-out:

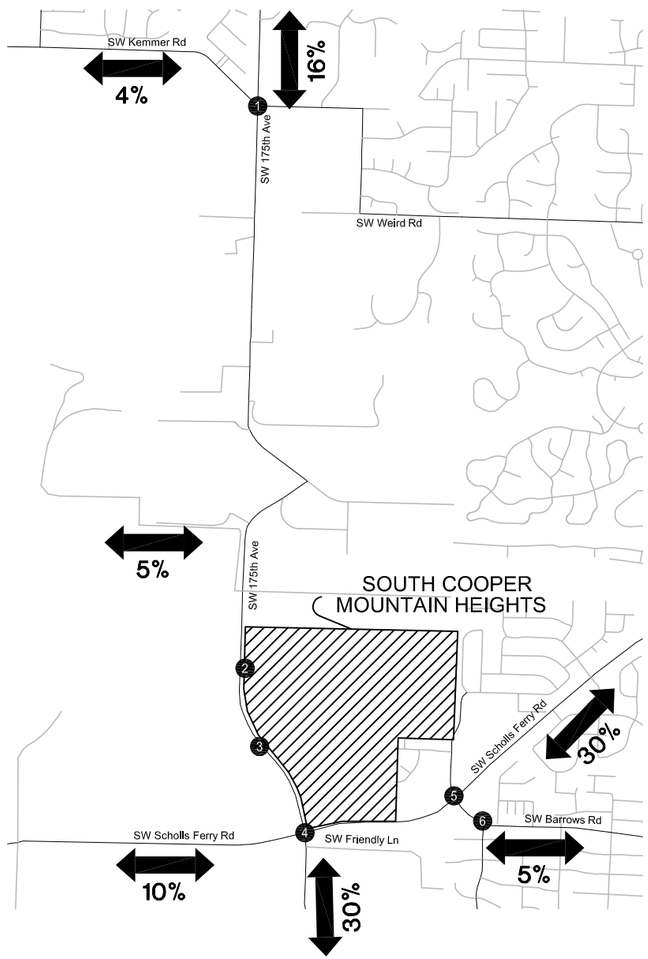
- SW 175th Avenue/SW Kemmer Road – Provide a proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County MSTIP-led project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing. (MSTIP – Years 1-3). The proportional share contribution is $214,302 per the methodology agreed to by Washington County[2]. *Attachment "A" includes the proportional share calculations for all proposed developments in the River Terrace and South Cooper Mountain Planning areas.*

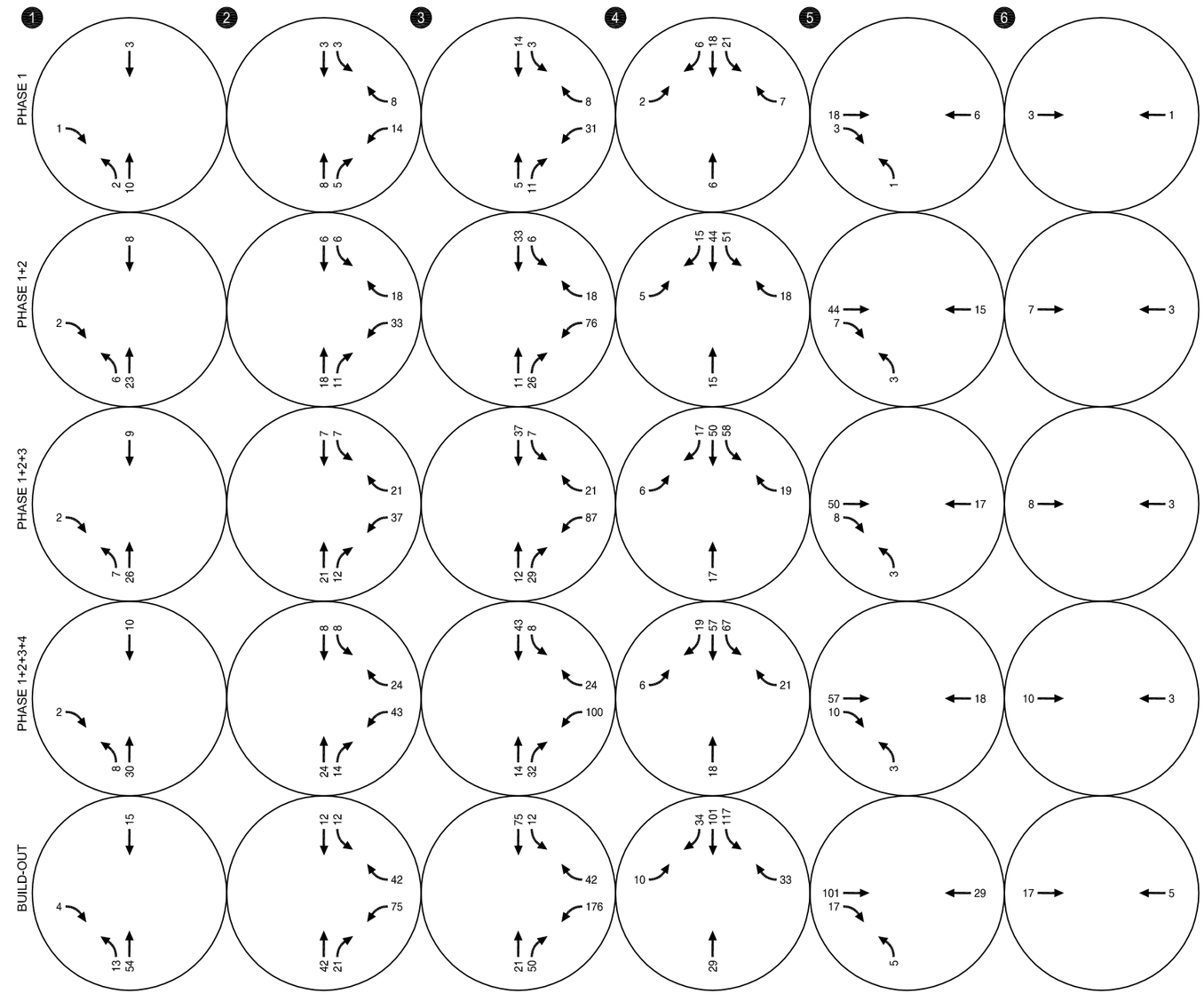
[1] Under City of Beaverton staff direction, the May 2015 Transportation Impact Analysis did not include the SW Loon Drive connection for the 2016 build-out analysis. However, this supplemental analysis was conducted with and without the SW Loon Drive connection.

[2] The proportional share contribution reflects the most up to date trip generation estimate for the South Cooper Mountain Heights site.

- SW 175th Avenue/Planned Collector 6b, 6c – Provide a stop-controlled intersection with a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes. (MSTIP – Years 1-3)
- SW 175th Avenue/High School – South Site Access – Install a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and westbound shared through-right and left-turn lanes. (MSTIP – Years 1-3)
- SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road – Optimize signal timing to provide additional green time to the northbound and southbound movements.
- Any future landscaping, above-ground utilities, and site signage should be located and maintained such that they provide minimum required sight lines in either direction at all access locations.

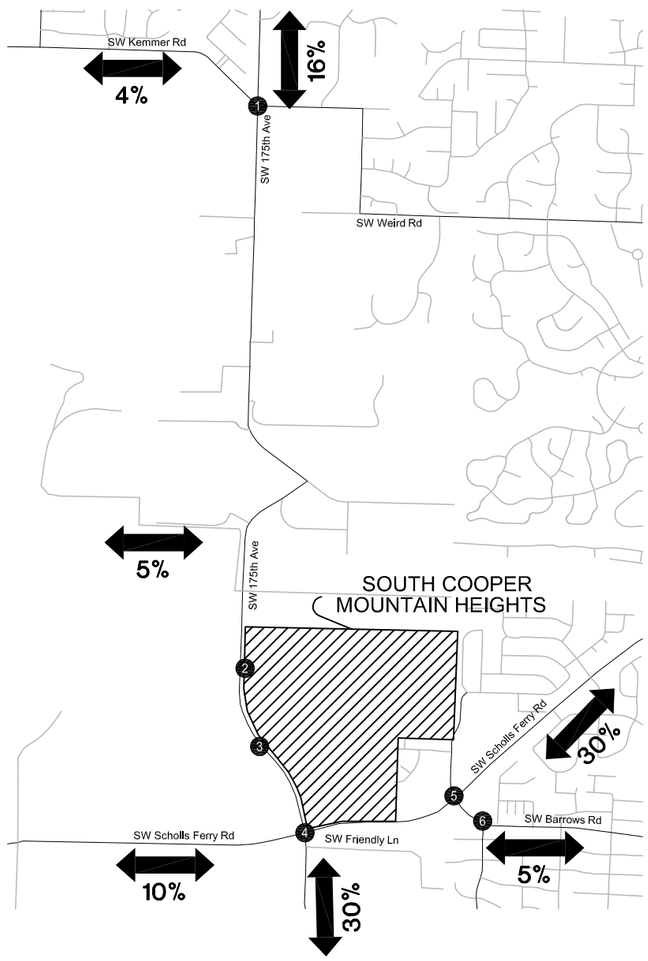
Based on a draft MSTIP High Growth Project list published in June 2015, the SW 175th Avenue/SW Kemmer Road intersection and the SW 175th Avenue segment between the Planned Collected 6b, 6c and SW Scholls Ferry Road are both planned within one to three years (Attachment "B").

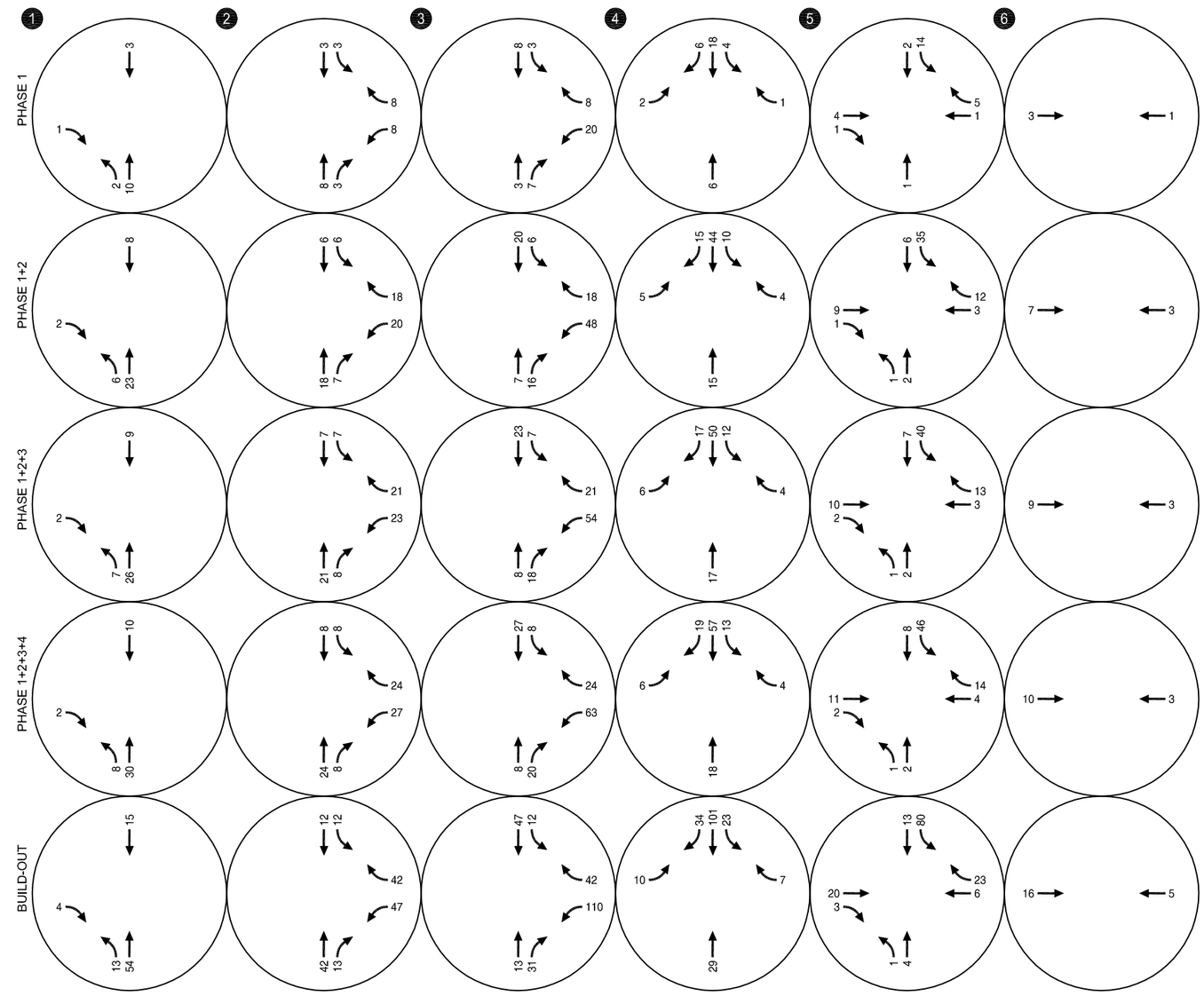




Trip Generation - Without Access to SW Loon Drive
Weekday AM Peak Hour
Beaverton, OR

Figure
1

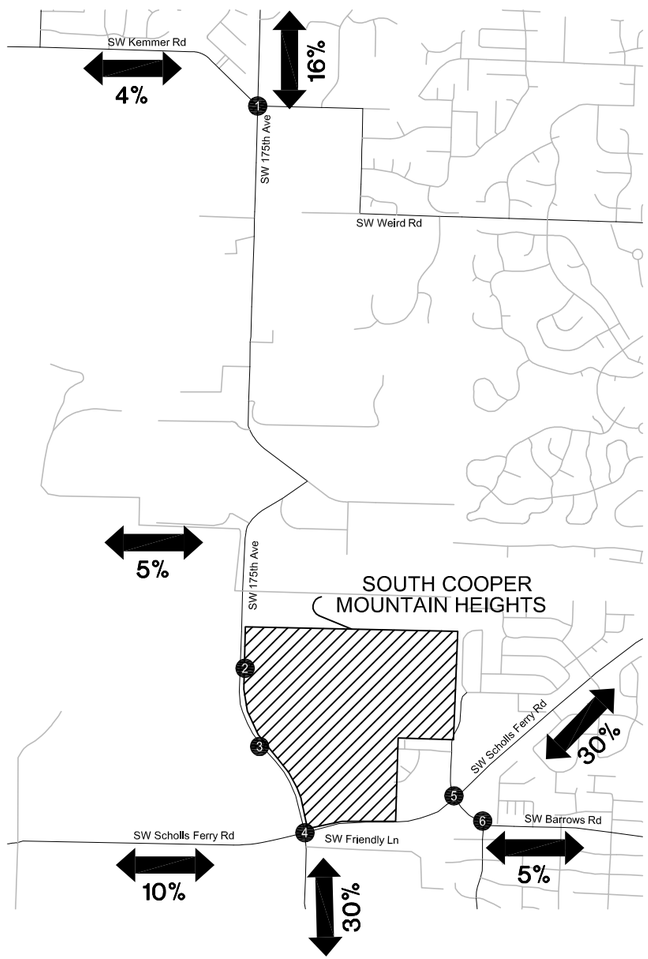


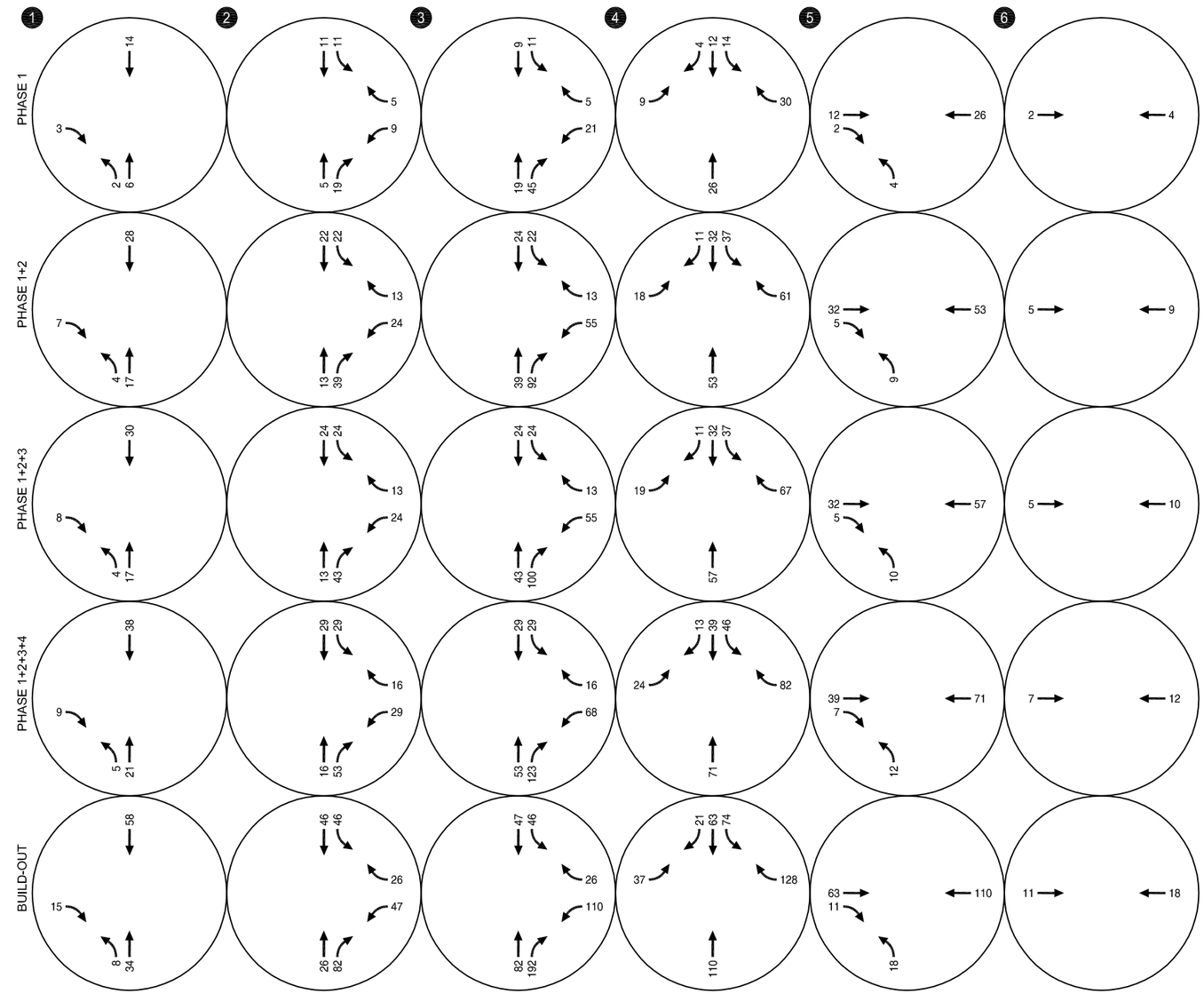


Trip Generation - With Access to SW Loon Drive
Weekday AM Peak Hour
Beaverton, OR

Figure
2

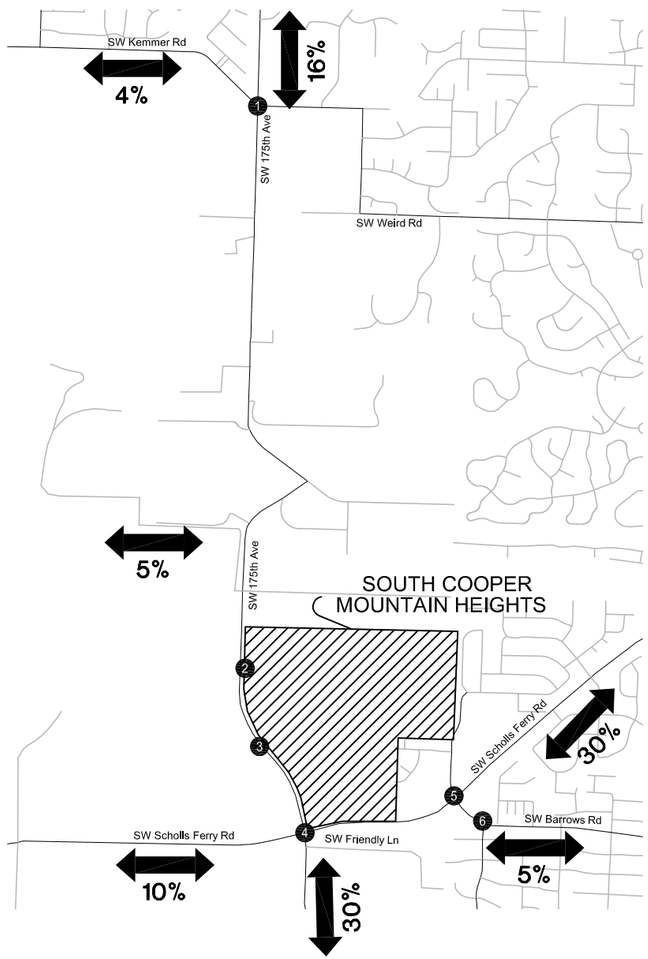
K:\H_Portland\projfile\17808 - South Cooper Mountain\dwgs\Figs\17808_TIA Fig.dwg Oct 13, 2015 - 4:26pm - amalinge Layout Tab: 2_supp_am added w

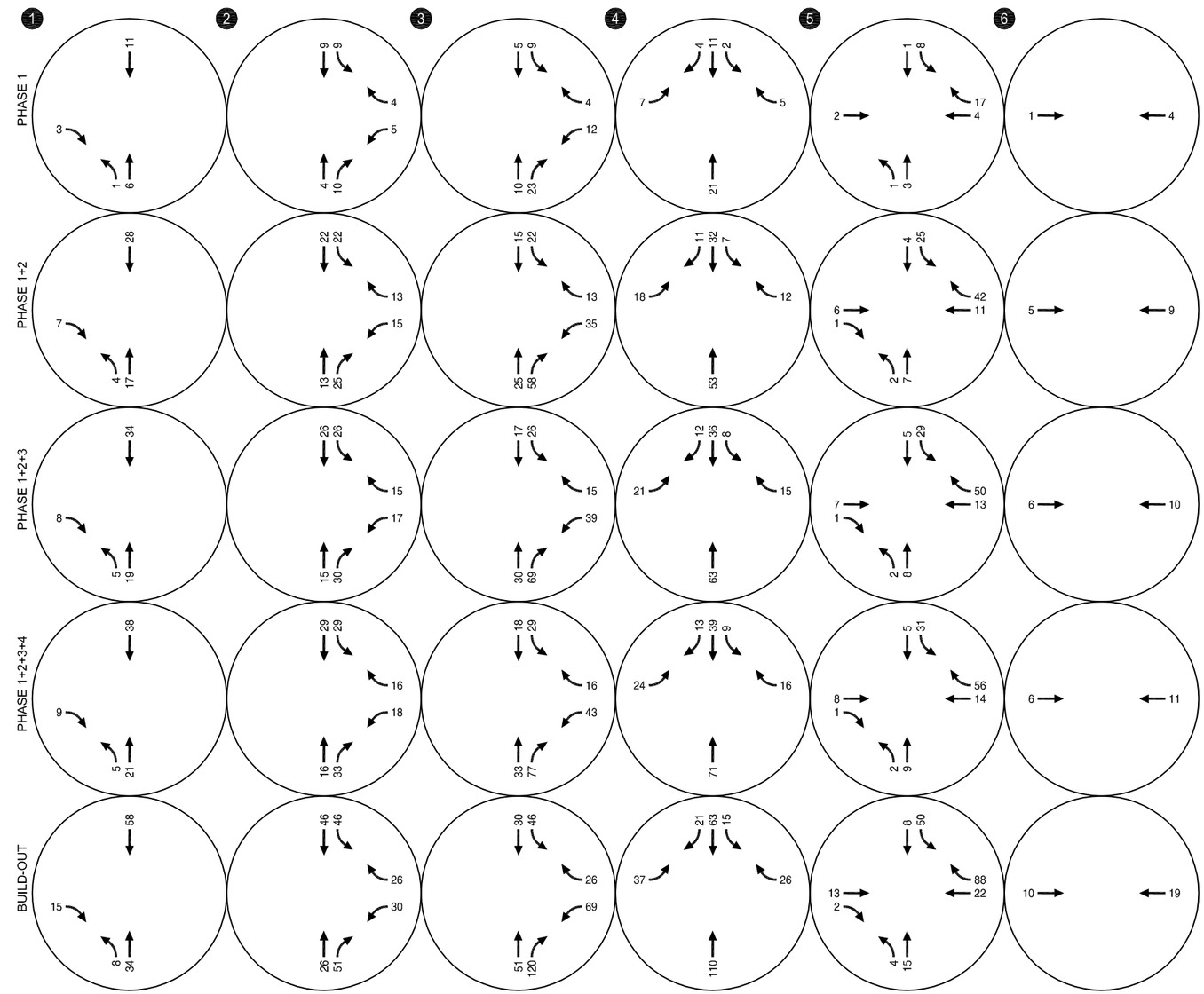




Trip Generation - Without Access to SW Loon Drive
Weekday PM Peak Hour
Beaverton, OR

Figure
3





Trip Generation - With Access to SW Loon Drive
Weekday PM Peak Hour
Beaverton, OR

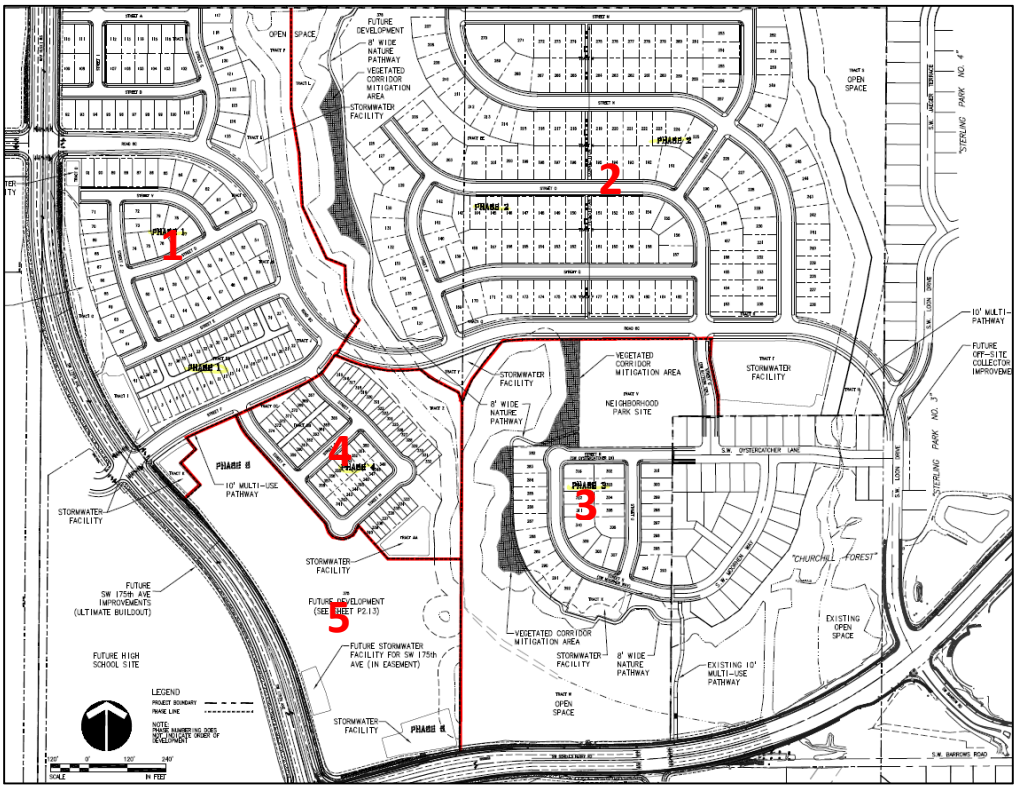
Figure
4

K:\H_Portland\projfile\17808 - South Cooper Mountain\dwgs\Figs\17808_TIA Fig.dwg Oct 14, 2015 - 10:48am - amalinge Layout Tab: 4_supp_pm added w

Phased Development

Exhibit 1 below shows the proposed phased development plan for South Cooper Mountain Heights.

Exhibit 1: Site Phasing



As shown in Exhibit 1, the South Cooper Mountain Heights development is proposed to develop in five phases. Phase 1 abuts SW 175th Avenue. Access to Phase 1 will be provided through the two main access points along SW 175th Avenue. Phase 2 is in the northern quadrant of the site and abuts SW Loon Drive. Phase 3 is west of the existing neighborhood and feeds in to SW Moorhen Way and SW Oystercatcher Lane. Phase 4 is southeast of Phase 1 and is dependent on Phase 1 to develop in order to gain access to the larger transportation network. Phase 5 represents the multi-family portion of the development and sits on the northeast quadrant of the SW Roy Rogers Road/SW Scholls Ferry Road intersection. Table 1 summarizes the cumulative trip generation assuming sequential phased development.

Table 1: Estimated Cumulative Trip Generation

Land Use	ITE Code	Size (Units)	Total Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
				Total	In	Out	Total	In	Out
Phase 1									
Single Family Detached	210	83	790	60	15	45	110	70	30
Townhome	230	43	250	20	5	15	25	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		**126**	**1,040**	**80**	**20**	**60**	**135**	**85**	**40**
Phase 1+2									
Single Family Detached	210	239	2,280	175	45	130	265	160	95
Townhome	230	43	250	20	5	15	25	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		**282**	**2,530**	**195**	**50**	**145**	**290**	**175**	**105**
Phase 1+2+3									
Single Family Detached	210	272	2,590	200	50	150	310	195	110
Townhome	230	43	250	20	5	15	20	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		**315**	**2,840**	**220**	**55**	**165**	**330**	**210**	**120**
Phase 1+2+3+4									
Single Family Detached	210	272	2,590	200	50	150	310	195	110
Townhome	230	110	640	50	10	40	55	40	20
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		**382**	**3,230**	**250**	**60**	**190**	**365**	**235**	**130**
Full Build-Out									
Single Family Detached	210	272	2,590	205	50	155	310	195	115
Townhome	230	110	640	50	10	40	55	35	20
Apartments	220	340	2,260	175	35	140	210	135	75
Total Net-New Trips		**722**	**5,490**	**430**	**95**	**335**	**575**	**365**	**210**

As required by City of Beaverton staff, the following analysis identifies when each proposed street improvement is needed based on the previously summarized phasing plan.

SW 175th Avenue/SW Kemmer Road (2019-2023 MSTIP – Years 1-3)

The intersection improvements are in the 1-3 year planning horizon per the 2019-2023 MSTIP draft project list. Per the May 2015 TIA, the proposed South Cooper Mountain Heights development is to provide proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County led MSTIP project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing. This contribution should be submitted either as a lump sum or proportion to the trips generated by each phase, as shown in Table 2.

Table 2: SW 175th Avenue/SW Kemmer Road Proportional Share

Phase	AM Peak Hour Trips	PM Peak Hour Trips	Avg. Peak Hour Trips	Share of Build-Out Trips	Proportional Share
Phase 1	16	21	18	19%	$39,767
Phase 2	23	31	27	28%	$59,651
Phase 3	5	7	6	6%	$13,256
Phase 4	6	7	7	7%	$15,465
Phase 5	36	41	39	40%	$86,162
Build-Out	86	107	97	100%	$214,302

SW 175th Avenue/Planned Collector 6b, 6c

The SW 175th Avenue/Planned Collector 6b, 6c is proposed as a stop-controlled intersection including a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes. The intersection is within the 2019-2023 MSTIP draft project list. However, assuming the proposed development develops before improvements are made along SW 175th Avenue, the southbound left-turn lane would be warranted upon construction of Phase 1. *Attachment "C" includes the left-turn lane warrant.*

SW 175th Avenue/High School–South Site Access

The intersection improvements for the SW 175th Avenue/High School-South Site Access includes the installation of a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and westbound shared through-right and left-turn lanes. The intersection is within the 2019-2023 MSTIP draft project list. Based on the development context[3], there are three scenarios in the overall development scheme, including:

1. South Cooper Mountain Heights develops before the High School and before the completion of the MSTIP project.
2. South Cooper Mountain Heights develops after the High School and before the completion of the MSTIP project.
3. South Cooper Mountain Heights develops after both the High School and the MSTIP project.

No matter the scenario, the southbound left-turn lane is warranted and the westbound approach should be developed upon build-out of Phase 1. Assuming Scenario 1, the intersection does not meet signal warrants until full 2016 build-out of the site. As such, the west approach would be stop-controlled, with one through travel lane in each direction, a southbound left-turn lane, and a

[3] The full intersection improvement is contingent on the High School development, the Washington County MSTIP project along SW 175th Avenue, and the proposed South Cooper Mountain Heights development. It is unknown which of these will materialize first.

westbound shared through-right and exclusive left-turn lane until full build-out of the development. *Attachment "D" includes the left-turn lane warrant and signal warrant assuming Scenario 1.*

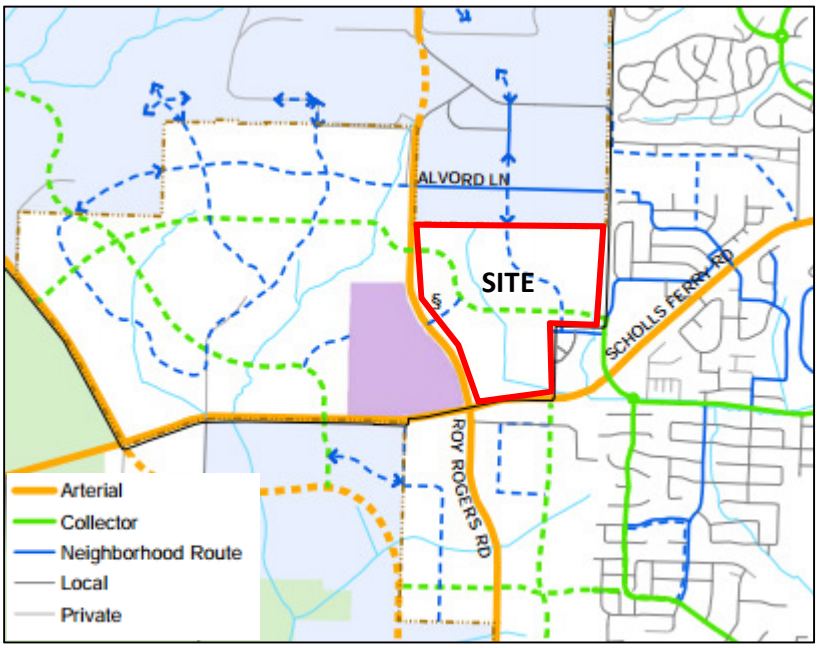
SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road

Per the May 2015 TIA, full build-out of the South Cooper Mountain Heights development will likely necessitate the optimization of signal timing to provide additional green time to the northbound and southbound movements. The phasing scheme does not impact the need for optimization – signal timing should be optimized following the completion of Phase 5.

LOCAL STREET STANDARDS

Exhibit 2 shows the transportation network for the South Cooper Mountain Concept Plan. As shown, a east-west collector (Collector 6c) is proposed through the South Cooper Mountain Heights development along with a north-south neighborhood route. Development to the north of the proposed South Cooper Mountain Height's site will be served by Alvord Lane, a proposed east-west neighborhood route. To this end, there are relatively limited trips anticipated to travel south through the site as those residents are likely to experience faster travel times along Alvord Lane to SW 175th Avenue.

Exhibit 2: South Cooper Mountain Concept Plan Transportation Network

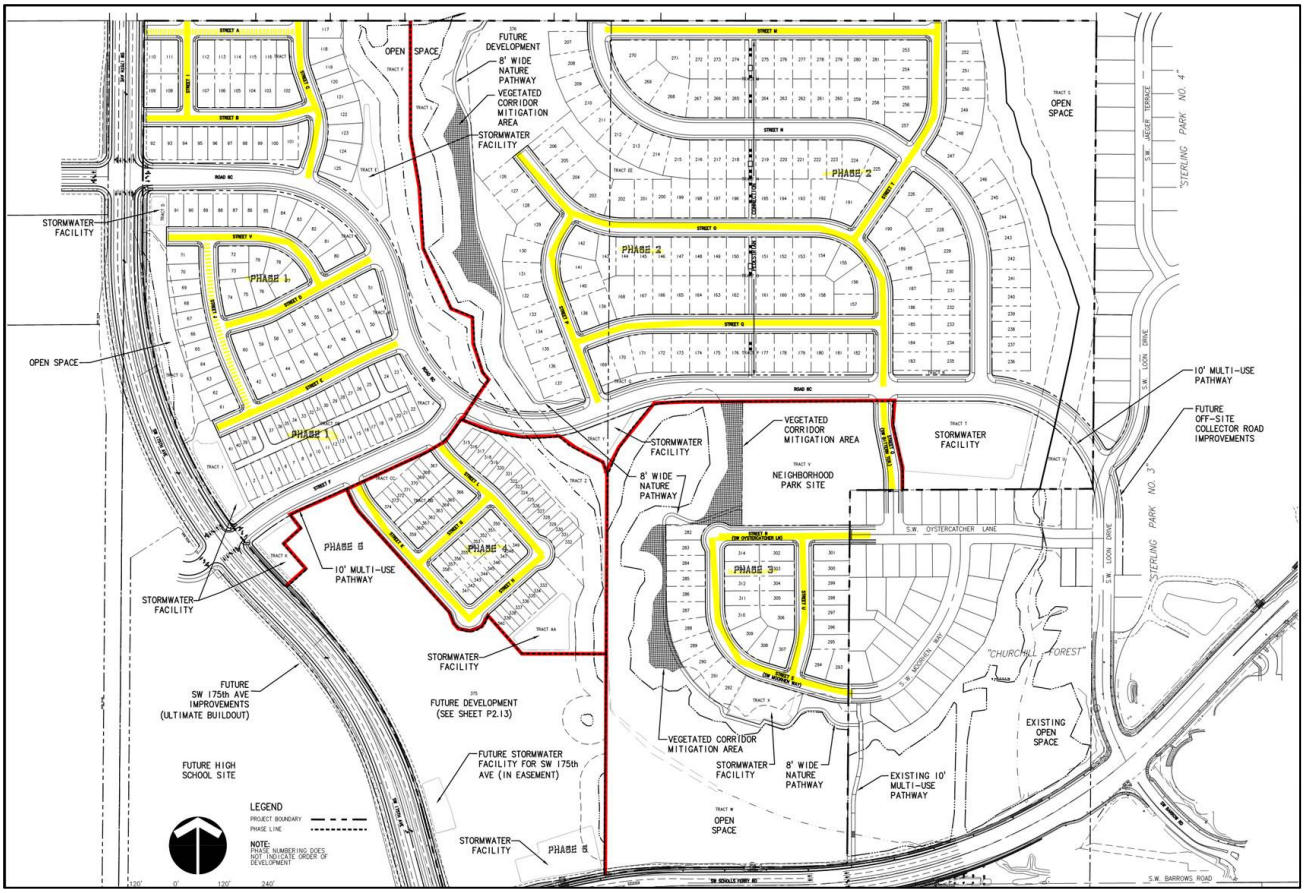


Source: City of Beaverton, South Cooper Mountain Concept Plan, ES-11

The local streets within the proposed development will likely only serve residences that abut those streets. Exhibit 3 shows the local streets within the site with a L2 standard (the streets highlighted in yellow are those proposed as L2 streets). Per City of Beaverton code, traffic along a L2 street should not

exceed 500 vehicles per day. The following analysis demonstrates that none of the streets with the L2 designation will exceed the 500 ADT threshold.

Exhibit 3: L2 Street Standard



The following local streets are designated as L2 and are direct access points to the larger street network:

- Street C will connect 35 single family detached homes to Collector 6c, or 330 daily trips.
- Street D will connect 35 single family detached homes to Collector 6c, or 330 daily trips.
- Street E will connect 13 single family detached homes and 43 single family attached homes to Collector 6c, or 370 daily trips.
- Street P will connect 51 single family detached homes to Collector 6c, or 490 daily trips.
- Street O will connect 30 single family detached homes to Collector 6c, or 290 daily trips.
- Street T will connect 18 single family detached homes to the north-south neighborhood route, or 170 daily trips.
- Street R and Street S connect 33 single family detached homes to SW Moorhen Way and SW Oystercatcher Lane, or 310 daily trips.

- Street L and Street K connect 67 single family attached homes to Street F, or 390 daily trips.

2016 TOTAL TRAFFIC CONDITIONS UPDATE

The following section serves as an amendment to the May 2015 TIA. Since submittal of the May 2015 TIA, the trip generation estimates have changed due to updates to the site layout. Table 3 provides a summary of the May 2015 and October 2015 trip generation estimates and the associated difference. As shown, there are an estimated 160 additional daily trips, 15 additional weekday AM peak hour trips (-5 in, +20 out), and 45 additional weekday PM peak hour trips (+30 in, +15 out).

Table 3: Trip Generation Estimate Difference

Land Use	ITE Code	Size (Units)	Total Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
				Total	In	Out	Total	In	Out
May 2015 TIA									
Single Family Detached	210	308	2,930	230	60	170	319	195	115
Townhome	230	104	600	45	10	35	55	35	20
Apartments	220	270	1,800	140	30	110	165	105	60
Total Net New Trips		**682**	**5,330**	**415**	**100**	**315**	**530**	**335**	**195**
October 2015 Update									
Single Family Detached	210	272	2,590	205	50	155	310	195	115
Townhome	230	110	640	50	10	40	55	35	20
Apartments	220	340	2,260	175	35	140	210	135	75
Total Net New Trips		**722**	**5,490**	**430**	**95**	**335**	**575**	**365**	**210**
Difference (October 2015 Update - May 2015 TIA)									
Total Net New Trips		**+40**	**+160**	**+15**	**-5**	**+20**	**+45**	**+30**	**+15**

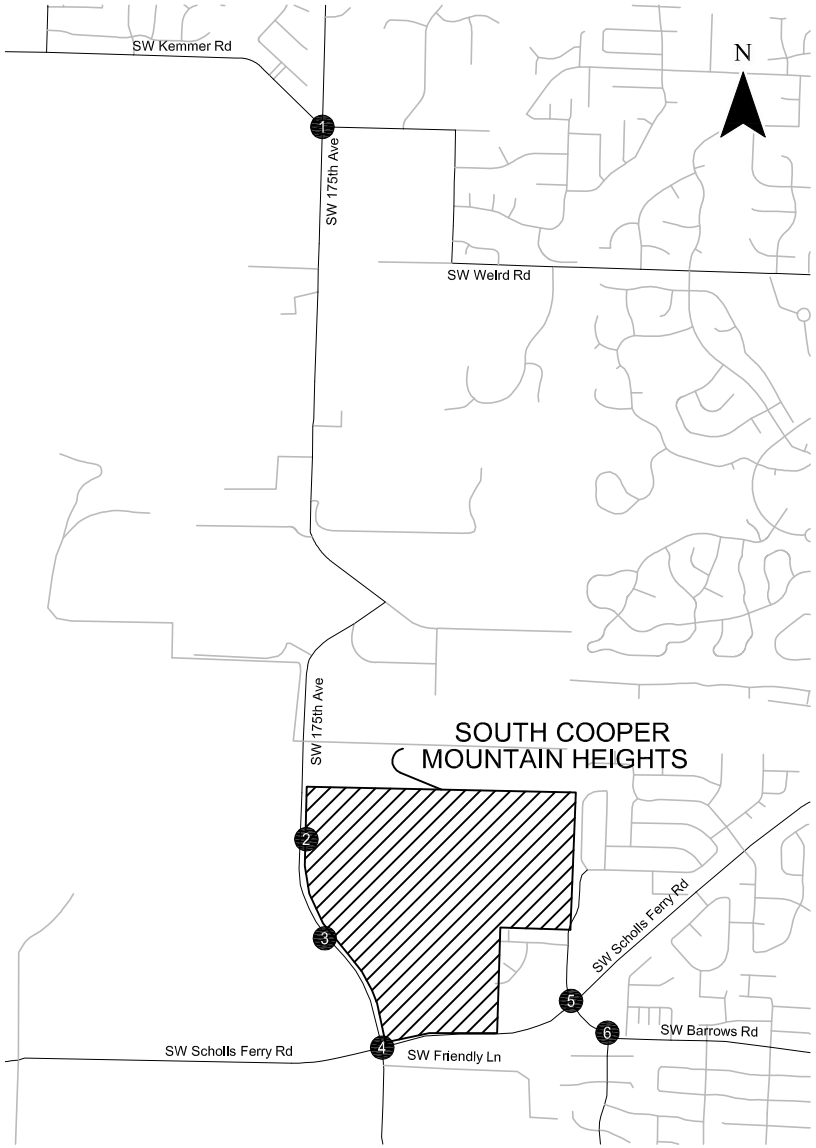
Figure 5 shows the 2016 total traffic conditions assuming the updated trip generation estimate and mitigations documented in the May 2015 TIA[4]. Figures 1 and 3 includes the trips distribution and assignment. As shown, all study intersections continue to operate acceptably assuming the provision of the May 2015 mitigations, as listed below:

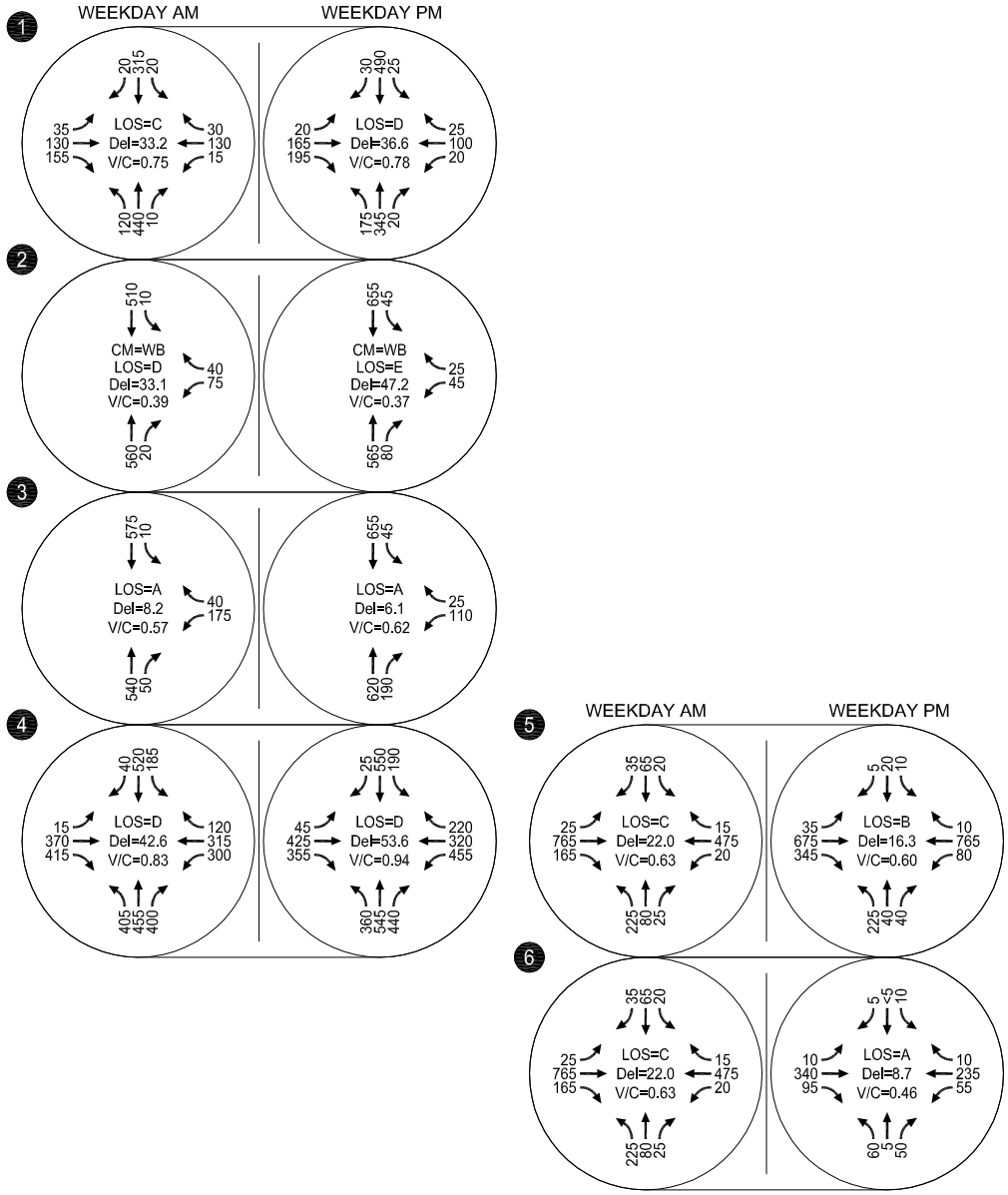
- SW 175th Avenue/SW Kemmer Road – Provide a proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County led project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing.
- SW 175th Avenue/Planned Collector 6b, 6c – Provide a stop-controlled intersection with a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes.

[4] Consistent with the May 2015 TIA, the 2016 total traffic conditions assumes no connection to SW Loon Drive.

- SW 175th Avenue/High School–South Site Access – Install a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and exclusive westbound shared through-right and left-turn lanes.
- SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road – Optimize signal timing to provide additional green time to the northbound and southbound movements.
- Any future landscaping, above-ground utilities, and site signage should be located and maintained such that they provide minimum required sight lines in either direction at all access locations.

Attachment "E" includes the 2016 Total Traffic Conditions worksheets.





CM = CRITICAL MOVEMENT (TWSC)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/
CRITICAL MOVEMENT LEVEL OF SERVICE (TWSC)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED) /
CRITICAL MOVEMENT CONTROL DELAY (TWSC)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO
TWSC = TWO-WAY STOP CONTROL

2016 Total Traffic Conditions
Weekday AM and PM Peak Hours
Beaverton, OR

Figure
5

K:\H_Portland\projfile\17808 - South Cooper Mountain\dwgs\figs\17808_TIA fig.dwg Oct 14, 2015 - 11:31am - amalinge Layout Tab: 5_supp_2016tt (mit)

FINDINGS

The following findings are a result of the analysis provided herein:

- All street improvements documented in the May 2015 TIA will be triggered as part of Phase 1 of the South Cooper Mountain Heights development.
- None of the streets with the L2 designation will exceed the 500 ADT threshold.
- The updated site layout results in an estimated 160 additional daily trips, 15 additional weekday AM peak hour trips (-5 in, +20 out), and 45 additional weekday PM peak hour trips (+30 in, +15 out).
- All study intersections continue to operate acceptably under 2016 total traffic conditions assuming the updated trip generation estimate and the provision of the recommendations documented in the May 2015 TIA.

Please contact us at (503) 228-5230 if you have any questions regarding this study.

Attachment A Proportional Share Calculation

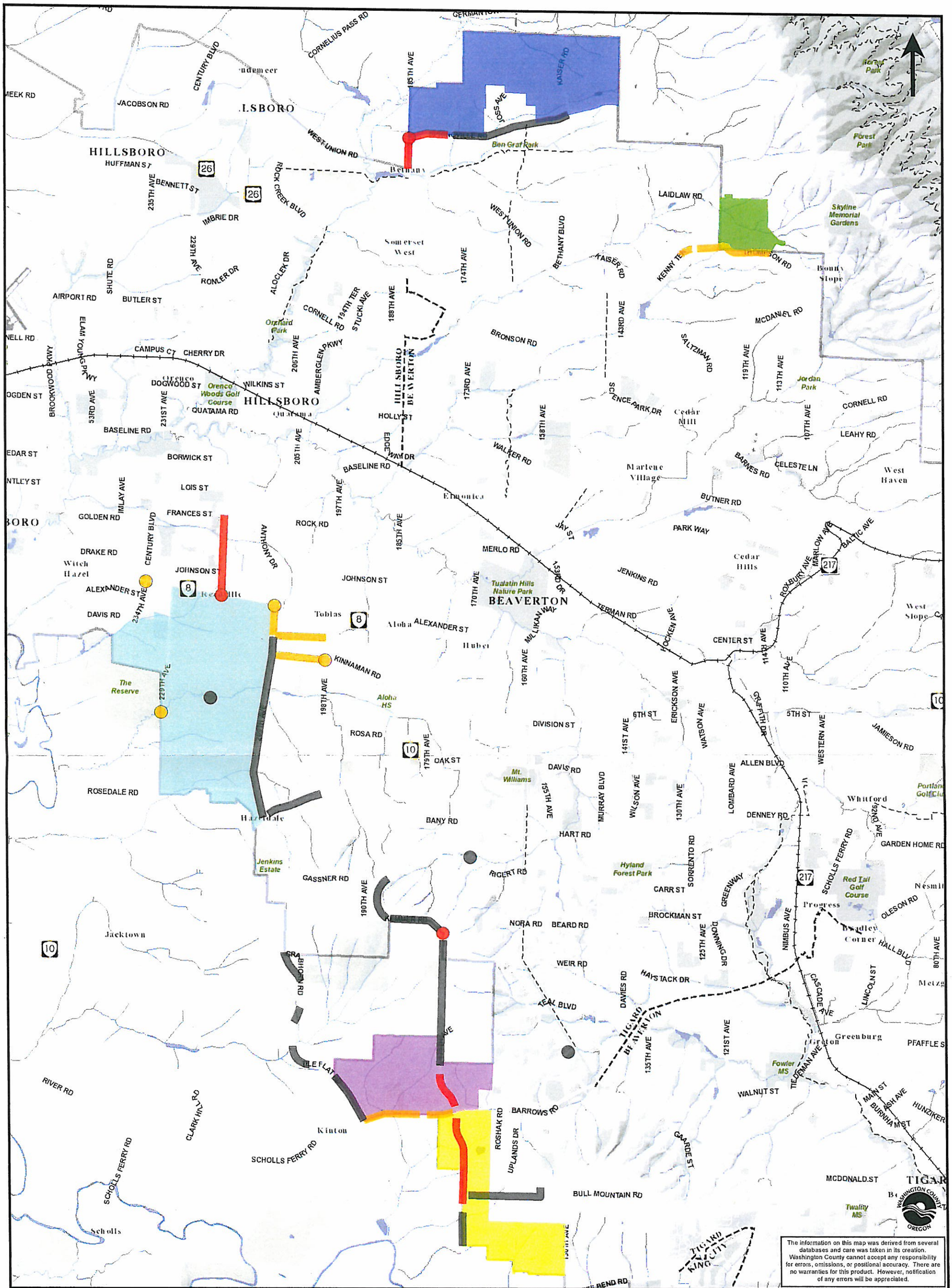
Development	Size	AM Peak Hour Trips	PM Peak Hour Trips	Avg Peak Hour Trips	% of Avg. Peak Hour Trips to 2016 total trips	% of Avg. Peak Hour Trips to total added trips	Full Share of $2.5 Millon Improvement at 175th/Kemmer	1/3 of Full Share 175th/Kemmer Improvements
Beaverton School District	1,700	272	84	178	10.0%	47.4%	1,185,876	395,292
South Cooper Mountain Heights	722	86	107	97	5.4%	25.7%	642,905	214,302
River Terrace Northwest	175	12	15	14	0.8%	3.6%	89,940	29,980
River Terrace East	286	20	25	23	1.3%	6.0%	149,900	49,967
West River Terrace	138	9	11	10	0.6%	2.7%	66,622	22,207
Roshak Ridge	244	16	20	18	1.0%	4.8%	119,920	39,973
South River Terrace	190	12	16	14	0.8%	3.7%	93,271	31,090
Bull Mountain Dickson	82	7	8	8	0.4%	2.0%	49,967	16,656
Metropolitan Land Group	173	13	18	15	0.9%	4.1%	101,599	33,866

Attachment B Draft MSTIP List

Road	Extent	Project*	Total Cost	County Cost (2/3)	Local Cost (1/3)	TDT Project #	Area**
Years 1-3							
Springville Rd	185th - west of PCC entrance	Widen to 5 lanes, realign	$ 11,750,000	$ 7,833,333	$ 3,916,667	1069 (WC)	NB/BSW
185th Ave	Springville - West Union	Widen to 5 lanes, intersection improvements at termini	$ 6,000,000	$ 4,000,000	$ 2,000,000	1013 (WC)	
Cornelius Pass Rd	Frances - TV Hwy	Widen to 5 lanes	$ 14,000,000	$ 9,333,333	$ 4,666,667	1030 (WC)	NB/BSW
TV Hwy	Cornelius Pass Rd	Westbound right turn lane	$ 3,107,000	$ 2,071,333	$ 1,035,667	3054 (H)	SH
175th Ave	Kemmer Rd	Intersection improvement	$ 5,000,000	$ 3,333,333	$ 1,666,667	1010 (WC)	SH
175th Ave	E-W collector - Scholls Ferry	Widen to 5 lanes	$ 6,345,000	$ 4,230,000	$ 2,115,000	Not on list	SCM
Roy Rogers Rd	Scholls Ferry - S of Bull Mountain	Widen to 5 lanes	$ 24,900,000	$ 16,600,000	$ 8,300,000	Not on list	SCM
		Year 1-3 total	***$ 71,102,000***	***$ 47,401,333***	***$ 23,700,667***		RT
Years 4-6							
Thompson Rd	Kenny - Saltzman	Realign, widen to 3 lanes	$ 6,000,000	$ 4,000,000	$ 2,000,000	Not on list	NB/BSW
TV Hwy	209th Ave	Intersection & railroad improvement	$ 14,794,000	$ 9,862,667	$ 4,931,333	1020 (WC)	SH
209th Ave	TV Hwy - Blanton	Widen to 5 lanes, signal at Blanton	$ 4,333,000	$ 2,888,667	$ 1,444,333	1020 (WC)	SH
Blanton St	209th - 198th	Sidewalks, turn lanes as needed	$ 3,261,000	$ 2,174,000	$ 1,087,000	Not on list	SH
Kinnaman Rd	209th - 198th	Sidewalks, bike lanes, turn lanes	$ 3,261,000	$ 2,174,000	$ 1,087,000	1053 (WC)	SH
Kinnaman Rd	198th Ave	Realign & signalize offset intersection	$ 4,917,000	$ 3,278,000	$ 1,639,000	1054 (WC)	SH
Scholls Ferry Rd	N-S Collector - Roy Rogers	Widen to 5 lanes	$ 2,750,000	$ 1,833,333	$ 916,667	Not on list	SCM/RT
		Year 4-6 total	***$ 39,316,000***	***$ 26,210,667***	***$ 13,105,333***		
Years 7-10							
Thompson Rd	Saltzman - Marcotte	Widen to 3 lanes	$ 4,000,000	$ 2,666,667	$ 1,333,333	1072 (WC)	NB/BSW
TV Hwy	Century Blvd	Widen NB/SB approaches to 5-lanes, EB Bus Pullout	$ 10,473,000	$ 6,982,000	$ 3,491,000	Not on list	
229th Ave	Butternut Creek	Replace bridge, widen to 3 lanes	$ 5,827,000	$ 3,884,667	$ 1,942,333	3020 (H)	SH
Scholls Ferry Rd	Tile Flat - N-S Collector	Interim 3-lane and north side half street	$ 5,500,000	$ 3,666,667	$ 1,833,333	Not on list	SH
		Year 7-10 total	***$ 25,800,000***	***$ 17,200,000***	***$ 8,600,000***		SCM/RT
		Year 1-10 total	***$ 136,218,000***	***$ 90,812,000***	***$ 45,406,000***		
Year 11+ or other funding sources							
Springville Rd	PCC entrance - Kaiser	Widen to 3 lanes	$ 8,000,000	$ 5,333,333	$ 2,666,667	1070 (WC)	NB/BSW
Cornelius Pass Rd	Butternut Creek	Construct new 5-lane bridge	$ 9,423,000	$ 6,282,000	$ 3,141,000	3055 (H)	SH
209th Ave	Blanton - Farmington	Widen to 5 lanes	$ 35,130,000	$ 23,420,000	$ 11,710,000	1020 (WC)	SH
Farmington Rd	209th - 198th	Widen to 5 lanes (partial funding)	$ 4,051,000	$ 2,700,667	$ 1,350,333	1036 (WC)	SH
170th Ave	Rigert Rd	Intersection improvement	$ 2,000,000	$ 1,333,333	$ 666,667	Not on list	SCM
175th Ave	Kemmer - E-W collector	Realign, widen to 3 lanes	$ 11,275,000	$ 7,516,667	$ 3,758,333	1011 (WC-part)	SCM
185th Ave	Gassner - Kemmer	Construct new 3-lane roadway	$ 5,760,000	$ 3,840,000	$ 1,920,000	Not on list	SCM
Kemmer Rd	185th - 175th	Widen to 3 lanes	$ 2,590,000	$ 1,726,667	$ 863,333	Not on list	SCM
Grabhorn / Tile Flat	Leonardo - Tile Flat	Realign curves	$ 12,215,000	$ 8,143,333	$ 4,071,667	Not on list	SCM
Tile Flat Rd	UGB - Scholls Ferry	Widen to 3 lanes	$ 3,025,000	$ 2,016,667	$ 1,008,333	Not on list	SCM
Scholls Ferry Rd	Teal / Horizon	Intersection improvement	$ 500,000	$ 333,333	$ 166,667	Not on list	SCM
Roy Rogers Rd	Bull Mountain - UGB	Widen to 5 lanes	$ 15,000,000	$ 10,000,000	$ 5,000,000	Not on list	RT
Bull Mountain Rd	Roy Rogers - Roshak	Widen to 3 lanes	$ 4,000,000	$ 2,666,667	$ 1,333,333	1027 (WC)	RT
		Year 11+ total	***$ 112,969,000***	***$ 75,312,667***	***$ 37,656,333***		
		Grand total	***$ 249,187,000***	***$ 166,124,667***	***$ 83,062,333***		

* "Widening" projects include pedestrian/bicycle facilities, lighting, stormwater, etc.

**NB/BSW =	North Bethany / Bonny Slope West	(unincorporated Washington County)
SH =	South Hillsboro	(City of Hillsboro)
SCM =	South Cooper Mountain	(City of Beaverton)
RT =	River Terrace	(City of Tigard)


HILLSBORO
BEAVERTON
Tualatin Hills Nature Park
Ben Graf Park
Forest Park
Skyline Memorial Gardens
Orchard Park
Orenco Woods Golf Course
Jordan Park
The Reserve
Aloha HS
Mt. Williams
Jenkins Estate
Hyland Forest Park
Red Tail Golf Course
Portland Golf Club
Fowler MS
Twality MS
Washington County- Long Range Planning
DRAFT MSTIP High Growth Project List
1:56,000
0 2,550 5,100 Feet
1-3
4-6
11+
Years 1 - 3
Years 4 - 10
Years 11+
South Hillsboro
South Cooper Mountain
River Terrace
Bonny Slope West
North Bethany
The information on this map was derived from several databases and care was taken in its creation. Washington County cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties for this product. However, notification of any errors will be appreciated.
Path: \\Emcgis\nas\GISDATA\Workgroups\GISPlanning\Joe\SteveZig\2015\MSTIP_High_Growth\HighGrowthAreas_11x17_P.mxd

Attachment C SW 175th Ave/Collector 6b, 6c
Left Turn Lane Warrant

Left-Turn Lane Warrant Analysis

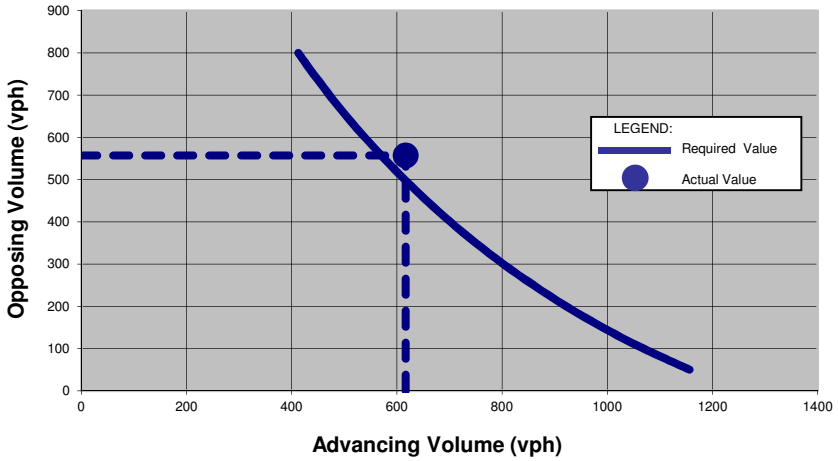
KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #:	17808
Project Name:	S Cooper Mtn Heights
Analyst:	axm
Intersection:	North Access/175th Ave
Scenario:	2016 Phase 1
Date:	10/13/2015
File:	K:\H_Portland\projfile\17808 - South Cooper Mountain\report\9 29 15 supplemental analysis\analysis\warrants\[LT_warra

Input Data:

Advancing Volume (vph) =	617	
Left-turning Vehicles (vph) =	9	
Opposing Volume (vph) =	557	
Speed (mph) =	40	
Number of Approach Lanes =	2	(not applicable for two lanes)
% Left-Turning Vehicles	1%	
Critical Gap (sec) =	6	
Maneuver Time (sec) =	4	
Exit Time (sec) =	1.9	
Utilization Factor =	0.02	

Left-Turn Lane Warrant Analysis Results



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

Attachment D SW 175th Ave/S. Access Left Turn Lane Warrant

Left-Turn Lane Warrant Analysis

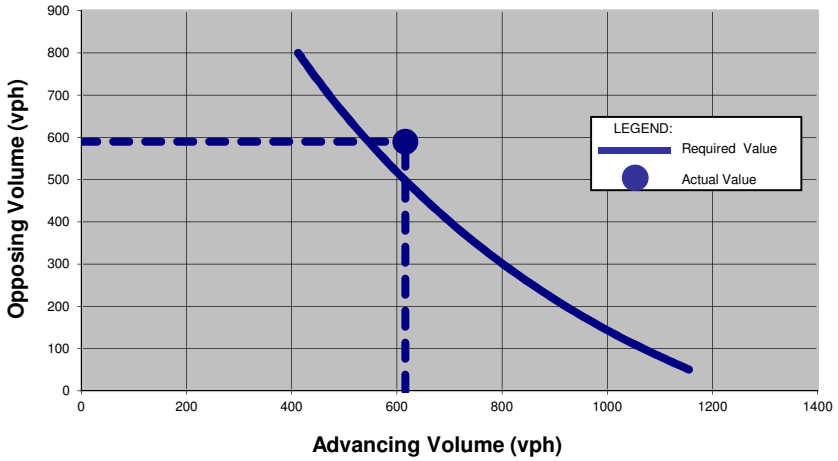
KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #:	17808
Project Name:	S Cooper Mtn Heights
Analyst:	axm
Intersection:	South Access/175th Ave
Scenario:	2016 Phase 1
Date:	10/13/2015
File:	K:\H_Portland\projfile\17808 - South Cooper Mountain\report\9 29 15 supplemental analysis\analysis\warrants\[LT_warra

Input Data:

Advancing Volume (vph) =	616	
Left-turning Vehicles (vph) =	9	
Opposing Volume (vph) =	590	
Speed (mph) =	40	
Number of Approach Lanes =	2	(not applicable for two lanes)
% Left-Turning Vehicles	1%	
Critical Gap (sec) =	6	
Maneuver Time (sec) =	4	
Exit Time (sec) =	1.9	
Utilization Factor =	0.02	

Left-Turn Lane Warrant Analysis Results



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

Attachment E 2016 Total Traffic Conditions

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	35	131	156	15	131	32	121	442	11	20	316	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt		0.93			0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1727			1800		1719	1852		1805	1827	1538
Flt Permitted		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1727			1800		1719	1852		1805	1827	1538
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	40	149	177	17	149	36	138	502	12	23	359	22
RTOR Reduction (vph)	0	38	0	0	9	0	0	1	0	0	0	16
Lane Group Flow (vph)	0	328	0	0	193	0	138	513	0	23	359	6
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	2%	3%	7%	2%	3%	5%	2%	9%	0%	4%	5%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	2	2		6	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)		18.8			12.9		9.6	30.7		1.4	22.5	22.5
Effective Green, g (s)		18.8			12.9		9.6	30.7		1.4	22.5	22.5
Actuated g/C Ratio		0.24			0.16		0.12	0.38		0.02	0.28	0.28
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		406			290		206	712		31	515	433
v/s Ratio Prot		c0.19			c0.11		c0.08	c0.28		0.01	0.20	
v/s Ratio Perm												0.00
v/c Ratio		0.81			0.66		0.67	0.72		0.74	0.70	0.01
Uniform Delay, d1		28.8			31.4		33.6	20.9		39.0	25.6	20.7
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		11.2			5.6		8.0	3.6		64.1	4.1	0.0
Delay (s)		40.0			37.1		41.6	24.5		103.1	29.7	20.7
Level of Service		D			D		D	C		F	C	C
Approach Delay (s)		40.0			37.1			28.1			33.4	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	79.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	75	42	561	21	12	511
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	79	44	591	22	13	538
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			1282			
pX, platoon unblocked	0.92	0.92			0.92	
vC, conflicting volume	1165	602			613	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1136	525			537	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	61	91			99	
cM capacity (veh/h)	205	513			960	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	79	44	613	13	538
Volume Left	79	0	0	13	0
Volume Right	0	44	22	0	0
cSH	205	513	1700	960	1700
Volume to Capacity	0.39	0.09	0.36	0.01	0.32
Queue Length 95th (ft)	27	5	0	1	0
Control Delay (s)	33.1	12.7	0.0	8.8	0.0
Lane LOS	D	B		A	
Approach Delay (s)	25.8		0.0	0.2	
Approach LOS	D				

Intersection Summary			
Average Delay	2.6		
Intersection Capacity Utilization	41.6%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	176	42	540	50	12	575
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1615	1844		1805	1863
Flt Permitted	0.95	1.00	1.00		0.35	1.00
Satd. Flow (perm)	1805	1615	1844		656	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	185	44	568	53	13	605
RTOR Reduction (vph)	0	35	5	0	0	0
Lane Group Flow (vph)	185	9	616	0	13	605
Heavy Vehicles (%)	0%	0%	2%	0%	0%	2%
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	6		8			4
Permitted Phases		6			4	
Actuated Green, G (s)	8.4	8.4	23.9		23.9	23.9
Effective Green, g (s)	8.4	8.4	23.9		23.9	23.9
Actuated g/C Ratio	0.20	0.20	0.57		0.57	0.57
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	358	320	1041		370	1052
v/s Ratio Prot	c0.10		c0.33			0.32
v/s Ratio Perm		0.01			0.02	
v/c Ratio	0.52	0.03	0.59		0.04	0.58
Uniform Delay, d1	15.1	13.7	6.0		4.1	5.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.3	0.0	0.9		0.0	0.8
Delay (s)	16.4	13.7	6.9		4.1	6.7
Level of Service	B	B	A		A	A
Approach Delay (s)	15.9		6.9			6.6
Approach LOS	B		A			A

Intersection Summary			
HCM 2000 Control Delay	8.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	42.3	Sum of lost time (s)	10.0
Intersection Capacity Utilization	49.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	370	415	302	314	119	405	457	399	187	522	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	0.95	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3574	1538	3467	3393		1770	1863	1568	1703	3475	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	3574	1538	3467	3393		1770	1863	1568	1703	3475	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	18	435	488	355	369	140	476	538	469	220	614	49
RTOR Reduction (vph)	0	0	48	0	31	0	0	0	87	0	5	0
Lane Group Flow (vph)	18	435	440	355	478	0	476	538	382	220	658	0
Heavy Vehicles (%)	0%	1%	5%	1%	2%	2%	2%	2%	3%	6%	2%	12%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	
Protected Phases	5	2	3	1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	2.9	21.7	55.3	14.5	33.3		33.6	40.1	54.6	19.2	25.7	
Effective Green, g (s)	2.9	21.7	55.3	14.5	33.3		33.6	40.1	54.6	19.2	25.7	
Actuated g/C Ratio	0.03	0.19	0.48	0.13	0.29		0.29	0.35	0.48	0.17	0.22	
Clearance Time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	45	677	742	439	986		519	652	747	285	779	
v/s Ratio Prot	0.01	c0.12	0.17	c0.10	0.14		c0.27	c0.29	0.06	0.13	0.19	
v/s Ratio Perm			0.11						0.18			
v/c Ratio	0.40	0.64	0.59	0.81	0.48		0.92	0.83	0.51	0.77	0.85	
Uniform Delay, d1	54.9	42.8	21.5	48.7	33.5		39.1	34.0	20.7	45.6	42.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.7	2.1	1.3	10.5	0.4		21.0	8.4	0.6	12.2	8.4	
Delay (s)	60.7	44.9	22.7	59.2	33.9		60.1	42.4	21.3	57.7	50.9	
Level of Service	E	D	C	E	C		E	D	C	E	D	
Approach Delay (s)		33.7			44.3			41.4			52.6	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	42.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	114.5	Sum of lost time (s)	19.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	24	767	165	18	474	14	227	78	24	20	66	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1612	3539	1538	1703	3526		1787	1743		1641	1730	
Flt Permitted	0.32	1.00	1.00	0.17	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	538	3539	1538	303	3526		1787	1743		1641	1730	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	29	935	201	22	578	17	277	95	29	24	80	40
RTOR Reduction (vph)	0	0	0	0	2	0	0	7	0	0	14	0
Lane Group Flow (vph)	29	935	201	22	593	0	277	117	0	24	106	0
Confl. Peds. (#/hr)									12	12		
Heavy Vehicles (%)	12%	2%	5%	6%	2%	0%	1%	6%	0%	10%	5%	3%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	33.7	30.1	81.5	30.5	28.5		21.8	21.8		9.6	9.6	
Effective Green, g (s)	33.7	30.1	81.5	30.5	28.5		21.8	21.8		9.6	9.6	
Actuated g/C Ratio	0.41	0.37	1.00	0.37	0.35		0.27	0.27		0.12	0.12	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	269	1307	1538	147	1233		477	466		193	203	
v/s Ratio Prot	0.00	c0.26		0.00	0.17		c0.15	0.07		0.01	c0.06	
v/s Ratio Perm	0.04		c0.13	0.05								
v/c Ratio	0.11	0.72	0.13	0.15	0.48		0.58	0.25		0.12	0.52	
Uniform Delay, d1	14.7	22.0	0.0	17.2	20.7		25.9	23.4		32.2	33.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	1.9	0.2	0.3	0.3		1.2	0.1		0.1	1.1	
Delay (s)	14.8	23.9	0.2	17.5	21.0		27.1	23.5		32.3	34.9	
Level of Service	B	C	A	B	C		C	C		C	C	
Approach Delay (s)		19.6			20.9			26.0			34.5	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	22.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	81.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	49.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	164	196	20	99	27	177	345	19	25	488	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt		0.93			0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1736			1832		1805	1883		1805	1900	1579
Flt Permitted		1.00			0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1736			1832		1805	1883		1805	1900	1579
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	18	167	200	20	101	28	181	352	19	26	498	30
RTOR Reduction (vph)	0	44	0	0	10	0	0	2	0	0	0	20
Lane Group Flow (vph)	0	341	0	0	139	0	181	369	0	26	498	10
Confl. Peds. (#/hr)	1					1	1		1	1		1
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	2	2		6	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)		19.4			11.4		10.1	34.2		2.8	26.9	26.9
Effective Green, g (s)		19.4			11.4		10.1	34.2		2.8	26.9	26.9
Actuated g/C Ratio		0.23			0.14		0.12	0.41		0.03	0.32	0.32
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		401			249		217	768		60	609	506
v/s Ratio Prot		c0.20			c0.08		c0.10	0.20		0.01	c0.26	
v/s Ratio Perm												0.01
v/c Ratio		0.85			0.56		0.83	0.48		0.43	0.82	0.02
Uniform Delay, d1		30.8			33.9		36.0	18.3		39.7	26.2	19.4
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		15.8			2.9		23.2	0.5		5.0	8.4	0.0
Delay (s)		46.6			36.7		59.2	18.7		44.7	34.6	19.5
Level of Service		D			D		E	B		D	C	B
Approach Delay (s)		46.6			36.7			32.0			34.2	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	83.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	47	26	563	82	46	654
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	49	27	593	86	48	688
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			1282			
pX, platoon unblocked	0.92	0.92			0.92	
vC, conflicting volume	1421	636			679	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1414	560			607	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	63	94			95	
cM capacity (veh/h)	133	489			902	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	49	27	679	48	688
Volume Left	49	0	0	48	0
Volume Right	0	27	86	0	0
cSH	133	489	1700	902	1700
Volume to Capacity	0.37	0.06	0.40	0.05	0.40
Queue Length 95th (ft)	25	3	0	3	0
Control Delay (s)	47.2	12.8	0.0	9.2	0.0
Lane LOS	E	B		A	
Approach Delay (s)	34.9		0.0	0.6	
Approach LOS	D				

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	48.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	110	26	619	192	46	655
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.97		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1615	1839		1805	1881
Flt Permitted	0.95	1.00	1.00		0.25	1.00
Satd. Flow (perm)	1805	1615	1839		469	1881
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	116	27	652	202	48	689
RTOR Reduction (vph)	0	23	14	0	0	0
Lane Group Flow (vph)	116	4	840	0	48	689
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	6		8			4
Permitted Phases		6			4	
Actuated Green, G (s)	7.0	7.0	33.5		33.5	33.5
Effective Green, g (s)	7.0	7.0	33.5		33.5	33.5
Actuated g/C Ratio	0.14	0.14	0.69		0.69	0.69
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	260	233	1270		323	1299
v/s Ratio Prot	c0.06		c0.46			0.37
v/s Ratio Perm		0.00			0.10	
v/c Ratio	0.45	0.02	0.66		0.15	0.53
Uniform Delay, d1	19.0	17.8	4.3		2.6	3.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.2	0.0	1.3		0.2	0.4
Delay (s)	20.2	17.8	5.6		2.8	4.1
Level of Service	C	B	A		A	A
Approach Delay (s)	19.8		5.6			4.0
Approach LOS	B		A			A

Intersection Summary			
HCM 2000 Control Delay	6.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	48.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	45	423	353	457	321	219	360	547	442	191	549	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3574	1583	3467	3350		1770	1900	1599	1805	1869	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	3574	1583	3467	3350		1770	1900	1599	1805	1869	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	47	445	372	481	338	231	379	576	465	201	578	26
RTOR Reduction (vph)	0	0	58	0	96	0	0	0	65	0	1	0
Lane Group Flow (vph)	47	445	314	481	473	0	379	576	400	201	603	0
Confl. Peds. (#/hr)							1					1
Heavy Vehicles (%)	0%	1%	2%	1%	2%	0%	2%	0%	1%	0%	1%	0%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	
Protected Phases	5	2	3	1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	6.2	18.7	46.3	18.0	30.5		27.6	50.0	68.0	18.2	40.6	
Effective Green, g (s)	6.2	18.7	46.3	18.0	30.5		27.6	50.0	68.0	18.2	40.6	
Actuated g/C Ratio	0.05	0.15	0.37	0.15	0.25		0.22	0.40	0.55	0.15	0.33	
Clearance Time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	90	539	591	503	824		394	766	877	265	612	
v/s Ratio Prot	0.03	c0.12	0.12	c0.14	0.14		c0.21	0.30	0.07	0.11	c0.32	
v/s Ratio Perm			0.08						0.18			
v/c Ratio	0.52	0.83	0.53	0.96	0.57		0.96	0.75	0.46	0.76	0.98	
Uniform Delay, d1	57.4	51.0	30.3	52.6	41.0		47.6	31.6	16.8	50.7	41.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.4	10.0	0.9	29.1	1.0		35.3	4.2	0.4	11.7	32.2	
Delay (s)	62.8	61.0	31.3	81.6	42.0		82.9	35.8	17.2	62.5	73.6	
Level of Service	E	E	C	F	D		F	D	B	E	E	
Approach Delay (s)		48.3			60.1			42.3			70.8	
Approach LOS		D			E			D			E	

Intersection Summary			
HCM 2000 Control Delay	53.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	123.9	Sum of lost time (s)	19.0
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	37	673	346	78	767	9	223	39	38	11	20	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.93		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	3574	1566	1805	3568		1805	1698		1583	1804	
Flt Permitted	0.22	1.00	1.00	0.23	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	414	3574	1566	437	3568		1805	1698		1583	1804	
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	43	774	398	90	882	10	256	45	44	13	23	7
RTOR Reduction (vph)	0	0	0	0	1	0	0	23	0	0	7	0
Lane Group Flow (vph)	43	774	398	90	891	0	256	66	0	13	23	0
Confl. Peds. (#/hr)	2					2			10	10		
Confl. Bikes (#/hr)			1			2						
Heavy Vehicles (%)	0%	1%	1%	0%	1%	0%	0%	5%	0%	14%	0%	7%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	29.7	26.3	71.4	33.5	28.2		18.7	18.7		3.1	3.1	
Effective Green, g (s)	29.7	26.3	71.4	33.5	28.2		18.7	18.7		3.1	3.1	
Actuated g/C Ratio	0.42	0.37	1.00	0.47	0.39		0.26	0.26		0.04	0.04	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	238	1316	1566	306	1409		472	444		68	78	
v/s Ratio Prot	0.01	0.22		0.02	c0.25		c0.14	0.04		0.01	0.01	
v/s Ratio Perm	0.07		c0.25	0.12								
v/c Ratio	0.18	0.59	0.25	0.29	0.63		0.54	0.15		0.19	0.30	
Uniform Delay, d1	13.0	18.2	0.0	11.4	17.4		22.7	20.2		32.9	33.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.7	0.4	0.4	0.9		0.7	0.1		0.5	0.8	
Delay (s)	13.3	18.9	0.4	11.8	18.4		23.4	20.3		33.4	33.9	
Level of Service	B	B	A	B	B		C	C		C	C	
Approach Delay (s)		12.6			17.8			22.6			33.7	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	16.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	71.4	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group