

Grand Mound Transportation Plan Existing Conditions Analysis

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FEHR  PEERS



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INTRODUCTION

Fehr & Peers has completed the existing conditions assessment as part of a transportation study for the Grand Mound Sub Area Plan. This report summarizes the methodology and findings of the analysis, which was based on data collected between August 2016 and November 2018.

This chapter outlines the transportation assessment, including a brief project description, the geographic extent of the study area, and the roadway segments and intersections identified as study locations.

Project Description

In November 2018, Thurston Regional Planning Council (TRPC) and Thurston County produced a comprehensive Transportation Current Conditions Report for the Grand Mound Urban Growth Area (UGA). The Current Conditions Report documents the findings of community outreach conducted in spring of 2018 and provides a qualitative assessment of transportation conditions, including identification of major issues and priorities by the community.

This transportation assessment includes technical analysis to supplement the November 2018 report, including detailed level of service analysis at study locations and safety analysis to both substantiate the report's findings and identify additional needs that might not have been identified as part of the qualitative assessment.

Study Area

The study area for this project includes roadway segments and intersections within the UGA defined for the Grand Mound area of Thurston County and unincorporated areas bordering the UGA limits.

As part of the existing conditions assessment, the following roadway segments, shown on **Figure 1**, were analyzed:

1. Elderberry St SW between 196th Ave SW and 193rd Ave SW
2. 196th Ave SW between Sargent Rd SW and Elderberry St SW



3. Sargent Rd SW between US-12 and 196th Ave SW
4. Elderberry St SW between US-12 and 196th St SW
5. Sargent Rd SW between 198th Way SW and US-12
6. 198th Ave SW between Sargent Rd SW and Old Hwy 99
7. Sargent Rd SW between Old Hwy 99 and 198th Way SW
8. Old Hwy 99 between 198th Ave SW and Sargent Rd
9. 201st Ave SW between Tea St SW and Old Hwy 99
10. Old Hwy 99 between 201st Ave SW and Old Hwy 9

The following intersections were also analyzed as part of the existing conditions assessment, and are shown on **Figure 1**:

1. Elderberry St SW and 193rd Ave SW
2. Elderberry St SW and 196th Ave SW
3. Sargent Rd SW and 196th Ave SW
4. Sargent Rd SW and US-12 (**future intersection**)
5. Old Hwy 99 and US-12
6. SB I-5 Ramp and US-12
7. NB I-5 Ramp and US-12
8. Old Hwy 99 and 198th Ave SW
9. Sargent Rd SW and 198th Ave SW (West)
10. Sargent Rd SW and 198th Ave SW (East)
11. Old Hwy 99 and Sargent Rd SW
12. Old Hwy 99 and 201st Ave SW
13. Old Hwy 99 and Old Hwy 9

It is important to note that the intersection of Sargent Road RW and US-12 does not currently exist but is expected to be complete by 2023 and is therefore included in all future analysis.

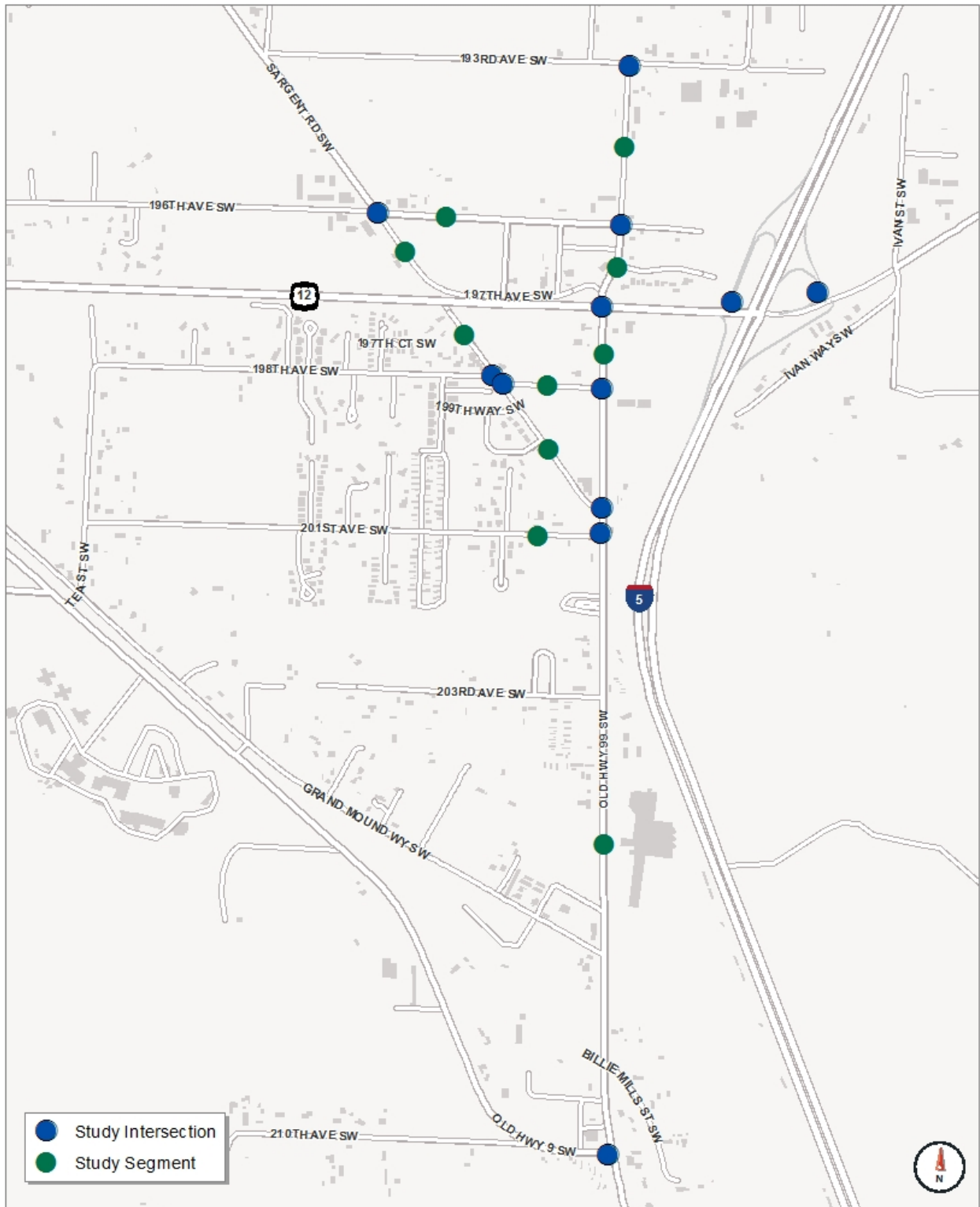


Figure 1. Study Intersections and Segments

ANALYSIS METHODOLOGIES

This section documents the analysis methodologies and assumptions used to evaluate the study segments and intersections.







Intersection Analysis

The operations of roadway facilities are described with the term *level of service*. Level of Service (LOS) is a qualitative description of traffic flow based on factors including speed, travel time, delay, and freedom to maneuver. Six levels are defined from LOS A, the best operating conditions, to LOS F, the worst operating conditions. LOS E represents “at-capacity” operations. When traffic volumes exceed the capacity, stop-and-go conditions result, and operations are designated as LOS F.

In order to evaluate how study intersections are performing, the Highway Capacity Manual, 6th Edition (HCM) (Transportation Research Board, 2016), methodology was applied using the Trafficware Synchro 10 software package. Synchro calculates vehicle delay and LOS based on procedures identified in Chapter 19 Section 3, Approach A. **Table 1** summarizes the relationship between the average control delay per vehicle and LOS, described above, for signalized intersections and unsignalized intersections. Per HCM 6th Edition methodology, LOS at signalized and all-way-stop control intersections is determined using the average delay experienced by all vehicles at the intersection. For side-street stop controlled intersections, the delay experience by vehicles at the highest-delay approach is considered.

SIDRA software and methodology consistent with Washington State Department of Transportation (WSDOT) guidelines for the analysis roundabouts was utilized to analyze the recently constructed roundabout at Old Highway 99 and 198th Avenue SW.

Table 1: Level of Service Definitions

Level of Service	Description	Signalized Intersection Delay (seconds/vehicle)	Unsignalized Intersection Delay (seconds/vehicle)
 A	Free-flowing Conditions	≤ 10	0-10
 B	Stable Flow (slight delays)	>10-20	>10-15
 C	Stable Flow (acceptable delays)	>20-35	>15-25
 D	Approaching Unstable Flow (tolerable delay)	>35-55	>25-35
 E	Unstable Flow (intolerable delay)	>55-80	>35-50
 F	Forced Flow (congested and queues fail to clear)	>80	>50

Roadway Segment Analysis

To evaluate the performance of county roadways, Fehr & Peers applied Thurston County’s LOS standard for roadway segments.

The County’s LOS policy associates daily traffic volumes with established capacity thresholds. The County’s service threshold capacities are based on data established by neighboring Pierce County and the HCM. Generally, the County strives to provide LOS “C” operations in rural (unincorporated) areas and LOS “D” operations in UGAs. Thurston County roadway segment service threshold capacities relevant to the study area are shown in **Table 2**. Using these thresholds each roadway segment was evaluated to determine if it is operating acceptably.



Table 2: Roadway Segment Service Threshold Capacities

Classification	Travel Lanes (each directions)	Service Threshold Capacities (PM Peak 2-Hour)	
		≤ 40 MPH	≥ 45 MPH
Urban (LOS D)	1	1550	1600
	2	3150	3250
Rural (LOS C)	1	1400	1450
	2	2800	2900

Performance Criteria

Based on the Draft Thurston County Comprehensive Plan Update (November 2019) standards on traffic impact analyses, the following performance criteria were used to determine if existing facilities are sized appropriately:

- Grand Mound Urban Growth Area:** As defined by the Comprehensive Plan, the Grand Mound UGA is designated as a non-rural urbanized area of Thurston County. LOS “D” is established as the minimum acceptable standard for county roads lying within the Grand Mound UGA.
- Rural Strategy Corridors:** Rural strategy corridors are defined as roadways where the adopted LOS standard may be exceeded. Old Highway 99 is one such roadway and is considered “built-out” today. In lieu of road widening, alternatives such as intersection improvements, connections to regional trails, and extending/increasing transit service shall be applied to mitigate congestion.
- Rural Unincorporated Thurston County:** Any rural unincorporated Thurston County roadways are defined as roadways lying outside of the current census urbanized area, including those roadways falling just outside of the Grand Mound Urban Growth Area. LOS “C” is established as the minimum acceptable standard for roadways lying within unincorporated Thurston County.

EXISTING CONDITIONS

Existing Roadway Facilities

Regional Roads

- **Interstate 5 Freeway (I-5):** I-5 is an interstate highway that runs in the north-south direction from San Diego, California at the southernmost end to the US-Canadian border in Washington at the northernmost end. I-5 is located at the eastern edge of the Grand Mound UGA and is a six-lane facility (three in each direction) at its junction with Old Highway 99/US-12. Access to I-5 within the study area exists only at US-12.
- **US-12:** US-12 is a federal highway that runs in the east-west direction from Aberdeen, WA in the west to I-5, where it runs in a north-south direction until Napavine, WA. US-12 cuts through the center of the Grand Mound UGA and is a two-lane facility (one lane in each direction) within the study area except between Old Highway 99 and the junction with I-5, where it is a four-lane facility (two lanes in each direction).
- **Old Highway 99:** Old Highway 99 is a regional highway that runs in the north-south direction from Fords Prairie, WA until it intersects with US-12 within the study area, at which point it runs in the east-west direction until Tenino, WA. Old Highway 99 cuts through the center of the Grand Mound UGA and is a two-lane facility (one lane in each direction) until Sargent Road SW, where it becomes a four-lane facility (two in each direction) until it crosses I-5 and reverts back to two lanes.

Local Roads

- **193rd Avenue SW:** 193rd Avenue SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs between Sargent Road and I-5, along the north boundary of the Grand Mound UGA.
- **Elderberry Street SW:** Elderberry Street SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs from the intersection of Old Highway 99 and US-12 until 193rd Avenue SW.

- **196th Avenue SW:** 196th Avenue SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs from Sargent Road to just past Elderberry Street SW.
- **Sargent Road SW:** Sargent Road SW is identified as a Major Collector in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs northwest-southeast from the northwest boundary of the Grand Mound UGA, dead-ends at US-12, then continues just south of US-12 until Old Highway 99.
- **198th Avenue SW:** 198th Avenue SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs from Tea Street SW to Old Highway 99.
- **201st Avenue SW:** 201st Avenue SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs from Tea Street SW to Old Highway 99.
- **Tea Street SW:** Tea Street SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs from Old Highway 9 to 198th Avenue SW.
- **Grand Mound Way SW:** Grand Mound Way SW is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs northwest-southeast from US-12 to Old Hwy 99.
- **Old Highway 9:** Old Highway 9 is identified as a Local County Road in the Thurston County Comprehensive Plan. In the study area, it is a two-lane facility that runs northwest-southeast from US-12 to Old Hwy 99.

Existing Transit

There is currently one Park and Ride within the limits of the Grand Mound UGA located just west of the interchange of I-5 with US-12/Old Highway 99. Service is provided “ruralTransit” (rT) managed by the Thurston Regional Planning Council, which operates two routes that stop weekdays at the Park and Ride. Route 3 runs along Highway 12 from Rochester, stopping at Pecan Street (outside study area) and the Grand Mound Park and Ride before taking I-5 north to Tumwater. Route 4 runs from Centralia, north on I-5 to the Grand Mound Park and Ride, then along Old Highway 99 toward Tenino. As of June 2019, Route 3 operated 12 routes per day (six northbound, six southbound), and Route 4 operated hourly from 6 am to 6 pm, Monday through Friday. This Park and Ride also is serviced by vanpool routes, facilitated by Intercity Transit, that go from Centralia to Olympia.

Existing and Proposed Pedestrian and Bicycle Facilities

Pedestrian infrastructure exists on many of the residential local roads. However, on major connectors such as US-12 or Old Highway 99, the existing pedestrian and bicycle facilities are provided as development occurs resulting in spot improvements often lacking connectivity. The following are current existing bicycle and pedestrian facilities on major roadways within the Grand Mound UGA. Existing facilities are shown in **Figure 2**.

- **US-12:** Bicycle and pedestrian facilities exist along US-12 from the intersection of US-12 with Old Highway 99 to just east of the Park and Ride on the east side of I-5. A wide shoulder that can accommodate bicyclists also exists from the intersection of US-12 with Pecan Street to the intersection of US-12 with Old Highway 99.
- **Elderberry Street/Old Highway 99:** Sidewalk exists on the west side of Elderberry Street just north of the intersection of Old Highway 99 and US-12. Additionally, bike lanes and sidewalks exist on the east and west side of Old Highway 99 from the intersection of Old Highway 99 and US-12 to just south of 198th Avenue SW. A wide shoulder and intermittent sidewalks continue until just south of 201st Avenue SW. Additional sidewalk infrastructure also exists on Old Highway 99 adjacent to the Great Wolf Lodge.

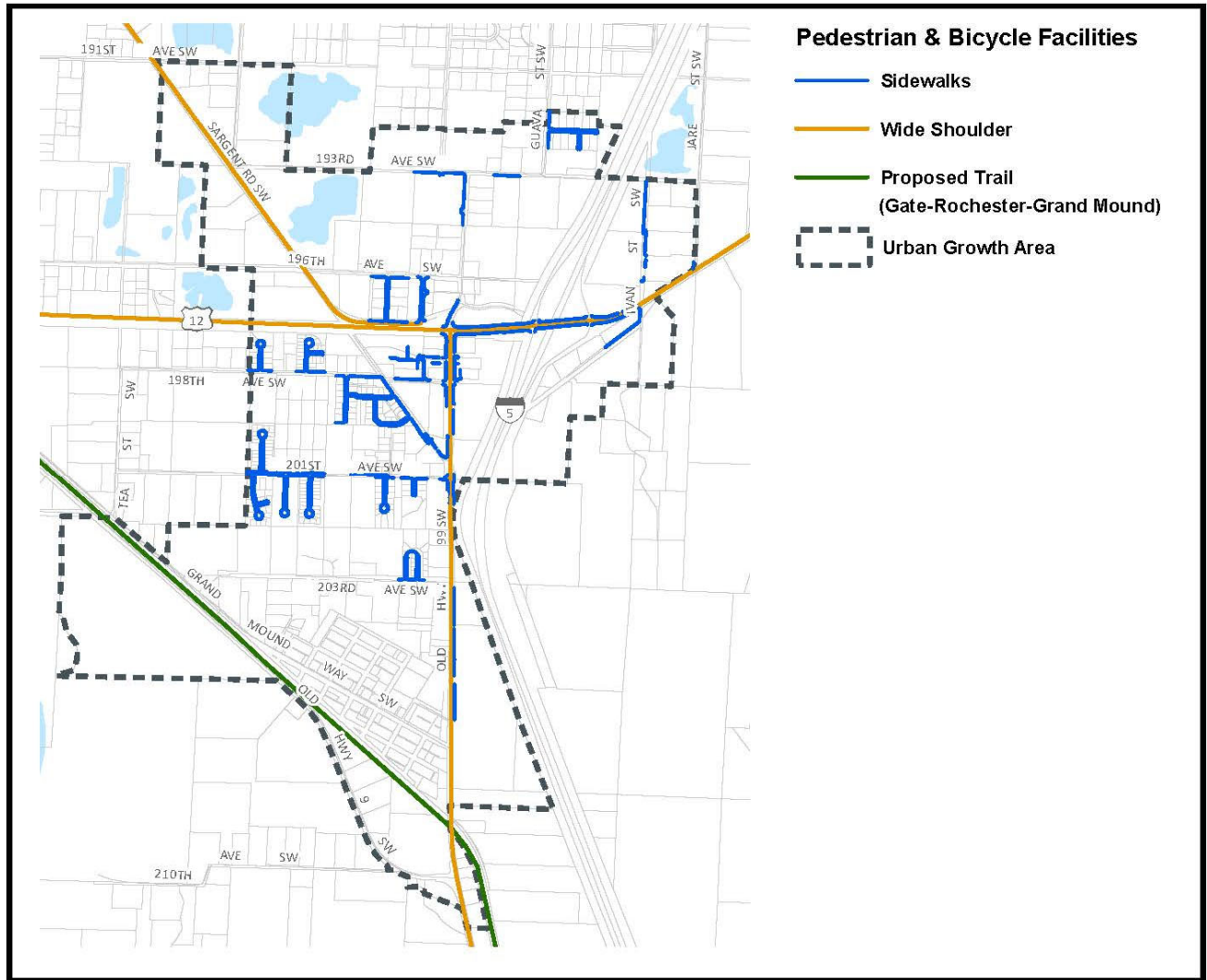


Figure 2. Existing Pedestrian and Bicycle Facilities

Traffic Volumes and Lane Configurations

Analysis for existing conditions was completed using data collected by TRPC and Thurston County within the study area between August 2016 and November 2018.

For the purpose of this assessment, analysis was completed for the PM peak hour. The peak hour was identified for the 12 study intersections and 11 roadway segments based on the PM peak period (4:00 to 6:00 PM) counts collected by TRPC and Thurston County. Existing PM peak hour volumes and lane configurations for the study intersections are summarized on **Figure 3**.

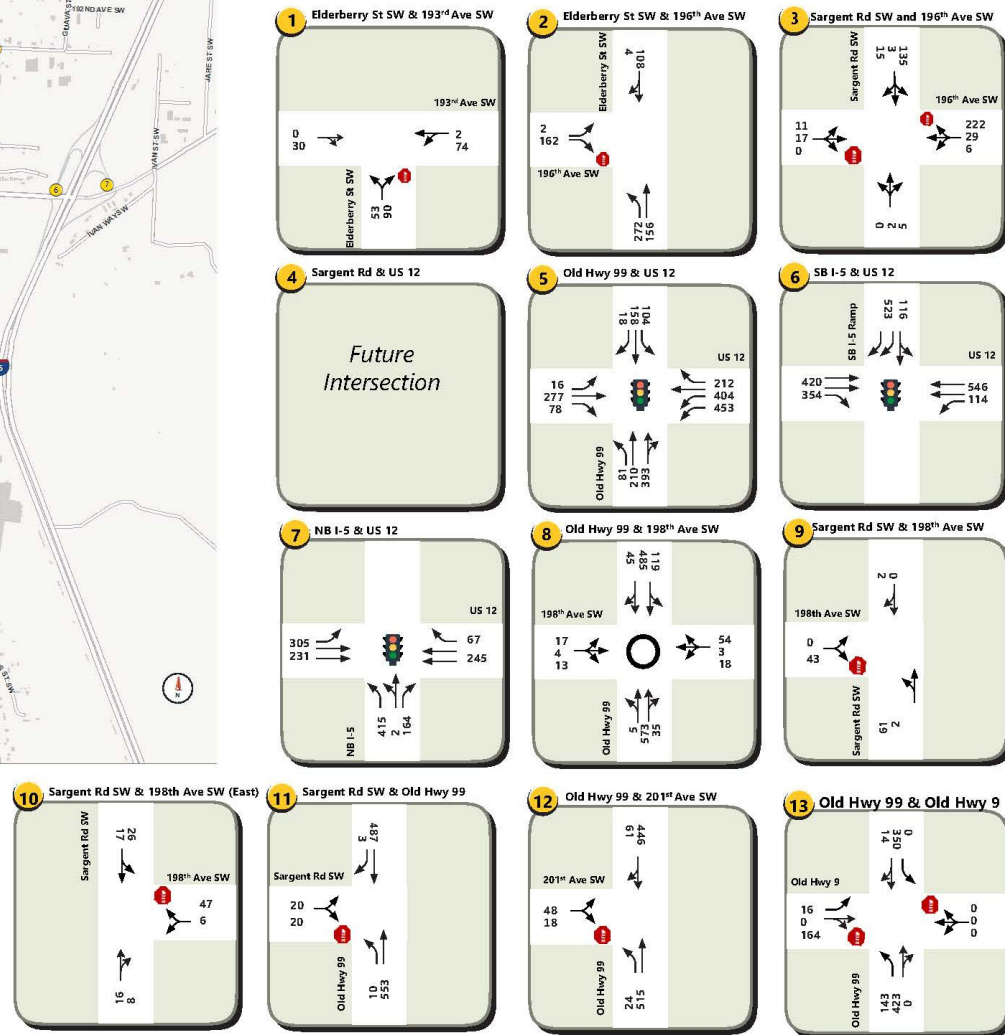
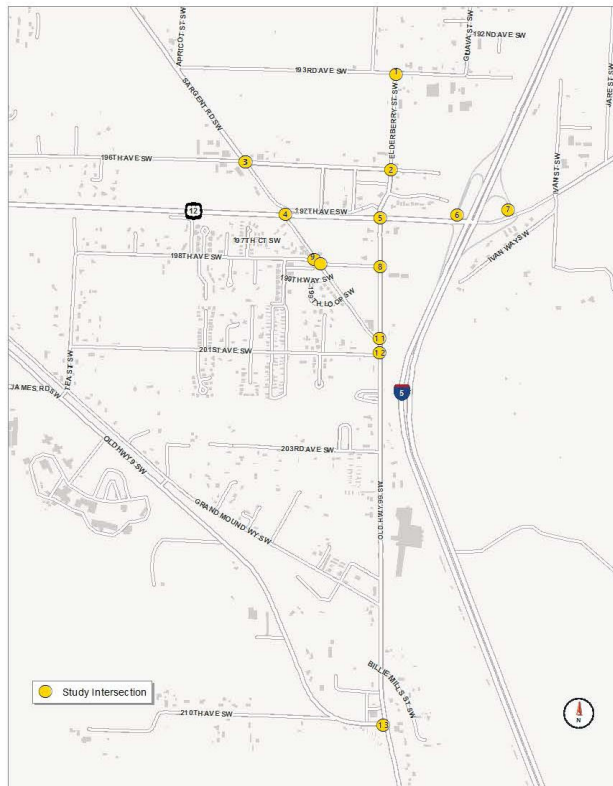


Figure 3. Existing PM Peak Hour Traffic Volume and Lane Configurations

Intersection and Roadway Segment Operations

Existing traffic volumes, lane configurations, and signal timings were used to calculate delay and LOS at the study intersections for existing PM peak hour conditions. **Figure 4** summarizes the results of the existing conditions assessment. The technical calculations are provided in **Appendix A**.

As shown on **Figure 4**, all intersections are operating at an acceptable level of service, based on the criteria presented in the Thurston County Comprehensive Plan.

Traffic volumes for the study segments during the two-hour PM peak period are summarized in **Table 3**. The LOS standard and calculated volume-to-capacity ratio (V/C) are also summarized in **Table 3**. All study segments are meeting the LOS standard consistent with the Thurston County Comprehensive Plan.



Table 3: Roadway Segment Operations

Project Location	Direction	PM Volume (2-hr)	LOS Standard	V/C Ratio	PM
					Pass/Fail
Elderberry Street SW between 196 th and 193 rd Avenue SW	NB	230	D	0.13	Pass
	SB	191	D	0.11	Pass
196 th Avenue SW between Sargent Rd SW and Elderberry Street SW	EB	321	D	0.18	Pass
	WB	523	D	0.30	Pass
Sargent Road SW between US-12 and 196 th Avenue SW	NB	14	D	0.01	Pass
	SB	64	D	0.04	Pass
Elderberry Street SW between US-12 and 196 th Street SW	NB	634	D	0.36	Pass
	SB	448	D	0.25	Pass
Sargent Road SW between 198 th Way SW and US-12	NB	-	D	0.00	Pass
	SB	4	D	0.00	Pass
198 th Avenue SW between Sargent Road SW and Old Hwy 99	EB	44	D	0.03	Pass
	WB	93	D	0.05	Pass
Sargent Road SW between Old Highway 99 and 198 th Way SW	NB	95	D	0.05	Pass
	SB	55	D	0.03	Pass
Old Highway 99 between 198 th Ave SW and Sargent Road	NB	1,050	D	0.30	Pass
	SB	1,054	D	0.30	Pass
201 st Avenue SW between Tea Street Old Highway 99	EB	143	D	0.08	Pass
	WB	194	D	0.11	Pass
Old Highway 99 between 201 st Avenue SW and Old Highway 9	NB	912	D	0.52	Pass
	SB	842	D	0.48	Pass

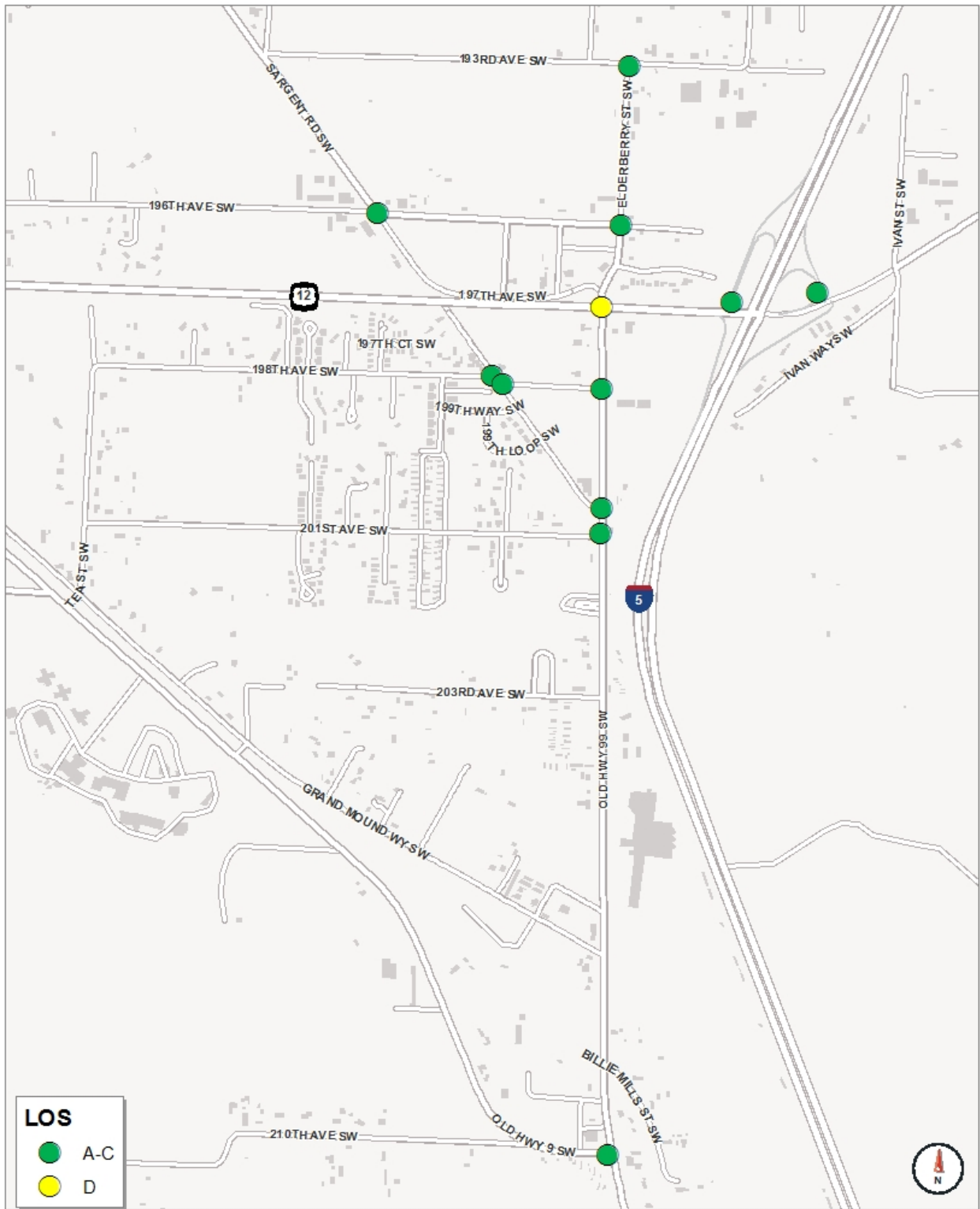


Figure 4. Intersection PM Peak Hour LOS – Existing Conditions

Safety Assessment

Grand Mound community members identified roadway safety as their greatest transportation-related concern during outreach events in 2018. Washington State has adopted Target Zero – a goal to reduce traffic fatalities and serious injuries on Washington’s roadways to zero by the year 2030. Thurston County has proposed the same transportation safety goal for County roadways in its Comprehensive Plan (draft Policy T.1.A.1).

Figure 5 maps recent crashes in Grand Mound, using data collected by Washington State Department of Transportation (WSDOT). During the five-year period of 2014 through 2018, there were 226 recorded traffic accidents in Grand Mound area. Overall, 37 percent of these collisions resulted in a possible injury, including two fatalities and five suspected serious injuries. Most accidents occurred along either US 12 (78 crashes) or Old Highway 99 SW (76), and the greatest concentration of incidents occurred at or near the intersection of these two roads. However, the types of accidents on the two roads differ: on US 12 rear-end accidents were the most common type of collision, occurring in 42 percent of accidents; while on Old Highway 99, the greatest proportion of crashes (45%) occurred from vehicles entering at an angle.

Intersections. Nearly half of all crashes (45%) that occurred in Grand Mound over the past five years were characterized as being related to an intersection. Intersections with the greatest number of collisions include:

- US 12/Old Highway 99 SW: 35
- US 12/I-5 ramps: 17
- Old Highway 99 SW/Old Highway 9 SW: 7
- Old Highway 99 SW/198th St SW: 6
- Old Highway 9 SW/Tea St SW: 6
- Old Highway 99 SW/Jare St: 4
- Old Highway 9 SW/James Rd SW: 4
- Elderberry St SW/196th Ave SW: 3
- Sargent Rd SW/191st Ave SW: 2
- Sargent Rd SW/196th Ave SW: 2

Along Old Highway 99 SW, a substantial portion of crashes (17) were related to vehicles entering or exiting driveways, rather than another street. In addition, a single collision at the intersection of Old Highway 99 SW and Sargent Rd SW resulted in one of the two fatalities during this period.

Contributing Conditions. WSDOT identifies inattention as the most frequent driver contributing condition to crashes during this period, playing a role in about a quarter of accidents. Drivers not granting right-of-way contributed to 19 accidents, most commonly along Old Highway 99 SW (including six collisions at the intersection with 198th Ave SW where a roundabout is being installed) and US 12. Consumption of alcohol or drugs¹ was a factor in 16 crashes.

Along US 12, disregarding stop lights, excessive speeding, not granting the right-of-way, improper turns, and following too closely were also listed as contributing factors in multiple crashes. These factors may contribute to the high proportion of rear-end collisions on this roadway.

Crashes with Fatalities. Over the past five years, Grand Mound suffered two fatal crashes, both in 2017. The first occurred in May when a vehicle traveling at night on an unlit portion of Old Highway 9 SW hit a pedestrian, who was in the middle of the travel lane. The second crash occurred when a vehicle taking a left onto Old Highway 99 SW from Sargent Rd SW collided with a tractor-trailer headed southbound, killing the driver of the car. A third fatal crash in 2017 occurred along Old Highway 99 SW just south the study area, near the intersection with Oregon Trail Rd SW.

Crashes with Serious Injuries. Since 2014, five accidents in Grand Mound have caused suspected serious injuries.

- **March 2016:** a head-on collision on Sargent Rd, when a pickup truck or van¹ crossed the center line in dry, daylight conditions. WSDOT identified driver distraction as a contributing factor.
- **December 2016:** a pickup truck or van hit a pedestrian walking in their lane of traffic on Grand Mound Way SW, during dark, raining conditions.
- **December 2016:** a pickup truck or van headed north on Old Highway 99 SW hit a guardrail.
- **April 2017:** a head-on collision on US 12, when a passenger car crossed the center line and hit a pickup truck or van in dark, but dry conditions. WSDOT identified driver distraction as a contributing factor.
- **August 2018:** a motorcycle overturned on Elderberry St SW in dry, dark conditions. WSDOT noted excessive speed as a factor in the accident.

¹ WSDOT lumps small truck and vans into a single vehicle category called "Pickup Panel Truck or Vanette under 10000 lb."

Pedestrian-Involved Crashes. An overall lack of continuous sidewalks and pathways makes the Grand Mound study area challenging to navigate on foot, and travel in this area is typically done by auto. Over the past five years, there have been only three crashes that involved pedestrians, however all have resulted in injury to the pedestrian, including a fatality.

- **December 2016:** a pickup truck or van hit and seriously injured a pedestrian walking in their lane of traffic on Grand Mound Way SW, during dark, raining conditions.
- **May 2017:** a vehicle traveling at night on an unlit portion of Old Highway 9 SW hit and killed a pedestrian, who was in the middle of the travel lane.
- **November 2018:** A pickup truck or van making a turn from Ivan Street SW into a driveway hit and injured a pedestrian, during dark, wet conditions in an area without streetlights.

Bicyclist-Involved Crashes. Similarly, the Grand Mound area can be challenging for cyclists, and there have been three accidents involving bicycles since 2014.

- **March 2015:** A passenger car making a left turn from Old Highway 99 SW into a driveway hit a cyclist, leading to a minor injury.
- **August 2016:** A pickup truck or van going straight on Sargent Rd SW near 196th Ave hit a cyclist in dry, daylight conditions, leading to a minor injury.
- **May 2018:** A vehicle going straight on Old Highway 9 SW hit a cyclist in dry daylight conditions.

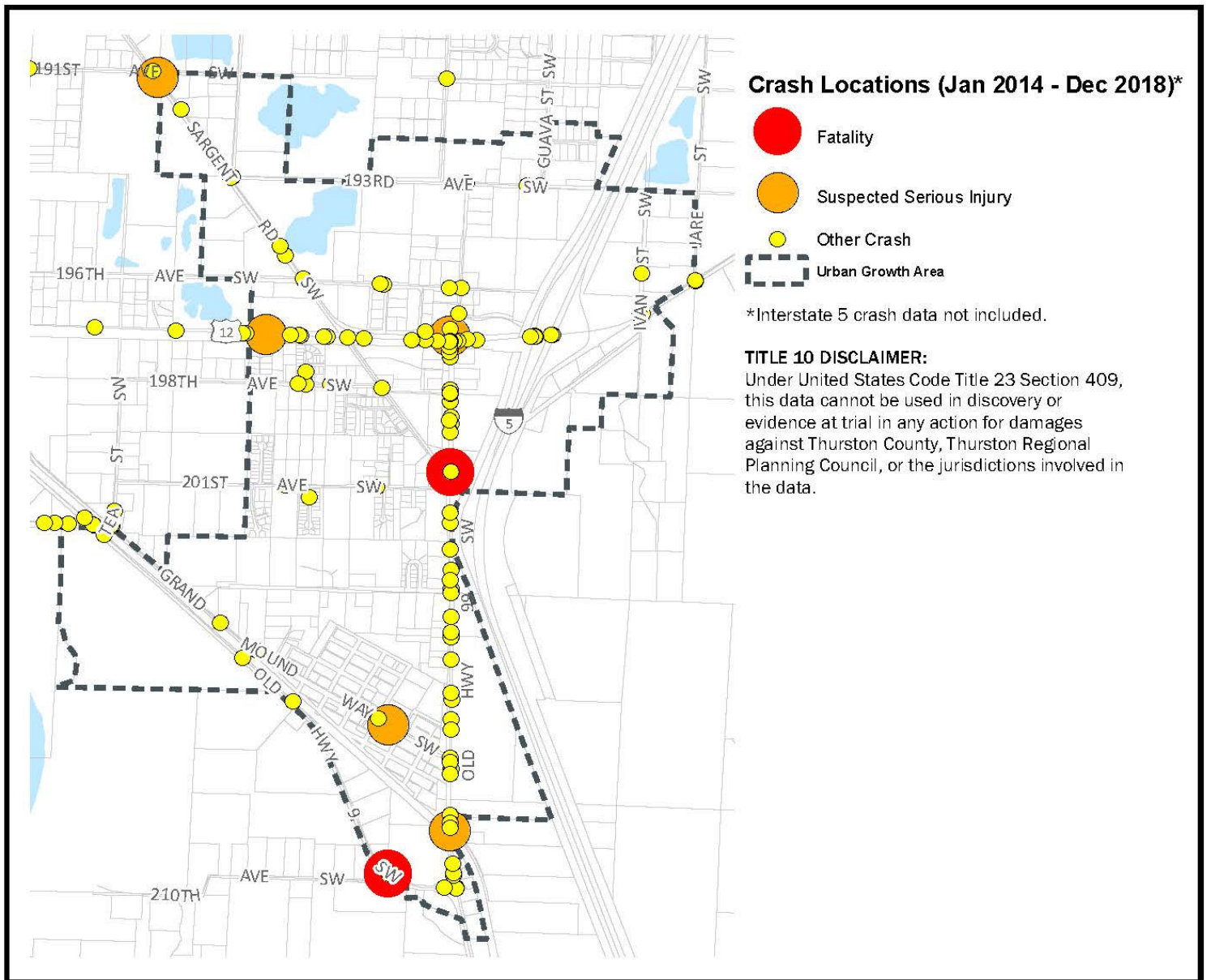


Figure 5. Grand Mound Crash Locations, 2014-2018



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Appendix A:
Intersection Level of Service Calculations



Existing Intersection LOS Summary

INT #	Intersection	Existing Control	Peak Hour	Existing	
				Delay	LOS
1	193rd Ave & Elderberry St	TWSC	PM	10	A
2	196th Ave & Elderberry St	TWSC	PM	10	A
3	196th Ave & Sargent Rd	TWSC	PM	14	B
5	Old Hwy 99/Elderberry St & US-12	Signalized	PM	48	D
6	SB I-5 Ramp & US-12	Signalized	PM	25	C
7	NB I-5 Ramp & US-12	Signalized	PM	28	C
8	198th Ave & Old Hwy 99	Roundabout ¹	PM	5	A
9	198th Ave (West) & Sargent Rd	TWSC	PM	9	A
10	198th Ave (East) & Sargent Rd	TWSC	PM	9	A
11	Sargent Rd & Old Hwy 99	TWSC	PM	14	B
12	201st Ave & Old Hwy 99	TWSC	PM	16	C
13	Old Hwy 9 & Old Hwy 99	TWSC	PM	14	B

Notes:

¹ Intersection analyzed using SIDRA Software.

Intersection analysis completed using Highway Capacity Manual 6th Edition Methodology & Synchro 10 Software.



Appendix B:
Intersection Level of Service Calculations



Intersection						
Int Delay, s/veh	7.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	0	30	74	2	53	90
Future Vol, veh/h	0	30	74	2	53	90
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	31	76	2	54	92

Major/Minor	Major1	Major2	Minor1		
Conflicting Flow All	0	0	31	0	170
Stage 1	-	-	-	-	16
Stage 2	-	-	-	-	154
Critical Hdwy	-	-	4.12	-	6.42
Critical Hdwy Stg 1	-	-	-	-	5.42
Critical Hdwy Stg 2	-	-	-	-	5.42
Follow-up Hdwy	-	-	2.218	-	3.518
Pot Cap-1 Maneuver	-	-	1582	-	820
Stage 1	-	-	-	-	1007
Stage 2	-	-	-	-	874
Platoon blocked, %	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1582	-	781
Mov Cap-2 Maneuver	-	-	-	-	781
Stage 1	-	-	-	-	959
Stage 2	-	-	-	-	874

Approach	EB	WB	NB
HCM Control Delay, s	0	7.2	9.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	938	-	-	1582	-
HCM Lane V/C Ratio	0.156	-	-	0.048	-
HCM Control Delay (s)	9.5	-	-	7.4	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.6	-	-	0.1	-

Intersection						
Int Delay, s/veh	5.4					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↙	↗	↙	↑	↗	
Traffic Vol, veh/h	2	162	272	156	108	4
Future Vol, veh/h	2	162	272	156	108	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	75	0	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	2	172	289	166	115	4

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	861	117	119	0	-	0
Stage 1	117	-	-	-	-	-
Stage 2	744	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	326	935	1469	-	-	-
Stage 1	908	-	-	-	-	-
Stage 2	470	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	262	935	1469	-	-	-
Mov Cap-2 Maneuver	262	-	-	-	-	-
Stage 1	729	-	-	-	-	-
Stage 2	470	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.8	5.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	EBLn2	SBT	SBR
Capacity (veh/h)	1469	-	262	935	-	-
HCM Lane V/C Ratio	0.197	-	0.008	0.184	-	-
HCM Control Delay (s)	8.1	-	18.9	9.7	-	-
HCM Lane LOS	A	-	C	A	-	-
HCM 95th %tile Q(veh)	0.7	-	0	0.7	-	-

Intersection												
Int Delay, s/veh	9.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	11	17	0	6	29	222	0	2	5	135	3	15
Future Vol, veh/h	11	17	0	6	29	222	0	2	5	135	3	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	12	18	0	7	32	241	0	2	5	147	3	16

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	446	312	11	319	318	5	19	0	0	7	0	0
Stage 1	305	305	-	5	5	-	-	-	-	-	-	-
Stage 2	141	7	-	314	313	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	523	603	1070	634	598	1078	1597	-	-	1614	-	-
Stage 1	705	662	-	1017	892	-	-	-	-	-	-	-
Stage 2	862	890	-	697	657	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	361	548	1070	574	543	1078	1597	-	-	1614	-	-
Mov Cap-2 Maneuver	361	548	-	574	543	-	-	-	-	-	-	-
Stage 1	705	601	-	1017	892	-	-	-	-	-	-	-
Stage 2	645	890	-	613	597	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.5	10.3	0	6.6
HCM LOS	B	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1597	-	-	455	953	1614	-	-
HCM Lane V/C Ratio	-	-	-	0.067	0.293	0.091	-	-
HCM Control Delay (s)	0	-	-	13.5	10.3	7.5	0	-
HCM Lane LOS	A	-	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	1.2	0.3	-	-

HCM 6th Signalized Intersection Summary
5: Old Hwy 99/Elderberry St & US-12

PM Peak Hour
Grand Mound Existing Conditions



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	16	277	78	453	404	212	81	210	393	104	158	18
Future Volume (veh/h)	16	277	78	453	404	212	81	210	393	104	158	18
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1856	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	17	295	24	482	430	48	86	223	138	111	168	3
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Percent Heavy Veh, %	2	2	2	3	2	2	2	2	2	2	2	2
Cap, veh/h	31	853	723	560	1126	954	175	277	164	135	199	169
Arrive On Green	0.02	0.46	0.46	0.16	0.60	0.60	0.10	0.13	0.13	0.08	0.11	0.11
Sat Flow, veh/h	1781	1870	1585	3428	1870	1585	1781	2144	1274	1781	1870	1585
Grp Volume(v), veh/h	17	295	24	482	430	48	86	183	178	111	168	3
Grp Sat Flow(s),veh/h/ln	1781	1870	1585	1714	1870	1585	1781	1777	1641	1781	1870	1585
Q Serve(g_s), s	1.2	13.2	0.7	17.8	15.5	1.0	5.9	13.0	13.8	8.0	11.5	0.2
Cycle Q Clear(g_c), s	1.2	13.2	0.7	17.8	15.5	1.0	5.9	13.0	13.8	8.0	11.5	0.2
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.78	1.00		1.00
Lane Grp Cap(c), veh/h	31	853	723	560	1126	954	175	229	212	135	199	169
V/C Ratio(X)	0.54	0.35	0.03	0.86	0.38	0.05	0.49	0.80	0.84	0.82	0.84	0.02
Avail Cap(c_a), veh/h	130	853	723	857	1126	954	212	302	279	185	289	245
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.89	0.89	0.89	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	63.3	22.8	8.4	53.0	13.4	3.7	55.5	55.0	55.3	59.2	57.0	40.4
Incr Delay (d2), s/veh	13.7	1.1	0.1	5.2	0.9	0.1	2.1	10.6	15.7	18.5	13.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	6.0	0.4	7.9	6.4	0.6	2.7	6.4	6.5	4.2	6.1	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	77.0	23.9	8.5	58.1	14.3	3.8	57.6	65.6	71.0	77.7	70.9	40.5
LnGrp LOS	E	C	A	E	B	A	E	E	E	E	E	D
Approach Vol, veh/h		336			960			447			282	
Approach Delay, s/veh		25.5			35.7			66.2			73.2	
Approach LOS		C			D			E			E	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	26.7	65.2	18.3	19.8	7.8	84.1	15.4	22.7				
Change Period (Y+Rc), s	5.5	5.9	5.5	5.9	5.5	5.9	5.5	5.9				
Max Green Setting (Gmax), s	32.5	39.1	15.5	20.1	9.5	62.1	13.5	22.1				
Max Q Clear Time (g_c+I1), s	19.8	15.2	7.9	13.5	3.2	17.5	10.0	15.8				
Green Ext Time (p_c), s	1.4	1.7	0.1	0.4	0.0	2.9	0.1	1.0				

Intersection Summary













HCM 6th Ctrl Delay	46.0
HCM 6th LOS	D

Notes

User approved pedestrian interval to be less than phase max green.























HCM Signalized Intersection Capacity Analysis
6: SB I-5 Ramp & US-12

PM Peak Hour
Grand Mound Existing Conditions

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↑↑	↗	↖	↑↑						↖	↗↗	
Traffic Volume (vph)	0	420	354	114	546	0	0	0	0	116	0	523	
Future Volume (vph)	0	420	354	114	546	0	0	0	0	116	0	523	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)		5.9	5.9	5.5	5.9						5.9	5.9	
Lane Util. Factor		0.95	1.00	1.00	0.95						1.00	0.88	
Frt		1.00	0.85	1.00	1.00						1.00	0.85	
Flt Protected		1.00	1.00	0.95	1.00						0.95	1.00	
Satd. Flow (prot)		3406	1583	1770	3539						1770	2760	
Flt Permitted		1.00	1.00	0.95	1.00						0.95	1.00	
Satd. Flow (perm)		3406	1583	1770	3539						1770	2760	
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)	0	483	407	131	628	0	0	0	0	133	0	601	
RTOR Reduction (vph)	0	0	187	0	0	0	0	0	0	0	0	520	
Lane Group Flow (vph)	0	483	220	131	628	0	0	0	0	0	133	81	
Heavy Vehicles (%)	2%	6%	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	
Turn Type		NA	Perm	Prot	NA						Perm	NA	Perm
Protected Phases		2		1	6							4	
Permitted Phases			2							4			4
Actuated Green, G (s)		70.3	70.3	15.4	91.2						17.5	17.5	
Effective Green, g (s)		70.3	70.3	15.4	91.2						17.5	17.5	
Actuated g/C Ratio		0.54	0.54	0.12	0.70						0.13	0.13	
Clearance Time (s)		5.9	5.9	5.5	5.9						5.9	5.9	
Vehicle Extension (s)		3.0	3.0	3.5	5.0						4.0	4.0	
Lane Grp Cap (vph)		1841	856	209	2482						238	371	
v/s Ratio Prot		c0.14		c0.07	0.18								
v/s Ratio Perm			0.14								0.08	0.03	
v/c Ratio		0.26	0.26	0.63	0.25						0.56	0.22	
Uniform Delay, d1		16.0	15.9	54.6	7.0						52.6	50.2	
Progression Factor		0.66	1.50	1.00	1.00						1.00	1.00	
Incremental Delay, d2		0.3	0.6	6.0	0.2						3.5	0.4	
Delay (s)		10.8	24.4	60.6	7.3						56.1	50.6	
Level of Service		B	C	E	A						E	D	
Approach Delay (s)		17.0			16.5			0.0			51.6		
Approach LOS		B			B			A			D		
Intersection Summary													
HCM 2000 Control Delay			27.5			HCM 2000 Level of Service					C		
HCM 2000 Volume to Capacity ratio			0.35										
Actuated Cycle Length (s)			130.0			Sum of lost time (s)				21.3			
Intersection Capacity Utilization			53.0%			ICU Level of Service				A			
Analysis Period (min)			15										
c Critical Lane Group													

HCM 6th Signalized Intersection Summary
7: NB I-5 Ramp & US-12

PM Peak Hour
Grand Mound Existing Conditions

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 								
Traffic Volume (veh/h)	305	231	0	0	245	67	415	2	164	0	0	0	
Future Volume (veh/h)	305	231	0	0	245	67	415	2	164	0	0	0	
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0				
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00				
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Work Zone On Approach		No			No			No					
Adj Sat Flow, veh/h/ln	1811	1870	0	0	1870	1870	1870	1870	1870				
Adj Flow Rate, veh/h	335	254	0	0	269	26	457	0	23				
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91				
Percent Heavy Veh, %	6	2	0	0	2	2	2	2	2				
Cap, veh/h	392	2470	0	0	1443	644	616	0	274				
Arrive On Green	0.23	0.70	0.00	0.00	0.41	0.41	0.17	0.00	0.17				
Sat Flow, veh/h	1725	3647	0	0	3647	1585	3563	0	1585				
Grp Volume(v), veh/h	335	254	0	0	269	26	457	0	23				
Grp Sat Flow(s),veh/h/ln	1725	1777	0	0	1777	1585	1781	0	1585				
Q Serve(g_s), s	16.6	2.1	0.0	0.0	4.3	0.9	10.9	0.0	1.1				
Cycle Q Clear(g_c), s	16.6	2.1	0.0	0.0	4.3	0.9	10.9	0.0	1.1				
Prop In Lane	1.00		0.00	0.00		1.00	1.00		1.00				
Lane Grp Cap(c), veh/h	392	2470	0	0	1443	644	616	0	274				
V/C Ratio(X)	0.85	0.10	0.00	0.00	0.19	0.04	0.74	0.00	0.08				
Avail Cap(c_a), veh/h	859	2470	0	0	1443	644	1360	0	605				
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Upstream Filter(I)	1.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00				
Uniform Delay (d), s/veh	33.1	4.5	0.0	0.0	17.0	16.0	35.1	0.0	31.0				
Incr Delay (d2), s/veh	7.5	0.1	0.0	0.0	0.3	0.1	2.5	0.0	0.2				
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
%ile BackOfQ(50%),veh/ln	7.4	0.6	0.0	0.0	1.7	0.3	4.7	0.0	0.4				
Unsig. Movement Delay, s/veh													
LnGrp Delay(d),s/veh	40.6	4.6	0.0	0.0	17.3	16.1	37.6	0.0	31.2				
LnGrp LOS	D	A	A	A	B	B	D	A	C				
Approach Vol, veh/h		589			295			480					
Approach Delay, s/veh		25.0			17.2			37.3					
Approach LOS		C			B			D					
Timer - Assigned Phs		2			5	6		8					
Phs Duration (G+Y+Rc), s		68.0			25.8	42.2		21.3					
Change Period (Y+Rc), s		5.9			5.5	5.9		5.9					
Max Green Setting (Gmax), s		62.1			44.5	29.1		34.1					
Max Q Clear Time (g_c+I1), s		4.1			18.6	6.3		12.9					
Green Ext Time (p_c), s		1.7			1.7	2.0		2.6					
Intersection Summary													
HCM 6th Ctrl Delay					27.7								
HCM 6th LOS					C								
Notes													
User approved volume balancing among the lanes for turning movement.													

Intersection						
Int Delay, s/veh	7.5					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T			T		
Traffic Vol, veh/h	0	43	61	2	0	2
Future Vol, veh/h	0	43	61	2	0	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	51	73	2	0	2

Major/Minor	Minor2	Major1		Major2	
Conflicting Flow All	149	1	2	0	0
Stage 1	1	-	-	-	-
Stage 2	148	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-
Pot Cap-1 Maneuver	843	1084	1620	-	-
Stage 1	1022	-	-	-	-
Stage 2	880	-	-	-	-
Platoon blocked, %				-	-
Mov Cap-1 Maneuver	805	1084	1620	-	-
Mov Cap-2 Maneuver	805	-	-	-	-
Stage 1	976	-	-	-	-
Stage 2	880	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	8.5	7.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1620	-	1084	-	-
HCM Lane V/C Ratio	0.045	-	0.047	-	-
HCM Control Delay (s)	7.3	0	8.5	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection						
Int Delay, s/veh	5.4					
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	W	R	T	R	L	T
Traffic Vol, veh/h	6	47	16	8	26	17
Future Vol, veh/h	6	47	16	8	26	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	56	19	10	31	20

Major/Minor	Minor1	Major1	Major2		
Conflicting Flow All	106	24	0	0	29
Stage 1	24	-	-	-	-
Stage 2	82	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12
Critical Hdwy Stg 1	5.42	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218
Pot Cap-1 Maneuver	892	1052	-	-	1584
Stage 1	999	-	-	-	-
Stage 2	941	-	-	-	-
Platoon blocked, %			-	-	-
Mov Cap-1 Maneuver	874	1052	-	-	1584
Mov Cap-2 Maneuver	874	-	-	-	-
Stage 1	979	-	-	-	-
Stage 2	941	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	8.7	0	4.4
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBRWBLn1	SBL	SBT
Capacity (veh/h)	-	-	1028	1584
HCM Lane V/C Ratio	-	-	0.061	0.02
HCM Control Delay (s)	-	-	8.7	7.3
HCM Lane LOS	-	-	A	A
HCM 95th %tile Q(veh)	-	-	0.2	0.1

Intersection						
Int Delay, s/veh	0.6					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y		Y	↑	↑	Y
Traffic Vol, veh/h	20	20	10	553	487	3
Future Vol, veh/h	20	20	10	553	487	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	75	-	-	75
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	98	98	98	98	98	98
Heavy Vehicles, %	2	2	2	6	3	2
Mvmt Flow	20	20	10	564	497	3

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1081	497	500	0	-	0
Stage 1	497	-	-	-	-	-
Stage 2	584	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	241	573	1064	-	-	-
Stage 1	611	-	-	-	-	-
Stage 2	557	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	239	573	1064	-	-	-
Mov Cap-2 Maneuver	371	-	-	-	-	-
Stage 1	606	-	-	-	-	-
Stage 2	557	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	13.8	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1064	-	450	-	-
HCM Lane V/C Ratio	0.01	-	0.091	-	-
HCM Control Delay (s)	8.4	-	13.8	-	-
HCM Lane LOS	A	-	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection						
Int Delay, s/veh	1.1					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔		↔	↑	↑	
Traffic Vol, veh/h	48	18	24	515	446	61
Future Vol, veh/h	48	18	24	515	446	61
Conflicting Peds, #/hr	0	1	1	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	6	3	2
Mvmt Flow	51	19	25	542	469	64

Major/Minor	Minor2	Major1	Major2			
Conflicting Flow All	1094	503	534	0	-	0
Stage 1	502	-	-	-	-	-
Stage 2	592	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	237	569	1034	-	-	-
Stage 1	608	-	-	-	-	-
Stage 2	553	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	231	568	1033	-	-	-
Mov Cap-2 Maneuver	360	-	-	-	-	-
Stage 1	593	-	-	-	-	-
Stage 2	552	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	15.9	0.4	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1033	-	400	-	-
HCM Lane V/C Ratio	0.024	-	0.174	-	-
HCM Control Delay (s)	8.6	-	15.9	-	-
HCM Lane LOS	A	-	C	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

Intersection												
Int Delay, s/veh	3.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗			↕		↖	↗		↖	↗	
Traffic Vol, veh/h	16	0	164	0	0	0	143	423	0	0	350	14
Future Vol, veh/h	16	0	164	0	0	0	143	423	0	0	350	14
Conflicting Peds, #/hr	0	0	1	1	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	125	-	-	-	-	-	120	-	-	75	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	2	2	5	2	2	2	6	6	2	2	3	2
Mvmt Flow	17	0	174	0	0	0	152	450	0	0	372	15

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	1134	1134	381	1222	1141	450	387	0	0	450	0	0
Stage 1	380	380	-	754	754	-	-	-	-	-	-	-
Stage 2	754	754	-	468	387	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.25	7.12	6.52	6.22	4.16	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.345	3.518	4.018	3.318	2.254	-	-	2.218	-	-
Pot Cap-1 Maneuver	180	203	660	156	201	609	1150	-	-	1110	-	-
Stage 1	642	614	-	401	417	-	-	-	-	-	-	-
Stage 2	401	417	-	575	610	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	162	176	659	103	174	609	1150	-	-	1110	-	-
Mov Cap-2 Maneuver	162	176	-	103	174	-	-	-	-	-	-	-
Stage 1	557	614	-	348	362	-	-	-	-	-	-	-
Stage 2	348	362	-	422	610	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	13.9	0	2.2	0
HCM LOS	B	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1150	-	-	162	659	-	1110	-	-
HCM Lane V/C Ratio	0.132	-	-	0.105	0.265	-	-	-	-
HCM Control Delay (s)	8.6	-	-	29.8	12.4	0	0	-	-
HCM Lane LOS	A	-	-	D	B	A	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	0.3	1.1	-	0	-	-

MOVEMENT SUMMARY

 Site: 101 [198th Ave & Old Hwy 99]

New Site
Site Category: (None)
Roundabout

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance ft	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed mph
South: Old Hwy 99												
3	L2	5	3.0	0.281	10.6	LOS B	1.3	34.2	0.31	0.45	0.31	31.0
8	T1	623	3.0	0.281	4.8	LOS A	1.3	34.3	0.31	0.45	0.31	36.9
18	R2	38	3.0	0.281	6.2	LOS A	1.3	34.3	0.31	0.46	0.31	21.0
Approach		666	3.0	0.281	4.9	LOS A	1.3	34.3	0.31	0.46	0.31	35.3
East: 198th Ave												
1	L2	20	3.0	0.102	2.0	LOS A	0.3	8.7	0.46	0.42	0.46	21.3
6	T1	3	3.0	0.102	2.0	LOS A	0.3	8.7	0.46	0.42	0.46	18.8
16	R2	59	3.0	0.102	2.0	LOS A	0.3	8.7	0.46	0.42	0.46	20.7
Approach		82	3.0	0.102	2.0	LOS A	0.3	8.7	0.46	0.42	0.46	20.8
North: Old Hwy 99												
7	L2	129	3.0	0.271	10.8	LOS B	1.4	36.2	0.13	0.51	0.13	20.9
4	T1	527	3.0	0.271	4.2	LOS A	1.4	36.2	0.13	0.44	0.13	37.1
14	R2	49	3.0	0.271	4.2	LOS A	1.4	36.2	0.13	0.38	0.13	29.7
Approach		705	3.0	0.271	5.4	LOS A	1.4	36.2	0.13	0.45	0.13	32.0
West: 198th Ave												
5	L2	18	3.0	0.046	7.2	LOS A	0.1	3.6	0.44	0.60	0.44	28.9
2	T1	4	3.0	0.046	6.3	LOS A	0.1	3.6	0.44	0.60	0.44	18.2
12	R2	14	3.0	0.046	2.9	LOS A	0.1	3.6	0.44	0.60	0.44	28.1
Approach		37	3.0	0.046	5.5	LOS A	0.1	3.6	0.44	0.60	0.44	26.8
All Vehicles		1490	3.0	0.281	5.0	LOS A	1.4	36.2	0.24	0.45	0.24	32.3

Site Level of Service (LOS) Method: Delay & v/c (HCM 2010). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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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