TENW
Transportation Engineering NorthWest

TECHNICAL MEMORANDUM

DATE: June 14, 2024

TO: Jesse Hannahs, PE / Jesse Birchman, PE, PTOE
City of Marysville, WA

FROM: Spenser Haynie / Chris Forster, PE
TENW

SUBJECT: Updated Limited Traffic Impact Analysis
Chick-fil-A Soper Hill Road – Marysville, WA
TENW Project No. 2023-197

CHRISTOPHER P. FORSTER
STATE OF WASHINGTON
38325
REGISTERED PROFESSIONAL ENGINEER
6/14/24

This technical memorandum documents the limited traffic impact analysis (TIA) completed for the proposed *Chick-fil-A Soper Hill Road* project and is based on scoping discussions with the City of Marysville. This traffic assessment includes a project description, trip generation estimate, project peak hour trip distribution and assignment, drive-through queuing analysis, and estimation of impact fees. This is an update to our previous traffic analysis dated December 1, 2023 to reflect an updated weekday PM peak hour trip generation estimate for White Barn development for the purposes of comparing to the previously approved TIA.

Project Description

The proposed *Chick-fil-A Soper Hill Road* site is located on the northeast corner of 87th Ave NE and Soper Hill Road in Marysville, WA, as shown in the Attachment A Vicinity Map. The project proposal includes a 5,773 square foot (SF) Chick-fil-A fast-food restaurant with drive-through on a pad site within the White Barn Development that is currently vacant. Vehicular access to the adjacent public streets is proposed via two driveways (one on Soper Hill Road and one on 87th Ave NE shared with other uses within the White Barn Development). A preliminary site plan is shown in Attachment B.

Project Trip Generation

The net new weekday PM peak hour trip generation estimate for the proposed project was based on methodology documented in the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 11th Edition for Land Use Code (LUC) 934 (Fast Food Restaurant with Drive-Thru). Adjustments to the trip generation estimates were made to account for internal and pass-by trips.

Pass-by trips are trips that are made by vehicles that are already on the adjacent streets and make intermediate stops at a commercial use on route to a primary destination (i.e., on the way from work to home). The pass-by reduction is based on studies documented in the appendices of the ITE *Trip Generation Manual*, 11th Edition.

Internal trips are made by people making multiple stops within a development without generating new trips onto the adjacent street system, such as trips between the proposed Chick-fil-A and other uses on the White Barn development site. The internal trip adjustments were based on the methodology established in the ITE Trip Generation Handbook, 3rd Edition (2017).

Table 1 summarizes the net new weekday PM peak hour trip generation with detailed trip generation calculations provided in Attachment C.

Table 1
Trip Generation Summary

	Net New Trips Generated		
Weekday Time Period	In	Out	Total
PM Peak Hour	34	15	49

Trip Generation Comparison to White Barn TIA

As requested by the City, below is a comparison of the weekday PM peak hour trip generation estimates documented in the original SEPA-approved White Barn TIA with the trip generation estimates associated with the known constructed and proposed development uses/businesses. As of the date of this study, below are the known constructed or proposed development uses/businesses on the White Barn site:

- Everett Clinic
- White Barn Gas Station
- Kids N Us
- White Barn Medical Office Building
- Soper Hill Road Chick-fil-A (this project)
- Brown Bear Car Wash

Table 2 summarizes the new weekday PM peak hour trip generation totals for the constructed or proposed developments and compares them to the total trip generation analyzed in the approved White Barn TIA. Note that the latest trip generation estimates for the overall White Barn development, including adjustments for internal capture and pass-by as approved by the City, were completed by Kimley-Horn and are included in Attachment C.

Table 2
Trip Generation Comparison

	Weekday PM Peak Hour		
Use	In	Out	Total
Everett Clinic	28	66	94
White Barn Gas Station	23	39	62
Kids N Us	9	17	26
White Barn MOB	18	14	32
Chick-fil-A	34	15	49
Brown Bear Car Wash	31	37	68
Total Constructed/Proposed	**143**	**188**	**331**
Original Approved White Barn TIA	**143**	**199**	**342**

Project Trip Distribution and Assignment

The distribution of weekday PM peak hour project-generated trips was estimated based on trip distribution patterns documented in the TIA prepared for the White Barn Development (dated February 2021) and traffic model distribution figures as provided by the City of Marysville.

The estimated distribution percentages were used to assign the weekday PM peak hour project trips generated by the *Chick-fil-A Soper Hill Road* project to the adjacent street network. In accordance with the *Snohomish County Traffic Worksheet and Traffic Study Requirements for Developments in the City of Marysville*, project trip impacts at Snohomish County key intersections were identified. Weekday PM peak hour trip distribution and assignment figures were prepared consistent with these guidelines and are included in Attachment D.

Drive-Through Queuing

A drive-through queuing analysis was conducted for the proposed drive-through lanes including a summary of the proposed drive-through lane storage capacity and an estimate of the 95th percentile queues based on service time information provided by Chick-fil-A.

Drive-Through Operations and Storage

Based on the current site plan, the proposed *Chick-fil-A Soper Hill Road* project includes two (2) drive-through lanes with approximately 1,015 total feet of queuing storage (41 vehicles) from the pick-up window to the entrance of the drive-through lanes.

Drive-Through Queue Analysis

A drive-through queuing analysis was conducted to estimate future queuing in the drive-through with the proposed *Chick-fil-A Soper Hill Road* project. The queue analysis was based on standard queue theory equations that relate the rate of vehicle arrivals to the rate of vehicle departures (service time), which are both based on a Poisson distribution (M/M/s) queue regime).

Queue analysis is based on the fact that a queue will form when vehicles arrive at a faster rate than they can be served. The key inputs in the model are (1) the arrival rate of vehicles during the peak hour, and (2) the service rate of the drive-through. The use of the Poisson distribution assumes arrival times are independent of each other and that the arrival time of one vehicle has no impact on the arrival time of the next vehicle, which is a reasonable assumption at a fast-food drive-through window where vehicle arrival rates fluctuate through the peak hour. The model also assumes that departure rates can vary (some customers take longer to order).

To estimate future queues in the proposed drive-through lanes, the queuing formula based on the M/M/s queuing regime was used. The M/M/s queuing regime assumes random (exponentially distributed) arrivals and departures and uses average arrival and departure rates.

Arrival Rate

The arrival rate at the drive-through was based on the forecasted future AM peak hour and PM peak hour project trip generation and information provided by Chick-Fil-A related to drive-through usage. Based on data provided by Chick-fil-A, approximately 65 percent of arriving customers are estimated to utilize the drive-through. During the weekday AM peak hour, 132 vehicles (gross project trip generation) are estimated to enter the *Chick-fil-A Soper Hill Road* site. Assuming 65 percent of the vehicles would use the drive-through, this would result in 86 vehicles in the drive-through lane. During the weekday PM peak hour, 99 vehicles (gross project trip generation) are estimated to enter the *Chick-fil-A Soper Hill Road* site. Assuming 65 percent of the vehicles would use the drive-through, this would result in 64 vehicles in the drive-through lane.

Departure Rate

The average service (departure) rate was based on information provided by Chick-fil-A. Per Chick-fil-A, on average, it takes approximately 60 seconds per vehicle at the order window and 30 seconds per vehicle at the pay/pick-up window. It should be noted that the average service time does not include queue "move-up" time, or the time it takes for the next vehicle in line to move forward. With the assumption of 5 seconds for "move-up" time, the average service rate would be conservatively estimated at *65 seconds* (60 seconds per vehicle for ordering + 5 seconds move-up time) at the order point and *35 seconds* (30 seconds per vehicle at each of the pay/pick-up window + 5 seconds move-up time) at the pay/pick-up window. Based on this information, the order point is the critical component of the drive-through operations and the cause for potential queuing. Therefore, the queuing analysis described next is for the queuing at the order point.

Drive-Through Queue Estimate

Queues were calculated at the order point based on the estimated drive-through volumes during the weekday AM and PM peak hours and the average service (departure) rate as provided by Chick-fil-A. Based on 86 entering vehicles utilizing the drive-through during the AM peak hour, 64 entering vehicles utilizing the drive-through during the PM peak hour, a service rate of 65 seconds per vehicle, and two (2) order points, a 95th percentile queue of 11 vehicles during the AM peak hour and 6 vehicles during the PM peak hour is estimated at the order point. The 95th percentile queues during the weekday peak hours would be accommodated within the drive-through lane storage provided (approximately 20 vehicles measured from the order point to the drive-through entrance). The detailed queue calculations are shown in Attachment E.

Mitigation

The following summarizes the measures proposed to mitigate the transportation impacts of the proposed *Chick-fil-A Soper Hill Road* project.

City of Marysville

The City of Marysville requires payment of transportation impact fees to help fund planned roadway improvements throughout the City. The City of Marysville's currently adopted transportation impact fee rate is $2,220 per PM peak hour trip. The proposed *Chick-fil-A Soper Hill Road* project is estimated to generate 49 net new PM peak hour trips. As a result, the estimated City of Marysville transportation impact fee is $108,780 ($2,220 x 49 PM peak hour trips). Actual impact fees will be calculated by the City based on the proposed land uses and trip generation rates in effect at the time of building permit issuance.

Additionally, based on the interlocal agreement between City of Marysville and the City of Lake Stevens, the City of Marysville is collecting fees to fund improvements to Soper Hill Road between SR 9 and 83rd Avenue NE. The City of Marysville is currently collecting an impact fee of $1,700 per PM peak hour trip impacting the new 87th Ave NE/Soper Hill Road roundabout. Based on the horizon year weekday PM peak hour trip distribution and assignment shown in Attachment D, the proposed *Chick-fil-A Soper Hill Road* project is anticipated to send 17 trips through the 87th Ave NE/Soper Hill Road roundabout resulting in an impact fee of $28,900 ($1,700 x 17 PM peak hour trips).

Snohomish County

The project is also subject to the requirements of an Interlocal Agreement between the City of Marysville and Snohomish County. Pursuant to this agreement, the project is required to evaluate potential impact fees to fund improvements in nearby unincorporated areas of Snohomish County. TENW reviewed the interlocal agreement requirements and based on the location of the nearest roadway improvements identified in the Snohomish County *Transportation Needs Report* (Appendix D), no impact fee projects are anticipated to be impacted by at least 3 directional peak hour trips. Therefore, we believe that no impact fees will be due to Snohomish County. The Snohomish County Traffic Worksheet and Traffic Mitigation Offer forms will be submitted separately.

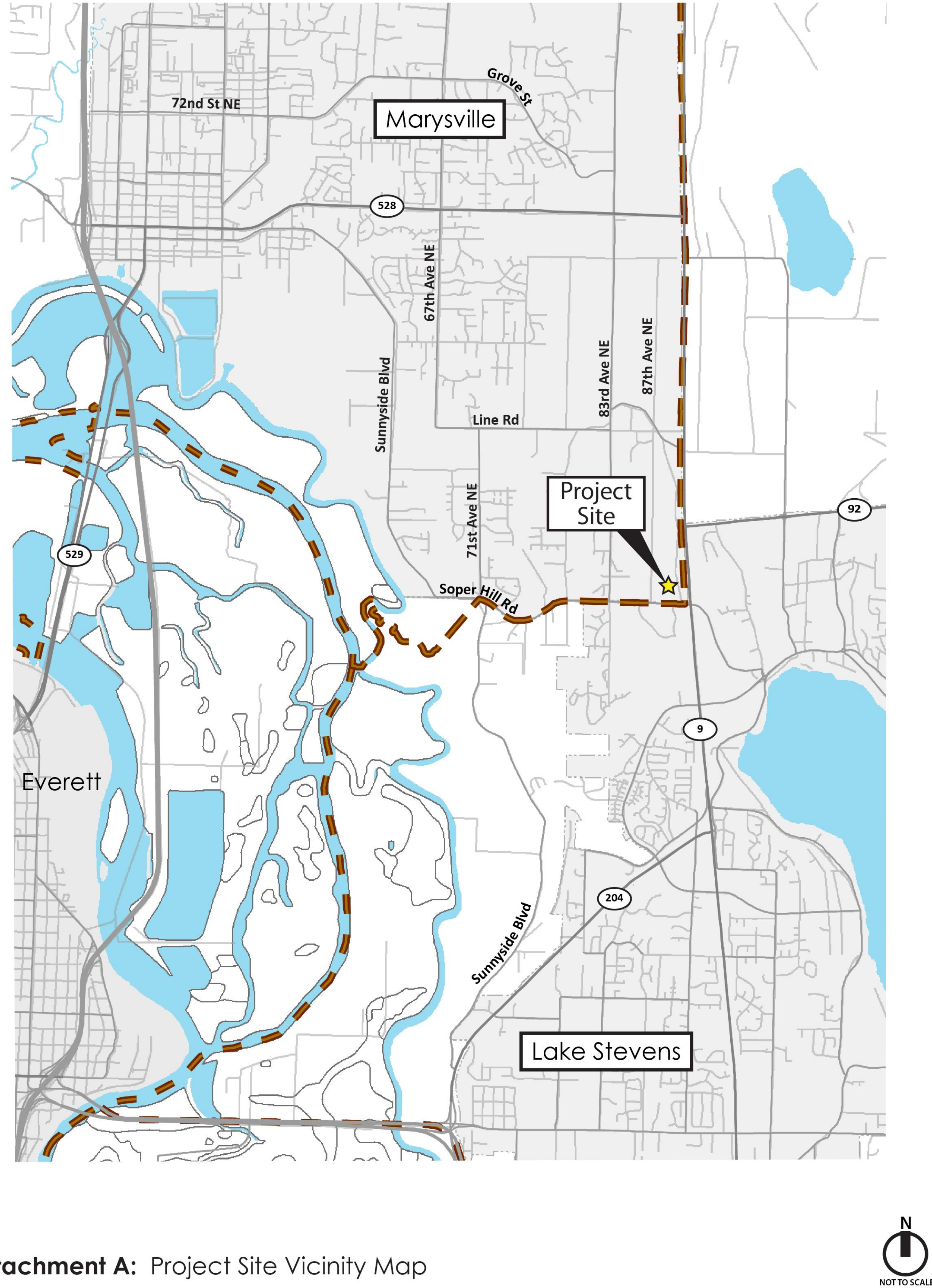
If you have any questions regarding the information presented in this limited Traffic Impact Analysis (TIA), please contact me at (206) 390-7253 or spenser@tenw.com.

cc: Steve Schwartz – Chick-fil-A, Inc
Andrew Hunt – 4G Development & Consulting

Attachments:
A. Project Site Vicinity
B. Preliminary Site Plan
C. Trip Generation Calculations
D. Weekday PM Peak Hour Project Trip Distribution and Assignment
E. Drive-Through Queuing Analysis

ATTACHMENT A

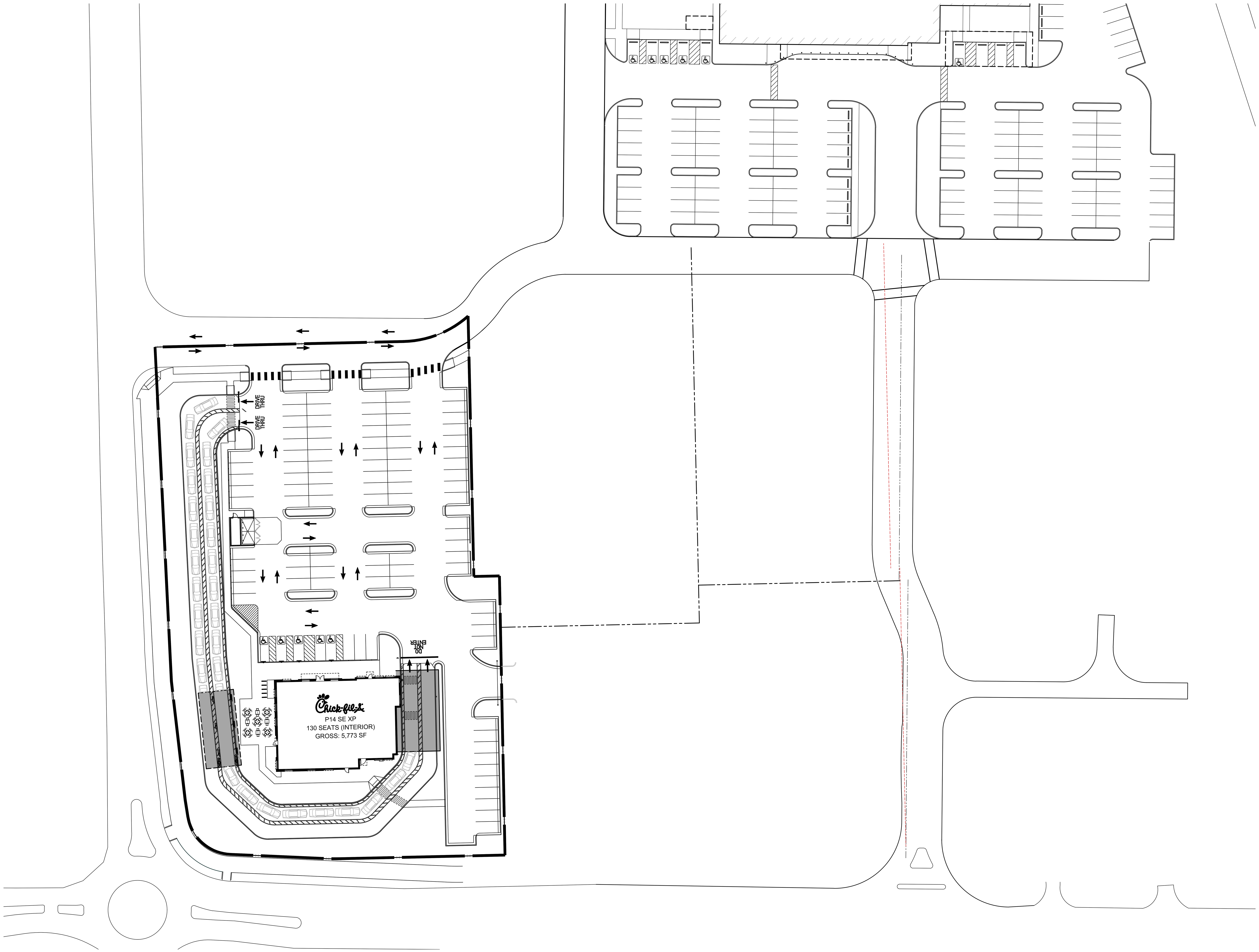
Vicinity Map



Attachment A: Project Site Vicinity Map

ATTACHMENT B

Preliminary Site Plan



PROJECT DATA:

SITE AREA:	
GROSS:	2.08 AC
	90,528 SF
BUILDING FOOTPRINT:	5,028 SF
BUILDING USE:	
COVERAGE:	
GROSS:	6%
NET:	6%
PARKING REQUIRED:	
RESTAURANT	30 STALLS
TOTAL	30 STALLS
PARKING PROVIDED:	
AUTO:	106 STALLS
	@21.08/1000 SF
REQ. ACCESSIBLE	*5 STALLS*
DT STACK:	49 CARS
OP CANOPY	11TH CAR AT INNER LANE

DEVELOPMENT STANDARDS:

ZONING:	CB-WR	1
MAX. HEIGHT:	55 FT	
BUILDING SETBACKS:		
FRONT:	0 FT	2
SIDE:	0 FT	3
REAR:	0 FT	3
LANDSCAPE SETBACKS:		
FRONT:		5
SIDE:		4
REAR:		4
LANDSCAPE REQ.:	15%	6
OFF-STREET PARKING:		
STANDARD:	8.5X18	9
COMPACT:	TBD	
COMPACT %:	TBD	
DRIVE AISLE:	22 FT	
FIRE LANE:	26 FT	
OVERHANG:	2 FT	
REQ. PARKING RATIO BY USE:		
RESTAURANT:		8
DRIVE-THROUGH:	1/75 SF	7

NOTES:

1 Community Business - Whiskey Ridge Subarea Plan

2 Subject to sight distance review at driveways and street intersections.

3 A 25-foot setback is required on property lines adjoining residentially designated property.

4 20 ft L1 landscaping buffer between commercial use and property designated single-family by the Marysville comprehensive plan.
10 ft L2 landscaping buffer between commercial use and property designated multiple-family by the Marysville comprehensive plan.

5 Required landscaping setbacks for developments on the north side of Soper Hill Road are 25 ft from the edge of sidewalk.
If the drive-through lane is abutting a street: (a) 10 ft setback required from a public right-of-way or private access road. The setback area shall be landscaped to the L3 standard; see Chapter 22C.120 MMC, Landscaping and Screening.
(b) 15 ft setback required from a public arterial right-of-way. The setback area shall be landscaped to the L3 standard; see Chapter 22C.120 MMC, Landscaping and Screening. (Ord. 2852 § 10 (Exh. A), 2011).

6 Maximum impervious surface: 85%

7 A stacking lane shall be an area measuring a minimum of 8'-6" wide by 20 feet deep. For each service lane of a drive-through restaurant, a minimum of 7 stacking spaces shall be provided. For high volume drive-through restaurants up to 12 stacking spaces may be required.

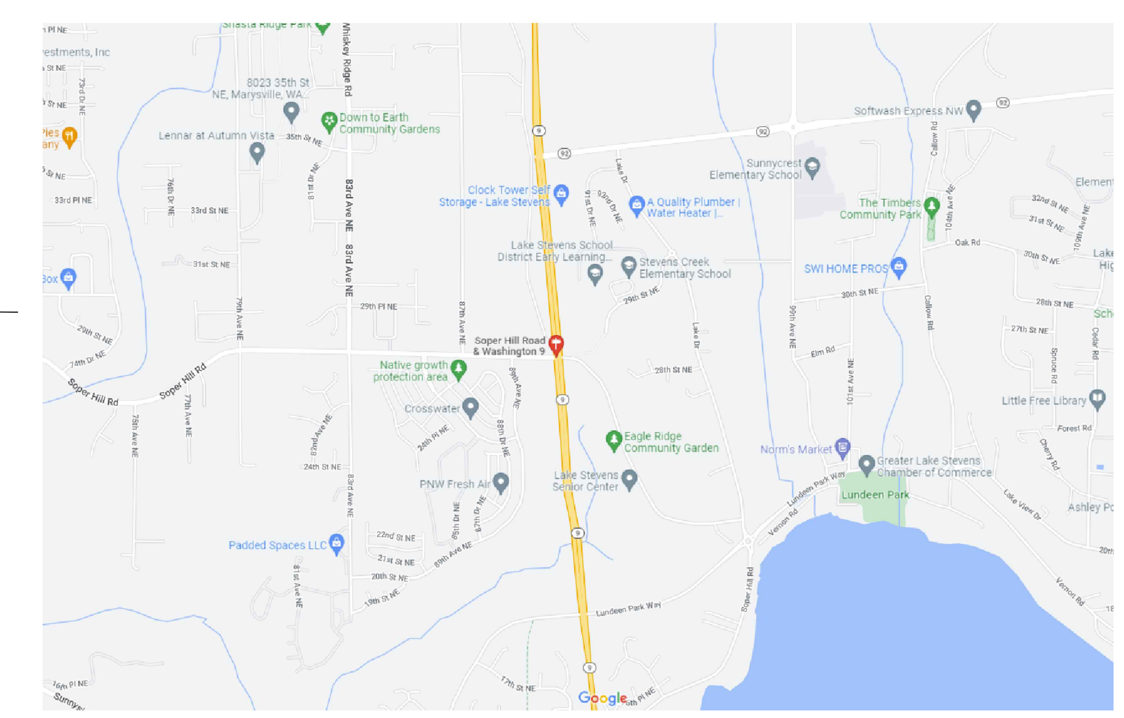
8 If < 4,000 SF, 1 per 200 SF gross floor area; if > 4,000 SF, 20 plus 1 per 100 SF gross floor area over 4,000 SF

9 Bicycle parking facilities shall be provided for any new use which requires 20 or more automobile parking spaces. The number of required bicycle parking spaces shall be 5% of the number of required off-street auto parking spaces. When any covered automobile parking is provided, all bicycle parking shall be covered.

This conceptual design is based upon a preliminary review of entitlement requirements and on unverified and possibly incomplete site and/or building information, and is intended merely to assist in exploring how the project might be developed.

Stormwater Management Design:
AVERAGE REGIONAL REQUIRED PROVIDED

Boundary Source:
GIS MAP & AERIAL IMAGE



1" =30'

0 15 30 60 150

NORTH

scheme: PSP10

Conceptual Site Plan

Soper Hill Rd & SR 9,
Marysville, WA 98258

WARE MALCOMB

SEA22-0053-00
01.11.2023

SHEET
PSP10

ATTACHMENT C

Trip Generation Calculations

White Barn PM Peak Hour Trip Generation Calculation

Lot (Submittal)	Project	Land Use	Setting	Size	Units	Rate[1]	Inbound %	Gross Trips Inbound	Gross Trips Outbound	Gross Trips Subtotal	Internal Trips[2] In	Internal Trips Out	Internal Trips Total	Internal Trips %	External Trips In	External Trips Out	External Trips Total	Pass-By Trips %	Pass-By Trips In	Pass-By Trips Out	Pass-By Trips Total	Primary Trips Inbound	Primary Trips Outbound	Primary Trips Total
Lot 9 (Submittal 1)	Everett Clinic	**Medical Office (720)**		**33,748**	sf																			
		PM Peak Hour	General Urban/Suburban			3.46	28%	33	84	117	5	18	23	20%	28	66	94		-	-	-	28	66	94
Lot 2 (Submittal 2)	Gas Station	**Gas Station (945)**		**12**	vfp																			
		PM Peak Hour	General Urban/Suburban			26.90	50%	161	162	323	45	30	75	23%	116	132	248	75%	93	93	186	23	39	62
Lot 8 (Submittal 3)	Kids N Us	**Day Care Center (565)**		**12,100**	sf																			
		PM Peak Hour	General Urban/Suburban			11.12	47%	63	72	135	16	13	29	21%	47	59	106	75%	38	42	80	9	17	26
Lot 6 (Submittal 4)	Medical Office	**Medical Office (720)**		**10,000**	sf																			
		PM Peak Hour	General Urban/Suburban			3.93	57%	22	17	39	4	3	7	19%	18	14	32		-	-	-	18	14	32
Lots 1 & 7 (Submittal 5)	Chick Fil A	**Fast Food Restaurant**		**5,773**	sf																			
		PM Peak Hour	General Urban/Suburban			33.03	52%	99	92	191	34	48	82	43%	65	44	109	55%	31	29	60	34	15	49
Lots 3 & 4 (Submittal 6)	Brown Bear	**Automated Car Wash (948)**		**1**	tunnels																			
		PM Peak Hour	General Urban/Suburban			77.50	50%	39	39	78	11	7	18	23%	28	32	60	40%	12	12	24	16	20	36
		Touchless Car Wash		**5**	bays																			
		PM Peak Hour	General Urban/Suburban			13.68	51%	35	33	68	10	6	16	24%	25	27	52	40%	10	10	20	15	17	32
Future	Future	**TBD**		**0**	sf																			
		PM Peak Hour	General Urban/Suburban					0	0	0	0	0	0		0	0	0			-	-		0	0
Future	Future	**TBD**		**0**	sf																			
		PM Peak Hour	General Urban/Suburban					0	0	0	0	0	0		0	0	0			-	-		0	0
		Subtotal																						
		PM Peak Hour						452	499	951	125	125	250	26%	327	374	701		184	186	370	143	188	331

	Inbound	Outbound	Total
Original Approval	143	199	342
difference:	0	-11	-11

Notes:

1. Trip rates based on Institute of Transportation Engineers' (ITE) *Trip Generation Manual (* 11th Edition).
2. Internal Capture per ITE's *Trip Generation Handbook* (3rd Ed).
3. Pass-by rates per ITE's *Trip Generaiton Manual* (11th Ed).

NCHRP 8-51 Internal Trip Capture Estimation Tool			
Project Name:	White Barn	**Organization:**	Transpo Group
Project Location:	Marysville	**Performed By:**	
Scenario Description:	Development submitted to date	**Date:**	7-May
Analysis Year:		**Checked By:**	
Analysis Period:	**PM Street Peak Hour**	**Date:**	

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				156.3	55	101.3
Retail				468.8	235	233.8
Restaurant				190.68219	99	91.68219
Cinema/Entertainment				135	63	72
Residential				0	0	0
Hotel				0	0	0
All Other Land Uses[2]				0	0	0
Total				950.78219	452	498.78219

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.	% Transit	% Non-Motorized	Veh. Occ.	% Transit	% Non-Motorized
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		19	2	0	0	0
Retail	5		29	9	0	0
Restaurant	3	38		7	0	0
Cinema/Entertainment	1	9	3		0	0
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	951	452	499
Internal Capture Percentage	26%	28%	25%
External Vehicle-Trips[3]	701	327	374
External Transit-Trips[4]	0	0	0
External Non-Motorized Trips[4]	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	16%	21%
Retail	28%	18%
Restaurant	34%	52%
Cinema/Entertainment	25%	18%
Residential	N/A	N/A
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Informational Report*, published by the Institute of Transportation Engineers.
[2]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
[3]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[4]Person-Trips
*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas Transportation Institute

Project Name:	White Barn
Analysis Period:	**PM Street Peak Hour**

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-P (D): Entering Trips				Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*		Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	55	55		1.00	101.3	101
Retail	1.00	235	235		1.00	233.8	234
Restaurant	1.00	99	99		1.00	91.68219	92
Cinema/Entertainment	1.00	63	63		1.00	72	72
Residential	1.00	0	0		1.00	0	0
Hotel	1.00	0	0		1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		20	4	0	2	0
Retail	5		68	9	61	12
Restaurant	3	38		7	17	6
Cinema/Entertainment	1	15	22		6	1
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		19	2	1	0	0
Retail	17		29	16	0	0
Restaurant	17	118		20	0	0
Cinema/Entertainment	3	9	3		0	0
Residential	31	24	14	0		0
Hotel	0	5	5	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	9	46	55		46	0	0
Retail	66	169	235		169	0	0
Restaurant	34	65	99		65	0	0
Cinema/Entertainment	16	47	63		47	0	0
Residential	0	0	0		0	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

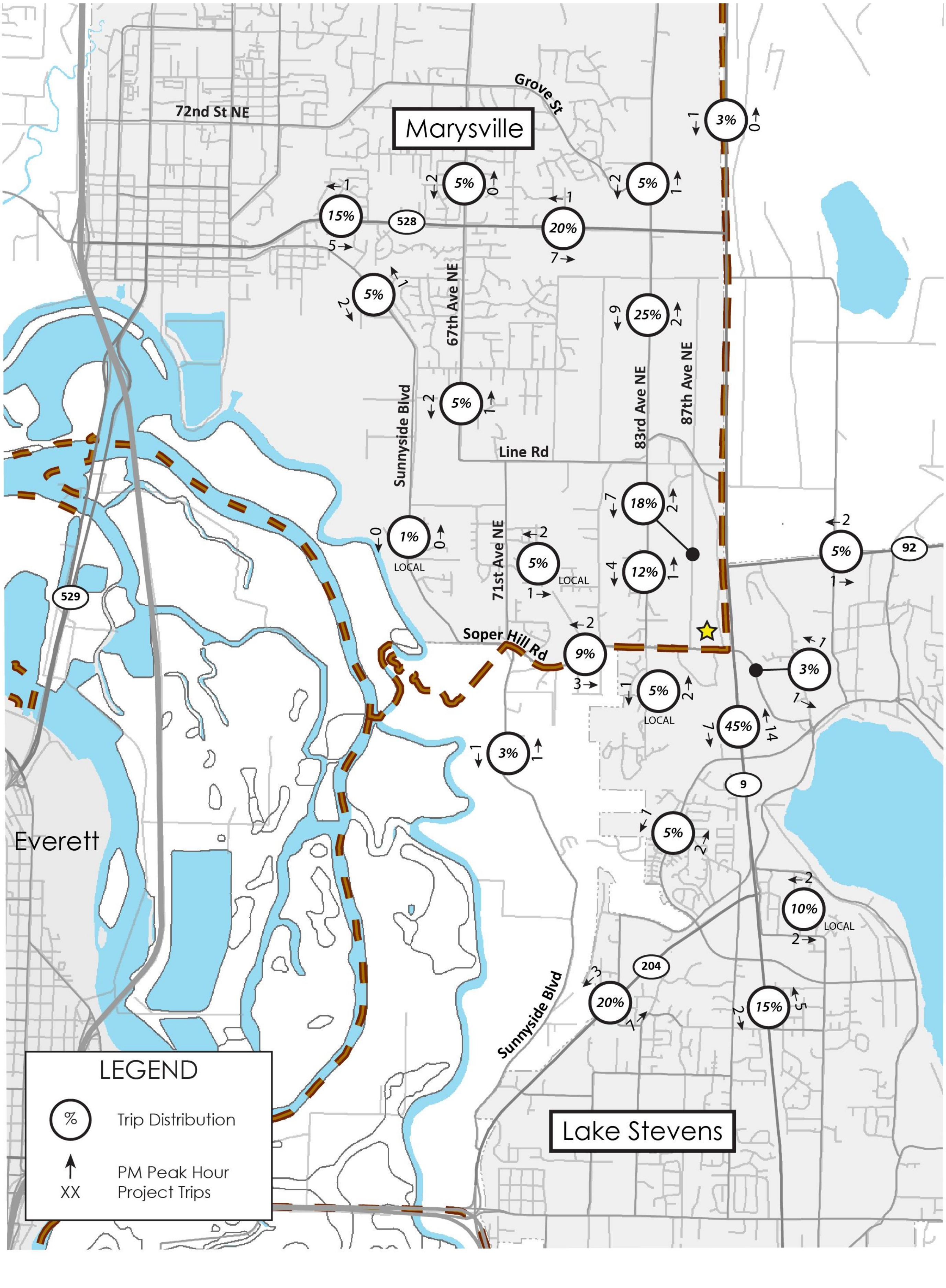
Table 9-P (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates				External Trips by Mode*		
	Internal	External	Total		Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	21	80	101		80	0	0
Retail	43	191	234		191	0	0
Restaurant	48	44	92		44	0	0
Cinema/Entertainment	13	59	72		59	0	0
Residential	0	0	0		0	0	0
Hotel	0	0	0		0	0	0
All Other Land Uses[3]	0	0	0		0	0	0

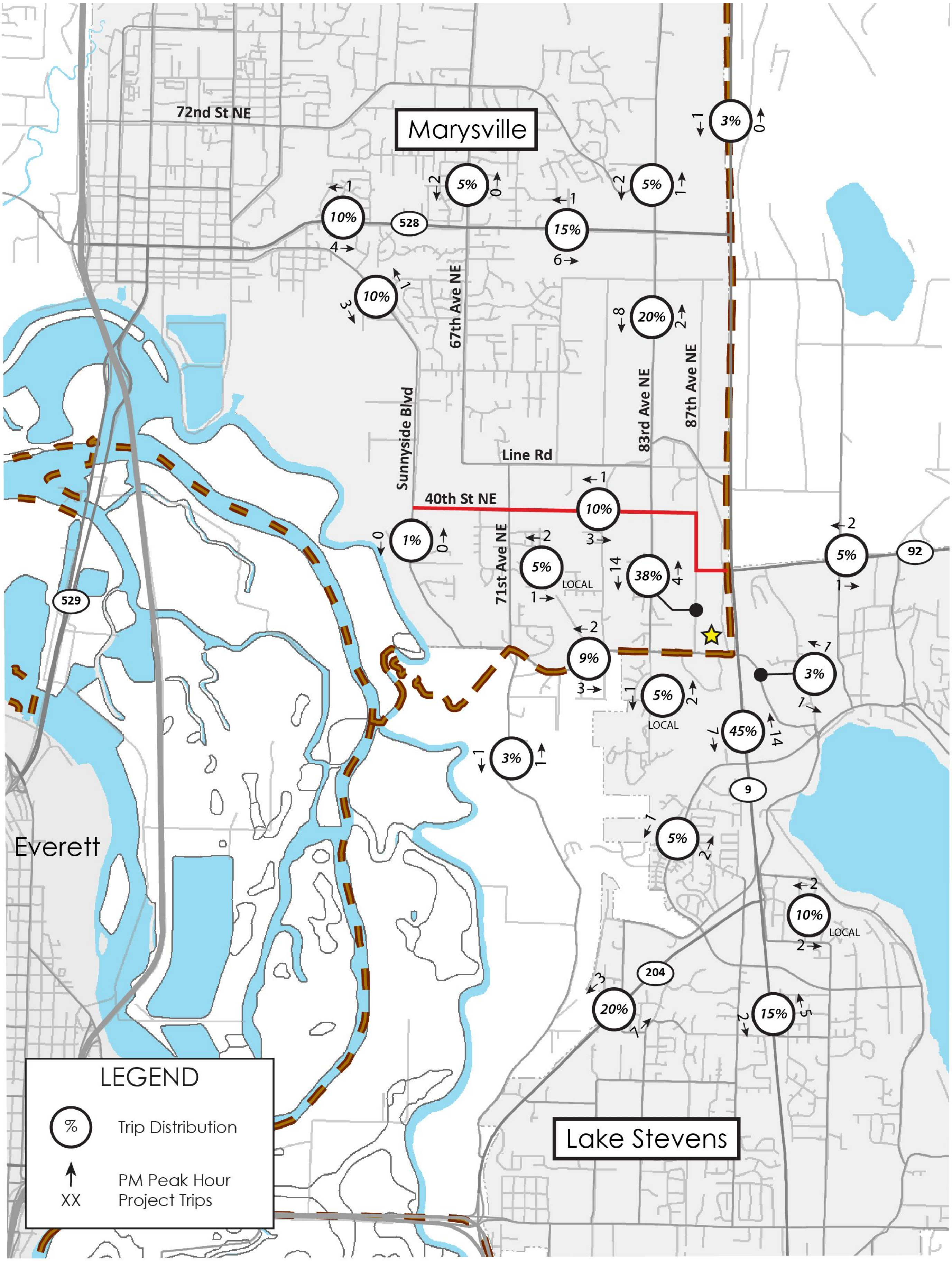
[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P
[2]Person-Trips
[3]Total estimate for all other land uses at mixed-use development site-not subject to internal trip capture computations in this estimator
*Indicates computation that has been rounded to the nearest whole number.

ATTACHMENT D

Weekday PM Peak Hour Project Trip Distribution and Assignment



Attachment D1: PM Peak Hour Project Trip Distribution and Assignment (Year of Opening)



Attachment D2: PM Peak Hour Project Trip Distribution and Assignment (Horizon Year)

N
NOT TO SCALE

Attachment D3: PM Peak Hour Project Trip Assignment at Snohomish County Key Intersections

N

NOT TO SCALE

ATTACHMENT E

Drive-Through Queuing Analysis

Chick-fil-A Soper Hill Rd
Weekday AM Peak Hour Queue Estimate
M/M/s Queuing Model

Entering Vehicles 132
% Drive-Through 65%

Order Point

Arrival Rate (λ)		Departure Rate (μ)	
86	veh/hr	65.0	sec
0.0239	veh/sec	0.0154	veh/sec

Inputs:

λ =	0.0239
μ =	0.0154
s =	2

Outputs:

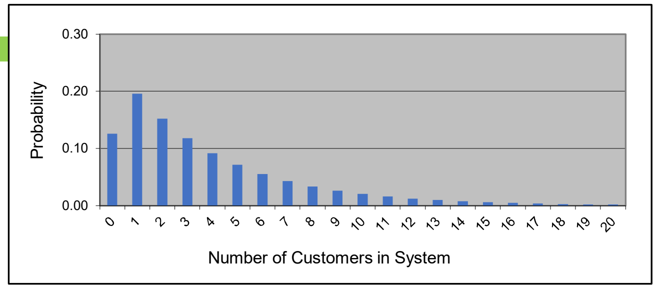
ρ =	0.77639
L =	**3.9 veh**
L_q =	2.4 veh
W =	163.63716
W_q =	98.63716

Probability Calcs:

n	P_n	Prob <= n Vehicles	Vehicles (n)
0	0.12587959	12.6%	0
1	0.19546304	32.1%	1
2	0.15175533	47.3%	2
3	0.11782115	59.1%	3
4	0.09147503	68.2%	4
5	0.07102020	75.3%	5
6	0.05513929	80.9%	6
7	0.04280953	85.1%	7
8	0.03323685	88.5%	8
9	0.02580472	91.0%	9
10	0.02003450	93.0%	10
11	0.01555456	**94.6%**	**11**
12	0.01207639	95.8%	12
13	0.00937597	96.7%	13
14	0.00727940	97.5%	14
15	0.00565165	98.0%	15
16	0.00438788	98.5%	16
17	0.00340670	98.8%	17
18	0.00264492	99.1%	18
19	0.00205349	99.3%	19
20	0.00159431	99.4%	20

Legend:

λ =	mean arrival rate
μ =	mean service rate
s =	# of servers
ρ =	traffic intensity
L =	**expected number of customers in system**
L_q =	expected number of customers in the queue
W =	expected waiting time of customer in system
W_q =	expected waiting time of customer in queue
P_0 =	probability of 0 cars in the system
Pn =	probability of n cars in the system



Chick-fil-A Soper Hill Rd
Weekday PM Peak Hour Queue Estimate
M/M/s Queuing Model

Entering Vehicles 99
% Drive-Through 65%

Order Point

Arrival Rate (λ)	Departure Rate (μ)
64 veh/hr	65.0 sec
0.0178 veh/sec	0.0154 veh/sec

Inputs:

$\lambda =$ 0.0178
$\mu =$ 0.0154
s = 2

Outputs:

$\rho =$ 0.57778

L = 1.7 veh
$L_q =$ 0.6 veh

W = 97.57228
$W_q =$ 32.57228

Probability Calcs:

n	P_n	Prob <= n Vehicles	Vehicles (n)
0	0.26760563	26.8%	0
1	0.30923318	57.7%	1
2	0.17866806	75.6%	2
3	0.10323043	85.9%	3
4	0.05964425	91.8%	4
5	0.03446112	**95.3%**	**5**
6	0.01991087	97.3%	6
7	0.01150406	98.4%	7
8	0.00664679	99.1%	8
9	0.00384037	99.5%	9
10	0.00221888	99.7%	10
11	0.00128202	99.8%	11
12	0.00074072	99.9%	12
13	0.00042797	99.9%	13
14	0.00024727	100.0%	14
15	0.00014287	100.0%	15
16	0.00008255	100.0%	16
17	0.00004769	100.0%	17
18	0.00002756	100.0%	18
19	0.00001592	100.0%	19
20	0.00000920	100.0%	20

Legend:

$\lambda =$	mean arrival rate
$\mu =$	mean service rate
s =	# of servers
$\rho =$	traffic intensity
L =	**expected number of customers in system**
$L_q =$	expected number of customers in the queue
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