# THREE LAKES CROSSING
# TRAFFIC IMPACT ANALYSIS

*City of Tumwater, WA*


12/10/2021

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THREE LAKES CROSSING
TRAFFIC IMPACT ANALYSIS

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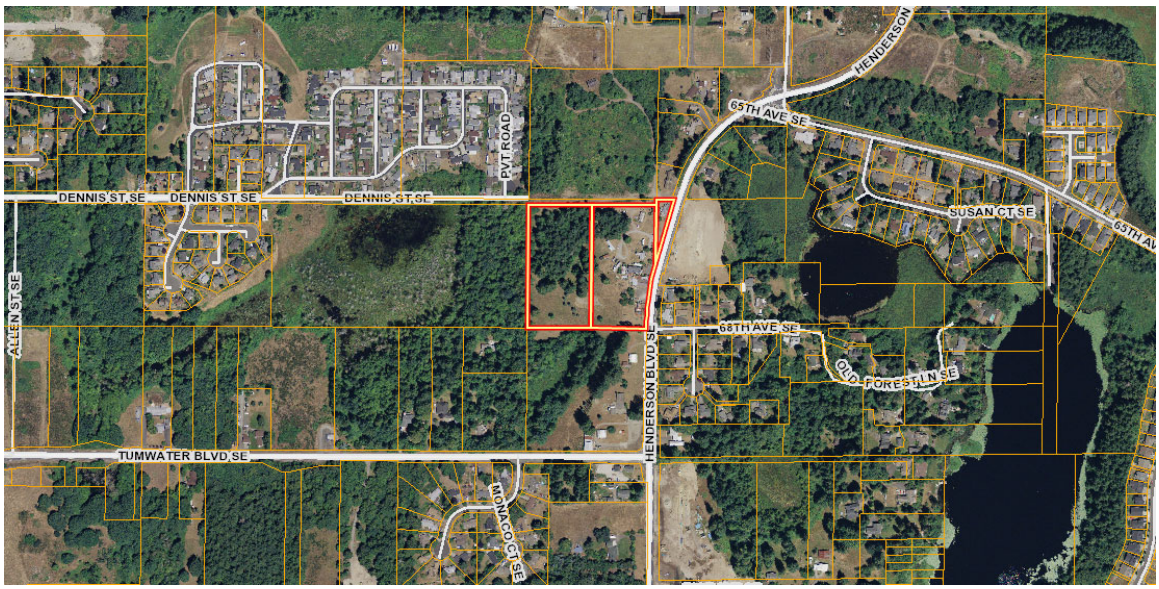
THREE LAKES CROSSING
TRAFFIC IMPACT ANALYSIS

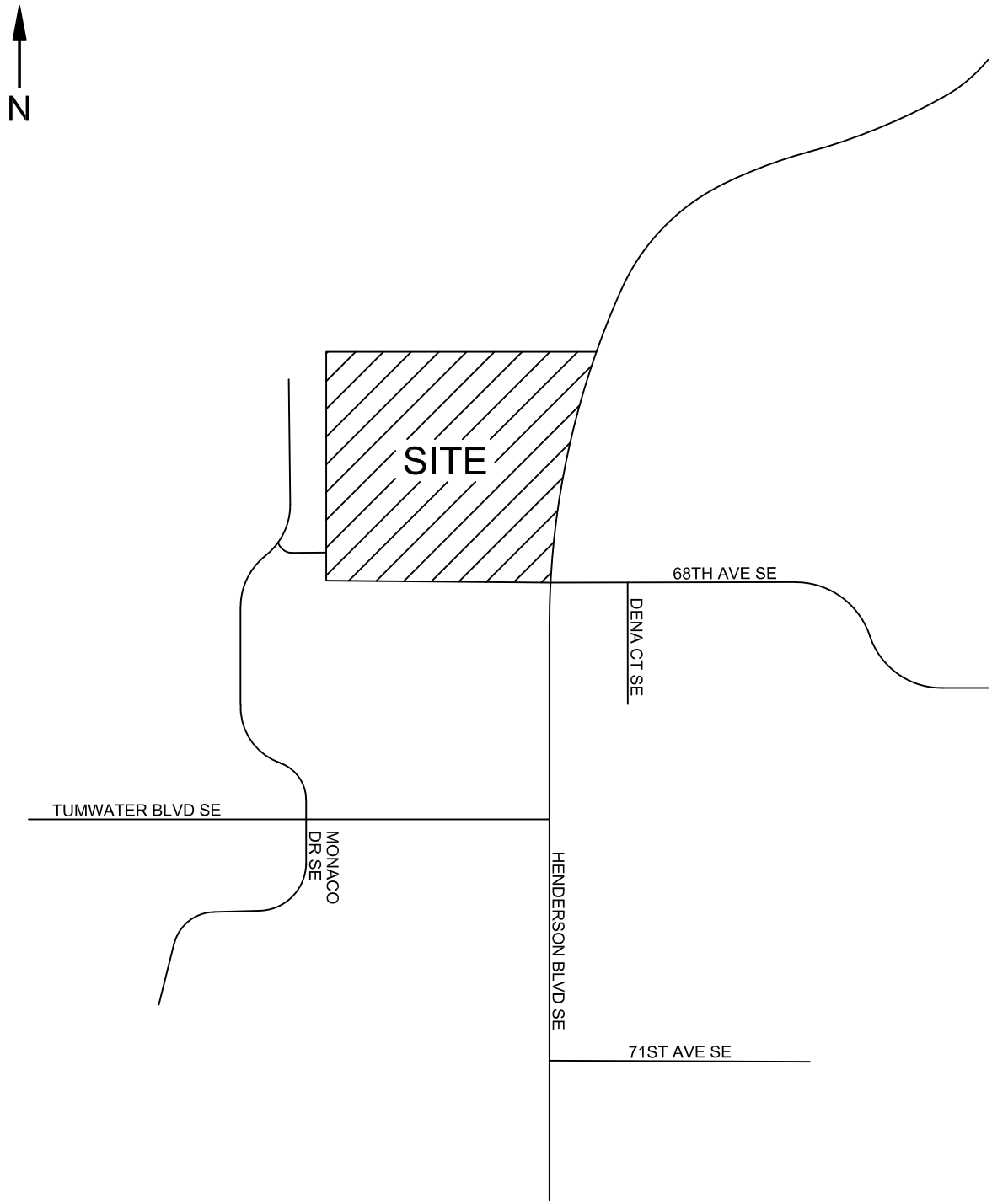
## 1. INTRODUCTION

The main goals of this study focus on the analysis of existing roadway conditions and forecasts of newly generated project traffic. The first task includes the review of general roadway information on the adjacent street system, baseline vehicular volumes, and entering sight distance data. Forecasts of future traffic and dispersion patterns on the street system are then determined using established trip generation and distribution techniques. As a final step, appropriate conclusions and mitigation measures are defined.

## 2. PROJECT DESCRIPTION

The Three Lakes Crossing project is a proposed residential development comprising up to 45 single-family dwelling units in the city of Tumwater. The subject site, bordered to the east by Henderson Boulevard SE, is located on a cumulative 16.66-acres within tax parcel #'s: 1270132-0105; 7930000-0100; & -0101. Access to the site is proposed via one new driveway extending west from Henderson Boulevard SE into the subject site. Moreover, internal connection is to be provided with a new development located south of the subject site, subsequently providing access to Tumwater Boulevard SE. All existing structures on-site are to be demolished prior to new construction. Figure 1 on the following page shows the aerial vicinity of the project. A conceptual site plan illustrating the proposed site layout including all access points is presented in Figure 2. A site aerial is provided below.



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TRAFFIC AND CIVIL ENGINEERING

THREE LAKES CROSSING

VICINITY MAP & ROADWAY SYSTEM
FIGURE 1


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THREE LAKES CROSSING

SITE PLAN
FIGURE 2

## 3. EXISTING CONDITIONS

### 3.1 Existing Roadway Characteristics

The major roadways and arterials serving the subject site are described below:

*Tumwater Boulevard SE:* is an east-west, two-lane minor arterial located south of the subject site. Travel lanes are approximately 12-feet in width. Paved shoulders approximately 7- to 11- feet in width are provided in the vicinity of the subject site along either side of the roadway. The posted speed limit is 35-mph.

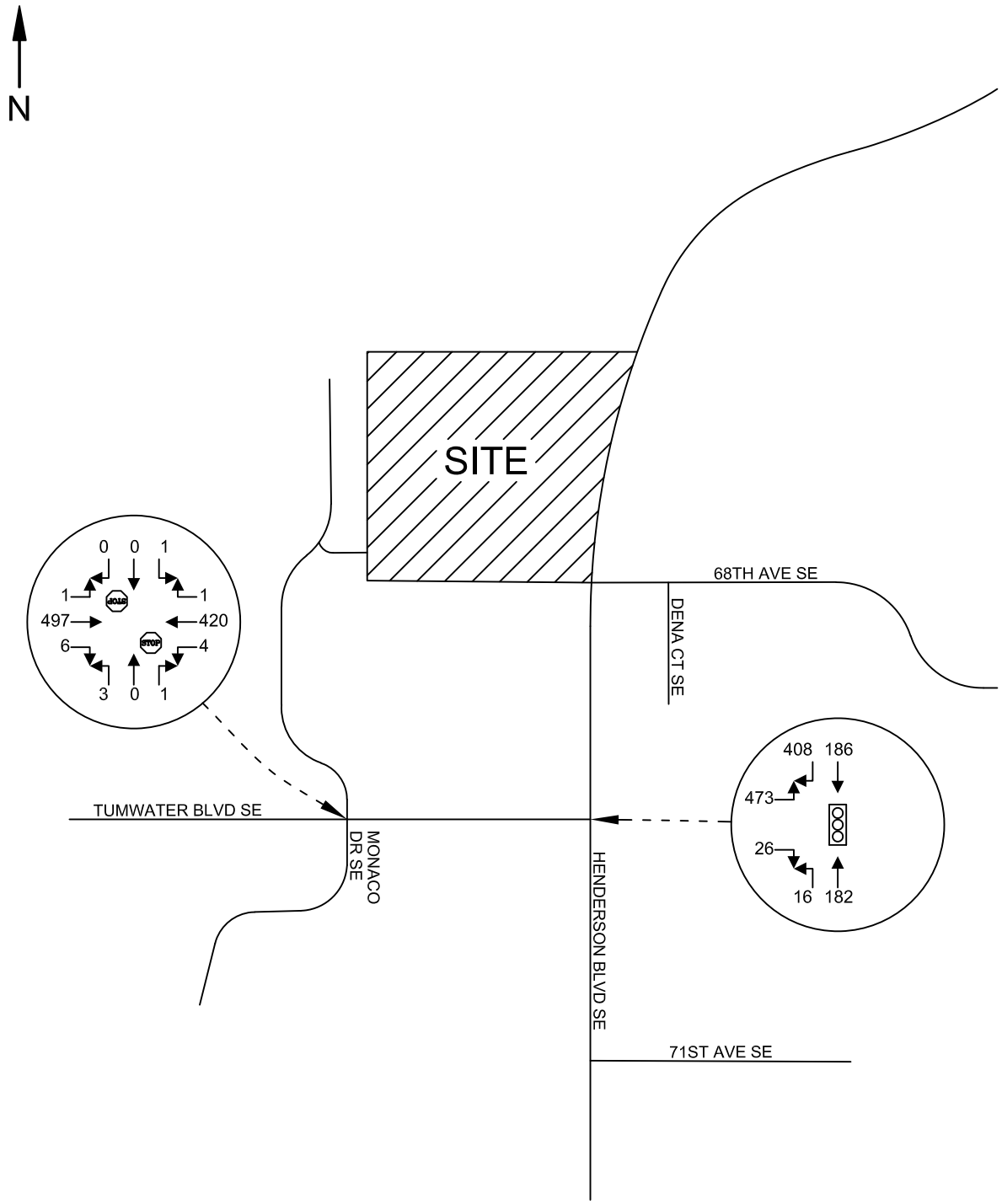
*Henderson Boulevard SE:* is a north-south, two-lane roadway that borders the subject site to the east. The roadway is designated as a minor arterial north of Tumwater Boulevard SE and an urban collector south of the intersection. Travel lanes are approximately 11- to 12-feet in width with additional turn-lanes provided at major intersections. Shoulder composition varies between paved segments varying in width to no formal treatment. The posted speed limit is 35-mph.

### 3.2 Non-Motorist Traffic

Non-motorist traffic was observed at the time of field counts. No non-motorist volumes were observed at the study intersection of Tumwater Boulevard SE & Henderson Boulevard SE during the PM peak hour. No pedestrians and three bicyclists were observed at Tumwater Boulevard SE & Monaco Drive SE during the PM peak hour. Non-motorist infrastructure is limited in the vicinity of the subject site. No significant increase in respect to non-motorist volumes is anticipated as a result of the proposed development.

### 3.3 Existing Peak Hour Volumes and Travel Patterns

Field data for this study was collected in September of 2021. Intersection data was collected at Tumwater Boulevard SE & Monaco Drive SE and Tumwater Boulevard SE & Henderson Boulevard SE. Data was obtained during the evening peak period between the hours of 4:00 PM – 6:00 PM, which generally translates to highest overall roadway volumes in a given 24-hour period. The one hour reflecting highest overall roadway volumes (peak hour) was then derived from these counts. Existing PM peak hour volumes observed on-site are illustrated in Figure 3. Full count sheets are attached in the appendix.

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THREE LAKES CROSSING

EXISTING PM PEAK HOUR VOLUMES

FIGURE 3

## 3.4 Level of Service

Baseline intersection delays were determined through the use of the *Highway Capacity Manual* 6th Edition. Capacity analysis is used to determine level of service (LOS) which is an established measure of congestion for transportation facilities. The range[1] for intersection level of service is LOS A to LOS F with the former indicating the best operating conditions with low control delays and the latter indicating the worst conditions with heavy control delays. Detailed descriptions of intersection LOS are given in the 2016 Highway Capacity Manual. Level of service calculations were made through the use of the *Synchro 11* analysis program. Delays presented represent overall weighted average delays for signalized control. For side-street, stop-controlled intersections, LOS is determined by the approach with the highest delay. Table 1 below portrays existing PM peak hour LOS delays for the key intersections of study.

**Table 1: Existing PM Peak Hour Level of Service**

*Delays given in seconds per vehicle*

| Intersection | Control | LOS | Delay |
|---|---|---|---|
| Tumwater Blvd SE & Monaco Dr SE | Stop | A | 6.2 |
| Tumwater Blvd SE & Henderson Blvd SE | Signal | C | 30.9 |

Existing PM peak hour delays are all shown to calculate within the LOS B or better range indicating stable operations during the critical peak hour of travel. All intersections meet the city of Tumwater's level of service standard of LOS D or better.

---

1 *Signalized Intersections - Level of Service*

| Level of Service | Control Delay per Vehicle (sec) |
|---|---|
| A | ≤10 |
| B | > 10 and ≤20 |
| C | > 20 and ≤35 |
| D | > 35 and ≤55 |
| E | > 55 and ≤80 |
| F | > 80 |

*Stop Controlled Intersections – Level of Service*

| Level of Service | Control Delay per Vehicle (sec) |
|---|---|
| A | ≤10 |
| B | > 10 and ≤15 |
| C | > 15 and ≤25 |
| D | > 25 and ≤35 |
| E | > 35 and ≤50 |
| F | > 50 |

Highway Capacity Manual, 6th Edition

### 3.5 Roadway Improvements

A review of the City of Tumwater's Six Year Transportation Improvement Program 2022-2027 indicates that improvement projects are planned in the vicinity. Descriptions and summaries of each project are provided in Table 2 below.

**Table 2: Transportation Improvement Projects**

| Name | Location | Improvement | Cost |
|---|---|---|---|
| Henderson Blvd Bridge (Map ID# 5) | Henderson Blvd | Design stages for future bridge widening or replacement to add capacity/non-motorist facilities | $250,000 |
| 93rd Ave / Kimmie Street Intersection (Map ID# 6) | 93rd Ave / Kimmie Street Intersection | ROW acquisition for future intersection improvements | $150,000 |
| Old Highway 99 Corridor Improvements (Map ID# 7) | 79th Ave to 73rd Ave | Design and construct urban road section and improvements determined from the Corridor Study. To include addition of traffic lanes, turn lanes, multi-modal facilities, etc. | $3,500,000 |
| Tumwater Blvd Interchange (Map ID# 9) | I-5 SB Ramps to I-5 NB Ramps | Design, acquire ROW, and construct improvements to Interchange | $6,650,000 |
| Deschutes Valley Trail (Map ID# 19-22) | E St to Pioneer Park | Construction of a paved walking / bicycling trail connection | $11,550,000 |

### 3.6 Transit Service

The Intercity Transit and TRPC regional bus schedules were reviewed in terms of transit available in the vicinity of the subject site. The nearest available transit service, provided 0.90 miles west at the intersection of Israel Road SE & Capitol Boulevard SE, is provided via Routes 2 and 12. Route 2 – Rainier, Tenino, Tumwater – provides service from Binghampton Street & Dakota Avenue to Tumwater Square from approximately 6:00 AM – 5:55 PM with 120-minute headways during peak travel hours. Route 12, L & I to Olympia Transit Center, provides service from the Olympia Transit Center to the Tumwater Labor & Industries Building. Other major destinations served by Route 12 include the Thurston County Courthouse and SPSCC. Weekday service is provided from approximately 5:39 AM to 8:25 PM with 30-minute headways during peak travel hours. Weekend service is provided from approximately 7:30 AM to 8:25 PM with approximately 30-minute headways. Refer to Intercity Transit and TRPC routes and schedules for more detailed information.

## 4. FUTURE TRAFFIC CONDITIONS

### 4.1 Trip Generation

Trip generation is defined as the number of vehicle movements that enter or exit a site during a designated time period such as a specific peak hour or an entire day. Data presented in this analysis was derived from the Institute of Transportation Engineer's (ITE) publication *Trip Generation,* 11th Edition. The proposed land use is to be defined as Single-Family Detached Housing (LUC 210). ITE average rates were used to determine trip ends with dwelling units used as the input variable. Table 3 below summarizes anticipated vehicular movements for the average weekday daily trips (AWDT), AM peak hour and PM peak hour. ITE Trip Generation sheets have been attached to the appendix for reference.

**Table 3: Project Trip Generation**

| Land Use | Size | ADT | AM Peak-Hour Trips | | | PM Peak-Hour Trips | | |
|---|---|---|---|---|---|---|---|---|
| | | | In | Out | Total | In | Out | Total |
| Single-Family Detached | 45 dwelling units | 424 | 8 | 23 | **31** | 26 | 16 | **42** |

Based on the data presented in Table 3, the project is anticipated to generate 424 new average weekday daily trips with 31 trips (8 in/23 out) occurring during the AM peak hour and 42 trips (26 in/16 out) occurring during the PM peak hour.

### 4.2 Trip Distribution and Assignment

Trip distribution describes the anticipated travel routes for inbound and outbound project traffic during the peak hour study period. The specific destinations and origins of the generated traffic primarily influences the key intersections, which will effectively receive the bulk of project impacts. Anticipated distribution percentages and travel routes for the PM peak hour are illustrated in Figure 4. Percentages are based on Thurston Regional Planning Council (TRPC) TAZ 232 Distribution Map. See appendix for complete TAZ map.

Moreover, project-generated trips anticipated to travel through the Tumwater I-5 Interchange to the south as identified from the TAZ 232 map are outlined in Figure A in the appendix. Approximately 2 project trips are identified to travel through the aforementioned interchanges during the critical PM peak hour.

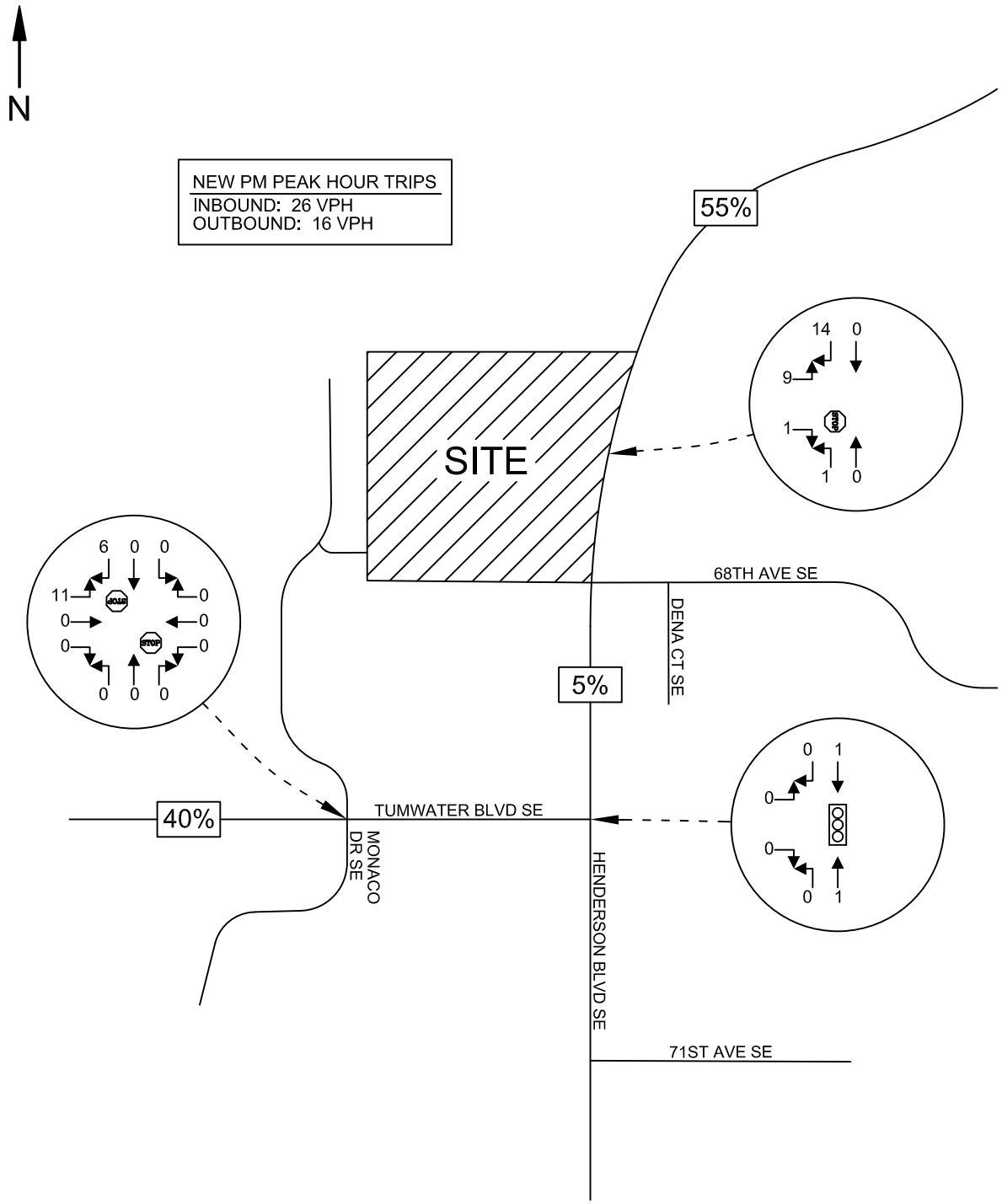
It should be noted that there is availability of access to the development by both the Tumwater Boulevard SE (via internal connection to southerly/westerly development) and Henderson Boulevard SE roadways.

### 4.3 Future Peak Hour Volumes

A 5-year horizon of 2026 was used for future traffic delay analysis. Forecast 2026 background traffic volumes were derived by applying a 1.5 percent compound annual growth rate to the existing volumes shown in Figure 3. This growth rate has been used for similar past projects in the area.

Moreover, pipeline volumes associated with the nearby Tumwater Boulevard Plat and Shinn Estates Plat projects were included in forecast analysis. It should be noted that Tumwater Boulevard Plat was under construction at the time of field counts. For this reason, trip generation associated with the proposed 26 single-family dwelling units was derived via ITE data and added to forecast volumes. PM peak hour pipeline volumes are illustrated in Figures 5A and 5B. Pipeline volumes illustrated in 5A are representative of forecast background volumes and do not include internal connection to the proposed Three Lakes Crossing development. Thereby, no access to Henderson Boulevard SE is illustrated. Pipeline volumes illustrated in Figure 5B include internal connection to the proposed project and redistribute traffic through the proposed Henderson Boulevard SE access.

Forecast 2026 PM peak hour volumes without and with project-generated traffic are illustrated in Figures 6 and 7.

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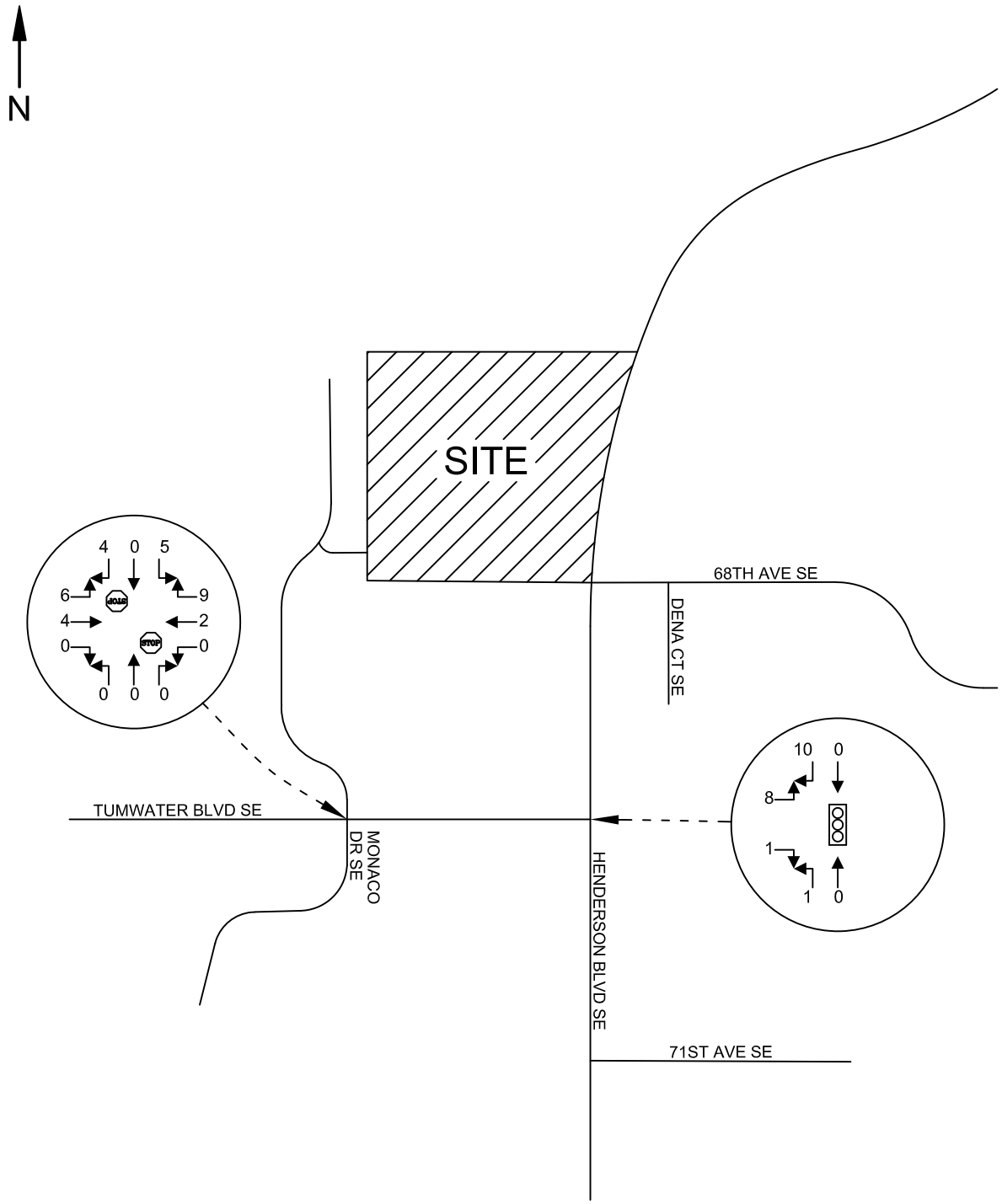
THREE LAKES CROSSING

PM PEAK HOUR TRIP DISTRIBUTION & ASSIGNMENT
FIGURE 4

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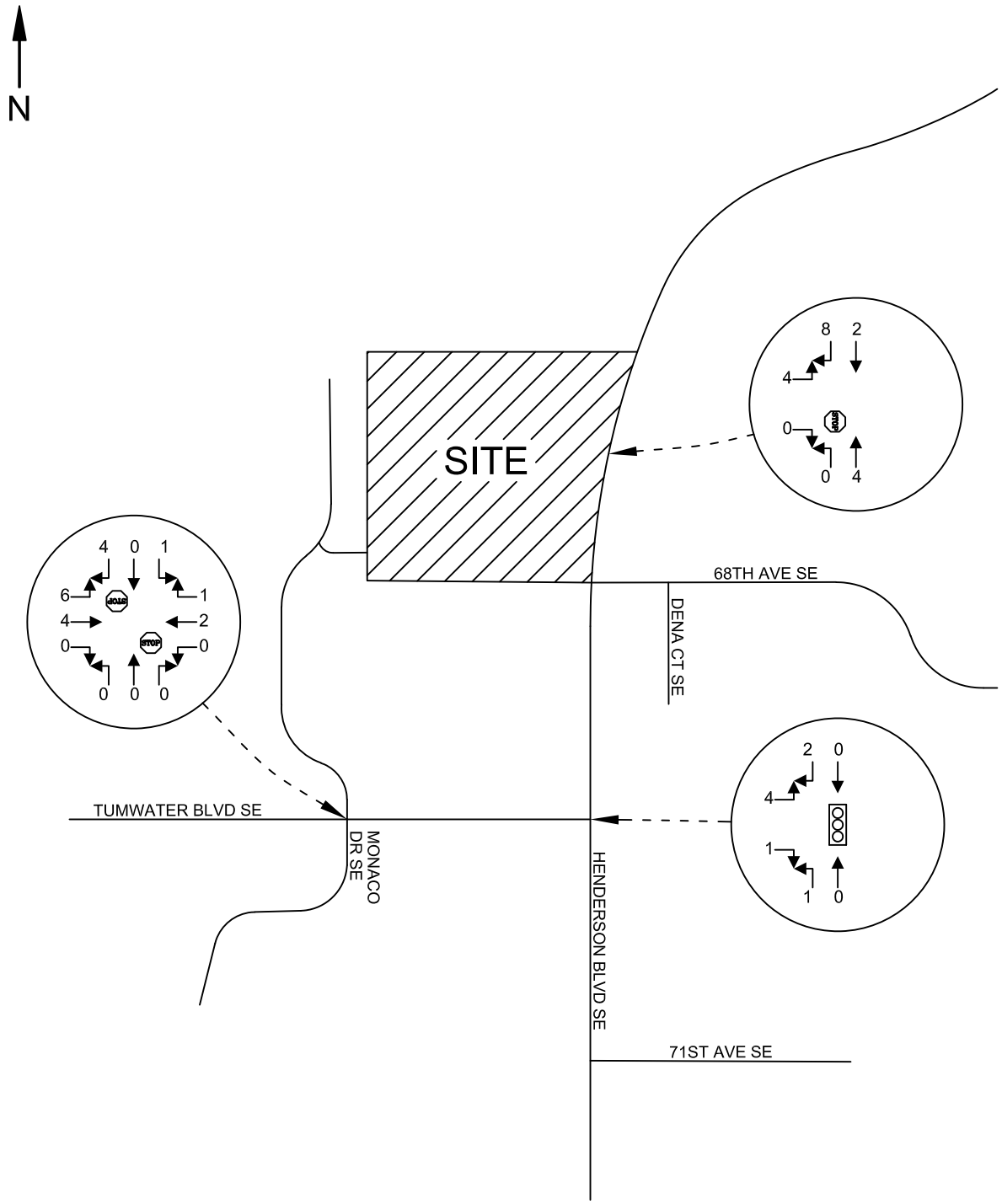
THREE LAKES CROSSING

PM PEAK HOUR PIPELINE VOLUMES: NO INTERNAL CONNECTION

FIGURE 5A

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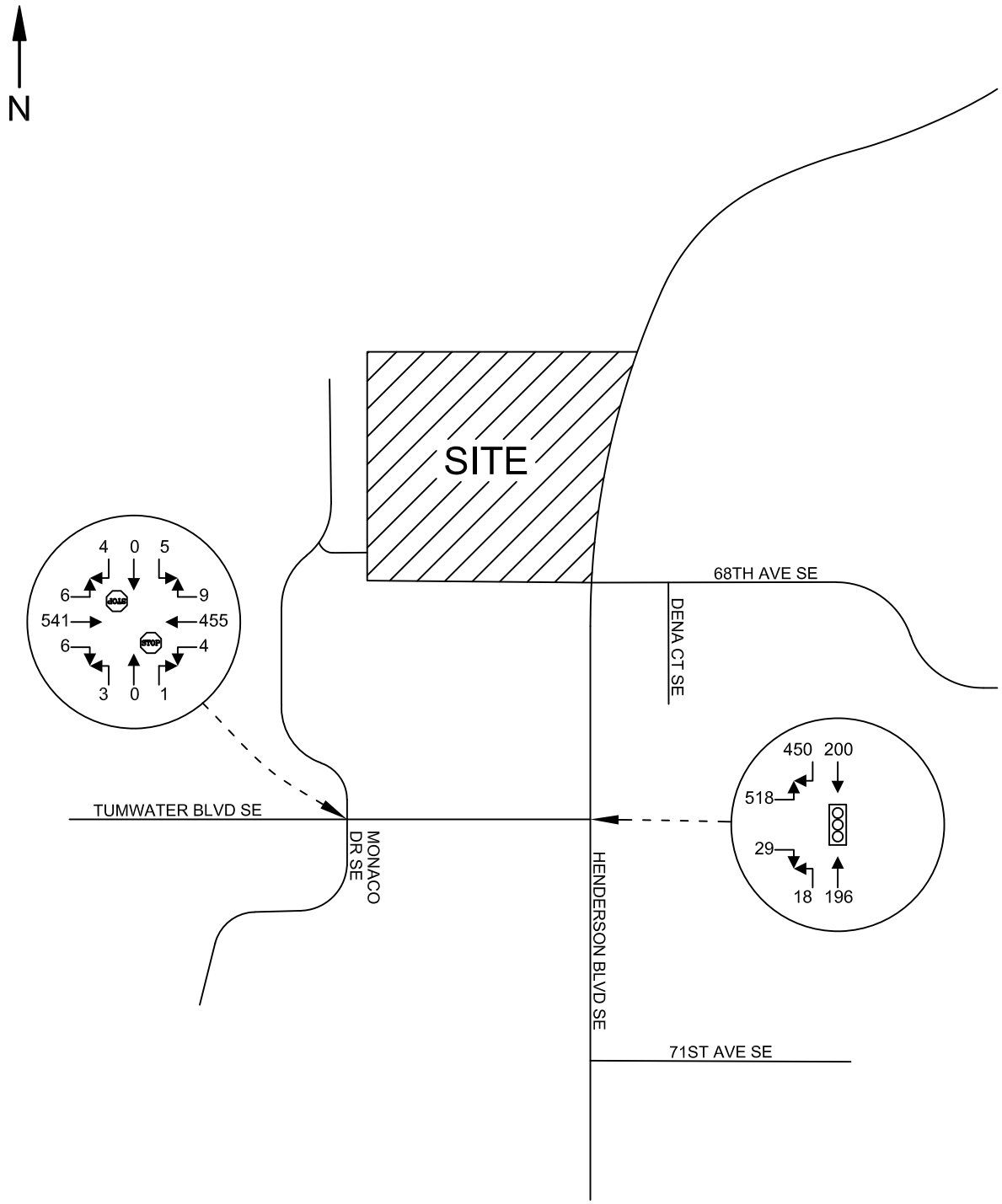
THREE LAKES CROSSING

PM PEAK HOUR PIPELINE VOLUMES: INTERNAL CONNECTION

FIGURE 5B

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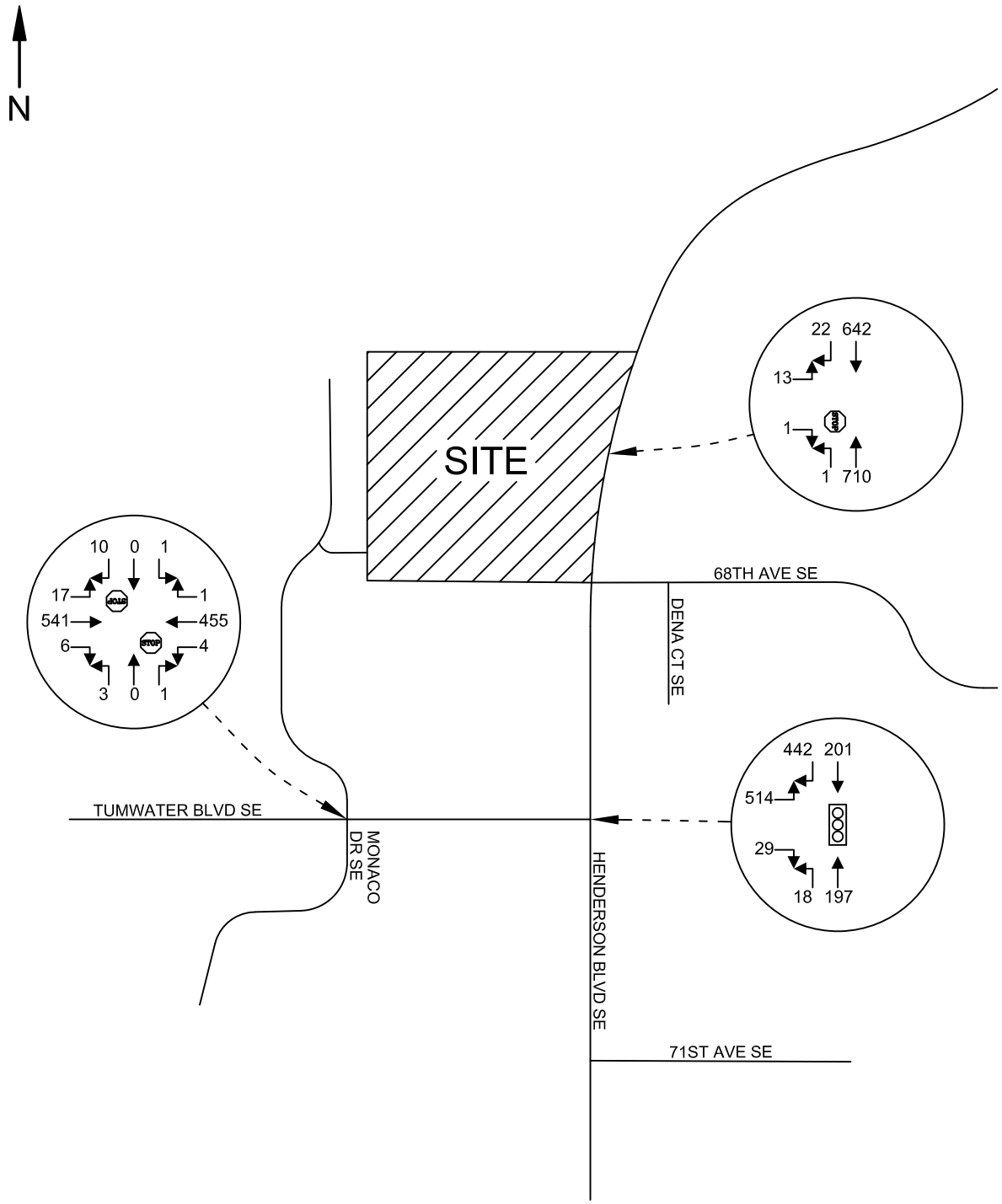
THREE LAKES CROSSING

FORECAST 2026 PM PEAK HOUR BACKGROUND VOLUMES

FIGURE 6

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THREE LAKES CROSSING

FORECAST 2026 PM PEAK HOUR VOLUMES WITH PROJECT

FIGURE 7

## 4.4 Future Level of Service

A level of service analysis was made of the future PM peak hour volumes without (background) and with project-generated trips. Results for intersection delay conditions were again determined using the *Synchro 11* analysis program. A summary of the results are shown in Table 4 for the forecast 2026 PM peak travel hour.

**Table 4: Forecast 2026 PM Peak Hour Level of Service**

*Delays given in seconds per vehicle*

| | | *Background* | | *With Project* | |
|---|---|---|---|---|---|
| **Intersection** | **Control** | **LOS** | **Delay** | **LOS** | **Delay** |
| Tumwater Blvd SE & Monaco Dr SE | Stop | C | 21.2 | C | 22.2 |
| Tumwater Blvd SE & Henderson Blvd SE | Signal | D | 48.4 | D | 45.5 |
| Project Access & Henderson Blvd SE | Stop | - | - | D | 32.9 |

Forecast 2026 PM peak hour delays are shown to operate at LOS D or better without or with the addition of project traffic. All intersections meet the city of Tumwater's level of service standard of LOS D or better.

It should be noted that Tumwater Boulevard SE & Henderson Boulevard SE is shown to operate with lesser delays with project-generated traffic than without. This is due to the diversion of a portion of pipeline traffic to the proposed project access on Henderson Boulevard SE, subsequently no longer traveling through the intersection.

## 4.5 Left Turn Lane Warrant

Left turn lanes are a means of providing necessary storage space for left turning vehicles at intersections. For this impact study, procedures prescribed by the WSDOT Design Manual Exhibit 1310-7a were used to ascertain storage requirements at the newly proposed access location on Henderson Boulevard SE and at Monaco Drive SE & Tumwater Boulevard SE. Based on forecast 2026 PM peak hour volumes with project traffic – a left turn lane *would not be warranted* at either intersection. Refer to the appendix for the warrant nomographs.

## 5. SUMMARY

The Three Lakes Crossing project proposes to construct 45 new single-family units within in the city of Tumwater. The subject site, bordered to the east by Henderson Boulevard SE, is located on a cumulative 16.66-acres within tax parcel #'s: 1270132-0105; 7930000-0100; & -0101. Access to the site is to be provided via one driveway extending west from Henderson Boulevard SE. Moreover, internal connection with the development to the southwest will provide access to Tumwater Boulevard SE. Refer to Figure 2 for the proposed access/roadway configuration and lot layout.

Based on ITE data the project would be anticipated to generate 424 new average weekday daily trips with 31 AM peak hour trips (8 in / 23 out) and 42 new PM peak hour trips (26 in / 16 out). Existing level of service (LOS) is summarized in Table 1 and indicates intersections operating with delays in the LOS C or better range. A five-year horizon of 2026 was utilized for forecast analyses, which included a compound annual growth rate of 1.5 percent and the addition of pipeline volumes. Forecast 2026 PM peak hour level of service without and with the addition of project generated traffic is provided in Table 4. All intersections of study are shown to operate with LOS D or better delays during the PM peak hour without or with the addition of project-generated traffic. All intersections are shown to meet the city of Tumwater's LOS standards.

Based on the analysis above, the following mitigation is required for the Three Lakes Crossing project.

1. Pay Traffic Impact Fees (TIF) as required by the city of Tumwater. Impact fees are collected at $3,918.63 per single-family dwelling unit in accordance to the City's 2021 Fee Resolution schedule. Therefore, the estimated TIF is collected at:

   45 units x $3,918.63 = $176,338.35

2. Pay Traffic Impact Fees (TIF) as required by the SEPA Mitigation Fee. Impact fees are collected at $4,219.00 per trip that travels through the I-5 Tumwater Interchanges located south of the subject site. Trip ends, as illustrated in Figure A in the appendix, were derived via the TRPC TAZ 232 Distribution Map. The estimated SEPA Mitigation Fee is collected at:

   2 trips x $4,219.00 = $8,438.00

No other mitigation is identified at this time.

# THREE LAKES CROSSING
# TRAFFIC IMPACT ANALYSIS

*APPENDIX*

# Heath & Associates

PO Box 397
Puyallup, WA 98371

File Name : 4722b
Site Code : 00004722
Start Date : 9/8/2021
Page No : 1

Groups Printed- Passenger + - Heavy

| | Monaco Dr. SE Southbound | | | | Tumwater Blvd SE Westbound | | | | Monaco Dr. SE Northbound | | | | Tumwater Blvd SE Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Int. Total |
| 04:00 PM | 0 | 0 | 1 | 1 | 0 | 88 | 0 | 88 | 0 | 0 | 0 | 0 | 2 | 88 | 0 | 90 | 179 |
| 04:15 PM | 0 | 0 | 0 | 0 | 0 | 91 | 1 | 92 | 1 | 0 | 0 | 1 | 1 | 86 | 0 | 87 | 180 |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 101 | 1 | 102 | 0 | 0 | 2 | 2 | 1 | 114 | 0 | 115 | 219 |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | 119 | 1 | 120 | 1 | 0 | 0 | 1 | 3 | 115 | 0 | 118 | 239 |
| Total | 0 | 0 | 1 | 1 | 0 | 399 | 3 | 402 | 2 | 0 | 2 | 4 | 7 | 403 | 0 | 410 | 817 |
| | | | | | | | | | | | | | | | | | |
| 05:00 PM | 0 | 0 | 1 | 1 | 0 | 101 | 0 | 101 | 0 | 0 | 0 | 0 | 2 | 142 | 1 | 145 | 247 |
| 05:15 PM | 0 | 0 | 0 | 0 | 0 | 99 | 2 | 101 | 0 | 0 | 1 | 1 | 0 | 126 | 0 | 126 | 228 |
| 05:30 PM | 0 | 0 | 0 | 0 | 0 | 83 | 0 | 83 | 1 | 0 | 1 | 2 | 0 | 101 | 0 | 101 | 186 |
| 05:45 PM | 0 | 0 | 0 | 0 | 0 | 85 | 1 | 86 | 0 | 0 | 0 | 0 | 1 | 82 | 0 | 83 | 169 |
| Total | 0 | 0 | 1 | 1 | 0 | 368 | 3 | 371 | 1 | 0 | 2 | 3 | 3 | 451 | 1 | 455 | 830 |
| | | | | | | | | | | | | | | | | | |
| Grand Total | 0 | 0 | 2 | 2 | 0 | 767 | 6 | 773 | 3 | 0 | 4 | 7 | 10 | 854 | 1 | 865 | 1647 |
| Apprch % | 0 | 0 | 100 | | 0 | 99.2 | 0.8 | | 42.9 | 0 | 57.1 | | 1.2 | 98.7 | 0.1 | | |
| Total % | 0 | 0 | 0.1 | 0.1 | 0 | 46.6 | 0.4 | 46.9 | 0.2 | 0 | 0.2 | 0.4 | 0.6 | 51.9 | 0.1 | 52.5 | |
| Passenger + | 0 | 0 | 1 | 1 | 0 | 746 | 6 | 752 | 3 | 0 | 4 | 7 | 10 | 841 | 1 | 852 | 1612 |
| % Passenger + | 0 | 0 | 50 | 50 | 0 | 97.3 | 100 | 97.3 | 100 | 0 | 100 | 100 | 100 | 98.5 | 100 | 98.5 | 97.9 |
| Heavy | 0 | 0 | 1 | 1 | 0 | 21 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 13 | 35 |
| % Heavy | 0 | 0 | 50 | 50 | 0 | 2.7 | 0 | 2.7 | 0 | 0 | 0 | 0 | 0 | 1.5 | 0 | 1.5 | 2.1 |

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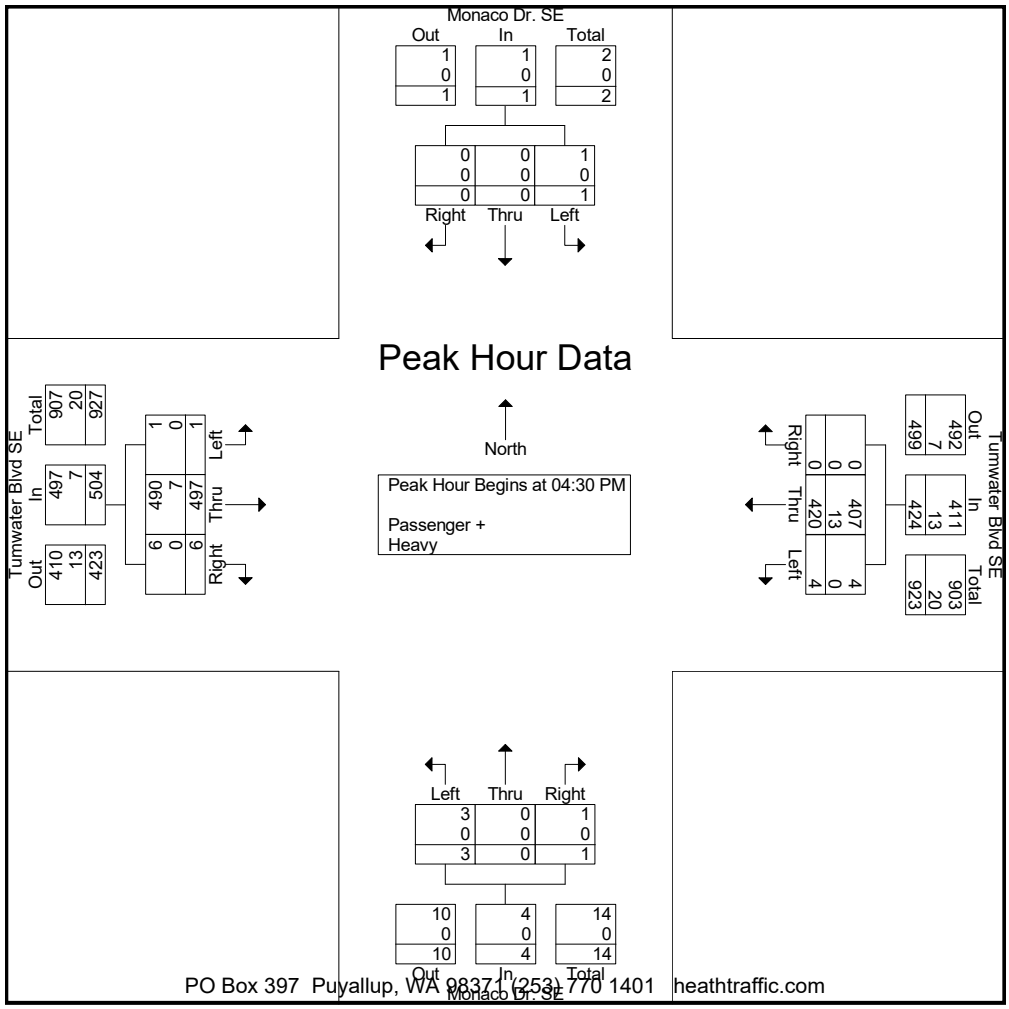
PO Box 397
Puyallup, WA 98371

File Name : 4722b
Site Code : 00004722
Start Date : 9/8/2021
Page No : 2

| | Monaco Dr. SE Southbound | | | | Tumwater Blvd SE Westbound | | | | Monaco Dr. SE Northbound | | | | Tumwater Blvd SE Eastbound | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Right | Thru | Left | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:30 PM | | | | | | | | | | | | | | | | | |
| 04:30 PM | 0 | 0 | 0 | 0 | 0 | 101 | 1 | 102 | 0 | 0 | **2** | **2** | 1 | 114 | 0 | 115 | 219 |
| 04:45 PM | 0 | 0 | 0 | 0 | 0 | **119** | 1 | **120** | **1** | 0 | 0 | 1 | **3** | 115 | 0 | 118 | 239 |
| 05:00 PM | 0 | 0 | **1** | **1** | 0 | 101 | 0 | 101 | 0 | 0 | 0 | 0 | 2 | **142** | **1** | **145** | **247** |
| 05:15 PM | 0 | 0 | 0 | 0 | 0 | 99 | **2** | 101 | 0 | 0 | 1 | 1 | 0 | 126 | 0 | 126 | 228 |
| Total Volume | 0 | 0 | 1 | 1 | 0 | 420 | 4 | 424 | 1 | 0 | 3 | 4 | 6 | 497 | 1 | 504 | 933 |
| % App. Total | 0 | 0 | 100 | | 0 | 99.1 | 0.9 | | 25 | 0 | 75 | | 1.2 | 98.6 | 0.2 | | |
| PHF | .000 | .000 | .250 | .250 | .000 | .882 | .500 | .883 | .250 | .000 | .375 | .500 | .500 | .875 | .250 | .869 | .944 |
| Passenger + | 0 | 0 | 1 | 1 | 0 | 407 | 4 | 411 | 1 | 0 | 3 | 4 | 6 | 490 | 1 | 497 | 913 |
| % Passenger + | 0 | 0 | 100 | 100 | 0 | 96.9 | 100 | 96.9 | 100 | 0 | 100 | 100 | 100 | 98.6 | 100 | 98.6 | 97.9 |
| Heavy | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 7 | 20 |
| % Heavy | 0 | 0 | 0 | 0 | 0 | 3.1 | 0 | 3.1 | 0 | 0 | 0 | 0 | 0 | 1.4 | 0 | 1.4 | 2.1 |



# Heath & Associates

PO Box 397
Puyallup, WA 98371

File Name : 4722a
Site Code : 00004722
Start Date : 9/8/2021
Page No : 1

Groups Printed- Passenger + - Heavy

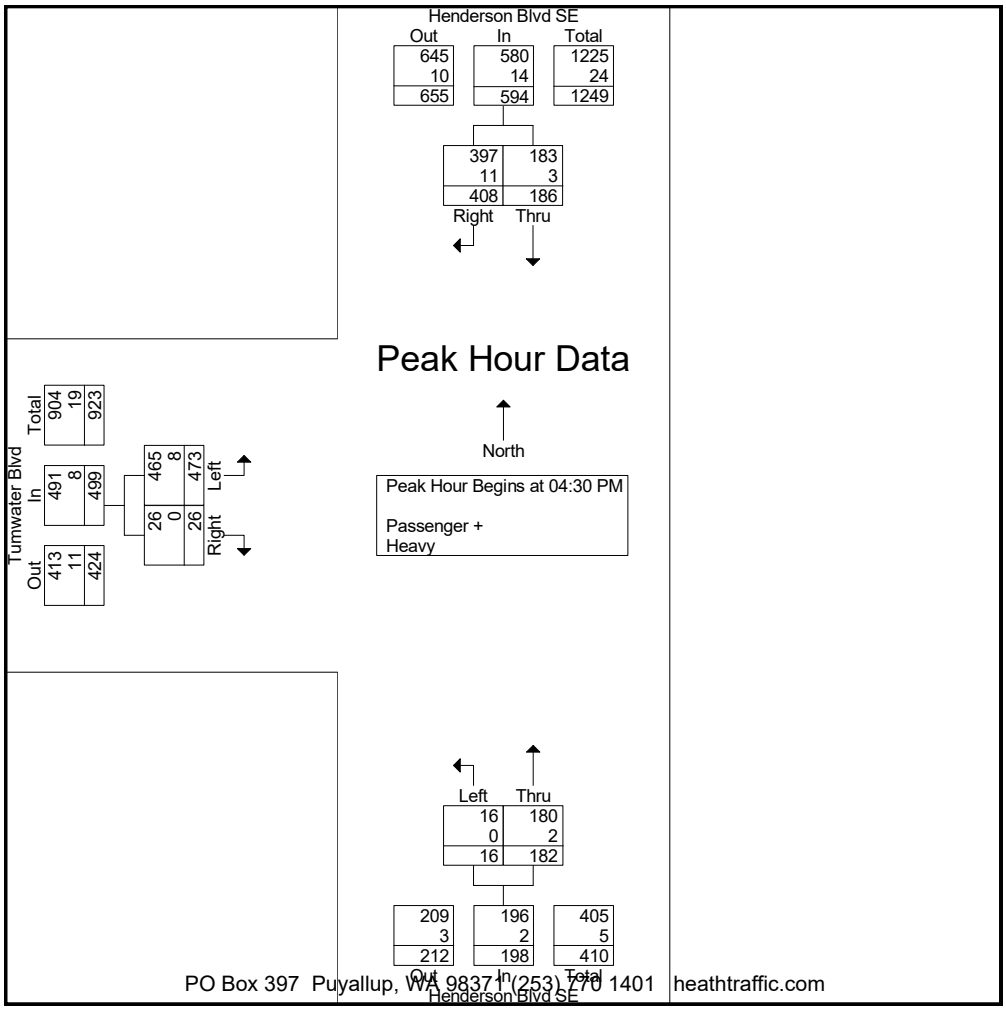
| | Henderson Blvd SE Southbound | | | Henderson Blvd SE Northbound | | | Tumwater Blvd Eastbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | App. Total | Thru | Left | App. Total | Right | Left | App. Total | Int. Total |
| 04:00 PM | 83 | 44 | 127 | 53 | 4 | 57 | 4 | 81 | 85 | 269 |
| 04:15 PM | 92 | 37 | 129 | 48 | 1 | 49 | 0 | 84 | 84 | 262 |
| 04:30 PM | 94 | 36 | 130 | 42 | 5 | 47 | 3 | 113 | 116 | 293 |
| 04:45 PM | 114 | 53 | 167 | 42 | 6 | 48 | 6 | 102 | 108 | 323 |
| Total | 383 | 170 | 553 | 185 | 16 | 201 | 13 | 380 | 393 | 1147 |
| | | | | | | | | | | |
| 05:00 PM | 103 | 33 | 136 | 51 | 2 | 53 | 9 | 138 | 147 | 336 |
| 05:15 PM | 97 | 64 | 161 | 47 | 3 | 50 | 8 | 120 | 128 | 339 |
| 05:30 PM | 81 | 48 | 129 | 31 | 3 | 34 | 5 | 101 | 106 | 269 |
| 05:45 PM | 79 | 35 | 114 | 41 | 4 | 45 | 4 | 73 | 77 | 236 |
| Total | 360 | 180 | 540 | 170 | 12 | 182 | 26 | 432 | 458 | 1180 |
| | | | | | | | | | | |
| Grand Total | 743 | 350 | 1093 | 355 | 28 | 383 | 39 | 812 | 851 | 2327 |
| Apprch % | 68 | 32 | | 92.7 | 7.3 | | 4.6 | 95.4 | | |
| Total % | 31.9 | 15 | 47 | 15.3 | 1.2 | 16.5 | 1.7 | 34.9 | 36.6 | |
| Passenger + | 729 | 344 | 1073 | 348 | 28 | 376 | 39 | 797 | 836 | 2285 |
| % Passenger + | 98.1 | 98.3 | 98.2 | 98 | 100 | 98.2 | 100 | 98.2 | 98.2 | 98.2 |
| Heavy | 14 | 6 | 20 | 7 | 0 | 7 | 0 | 15 | 15 | 42 |
| % Heavy | 1.9 | 1.7 | 1.8 | 2 | 0 | 1.8 | 0 | 1.8 | 1.8 | 1.8 |

# Heath & Associates

PO Box 397
Puyallup, WA 98371

File Name : 4722a
Site Code : 00004722
Start Date : 9/8/2021
Page No : 2

| | Henderson Blvd SE Southbound | | | Henderson Blvd SE Northbound | | | Tumwater Blvd Eastbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start Time | Right | Thru | App. Total | Thru | Left | App. Total | Right | Left | App. Total | Int. Total |
| Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1 | | | | | | | | | | |
| Peak Hour for Entire Intersection Begins at 04:30 PM | | | | | | | | | | |
| 04:30 PM | 94 | 36 | 130 | 42 | 5 | 47 | 3 | 113 | 116 | 293 |
| 04:45 PM | **114** | 53 | **167** | 42 | **6** | 48 | 6 | 102 | 108 | 323 |
| 05:00 PM | 103 | 33 | 136 | **51** | 2 | **53** | **9** | **138** | **147** | 336 |
| 05:15 PM | 97 | **64** | 161 | 47 | 3 | 50 | 8 | 120 | 128 | **339** |
| Total Volume | 408 | 186 | 594 | 182 | 16 | 198 | 26 | 473 | 499 | 1291 |
| % App. Total | 68.7 | 31.3 | | 91.9 | 8.1 | | 5.2 | 94.8 | | |
| PHF | .895 | .727 | .889 | .892 | .667 | .934 | .722 | .857 | .849 | .952 |
| Passenger + | 397 | 183 | 580 | 180 | 16 | 196 | 26 | 465 | 491 | 1267 |
| % Passenger + | 97.3 | 98.4 | 97.6 | 98.9 | 100 | 99.0 | 100 | 98.3 | 98.4 | 98.1 |
| Heavy | 11 | 3 | 14 | 2 | 0 | 2 | 0 | 8 | 8 | 24 |
| % Heavy | 2.7 | 1.6 | 2.4 | 1.1 | 0 | 1.0 | 0 | 1.7 | 1.6 | 1.9 |



# Single-Family Detached Housing
(210)

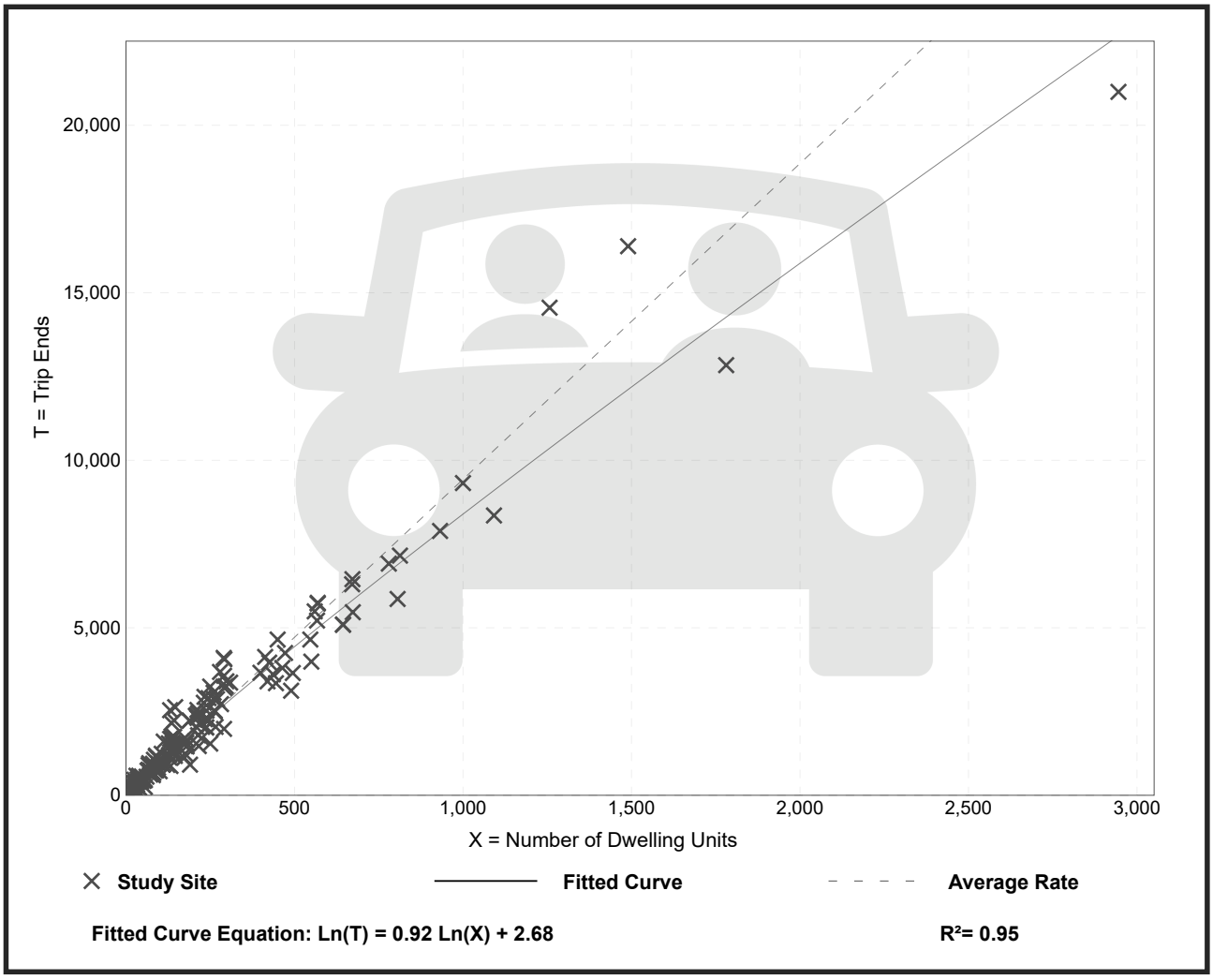
**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday**

**Setting/Location:** **General Urban/Suburban**
Number of Studies: 174
Avg. Num. of Dwelling Units: 246
Directional Distribution: 50% entering, 50% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 9.43 | 4.45 - 22.61 | 2.13 |

## Data Plot and Equation

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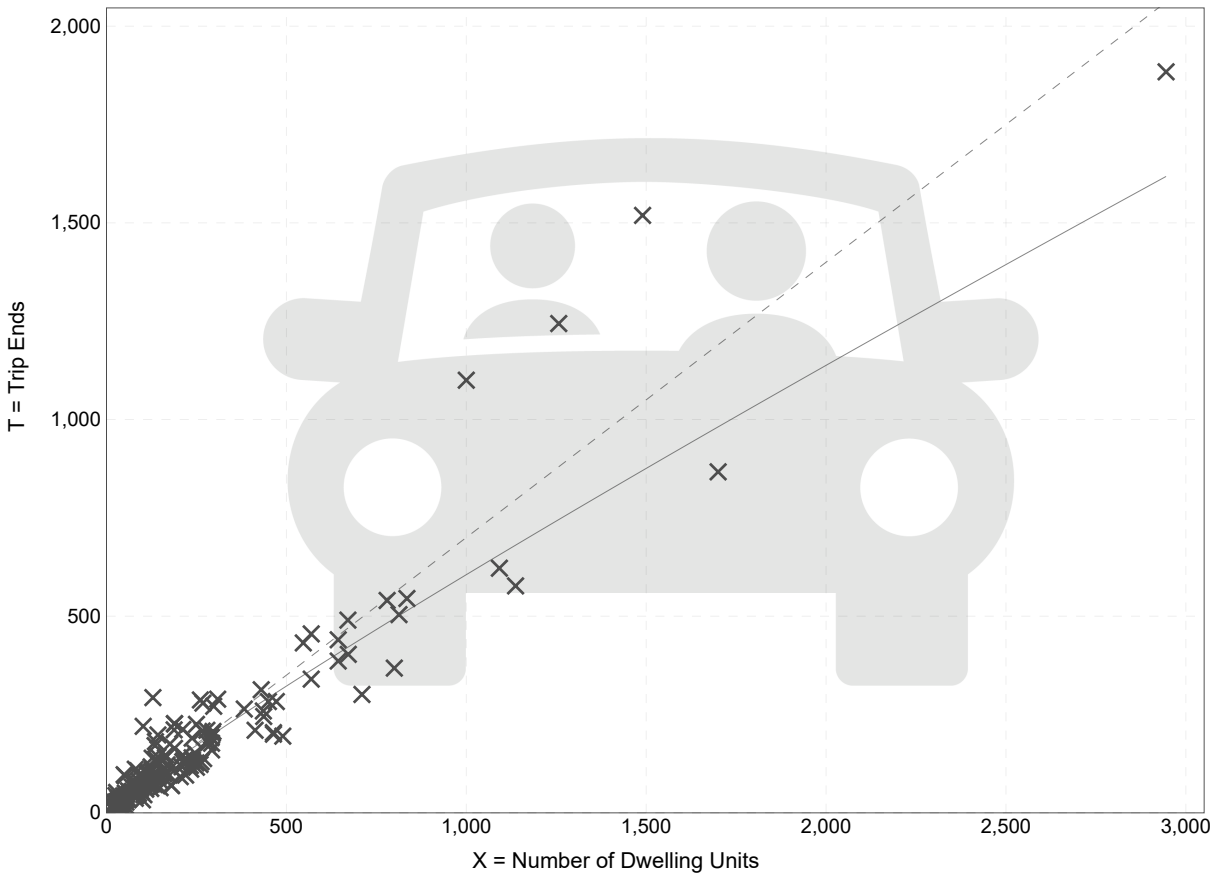
# Single-Family Detached Housing
(210)

**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday,**
**Peak Hour of Adjacent Street Traffic,**
**One Hour Between 7 and 9 a.m.**
**Setting/Location:** **General Urban/Suburban**
Number of Studies: 192
Avg. Num. of Dwelling Units: 226
Directional Distribution: 26% entering, 74% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.70 | 0.27 - 2.27 | 0.24 |

## Data Plot and Equation




**Fitted Curve Equation: Ln(T) = 0.91 Ln(X) + 0.12** **$R^2$= 0.90**

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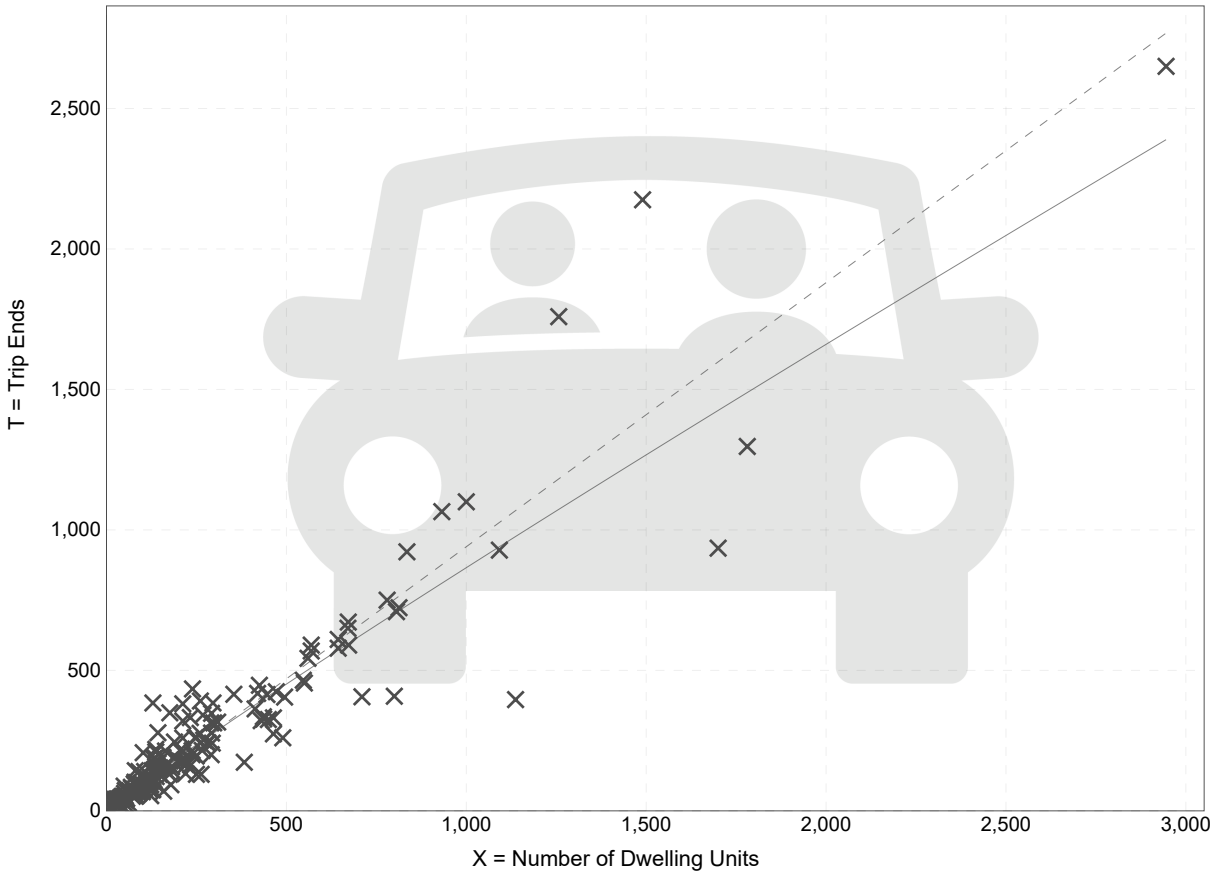
# Single-Family Detached Housing
(210)

**Vehicle Trip Ends vs:** **Dwelling Units**
**On a:** **Weekday,**
**Peak Hour of Adjacent Street Traffic,**
**One Hour Between 4 and 6 p.m.**
**Setting/Location:** **General Urban/Suburban**
Number of Studies: 208
Avg. Num. of Dwelling Units: 248
Directional Distribution: 63% entering, 37% exiting

## Vehicle Trip Generation per Dwelling Unit

| Average Rate | Range of Rates | Standard Deviation |
|---|---|---|
| 0.94 | 0.35 - 2.98 | 0.31 |

## Data Plot and Equation




**Fitted Curve Equation: Ln(T) = 0.94 Ln(X) + 0.27** **$R^2$= 0.92**

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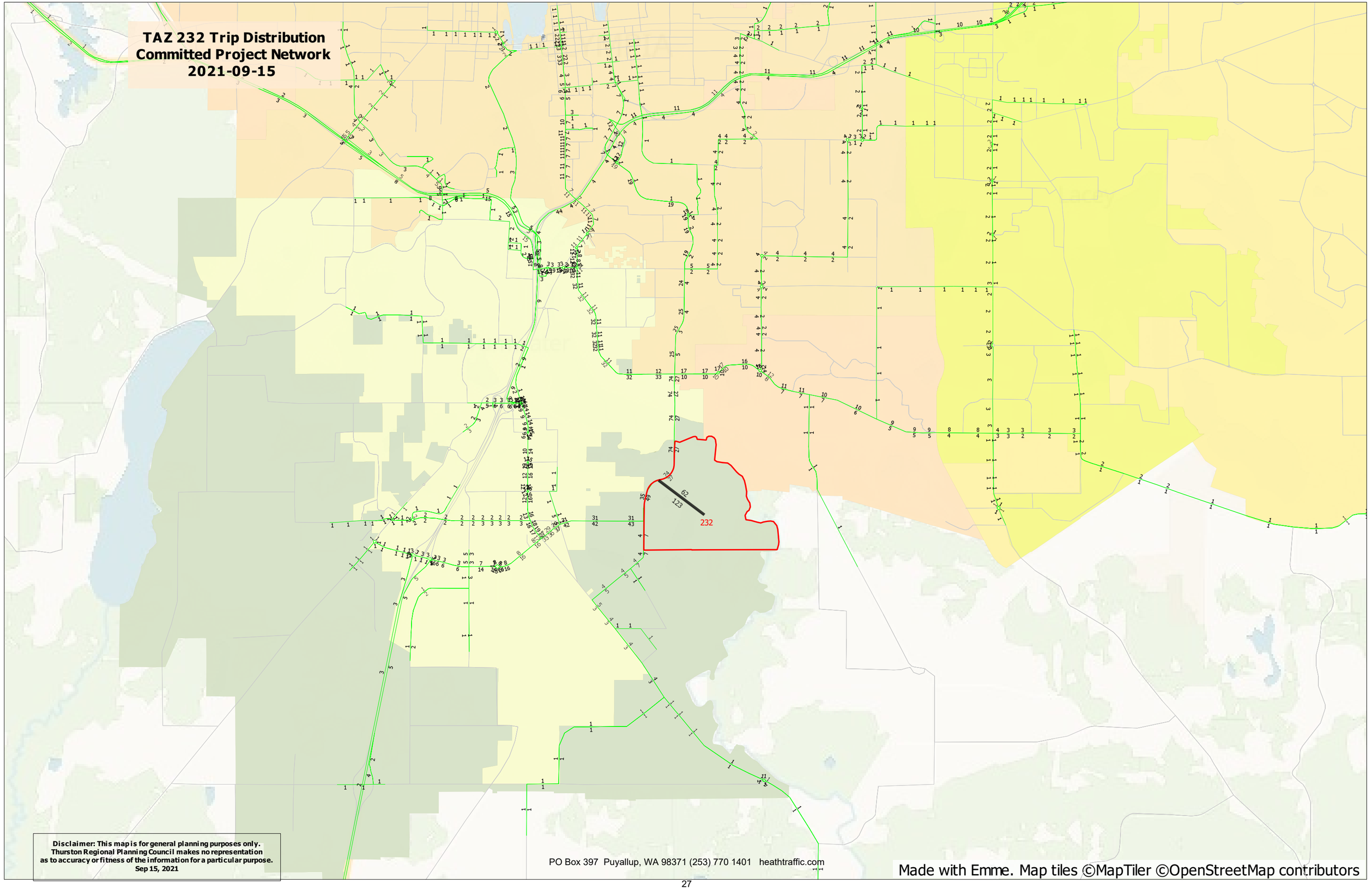
**TAZ 232 Trip Distribution**
**Committed Project Network**
**2021-09-15**




**Disclaimer: This map is for general planning purposes only. Thurston Regional Planning Council makes no representation as to accuracy or fitness of the information for a particular purpose.**
**Sep 15, 2021**

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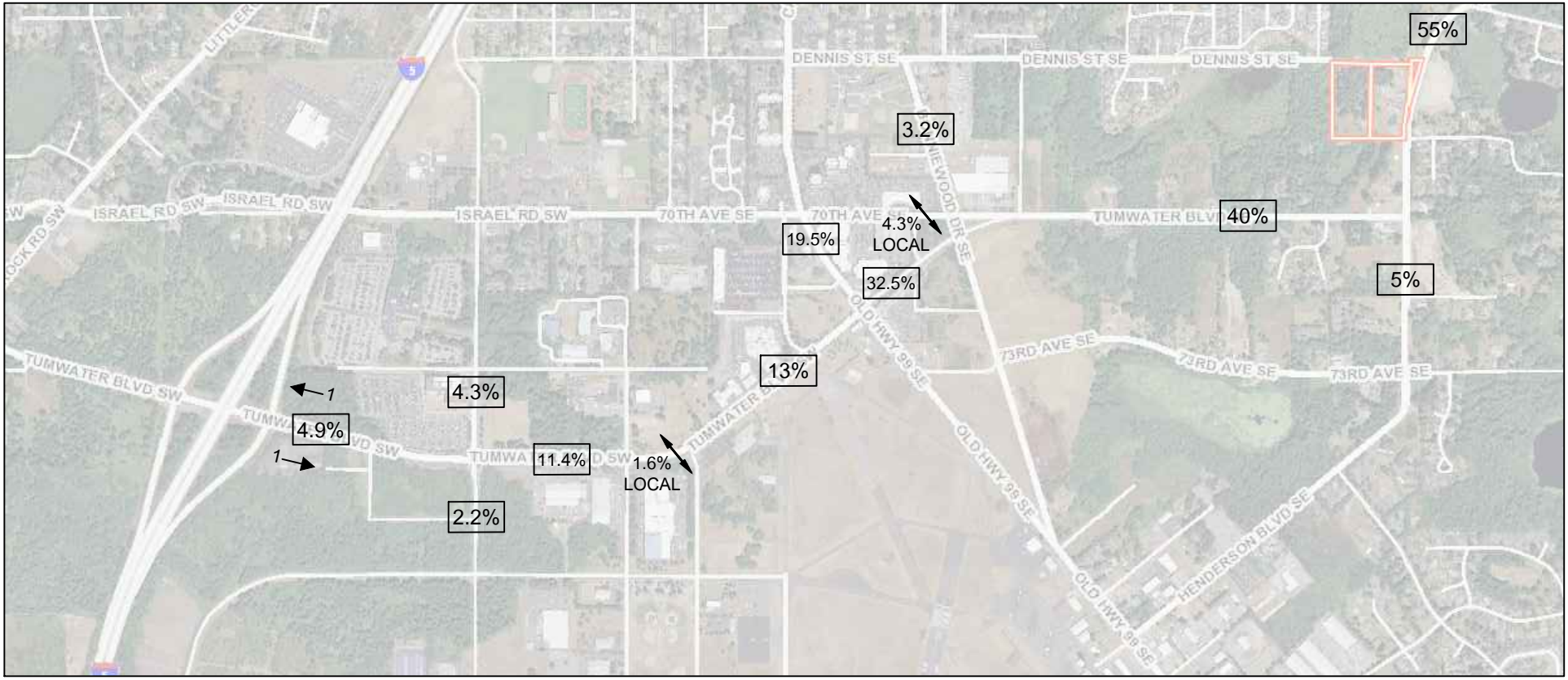
N

NEW PM PEAK HOUR TRIPS
INBOUND: 26 VPH
OUTBOUND: 16 VPH




HEATH & ASSOCIATES
TRAFFIC AND CIVIL ENGINEERING

THREE LAKES CROSSING
PM PEAK HOUR TRIP DISTRIBUTION & ASSIGNMENT
FIGURE A

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.1 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↕ | | | ↕ | | | ↕ | | | ↕ | |
| Traffic Vol, veh/h | 1 | 497 | 6 | 4 | 420 | 0 | 3 | 0 | 1 | 1 | 0 | 0 |
| Future Vol, veh/h | 1 | 497 | 6 | 4 | 420 | 0 | 3 | 0 | 1 | 1 | 0 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| 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, % | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mvmt Flow | 1 | 529 | 6 | 4 | 447 | 0 | 3 | 0 | 1 | 1 | 0 | 0 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 447 | 0 | 0 | 535 | 0 | 0 | 989 | 989 | 532 | 990 | 992 | 447 |
| Stage 1 | - | - | - | - | - | - | 534 | 534 | - | 455 | 455 | - |
| Stage 2 | - | - | - | - | - | - | 455 | 455 | - | 535 | 537 | - |
| Critical Hdwy | 4.11 | - | - | 4.11 | - | - | 7.11 | 6.51 | 6.21 | 7.11 | 6.51 | 6.21 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Follow-up Hdwy | 2.209 | - | - | 2.209 | - | - | 3.509 | 4.009 | 3.309 | 3.509 | 4.009 | 3.309 |
| Pot Cap-1 Maneuver | 1119 | - | - | 1038 | - | - | 227 | 248 | 549 | 226 | 247 | 614 |
| Stage 1 | - | - | - | - | - | - | 532 | 526 | - | 587 | 570 | - |
| Stage 2 | - | - | - | - | - | - | 587 | 570 | - | 531 | 524 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1119 | - | - | 1038 | - | - | 226 | 247 | 549 | 224 | 246 | 614 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 226 | 247 | - | 224 | 246 | - |
| Stage 1 | - | - | - | - | - | - | 531 | 525 | - | 586 | 567 | - |
| Stage 2 | - | - | - | - | - | - | 584 | 567 | - | 529 | 523 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0 | 0.1 | 18.8 | 21.1 |
| HCM LOS | | | C | C |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 265 | 1119 | - | - | 1038 | - | - | 224 |
| HCM Lane V/C Ratio | 0.016 | 0.001 | - | - | 0.004 | - | - | 0.005 |
| HCM Control Delay (s) | 18.8 | 8.2 | 0 | - | 8.5 | 0 | - | 21.1 |
| HCM Lane LOS | C | A | A | - | A | A | - | C |
| HCM 95th %tile Q(veh) | 0 | 0 | - | - | 0 | - | - | 0 |



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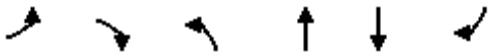

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 473 | 26 | 16 | 182 | 186 | 408 |
| Future Volume (veh/h) | 473 | 26 | 16 | 182 | 186 | 408 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 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 | 1870 | 1885 | 1885 | 1885 | 1870 | 1856 |
| Adj Flow Rate, veh/h | 498 | 27 | 17 | 192 | 196 | 429 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 |
| Percent Heavy Veh, % | 2 | 1 | 1 | 1 | 2 | 3 |
| Cap, veh/h | 568 | 31 | 23 | 261 | 549 | 462 |
| Arrive On Green | 0.34 | 0.34 | 0.15 | 0.15 | 0.29 | 0.29 |
| Sat Flow, veh/h | 1676 | 91 | 153 | 1725 | 1870 | 1572 |
| Grp Volume(v), veh/h | 526 | 0 | 209 | 0 | 196 | 429 |
| Grp Sat Flow(s),veh/h/ln | 1770 | 0 | 1878 | 0 | 1870 | 1572 |
| Q Serve(g_s), s | 17.4 | 0.0 | 6.6 | 0.0 | 5.2 | 16.5 |
| Cycle Q Clear(g_c), s | 17.4 | 0.0 | 6.6 | 0.0 | 5.2 | 16.5 |
| Prop In Lane | 0.95 | 0.05 | 0.08 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 600 | 0 | 284 | 0 | 549 | 462 |
| V/C Ratio(X) | 0.88 | 0.00 | 0.74 | 0.00 | 0.36 | 0.93 |
| Avail Cap(c_a), veh/h | 1099 | 0 | 587 | 0 | 549 | 462 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 19.4 | 0.0 | 25.3 | 0.0 | 17.4 | 21.4 |
| Incr Delay (d2), s/veh | 4.3 | 0.0 | 3.7 | 0.0 | 0.4 | 25.4 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 7.1 | 0.0 | 3.1 | 0.0 | 2.1 | 8.8 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 23.7 | 0.0 | 29.0 | 0.0 | 17.8 | 46.8 |
| LnGrp LOS | C | A | C | A | B | D |
| Approach Vol, veh/h | 526 | | | 209 | 625 | |
| Approach Delay, s/veh | 23.7 | | | 29.0 | 37.7 | |
| Approach LOS | C | | | C | D | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 13.9 | | 25.6 | | 22.8 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | | 4.5 |
| Max Green Setting (Gmax), s | | 19.5 | | 38.7 | | 18.3 |
| Max Q Clear Time (g_c+I1), s | | 8.6 | | 19.4 | | 18.5 |
| Green Ext Time (p_c), s | | 0.8 | | 1.7 | | 0.0 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay | | 30.9 |
| HCM 6th LOS | | C |



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| Intersection | |
|---|---|
| Int Delay, s/veh | 0.3 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↕ | | | ↕ | | | ↕ | | | ↕ | |
| Traffic Vol, veh/h | 6 | 541 | 6 | 4 | 455 | 9 | 3 | 0 | 1 | 5 | 0 | 4 |
| Future Vol, veh/h | 6 | 541 | 6 | 4 | 455 | 9 | 3 | 0 | 1 | 5 | 0 | 4 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| 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, % | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mvmt Flow | 6 | 576 | 6 | 4 | 484 | 10 | 3 | 0 | 1 | 5 | 0 | 4 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 494 | 0 | 0 | 582 | 0 | 0 | 1090 | 1093 | 579 | 1089 | 1091 | 489 |
| Stage 1 | - | - | - | - | - | - | 591 | 591 | - | 497 | 497 | - |
| Stage 2 | - | - | - | - | - | - | 499 | 502 | - | 592 | 594 | - |
| Critical Hdwy | 4.11 | - | - | 4.11 | - | - | 7.11 | 6.51 | 6.21 | 7.11 | 6.51 | 6.21 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Follow-up Hdwy | 2.209 | - | - | 2.209 | - | - | 3.509 | 4.009 | 3.309 | 3.509 | 4.009 | 3.309 |
| Pot Cap-1 Maneuver | 1075 | - | - | 997 | - | - | 193 | 215 | 517 | 194 | 216 | 581 |
| Stage 1 | - | - | - | - | - | - | 495 | 496 | - | 557 | 546 | - |
| Stage 2 | - | - | - | - | - | - | 555 | 544 | - | 494 | 495 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1075 | - | - | 997 | - | - | 190 | 212 | 517 | 191 | 213 | 581 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 190 | 212 | - | 191 | 213 | - |
| Stage 1 | - | - | - | - | - | - | 491 | 492 | - | 553 | 543 | - |
| Stage 2 | - | - | - | - | - | - | 548 | 541 | - | 489 | 491 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0.1 | 0.1 | 21.2 | 18.7 |
| HCM LOS | | | C | C |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 226 | 1075 | - | - | 997 | - | - | 272 |
| HCM Lane V/C Ratio | 0.019 | 0.006 | - | - | 0.004 | - | - | 0.035 |
| HCM Control Delay (s) | 21.2 | 8.4 | 0 | - | 8.6 | 0 | - | 18.7 |
| HCM Lane LOS | C | A | A | - | A | A | - | C |
| HCM 95th %tile Q(veh) | 0.1 | 0 | - | - | 0 | - | - | 0.1 |



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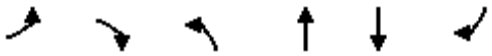

| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 518 | 29 | 18 | 196 | 200 | 450 |
| Future Volume (veh/h) | 518 | 29 | 18 | 196 | 200 | 450 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 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 | 1870 | 1885 | 1885 | 1885 | 1870 | 1856 |
| Adj Flow Rate, veh/h | 545 | 31 | 19 | 206 | 211 | 474 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 |
| Percent Heavy Veh, % | 2 | 1 | 1 | 1 | 2 | 3 |
| Cap, veh/h | 610 | 35 | 25 | 270 | 514 | 432 |
| Arrive On Green | 0.36 | 0.36 | 0.16 | 0.16 | 0.27 | 0.27 |
| Sat Flow, veh/h | 1672 | 95 | 159 | 1719 | 1870 | 1572 |
| Grp Volume(v), veh/h | 577 | 0 | 225 | 0 | 211 | 474 |
| Grp Sat Flow(s),veh/h/ln | 1770 | 0 | 1877 | 0 | 1870 | 1572 |
| Q Serve(g_s), s | 20.4 | 0.0 | 7.6 | 0.0 | 6.1 | 18.3 |
| Cycle Q Clear(g_c), s | 20.4 | 0.0 | 7.6 | 0.0 | 6.1 | 18.3 |
| Prop In Lane | 0.94 | 0.05 | 0.08 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 646 | 0 | 295 | 0 | 514 | 432 |
| V/C Ratio(X) | 0.89 | 0.00 | 0.76 | 0.00 | 0.41 | 1.10 |
| Avail Cap(c_a), veh/h | 1024 | 0 | 556 | 0 | 514 | 432 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 19.9 | 0.0 | 26.8 | 0.0 | 19.7 | 24.1 |
| Incr Delay (d2), s/veh | 6.5 | 0.0 | 4.1 | 0.0 | 0.5 | 71.8 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 8.7 | 0.0 | 3.6 | 0.0 | 2.6 | 14.9 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 26.4 | 0.0 | 30.9 | 0.0 | 20.2 | 96.0 |
| LnGrp LOS | C | A | C | A | C | F |
| Approach Vol, veh/h | 577 | | | 225 | 685 | |
| Approach Delay, s/veh | 26.4 | | | 30.9 | 72.6 | |
| Approach LOS | C | | | C | E | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 15.0 | | 28.8 | | 22.8 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | | 4.5 |
| Max Green Setting (Gmax), s | | 19.7 | | 38.5 | | 18.3 |
| Max Q Clear Time (g_c+I1), s | | 9.6 | | 22.4 | | 20.3 |
| Green Ext Time (p_c), s | | 0.8 | | 1.8 | | 0.0 |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay | | 48.4 |
| HCM 6th LOS | | D |



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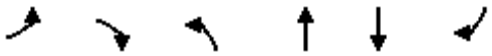
| Intersection | |
|---|---|
| Int Delay, s/veh | 0.4 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ⇕ | | | ⇕ | | | ⇕ | | | ⇕ | |
| Traffic Vol, veh/h | 17 | 541 | 6 | 4 | 455 | 1 | 3 | 0 | 1 | 1 | 0 | 10 |
| Future Vol, veh/h | 17 | 541 | 6 | 4 | 455 | 1 | 3 | 0 | 1 | 1 | 0 | 10 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| 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, % | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Mvmt Flow | 18 | 576 | 6 | 4 | 484 | 1 | 3 | 0 | 1 | 1 | 0 | 11 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 485 | 0 | 0 | 582 | 0 | 0 | 1113 | 1108 | 579 | 1109 | 1111 | 485 |
| Stage 1 | - | - | - | - | - | - | 615 | 615 | - | 493 | 493 | - |
| Stage 2 | - | - | - | - | - | - | 498 | 493 | - | 616 | 618 | - |
| Critical Hdwy | 4.11 | - | - | 4.11 | - | - | 7.11 | 6.51 | 6.21 | 7.11 | 6.51 | 6.21 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.11 | 5.51 | - | 6.11 | 5.51 | - |
| Follow-up Hdwy | 2.209 | - | - | 2.209 | - | - | 3.509 | 4.009 | 3.309 | 3.509 | 4.009 | 3.309 |
| Pot Cap-1 Maneuver | 1083 | - | - | 997 | - | - | 187 | 211 | 517 | 188 | 210 | 584 |
| Stage 1 | - | - | - | - | - | - | 480 | 484 | - | 560 | 549 | - |
| Stage 2 | - | - | - | - | - | - | 556 | 549 | - | 480 | 482 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1083 | - | - | 997 | - | - | 179 | 205 | 517 | 183 | 204 | 584 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 179 | 205 | - | 183 | 204 | - |
| Stage 1 | - | - | - | - | - | - | 468 | 472 | - | 546 | 546 | - |
| Stage 2 | - | - | - | - | - | - | 543 | 546 | - | 467 | 470 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0.3 | 0.1 | 22.2 | 12.6 |
| HCM LOS | | | C | B |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 214 | 1083 | - | - | 997 | - | - | 487 |
| HCM Lane V/C Ratio | 0.02 | 0.017 | - | - | 0.004 | - | - | 0.024 |
| HCM Control Delay (s) | 22.2 | 8.4 | 0 | - | 8.6 | 0 | - | 12.6 |
| HCM Lane LOS | C | A | A | - | A | A | - | B |
| HCM 95th %tile Q(veh) | 0.1 | 0.1 | - | - | 0 | - | - | 0.1 |



| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 514 | 29 | 18 | 197 | 201 | 442 |
| Future Volume (veh/h) | 514 | 29 | 18 | 197 | 201 | 442 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | 1.00 | 1.00 | | | 1.00 |
| Parking Bus, Adj | 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 | 1870 | 1885 | 1885 | 1885 | 1870 | 1856 |
| Adj Flow Rate, veh/h | 541 | 31 | 19 | 207 | 212 | 465 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 |
| Percent Heavy Veh, % | 2 | 1 | 1 | 1 | 2 | 3 |
| Cap, veh/h | 606 | 35 | 25 | 272 | 516 | 434 |
| Arrive On Green | 0.36 | 0.36 | 0.16 | 0.16 | 0.28 | 0.28 |
| Sat Flow, veh/h | 1671 | 96 | 158 | 1719 | 1870 | 1572 |
| Grp Volume(v), veh/h | 573 | 0 | 226 | 0 | 212 | 465 |
| Grp Sat Flow(s),veh/h/ln | 1770 | 0 | 1877 | 0 | 1870 | 1572 |
| Q Serve(g_s), s | 20.2 | 0.0 | 7.6 | 0.0 | 6.1 | 18.3 |
| Cycle Q Clear(g_c), s | 20.2 | 0.0 | 7.6 | 0.0 | 6.1 | 18.3 |
| Prop In Lane | 0.94 | 0.05 | 0.08 | | | 1.00 |
| Lane Grp Cap(c), veh/h | 642 | 0 | 297 | 0 | 516 | 434 |
| V/C Ratio(X) | 0.89 | 0.00 | 0.76 | 0.00 | 0.41 | 1.07 |
| Avail Cap(c_a), veh/h | 1027 | 0 | 557 | 0 | 516 | 434 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 19.9 | 0.0 | 26.7 | 0.0 | 19.6 | 24.0 |
| Incr Delay (d2), s/veh | 6.3 | 0.0 | 4.0 | 0.0 | 0.5 | 63.8 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 8.6 | 0.0 | 3.6 | 0.0 | 2.6 | 14.0 |
| Unsig. Movement Delay, s/veh | | | | | | |
| LnGrp Delay(d),s/veh | 26.3 | 0.0 | 30.8 | 0.0 | 20.1 | 87.8 |
| LnGrp LOS | C | A | C | A | C | F |
| Approach Vol, veh/h | 573 | | | 226 | 677 | |
| Approach Delay, s/veh | 26.3 | | | 30.8 | 66.6 | |
| Approach LOS | C | | | C | E | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 |
|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 15.0 | | 28.6 | | 22.8 |
| Change Period (Y+Rc), s | | 4.5 | | 4.5 | | 4.5 |
| Max Green Setting (Gmax), s | | 19.7 | | 38.5 | | 18.3 |
| Max Q Clear Time (g_c+I1), s | | 9.6 | | 22.2 | | 20.3 |
| Green Ext Time (p_c), s | | 0.8 | | 1.8 | | 0.0 |

| Intersection Summary | | | | | | |
|---|---|---|---|---|---|---|
| HCM 6th Ctrl Delay | | | 45.5 | | | |
| HCM 6th LOS | | | D | | | |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0.3 |

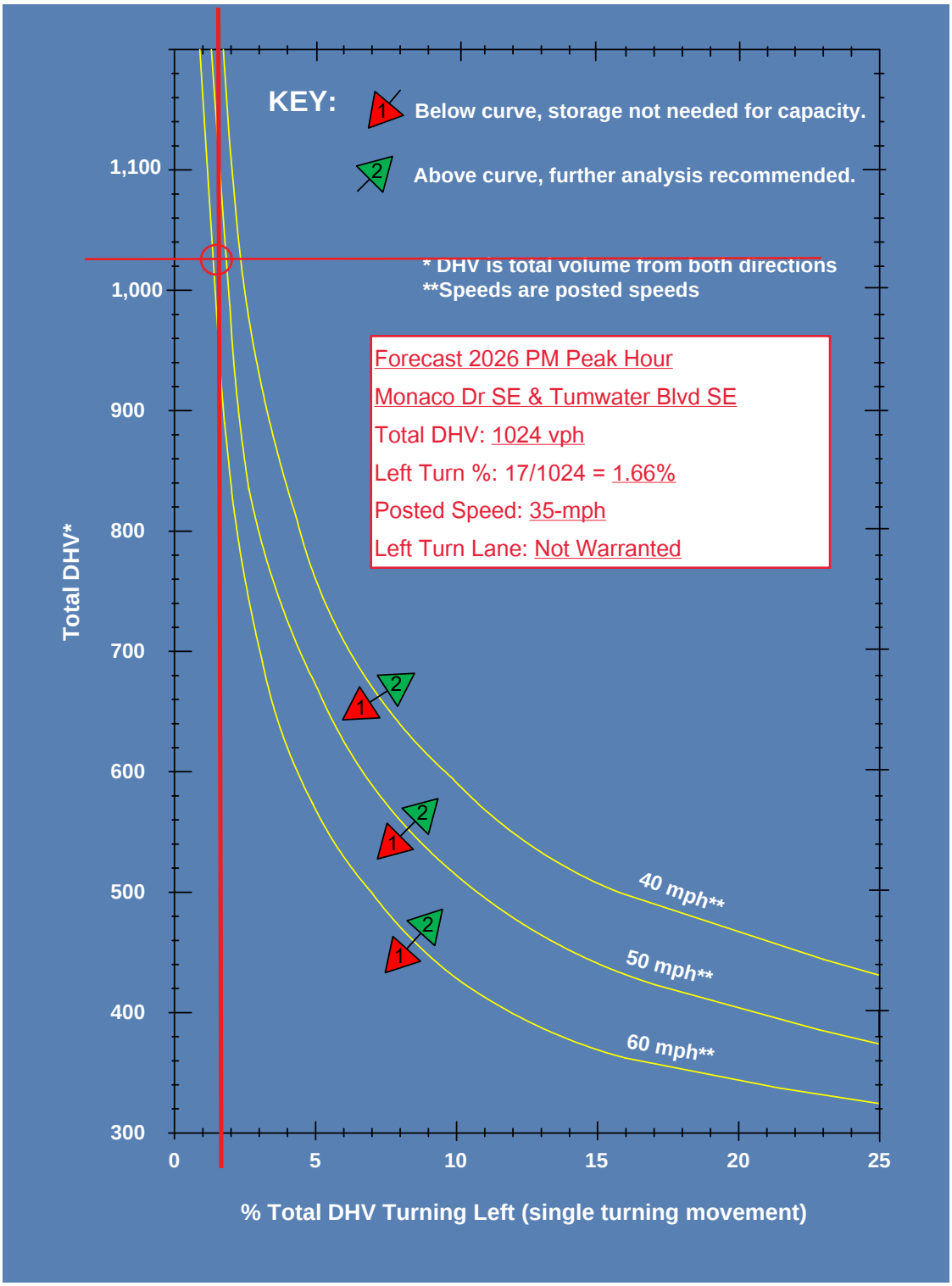
| Movement | EBL | EBR | NBL | NBT | SBT | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 13 | 1 | 1 | 710 | 642 | 22 |
| Future Vol, veh/h | 13 | 1 | 1 | 710 | 642 | 22 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | 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 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 14 | 1 | 1 | 772 | 698 | 24 |

| Major/Minor | Minor2 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 1484 | 710 | 722 | 0 | - | 0 |
| Stage 1 | 710 | - | - | - | - | - |
| Stage 2 | 774 | - | - | - | - | - |
| 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 | 137 | 434 | 880 | - | - | - |
| Stage 1 | 487 | - | - | - | - | - |
| Stage 2 | 455 | - | - | - | - | - |
| Platoon blocked, % | | | | - | - | - |
| Mov Cap-1 Maneuver | 137 | 434 | 880 | - | - | - |
| Mov Cap-2 Maneuver | 137 | - | - | - | - | - |
| Stage 1 | 486 | - | - | - | - | - |
| Stage 2 | 455 | - | - | - | - | - |

| Approach | EB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 32.9 | 0 | 0 |
| HCM LOS | D | | |

| Minor Lane/Major Mvmt | NBL | NBT | EBLn1 | SBT | SBR |
|---|---|---|---|---|---|
| Capacity (veh/h) | 880 | - | 144 | - | - |
| HCM Lane V/C Ratio | 0.001 | - | 0.106 | - | - |
| HCM Control Delay (s) | 9.1 | 0 | 32.9 | - | - |
| HCM Lane LOS | A | A | D | - | - |
| HCM 95th %tile Q(veh) | 0 | - | 0.3 | - | - |

## Exhibit 1310-7a Left-Turn Storage Guidelines: Two-Lane, Unsignalized



Date: December 10, 2021

To: Evan Mann
SoundBuilt Homes

From: Aaron Van Aken, PE, PTOE

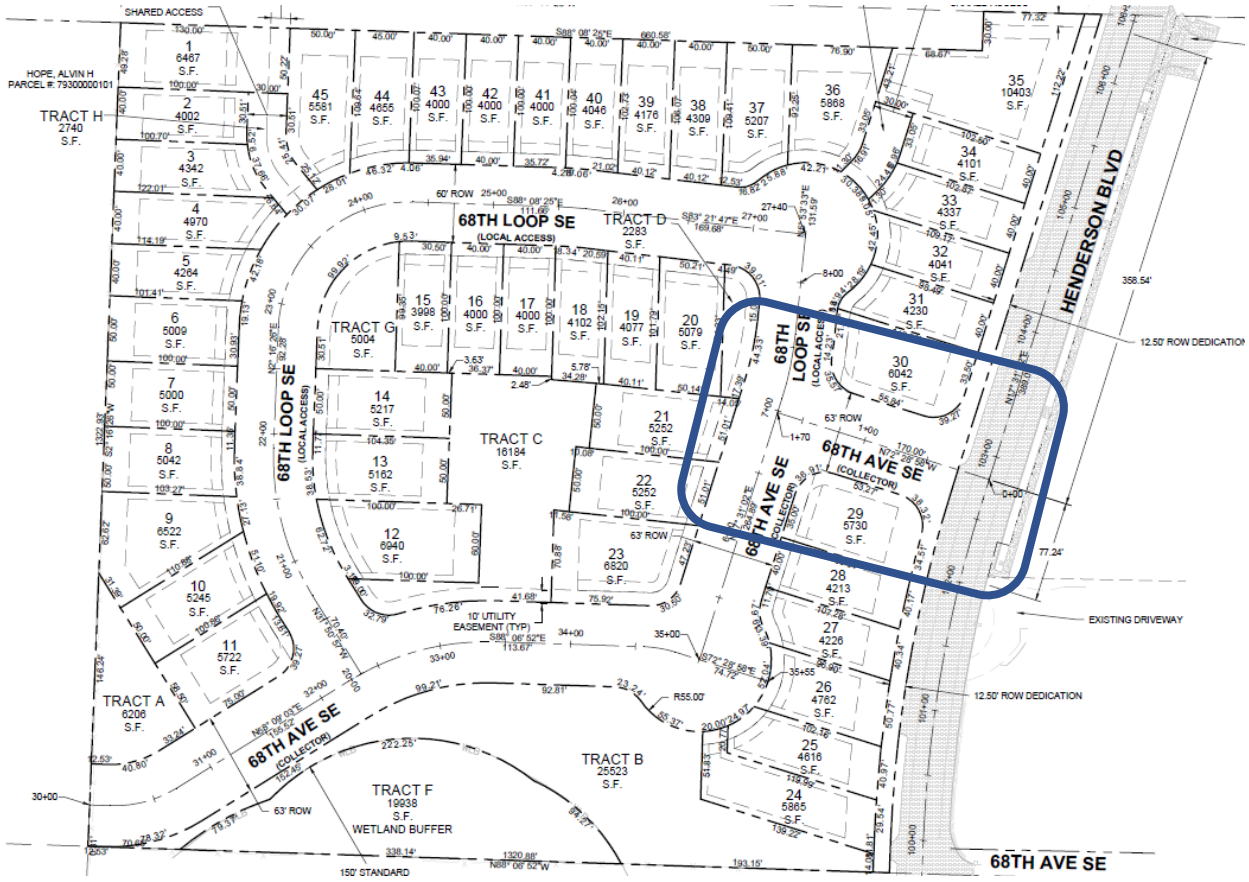
Subject: Three Lakes Crossing Queuing Analysis

The intent of this technical memorandum serves to evaluate queuing demands at the proposed access intersection to Henderson Boulevard SE for the proposed Three Lakes Crossing development. This evaluation uses data and information from the updated *Three Lakes Crossing* (12/10/2021) Transportation Impact Analysis (TIA). Below is a project summary and projected queuing estimates.

## PROJECT DESCRIPTION

Three Lakes Crossing is a proposed 45-unit single-family development located in the city of Tumwater. The subject properties are situated on the west side of Henderson Blvd SE and just north of Tumwater Blvd SE. Access to and from the site is proposed via a new roadway extending west from Henderson Blvd SE and a connection to an adjacent property on the southwest corner of the site. According to the TIA, this project is estimated to generate 42 new trips in the PM peak hour (26 inbound / 16 outbound).

**Figure 1: Site Plan**




Shown above is the proposed site plan with proposed accesses and internal roadway configuration. This evaluation will focus on queuing at the primary access intersection with Henderson Blvd SE. Approximately 145 feet of spacing is available from Henderson Blvd SE to the internal intersection as shown the image above.

To evaluate peak hour queues, forecast 2026 PM peak hour projected volumes were applied (see attached figure from TIA). Queues were estimated using *SimTraffic* and *Synchro 11* modeling programs. Five peak hour simulations were performed in order to establish an average queue at the access intersection.

## QUEUING

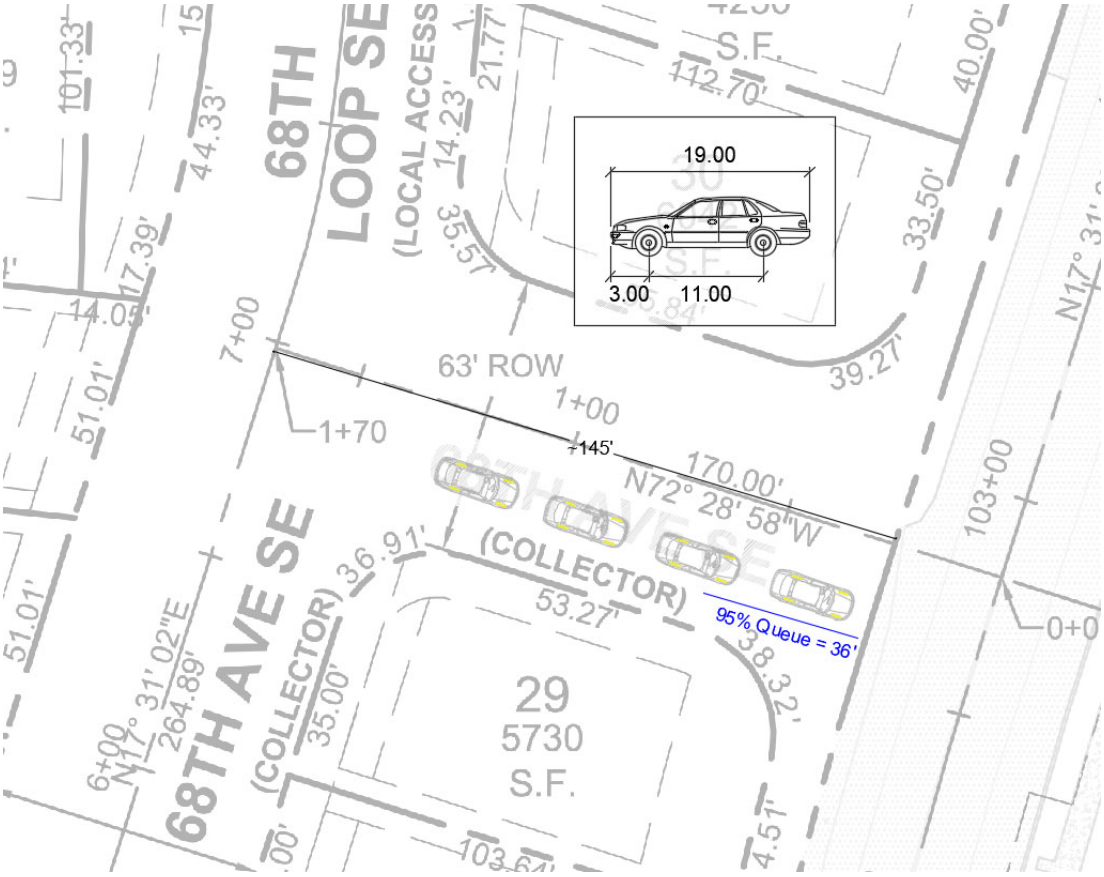
A total of five peak hour simulations were performed. The table below summarizes the aggregated findings. See appendix for detailed report sheets.

**Table 1: Forecast 2026 PM Peak Hour Queues & Delays**

*Delays Given in Seconds per Vehicle*

| Intersection | Control | Movement | 95th% Queue | Delay |
|---|---|---|---|---|
| Access & Henderson Blvd | Stop | Eastbound | 36 ft | 17.7 sec |

Based on the modeling outputs, maximum queues are estimated to be up to 36 feet (1-2 vehicle lengths) during the critical peak travel hour. In other words, vehicles waiting to leave the subject site and enter Henderson Blvd SE are estimated to be up to two vehicles for all but the rarest events. With approximately 145-foot spacing to the internal intersection, no blockage or queue spillover is estimated to occur. Shown in the image below in blue is the calculated 95th percentile queuing distance (36'). Up to four vehicle lengths can comfortably stack up before the internal intersection indicating sufficient spacing availability.

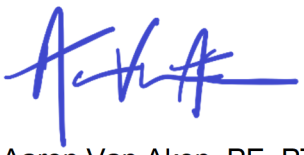


## CONCLUSION

Three Lakes Crossing, a proposed 45-unit single-family development located in the city of Tumwater, has been evaluated in terms of queuing and operations at the proposed access off Henderson Boulevard SE. This memo uses information and builds upon the *Three Lakes Crossing* TIA (12/10/2021).

Using the 2026 PM peak hour traffic volume estimates from the original TIA in conjunction with additional traffic modeling and simulations, queues at the primary access intersection were calculated. Based on the simulations, a 95th percentile queue of 36 feet (one to two vehicles) was derived for the eastbound approach waiting to enter Henderson Blvd. On average, one vehicle or less would typically be waiting to leave the subject property. Based on the queuing assessments provided herein, no conflict with respect to the 145-foot spacing from Henderson Blvd to the internal plat intersection is expected.

Please call if you require additional information.

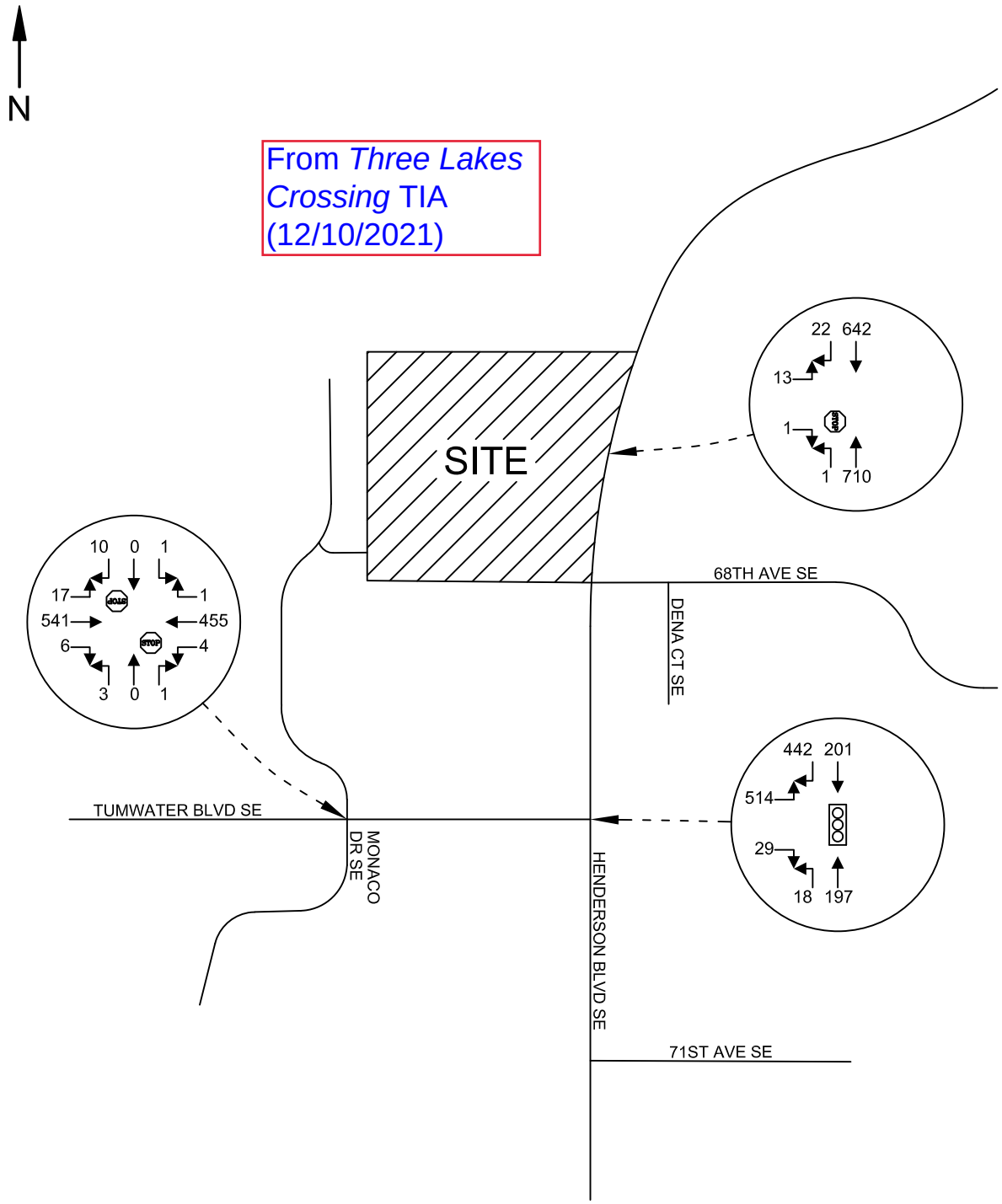


Aaron Van Aken, PE, PTOE

THREE LAKES CROSSING

QUEUING MEMO

*APPENDIX*




HEATH & ASSOCIATES

TRAFFIC AND CIVIL ENGINEERING

THREE LAKES CROSSING

FORECAST 2026 PM PEAK HOUR VOLUMES WITH PROJECT

FIGURE 7

## 3: Henderson Blvd SE & Access Performance by approach

| Approach | EB | NB | SB | All |
|---|---|---|---|---|
| Denied Del/Veh (s) | 0.1 | 0.0 | 0.5 | 0.3 |
| Total Del/Veh (s) | 17.7 | 2.4 | 0.6 | 1.7 |



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## Intersection: 3: Henderson Blvd SE & Access

| Movement | EB | NB | SB |
|---|---|---|---|
| Directions Served | LR | LT | TR |
| Maximum Queue (ft) | 39 | 69 | 4 |
| Average Queue (ft) | 11 | 4 | 0 |
| 95th Queue (ft) | 36 | 44 | 3 |
| Link Distance (ft) | 636 | 875 | 372 |
| Upstream Blk Time (%) | | | |
| Queuing Penalty (veh) | | | |
| Storage Bay Dist (ft) | | | |
| Storage Blk Time (%) | | | |
| Queuing Penalty (veh) | | | |



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