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Raspberry Hill Traffic Impact Analysis

Jurisdiction: City of Monroe

October 2016



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1. DEVELOPMENT IDENTIFICATION

Gibson Traffic Consultants, Inc. (GTC) has been retained to provide a traffic impact analysis for the proposed Raspberry Hill development to address the City of Monroe, Snohomish County and Washington State Department of Transportation (WSDOT) traffic impacts. Brad Lincoln, responsible for this report and traffic analysis, is a licensed professional engineer (Civil) in the State of Washington and member of the Washington State section of ITE.

The Raspberry Hill development is proposed to consist of a total of 28 single-family residential units that will be constructed in one phase. There is one existing single-family residential unit that will be removed and will be credited to the development. The analysis in this report has therefore been performed for 27 new single-family residential units. The development site is located along the south side of 134th Street SE, west of 191st Avenue SE. A site vicinity map has been included in Figure 1.

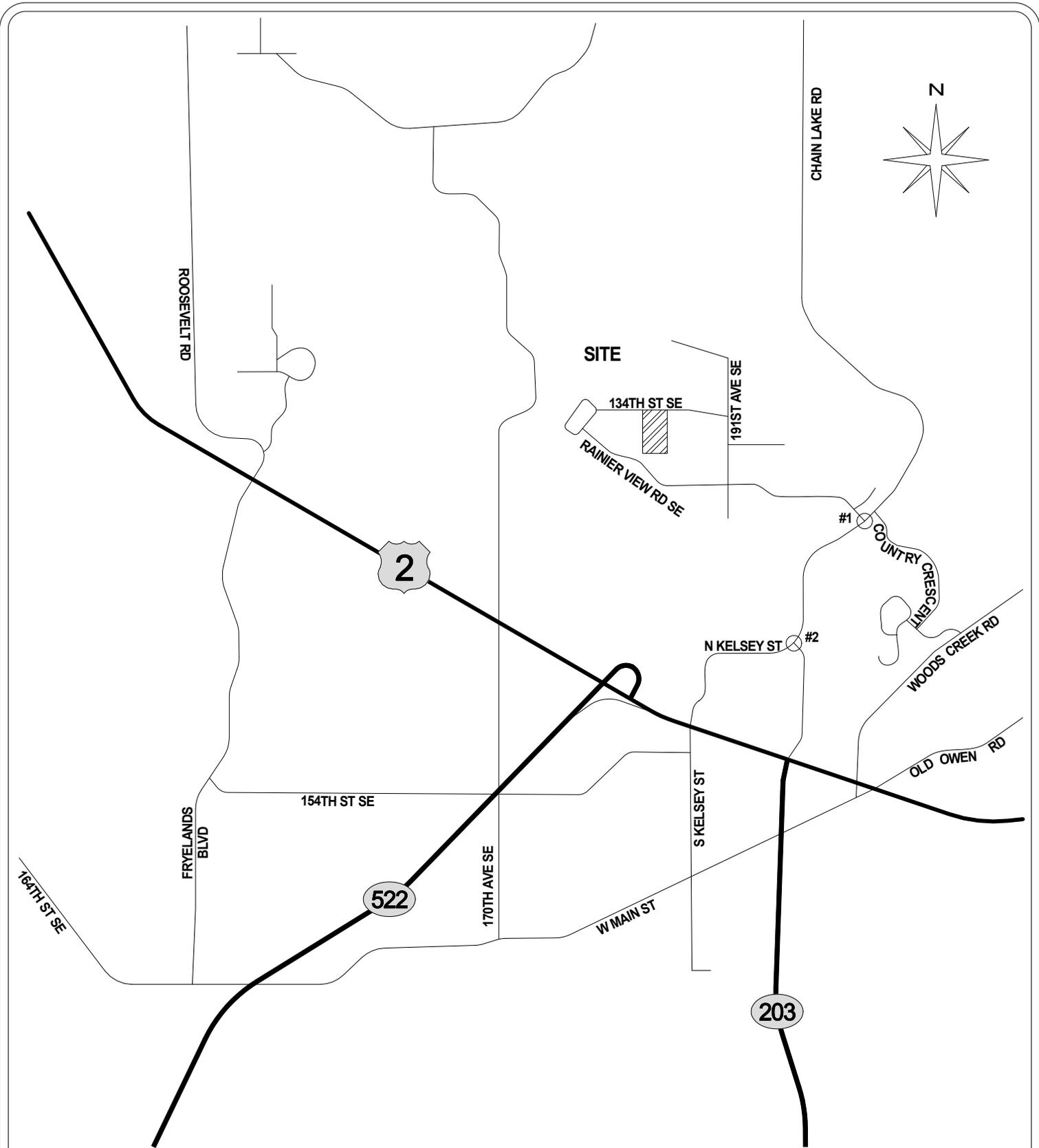
2. METHODOLOGY

Trip generation calculations for the Raspberry Hill development have been performed utilizing average trip generation data contained in the Institute of Transportation Engineers' (ITE) *Trip Generation, 9th Edition (2012)*. The distribution of trips generated by the site is based on approved distributions for developments in the site vicinity.

Intersection level of service analysis has been performed based on typical City of Monroe requirements and previous scoping conversations with City of Monroe staff. Level of service analysis has been performed for the following City of Monroe intersections:

1. Chain Lake Road at Rainier View Road SE
2. Chain Lake Road at Kelsey Street

Congestion at intersections is generally measured in terms of level of service (LOS). In accordance with *Highway Capacity Manual: 2010 Edition (HCM)* by the Transportation Research Board, road facilities and intersections are rated between LOS A and LOS F, with LOS A being free flow and LOS F being forced flow or over-capacity conditions. The level of service at signalized, roundabout and all-way stop-controlled intersections is based on the average delay of all approaches. The level of service for two-way stop-controlled intersections is based on average delays for the stopped approach with the highest delay. Geometric characteristics and conflicting traffic movements are taken into consideration when determining level of service values. A summary of the intersection level of service criteria is included in Table 1.



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**TRAFFIC IMPACT STUDY
GTC #16-165**

**RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS**

CITY OF MONROE

LEGEND



DEVELOPMENT SITE



STUDY INTERSECTION

**FIGURE 1
SITE VICINITY
MAP**

Table 1: Level of Service Criteria for Intersections

Level of ¹ Service	Expected Delay	Intersection Control Delay (Seconds per Vehicle)	
		Unsignalized Intersections	Signalized Intersections
A	Little/No Delay	≤10	≤10
B	Short Delays	>10 and ≤15	>10 and ≤20
C	Average Delays	>15 and ≤25	>20 and ≤35
D	Long Delays	>25 and ≤35	>35 and ≤55
E	Very Long Delays	>35 and ≤50	>55 and ≤80
F	Extreme Delays ²	>50	>80

The City of Monroe has a level of service threshold of LOS D for arterial road intersections, which includes both of the City of Monroe study intersections. The level of service analysis has been performed utilizing the *Synchro 9.1 Build 907* software for the stop-controlled intersection (intersection 1). The *Sidra 6.0* software has been utilized for the intersection of Chain Lake Road at Kelsey Street (intersection 2), which is a roundabout.

The City of Monroe also has an interlocal agreement with Snohomish County to provide turning movements at Snohomish County key intersections impacted with 3 or more directional peak-hour trips on any approach or departure and for traffic mitigation fees.

¹ **Source:** *Highway Capacity Manual 2010*.

LOS A: Free-flow traffic conditions, with minimal delay to stopped vehicles (no vehicle is delayed longer than one cycle at signalized intersection).

LOS B: Generally stable traffic flow conditions.

LOS C: Occasional back-ups may develop, but delay to vehicles is short term and still tolerable.

LOS D: During short periods of the peak hour, delays to approaching vehicles may be substantial but are tolerable during times of less demand (i.e. vehicles delayed one cycle or less at signal).

LOS E: Intersections operate at or near capacity, with long queues developing on all approaches and long delays.

LOS F: Jammed conditions on all approaches with excessively long delays and vehicles unable to move at times.

² When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection.

3. TRIP GENERATION

The trip generation calculations for the Raspberry Hill development are based on the average trip generation rates for ITE Land Use Code 210, Single-Family Detached Housing. The trip generation calculations are based on the 27 new units of the Raspberry Hill development, which includes credit for the existing unit on the site, and are summarized in Table 2.

Table 2: Trip Generation Summary

27 New Single-Family Residential Units	Average Daily Trips			AM Peak-Hour Trips			PM Peak-Hour Trips		
	Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
Generation Rate	9.52 trips per unit			0.75 trips per unit			1.00 trips per unit		
Splits	50%	50%	100%	25%	75%	100%	63%	37%	100%
Trips	128.52	128.52	257.04	5.06	15.19	20.25	17.01	9.99	27.00

The 27 new units are anticipated to generate approximately 257.04 average daily trips with approximately 20.25 AM peak-hour trips and 27.00 PM peak-hour trips.

4. TRIP DISTRIBUTION

The distribution of trips generated by the Raspberry Hill development is based on approved distributions for developments in the site vicinity. It is anticipated that 25% of the development's trips will travel to and from the west along US-2. Approximately 35% of the development's trips will travel to and from the south, twenty-five percent along SR-522 and ten percent along SR-203. It is estimated that 28% of the development's trips will travel to and from local areas in the vicinity of the development, ten percent south of US-2, fifteen percent north of US-2, and three percent to the east. The remaining 12% of the development's trips are anticipated to travel to and from the north and east, seven percent to and from the north along Chain Lake Road and five percent to and from the east along US-2. Detailed distributions are included in Figure 2 for the AM peak-hour and Figure 3 for the PM peak-hour.

The interlocal agreement with Snohomish County requires key intersections impacted with 3 or more directional peak-hour trips on any approach or departure to be shown. The Raspberry Hill development will impact 3 key intersections during the AM and PM peak-hours. The key intersection impacts are shown in detail in the attachments of this report. Snohomish County's trip distribution policy states that trips along US-2 do not need to be distributed west of 88th Street SE. Trips traveling to and from the south along SR-522 and SR-203 are anticipated to travel to and from King County. Trips traveling to the east on US-2 are expected to travel locally between Monroe and Sultan.

5. INTERSECTION LEVEL OF SERVICE ANALYSIS

The intersections that have been analyzed as part of this report are based on the typical City of Monroe requirements and previous scoping discussions with City of Monroe staff. Level of service analysis has been performed for the following intersections for the weekday PM peak-hour:

1. Chain Lake Road at Rainier View Road SE
2. Chain Lake Road at Kelsey Street

5.1 Turning Movement Volumes

The existing turning movements at the study intersections are based on data collected by the independent count firm, Traffic Data Gathering (TDG), in August and September 2016. The existing turning movements at the study intersections are shown in Figure 4.

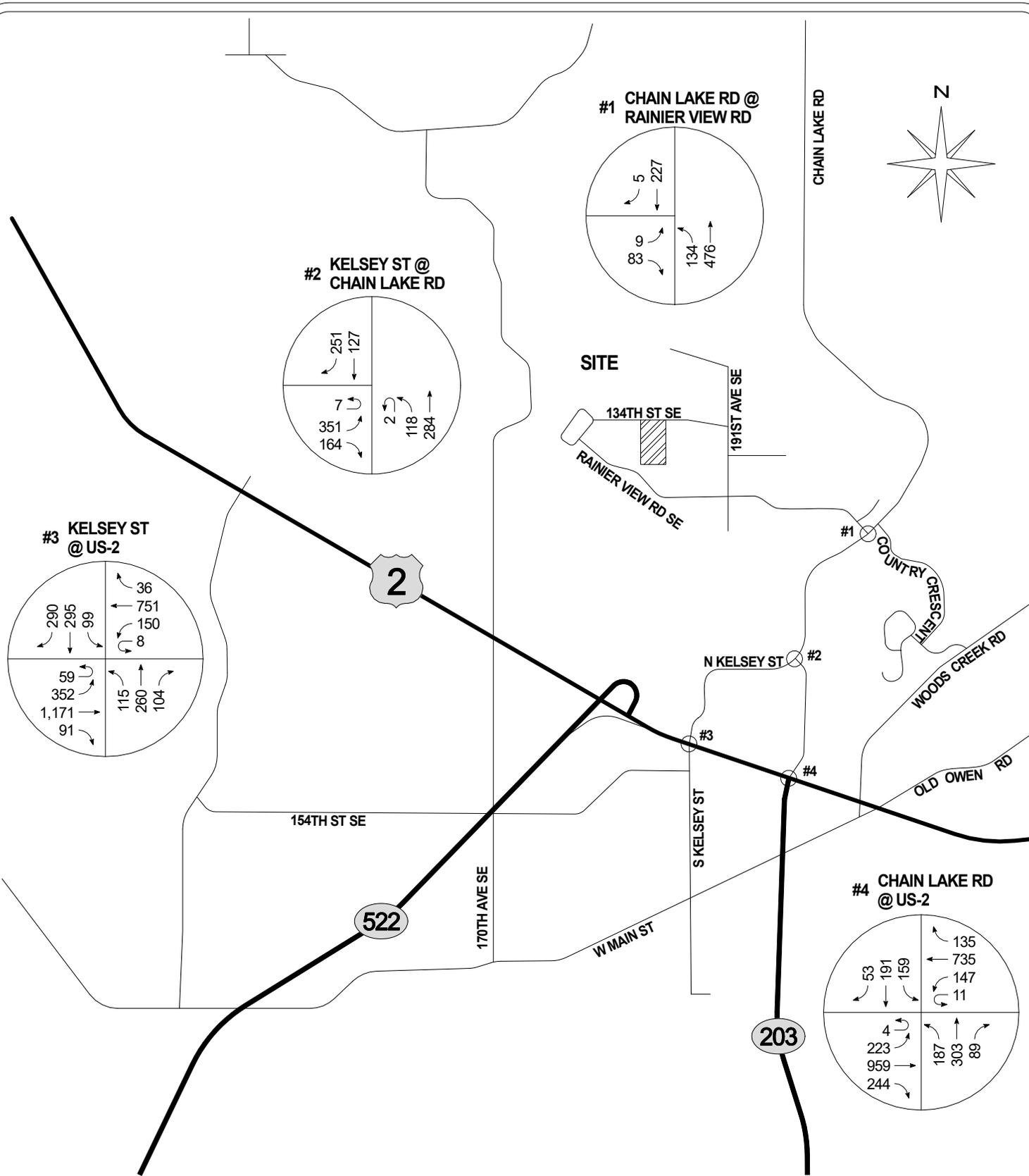
The 2026 baseline volumes have been calculated using a 10-year horizon period and applying a 2% annually compounding growth rate with the following pipeline developments:

- Eaglemont I-III – 149 new single-family units
- Eaglemont IV-VIII – 117 new single-family units
- Sky View Ridge – 44 new single-family units
- Leighty Estates – 34 new single-family units
- Klier Property – 87 new single-family units
- Worthington Heights – 102 new single-family units

The approved PM peak-hour trip distributions for the pipeline developments are included in the attachments. The 2026 baseline turning movements at the study intersections are shown in Figure 5.

The 2026 future with development turning movements were calculated by adding the development's turning movements to the 2026 baseline turning movements. The 2026 future with development turning movements are shown in Figure 6.

The existing turning movement counts and turning movement calculations are included in the attachments.



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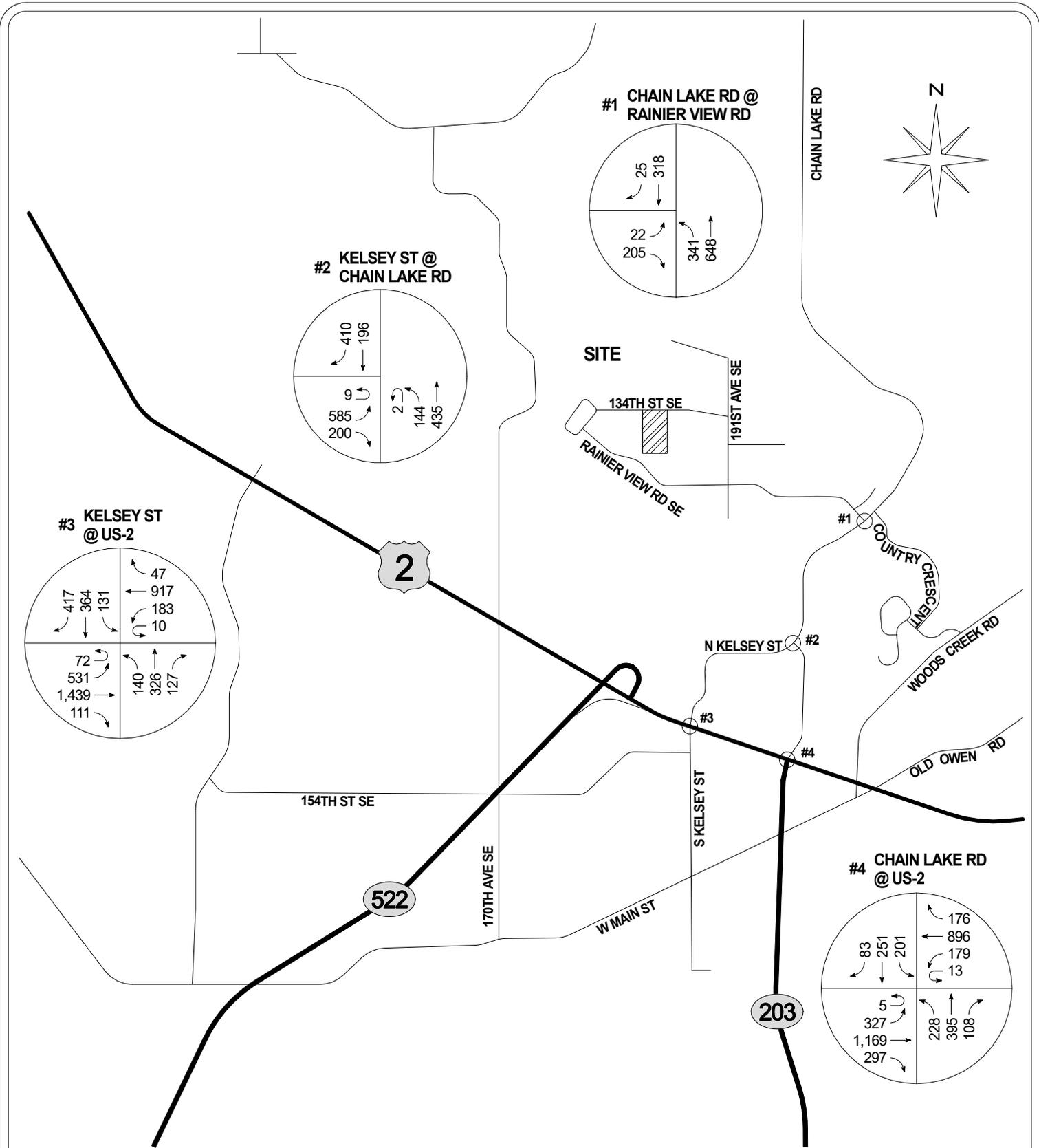
**RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS**

LEGEND

XXX → PM PEAK-HOUR TURNING MOVEMENT VOLUMES

**FIGURE 4
2015 EXISTING
TURNING MOVEMENTS**

CITY OF MONROE



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GTC #16-165**

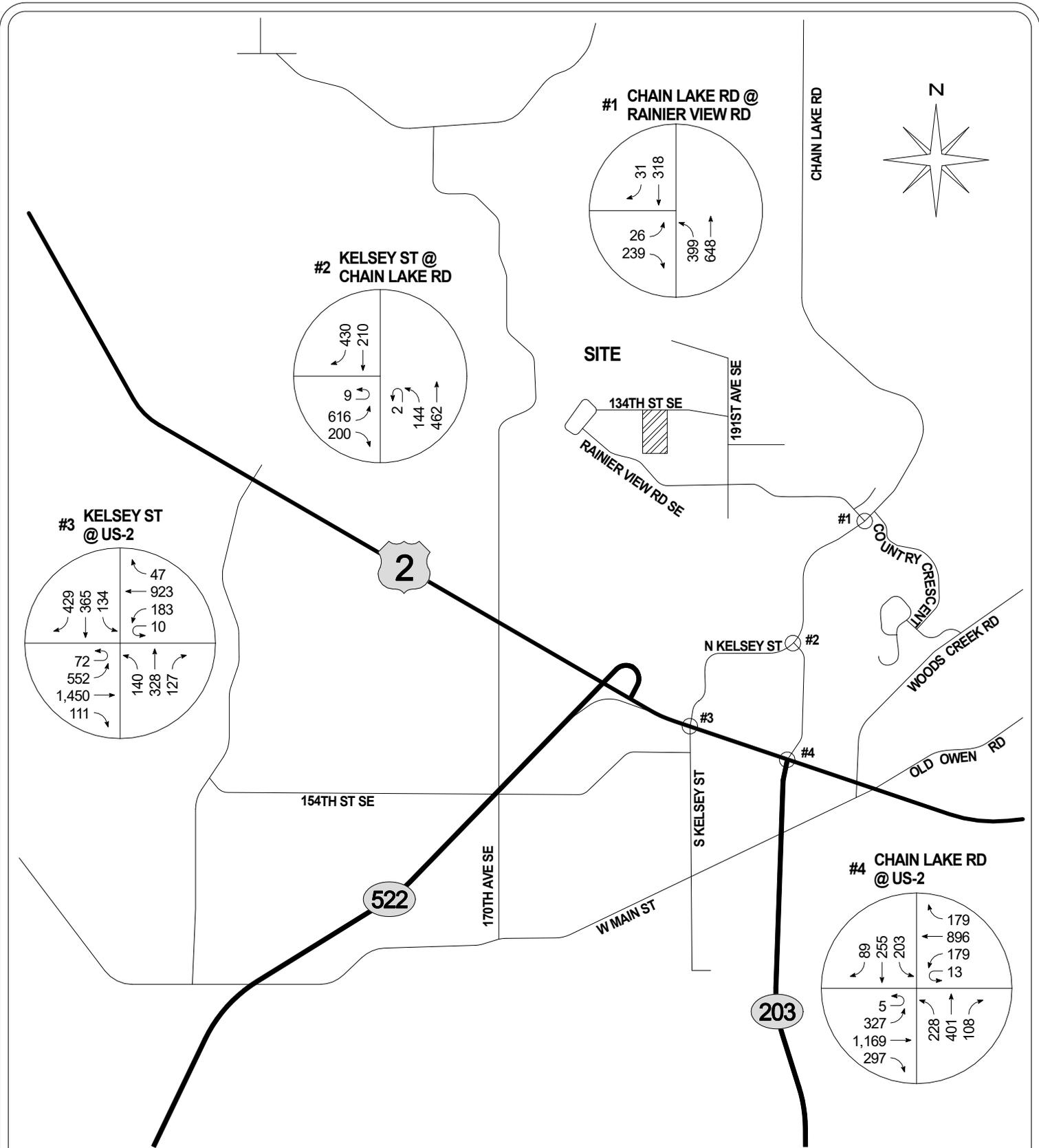
**RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS**

LEGEND

XXX → PM PEAK-HOUR TURNING MOVEMENT VOLUMES

**FIGURE 5
2025 BASELINE
TURNING MOVEMENTS**

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**RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS**

LEGEND

XXX → PM PEAK-HOUR TURNING MOVEMENT VOLUMES

CITY OF MONROE

**FIGURE 6
2025 FUTURE
WITH DEVELOPMENT
TURNING MOVEMENTS**

5.2 Intersection Level of Service Results

The level of service analysis has been performed utilizing the existing control, channelization, peak-hour factors and heavy-vehicle factors from the 2016 counts.

The level of service analysis shows that the development will not cause any intersection to operate at LOS F and will not cause the level of service to change from the 2026 baseline conditions. However, the intersection of Chain Lake Road at Rainier View Road SW is anticipated to operate at LOS F under the 2026 baseline and 2026 future with development conditions. The level of service results for the study intersections are summarized in Table 3.

Table 3: Intersection Level of Service Summary

Intersection	Intersection Type	2016 Existing Conditions		2026 Baseline Conditions		2026 Future Conditions with Development	
		LOS	Delay	LOS	Delay	LOS	Delay
1. Chain Lake Road at Rainier View Road SW	Two-Way Stop-Control	B	12.1 sec	F	134.4 sec	F	169.9 sec
with revised intersection control	All-Way Stop-Control	---	---	---	---	E	44.2 sec
2. Chain Lake Road at Kelsey Street	Roundabout	A	7.4 sec	B	13.8 sec	B	14.7 sec

The level of service calculations are included in the attachments.

5.2.1. Chain Lake Road at Rainier View Road

The intersection of Chain Lake Road at Rainier View Road was analyzed with all-way stop-control to determine if that would result in an acceptable level of service. The all-way stop-control would require minor improvements of signing and striping, but will not require the intersection to be reconstructed. If the intersection is converted to an all-way stop-control, it will operate at LOS E in the 2026 future with development conditions.

Improvements to the Chain Lake Road corridor have been analyzed as part of the updated City of Monroe Comprehensive Plan. Improvements to Chain Lake Road to increase vehicle capacity are included in the Comprehensive Plan and show the intersection of Chain Lake Road at Rainier View Road operating at LOS C. The City of Monroe traffic mitigation fees, which are discussed later in this report, will help fund these improvements. The level of service calculations are included in the attachments.

6. TRAFFIC MITIGATION FEES

The Washington Growth Management Act and Revised Code of Washington 82.02.050(2) authorize local jurisdictions to establish proportionate share traffic mitigation fees in order to fund capital facilities, such as roads and intersections. The Raspberry Hill development is located within the City of Monroe, which has established traffic mitigation fees. The City of Monroe also has interlocal agreements with Snohomish County and WSDOT for traffic mitigation fees.

6.1 City of Monroe

The City of Monroe has established a traffic mitigation fee schedule. The fee for single-family residential units is \$3,449 per unit. The 27 new units of the Raspberry Hill development will have City of Monroe traffic mitigation fees of \$93,123.00. It should be noted that these fees may not vest and may be higher when the building applications are pulled.

6.2 Snohomish County

The City of Monroe and Snohomish County have an interlocal agreement that provides for the payment of traffic mitigation for impacts to Snohomish County roadways by City of Monroe developments. Traffic mitigation fees are based on predetermined area impacts or impacts to actual improvement projects. The trip distribution shows that the Raspberry Hill development will not impact any Snohomish County improvement projects in the Transportation Needs Report with three directional PM peak-hour trips. According to Section 3(a)2 of the *Snohomish County Traffic Worksheet and Traffic Study Requirements for Developments in the City of Monroe*, City of Monroe developments are only required to pay traffic mitigation fees for improvements in the Transportation Needs Report impacted with three directional peak-hour trips. The Raspberry Hill is therefore not required to pay traffic mitigation fees to Snohomish County.

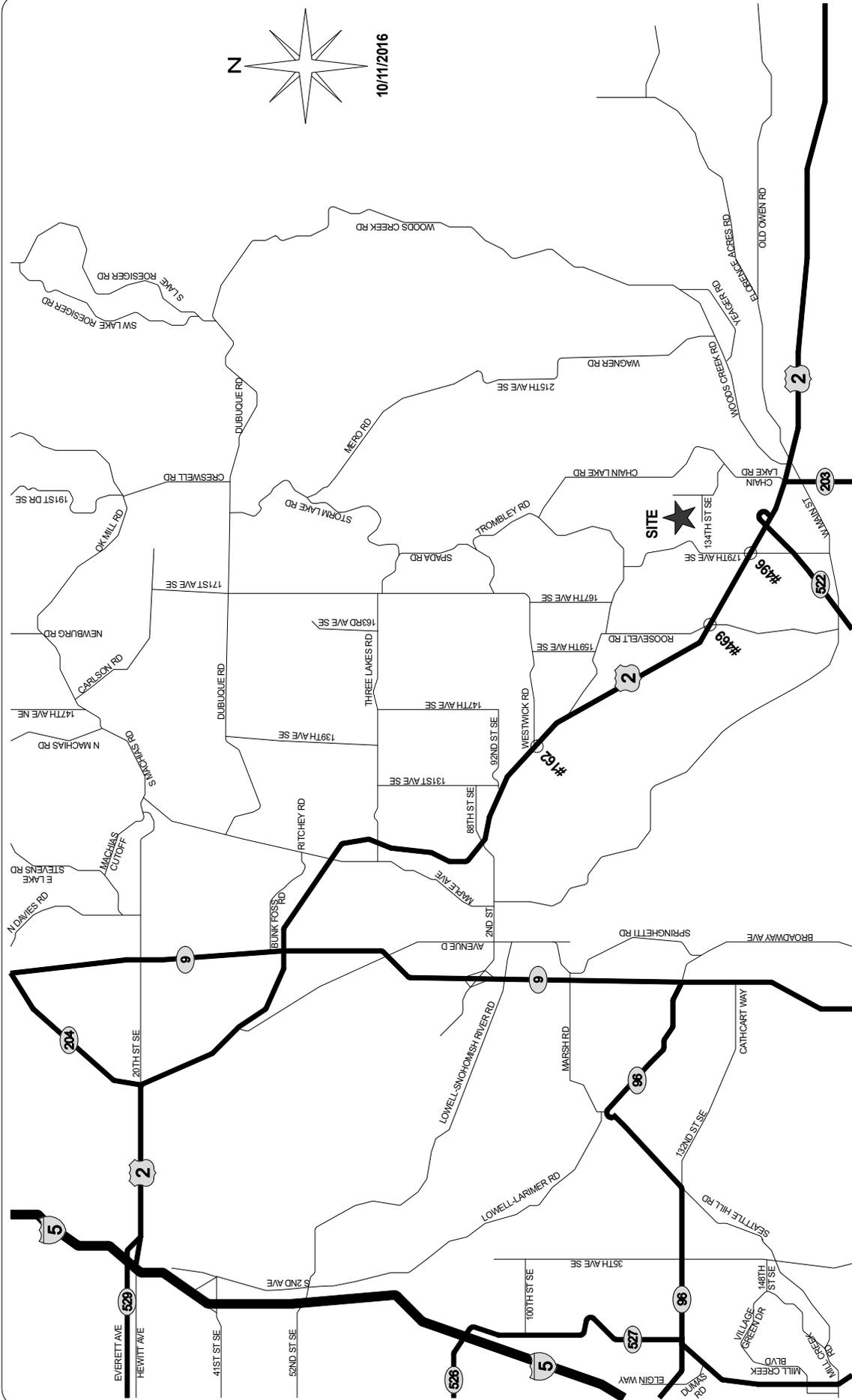
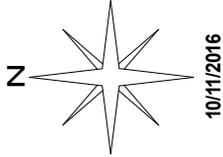
6.3 WSDOT

The City of Monroe and WSDOT have an interlocal agreement that provides for the payment of traffic mitigation fees. The interlocal agreement states that a development only has a “significant adverse impact” if the development contributes 25 or more trips to a WSDOT intersection. The Raspberry Hill development is not anticipated to impact any WSDOT intersections with 25 PM peak-hour trips and is therefore not anticipated to have a “significant adverse impact” on WSDOT intersections. WSDOT does not have a collection project for any of the intersections in the vicinity of the Raspberry Hill development and therefore WSDOT traffic mitigation fees should not be assessed for the Raspberry Hill development.

7. CONCLUSIONS

The Raspberry Hill development is proposed to consist of 28 single-family residential units with 1 existing unit being removed. The 27 new units of the Raspberry Hill development are anticipated to generate approximately 257.04 average daily trips with approximately 20.25 AM peak-hour trips and 27.00 PM peak-hour trips. The level of service analysis shows that all of the study intersections are anticipated to operate at acceptable levels of service with the exception of Chain Lake Road at Rainier View Road SW, which will operate at LOS F in the 2026 baseline and future with development conditions. This can be mitigated by converting the intersection to an all-way stop-control intersection and is also planned to include capacity improvements, as identified in the latest Comprehensive Plan. The Raspberry Hill development will have City of Monroe traffic mitigation fees of \$93,123.00. The development will not meet the thresholds for paying traffic mitigation fees to Snohomish County or WSDOT.

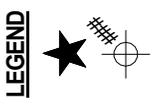
Snohomish County Key Intersection Impacts



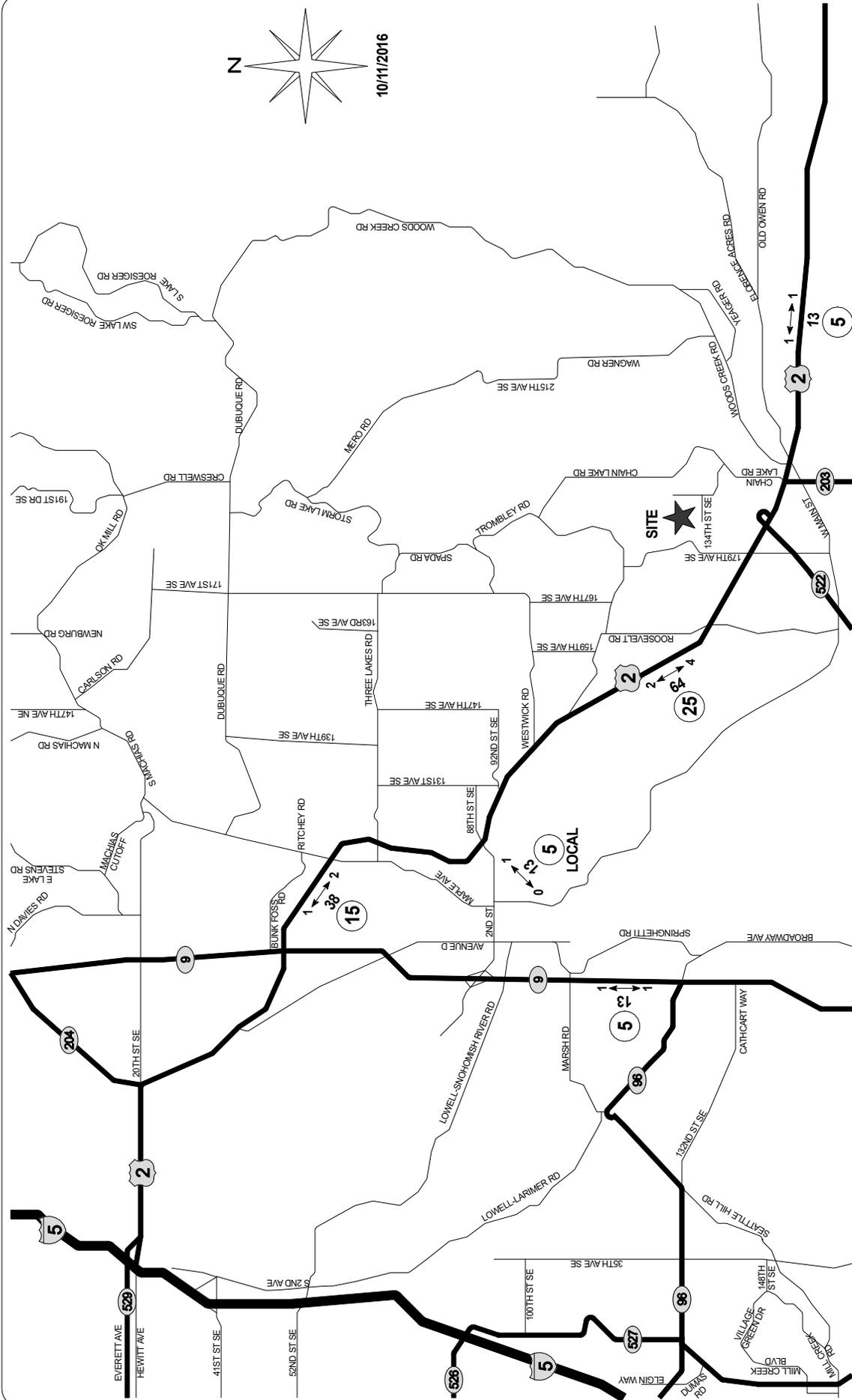
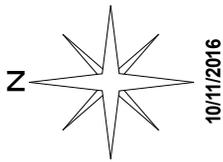
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FIGURE A1
KEY INTERSECTION
LOCATIONS

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RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS
CITY OF MONROE



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FIGURE A3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR

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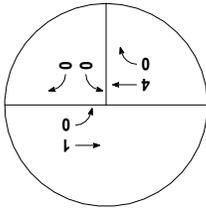
LEGEND
NEW SITE TRAFFIC
DAILY AND PM PEAK-HOUR
TRIP DISTRIBUTION %

AWMT
PM ← PEAK
XX

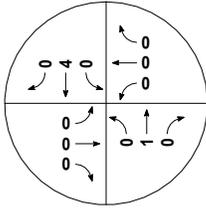
RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS
CITY OF MONROE

**AM
PEAK-HOUR**

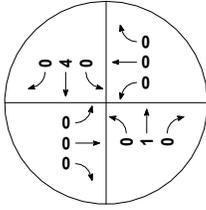
#162
SR-2 @
WESTWICK RD



#469
SR-2 @
ROOSEVELT RD

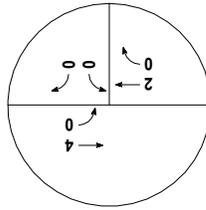


#496
SR-2 @
179TH AVE SE

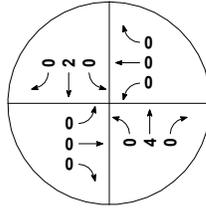


**PM
PEAK-HOUR**

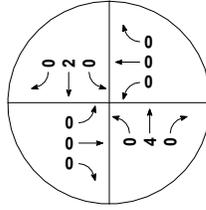
#162
SR-2 @
WESTWICK RD



#469
SR-2 @
ROOSEVELT RD



#496
SR-2 @
179TH AVE SE



GIBSON TRAFFIC CONSULTANTS

LEGEND

XX →

PEAK HOUR
TURNING MOVEMENT VOLUME

**RASPBERRY HILL
27 NEW SINGLE FAMILY
DWELLINGS**

CITY OF MONROE

TRAFFIC IMPACT STUDY
GTC #16-165

FIGURE A4
DEVELOPMENT
KEY INTERSECTION VOLUMES
AM & PM PEAK-HOURS

Key AM Peak-Hour Key Intersection Volumes

Intersection	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
#161: SR-2 NB Ramps at 88 th St SE	00	0	N/A	N/A	0	0	6	0	0	N/A	N/A	N/A
#162: SR-2 at Westwick Rd	N/A	N/A	N/A	0	N/A	0	N/A	14	0	0	5	N/A
#287: SR-2 SB Ramps at 88 th St SE	N/A	0	2	0	6	N/A	N/A	N/A	N/A	0	0	0
#318: SR-203 at 203 rd St SE	0	N/A	0	N/A	N/A	N/A	0	2	N/A	N/A	6	0
#320 SR-203 at Ben Howard Rd	N/A	N/A	N/A	0	N/A	0	N/A	2	0	0	6	N/A
#469: SR-2 at Roosevelt Rd	0	5	0	0	14	0	0	0	0	0	0	0
#496: SR-2 at 179 th Ave SE	0	5	0	0	14	0	0	0	0	0	0	0

PM Peak-Hour Key Intersection Volumes

Intersection	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
#123: SR-9 at Cathcart Way	1	N/A	0	N/A	N/A	N/A	0	2	N/A	N/A	1	1
#155: Woods Creek Rd at SR-2	0	2	0	N/A	3	0	N/A	N/A	0	N/A	N/A	0
#161: SR-2 NB Ramps at 88 th St SE	0	0	N/A	N/A	0	0	4	0	0	N/A	N/A	N/A
#162: SR-2 at Westwick Rd	N/A	N/A	N/A	0	N/A	0	N/A	9	0	0	16	N/A
#169: SR-9 at Airport Way	0	1	0	1	1	0	0	0	2	0	0	0
#172: SR-9 at Broadway Ave	0	0	0	0	0	0	0	3	0	0	2	0
#189 Airport Way at Lowell-Snohomish River Rd	0	0	0	0	0	0	0	3	0	0	2	0
#208: Airport Way at 99 th Ave SE	3	0	0	0	0	0	0	0	0	0	0	2
#287: SR-2 SB Ramps at 88 th St SE	N/A	0	6	0	4	N/A	N/A	N/A	N/A	0	0	0
#313: Old Owen Rd at SR-2	0	2	0	0	3	0	0	0	0	0	0	0
#318: SR-203 at 203 rd St SE	0	N/A	0	N/A	N/A	N/A	0	6	N/A	N/A	4	0
#320 SR-203 at Ben Howard Rd	N/A	N/A	N/A	0	N/A	0	N/A	6	0	0	4	N/A
#390 Airport Way at 1 st St	0	0	0	0	0	0	0	3	0	0	2	0
#455 Springhetti Rd at Airport Way	3	N/A	0	N/A	N/A	N/A	0	0	N/A	N/A	0	2
#469: SR-2 at Roosevelt Rd	0	16	0	0	9	0	0	0	0	0	0	0
#496: SR-2 at 179 th Ave SE	0	16	0	0	9	0	0	0	0	0	0	0

Turning Movement Volume Calculations

1 Rainier View @ Chain Lake Rd

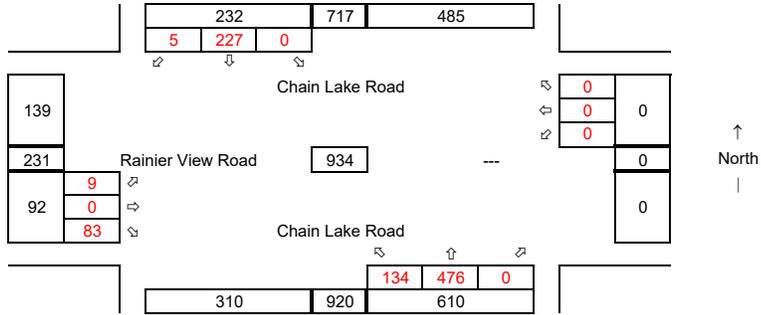
Synchro ID: 1

Existing

Average Weekday
PM Peak Hour

Year: 9/7/16

Data Source: TDG



Future without Project

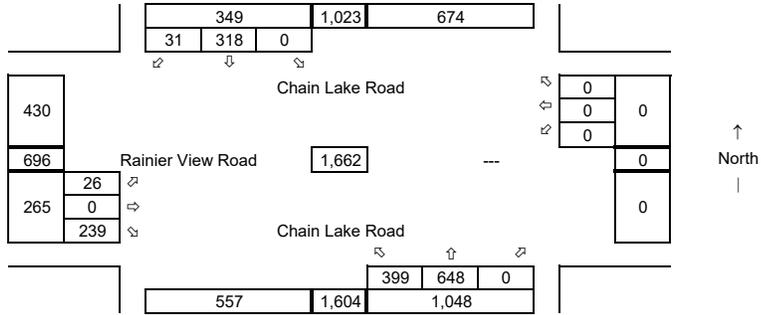
Average Weekday
PM Peak Hour

Year: 2026

Growth Rate = 2.0%

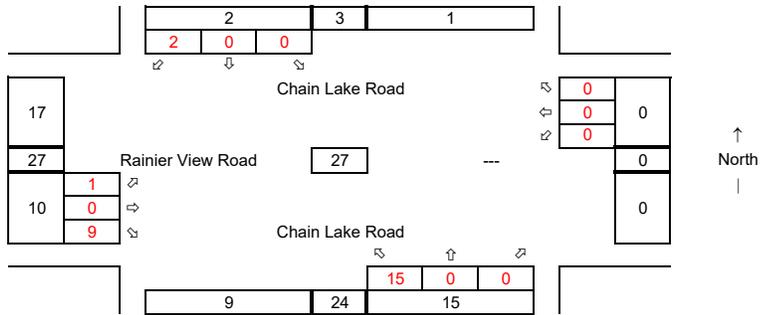
Years of Growth = 10

Total Growth = 1.2190



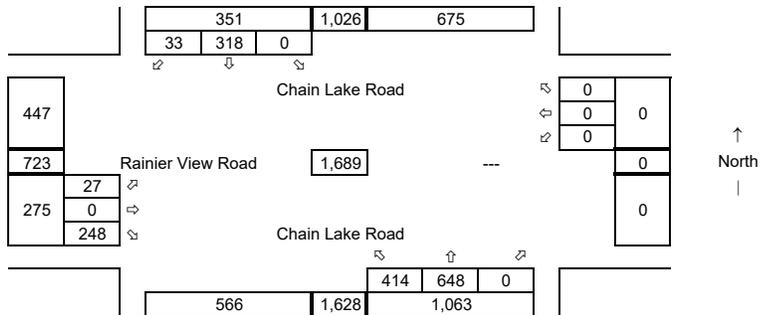
Total Project Trips

Average Weekday
PM Peak Hour



Future with Project

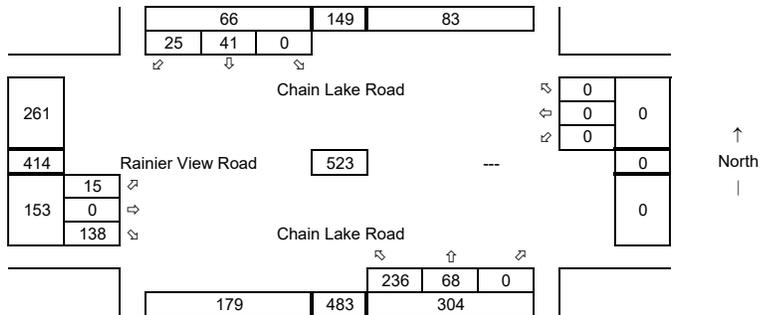
Average Weekday
PM Peak Hour



Pipeline Trips

Average Weekday
PM Peak Hour

Eaglemont 1-8
Sky View Ridge
Leighty Estates
Klier Property
Worthington Heights



2 Kelsey St @ Chain Lake Rd

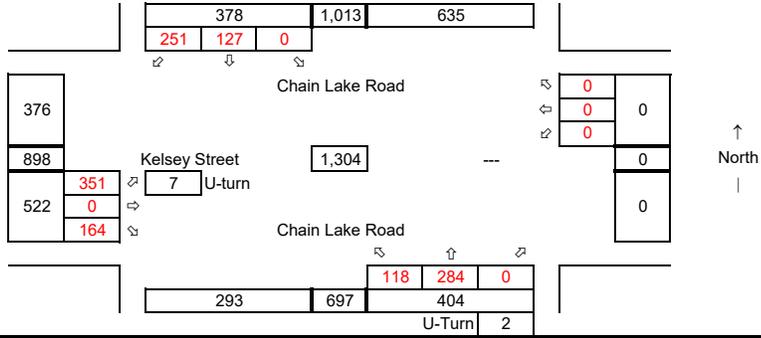
Synchro ID: 2

Existing

Average Weekday
PM Peak Hour

Year: 8/30/16

Data Source: TDG



Future without Project

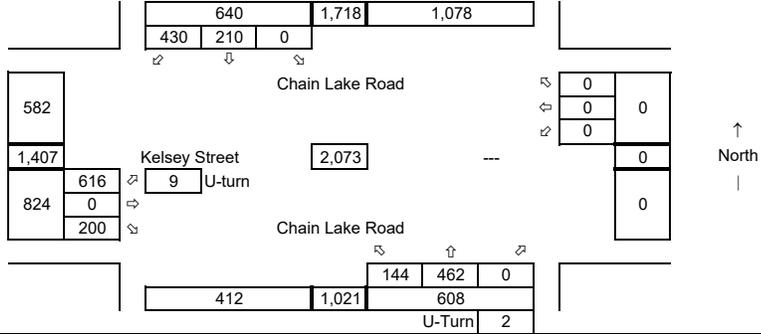
Average Weekday
PM Peak Hour

Year: 2026

Growth Rate = 2%

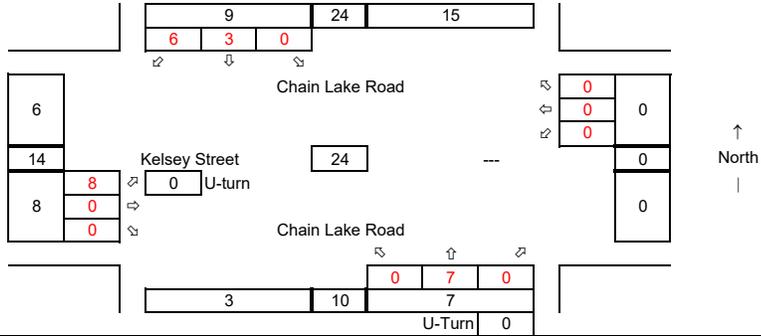
Years of Growth = 10

Total Growth = 1.2190



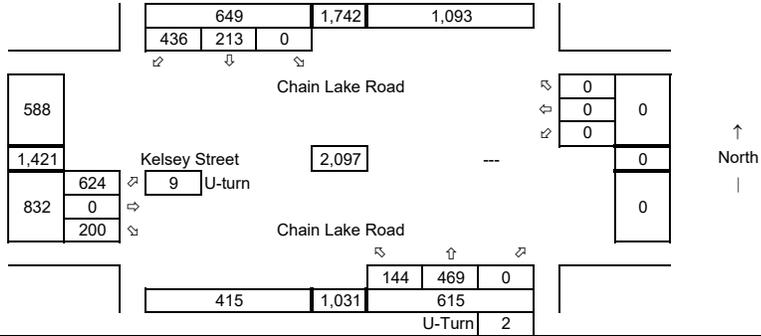
Total Project Trips

Average Weekday
PM Peak Hour



Future with Project

Average Weekday
PM Peak Hour



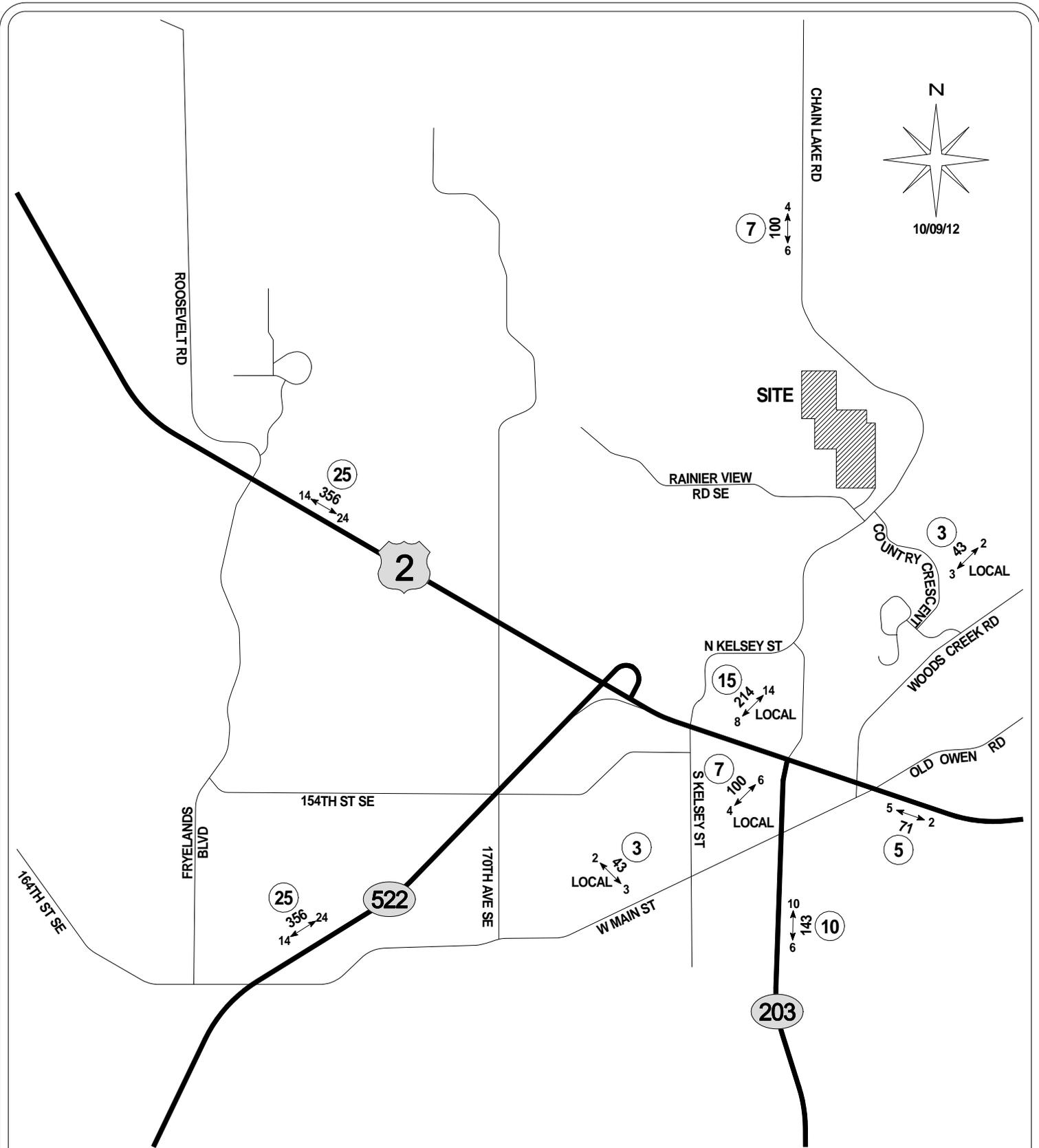
Pipeline Trips

Average Weekday
PM Peak Hour

Eaglemont 1-8
Sky View Ridge
Leighty Estates
Klier Property
Worthington Heights



Pipeline Information



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TRAFFIC IMPACT STUDY
GTC #12-087

EAGLEMONT
149 SINGLE-FAMILY UNITS

LEGEND

AWDT
PM ↔ PEAK

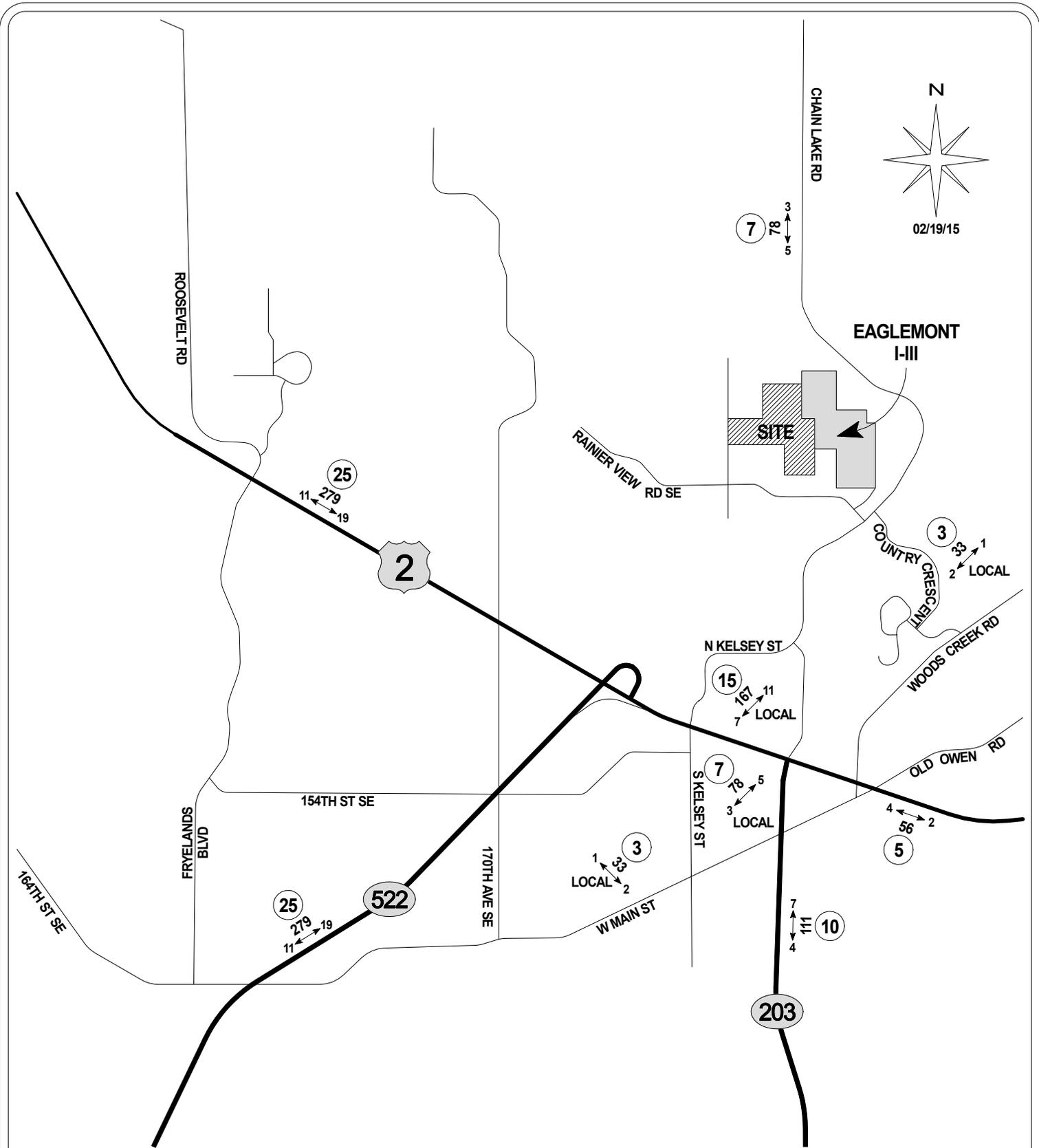
NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)

(25)

TRIP DISTRIBUTION %

CITY OF MONROE

FIGURE 3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR



GIBSON TRAFFIC CONSULTANTS

TRAFFIC IMPACT STUDY
GTC #15-045

EAGLEMONT IV-VIII
117 NEW SINGLE-FAMILY UNITS

LEGEND

AWDT
PM ↔ PEAK

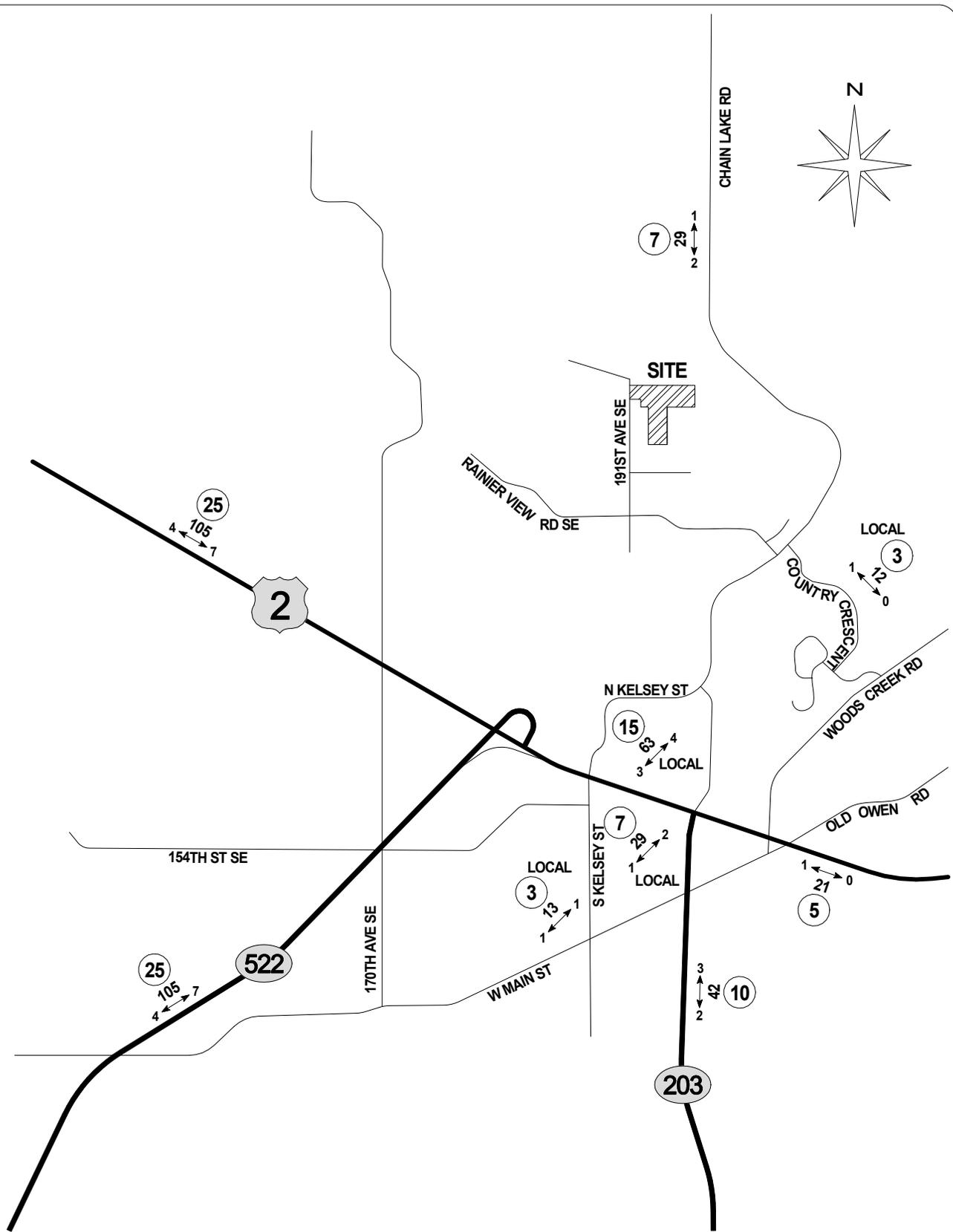
NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)

XX

TRIP DISTRIBUTION %

CITY OF MONROE

FIGURE 3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR



GIBSON TRAFFIC CONSULTANTS

TRAFFIC IMPACT STUDY
GTC #15-244

SKY VIEW RIDGE
44 NEW SINGLE-FAMILY UNITS

LEGEND

AWDT
PM ↔ PEAK

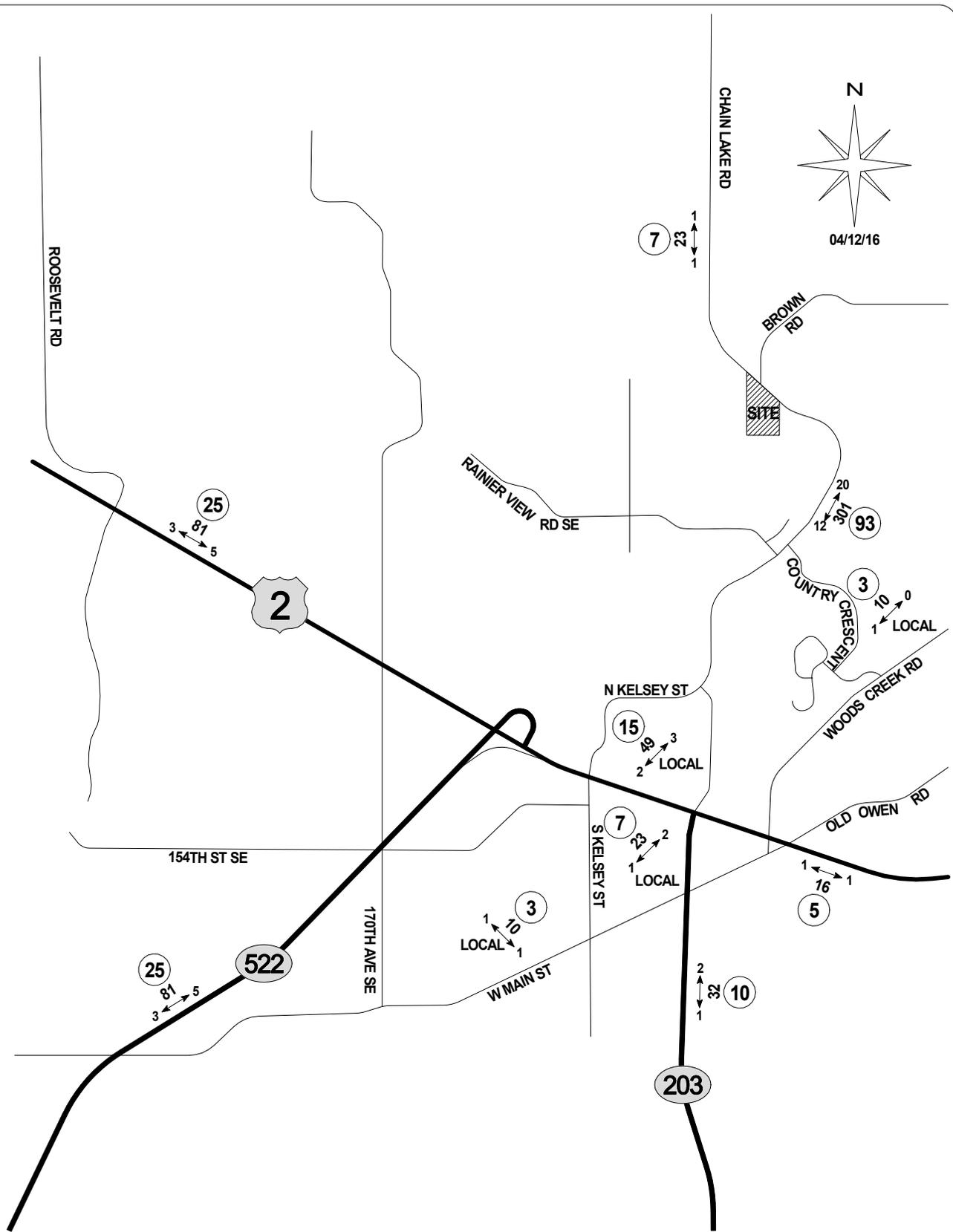
NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)



TRIP DISTRIBUTION %

FIGURE 2
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR

CITY OF MONROE



GIBSON TRAFFIC CONSULTANTS

**TRAFFIC IMPACT STUDY
GTC #15-132**

**LEIGHTY ESTATES
34 NEW SINGLE-FAMILY UNITS**

CITY OF MONROE

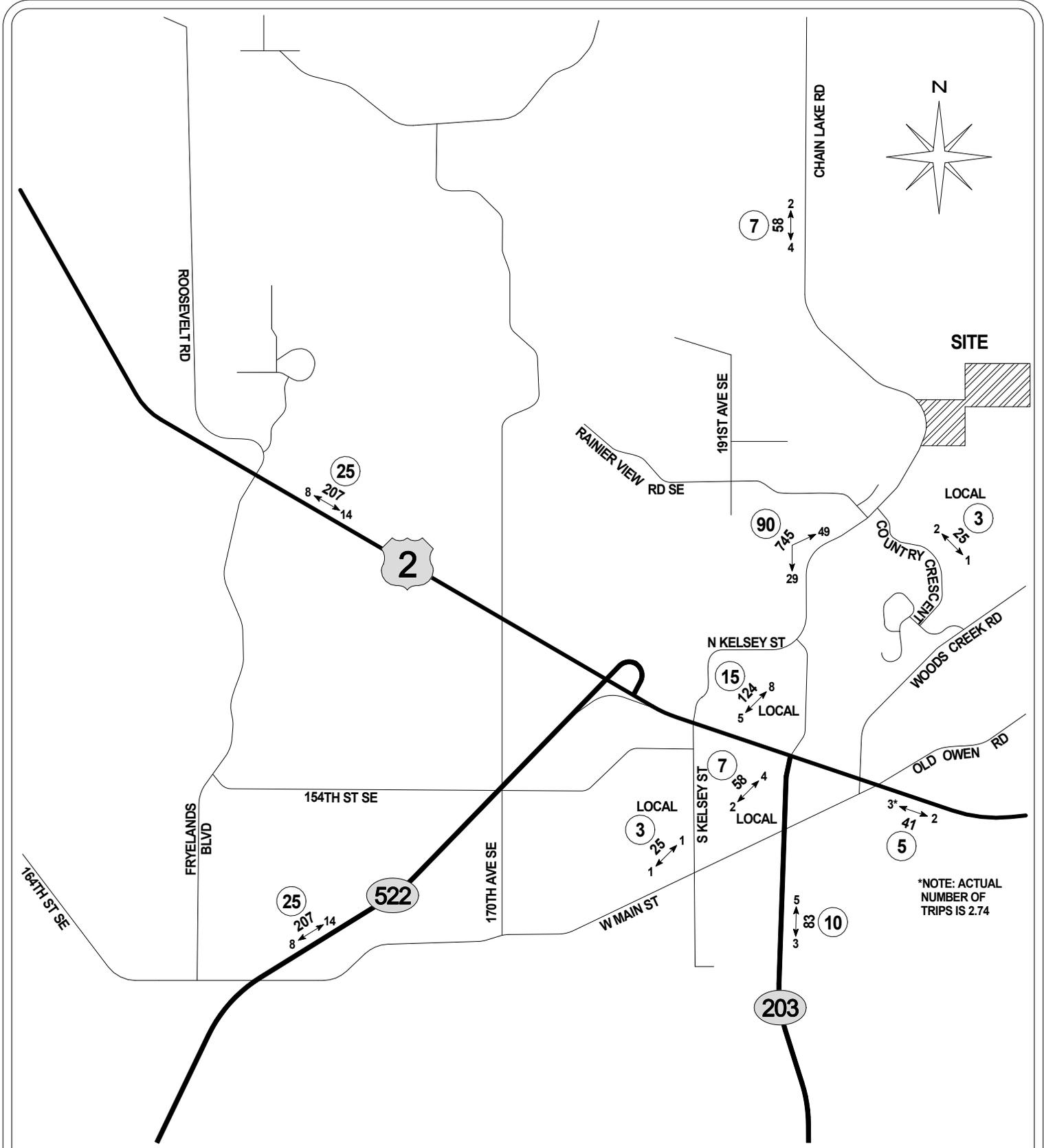
LEGEND

AWDT
PM ↔ PEAK

NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)

XX
TRIP DISTRIBUTION %

**FIGURE 3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR**



GIBSON TRAFFIC CONSULTANTS

**TRAFFIC IMPACT STUDY
GTC #16-030**

**KLIER DEVELOPMENT
87 NEW SINGLE FAMILY
DWELLINGS**

LEGEND

AWDT
PM ↔ PEAK

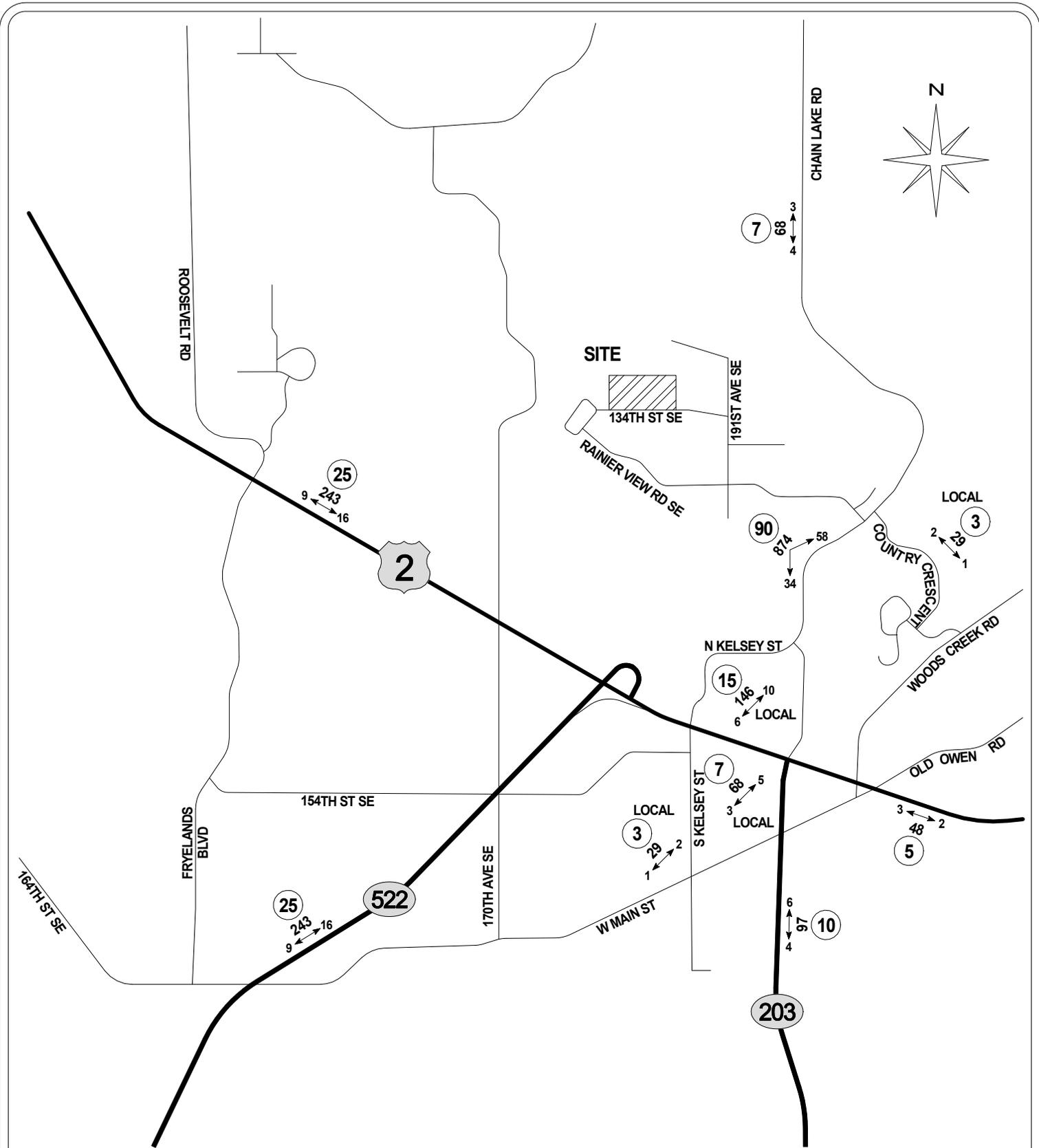
NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)

XX

TRIP DISTRIBUTION %

**FIGURE 3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR**

CITY OF MONROE



GIBSON TRAFFIC CONSULTANTS

**TRAFFIC IMPACT STUDY
GTC #16-171**

**WORTHINGTON HEIGHTS
106 SINGLE FAMILY
DWELLINGS**

CITY OF MONROE

LEGEND

AWDT
PM ↔ PEAK



NEW SITE TRAFFIC
(DAILY/PEAK-HOUR)

TRIP DISTRIBUTION %

**FIGURE 3
DEVELOPMENT
TRIP DISTRIBUTION
PM PEAK-HOUR**

Level of Service Calculations

1: Chain Lake Road & Rainier View Road SE

Intersection

Int Delay, s/veh 2.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	9	83	134	476	227	5
Future Vol, veh/h	9	83	134	476	227	5
Conflicting Peds, #/hr	0	0	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	200	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	79	79	95	95	89	89
Heavy Vehicles, %	4	4	2	2	3	3
Mvmt Flow	11	105	141	501	255	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1043	260	263	0	-	0
Stage 1	260	-	-	-	-	-
Stage 2	783	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.12	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.218	-	-	-
Pot Cap-1 Maneuver	252	774	1301	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	447	-	-	-	-	-
Platoon blocked, %						
Mov Cap-1 Maneuver	224	773	1301	-	-	-
Mov Cap-2 Maneuver	224	-	-	-	-	-
Stage 1	778	-	-	-	-	-
Stage 2	398	-	-	-	-	-

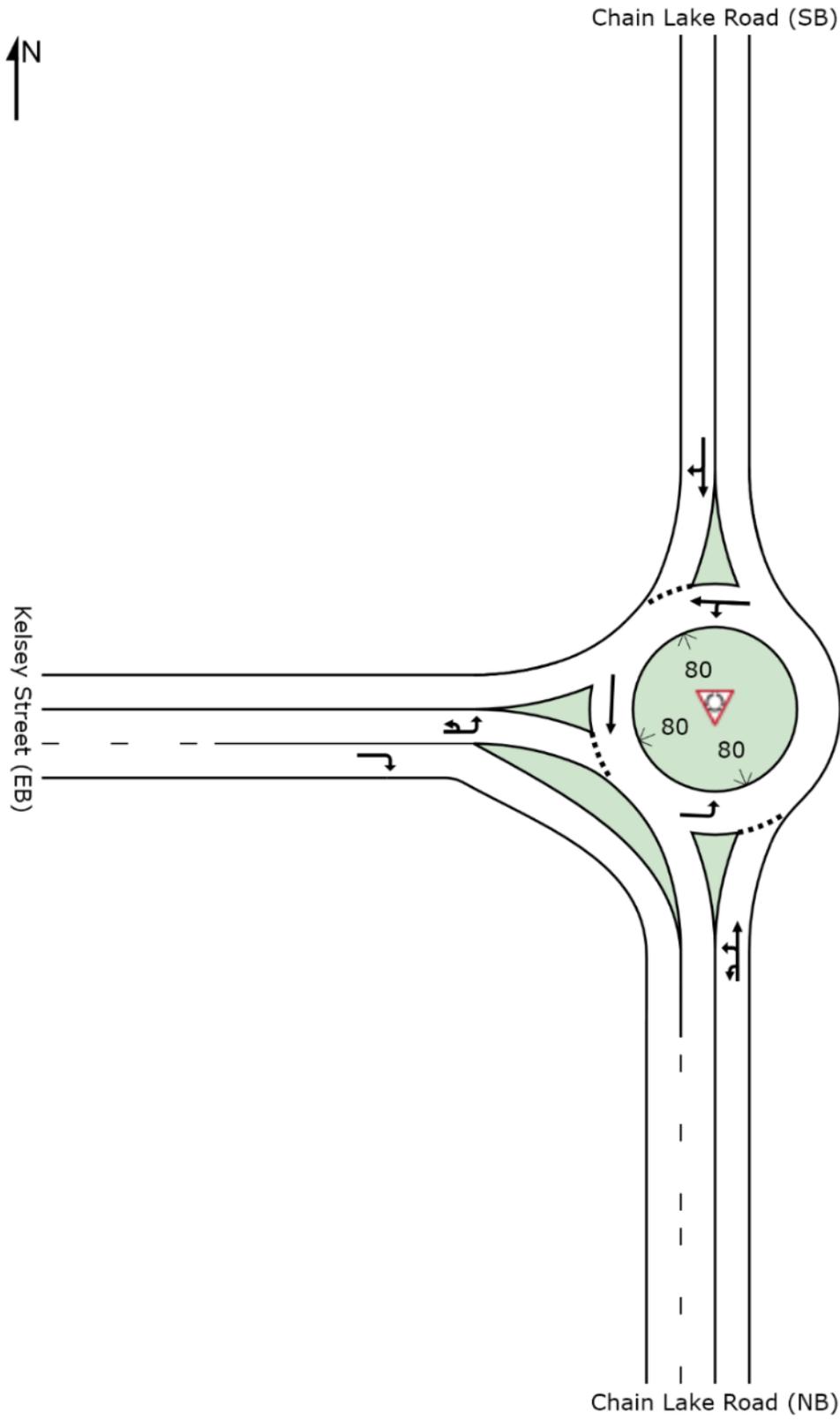
Approach	EB		NB		SB
HCM Control Delay, s	12.1		1.8		0
HCM LOS	B				

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1301	-	624	-	-
HCM Lane V/C Ratio	0.108	-	0.187	-	-
HCM Control Delay (s)	8.1	-	12.1	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0.4	-	0.7	-	-

SITE LAYOUT

Site: Chain Lake Rd at N Kelsey St - 2016 Existing

Chain Lake Road at N Kelsey Street
Roundabout



MOVEMENT SUMMARY

Site: Chain Lake Rd at N Kelsey St - 2016 Existing

Chain Lake Road at N Kelsey Street
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Chain Lake Road (NB)											
3u	U	2	3.0	0.438	14.5	LOS B	3.0	77.4	0.67	0.72	35.2
3	L2	124	3.0	0.438	12.2	LOS B	3.0	77.4	0.67	0.72	34.5
8	T1	299	3.0	0.438	7.0	LOS A	3.0	77.4	0.67	0.72	34.6
Approach		425	3.0	0.438	8.6	LOS A	3.0	77.4	0.67	0.72	34.6
North: Chain Lake Road (SB)											
4	T1	134	3.0	0.337	5.1	LOS A	2.4	60.4	0.42	0.51	36.3
14	R2	264	3.0	0.337	5.0	LOS A	2.4	60.4	0.42	0.51	35.3
Approach		398	3.0	0.337	5.0	LOS A	2.4	60.4	0.42	0.51	35.7
West: Kelsey Street (EB)											
5u	U	7	3.0	0.265	12.4	LOS B	1.7	43.4	0.35	0.62	34.4
5	L2	369	3.0	0.265	10.1	LOS B	1.7	43.4	0.35	0.62	33.8
12	R2	173	3.0	0.106	3.8	LOS A	0.0	0.0	0.00	0.47	36.8
Approach		549	3.0	0.265	8.1	LOS A	1.7	43.4	0.24	0.58	34.6
All Vehicles		1373	3.0	0.438	7.4	LOS A	3.0	77.4	0.42	0.60	34.9

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: H:\2016\16-165\Sidra\Chain Lake Rd at Kelsey St.sip6

Intersection

Int Delay, s/veh 26.9

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	26	239	399	648	318	31
Future Vol, veh/h	26	239	399	648	318	31
Conflicting Peds, #/hr	0	0	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	200	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	79	79	95	95	89	89
Heavy Vehicles, %	4	4	2	2	3	3
Mvmt Flow	33	303	420	682	357	35

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1899	377	394	0	-	0
Stage 1	377	-	-	-	-	-
Stage 2	1522	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.12	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.218	-	-	-
Pot Cap-1 Maneuver	75	665	1165	-	-	-
Stage 1	689	-	-	-	-	-
Stage 2	197	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	48	664	1165	-	-	-
Mov Cap-2 Maneuver	48	-	-	-	-	-
Stage 1	688	-	-	-	-	-
Stage 2	126	-	-	-	-	-

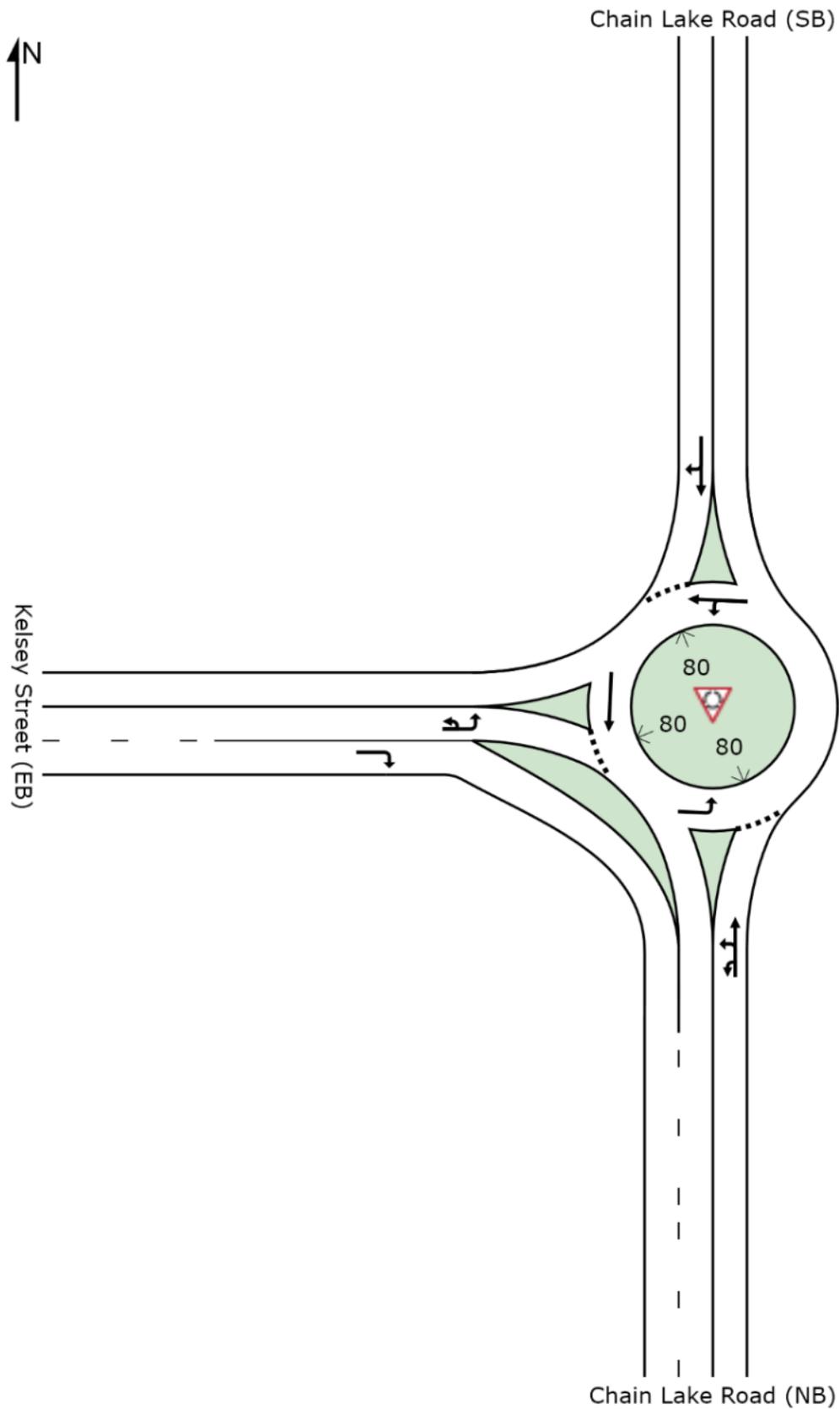
Approach	EB		NB		SB
HCM Control Delay, s	134.4		3.7		0
HCM LOS	F				

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1165	-	294	-	-
HCM Lane V/C Ratio	0.361	-	1.141	-	-
HCM Control Delay (s)	9.8	-	134.4	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	1.7	-	14.1	-	-

SITE LAYOUT

Site: Chain Lake Rd at N Kelsey St - 2026 Baseline

Chain Lake Road at N Kelsey Street
Roundabout



MOVEMENT SUMMARY

Site: Chain Lake Rd at N Kelsey St - 2026 Baseline

Chain Lake Road at N Kelsey Street
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Chain Lake Road (NB)											
3u	U	2	3.0	0.892	34.8	LOS C	17.3	442.9	1.00	1.43	27.2
3	L2	152	3.0	0.892	32.5	LOS C	17.3	442.9	1.00	1.43	26.7
8	T1	486	3.0	0.892	27.3	LOS C	17.3	442.9	1.00	1.43	26.8
Approach		640	3.0	0.892	28.6	LOS C	17.3	442.9	1.00	1.43	26.8
North: Chain Lake Road (SB)											
4	T1	221	3.0	0.595	5.8	LOS A	5.9	151.1	0.65	0.59	35.7
14	R2	453	3.0	0.595	5.7	LOS A	5.9	151.1	0.65	0.59	34.7
Approach		674	3.0	0.595	5.7	LOS A	5.9	151.1	0.65	0.59	35.1
West: Kelsey Street (EB)											
5u	U	9	3.0	0.501	13.1	LOS B	4.2	107.9	0.59	0.67	33.9
5	L2	648	3.0	0.501	10.8	LOS B	4.2	107.9	0.59	0.67	33.2
12	R2	211	3.0	0.129	3.8	LOS A	0.0	0.0	0.00	0.47	36.8
Approach		868	3.0	0.501	9.2	LOS A	4.2	107.9	0.44	0.62	34.0
All Vehicles		2182	3.0	0.892	13.8	LOS B	17.3	442.9	0.67	0.85	31.8

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Intersection

Int Delay, s/veh 34.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	27	248	414	648	318	33
Future Vol, veh/h	27	248	414	648	318	33
Conflicting Peds, #/hr	0	0	2	0	0	2
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	200	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	79	79	95	95	89	89
Heavy Vehicles, %	4	4	2	2	3	3
Mvmt Flow	34	314	436	682	357	37

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1932	378	396	0	-	0
Stage 1	378	-	-	-	-	-
Stage 2	1554	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.12	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.218	-	-	-
Pot Cap-1 Maneuver	72	664	1163	-	-	-
Stage 1	688	-	-	-	-	-
Stage 2	190	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	45	663	1163	-	-	-
Mov Cap-2 Maneuver	45	-	-	-	-	-
Stage 1	687	-	-	-	-	-
Stage 2	119	-	-	-	-	-

Approach	EB		NB		SB
HCM Control Delay, s	169.9		3.9		0
HCM LOS	F				

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1163	-	282	-	-
HCM Lane V/C Ratio	0.375	-	1.234	-	-
HCM Control Delay (s)	9.9	-	169.9	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	1.8	-	16.3	-	-

Intersection

Intersection Delay, s/veh 44.2
 Intersection LOS E

Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBU	SBT	SBR
Lane Configurations									
Traffic Vol, veh/h	0	27	248	0	414	648	0	318	33
Future Vol, veh/h	0	27	248	0	414	648	0	318	33
Peak Hour Factor	0.92	0.99	0.99	0.92	0.99	0.99	0.92	0.99	0.99
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	27	251	0	418	655	0	321	33
Number of Lanes	0	1	0	0	1	1	0	1	0

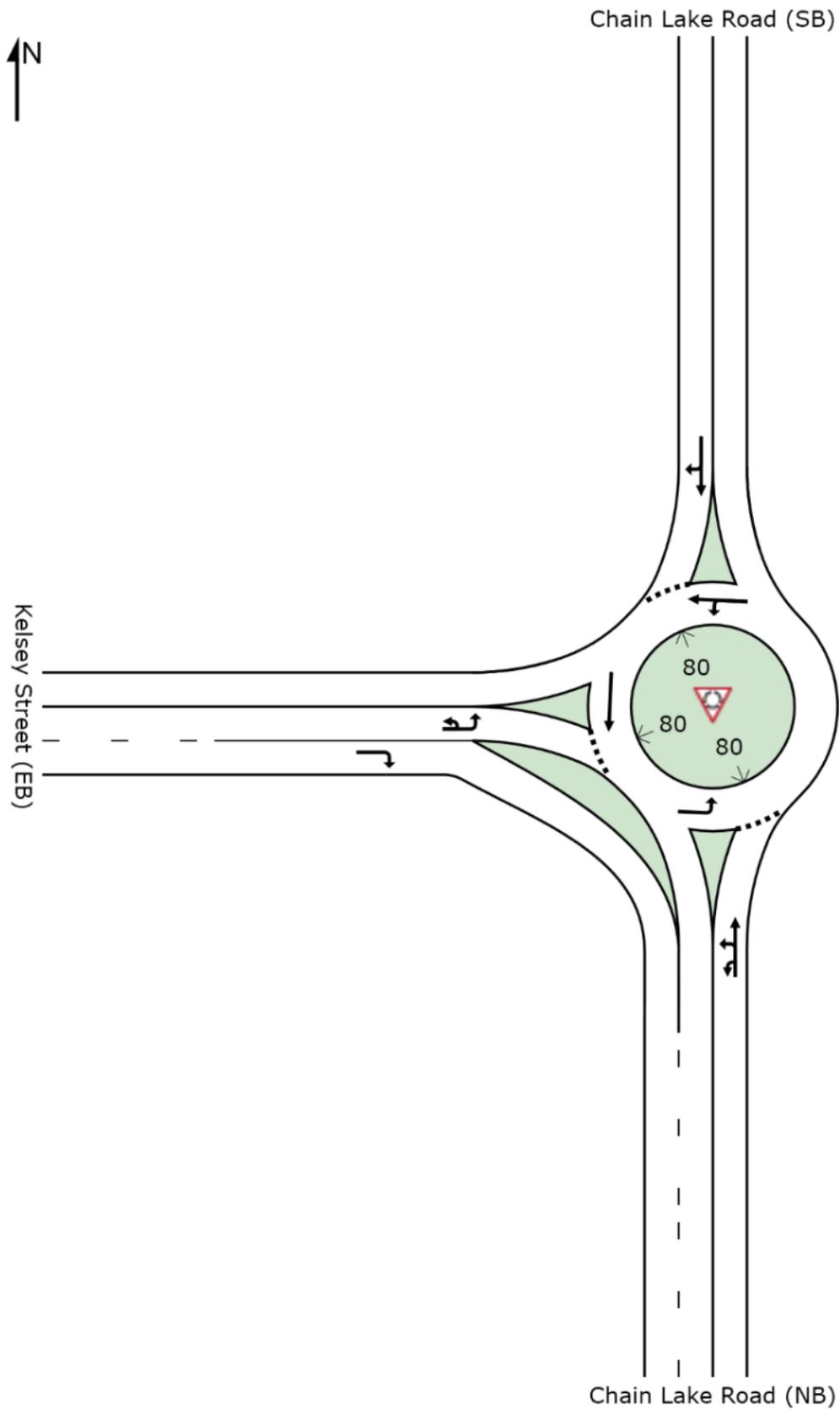
Approach	EB	NB	SB
Opposing Approach			NB
Opposing Lanes	0	1	2
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	2	0	1
HCM Control Delay	14.2	61.1	16.5
HCM LOS	B	F	C

Lane	NBLn1	NBLn2	EBLn1	SBLn1
Vol Left, %	100%	0%	10%	0%
Vol Thru, %	0%	100%	0%	91%
Vol Right, %	0%	0%	90%	9%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	414	648	275	351
LT Vol	414	0	27	0
Through Vol	0	648	0	318
RT Vol	0	0	248	33
Lane Flow Rate	418	655	278	355
Geometry Grp	7	7	2	5
Degree of Util (X)	0.749	1.081	0.46	0.569
Departure Headway (Hd)	6.451	5.944	6.099	5.939
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	565	615	594	610
Service Time	4.151	3.644	4.099	3.939
HCM Lane V/C Ratio	0.74	1.065	0.468	0.582
HCM Control Delay	25.9	83.6	14.2	16.5
HCM Lane LOS	D	F	B	C
HCM 95th-tile Q	6.5	19	2.4	3.6

SITE LAYOUT

 Site: Chain Lake Rd at N Kelsey St - 2026 Future w Dev

Chain Lake Road at N Kelsey Street
Roundabout



MOVEMENT SUMMARY

 **Site: Chain Lake Rd at N Kelsey St - 2026 Future w Dev**

Chain Lake Road at N Kelsey Street
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance ft	Prop. Queued	Effective Stop Rate per veh	Average Speed mph
South: Chain Lake Road (NB)											
3u	U	2	3.0	0.913	37.7	LOS D	19.0	486.0	1.00	1.49	26.2
3	L2	152	3.0	0.913	35.5	LOS D	19.0	486.0	1.00	1.49	25.9
8	T1	494	3.0	0.913	30.2	LOS C	19.0	486.0	1.00	1.49	25.9
Approach		647	3.0	0.913	31.5	LOS C	19.0	486.0	1.00	1.49	25.9
North: Chain Lake Road (SB)											
4	T1	224	3.0	0.604	5.8	LOS A	6.1	155.0	0.66	0.59	35.7
14	R2	459	3.0	0.604	5.7	LOS A	6.1	155.0	0.66	0.59	34.7
Approach		683	3.0	0.604	5.7	LOS A	6.1	155.0	0.66	0.59	35.0
West: Kelsey Street (EB)											
5u	U	9	3.0	0.508	13.1	LOS B	4.3	110.6	0.59	0.67	33.8
5	L2	657	3.0	0.508	10.9	LOS B	4.3	110.6	0.59	0.67	33.2
12	R2	211	3.0	0.129	3.8	LOS A	0.0	0.0	0.00	0.47	36.8
Approach		877	3.0	0.508	9.2	LOS A	4.3	110.6	0.45	0.63	34.0
All Vehicles		2207	3.0	0.913	14.7	LOS B	19.0	486.0	0.68	0.87	31.4

Level of Service (LOS) Method: Delay & v/c (HCM 2010).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement

LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).

Intersection and Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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