**Exhibit 54**

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# MEMORANDUM

Date: November 20, 2014 Project #: 13865

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Jeff Barsness, P.E.; Washington State Department of Transportation
David Jardin, Clark County
Randy Printz, Landerholm Law Firm
John Schmidt and John O'Neil; Green Mountain Land, LLC

From: Chris Brehmer, P.E., Kelly Laustsen, and Ribeka Toda; Kittelson & Associates, Inc.

Project: Green Mountain Master Plan

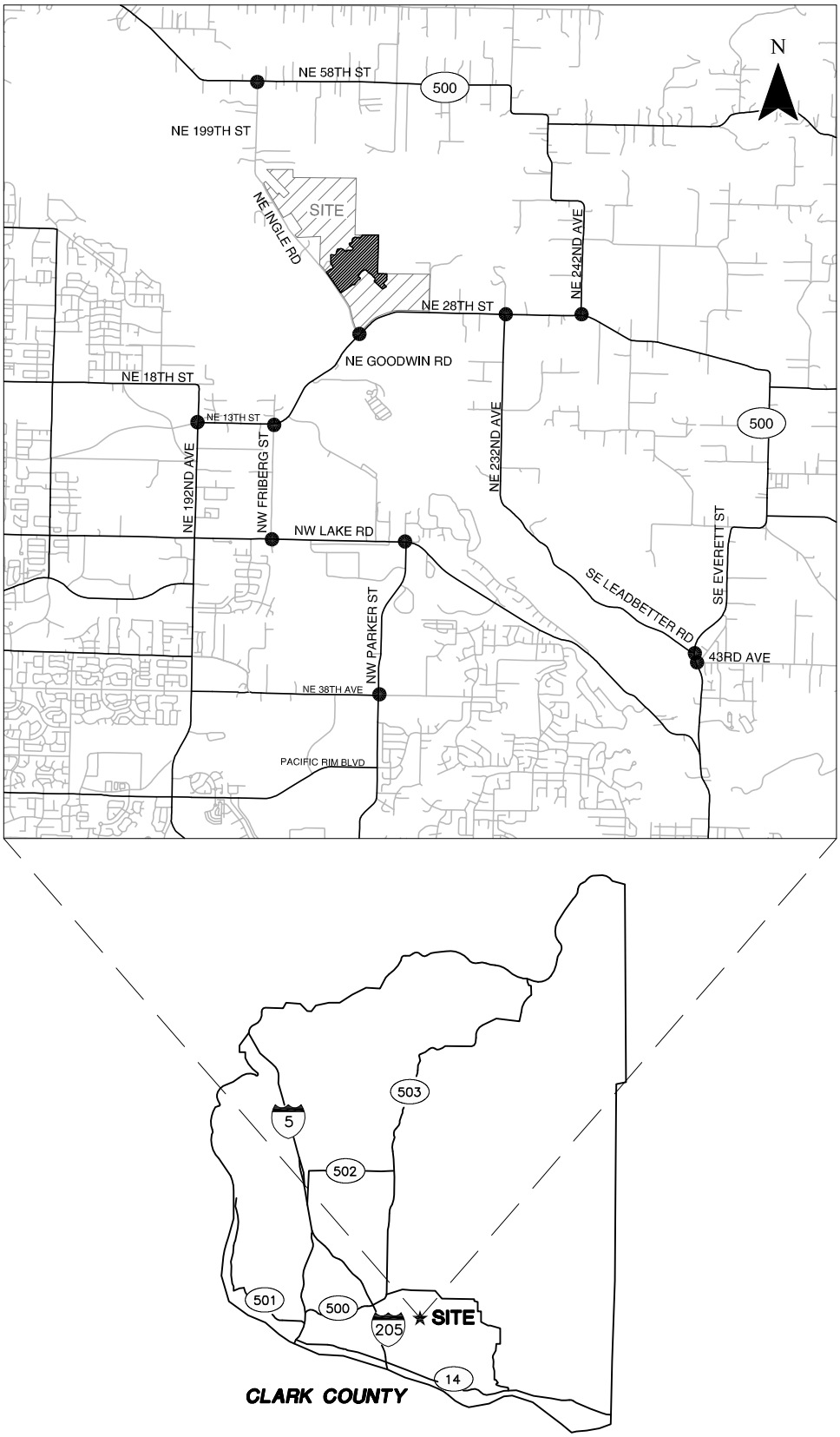
Subject: Transportation Impact Analysis

This memorandum documents the results of the transportation impact analysis prepared by Kittelson & Associates, Inc. (KAI) for the proposed Green Mountain Master Plan development to be located at the northeast corner of NE Ingle Road and NE Goodwin Road in Camas, Washington. This study concludes that Phase 1 of the site can be developed as proposed while maintaining safe and acceptable traffic operations at the study intersections assuming provision of an eastbound left-turn lane on NE Goodwin Road at NE Ingle Road. Further transportation improvements are recommended to accommodate full build-out of the proposed development. The methodology of our analysis, pertinent findings, and our recommendations are documented in this memorandum.

## INTRODUCTION

Green Mountain Land, LLC is in the process of preparing a master plan to establish a mixed-use development on the 283-acre site. Green Mountain Golf Course is currently located on a large portion of the property; otherwise the site is vacant. The site is currently zoned for a mix of residential uses (R-10, MF-10 and R-6) and Community Commercial (CC). Figure 1 illustrates the site vicinity map.

The master plan proposes eight phases of development, with the sequence and timing of phases largely market dependent. It is expected that Phase 1 will be completed by 2018 and full master plan build-out will be assumed by 2029 for traffic impact assessment purposes.




● - Study Intersections

Site Vicinity
Camas, Washington

Figure
1

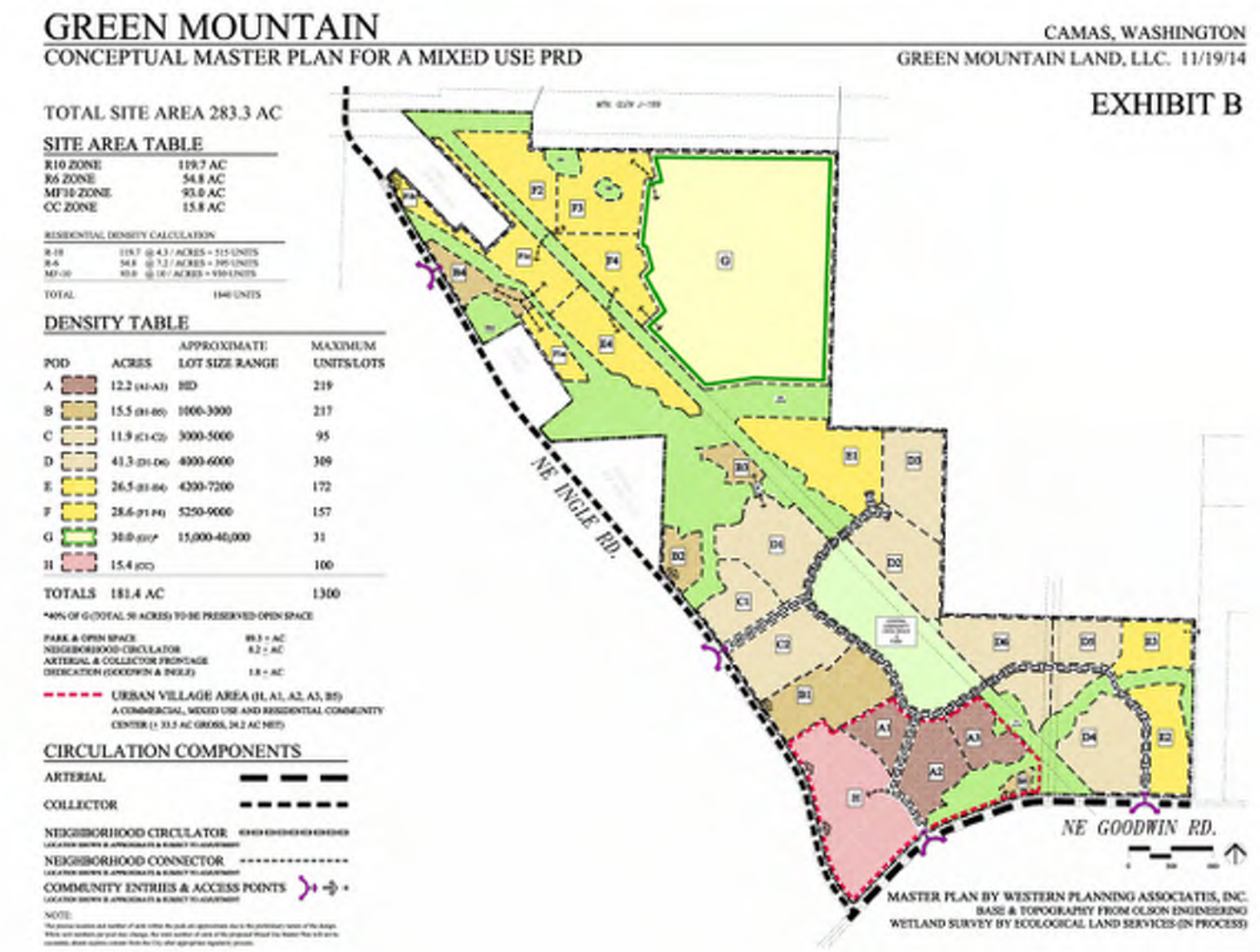
Figure 2 illustrates a conceptual image of the master plan site vision. A mix of residential and commercial uses is planned in accordance with the zoning, with a mixed use village proposed to better integrate the commercially zoned portion of the property. The village would be located at the southwest corner of the project and will encompass approximately twenty-four acres. Further project details are provided later in this report.

## SCOPE OF THE REPORT

This analysis identifies the transportation-related impacts associated with the proposed Green Mountain Master Plan development and was prepared in accordance with City of Camas transportation impact analysis requirements. The study scope and overall study area for this project were selected based on a review of the local transportation system and direction provided by City of Camas, City of Vancouver, Clark County, and Washington Department of Transportation (WSDOT) staff.

Operational analyses were performed at the following intersections:

- NE 199th Avenue/NE 58th Street (SR 500, WSDOT maintained)
- NE 192nd Avenue/NE 13th Street (City of Vancouver maintained)
- NW Friberg Street/NE Goodwin Road
- NE Ingle Road/NE Goodwin Road
- NE 232nd Avenue/NE 28th Street
- NE 242nd Avenue (SR 500)/NE 28th Street (WSDOT maintained)
- NW Friberg Street/NW Lake Road
- NW Parker Street/NW Lake Road
- NE Everett Street (SR 500)/SE Leadbetter Road
- NW Parker Street/NE 38th Avenue
- NE Everett Street (SR 500)/NE 43rd Avenue (WSDOT maintained)
- Site-Access Driveways




Plan provided by Western Planning Associates, 11/19/14

Conceptual Master Plan
Camas, Washington

Figure 2

As required by the City of Camas, a transportation impact study was prepared to address the following transportation issues:

- Year 2014 existing land use and transportation system conditions within the site vicinity during the weekday a.m. and p.m. peak hours;
- Planned developments and transportation improvements in the study area;
- Trip generation and distribution estimates for the proposed development;
- Forecast year 2018 background traffic conditions without the proposed development during the weekday a.m. and p.m. peak hours;
- Forecast year 2018 total traffic conditions with the completion of Phase 1 of the proposed development during the weekday a.m. and p.m. peak hours;
- Forecast year 2029 background traffic conditions without the proposed development during the weekday a.m. and p.m. peak hours;
- Forecast year 2029 total traffic conditions with full build-out and occupancy of the proposed development during the weekday a.m. and p.m. peak hours;
- Level of service analyses for the study intersections; and
- On-site access and circulation.

Conclusions and recommendations are provided following the operational analysis.

## ANALYSIS METHODOLOGY

All level of service analyses described in this report were performed in accordance with the procedures stated in the *2000 Highway Capacity Manual* (Reference 1). A description of level of service and the criteria by which they are determined is presented in *Appendix "A". Appendix "A"* also indicates how level of service is measured and what is generally considered the acceptable range of level of service.

To ensure that this analysis was based on a reasonable worst-case scenario, the peak 15 minute flow rate during the peak hour analysis periods was used in the evaluation of all intersection levels of service. For this reason, the analysis reflects conditions that are only likely to occur for 15 minutes out of each average peak hour. Traffic conditions during other weekday hours and throughout the weekend will likely be better than those described in this report.

At the City of Vancouver-maintained NE 192nd Avenue/NE 13th Street intersection, the peak 15-minute flow rate was assessed by applying the peak 15-minute volume across the hour and not applying a peak hour factor in accordance with guidance provided by the City.

## Operating Standards

The study intersections are each operated and maintained by one of three impacted jurisdictions: WSDOT, the City of Vancouver, or the City of Camas. Each of these jurisdictions has their own operating standards. WSDOT requires LOS "E" or better for non-HSS (Highways of Statewide Significance) in urban areas, City of Vancouver requires LOS "E" or better and a v/c ratio of less than 0.95 for signalized intersections. The City of Camas requires LOS "D" or better and a v/c ratio of 0.90 or better for all intersections. Table 1 lists the study intersections, the responsible jurisdiction, and the corresponding operating standard.

Table 1: Operating Standards at Study Intersections

| ID | Study Intersection | Jurisdiction | Standard |
|---|---|---|---|
| 1 | NE 199th Avenue/NE 58th Street (SR 500) | WSDOT | LOS "C" for non-HSS in rural area[1] |
| 2 | NE 192nd Avenue/NE 13th Street | Vancouver | LOS "E" and v/c ratio less than 0.95 |
| 3 | NW Friberg Street/NE Goodwin Road | Camas | LOS "D" and v/c of 0.90 or better |
| 4 | NE Ingle Road/NE Goodwin Road | Camas | LOS "D" and v/c of 0.90 or better |
| 5 | NE 232nd Avenue/NE 28th Street | Camas | LOS "D" and v/c of 0.90 or better |
| 6 | NE 242nd Avenue (SR 500)/NE 28th Street | WSDOT | LOS "C" for non-HSS in rural area[1] |
| 7 | NW Friberg Street/NW Lake Road | Camas | LOS "D" and v/c of 0.90 or better |
| 8 | NW Parker Street/NW Lake Road | Camas | LOS "D" and v/c of 0.90 or better |
| 9 | NE Everett Street (SR 500)/SE Leadbetter Road | WSDOT | LOS "C" for non-HSS in rural area[1] |
| 10 | NW Parker Street/NE 38th Avenue | Camas | LOS "D" and v/c of 0.90 or better |
| 11 | NE Everett Street (SR 500)/NE 43rd Avenue | WSDOT | LOS "C" for non-HSS in rural area[1] |

[1]The City of Camas TIF Update applied the WSDOT standard for facilities in urban areas (LOS "E" for non-HSS in urban area). Based on conversations with WSDOT, the standard for rural areas is currently applicable to the WSDOT study intersections.

Source: City of Camas Traffic Impact Fee Update (Reference 2)

### Turn Lane Guidelines

For roadways under Washington State jurisdiction, such as SR 500, WSDOT has defined traffic-volume based turn lane guidelines within the *WSDOT Design Manual* (Reference 3). Left-turn lane guidelines are provided in section 1310.04(2)(a) while right-turn lane guidelines are provided in section 1310.04(3).

## EXISTING CONDITIONS

The existing conditions analysis identifies site conditions and the current operational and geometric characteristics of roadways within the study area. These conditions will be compared with future conditions later in this report.

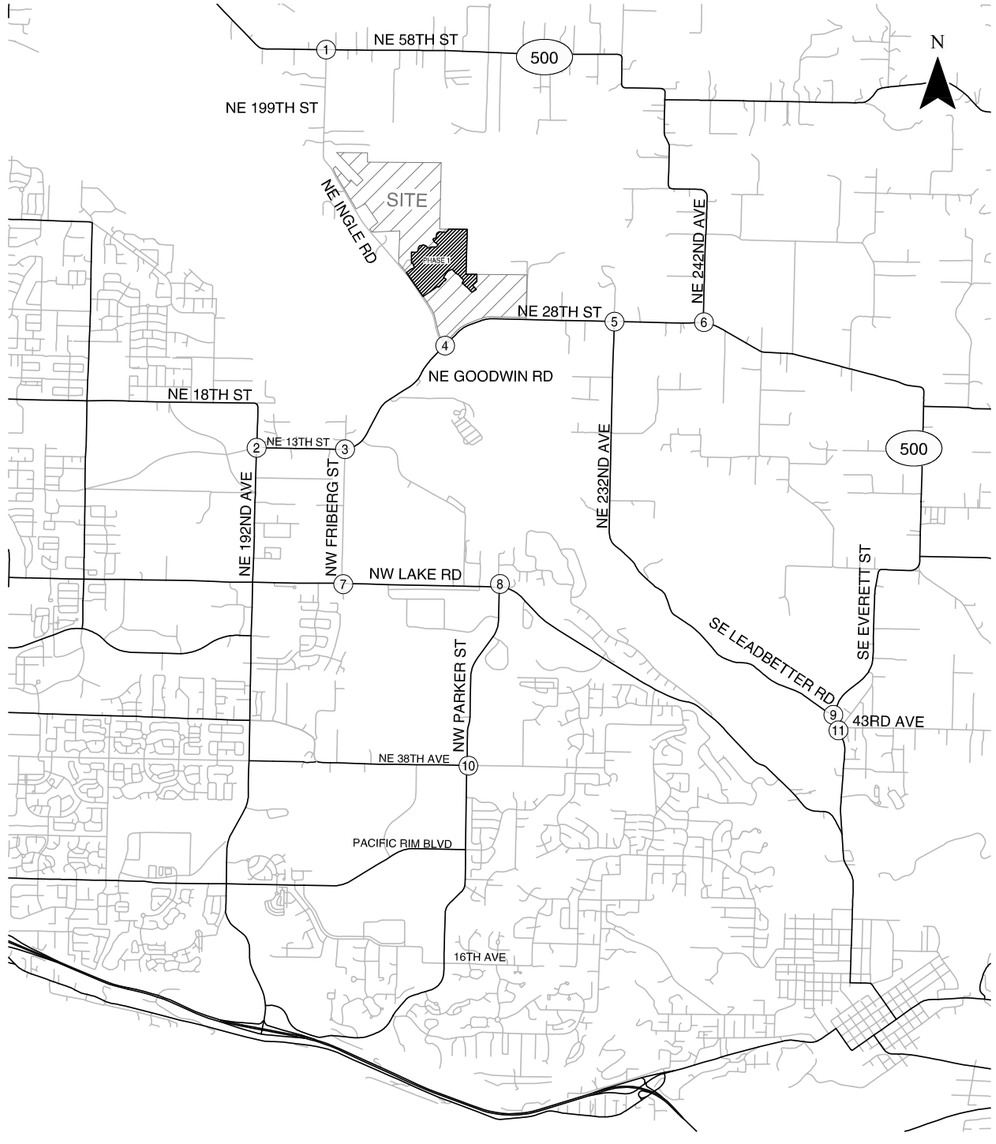
The site of the proposed development and surrounding study area was visited and inventoried in March 2014. At that time, information was collected regarding site conditions, adjacent land uses, existing traffic operations, and transportation facilities in the study area.

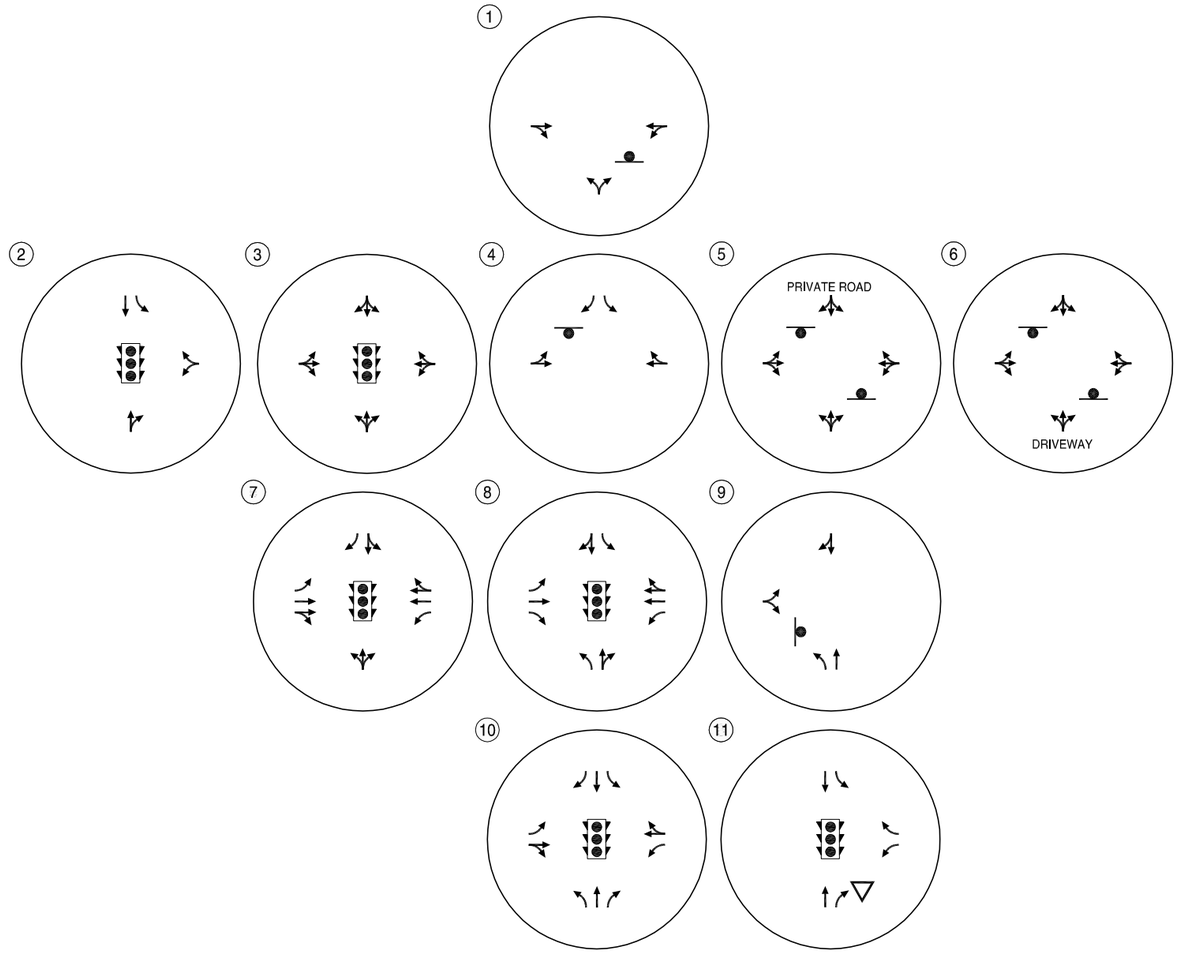
### Site Conditions and Adjacent Land Uses

The area encompassed by the master plan site is largely undeveloped. The southwest corner of the property is occupied by the Green Mountain Golf Course, a portion of which is proposed to remain open after completion of the Phase 1 master plan development. The areas surrounding the site are also largely undeveloped, with a few single family homes situated along NE 28$^{th}$ Street, NE 199$^{th}$ Avenue, and SR 500.

### Transportation Facilities

Table 2 provides a summary of key transportation facilities in the site vicinity and Figure 3 illustrates the existing lane configurations and traffic control devices at the study intersections.




- STOP SIGN
- TRAFFIC SIGNAL
- YIELD SIGN

Existing Lane Configurations and Traffic Control Devices
Camas, Washington

Figure 3

Table 2: Existing Transportation Facilities and Roadway Designations

| Roadway | Classification[1] | Cross-Section | Speed Limit (mph) | Side-Walks? | Bicycle Lanes? | Median? | On-Street Parking? |
|---|---|---|---|---|---|---|---|
| NE 13th Street / NE Goodwin Road / NE 28th Street | Arterial | 5-lane | 40 | Yes | Yes | Yes | None |
| SR 500 | Non-HSS[2] | 2-lane | 50 | None | None | None | None |
| NE Ingle Road / NE 199th Avenue | Collector | 2-lane | 50 | None | None | None | None |
| NE 192nd Avenue | Arterial | 2-lane | 40 | Partial | None | None | None |
| SE 192nd Avenue | Arterial | 5-lane | 40 | Partial | None | None | None |
| NW Friberg Street / NE 202nd Avenue | Arterial | 2-lane | 40 | Partial | None | None | None |
| SE 1st Street / NW Lake Road | Arterial | 5-lane | 40 | Yes | Yes | Yes | None |
| NW Parker Street | Arterial | 5-lane | 35 | Yes | Yes | None | None |
| NE Everett Road | Arterial | 2-lane | 35 | None | None | None | None |
| NW Pacific Rim Blvd./ SE 34TH Street | Arterial | 5-lane | 40 | Yes | None | Yes | None |

[1] Source: City of Camas Traffic Impact Fee Update (Reference 2)
[2] HSS = Highways of Statewide Significance

## Pedestrian and Bicycle Facilities

Neither sidewalks nor striped bicycle facilities are provided in the vicinity of the site on either NE Ingle Road or NE Goodwin Road/NE 28th Street.

## Transit Facilities

The C-Tran *Camas Connector* Dial-A-Ride service currently operates within a portion of the study area, with a northern boundary of Lake Road, western boundary of Parker Street, and eastern boundary of SR 500. This service operates by accepting telephone calls from riders to be taken to a location inside a defined boundary. The hours of operation are Monday through Friday from 5:30 a.m. to 9:15 a.m. and 2:00 p.m. to 7:00 p.m. No service is available on holidays (Reference 4).

## Crash Analysis

The crash histories of the study intersections were reviewed in an effort to identify potential intersection safety issues. Crash records were obtained from WSDOT. The data represents records between January 1, 2008 and November 30, 2013. The crash rate was calculated to determine the number of crashes per million entering vehicles (MEV). Generally speaking, a crash rate greater than 1.0 crashes per MEV suggests locations where crash patterns should be reviewed in greater detail.

A brief discussion of the crash data at key intersections is presented after Table 3. There were no fatalities reported at the study intersections during the time periods studied. *Appendix "B" contains the crash data.*

As shown in Table 3, the two intersections where the highest crash rates were observed were NE 199th Avenue/NE 58th Street and NE Ingle Road/NE Goodwin Road. At all other intersections, the observed crash rates are well below 1.0 crash per million entering vehicles.

Table 3: Intersection Crash Histories (1/1/2008 - 11/30/2013)

| Intersection | Total | Collision Type | | | | | | Severity | | Crash Rate Crashes/ MEV[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rear End | Turn -ing | Angle | Pedes -trian | Fixed Object | Road way Ditch | PDO[1] | Injury | |
| 1. NE 199th Ave / NE 58th St (SR 500) | 7 | 0 | 0 | 4 | 0 | 3 | 0 | 5 | 2 | 0.57 |
| 2. NE 192nd Ave / NE 13th St | 8 | 1 | 6 | 0 | 0 | 1 | 0 | 4 | 4 | 0.27 |
| 3. NE Friberg St / NE Goodwin Rd | 5 | 1 | 3 | 1 | 0 | 0 | 0 | 3 | 2 | 0.32 |
| 4. NE Ingle Rd / NE Goodwin Rd | 16 | 4 | 0 | 5 | 1 | 4 | 2 | 11 | 5 | 1.03 |
| 5. NE 232nd Ave / NE 28th St | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 1 | 0.25 |
| 6. NE 242nd Ave (SR 500)/ NE 28th St | 4 | 0 | 0 | 2 | 0 | 1 | 1 | 2 | 2 | 0.30 |
| 7. NW Friberg St / NW Lake Rd | 6 | 3 | 0 | 1 | 0 | 2 | 0 | 6 | 0 | 0.24 |
| 8. NW Parker St / NW Lake Rd | 3 | 0 | 1 | 0 | 0 | 2 | 0 | 3 | 0 | 0.12 |
| 9. NE Everett St (SR 500)/ SE Leadbetter Rd | 5 | 0 | 0 | 0 | 0 | 3 | 2 | 2 | 3 | 0.54 |
| 10. NW Parker St / NE 38th Ave | 9 | 0 | 5 | 4 | 0 | 0 | 0 | 6 | 3 | 0.29 |
| 11. NE Everett St (SR 500) / NE 43rd Ave | 7 | 1 | 5 | 0 | 0 | 1 | 0 | 3 | 4 | 0.36 |

[1] PDO = Property Damage Only | [2] MEV = Million Entering Vehicles

### *NE 199th Avenue/NE 58th Street (SR 500)*

The second highest crash rate, 0.57, occurs at the intersection of NE 199th Avenue/NE 58th Street. There have been seven reported collisions, including four angle collisions and three fixed-object collisions at this intersection. The crash data was reviewed in an effort to identify potential trends. Three of the angle crashes involved vehicles making a northbound left turn from NE 199th Avenue to NE 58th Street; another involved an eastbound vehicle turning right from NE 58th Street to NE 199th Avenue. Of the three fixed object collisions, two involved utility poles and one involved a domestic animal. Collisions with domestic animals are challenging to eliminate and one of the collisions with the utility poles involved a driver asleep at the wheel. Four of the seven crashes occurred during wet road surface conditions. Given the relatively low number of reported collisions

and the unusual nature of three of the seven collisions (the three fixed-object collisions), there are no safety-based mitigation measures recommended at this intersection at this time in conjunction with site development. If an eastbound right-turn lane is added to the intersection in the future (which is currently warranted as will be described later in this report), it may provide safety benefits.

### *NE Ingle Road/NE Goodwin Road*

The highest crash rate, 1.03, occurs at the intersection of NE Ingle Road/NE Goodwin Road. There have been reported collisions including 4 four rear-end collisions, 5 five angle collisions, 4 fixed-object collisions (involving a utility pole, a mailbox, a boulder, and a wood sign post), 2 roadway ditch collisions, and a pedestrian collision at this intersection. As discussed later in this report, the Green Mountain Master Plan proposes to construct an exclusive eastbound left-turn lane on NE Goodwin Road at NE Ingle Road in conjunction with the Phase 1 site development. Providing an eastbound left-turn lane and potential related reconfiguration of the southbound stop bar location (refer to sight distance discussion below) in conjunction with Phase 1 site development could provide a safety benefit at this intersection.

Two of the angle collisions involved vehicles exceeding reasonably safe speeds while making a westbound right-turn at the intersection. One of the recommended mitigation measures for the 2029 full build-out scenario of the proposed development is the addition of a westbound right-turn lane at this intersection, which could provide a safety benefit for turning vehicles. Additional long-term mitigation measures anticipated in conjunction with site development include constructing a three-lane roadway section on NE Goodwin Road along the site frontage and signalizing the intersection when warranted.

## Intersection Sight Distance

Intersection sight distance was observed at the study intersections and was found to meet applicable city or WSDOT standards, with the exception of the sight distance at the NE Ingle Road/NE Goodwin Road intersection. As shown in Exhibit 1 below, the stop bar on NE Ingle Road is set back approximately 25 feet from the edge of NE Goodwin Road.

**Exhibit 1: Stop Bar on NE Ingle Road at NE Goodwin Road**

Image source: Google Maps (right image)

As indicated in Exhibit 2, vehicles currently pull past the stop bar to obtain sufficient sight distance to then execute a turning maneuver. Regardless of the proposed site development, we recommend that the City of Camas consider potential improvements to enhance the intersection sight distance, such as relocating the stop bar closer to NE Goodwin Road.

**Exhibit 2: Vehicle Waiting to Make Left-Turn from NE Ingle Road to NE Goodwin Road**

## Existing Traffic Operations

Manual turning-movement counts were conducted at the study intersections in March and April 2014. The counts were conducted on a typical mid-week day during the morning peak period (7:00 to 9:00 a.m.) and the evening peak period (4:00 to 6:00 p.m.) per City requirements. Individual Intersection peak hours were then identified for operational analysis purposes.

Figures 4 and 5 provide a summary of the existing turning-movement counts, which are rounded to the nearest five vehicles per hour for the weekday a.m. and p.m. peak hours, respectively. *Appendix "C" contains the traffic count worksheets used in this study*.

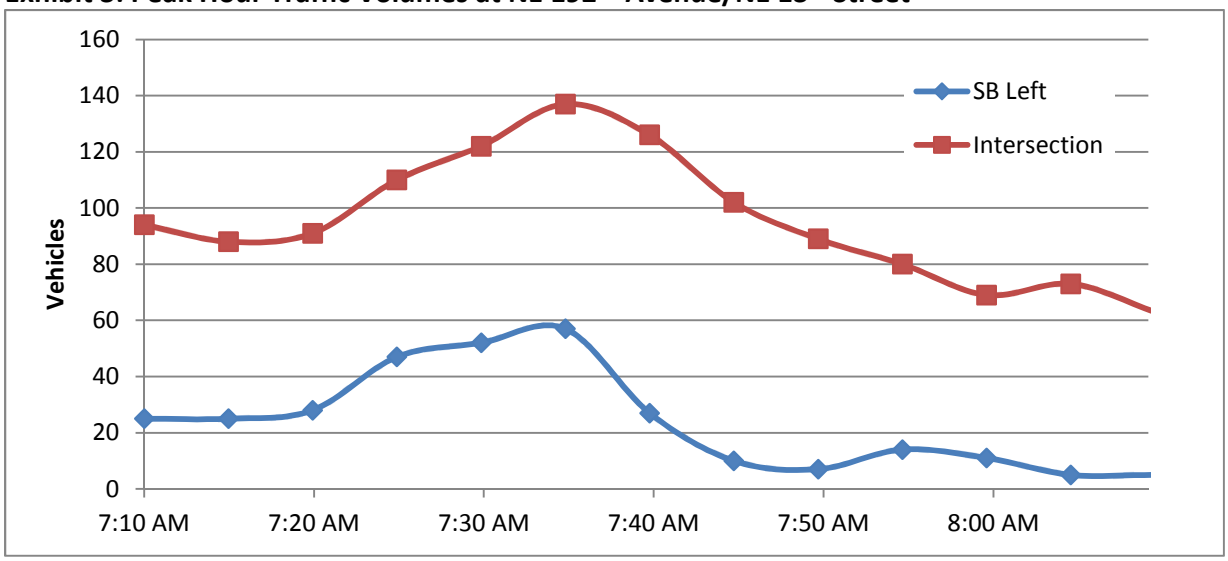
As shown in Figures 4 and 5, the study intersections operate acceptably during both study periods. *Appendix "D" contains the existing conditions traffic operations worksheets.*

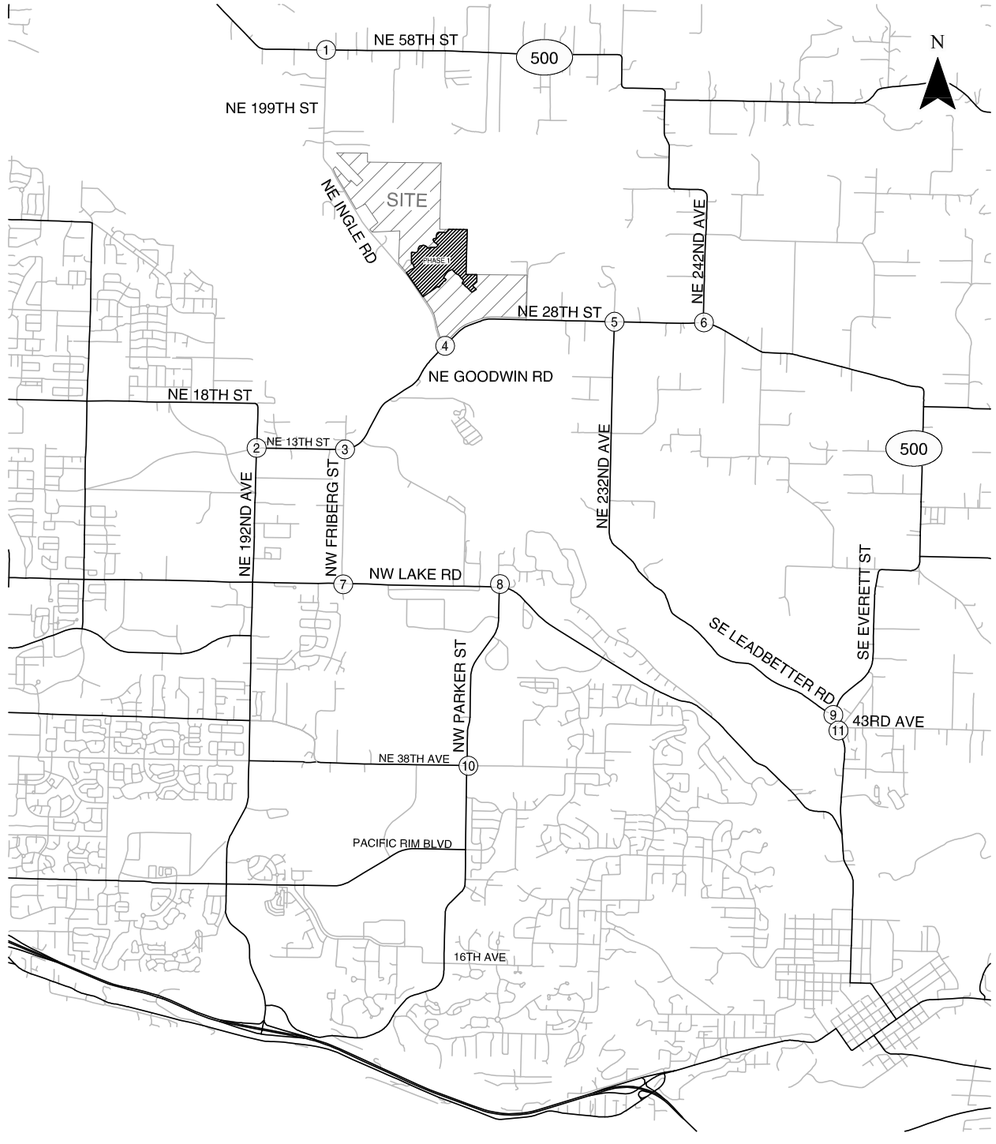
### *Operations at NE 192nd Avenue / NE 13th Street*

As noted in the "Analysis Methodology" section, analysis of the City of Vancouver-maintained NE 192nd Avenue/NE 13th Street intersection involved application of the peak 15-minute flow rate across the hour and not applying a peak hour factor. This analysis methodology is in accordance with guidance provided by the City.

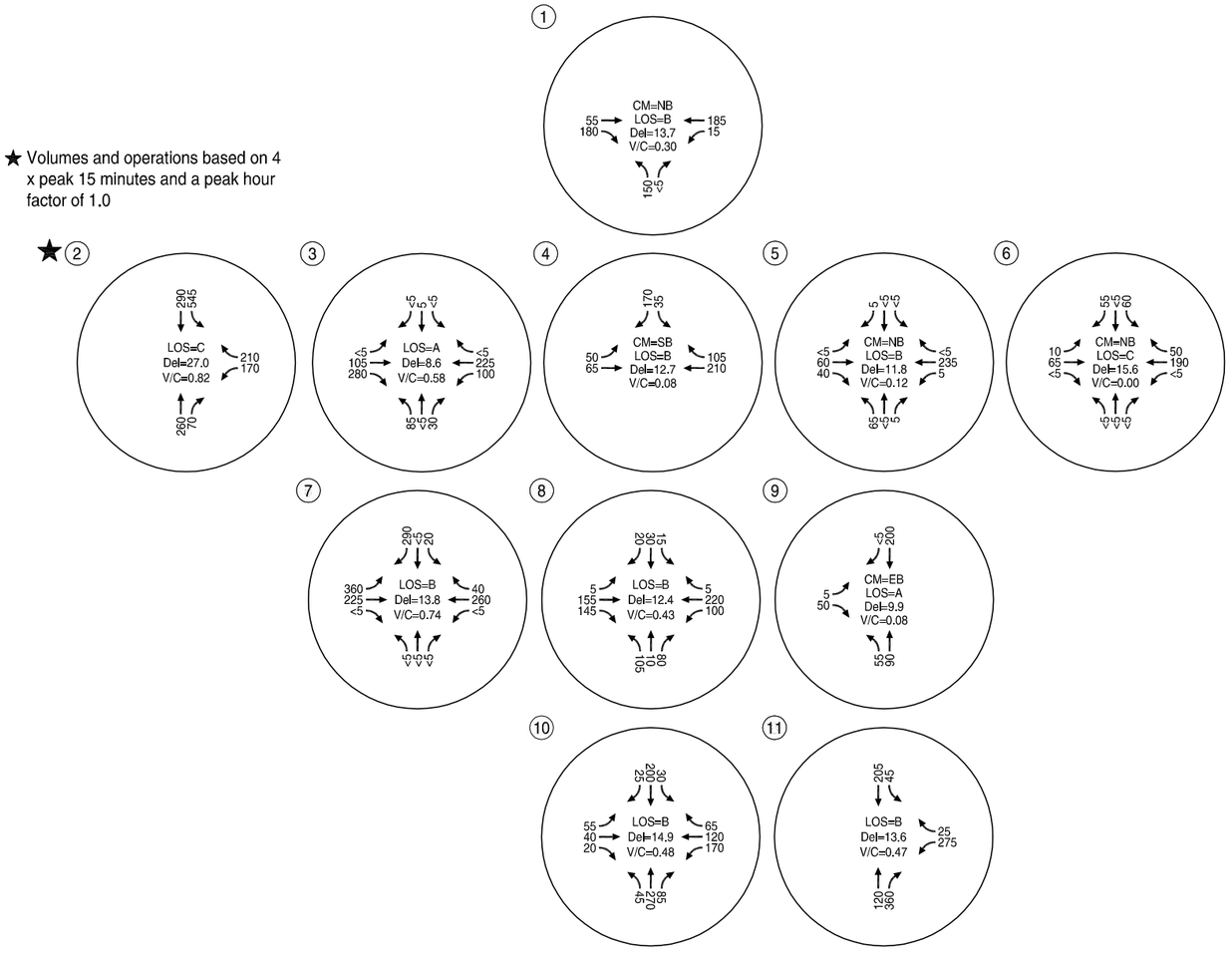
During the weekday AM peak hour, significant peaking occurs at the intersection related to vehicles accessing Union High School on NW Friberg Street. In particular, the southbound left-turning volume peaks in advance of the school start at 7:45 AM, as shown in Exhibit 3. During this "peak of the peak" period, queueing for the southbound left-turn lane sometimes exceeds the available striped storage (approximately 160 feet). Based on field observation, heightened delays and queueing for the southbound left-turn movement are contained to about fifteen minutes in advance of the school start, during which time some southbound left-turning vehicles do not clear through the intersection during each cycle. After this time, volumes decrease significantly and left-turning vehicles consistently clear through the intersection in a single cycle.

**Exhibit 3: Peak Hour Traffic Volumes at NE 192nd Avenue/NE 13th Street**





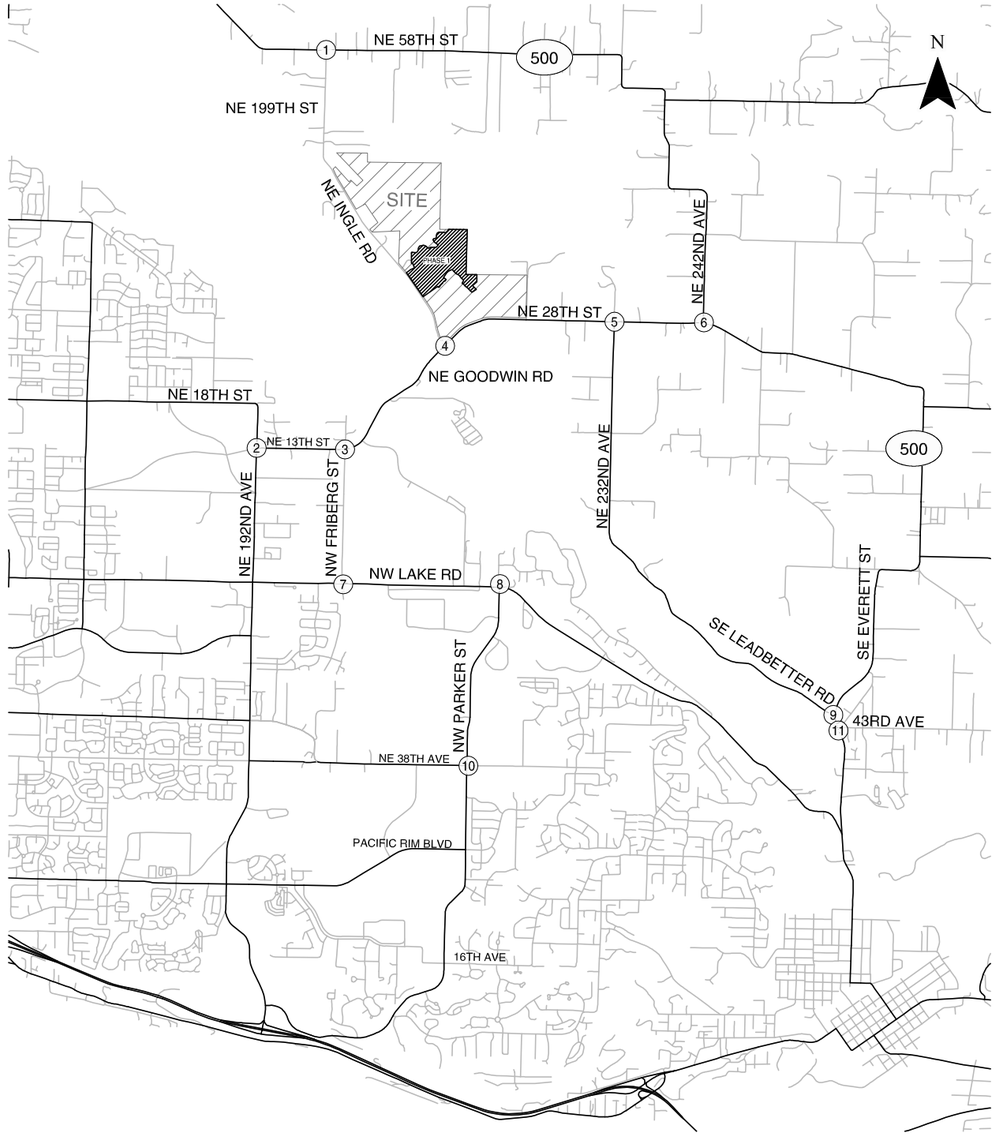

★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0




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

# Existing Intersection Operations Weekday AM Peak Hour Camas, Washington

Figure 4

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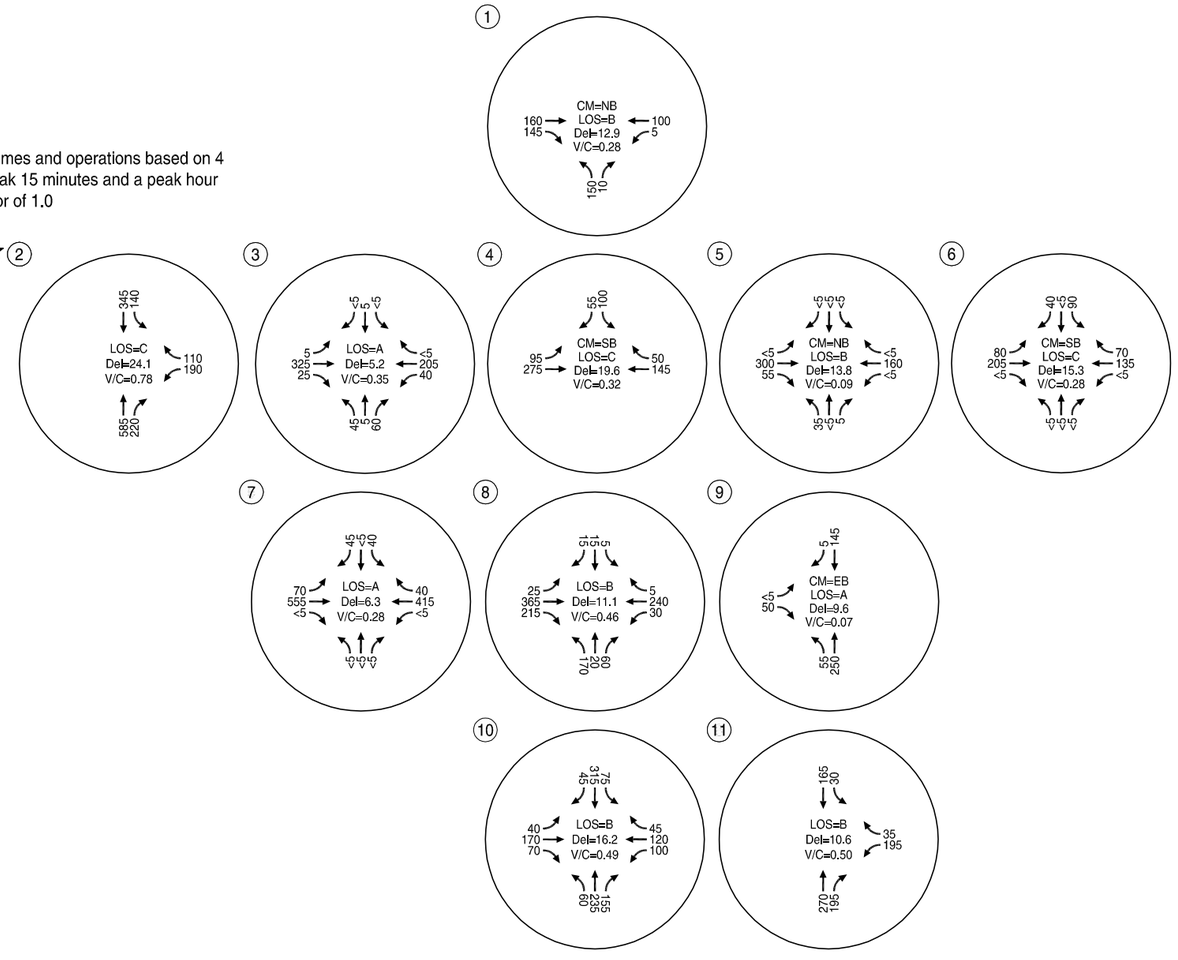


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TWSC = TWO-WAY STOP CONTROL

# Existing Intersection Operations Weekday PM Peak Hour Camas, Washington

Figure 5

# TRAFFIC IMPACT ANALYSIS

The traffic impact analysis identifies how the study area's transportation system will operate upon phased build-out of the proposed master plan site. A horizon year of 2018 was selected to assess conditions with build-out of Phase 1 while a 15-year 2029 horizon year was assumed for site build-out. The impact of site-generated weekday a.m. and p.m. peak hour trips was examined as follows:

- Planned developments and transportation improvements in the study area were identified and accounted for;
- Trip generation and distribution estimates for the proposed development were prepared for Phase 1 and full build-out of the proposed development;
- Forecast year 2018 background traffic conditions without the proposed development were analyzed at the study intersections;
- Forecast year 2018 total traffic conditions with completion of Phase 1 of the proposed development were analyzed at the study intersections;
- Forecast year 2029 background traffic conditions without the proposed development were analyzed at the study intersections;
- Forecast year 2029 total traffic conditions with full build-out and occupancy of the proposed development were analyzed at the study intersections; and
- On-site circulation and site-access operations were evaluated.

## Proposed Development Plan

Green Mountain Land, LLC is proposing to master plan the 283-acre site with mixed-use development. Green Mountain Golf Course is currently located on a large portion of the master plan property. We understand that a portion of the existing Green Mountain Golf Course may remain temporarily available for use after completion of Phase 1 site development and that, ultimately, the golf course will be closed prior to full master plan build-out. No effort has been made to account for "credit" for existing trips to and from the golf course for the purposes of this transportation impact analysis report.

The master plan proposes eight phases of development, with the sequence and timing of phases to be finalized pending market conditions. It is expected that Phase 1 will be completed by 2018 and full master plan build-out is assumed by 2029 for traffic impact assessment purposes. A mix of residential and commercial uses is planned in accordance with the zoning, with a mixed use village proposed to better integrate the commercially zoned portion of the property. The application seeks

approval of an overlay zone for a portion of the site intended for an urban village. The village would be located at the southwest corner of the project and will encompass approximately twenty-four acres.

For traffic impact study purposes, Phase 1 is assumed to consist of a residential component with 215 single-family detached homes. Full build-out of the master plan residential component assumed construction of up to 536 apartment units and 764 single-family detached homes. The retail portion of the proposed development plan was assumed to develop after Phase 1 and was assumed to be a 90,000 square-foot shopping center for trip generation purposes[1].

Access to Phase 1 development is anticipated along NE Ingle Road, with additional access added to NE Goodwin Road during later stages of the development. Final details of the number and location of site access points will be defined during preparation of individual site plan applications, therefore appropriate planning level assumptions have been made for master planning purposes. The proposed master plan anticipates two public street neighborhood circulator connections to NE Goodwin Road serving the site in conjunction with two public street neighborhood circulator connections along NE Ingle Road. The commercial site is expected to have direct driveway access to NE Ingle Road. Some residential areas (not individual residence driveways) not served by the anticipated neighborhood circulator facilities may also seek direct access to NE Ingle Road or NE Goodwin Road as appropriate.

### *Trip Generation*

Trip generation estimates for the proposed development were generated based on information provided in the standard reference manual *Trip Generation, 9th Edition* published by the Institute of Transportation Engineers (ITE – Reference 7). The internal and pass-by trip rates applied to each land use were also determined from ITE's *Trip Generation, 9th Edition.* Table 4 summarizes the daily, weekday a.m., and weekday p.m. peak-hour trips for the Phase 1 assumed development while Table 5 summarizes the complete master plan site trip generation estimate. All daily trips have been rounded to the nearest ten and all peak hour trips have been rounded to the nearest five trips.

[1] The unit mix for phase 1 and buildout was developed based on a reasonable worst-case scenario. Final development may result in a less-intense mix of residential units.

Table 4: Trip Generation Estimate – Phase 1

| Land Use | ITE Code | Size | Daily | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | In | Out | Total | In | Out |
| Single-Family Detached Housing | 210 | 215 units | 2,050 | 160 | 40 | 120 | 215 | 135 | 80 |

Table 5: Trip Generation Estimate – Build-out (Includes Phase 1)

| Land Use | ITE Code | Size | Daily | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | In | Out | Total | In | Out |
| Apartment | 220 | 536 units | 3,570 | 275 | 55 | 220 | 330 | 215 | 115 |
| Single-Family Detached Housing | 210 | 764 units | 7,270 | 575 | 145 | 430 | 765 | 480 | 285 |
| **Total Residential (1,300 units)** | | | **10,840** | **850** | 200 | 650 | 1,095 | 695 | 400 |
| *Internalization (6% Daily, 5% PM)* | | | 630 | 0 | 0 | 0 | 60 | 30 | 30 |
| Shopping Center | 820 | 90,000 square feet | 6,340 | 145 | 90 | 55 | 560 | 270 | 290 |
| *Internalization (10% Daily, 11% PM)* | | | *630* | *0* | *0* | *0* | *60* | *30* | *30* |
| *Pass-By Trips (34%)* | | | *1,940* | *50* | *25* | *25* | *170* | *85* | *85* |
| Total Trips | | | 17,180 | 995 | 290 | 705 | 1,655 | 965 | 690 |
| *Less Internalization* | | | *1,260* | *0* | *0* | *0* | *120* | *60* | *60* |
| *Less Pass-by trips* | | | *1,940* | *50* | *25* | *25* | *170* | *85* | *85* |
| ***Net New Trips for Full Build-out*** | | | ***13,980*** | ***945*** | ***265*** | ***680*** | ***1,365*** | ***820*** | ***545*** |

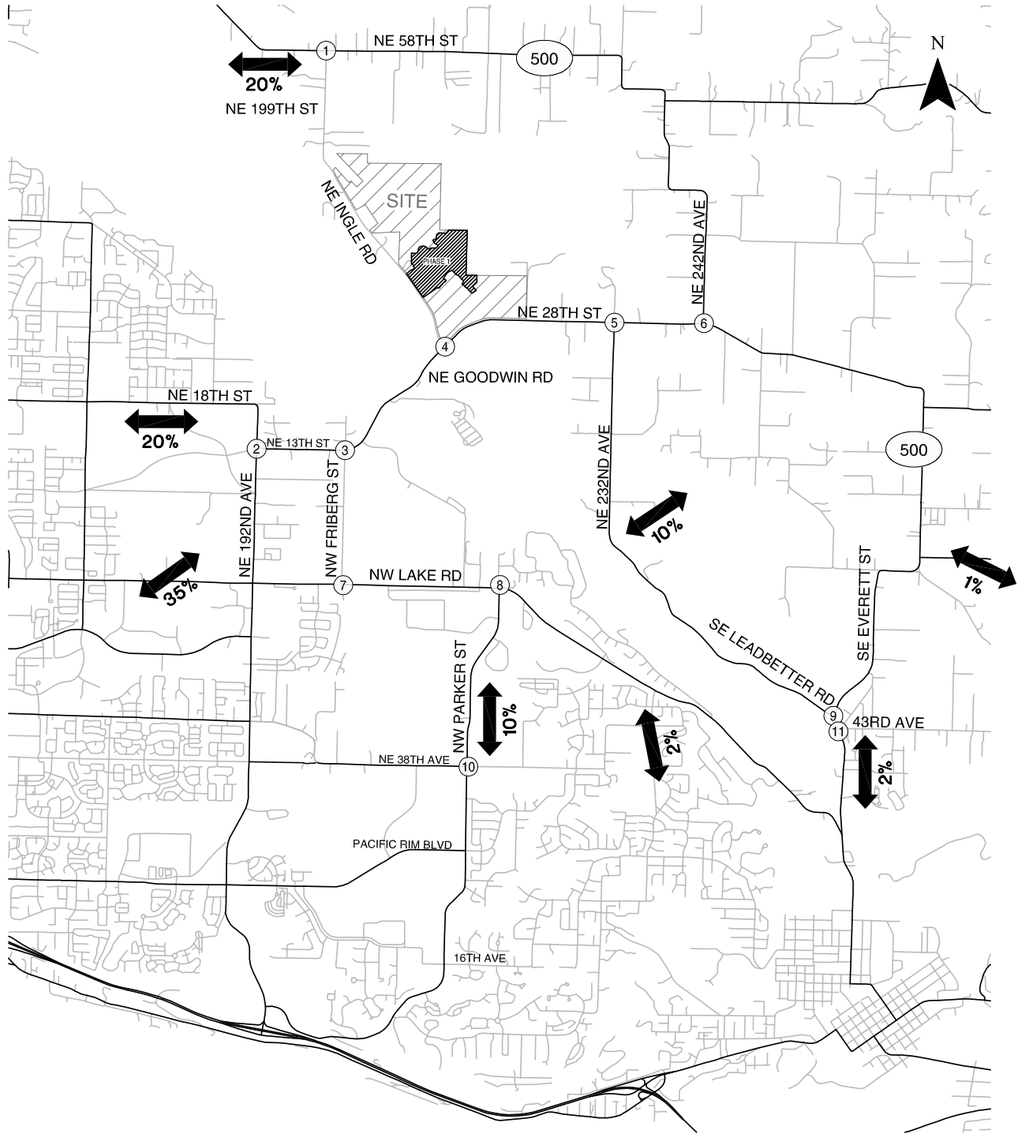
### *Trip Distribution*

The distribution of site-generated trips onto the study area roadway system was estimated based on a review of surrounding roadway characteristics, existing uses, the 2035 travel demand model maintained by the Southwest Washington Regional Transportation Council (RTC), and review agency guidance. Trip distribution patterns were developed separately for the residential and retail trips. Figure 6 illustrates the trip distribution patterns for the residential and retail trips.

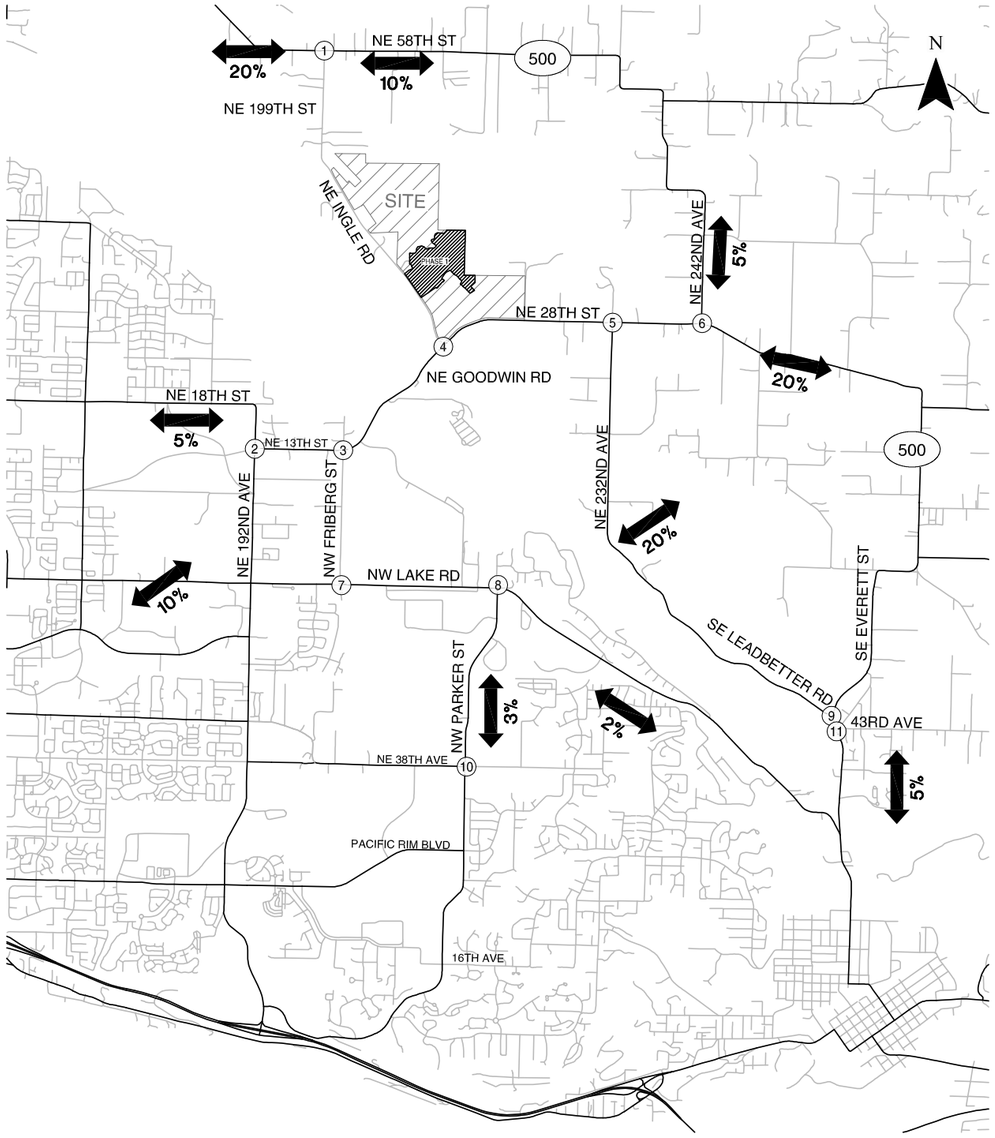
### *Trip Assignment*

The weekday a.m. and p.m. peak hour site trips shown in Tables 4 and 5 were assigned to the roadway network based on the trip distribution patterns shown in Figure 6. Figures 7 through 10 show the assignment of site-generated trips during the weekday a.m. and p.m. peak hours for Phase 1 and at Build-out. Note that the site-generated build-out volumes shown in Figures 9 and 10 include the Phase 1 site-generated trips and thus reflect the total number of trips generated. *A figure showing the assignment of pass-by trips is provided in Appendix "E".*

RESIDENTIAL DISTRIBUTION:

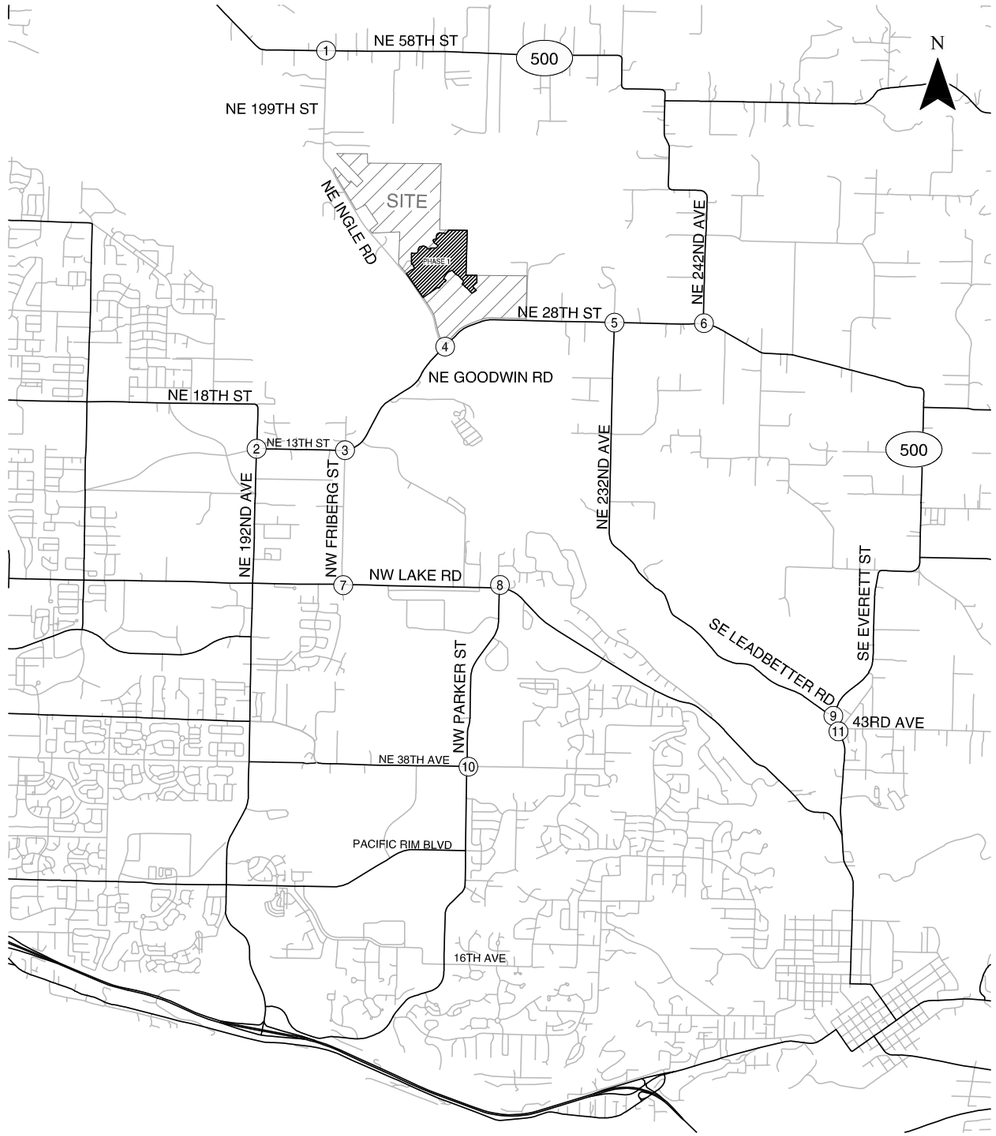


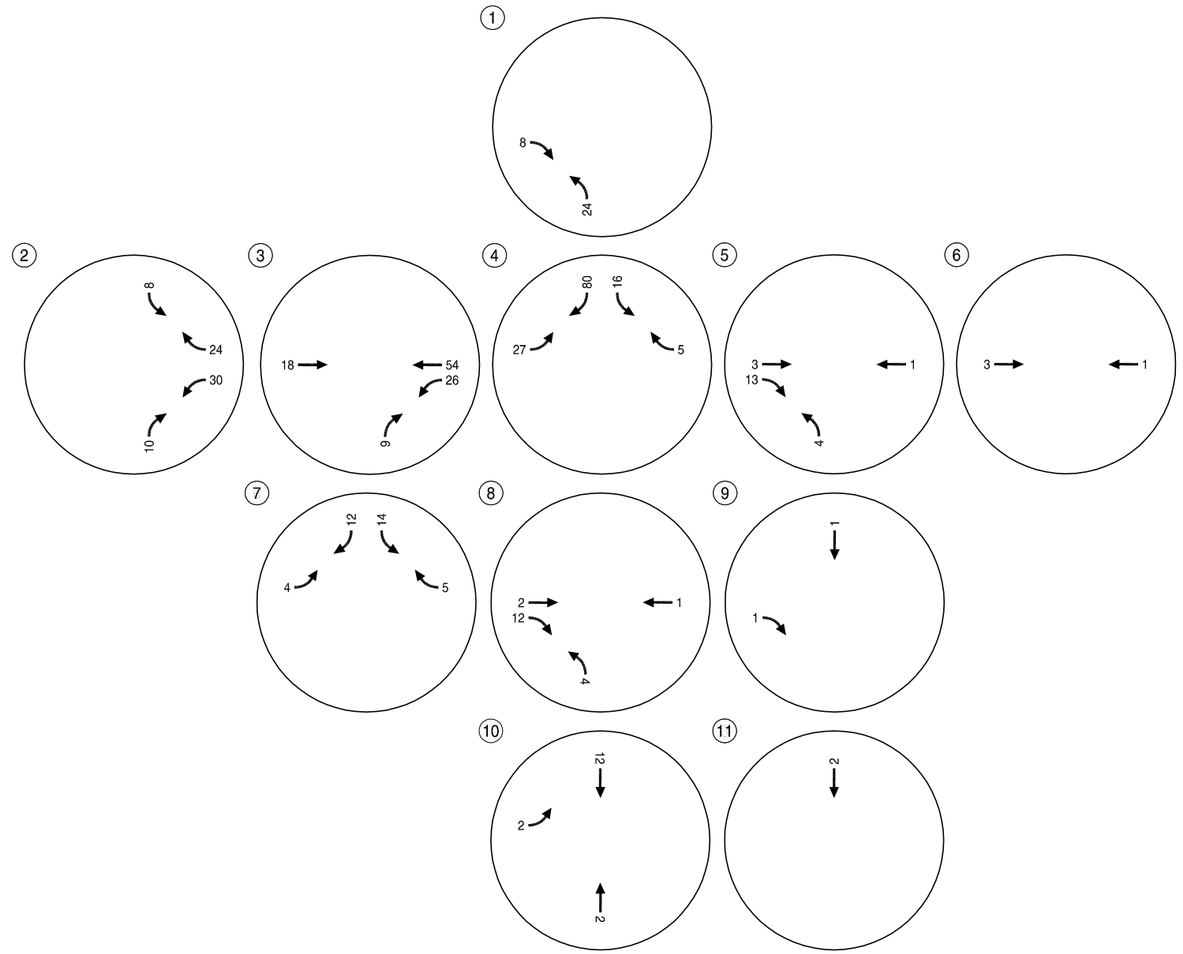

RETAIL DISTRIBUTION:




Estimated Trip Distribution Pattern
Camas, Washington

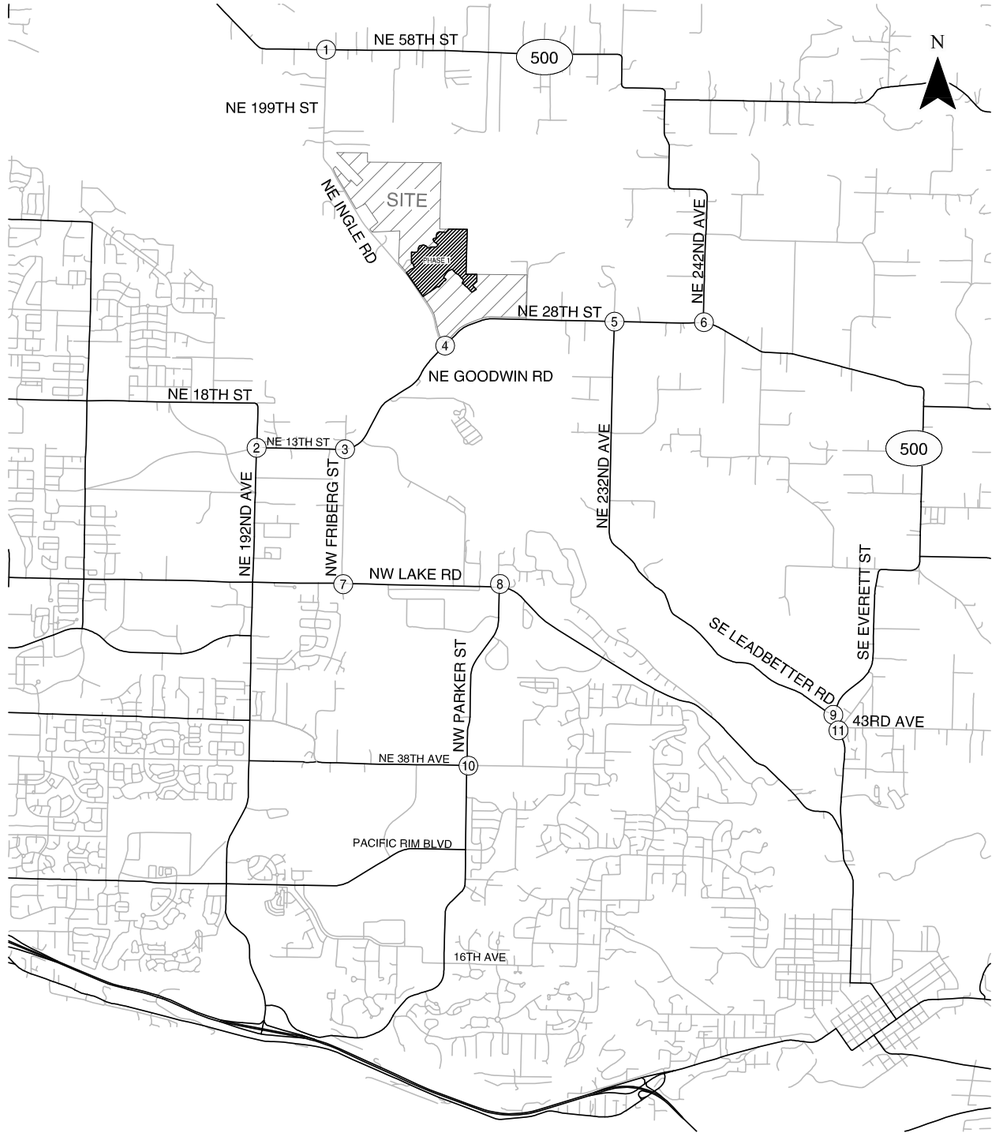
Figure
6

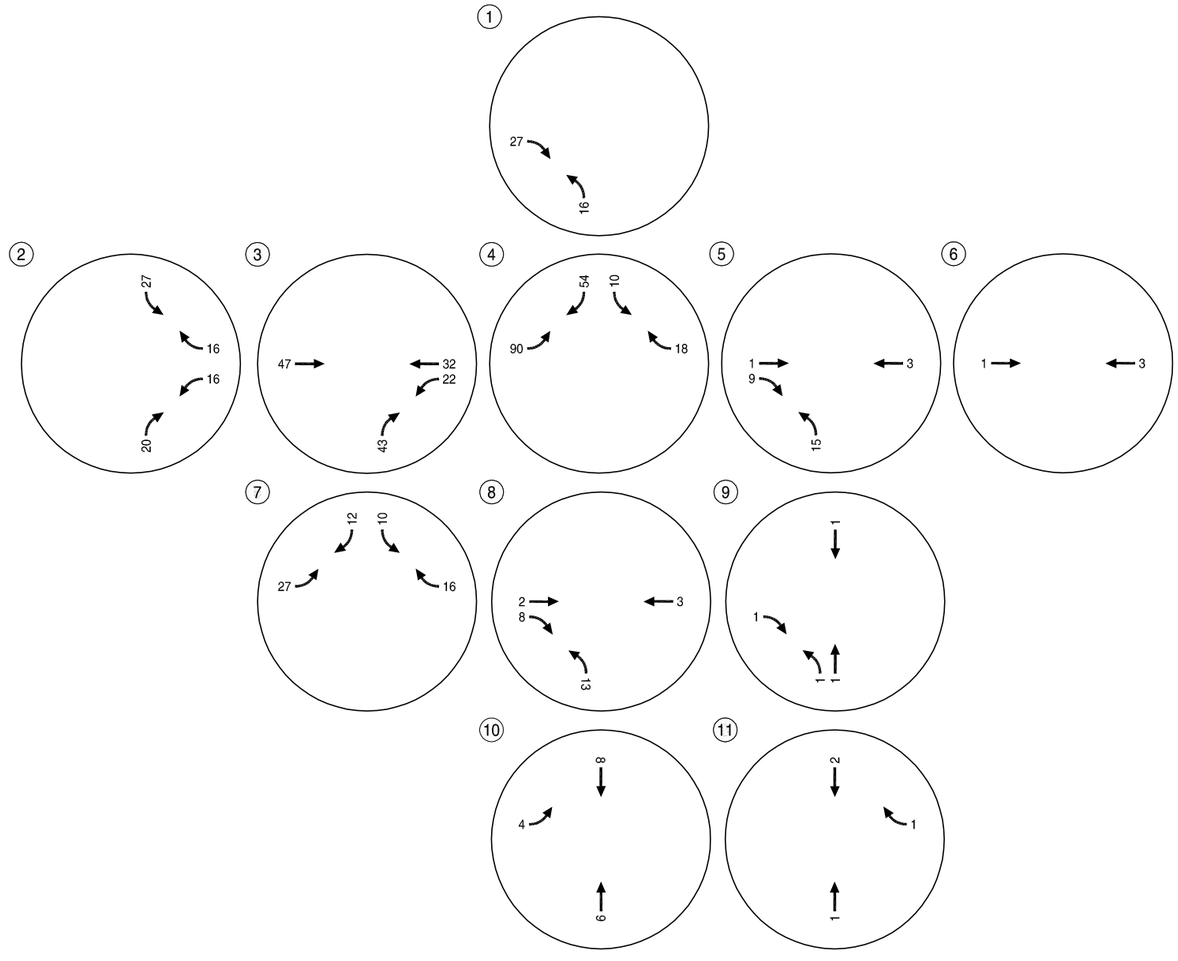



Total Estimated Trip Assignment - Phase 1
Weekday AM Peak Hour
Camas, Washington

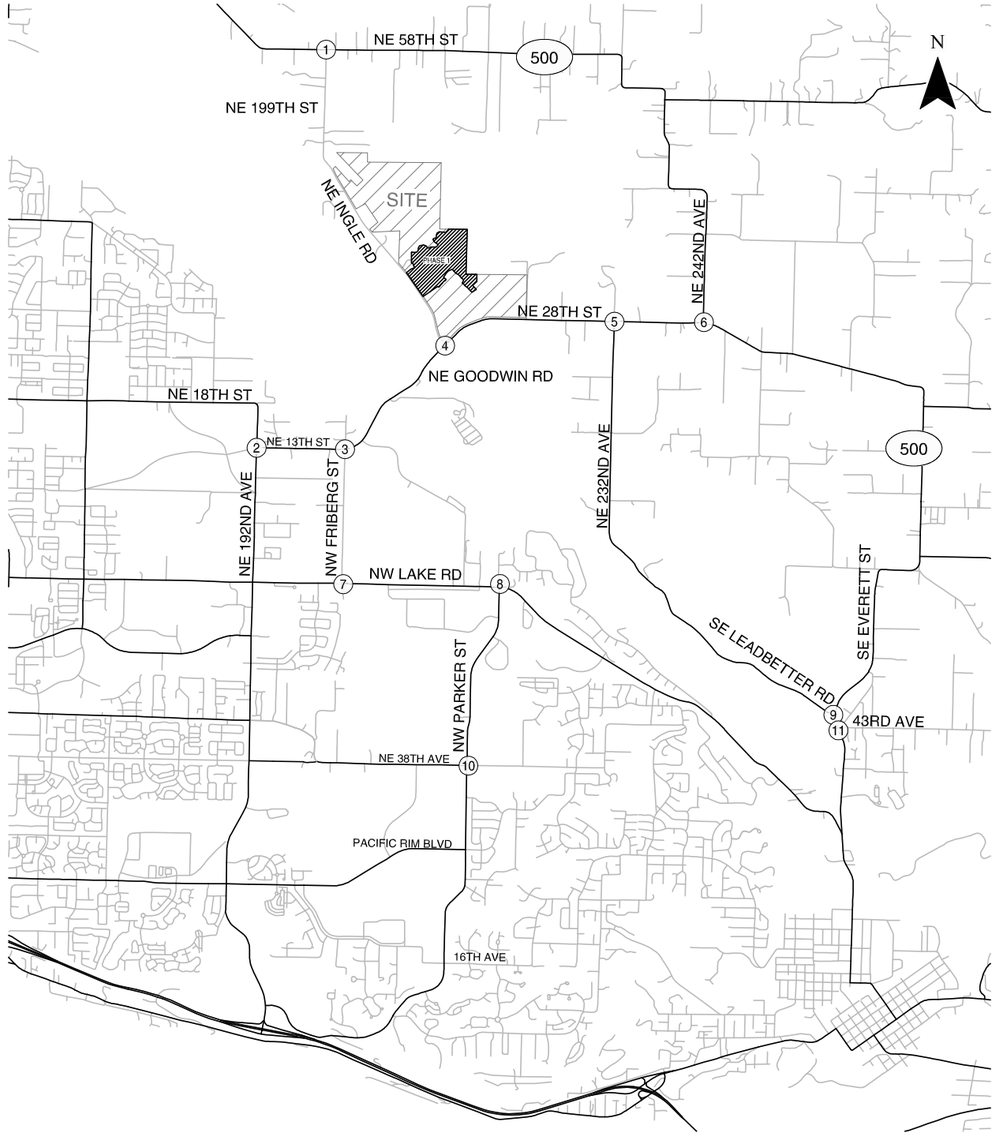
Figure
7

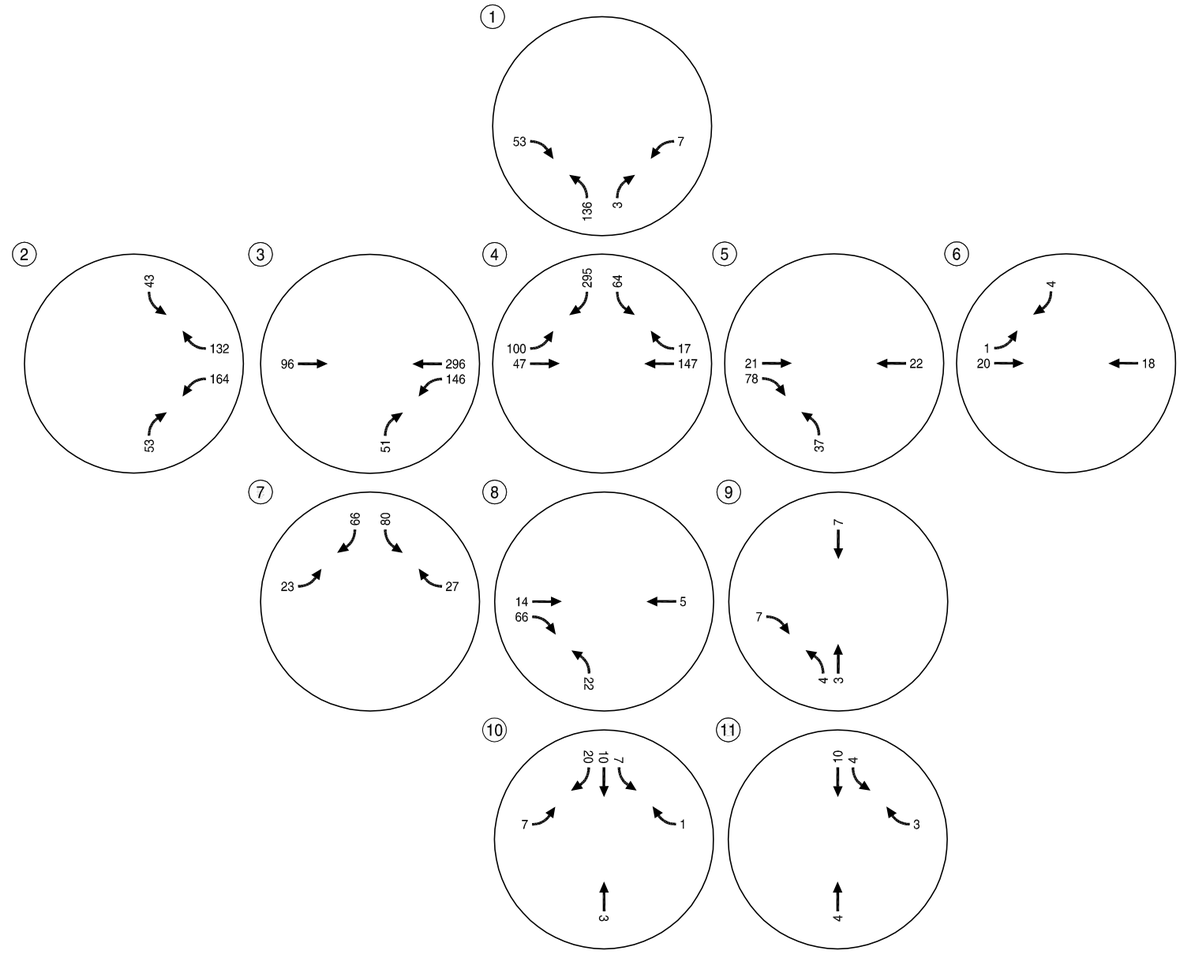



Total Estimated Trip Assignment - Phase 1
Weekday PM Peak Hour
Camas, Washington

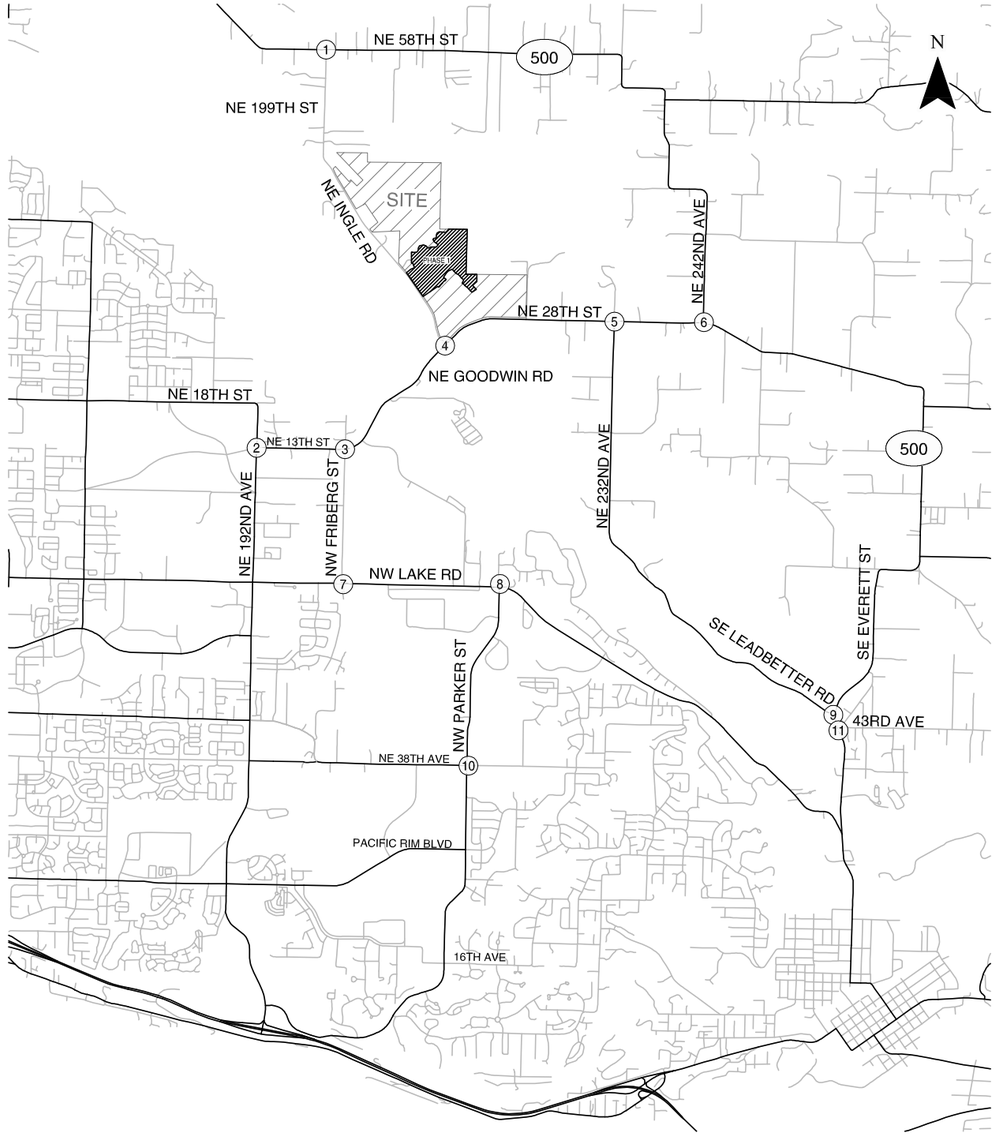
Figure
8

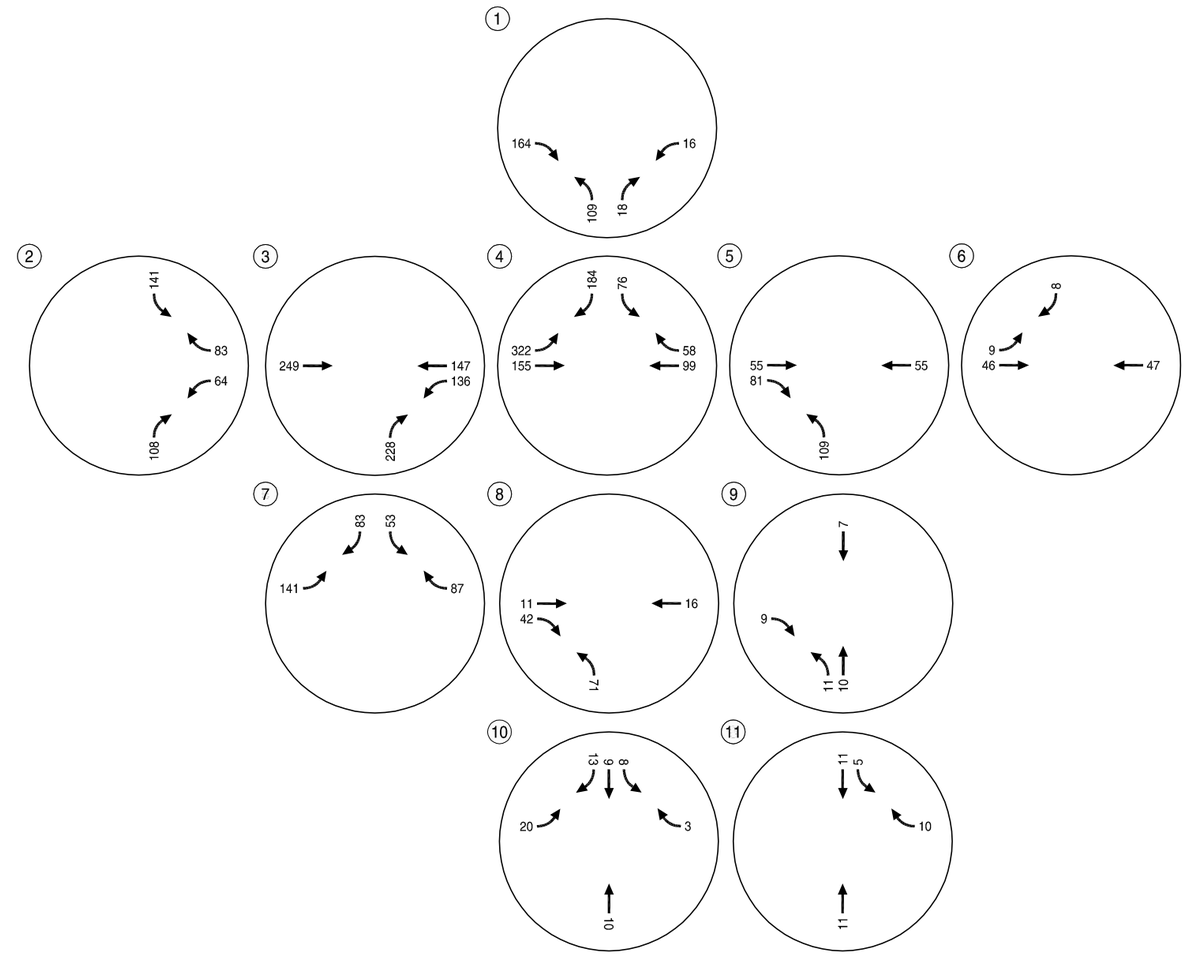



Total Estimated Trip Assignment - Full Build-Out
Weekday AM Peak Hour
Camas, Washington

Figure
9




Total Estimated Trip Assignment - Full Build-Out
Weekday PM Peak Hour
Camas, Washington

Figure
10

## 2018 Background Traffic Conditions

The 2018 background traffic analysis projects how the study area's transportation system will operate during the year that Phase 1 of the proposed development is expected to be completed. This analysis includes traffic growth due to previously approved in-process developments within the study area, but does not include traffic from any of the proposed Green Master Plan development phases. Per agency direction, no growth was applied to City of Camas roadways and a 2% growth rate was applied to City of Vancouver roadways (Reference 8).

### *Planned Developments and Transportation Improvements*

City of Camas staff identified 13 local development projects that are approved but not yet occupied. These in-process developments include:

- Lake Hills
- Two Creeks
- The Summit at Columbia Vista
- Parker Village
- The Hills at Round Lake
- North Hills Subdivision
- Brady Road Subdivision
- Deerhaven Subdivision
- Hadley's Glen
- Millshore Downs
- Fisher Creek Campus
- Lacamas Prairie
- 192nd Plaza West

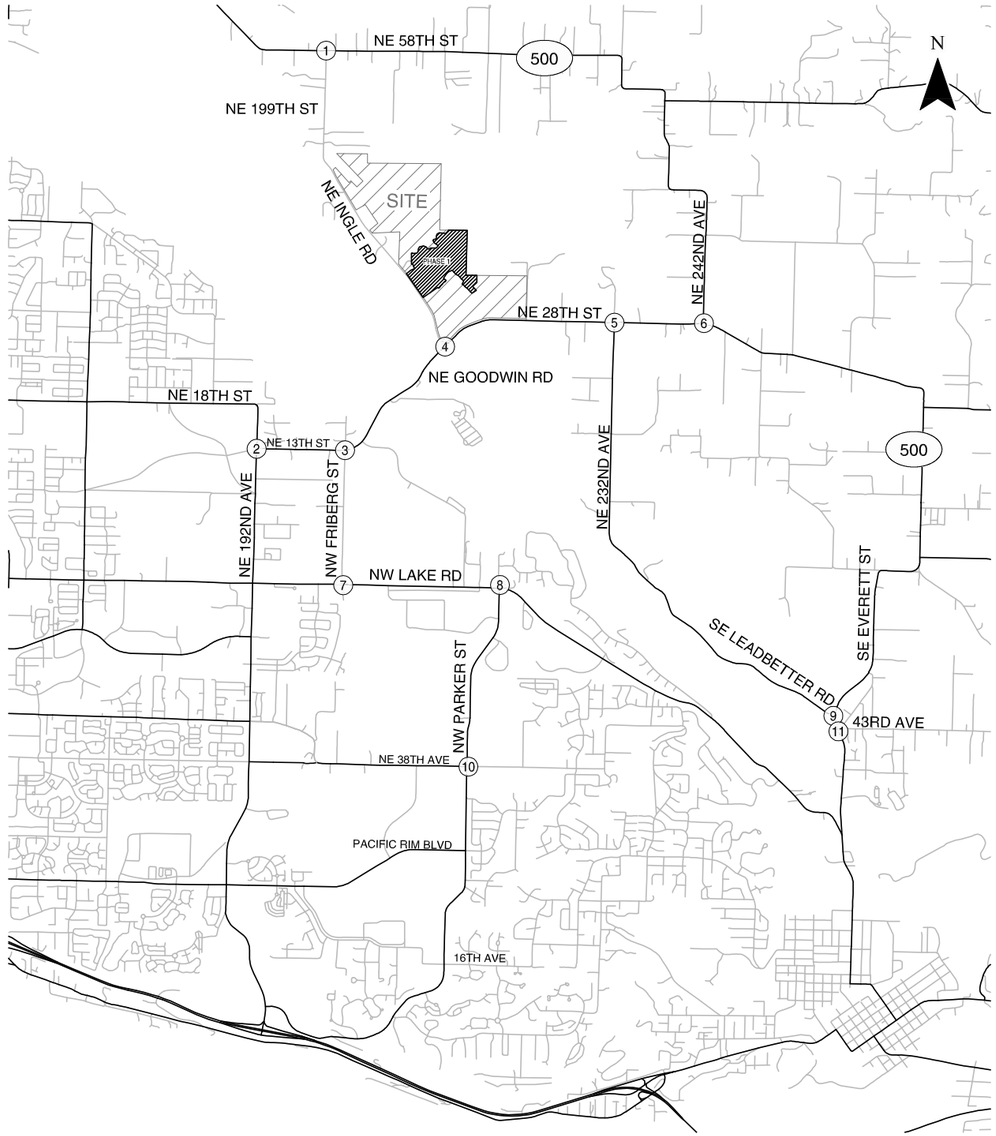
*Appendix "F" contains the data received pertaining to the in-process trips.*

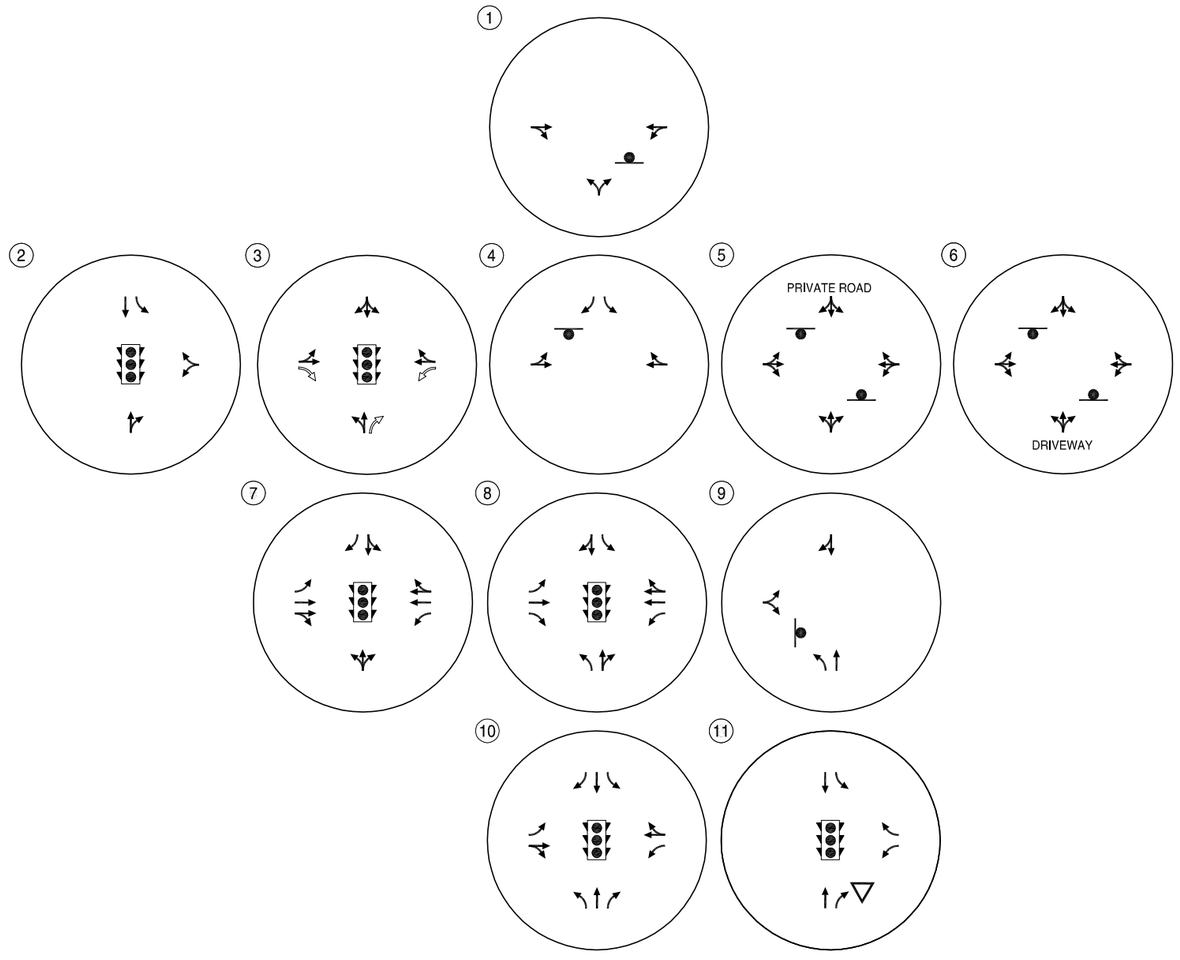
Planned and funded transportation improvements within the study area include the widening of NW Friberg Street (between Lake Road and NE 13th Street) and the addition of a westbound left-turn lane, northbound right-turn lane, and eastbound right-turn lane at the NW Friberg Street/NE Goodwin Road intersection. Figure 11 shows the lane configuration and traffic control devices assumed in the 2018 analysis.

### *Traffic Operations*

Figures 12 and 13 summarize the year 2018 background traffic operations analysis results at the study intersections for the weekday a.m. and weekday p.m. peak-hours, respectively. The projected turning movement counts are rounded to the nearest five vehicles per hour. As shown, the study intersections operate acceptably during the weekday a.m. and weekday p.m. peak periods in the 2018 background conditions.

*Appendix "G" contains the 2018 background conditions traffic operations worksheets.*

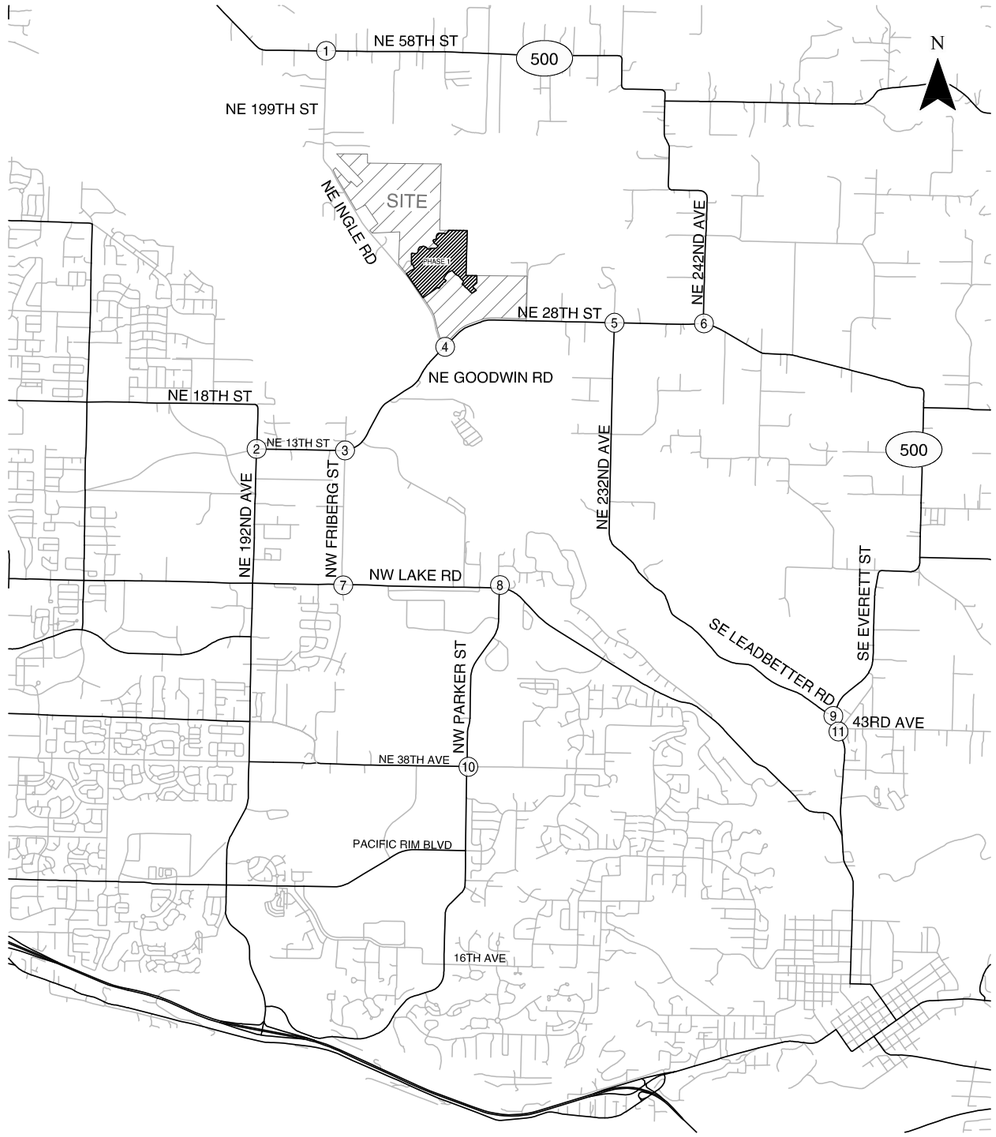


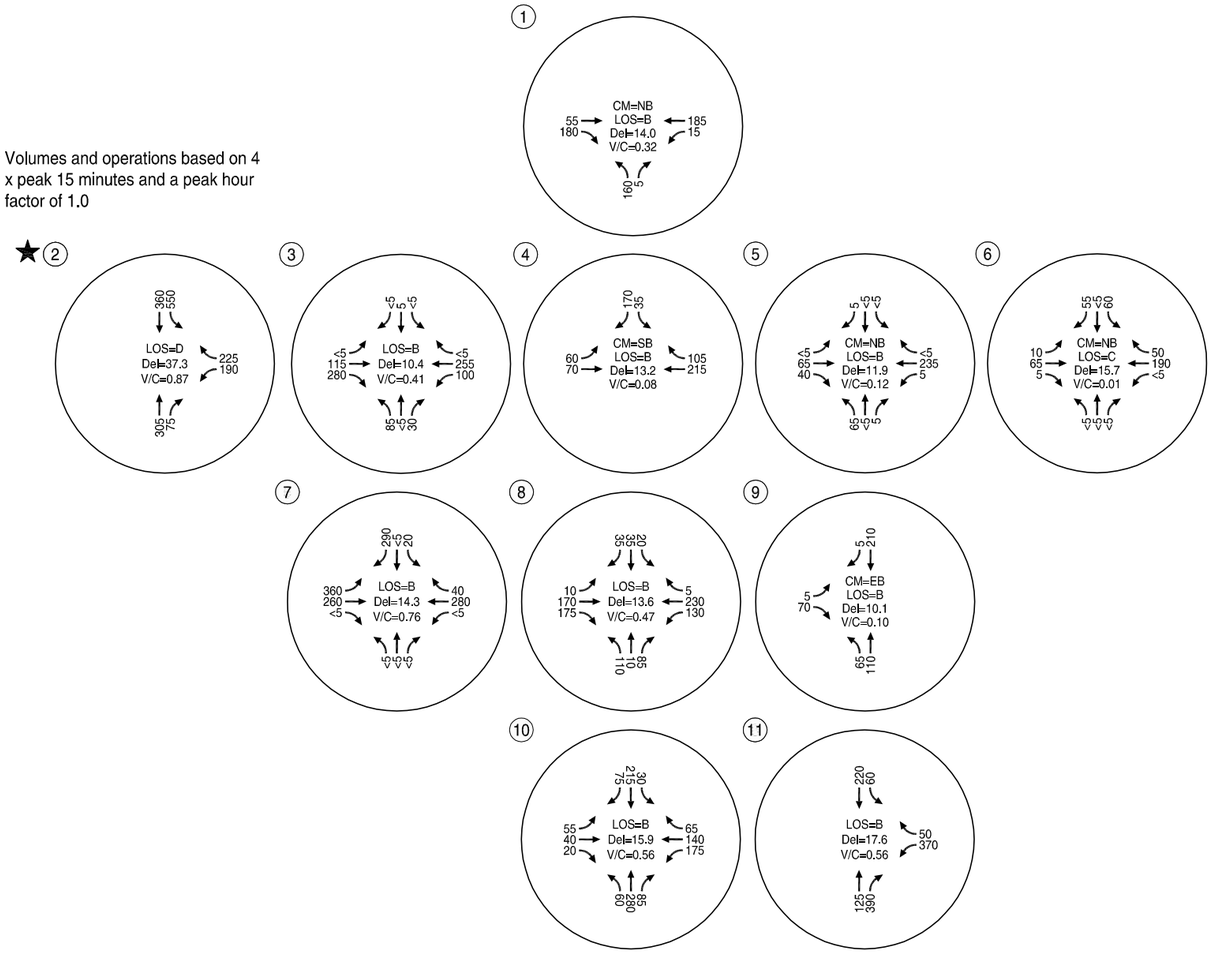

- STOP SIGN
- TRAFFIC SIGNAL
- YIELD SIGN
- PLANNED IMPROVEMENT

Year 2018 Lane Configurations and Traffic Control Devices
Camas, Washington

Figure
11



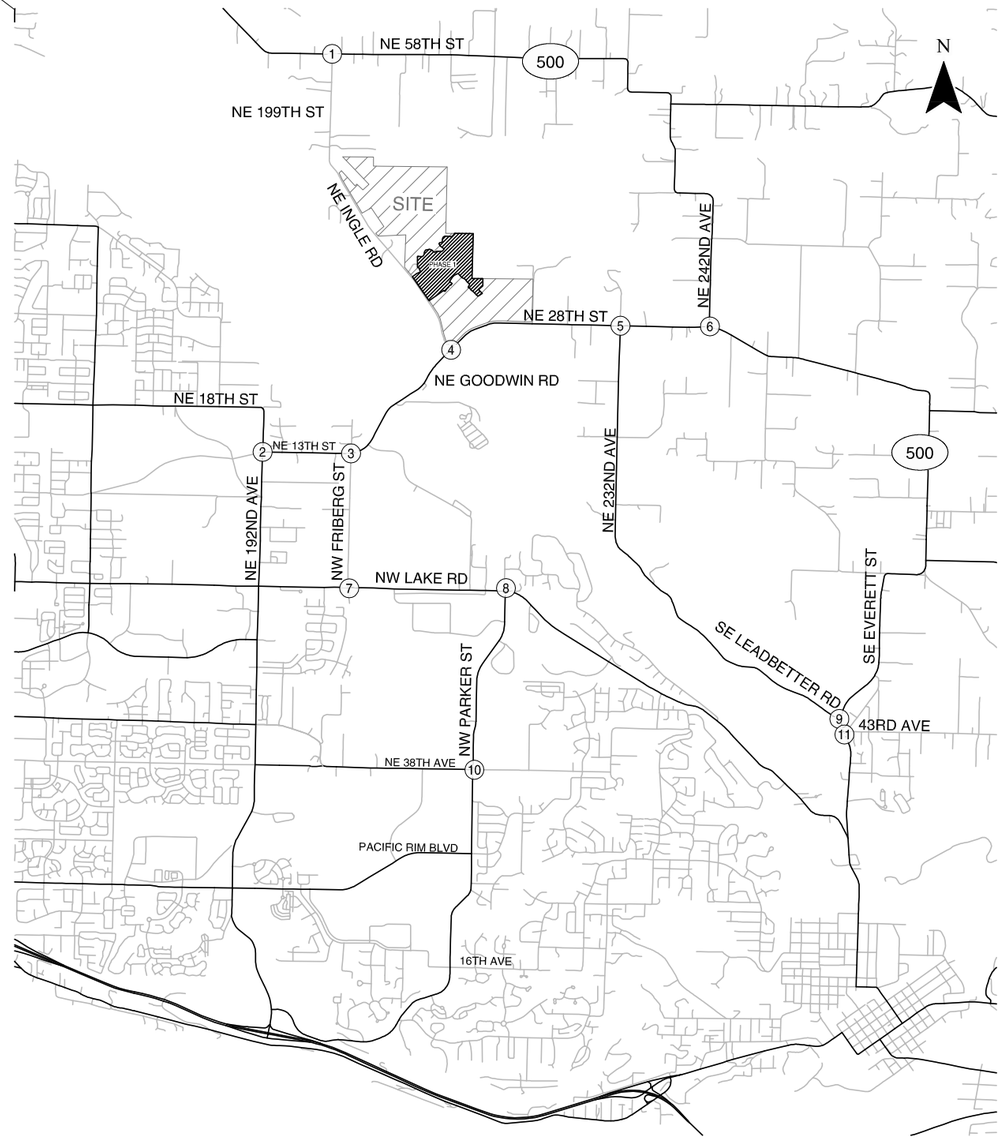

★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0



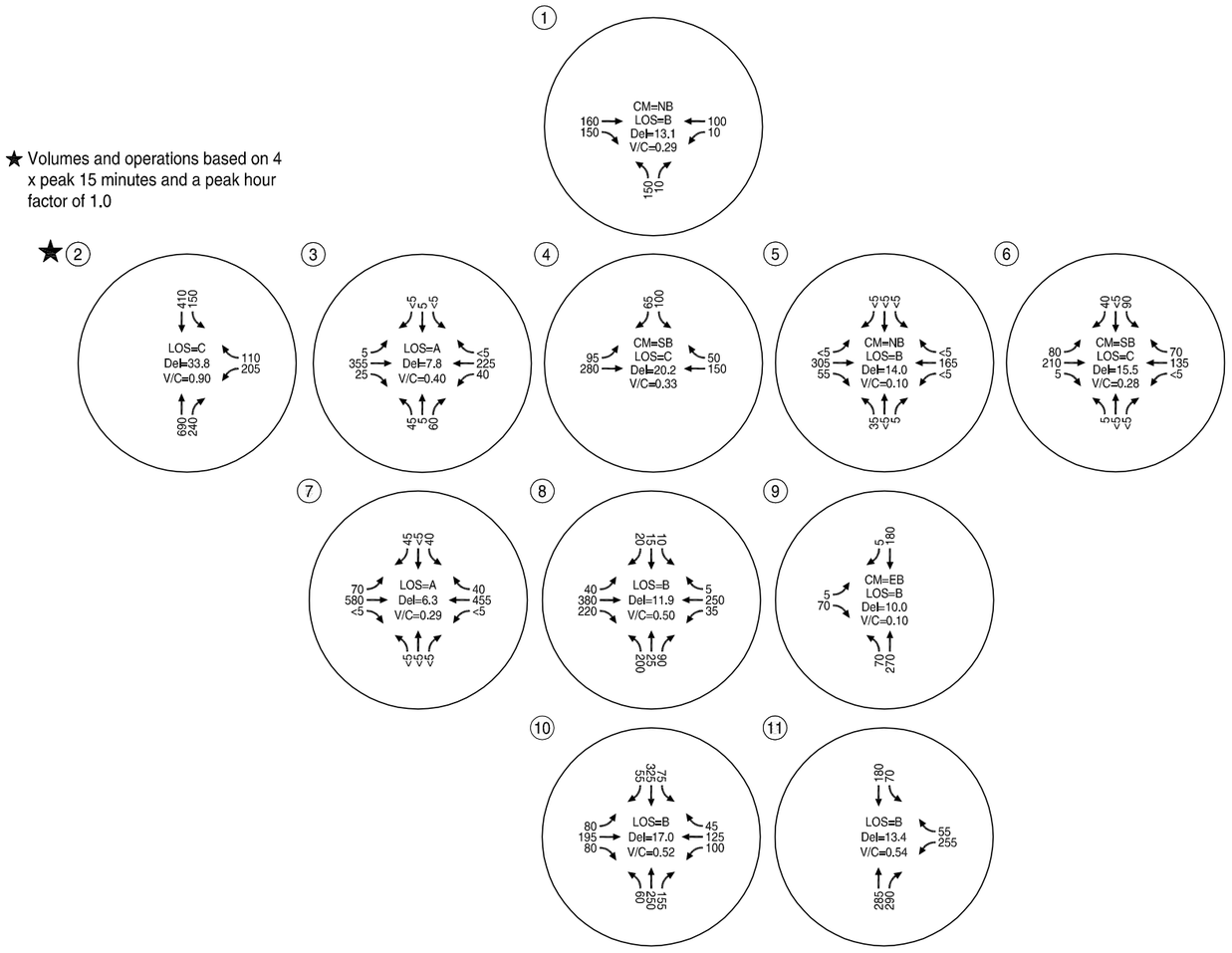

CM = CRITICAL MOVEMENT (TWSC)
LOS = INTERSECTION LEVEL OF SERVICE (SIG) / CRITICAL MOVEMENT LEVEL OF SERVICE (TWSC)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIG / CRITICAL MOVEMENT CONTROL DELAY (TWSC)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO
TWSC = TWO-WAY STOP CONTROL

# 2018 Background Conditions Weekday AM Peak Hour Camas, Washington

Figure 12




★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0




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

2018 Background Conditions
Weekday PM Peak Hour
Camas, Washington

Figure
13

## 2018 Total Traffic Conditions

The year 2018 total traffic analysis forecasts how the study area's transportation system will operate with the addition of traffic from Phase 1 of the proposed development. Phase 1 site-generated trips were added to the 2018 background traffic volumes at the study intersections to arrive at the total traffic volumes.

All lane configurations are consistent with background conditions with the exception of the intersection of NE Ingle Road/NE Goodwin Road. The developer proposes to construct an exclusive eastbound left-turn lane on NE Goodwin Road at NE Ingle Road in conjunction with the Phase 1 site development. Consequently, provision of the turn lane was assumed for the total traffic analysis.

### *Traffic Operations*

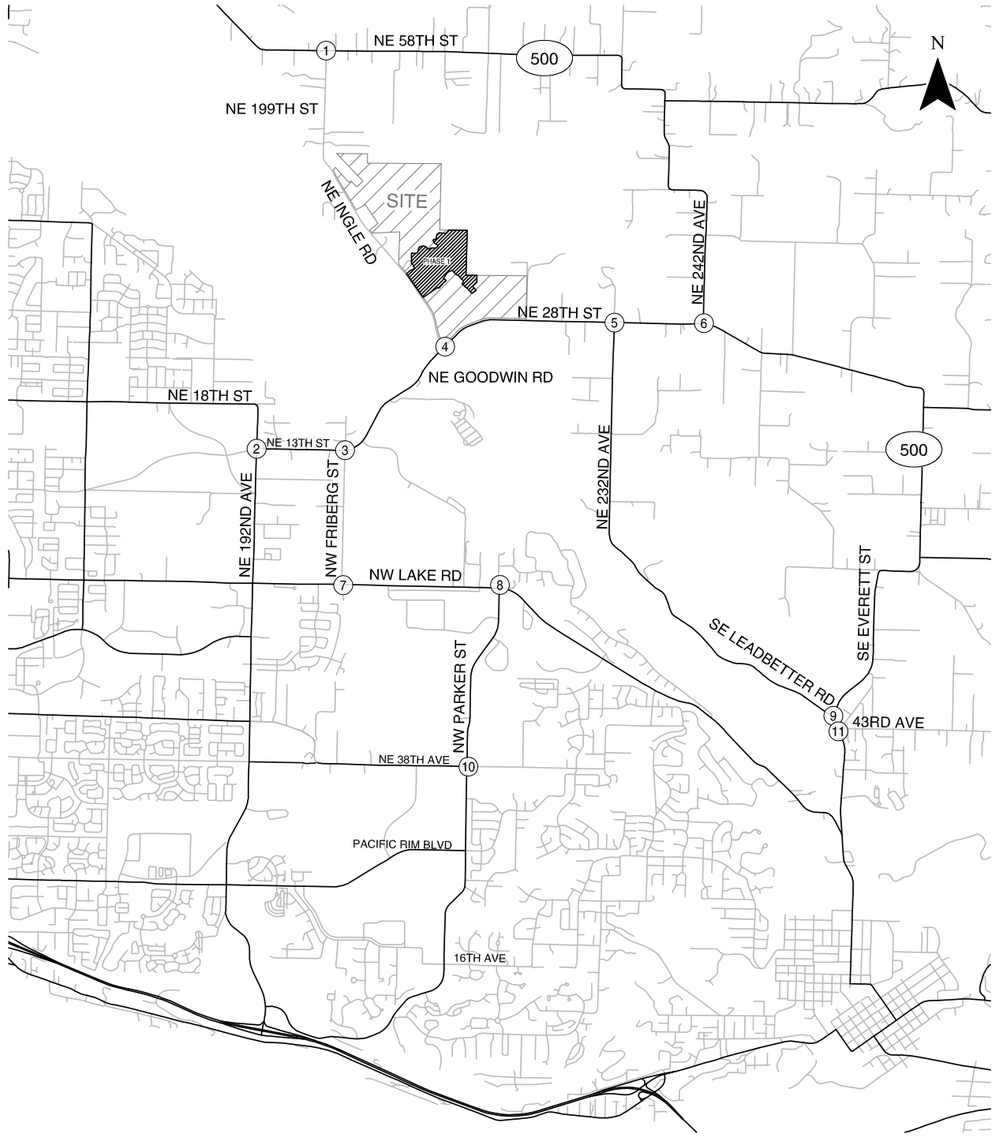
Figures 14 and 15 summarize the year 2018 total traffic operations analysis results at the study intersections for the weekday a.m. and weekday p.m. peak-hours, respectively. The projected turning movement counts are rounded to the nearest five vehicles per hour. As shown, all but one of the study intersections are forecast to operate acceptably during the weekday a.m. and p.m. peak periods under 2018 total traffic conditions. The southbound movement at the intersection of NE Ingle Road/NE Goodwin Road is anticipated to operate at a LOS E during the weekday p.m. peak hour. Operations at this intersection could be mitigated with the addition of an eastbound right-turn lane. Based on a sensitivity analysis, this mitigation is triggered by the 203$^{rd}$ unit to be constructed. Up until this point, the southbound left-turn lane is forecast to operate at a LOS D. Table 6 provides the operations at NE Ingle Road/NE Goodwin Road during the weekday PM peak hour supporting the sensitivity analysis.

Table 6: NE Ingle Road/NE Goodwin Road Operations Assessment – weekday PM peak hour

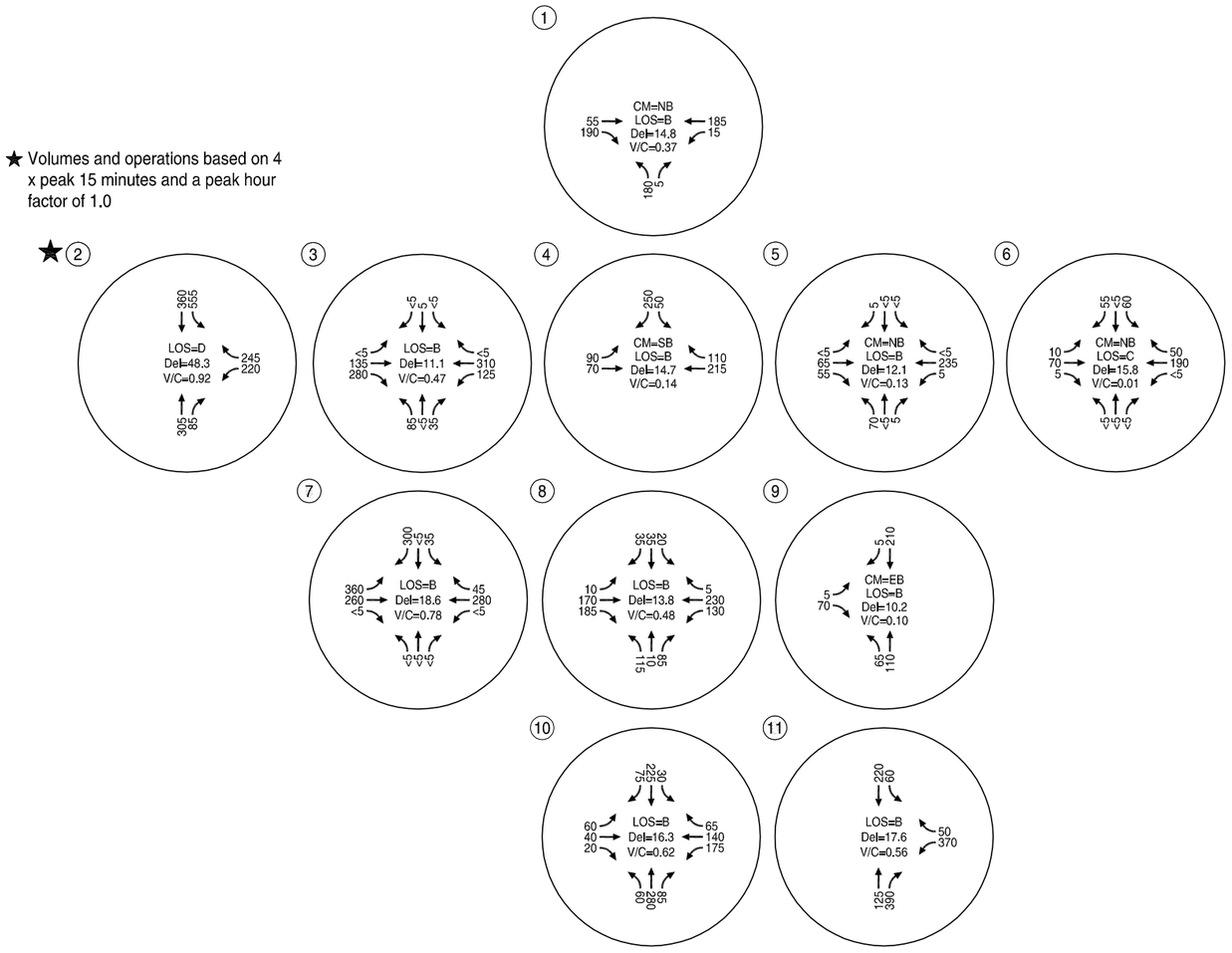
| Scenario | Critical Movement | LOS | v/c ratio |
|---|---|---|---|
| 2018 Background Conditions | SBL | C | 0.33 |
| 2018 Background + 200 Homes | SBL | D | 0.52 |
| 2018 Background + 203 homes | SBL | E | 0.53 |
| 2018 Total Traffic (215 homes) | SBL | E | 0.53 |
| 2018 Total Traffic (2015 homes) – mitigated[1] | SBL | D | 0.51 |

Notes: LOS = Level of Service; v/c ratio = volume-to-capacity ratio
[1]Mitigation includes provision of westbound right-turn lane

*Appendix "H" contains the 2018 total traffic conditions traffic operations worksheets. Appendix "I" contains the traffic operations worksheets supporting the sensitivity analysis at NE Ingle Road/NE Goodwin Road.*




★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0

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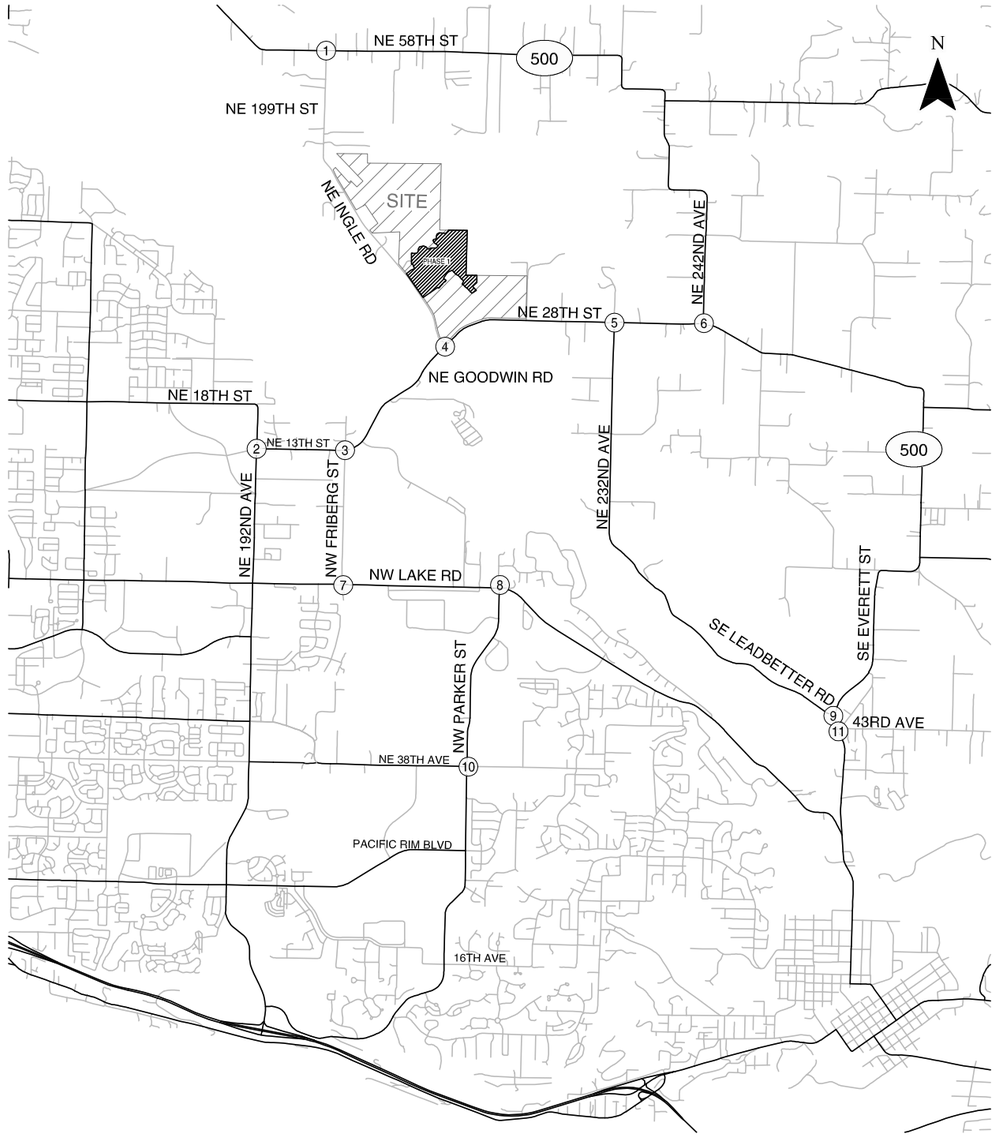
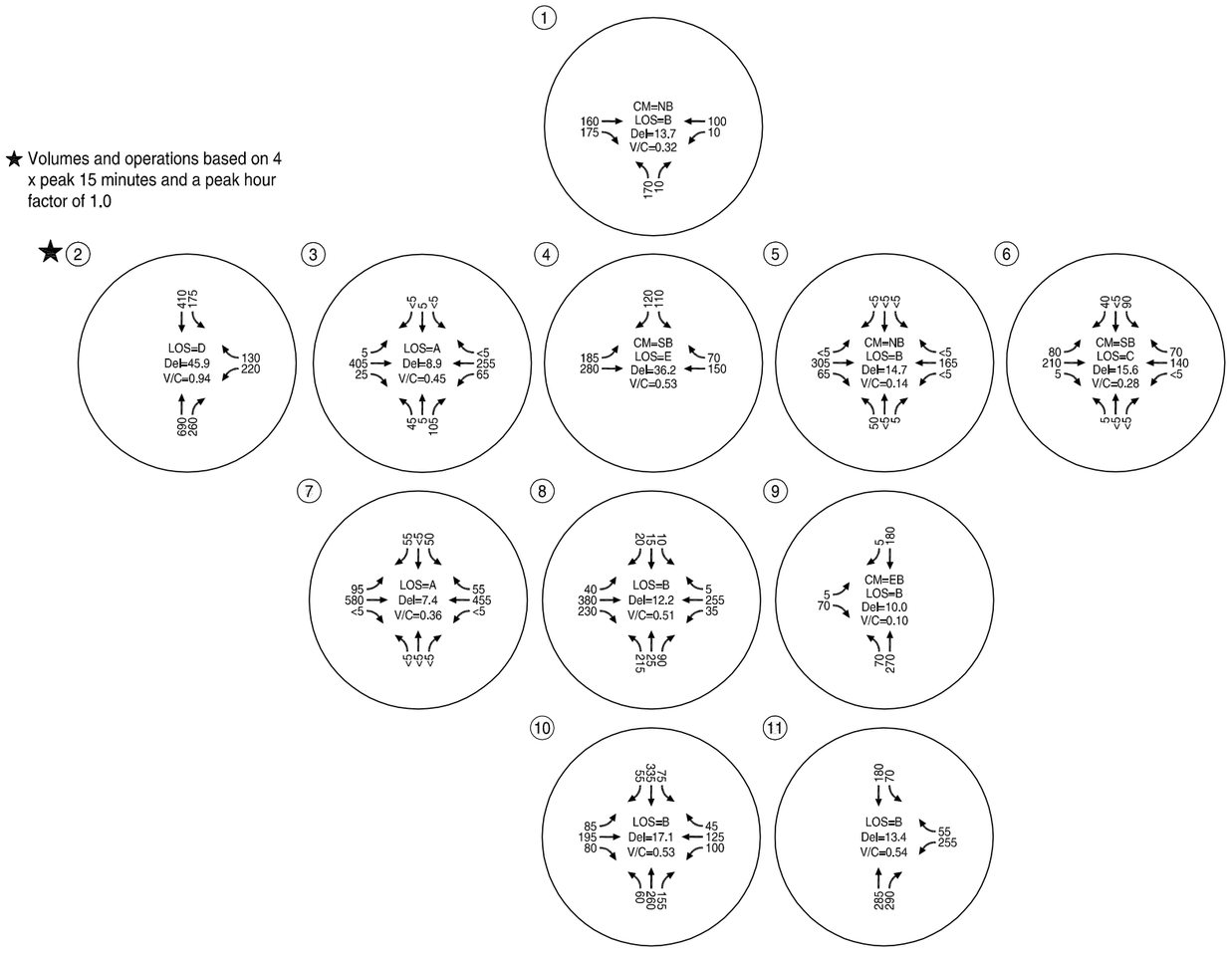
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO
TWSC = TWO-WAY STOP CONTROL

## 2018 Total Traffic Conditions (Phase 1)
## Weekday AM Peak Hour
## Camas, Washington

Figure
14




★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0

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TWSC = TWO-WAY STOP CONTROL

## 2018 Total Traffic Conditions (Phase 1)
## Weekday PM Peak Hour
## Camas, Washington

Figure
15

## 2029 Background Traffic Conditions

The 2029 background traffic analysis identifies how the study area's transportation system will operate with regional growth, including completion of Phase 1 development. No further funded transportation improvement projects were identified at the study intersections that would be in place prior to the year 2029. In addition to the previously described in-process development, a one percent annual growth rate was applied to the 2018 background traffic volumes on City of Camas roadways to account for regional growth in the area per staff direction. Continued use of a two percent annual growth rate was assumed to the City of Vancouver roadways (NE 192nd Avenue).

The same lane configurations used in the 2018 analysis were assumed, with the exception of the configuration at NE Ingle Road/NE Goodwin Road. As previously noted, the developer proposes to construct an exclusive eastbound left-turn lane at the intersection in conjunction with the Phase 1 site development so this turn lane was assumed for the 2029 analysis. Signal timings were optimized with the assumption that signals in the area will be re-timed in the next fifteen years. In addition, some peak hour factors (PHF) were increased to account for future traffic changes, including:

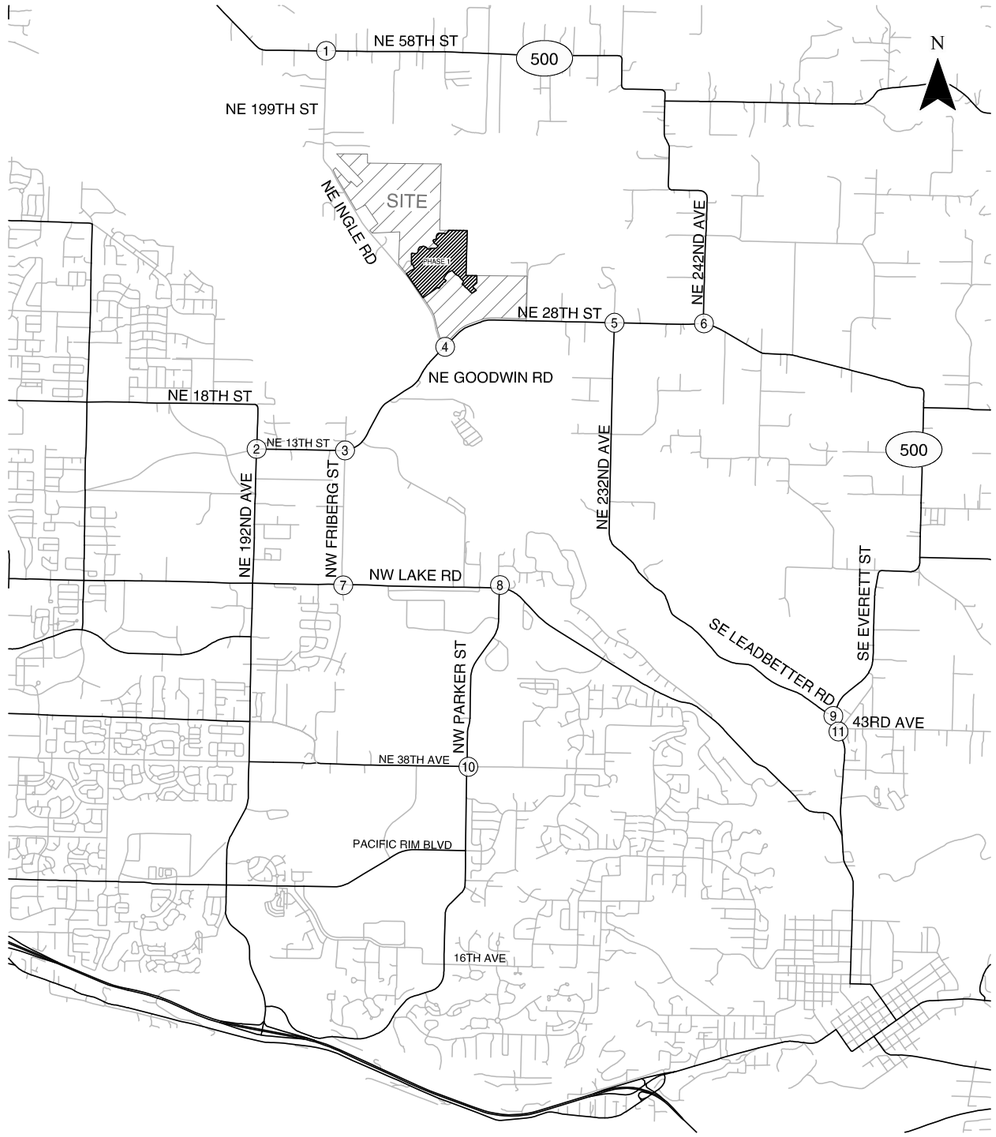
- PHF increased to 0.80 in the a.m. peak hour at NW Friberg Street/NE Goodwin Road and NE 242nd Avenue/NE 28th Street
- PHF increased to 0.75 in the a.m. peak hour at NW Friberg Street/NW Lake Road; NW Parker Street/NW Lake Road; and NW Parker Street/NE 38th Avenue

### *Traffic Operations*

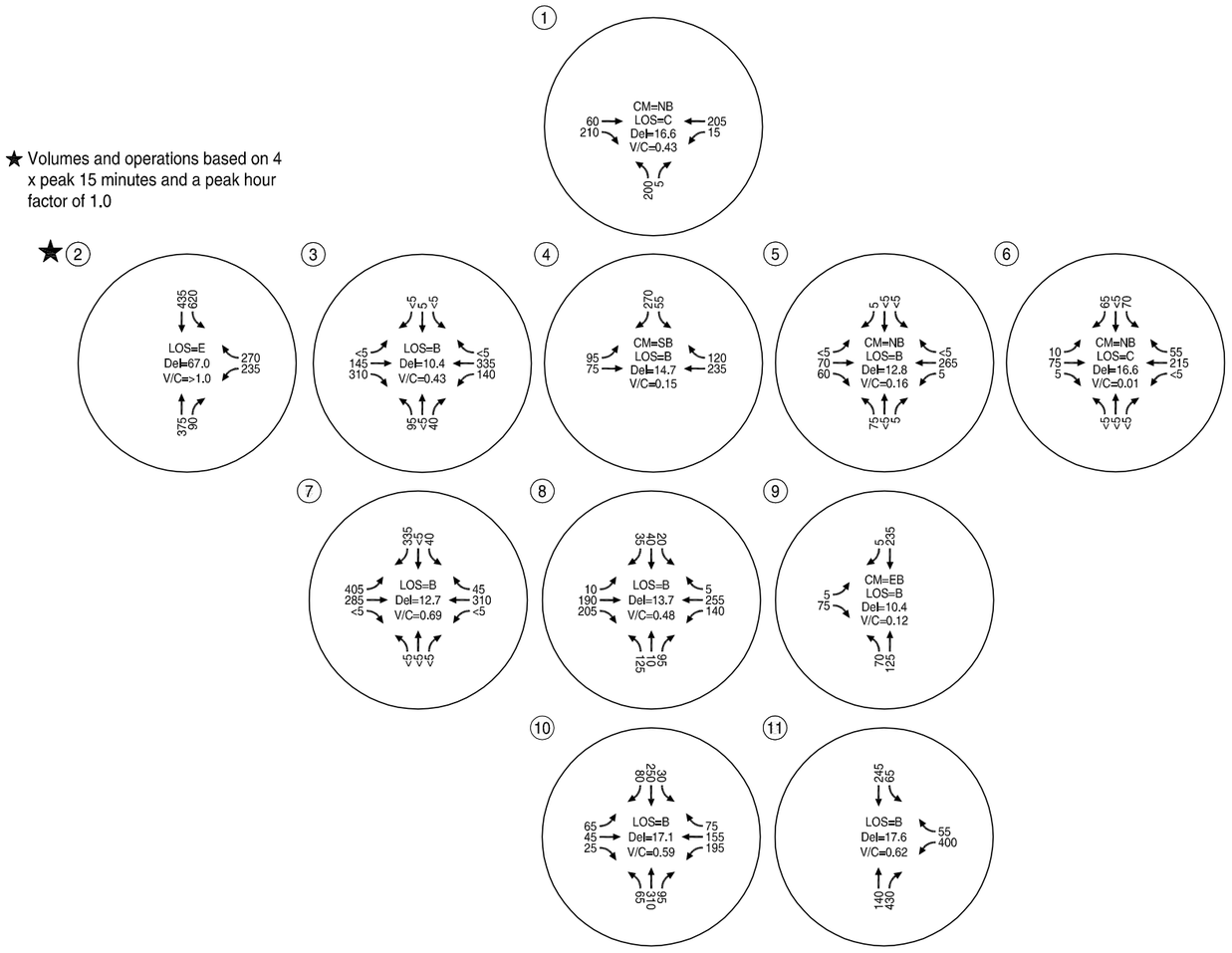
Figures 16 and 17 summarize the year 2029 background traffic operations analysis results at the study intersections for the weekday a.m. and weekday p.m. peak-hours, respectively. As illustrated in the figures, all but two of the study intersections are forecast to operate acceptably:

- The intersection of NE 192nd Avenue/NE 13th Street is projected to operate at a LOS E and over-capacity during the weekday a.m. peak hour and LOS F and over-capacity during the p.m. peak hour.
- The southbound approach to the intersection of NE Ingle Road/NE Goodwin Road is projected to operate at a LOS E during the weekday p.m. peak hour (with provision of the westbound right-turn lane recommended in conjunction with Phase 1 site development).

*Appendix "J" contains the 2029 background conditions traffic operations worksheets.*




★ Volumes and operations based on 4 x peak 15 minutes and a peak hour factor of 1.0

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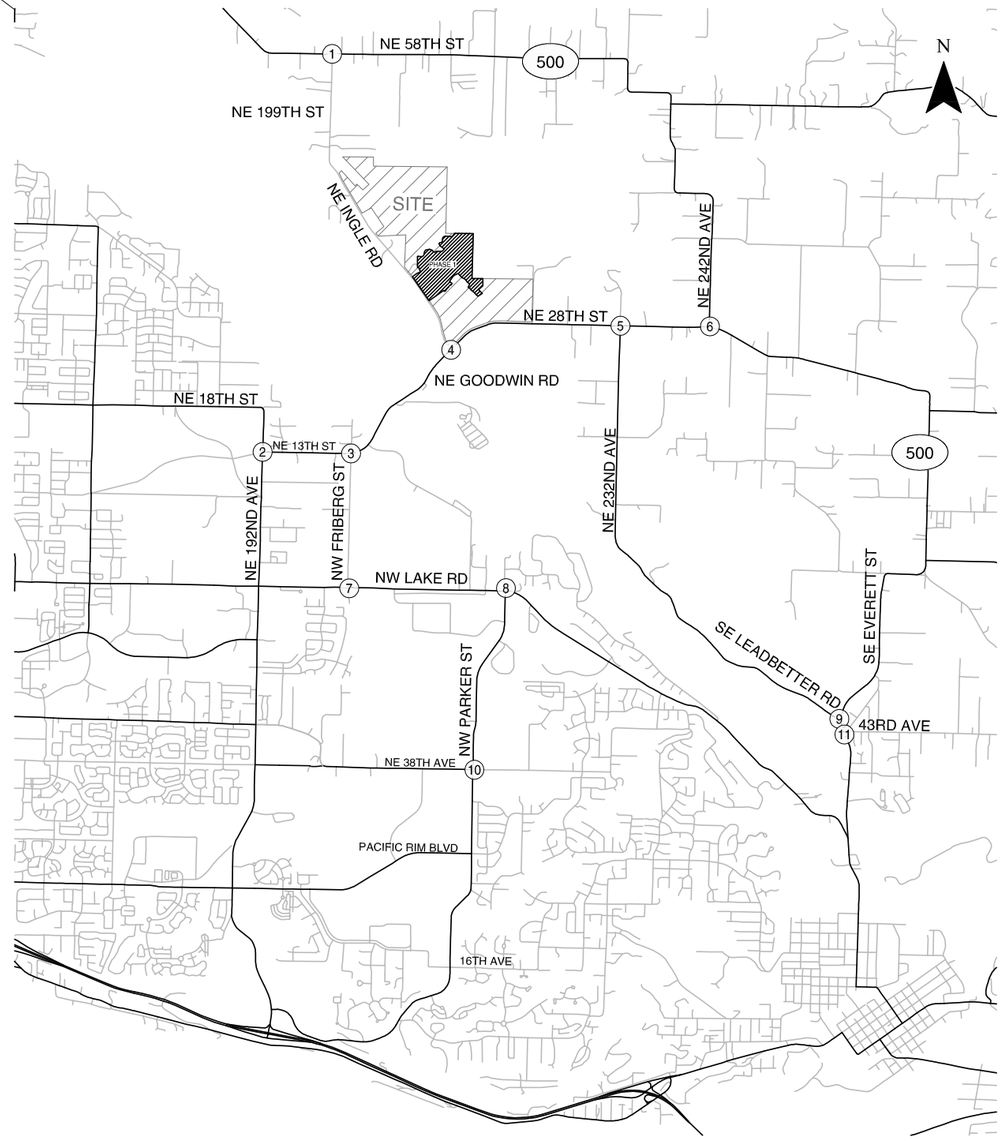
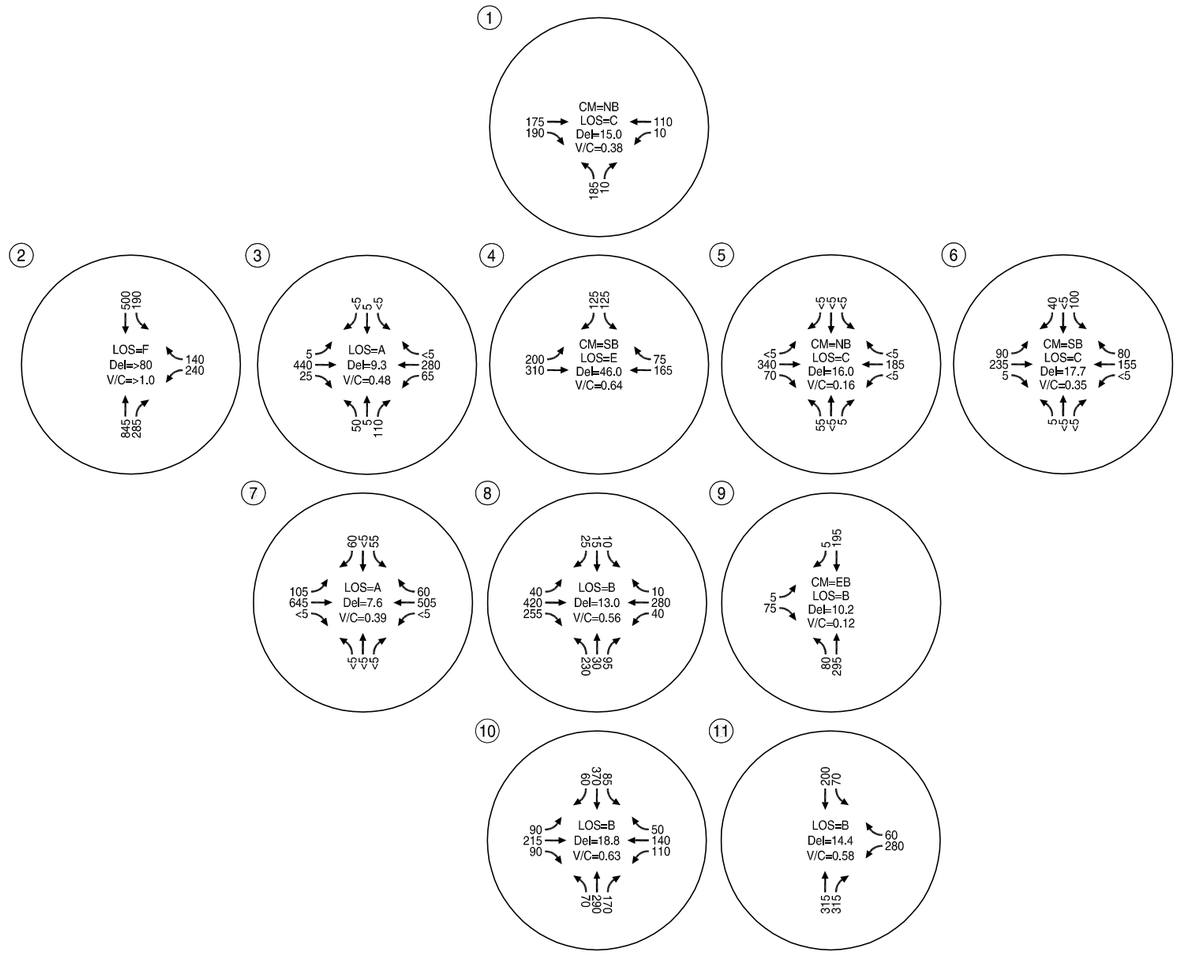
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO
TWSC = TWO-WAY STOP CONTROL

## 2029 Background Conditions Weekday AM Peak Hour Camas, Washington

Figure 16

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TWSC = TWO-WAY STOP CONTROL

## 2029 Background Conditions
## Weekday PM Peak Hour
## Camas, Washington

Figure
17

## 2029 Total Traffic Conditions

The year 2029 total traffic analysis forecasts how the study area's transportation system will operate with full build-out of the proposed master plan development. The year 2029 background traffic volumes were added to the full build-out site-generated traffic to arrive at the total traffic volumes.

### *Traffic Operations*

Figures 18 and 19 summarize the year 2029 total traffic operations analysis results at the study intersections for the weekday a.m. and weekday p.m. peak-hours, respectively. The projected turning movement counts are rounded to the nearest five vehicles per hour. As shown, the following study intersections do not meet standards during either the weekday a.m. or p.m. peak periods:

- NE 199th Avenue/NE 58th Street (SR 500) (weekday a.m. and p.m. peak hours)
- NE 192nd Avenue/NE 13th Street (weekday a.m. and p.m. peak hours, previously was failing during background a.m. and p.m. peak hours)
- NE Ingle Road/NE Goodwin Road (weekday a.m. and p.m. peak hours, previously was failing during background p.m. peak hour)

Potential mitigation measures for these intersections are discussed later in the report.

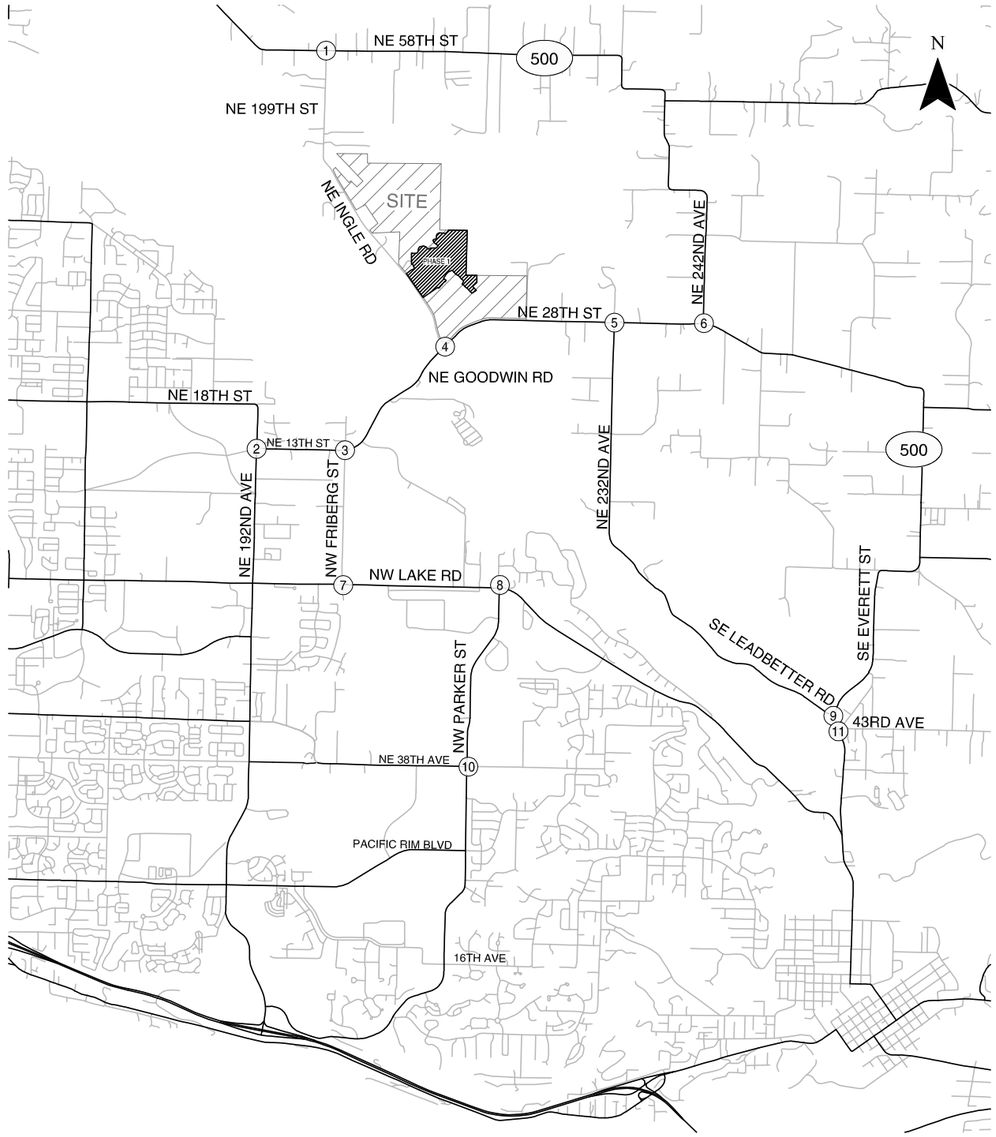
*Appendix "K" contains the 2029 total traffic conditions traffic operations worksheets.*

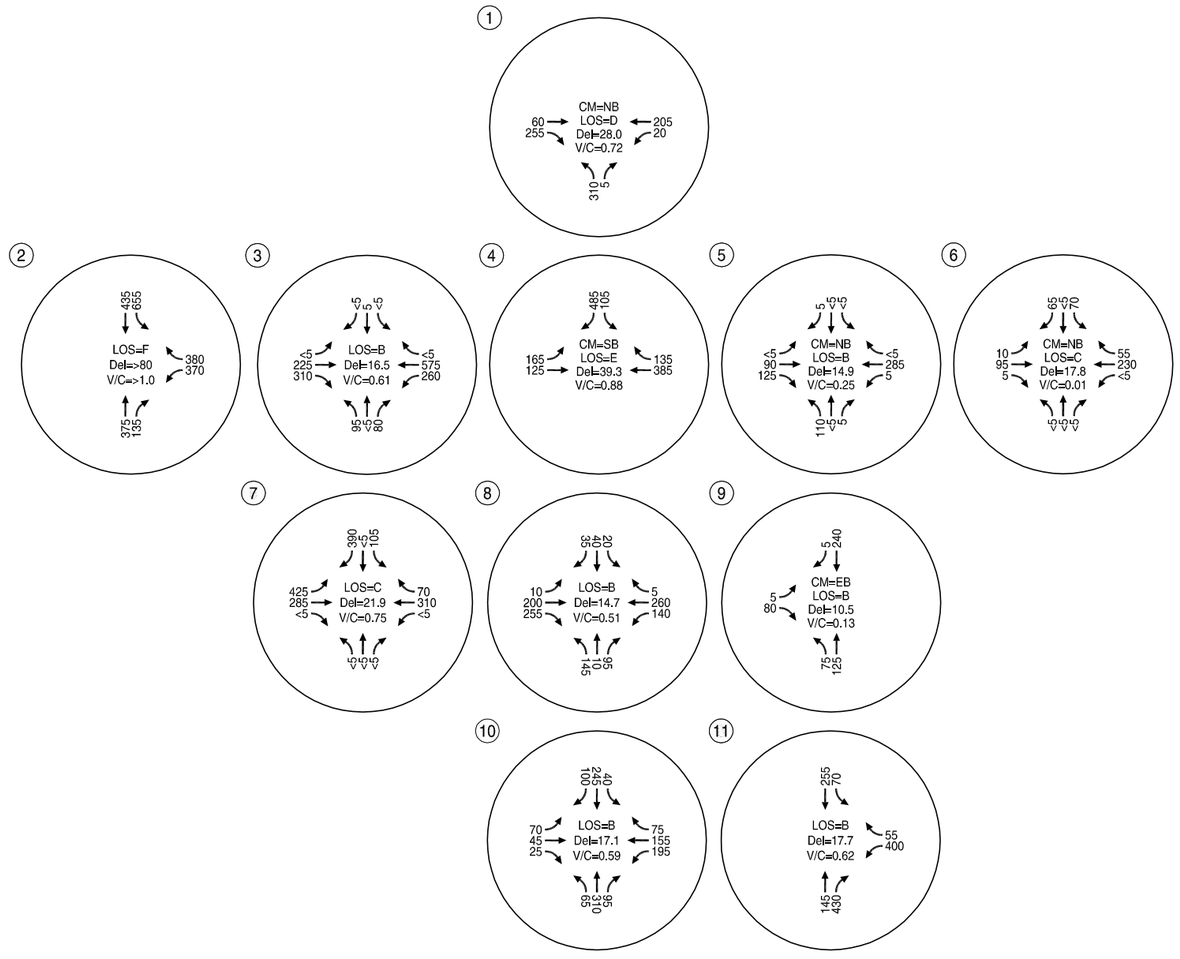
## Turn-Lane Considerations

As referenced under the "Analysis Methodology," roadways under Washington State jurisdiction are subject to the turn lane guidelines contained in the *WSDOT Design Manual* (Reference 3). The potential need for turn-lanes at each study intersection was reviewed for the analysis scenarios. Intersections that meet turn-lane guidelines are further discussed below.

### *NE 199th Avenue/NE 58th Street (SR 500)*

Traffic volumes at the intersection of NE 199th Avenue/NE 58th Street (SR 500) meet WSDOT's guidelines for an eastbound right-turn lane on NE 58th Street under existing conditions and all future scenarios during both the weekday a.m. and p.m. peak hour. Construction of a right-turn lane could require right-of-way acquisition and will likely impact one or more private driveways along NE 58th Street (depending on the length of the deceleration lane constructed).

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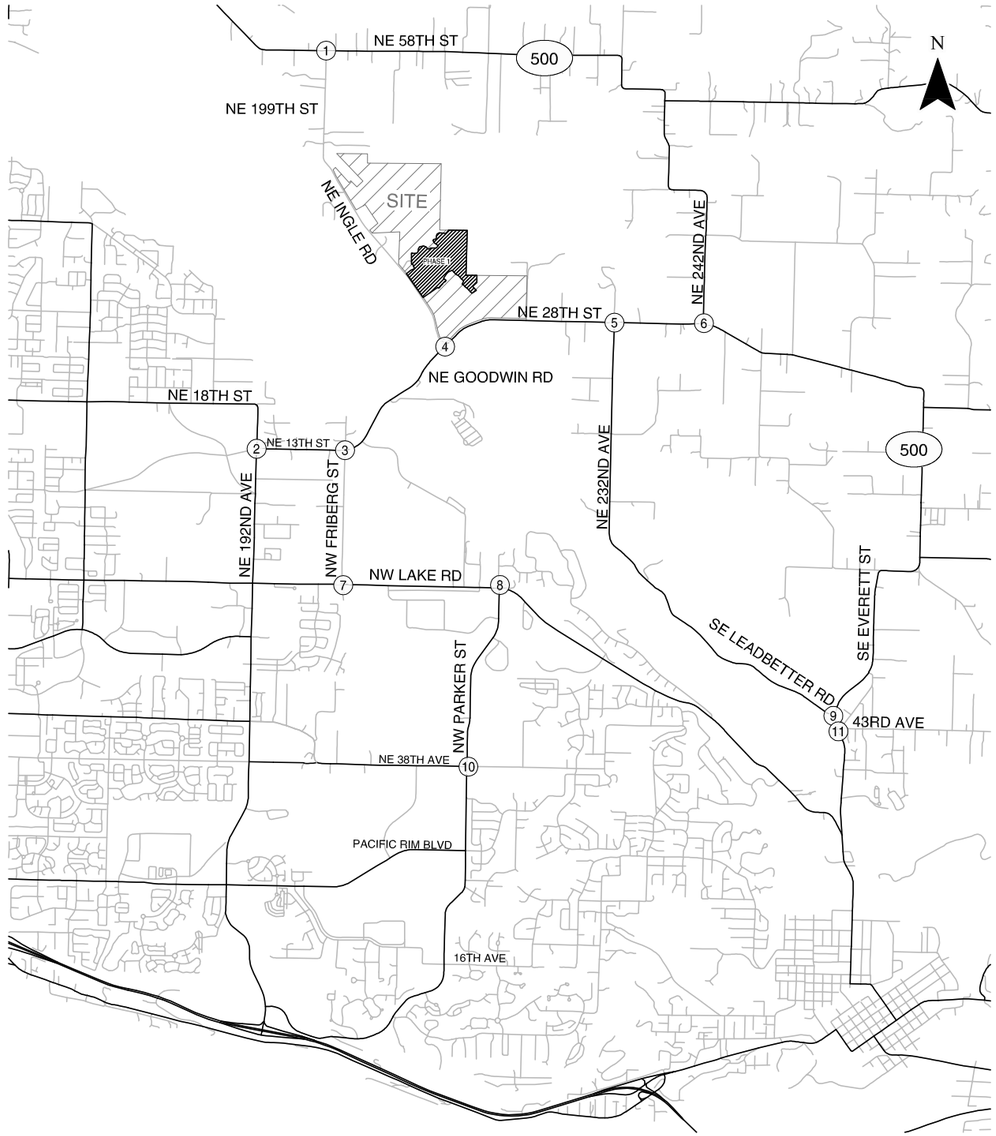
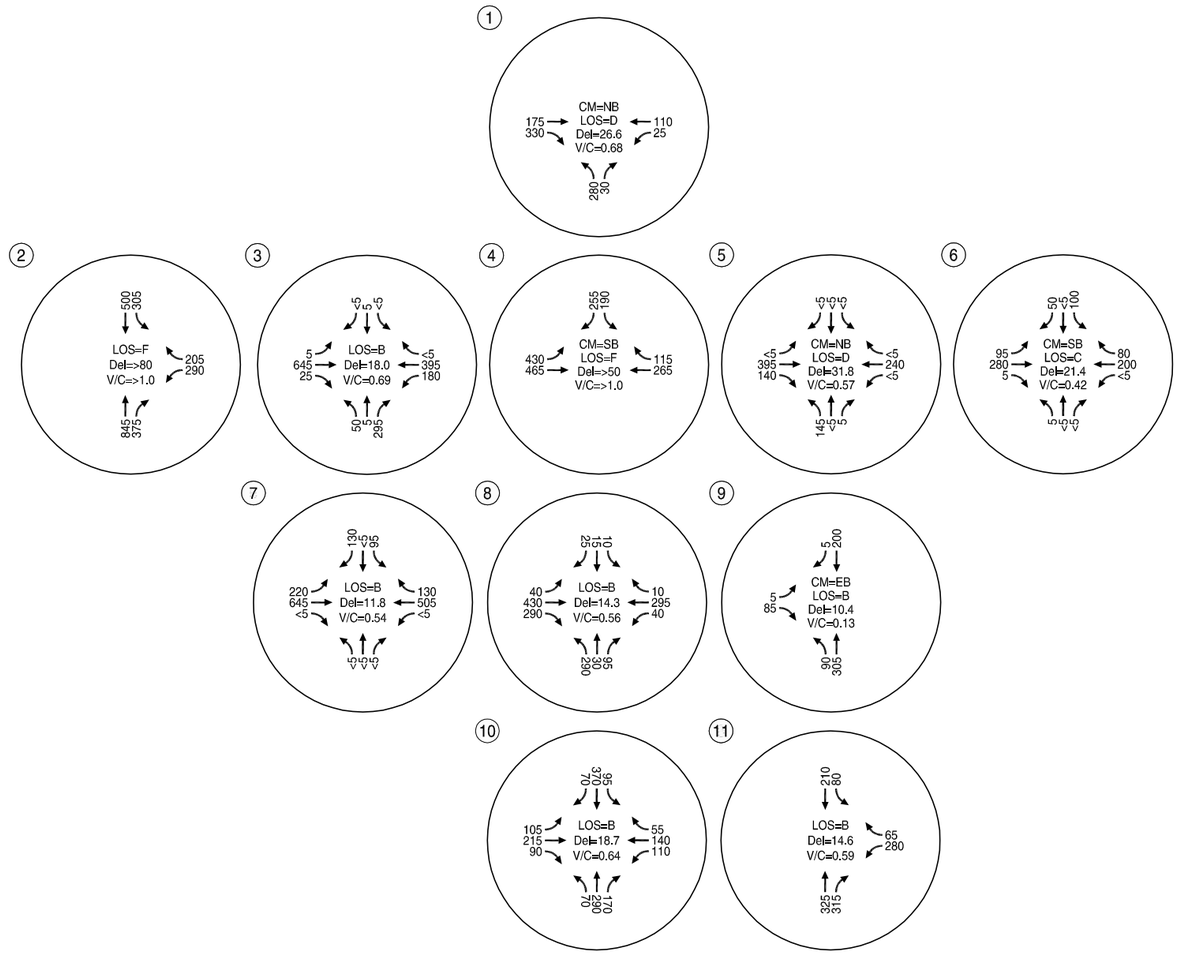
## 2029 Total Traffic Conditions (Build Out)
## Weekday AM Peak Hour
## Camas, Washington

Figure
18

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TWSC = TWO-WAY STOP CONTROL

## 2029 Total Traffic Conditions (Build Out)
## Weekday PM Peak Hour
## Camas, Washington

Figure
19

The table below assesses volumes at the intersection for various horizon year scenarios and the impact of the proposed development.

Table 7: NE 199th Avenue/NE 58th Street (SR 500) Eastbound Right-Turn Lane Assessment

| Scenario | Eastbound Right-Turn (EBRT) Volume | Meets Guideline? | Development-Added EBRT Trips | Impact of Development |
|---|---|---|---|---|
| 2014 Existing Traffic – AM Peak | 180 | Yes | - | - |
| 2014 Existing Traffic – PM Peak | 145 | Yes | - | - |
| 2018 Background Traffic – AM Peak | 180 | Yes | 8 (Phase 1) | 4% |
| 2018 Background Traffic – PM Peak | 150 | Yes | 27 (Phase 1) | 18% |
| 2029 Background Traffic – AM Peak | 210 | Yes | 45 (Build-out) | 21% |
| 2029 Background Traffic – PM Peak | 190 | Yes | 138 (Build-out) | 73% |

The recorded crash history at the intersection was reviewed to identify potential safety issues that an eastbound right-turn lane might address. No crashes were reported involving vehicles making an eastbound right-turn. Given the lack of crash history and the relatively small impact of Phase 1, no improvements are recommended in conjunction with Phase 1. Nonetheless, given the amount of site-generated traffic that will be added to the eastbound right-turn movement as future phases of the master plan build-out, if right turn crashes materially increased, it is possible that a nexus could be established between requiring construction of an eastbound right-turn lane and traffic volume increases attributable to master plan trip development. Accordingly, we recommend that future site plan applications prepared subsequent to Phase 1 provide an updated assessment as to the potential need for providing a right-turn taper or lane at the intersection.

### *NE 242nd Avenue (SR 500)/NE 28th Street*

Traffic volumes at the intersection of NE 242nd Avenue (SR 500)/NE 28th Street meet WSDOT's guidelines for a left-turn lane on the eastbound approach under existing conditions and all future scenarios during the weekday p.m. peak hour. The table below assesses volumes at the intersection for each horizon year scenario and the impact of the proposed development. *As shown in the table, the Phase 1 development does not add any trips to the eastbound left-turn lane*. The trips generated by build-out of the master plan development are from the retail component and total less than 10.

Table 8: NE 242nd Avenue (SR 500)/NE 28th Street Eastbound Left-Turn Lane Assessment

| Scenario | Eastbound Left-Turn Volume | Meets Guidelines? (Recommended Storage) | Development-Added Trips | Impact of Development |
|---|---|---|---|---|
| 2014 Existing Traffic – AM Peak | 10 | No | - | - |
| 2014 Existing Traffic – PM Peak | 80 | Yes (100 feet) | - | - |
| 2018 Background Traffic – AM Peak | 10 | No | 0 (Phase 1) | 0% |
| 2018 Background Traffic – PM Peak | 80 | Yes (100 feet) | 0 (Phase 1) | 0% |
| 2029 Background Traffic – AM Peak | 10 | No | 2 (Build-out) | 20% |
| 2029 Background Traffic – PM Peak | 90 | Yes (100 feet) | 9 (Build-out) | 10% |

The recorded crash history at the intersection was reviewed to identify potential safety issues that an eastbound left-turn lane might address. While two angle crashes were reported from vehicles making a southbound left-turn, no crashes were reported involving vehicles making an eastbound left-turn.

Based on our review of the information provided above, we find no basis for recommending improvements to the NE 242nd Avenue (SR 500)/NE 28th Street intersection in conjunction with Phase 1 site development. We base this conclusion on the proposed development adding no trips to the left-turn movement in question, the lack of crash history related to left-turns, and the general lack of a nexus given the small trip impact of the proposed Phase 1 development at this location.

### *Planned Future Intersection Improvements*

The *2012 City of Camas Traffic Impact Fee Update Report* (Reference 2) identifies the future need to widen NE 28th Street to have a center left-turn lane from Ingle Road to NE 242nd Avenue. A related project would create a new NE 242nd Avenue extension south of NE 28th Street. Given the City's planned improvements, we recommend the City of Camas make a finding that the traffic impact fee payments made by the master plan for Phase 1 and future phases of the project mitigate development impacts at the intersection, and therefore require no additional mitigation.

## Recommended Mitigations

As discussed above, all study intersections meet operating standards under existing and 2018 background and total traffic conditions for both the weekday a.m. and p.m. peak hours. Four intersections do not meet operating standards in 2029 under background and/or total traffic conditions; each is discussed below.

### *NE 199th Avenue/NE 58th Street (SR 500)*

The minor street northbound left-turn at the intersection of NE 199th Avenue/NE 58th Street (SR 500) is projected to not meet current WSDOT standards in the 2029 total traffic conditions during the weekday a.m. and p.m. peak hours. The intersection is projected to operate at a volume-to-capacity (v/c) ratio of 0.72 and LOS D during the a.m. peak hour and v/c ratio of 0.70 and LOS D during the p.m. peak hour. It is therefore not within WSDOT's LOS requirement (LOS C) for non-HSS facilities in rural areas. The intersection is three-legged and stop-controlled on the northbound approach. The northbound left-turn is the critical movement at the intersection, with all other movements operating at a LOS A and well under capacity. During both the weekday a.m. and p.m. peak hours, the northbound left-turn is 3 seconds or less over the delay threshold between LOS C and LOS D. In the event that the area around the intersection urbanizes before build-out, the WSDOT performance standard will shift to LOS E and the intersection would operate within WSDOT standards.

As discussed in the *Turn-Lane Considerations* section above, the intersection currently meets warrants for an eastbound right-turn lane, which would improve operations for northbound left-turning vehicles to a LOS C during the 2029 total traffic conditions. As also discussed above, it is expected that a nexus might ultimately be established between requiring construction of an eastbound right-turn lane and traffic volume increases attributable to master plan trip development, based on LOS and delay at the intersection. Accordingly, we recommend that future site plan applications prepared subsequent to Phase 1 provide an updated assessment as to the potential need for providing a right-turn taper or lane at the intersection, considering both the need for a right-turn taper or lane and delay with the northbound left-turn.

*Appendix "L" contains the traffic operations worksheets supporting the potential mitigations at NE 199th Avenue/NE 58th Street (SR 500).*

### *NE 192nd Avenue/NE 13th Street*

The intersection of NE 192nd Avenue/NE 13th Street is projected to not meet standards in the 2029 background conditions and the 2029 total traffic conditions during both the weekday a.m. and p.m. peak hours. The intersection operates over-capacity in all four of these scenarios and at a LOS F during the weekday p.m. peak hour in the background conditions and weekday a.m. and p.m. peak hours in the total traffic scenarios.

#### *Potential Future City of Vancouver Improvements*

The City of Vancouver has identified NE 192nd Avenue as ultimately requiring five travel lanes (two southbound through lanes, a center left-turn lane, and two northbound through lanes) and includes

the widening on the City's Traffic Impact Fee (TIF) program project list. Because no near-term funding has been programmed for the future five-lane section, the existing section was assumed to be in place in 2029 for the purposes of this traffic study. Widening by the City of Vancouver or others in the interim would add capacity and change the intersection operations.

In the event that NE 192nd Avenue is widened to five lanes through the NE 13th Street intersection, the intersection is projected to meet City of Vancouver intersection operating standards under 2029 background conditions. To mitigate total traffic conditions, a westbound right-turn lane would also be required. In the event that 192nd Avenue is not widened, a northbound right-turn lane and westbound right-turn lane would be sufficient to mitigate 2029 total traffic conditions (mitigation assumes maintaining operations equivalent to or better than those experienced under 2029 background conditions with site build-out but does not fully accommodate forecast queuing).

### *Potential Master Plan Development Mitigation Options*

As noted above, the provision of a northbound right-turn lane and westbound right-turn lane would offer more than sufficient capacity to mitigate the impact of the master plan site build-out while also providing additional capacity to allow for future growth and development. Therefore, we recommend the Green Mountain Master Plan provide a proportionate share contribution towards the construction of a northbound right-turn lane and a westbound right-turn lane on NE 13th Avenue. The City of Vancouver has successfully administered pro-rata share contribution collection systems at other intersections, allowing each development impacting a failing intersection to contribute a "fair-share" of the mitigation cost.

*Appendix "M"* identifies a proposed proportionate cost sharing methodology. Under this methodology, each trip would be assessed a fee of $391. Therefore the Green Mountain development contribution at full build-out would be approximately $123,600. *Details of the cost estimate, capacity generated by the improvements, and impact of the proposed development supporting the proportionate share calculations are provided in Appendix "M."*

It should be noted that the NE 192nd Avenue/NE 13th Street intersection is listed on the City of Vancouver's TIF program project list. In the case of the Green Mountain Master plan, any TIF credits issued by the City of Vancouver would only be redeemable for development impacts in Vancouver (not Camas).

### *NE Ingle Road/NE Goodwin Road*

The intersection of NE Ingle Road/NE Goodwin Road is projected to not meet City of Camas intersection operating standards in the 2029 background conditions during the weekday p.m. peak

hour and the 2029 total traffic conditions during both the weekday a.m. and p.m. peak hours. In order to mitigate 2029 background conditions, a two-way left-turn lane could potentially be provided east of the intersection to facilitate southbound left-turns, which are the critical movement at the intersection.

The City's long-term plans anticipate significant reconstruction of the intersection and the approaching roadways as recorded in the 2012 *City of Camas Traffic Impact Fee Update* (Reference 2). Identified improvement needs include:

- Installation of a traffic signal at NE Ingle Road/NE Goodwin Road;
- The extension of a new collector roadway from NE Ingle Road south to NE 232nd Avenue;
- Widening of NE Goodwin Road from two to three lanes between NE Ingle Road and NE 232nd Avenue; and
- Widening of NE Goodwin Road from two to five lanes NE between Friberg Street and NE Ingle Road.

Considering the Green Mountain Master Plan project location and traffic impacts at the intersection, we recommend the following series of mitigations in conjunction with the proposed development:

- Construct an eastbound left-turn lane on NE Goodwin Road at NE Ingle Road with the first Phase 1 trip.
- Construct a westbound right-turn lane on NE Goodwin Road at NE Ingle Road with the 203rd Phase 1 trip (prior to occupancy of 203rd single family home on site). The right-turn lane should provide at least 100 feet of storage. (Note, in the long-term future, the City could consider restriping the right-turn lane to a shared through/right lane when widening of NE Goodwin Road west of NE Ingle Road develops two westbound receiving lanes).
- Construct a three-lane roadway section (with center two-way left-turn lane) on NE Goodwin Road along the site frontage in conjunction with standard frontage improvements as adjacent development occurs.
- Upon completion of Phase 1 site development (including construction of the eastbound left-turn lane and westbound right-turn lane on NE Goodwin Road at NE Ingle Road with Phase 1), the developer shall monitor the need for installation of a traffic signal with each future site plan application at the intersection and construct a traffic signal when the intersection no longer satisfies City of Camas performance standard (LOS "D" and v/c of 0.90 or better) *and* the intersection volumes meet traffic signal warrants (subject to direction from the City of Camas).

- The monitoring effort is recommended to require preparation of then-current traffic counts, assessment of traffic signal warrants based on build-out of the then-current site plan application (and all other approved development), and a summary report prepared by a licensed professional engineer. The study should consider potential turn movement re-routing that is expected to occur at the NE Goodwin Road/NE Ingle Road intersection as new connections to the master plan site are made to NE Goodwin Road east of NE Ingle Road.

## On-site Circulation and Operations

We recommend that a detailed review of on-site circulation and operations be prepared in conjunction with each future site plan application. This review will provide an opportunity to consider site-specific details when they become available and should include consideration of vehicular, pedestrian, and delivery vehicle paths.

On-site landscaping, signage and any above-ground utilities should be provided appropriately to ensure that adequate sight distance is provided and maintained and should be considered as part of future site plan applications.

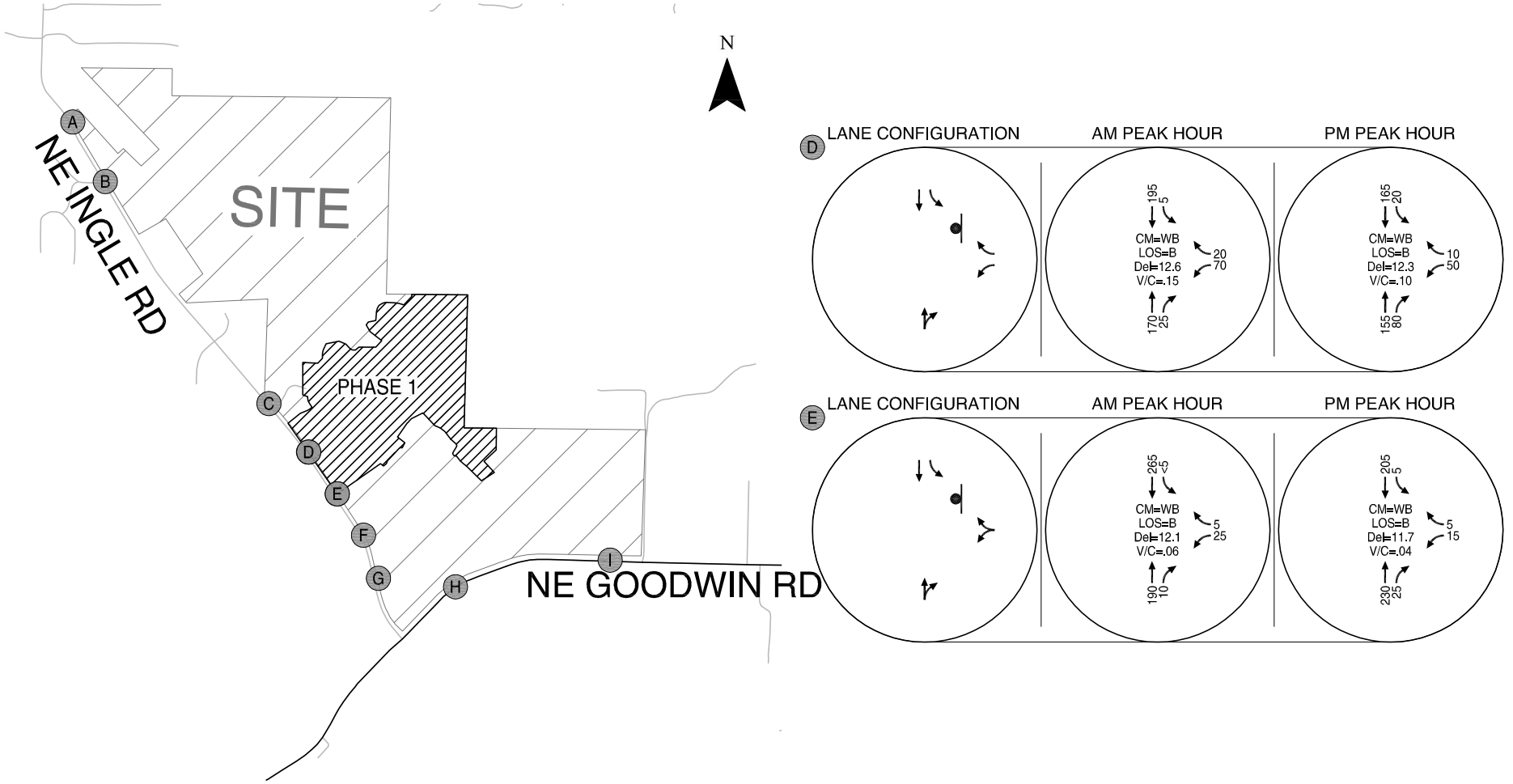
### *Access Requirements*

The City of Camas requires a minimum intersection spacing of 330 feet on three lane collector streets. This spacing should be maintained with the proposed development.

### *Phase 1 Access Operations*

The portion of the site that will be developed with Phase 1 is noted in Figure 2. As seen, two access points are proposed for the Phase 1 development. The proposed lane configuration at these accesses and operations is shown in Figure 20. The developer has proposed to maintain access to the existing golf course in conjunction with the Phase 1 development. The existing gravel maintenance only access will be improved to provide an interim main access to the remaining portion of the golf course (reduced to eight holes). The proposed interim golf course access is located approximately 400 feet south of the proposed southern access, which meets the City's intersection spacing requirements for a collector street noted above.

*Appendix "N" contains the traffic operations worksheets for the Phase 1 access operations.*




- STOP SIGN

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

# 2018 Site Access Lane Configurations and Operations (Phase 1) Camas, Washington

Figure 20

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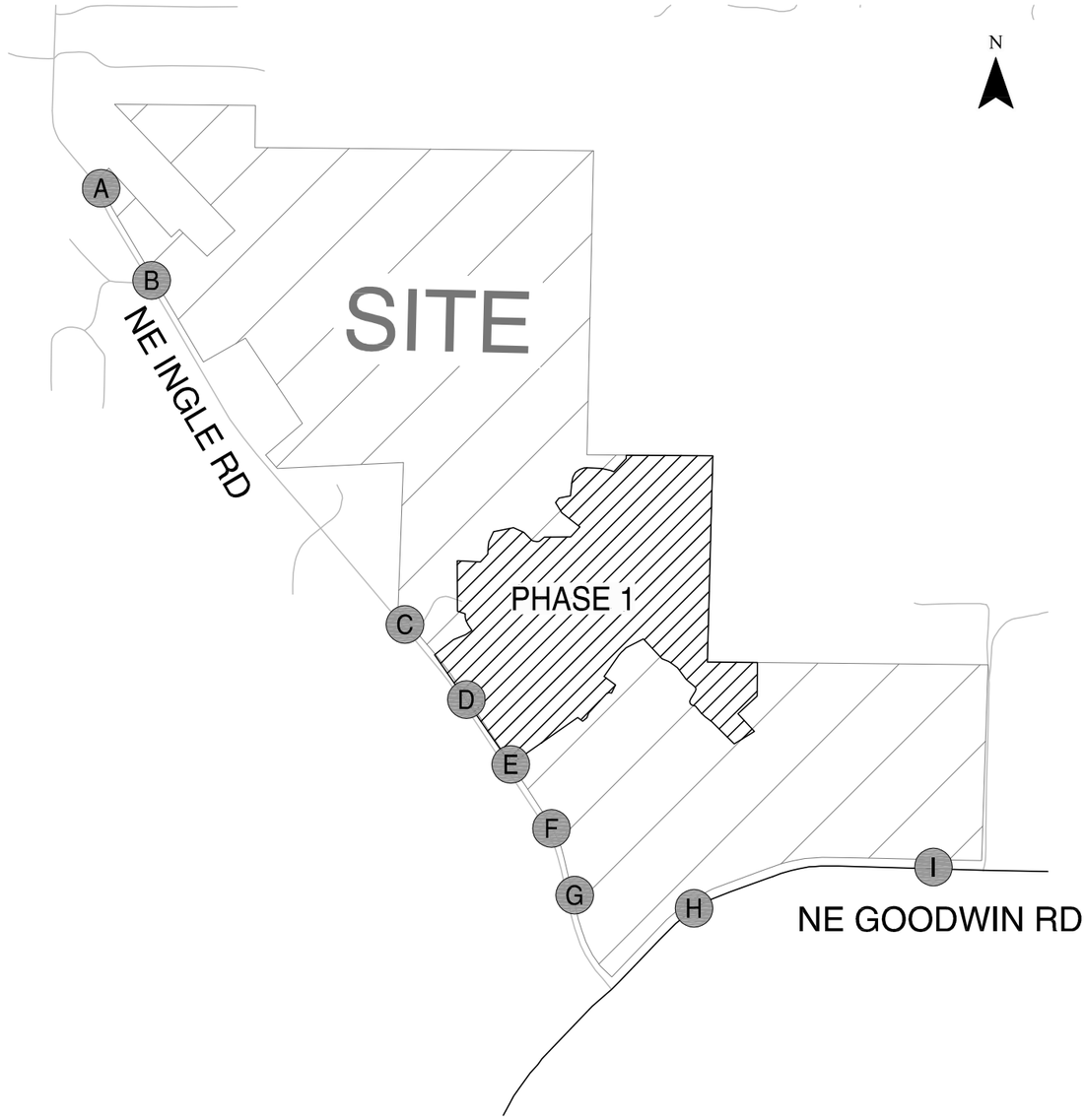
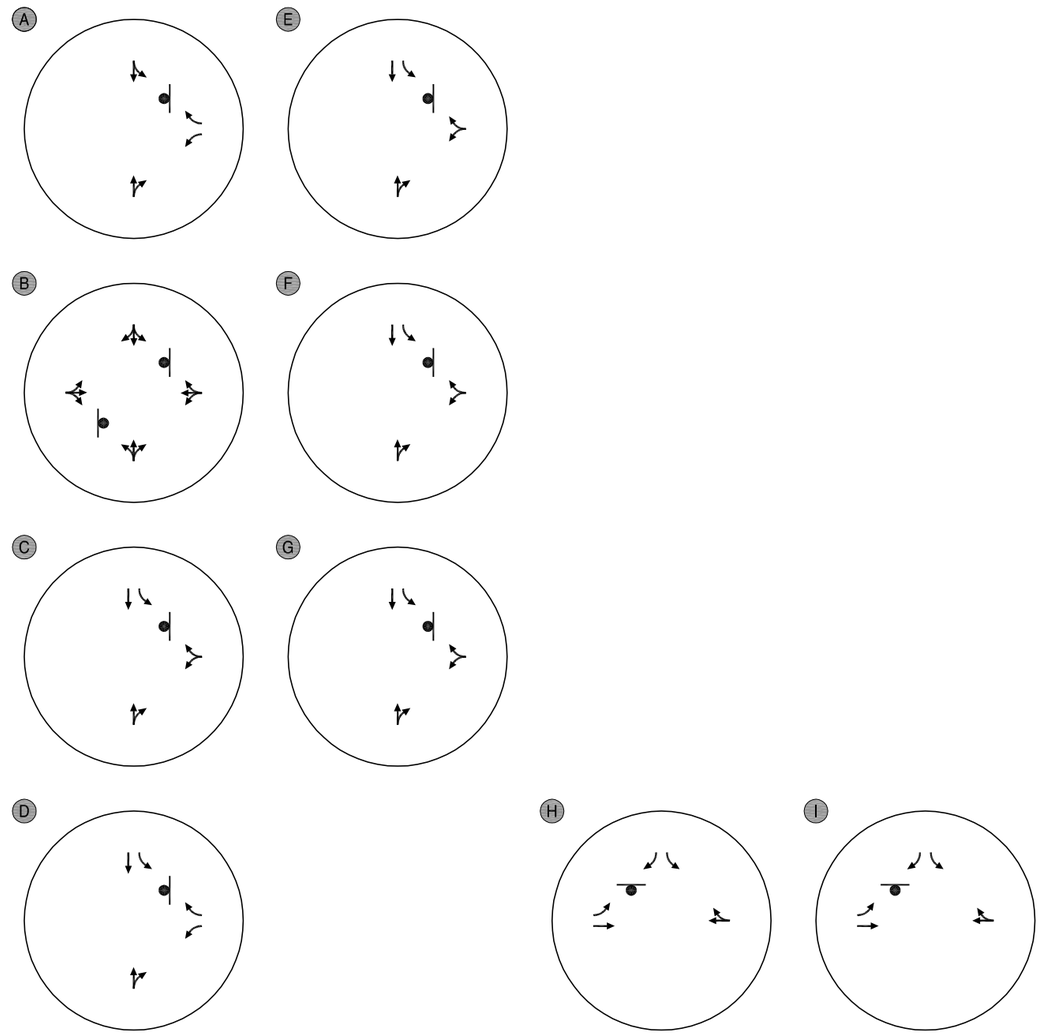
### *Build-out Access Operations*

An additional five access points on NE Ingle Road and two access points on NE Goodwin Road are anticipated with full build-out of the development. The exact location of the access points may change as the plans for the development are refined. We assessed operations at these access points assuming the lane configuration shown in Figure 21. As seen in the figure, we expect NE Ingle Road will be developed with a center two-way left-turn lane (TWLTL) through access "C" and NE Goodwin Road will be developed with a TWLTL along the site frontage. Operations at the site accesses for the weekday a.m. and p.m. peak hours are shown in Figures 22 and 23. As seen in the figures, all access points operate at a LOS "C" or better, with the exception of the eastern access on NE Goodwin Road. The southbound left-turn movement at this intersection operates at a LOS D during the weekday p.m. peak hour.

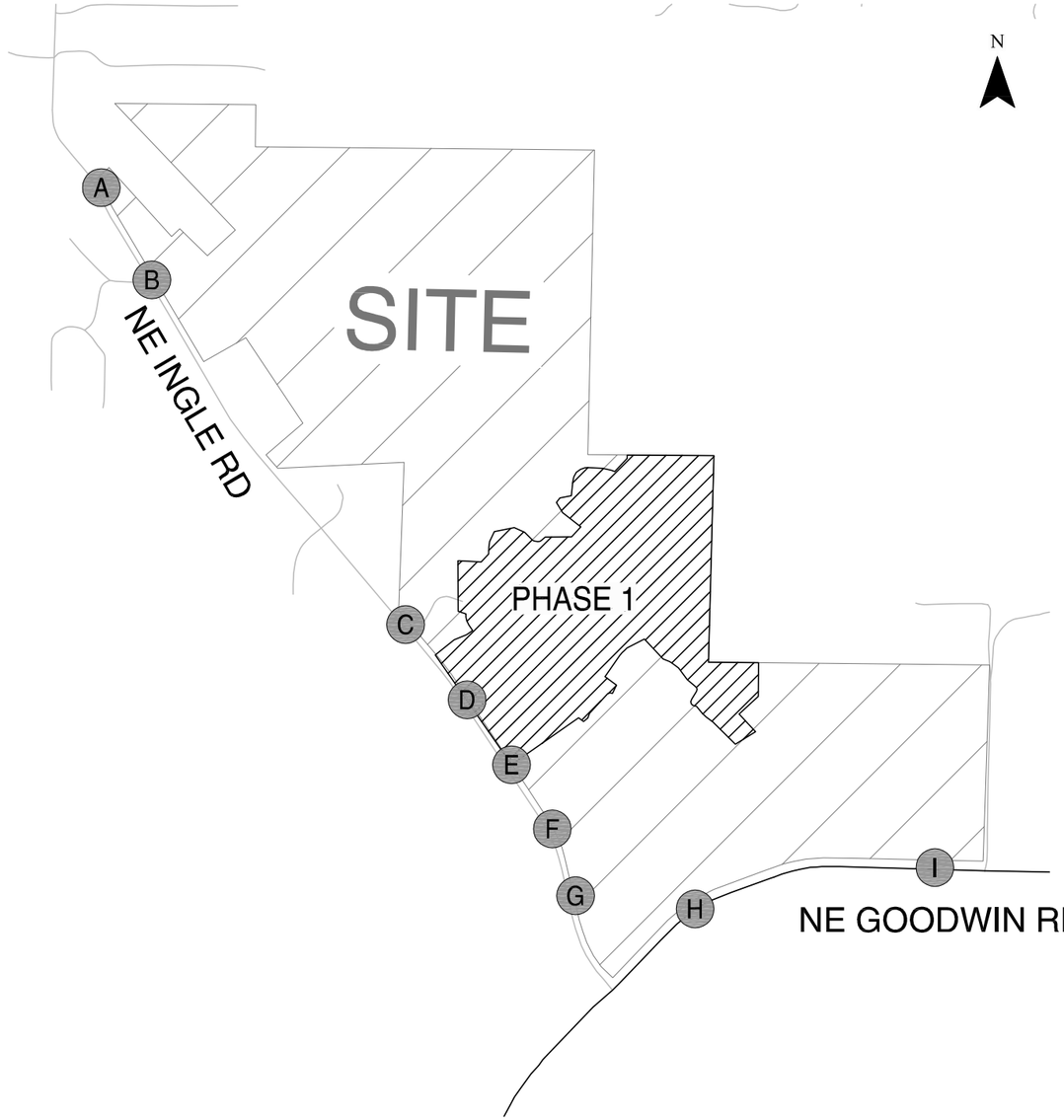
We recommend further evaluation of potential right-turn deceleration lane needs be considered at the time of site plan application. This evaluation should consider the potential need for southbound left-turn lanes or northbound right-turn lanes along NE Ingle Road at the remaining access points as well as corresponding turn lane queue storage requirements. *Appendix "O" contains the traffic operations worksheets for the full build-out access operations.*

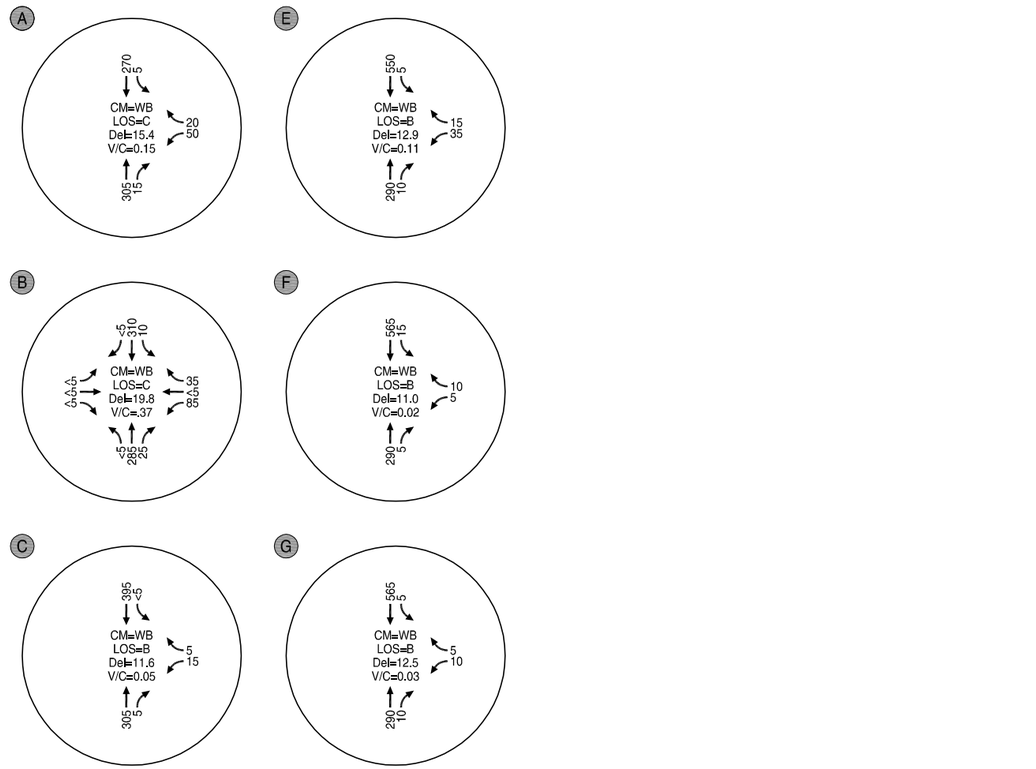


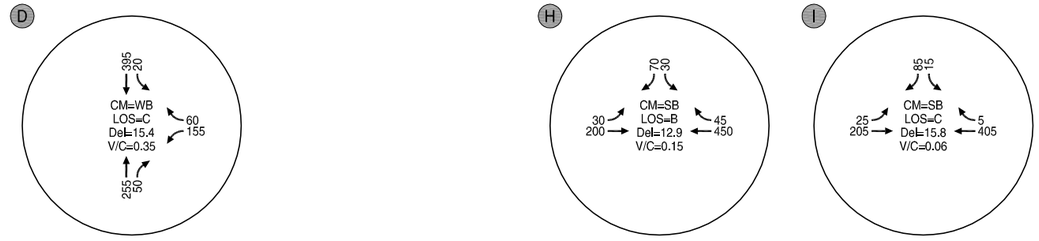




Site Access Lane Configurations and Traffic Control Devices (Buildout)
Camas, Washington

Figure 21

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Del = INTERSECTION AVERAGE CONTROL DELAY (SIG / CRITICAL MOVEMENT CONTROL DELAY (TWSC)
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TWSC = TWO-WAY STOP CONTROL

2029 Site Access Operations (Build Out)
Weekday AM Peak Hour
Camas, Washington

Figure 22

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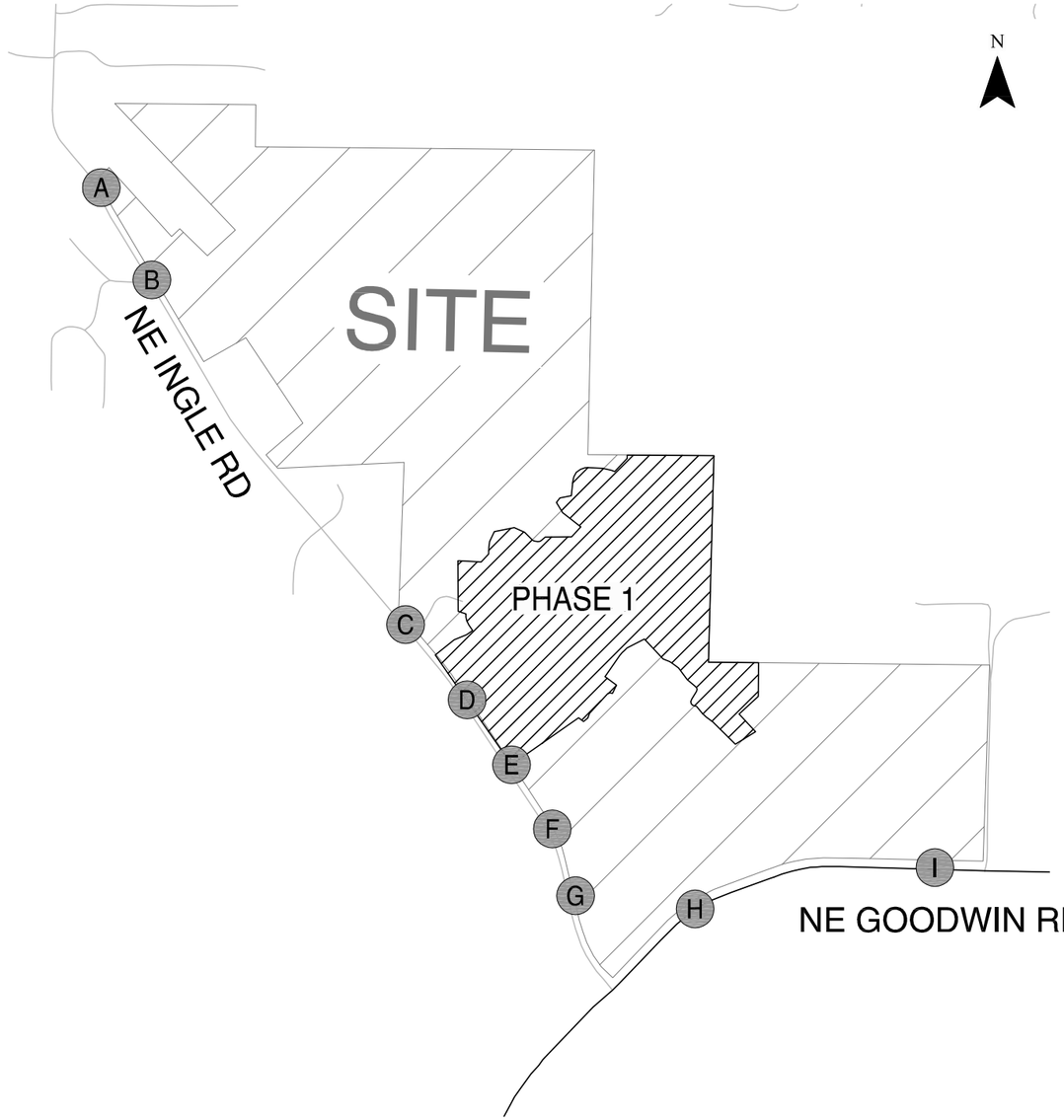
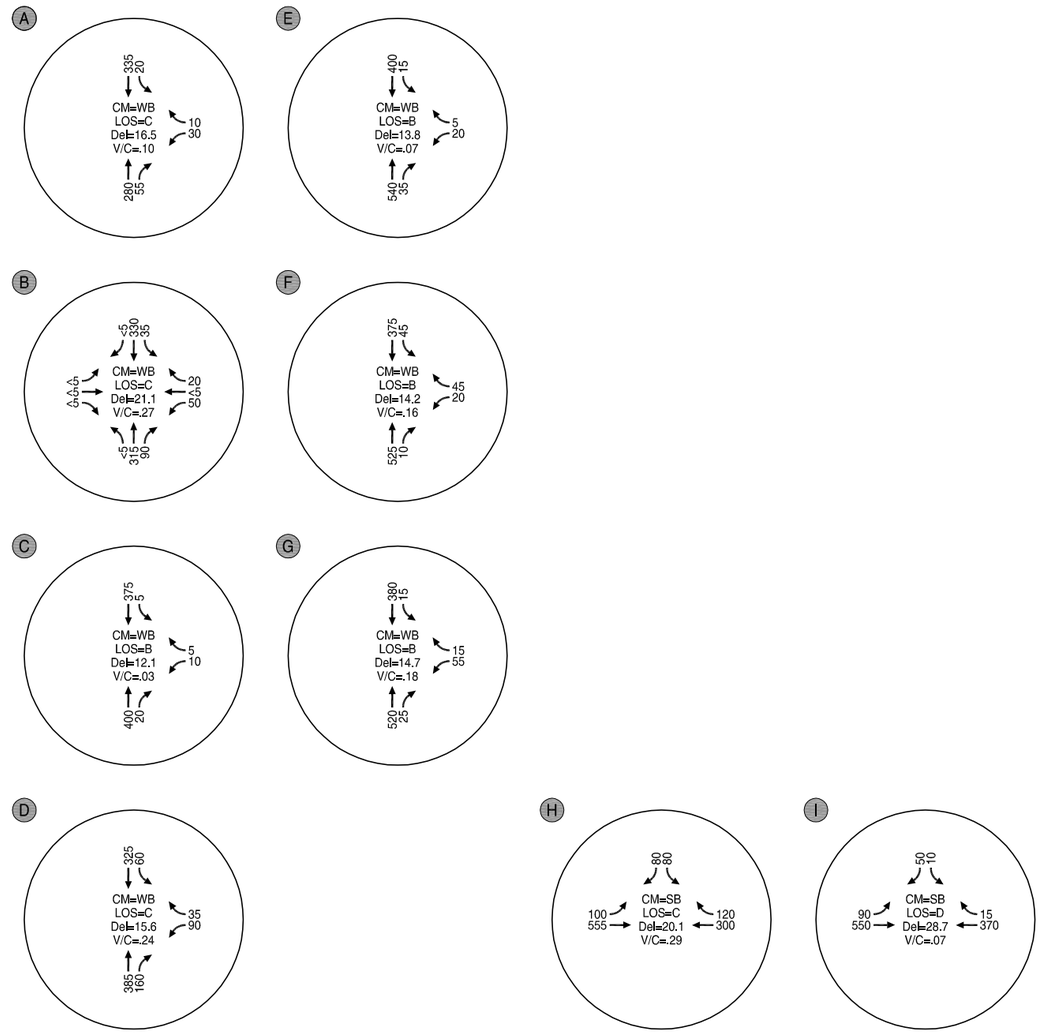
TRANSPORTATION ENGINEERING/PLANNING

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TWSC = TWO-WAY STOP CONTROL

## 2029 Site Access Operations (Build Out)
## Weekday PM Peak Hour
## Camas, Washington

Figure 23

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TRANSPORTATION ENGINEERING/PLANNING

## TRANSPORTATION COMPLIANCE LETTER

This master plan traffic study documents the transportation implications of the proposed development at build-out. There are on-site access, circulation, turn lane, and driveway location and design considerations that will need to be addressed when specific site plan applications are made. Further, the phasing and timing of master plan build-out is likely to evolve over time to adapt to market conditions. Accordingly, it is recommended that a transportation compliance letter be prepared for each preliminary plat or site plan application to address on-site transportation, access and pedestrian standards and to ensure that the mitigation measures provided for in this report are applied at the appropriate phase of development. The transportation compliance letter should also document the trip generation of each phase of development to ensure that the total number of trips generated from future development does not exceed the number of trips vested under the Development Agreement.

We recommend each transportation compliance letter could document:

- The number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) estimated to be used by the then-current proposed site development application.
- The number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) previously used by approved site development applications on the master plan site.
- An accounting of the number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) remaining assuming approval of the then-current site plan application.
    - Note: In the event that a future site plan application is projected to use more trips than were previously assumed through the master plan, additional traffic capacity/concurrency analysis would be triggered (unless a traffic count cordon-study of the master plan campus demonstrates the number of trips generated by the site is less than projected by standard ITE trip rates and thus the overall development impact actually is less than or equal to the number of trips assumed by the master plan).
- Evaluation of outstanding mitigation needs (as appropriate consistent with the Master Plan recommendations) at the intersections of:
    - Need for an eastbound right-turn lane at NE 199$^{th}$ Avenue/NE 58$^{th}$ Street (SR 500)
    - NE Ingle Road/NE Goodwin Road (including traffic signal warrant analysis)

# FINDINGS AND RECOMMENDATIONS

Based on the results of the transportation impact analysis, Phase 1 of the Green Mountain Master Plan (estimated to generate 2,050 daily trips and 215 net new p.m. peak hour trips) can be developed while maintaining acceptable levels of service and safety at the study intersections without any required off-site mitigations. The primary findings and recommendations of this study are summarized below.

## Existing Conditions

- All of the study intersections currently operate acceptably during the weekday a.m. and p.m. peak hours.

## Proposed Development Activities

- Phase 1 site development includes 215 residential units. It is estimated to generate 160 net new a.m. peak hour trips (40 in and 120 out) and 215 net new p.m. peak hour trips (135 in and 80 out).
- Build-out of the site development includes 1,300 residential units and 90,000 square feet of retail use. Build-out (including Phase 1) is collectively estimated to generate a total of 995 net new a.m. peak hour trips (290 in and 705 out) and 1,655 net new p.m. peak hour trips (965 in and 690 out).
- Access to Phase 1 of the site will be provided via two full movement driveways on NW Ingle Road. In the future when the site is built out, access will be provided on both NW Ingle Road and NW Goodwin Road.

## Year 2018 Background Traffic Conditions

- Year 2018 background conditions (without construction of the Green Mountain mixed-use development) were estimated assuming completion of approved in-process developments within the study area and an annual 2% growth rate on City of Vancouver roadways.
- Operational analyses indicate that the study intersections are forecast to continue to operate acceptably.

## Year 2018 Total Traffic Conditions

- Year 2018 total traffic conditions were estimated assuming completion of approved in-process developments within the study area plus Phase 1 of the proposed development.
- Operational analyses indicate that the study intersections are forecast to continue to operate acceptably under 2018 total traffic conditions with one exception:
    - The southbound movement at the intersection of NE Ingle Road/NE Goodwin Road is projected to operate at a LOS E during the weekday p.m. peak hour. This failure is triggered by the 203rd single family residential unit in Phase 1 of the development.

## Year 2029 Background Traffic Conditions

- Year 2029 background conditions (with construction of only Phase 1 of proposed development but no further phases) were estimated assuming the same in-process developments included in the 2018 analysis as well as a one percent growth rate on City of Camas roadways and two percent growth rate on City of Vancouver roadways.
- Operational analyses indicate that the study intersections are forecast to continue to operate acceptably under year 2029 background traffic conditions with two exceptions:
    - The intersection of NE 192nd Avenue/NE 13th Street is projected to operate at a LOS E and over-capacity during the weekday a.m. peak hour and LOS F and over-capacity during the weekday p.m. peak hour,
    - The southbound approach to the intersection of NE Ingle Road/NE Goodwin Road is projected to operate at a LOS F during the weekday p.m. peak hour.

## Year 2029 Total Traffic Conditions

- Year 2029 total traffic conditions were estimated assuming year 2029 background traffic and complete build-out of the proposed Green Mountain development.
- Operational analyses indicate that the study intersections are forecast to continue to operate acceptably under year 2029 total traffic conditions, with the exception of:
    - NE 199th Avenue/NE 58th Street (SR 500) (weekday a.m. and p.m.)
    - NE 192nd Avenue/NE 13th Street (weekday a.m. and p.m.)
    - NE Ingle Road/NE Goodwin Road (weekday a.m. and p.m.)

## Turn-Lane Considerations

- An assessment of turn-lane need was conducted for each study intersection.
- The intersection of NE 199th Avenue/NE 58th Street (SR 500) meets WSDOT's guidelines for a right-turn lane on the eastbound approach under existing conditions and all future scenarios during both the weekday a.m. and p.m. peak hour.
    - The crash history indicates that no crashes were recorded between 2008-2013 involving vehicles making an eastbound right-turn.
    - Given the lack of crash history related to eastbound right-turns and the relatively small impact of Phase 1 (eight eastbound right-turn trips during the weekday a.m. peak hour, 27 eastbound right-turn trips during the weekday p.m. peak hour), no improvements are recommended in conjunction with Phase 1.
    - In the future, the provision of a right-turn taper or lane could be considered if suggested by the crash history at the intersection.
- The intersection of NE 242nd Avenue (SR 500)/NE 28th Street meets WSDOT's guidelines for a left-turn lane on the eastbound approach under existing conditions and all future scenarios during the weekday p.m. peak hour.
    - The crash history indicates that no crashes were recorded between 2008-2013 involving vehicles making an eastbound left-turn.
    - The City's long-term plans include a traffic signal and southbound left-turn lane at NE 242nd Avenue (SR 500)/NE 28th Street.
    - Given the lack of recorded crash history, the small impact of the proposed development (no Phase 1 eastbound left-turns and less than 10 at master plan build-out), and future improvement plans at this intersection, no turn-lane improvements are recommended with Phase 1 site development.

## Recommendations

- Regardless of the proposed master plan application, we recommend that the City of Camas consider potential improvements to the intersection of NE Ingle Road/NE Goodwin Road to address intersection sight distance limitations associated with the location of the stop bar, such as relocating the stop bar.
- The following improvements should be provided in conjunction with site development:
    - Phase 1 Site Development

- An eastbound left-turn lane with 100 feet of storage should be provided at NE Ingle Road/NE Goodwin Road.
- A westbound right-turn lane on NE Goodwin Road at NE Ingle Road prior to occupancy of the 203rd single family home in Phase 1. The right-turn lane should provide at least 100 feet of storage.
- On-site and off-site landscaping and any above ground utilities at the site-access driveways and internal roadways should be provided appropriately to ensure that adequate sight-distance is maintained.

- For Phase 1 and all future phases, a Transportation Compliance Letter as described above should be prepared by a licensed professional engineer and submitted with the then-current site plan application.
- Full Build-Out of Site Development (items to be assessed in Transportation Compliance Letter unless otherwise mitigated):
  - Future site plan applications should provide an updated assessment as to the potential need for providing an eastbound right-turn taper or lane at the 199th Avenue (SR 500)/NE 58th Street intersection unless otherwise deemed mitigated by the project or others.
  - Pay a proportionate "fair-share" financial contribution towards capacity mitigations at the intersection of NE 192nd Avenue/NE 13th Street. This contribution would partially fund the eventual construction of a northbound right-turn lane on NE 192nd Avenue and a westbound right-turn lane on NE 13th Avenue.

- Mitigations will be needed to improve NE Ingle Road/NE Goodwin Road in 2029. We recommend the following:
  - The applicant construct a three-lane section (with center two-way left-turn lane) on NE Goodwin Road along the site frontage.
  - The applicant assess traffic volumes and signal warrants at NE Ingle Road/NE Goodwin Road with each phase of development and construct a traffic signal and related appurtenances when the intersection no longer satisfies City of Camas performance standard (LOS "D" and v/c of 0.90 or better) and intersection volumes meet traffic signal warrants.

- On-site and off-site landscaping and any above ground utilities at the site-access driveways and internal roadways should be provided appropriately to ensure that adequate sight-distance is maintained.

We trust this letter adequately addresses the traffic impacts associated with the proposed Green Mountain Master Plan development. Please contact us if you have any questions or comments regarding the contents of this report or the analysis performed.

## REFERENCES

1. Transportation Research Board 2000. Highway Capacity Manual. 2000.
2. DKS Associates. *City of Camas Traffic Impact Fee Update*. May 2012.
3. Washington State Department of Transportation. *Design Manual*. July 2013.
4. C-Tran. http://www.c-tran.com. May 2014.
5. Oregon Department of Transportation Research Section. *SPR 667 Assessment of Statewide Intersection Safety Performance*. June 2011.
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8. City of Vancouver. *Traffic Study Guidelines.* December 2013.

# Appendix B Phase 2 Transportation Compliance Letter

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

# MEMORANDUM

Date: November 8, 2016 Project #: 20495

To: Curleigh Carothers, P.E.; City of Camas

cc: Ralph Emerson, CLB Washington Option Solutions, LLC
Kurt Stonex, P.E., Mike Odren, Stacey Hickman; Olson Engineering

From: Chris Brehmer, P.E., Kelly Laustsen; Kittelson & Associates, Inc.

Project: Green Mountain Phase 2

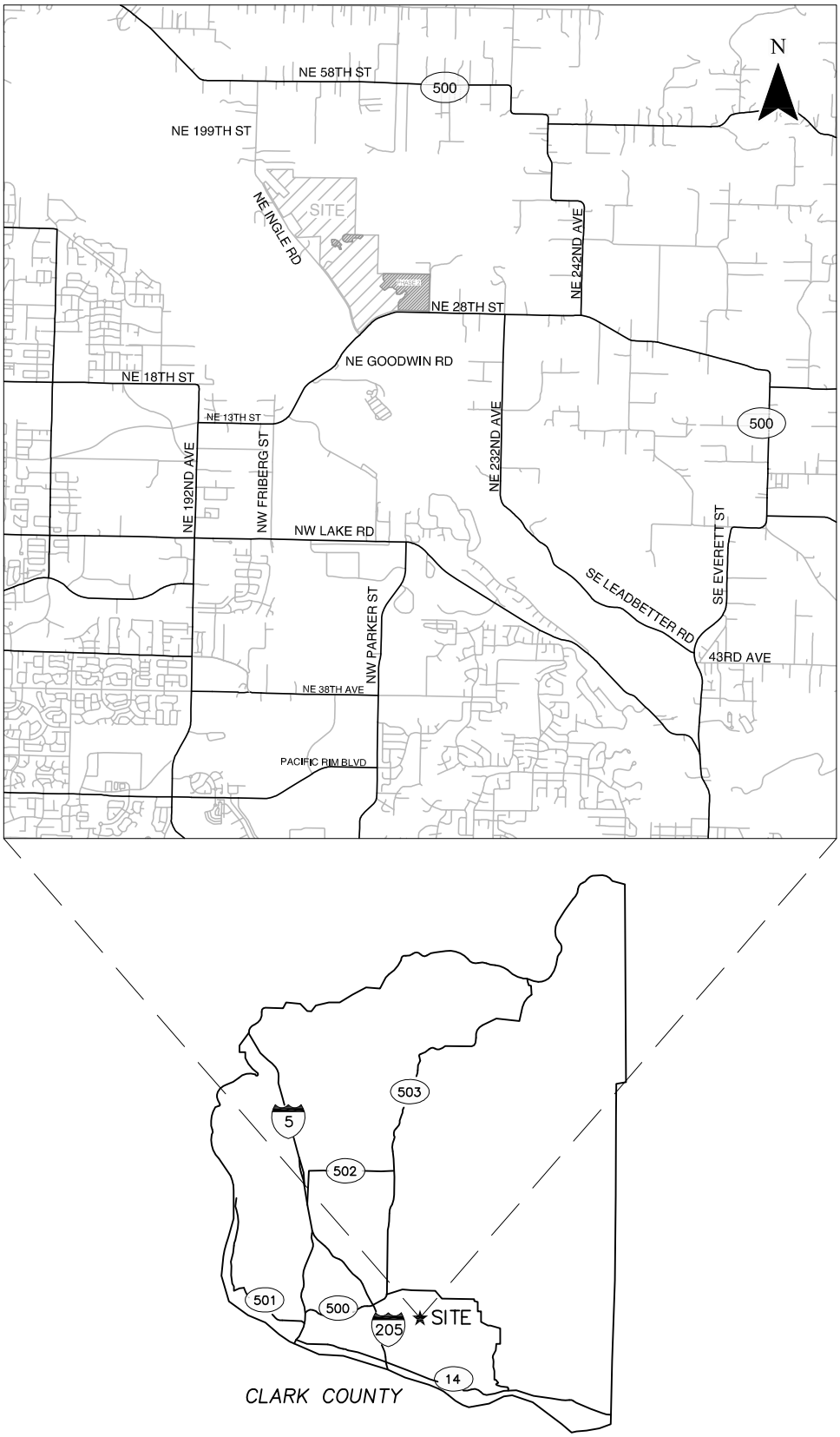
Subject: Transportation Compliance Letter

This memorandum provides a transportation compliance letter to support Phase 2 of the proposed Green Mountain Master Plan development to be located at the northeast corner of NE Ingle Road and NE Goodwin Road in Camas, Washington. The contents of this memorandum are based on the recommendations provided in the *Green Mountain Master Plan Transportation Impact Analysis* (TIA), prepared by Kittelson & Associates, Inc. and dated June 2014 (provided in *Appendix A*). The intent of this memorandum is to document the trip generation of Phase 2 and ensure that the mitigation measures provided in the Masterplan TIA are applied at the appropriate phase of development.

## BACKGROUND

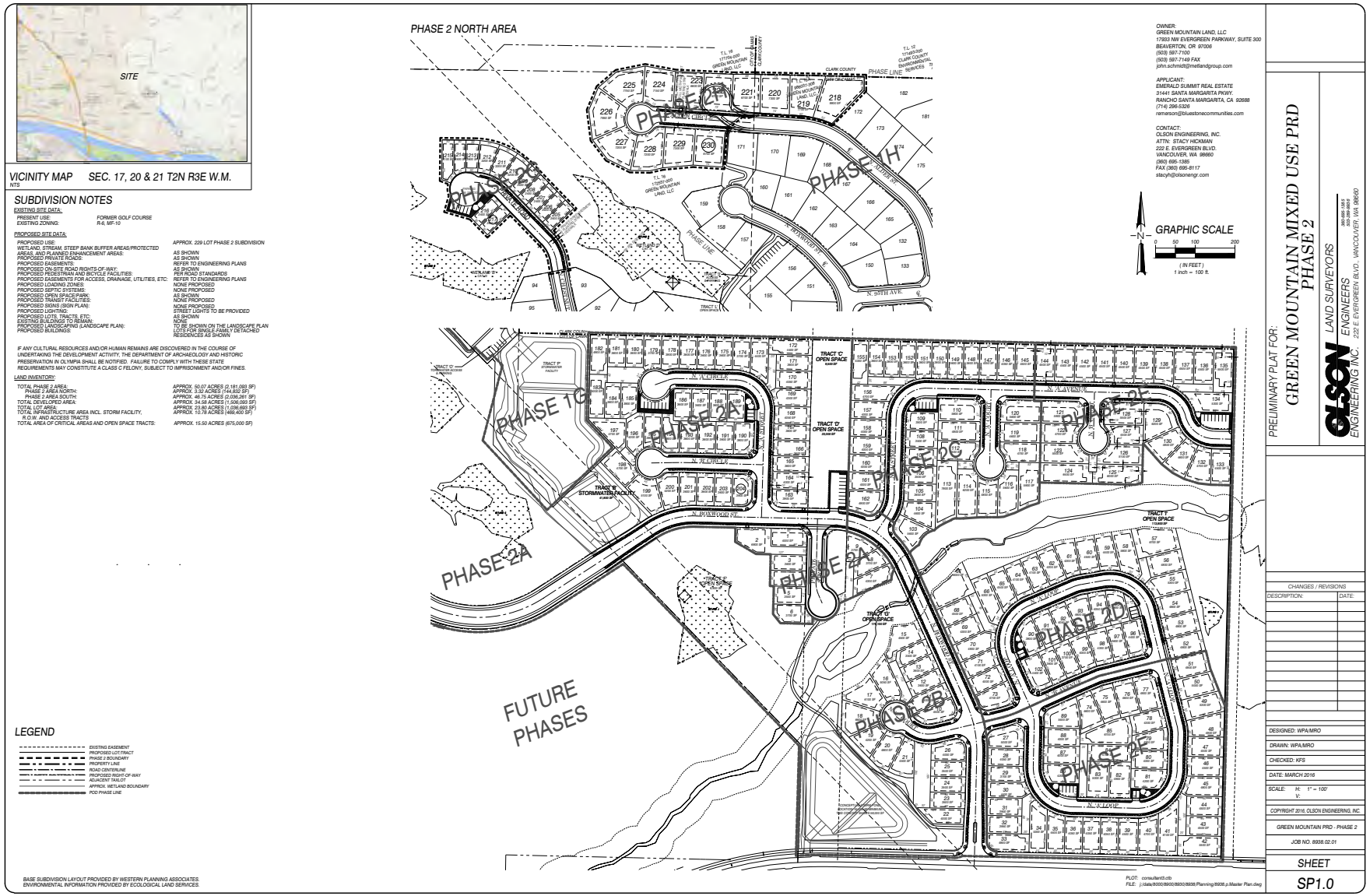
The TIA for the Green Mountain Master Plan developed in 2014 provided a near- and long-term analysis for full buildout of the Green Mountain site, including 283-acres of mixed-use development. The master plan includes eight phases of the development, the first of which is currently underway.

Figure 1 illustrates the site vicinity and location of the Master Plan site. A mix of residential and commercial uses is planned in accordance with the zoning. Development of Phase 2 of the site is currently proposed, with the site plan shown in Figure 2. Phase 2 includes development of 230 residential units with an additional access via NE 28th Street.




Site Vicinity
Camas, Washington

Figure
1




Plan provided by Olson Engineering, October 25, 2016

Conceptual Site Plan
Camas, Washington

Figure
2

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## SCOPE OF THE REPORT

This analysis identifies the transportation-related impacts associated with Phase 2 of the proposed Green Mountain Master Plan development and was prepared in accordance with the recommendations outlined in the Master Plan TIA. It documents the following:

- The number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) estimated with Phase 2.
- The number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) previously debited by approved site development applications on the master plan site.
- An accounting of the number of site-generated trips (daily, weekday a.m. peak hour, weekday p.m. peak hour) remaining assuming approval of the Phase 2 subdivision application.
- Evaluation of outstanding mitigation needs (as appropriate consistent with the Master Plan recommendations) involving:
  - Need for an eastbound right-turn lane at NE 199$^{th}$ Avenue/NE 58$^{th}$ Street (SR 500)
  - NE Ingle Road/NE Goodwin Road intersection operations
  - Assessment of proportionate share contribution at NE 192$^{nd}$ Avenue/NE 13$^{th}$ Street intersection
- On-site access and circulation.
- Conclusions and recommendations.

## ANALYSIS METHODOLOGY

As with the Master Plan TIA, all level of service analyses described in this report were performed in accordance with the procedures stated in the *2000 Highway Capacity Manual* (Reference 1). A description of level of service and the criteria by which they are determined is presented in *Appendix B. Appendix B* also indicates how level of service is measured and what is generally considered the acceptable range of level of service.

To ensure that this analysis was based on a reasonable worst-case scenario, the peak 15 minute flow rate during the peak hour analysis periods was used in the evaluation of all intersection levels of service. For this reason, the analysis reflects conditions that are only likely to occur for 15 minutes out of each average peak hour. Traffic conditions during other weekday hours and throughout the weekend will likely be better than those described in this report.

# CURRENT PROPOSED DEVELOPMENT PLAN

Phase 2 consists of 230 single-family detached homes and is expected to be completed by 2018. Phase 2 is primarily located in the southeast portion of the overall site, with access anticipated on NE 28th Street via a neighborhood circulator. As part of Phase 2, two pods adjacent to and northwest of Phase 1 will also be constructed. Phase 2 will be connected to Phase 1 via the extension of N. Boxwood Street, as shown in the site plan in Figure 1. The proposed master plan anticipates two public street neighborhood circulator connections to NE Goodwin Road serving the site in conjunction with two public street neighborhood circulator connections along NE 28th Street.

## Trip Generation

Trip generation estimates for the proposed development were generated based on information provided in the standard reference manual *Trip Generation, 9th Edition* published by the Institute of Transportation Engineers (ITE – Reference 2). Table 1 summarizes the daily, weekday a.m., and weekday p.m. peak-hour trips for the Phase 2 assumed development. All daily trips have been rounded to the nearest ten and all peak hour trips have been rounded to the nearest five trips.

Table 1: Trip Generation Estimate – Phase 2

| Land Use | ITE Code | Size | Daily | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | In | Out | Total | In | Out |
| Single-Family Detached Housing | 210 | 230 units | 2,190 | 175 | 45 | 130 | 230 | 145 | 85 |

Table 2 summarizes the overall master plan trip generation and then deducts for the Phase 1[1] and Phase 2 trips to summarize the number of net new trips that will remain vested.

[1] While approved for 215 units, Phase 1 now consists of 201 units. The updated trip totals are shown in Table 2 with the full trip generation provided in *Appendix C.*

Table 2: Master Plan Trip Generation and Build-out Debiting (Includes Phase 1 and Phase 2)

| Land Use | ITE Code | Size | Daily | Weekday AM Peak Hour | | | Weekday PM Peak Hour | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Total | In | Out | Total | In | Out |
| Apartment | 220 | 536 units | 3,570 | 275 | 55 | 220 | 330 | 215 | 115 |
| Single-Family Detached Housing | 210 | 764 units | 7,270 | 575 | 145 | 430 | 765 | 480 | 285 |
| **Total Residential (1,300 units)** | | | **10,840** | **850** | 200 | 650 | 1,095 | 695 | 400 |
| *Internalization (6% Daily,54% PM)* | | | 630 | 0 | 0 | 0 | 60 | 30 | 30 |
| Shopping Center | 820 | 90,000 square feet | 6,340 | 145 | 90 | 55 | 560 | 270 | 290 |
| *Internalization (10% Daily, 11% PM)* | | | *630* | *0* | *0* | *0* | *60* | *30* | *30* |
| *Pass-By Trips (34%)* | | | *1,940* | *50* | *25* | *25* | *170* | *85* | *85* |
| Total Vested Trips | | | 17,180 | 995 | 290 | 705 | 1,655 | 965 | 690 |
| *Less Internalization* | | | *1,260* | *0* | *0* | *0* | *120* | *60* | *60* |
| *Less Pass-by trips* | | | *1,940* | *50* | *25* | *25* | *170* | *85* | *85* |
| ***Vested Net New Trips for Full Build-out*** | | | ***13,980*** | ***945*** | ***265*** | ***680*** | ***1,365*** | ***820*** | ***545*** |
| *Deduct for Net New Trips for Phase 1* | | | *1,915* | *150* | *40* | *110* | *200* | *125* | *75* |
| *Deduct for Net New Trips for Phase 2* | | | *2,190* | *175* | *45* | *130* | *230* | *145* | *85* |
| **Remaining Trips** | | | **9,885** | **620** | **180** | **440** | **935** | **550** | **385** |

As seen in Table 2, after accounting for Phase 1 and Phase 2; 9,885 daily; 620 weekday a.m. peak hour; and 935 weekday p.m. peak hour trips remain in the master plan approval.

### Trip Distribution and Assignment

The distribution of site-generated trips onto the study area roadway system was estimated utilizing the trip distribution provided in the Master Plan TIA. The majority of trips are anticipated to use the new access on NE Goodwin Road, while a small portion of trips may utilize the neighborhood circulator access on NE Ingle Road developed with Phase 1. *Appendix D* illustrates the trip assignment.

## EVALUATION OF OUTSTANDING MITIGATION NEEDS

The Master Plan TIA included recommended mitigations for intersections not meeting standards under background and/or total traffic conditions. As part of each phase's transportation compliance letter, it recommended evaluation of the following:

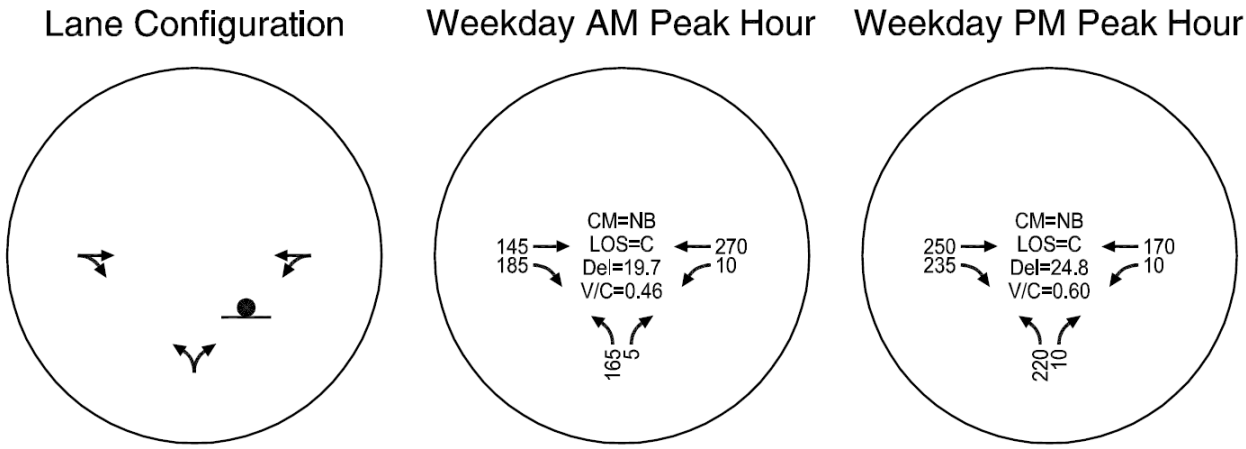
- Need for an eastbound right-turn lane at NE 199$^{th}$ Avenue/NE 58$^{th}$ Street (SR 500)
- NE Ingle Road/NE Goodwin Road operations (including traffic signal warrant analysis)
- Assessment of proportionate share contribution at NE 192$^{nd}$ Avenue/NE 13$^{th}$ Street

Updated traffic counts were collected in October 2016 at NE 199$^{th}$ Avenue/NE 58$^{th}$ Street and NE Ingle Road/NE Goodwin Road to inform an updated operations analysis. The count sheets are provided in *Appendix E.* The results are discussed below.

## NE 199th Avenue/NE 58th Street (SR 500)

The Master Plan TIA recommended that future subdivision applications provide an updated assessment as to the potential need for providing a right-turn taper or lane at NE 199th Avenue/NE 58th Street (SR 500), considering both the need for a right-turn taper or lane and delay with the northbound left-turn. Year 2018 total traffic conditions were analyzed using the same approach from the Master Plan TIA, accounting for in-process developments (details are provided in *Appendix F*), Green Mountain Phase 1, and Green Mountain Phase 2. The lane configuration and projected operations under 2018 total traffic conditions are shown in Exhibit 1. *Appendix G* contains the 2018 total traffic conditions traffic operations worksheets.

**Exhibit 1: NE 199th Avenue/NE 58th Street (SR 500) Total Traffic Lane Configuration and Operations**




As seen in the exhibit, the minor street northbound left-turn at the intersection of NE 199th Avenue/NE 58th Street (SR 500) is projected to satisfy WSDOT standards during the weekday a.m. and p.m. peak hours. The intersection is projected to operate at a volume-to-capacity (v/c) ratio of 0.46 and LOS C during the a.m. peak hour and v/c ratio of 0.60 and LOS C during the p.m. peak hour. It therefore complies with WSDOT's LOS requirement (LOS C) for non-HSS facilities in rural areas.

Roadways under Washington State jurisdiction are subject to the turn lane guidelines contained in the *WSDOT Design Manual* (Reference 3). Traffic volumes at the intersection of NE 199th Avenue/NE 58th Street (SR 500) meet WSDOT's guidelines for an eastbound right-turn lane on NE 58th Street under existing conditions and all future scenarios during both the weekday a.m. and p.m. peak hour (consistent with findings from the Master Plan TIA). Construction of a right-turn lane could require right-of-way acquisition and will likely impact one or more private driveways along NE 58th Street (depending on the length of the deceleration lane constructed).

The table below assesses volumes at the intersection for various horizon year scenarios and the impact of the proposed development.

Table 3: NE 199th Avenue/NE 58th Street (SR 500) Eastbound Right-Turn Lane Assessment

| Scenario | Eastbound Right-Turn (EBRT) Volume | Meets Guideline? | Development-Added EBRT Trips | Impact of Development |
|---|---|---|---|---|
| 2016 Existing Traffic – AM Peak | 156 | Yes | - | - |
| 2016 Existing Traffic – PM Peak | 161 | Yes | - | - |
| 2018 Background Traffic – AM Peak | 178 | Yes | 8 (Phase 1) | 4% |
| 2018 Background Traffic – PM Peak | 206 | Yes | 25 (Phase 1) | 12% |
| 2018 Total Traffic – AM Peak | 187 | Yes | 9 (Phase 2) | 5% |
| 2018 Total Traffic – PM Peak | 235 | Yes | 29 (Phase 2) | 12% |

The findings in Table 3 are consistent with those presented in the June 2014 TIA. Given that no homes are yet occupied at the development site and no material changes relative to the proposed development plan have occurred since approval of the TIA, no right-turn improvements are recommended in conjunction with Phase 2. Consistent with the master plan approval conditions, future subdivision applications should continue to assess the potential need for providing a right-turn taper or lane at the intersection.

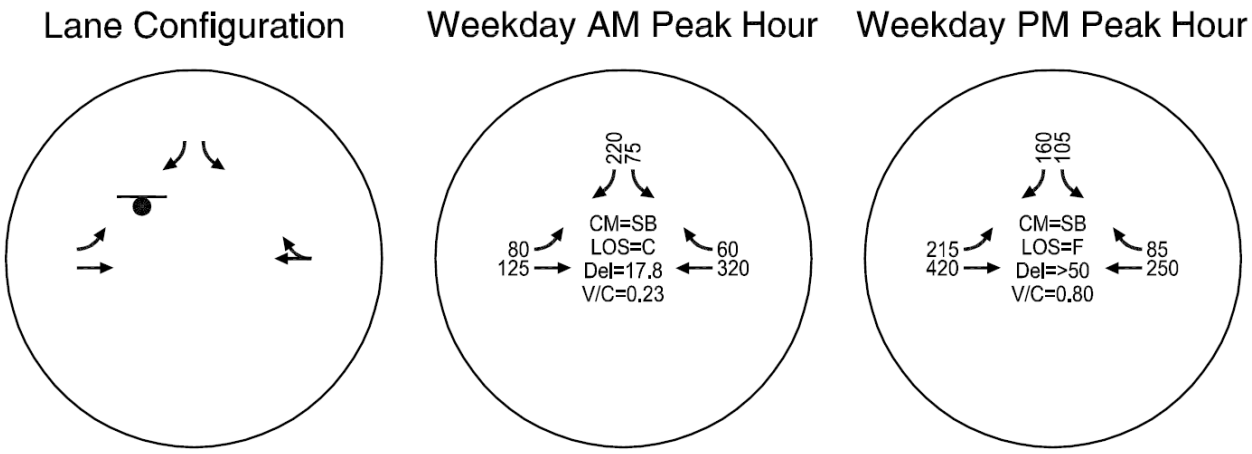
## NE Ingle Road/NE Goodwin Road

In the Master Plan TIA, the intersection of NE Ingle Road/NE Goodwin Road was projected to not meet City of Camas intersection operating standards in the 2029 background conditions during the weekday p.m. peak hour and the 2029 total traffic conditions during both the weekday a.m. and p.m. peak hours. Therefore, the following series of mitigations were recommended in conjunction with the proposed development:

- Construct an eastbound left-turn lane on NE Goodwin Road at NE Ingle Road with the first Phase 1 trip *(currently under construction).*
- Construct a westbound right-turn lane on NE Goodwin Road at NE Ingle Road with the 203rd Phase 1 trip (prior to occupancy of 203rd single family home on site). The right-turn lane should provide at least 100 feet of storage. *(Phase 1 was reduced to 201 homes, so construction of the westbound right-turn lane has not yet occurred).*
- Construct a three-lane roadway section (with center two-way left-turn lane) on NE Goodwin Road along the site frontage in conjunction with standard frontage improvements as adjacent development occurs *(applicable to Phase 2 development)*.
- Upon completion of Phase 1 site development (including construction of the eastbound left-turn lane on NE Goodwin Road at NE Ingle Road with Phase 1), the developer shall monitor the need for installation of a traffic signal with each future subdivision application at the intersection and construct a traffic signal when the intersection no longer satisfies City of Camas performance standard (LOS "D" and v/c of 0.90 or better) *and* the intersection volumes meet traffic signal warrants (subject to direction from the City of Camas) *(discussion provided below).*

Operations of the intersection as a stop-controlled intersection are provided in Exhibit 2 assuming Phase 1 and 2 site development as well as approved background traffic. *Appendix G* contains the 2018 total traffic conditions traffic operations worksheets.

**Exhibit 2: NE Ingle Road/NE Goodwin Road 2018 Total Traffic Lane Configuration and Operations**




As seen in Exhibit 2, the southbound left-turn at NE Ingle/NE Goodwin Road is projected to operate at a LOS F during the weekday p.m. peak hour with buildout of Phase 2 but operates under capacity with a v/c ratio of 0.80. Installation of a westbound right-turn lane (previously recommended with development of the 203rd home) is recommended with Phase 2 site development and will improve intersection operations compared to those reported in Exhibit 2. Further, to meet City of Camas standards, provision of a center two-way left-turn lane is recommended on NE Goodwin Road east of NE Ingle Road to accommodate two stage southbound left-turns. Operations with these mitigations are shown in Table 4. *Appendix H* contains the supporting traffic operations worksheets.

Table 4: NE Ingle Road/NE Goodwin Road 2018 Total Traffic Operations

| Scenario | Weekday AM Peak Hour | | Weekday PM Peak Hour | |
|---|---|---|---|---|
| | Delay | v/c | Delay | v/c |
| Current Intersection Configuration (refer to Exhibit 2) | 17.8 (LOS C) | 0.23 | 87.9 (LOS F) | 0.80 |
| Provision of a westbound right-turn lane | 17.1 (LOS C) | 0.22 | 75.1 (LOS F) | 0.74 |
| Provision of a TWLTL on NE Goodwin Road | 12.5 (LOS B) | 0.15 | 25.8 (LOS D) | 0.41 |

Note: Operations shown are for the critical movement (southbound left-turn)
TWLTL = Two-way left-turn lane

Recognizing that the intersection satisfies City of Camas performance standards with these recommended mitigations, installation of a traffic signal is not recommended with Phase 2 development. Per the Master Plan conditions of approval, the developer shall monitor the need for installation of a traffic signal with future subdivision applications.

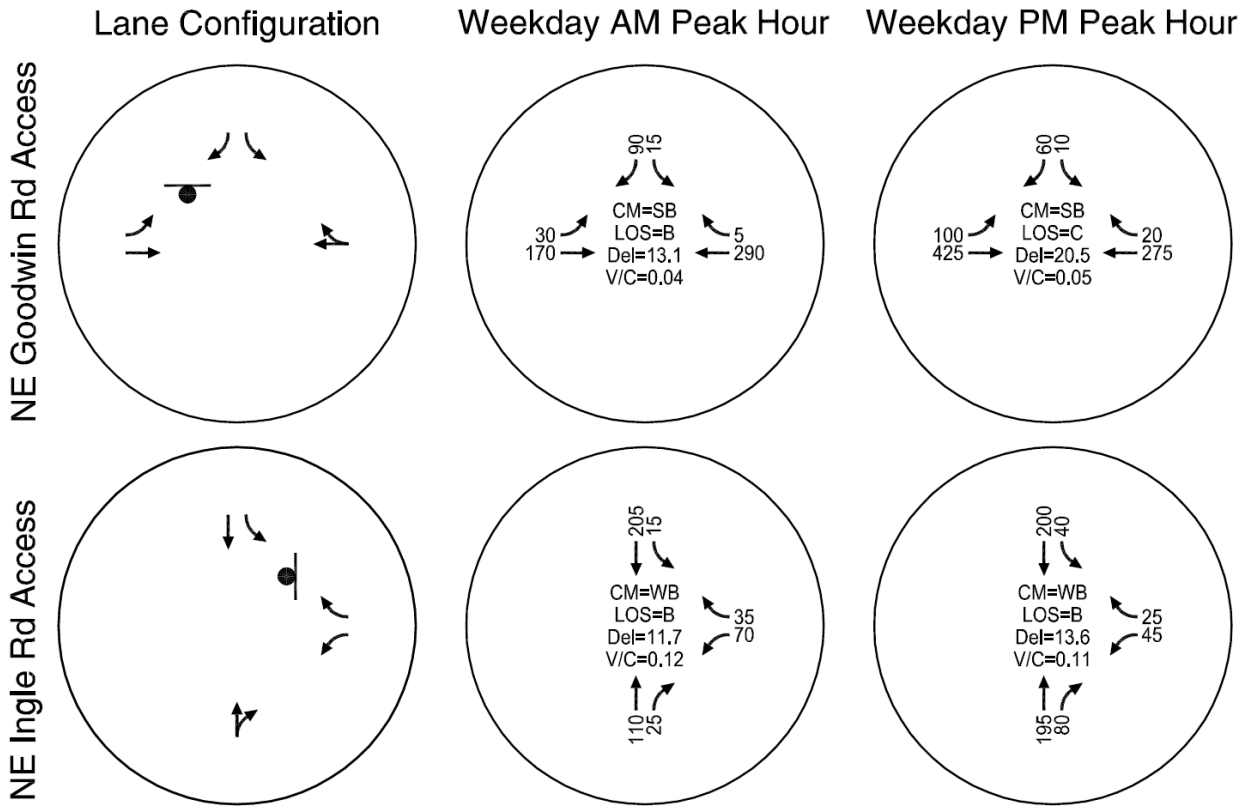
### NE 192nd Avenue/NE 13th Street

The Master Plan TIA identified a proposed proportionate cost sharing methodology to fund future construction of a northbound right-turn lane and a westbound right-turn lane on NE 13th Avenue at NE 192nd Avenue, provided in *Appendix I.* Under this methodology, each weekday p.m. peak hour trip would be assessed a fee of $319. Based on the Phase 2 trip assignment (refer to *Appendix D*), Phase 2 adds 103 trips to the intersection of NE 192nd Avenue/NE 13th Street and therefore should be responsible for contributing $32,857 towards future improvements at the intersection.

## ON-SITE CIRCULATION AND OPERATIONS

As seen in Figure 2, Phase 2 is located in the southeast portion of the overall site, with access anticipated on NE 28th Street (NE Goodwin Road) via a neighborhood circulator. Phase 2 will be connected to Phase 1 via the extension of N. Boxwood Street, as shown in the site plan in Figure 1. Therefore, some trips were assumed to utilize the neighborhood circulator access on NE Ingle Road developed with Phase 1. The proposed lane configuration for the access on NE 28th Street (NE Goodwin Road) and weekday a.m. and p.m. peak hour operations are shown in Exhibit 3. The operations for the access on NE Ingle Road developed with Phase 1 are also shown. *Appendix J* contains the traffic operations worksheets for the Phase 2 access operations.

**Exhibit 3: Site Accesses – 2018 Total Traffic Lane Configuration and Operations**



As seen in the exhibit, both accesses are projected to operate acceptably during both the weekday a.m. and p.m. peak hours. Anticipated queueing is provided in Table 4.

Table 5: Site Access Queueing – 2018 Total Traffic Conditions

| Location | Movement | 95th Percentile Queue | |
|---|---|---|---|
| | | Weekday AM Peak Hour | Weekday PM Peak Hour |
| NE Goodwin Road/ Site Access | Eastbound left-turn | 25 | 25 |
| | Westbound right-turn | <25 | <25 |
| | Southbound left-turn | 25 | 25 |
| | Southbound right-turn | 25 | 25 |
| NE Ingle Road/ Site Access | Westbound left-turn | 25 | 25 |
| | Westbound right-turn | 25 | 25 |
| | Southbound left-turn | 25 | 25 |

As seen in table three, 95th percentile queues are anticipated to be one vehicle or less.

On-site landscaping, signage and any above-ground utilities should be provided appropriately to ensure that adequate sight distance is provided and maintained.

## FINDINGS AND RECOMMENDATIONS

Based on the results of the transportation impact analysis, Phase 2 of the Green Mountain Master Plan can be developed while maintaining acceptable levels of service and safety at the study intersections without any required off-site mitigations. The primary findings and recommendations of this study are summarized below.

### Trip Generation

- Phase 2 includes 230 single family homes and is estimated to generate 2,190 daily trips, 175 net new a.m. peak hour trips, and 230 net new p.m. peak hour trips.
- After accounting for Phase 1 and Phase 2; 9,885 daily; 620 weekday a.m. peak hour; and 935 weekday p.m. peak hour trips remain in the master plan approval.

### NE 199th Avenue/NE 58th Street (SR 500)

- Consistent with prior analysis, the intersection of NE 199th Avenue/NE 58th Street (SR 500) continues to satisfy WSDOT's guidelines for a right-turn lane on the eastbound approach under existing conditions and all future scenarios during both the weekday a.m. and p.m. peak hours.
    - Given the lack of crash history related to eastbound right-turns and the relatively small impact of Phase 2 (nine eastbound right-turn trips during the weekday a.m.

peak hour, 29 eastbound right-turn trips during the weekday p.m. peak hour), no improvements are recommended in conjunction with Phase 2.

- In the future, the provision of a right-turn taper or lane could be considered if suggested by the crash history at the intersection or intersection operations.

## NE Ingle Road/NE Goodwin Road

- The southbound left-turn at NE Ingle/NE Goodwin Road is projected to operate at a LOS F and below capacity with buildout of Phase 2.
- Construction of a westbound right-turn lane on NE Goodwin Road at NE Ingle Road with at least 100 feet of storage and provision of a two-way left-turn lane on NE Goodwin Road east of NE Ingle Road are recommended with Phase 2 development. With these mitigations in place, the intersection satisfies City of Camas operating standards.

## NE 192nd Avenue/NE 13th Street

- Phase 2 is forecast to add 103 weekday p.m. peak hour trips to the intersection of NE 192nd Avenue/NE 13th Street. This equates to a proportionate cost share of $32,857 ($391 per trip) based on the proposed methodology presented in the Master Plan TIA.

## Recommendations

- The following should be provided in conjunction with site development:
  - Construction of a three-lane roadway section (with center two-way left-turn lane) on NE Goodwin Road along the site frontage in conjunction with standard frontage improvements.
  - Construction of a westbound right-turn lane on NE Goodwin Road at NE Ingle Road with at least 100 feet of storage and provision of a two-way left-turn lane on NE Goodwin Road east of NE Ingle Road.
  - Contribution of $32,857 towards future improvements at NE 192nd Avenue/NE 13th Street.
  - On-site and off-site landscaping and any above ground utilities at the site-access driveways and internal roadways should be provided appropriately to ensure that adequate sight-distance is maintained.

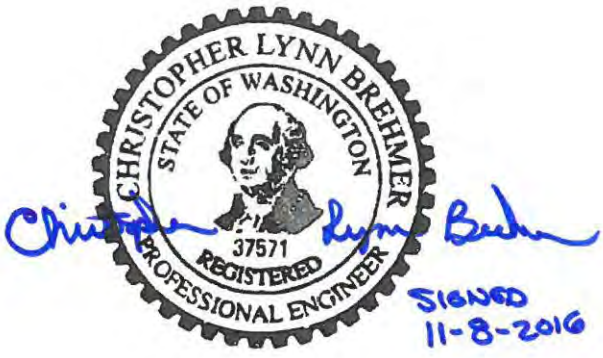
We trust this letter adequately addresses the traffic impacts associated with the proposed Green Mountain Master Plan Phase 2 site development. Please contact us if you have any questions or comments regarding the contents of this report or the analysis performed.

# REFERENCES

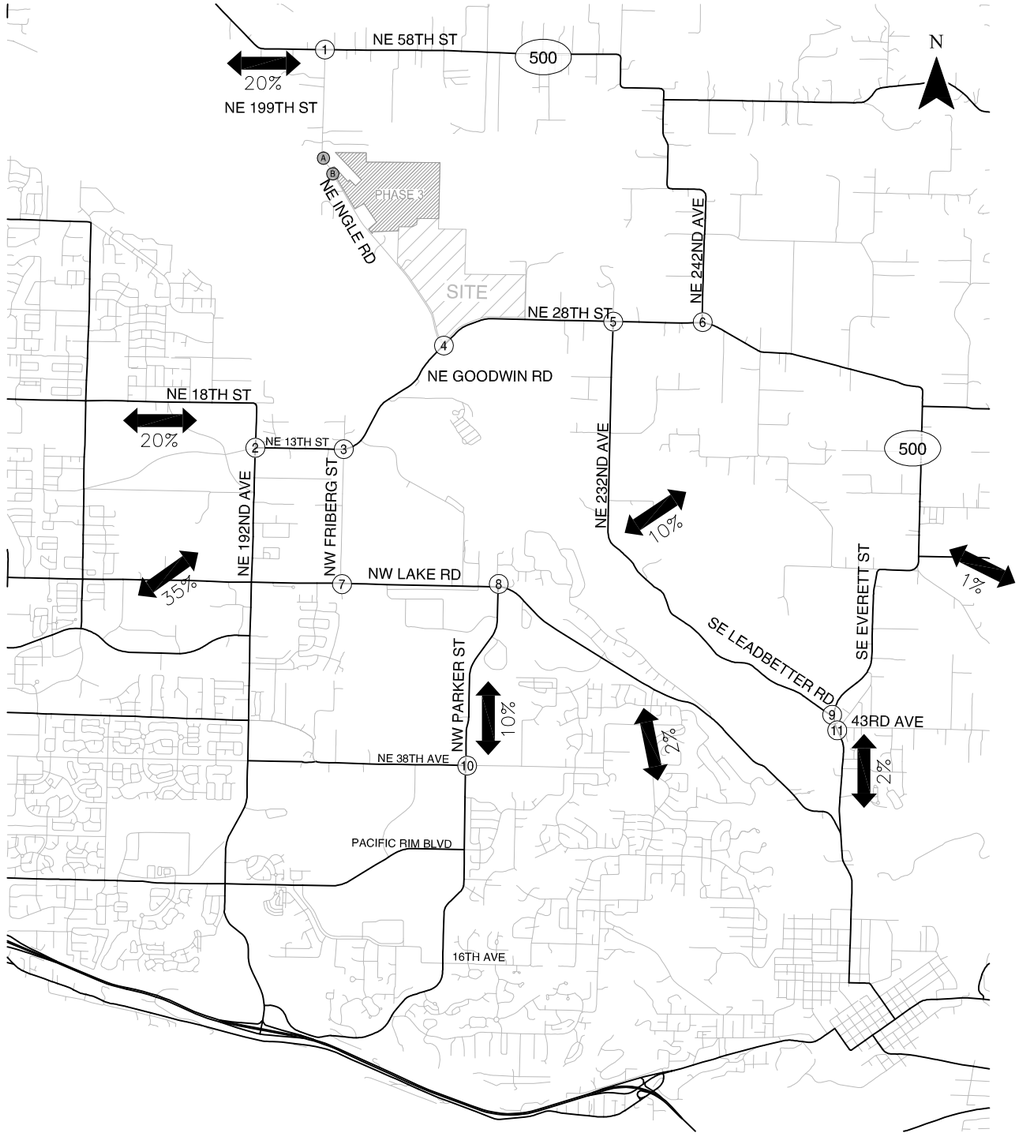
1. Transportation Research Board 2000. Highway Capacity Manual. 2000.

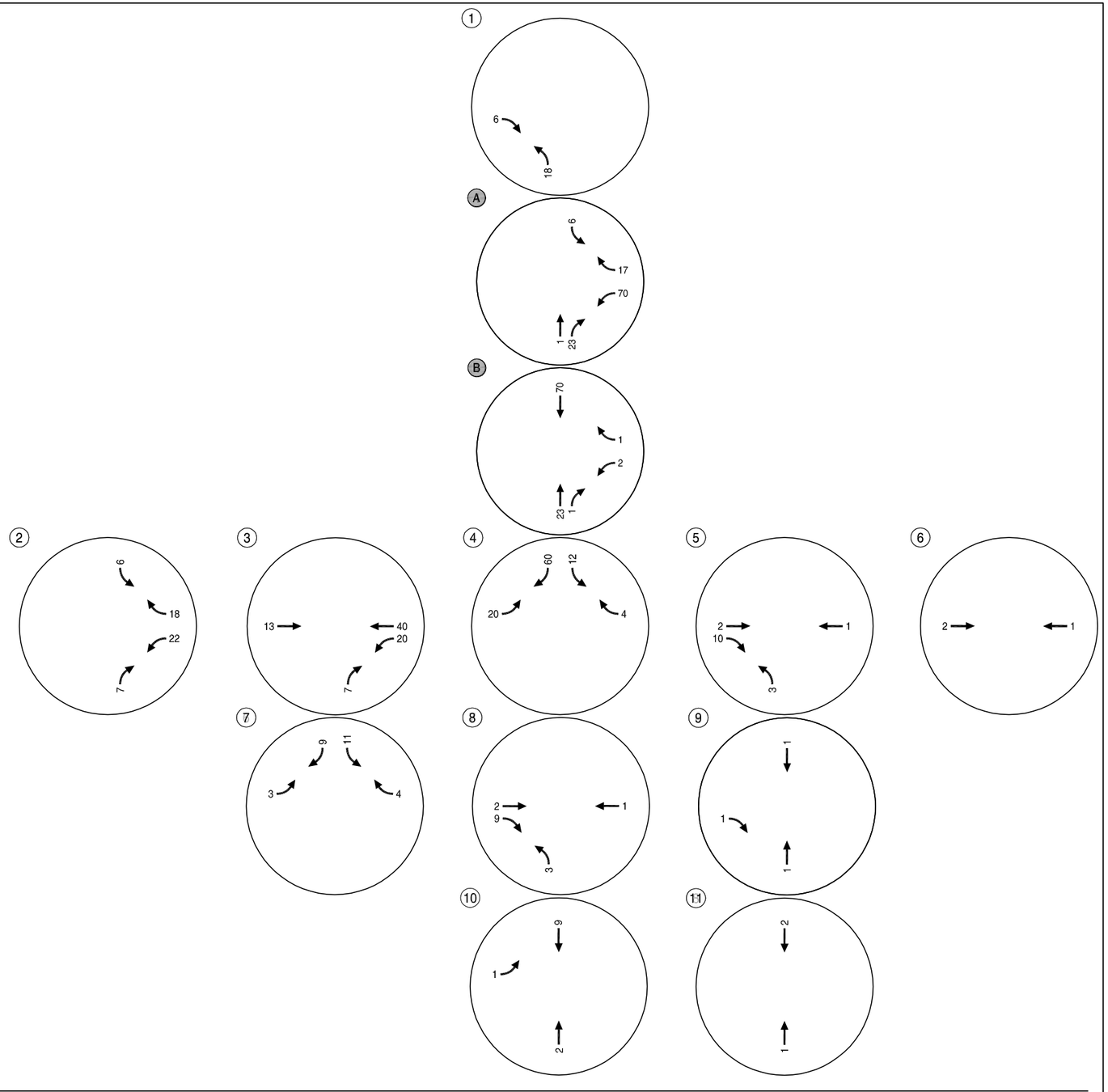
2. Institute of Transportation Engineers. *Trip Generation Manual, 9th Edition*. 2012.

3. Washington State Department of Transportation. *Design Manual*. July 2013.



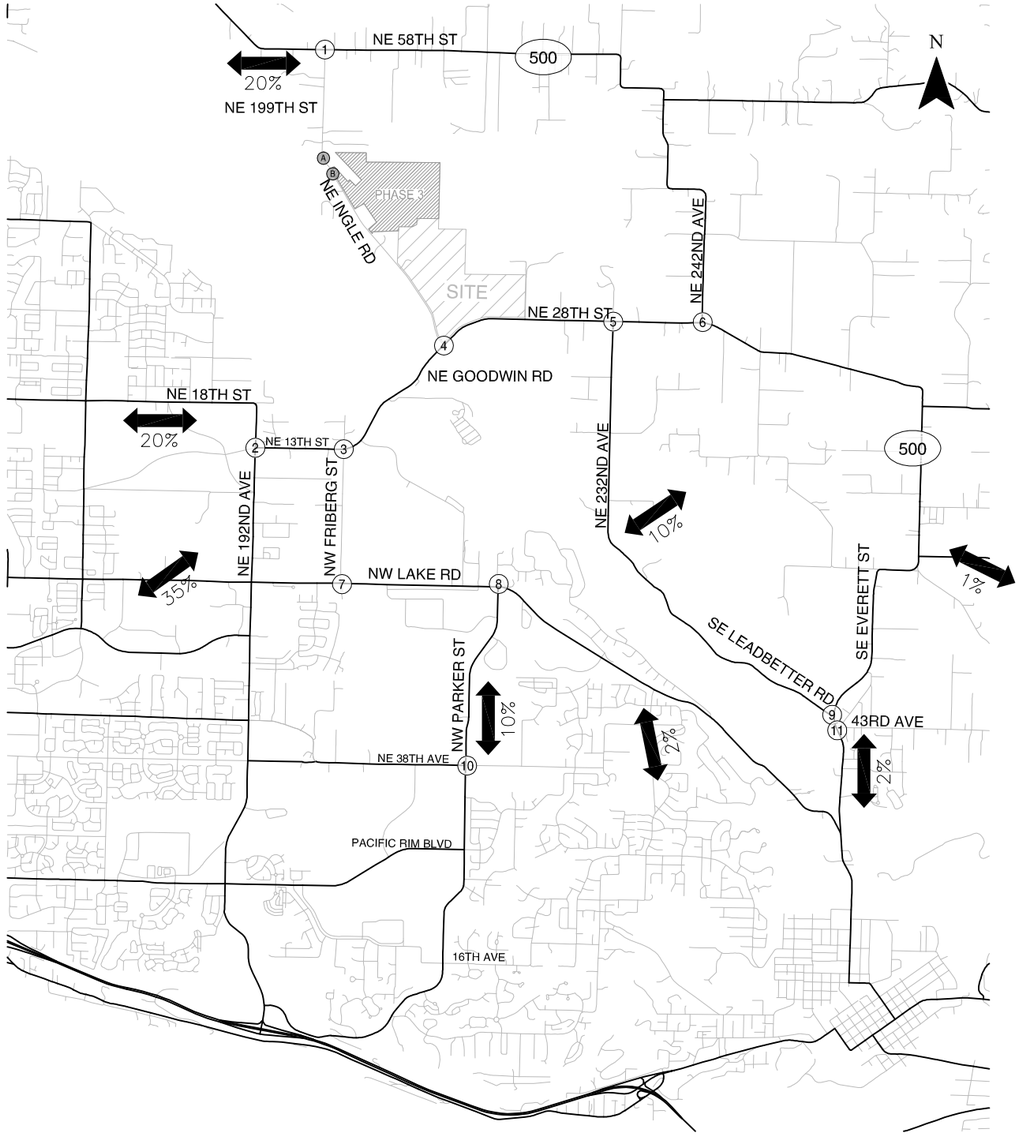
# Appendix C Phase 3 Trip Assignment

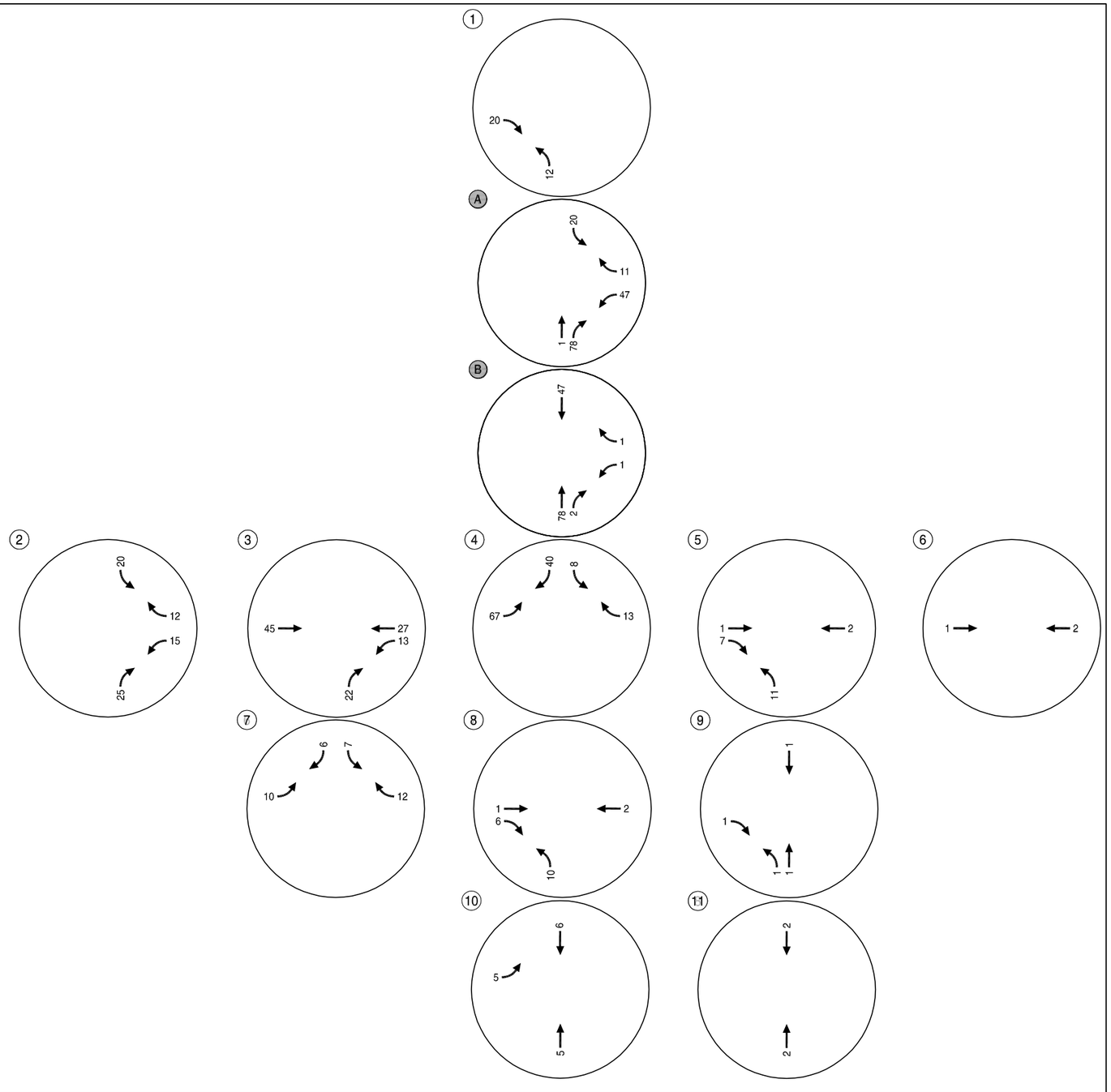



Total Estimated Trip Assignment - Phase 3
Weekday AM Peak Hour
Camas, Washington

Figure
C-1




Total Estimated Trip Assignment - Phase 3
Weekday PM Peak Hour
Camas, Washington

Figure
C-2

# Appendix D Traffic Counts

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

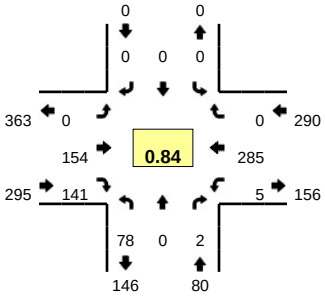
**LOCATION:** NE 199th Ave -- NE 58th St

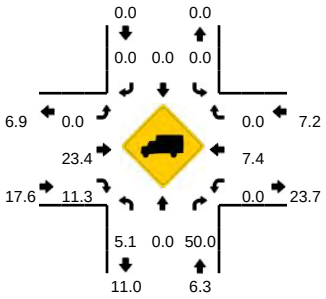
**CITY/STATE:** Vancouver, WA

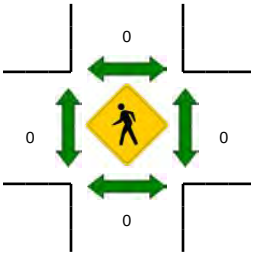
**QC JOB #:** 14399101

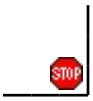
**DATE:** Tue, May 02 2017

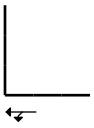
**Peak-Hour: 7:15 AM -- 8:15 AM**
**Peak 15-Min: 7:40 AM -- 7:55 AM**

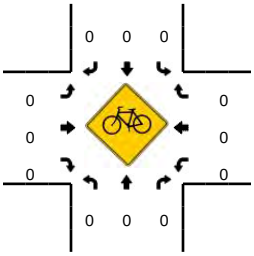


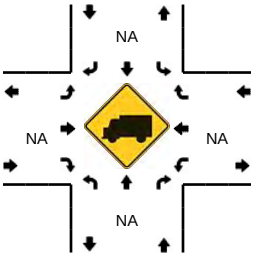



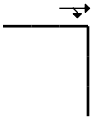



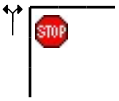



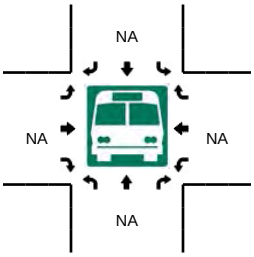








| 5-Min Count Period Beginning At | NE 199th Ave (Northbound) | | | | NE 199th Ave (Southbound) | | | | NE 58th St (Eastbound) | | | | NE 58th St (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 7:00 AM | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 16 | 0 | 1 | 16 | 0 | 0 | 45 | |
| 7:05 AM | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 12 | 0 | 1 | 20 | 0 | 0 | 51 | |
| 7:10 AM | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 11 | 0 | 0 | 10 | 0 | 0 | 38 | |
| 7:15 AM | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 12 | 0 | 0 | 22 | 0 | 0 | 59 | |
| 7:20 AM | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 12 | 0 | 2 | 25 | 0 | 0 | 57 | |
| 7:25 AM | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 11 | 0 | 0 | 26 | 0 | 0 | 55 | |
| 7:30 AM | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 11 | 0 | 0 | 28 | 0 | 0 | 56 | |
| 7:35 AM | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 14 | 0 | 0 | 28 | 0 | 0 | 64 | |
| 7:40 AM | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 11 | 0 | 1 | 28 | 0 | 0 | 61 | |
| 7:45 AM | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 18 | 0 | 0 | 24 | 0 | 0 | 68 | |
| 7:50 AM | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 2 | 30 | 0 | 0 | 68 | |
| 7:55 AM | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 8 | 0 | 0 | 22 | 0 | 0 | 41 | 663 |
| 8:00 AM | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 14 | 0 | 0 | 8 | 0 | 0 | 40 | 658 |
| 8:05 AM | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 11 | 0 | 0 | 22 | 0 | 0 | 51 | 658 |
| 8:10 AM | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 7 | 0 | 0 | 22 | 0 | 0 | 45 | 665 |
| 8:15 AM | 7 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 4 | 0 | 2 | 19 | 0 | 0 | 40 | 646 |
| 8:20 AM | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 1 | 27 | 0 | 0 | 59 | 648 |
| 8:25 AM | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 7 | 0 | 1 | 18 | 0 | 0 | 40 | 633 |
| 8:30 AM | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 13 | 0 | 0 | 8 | 0 | 0 | 39 | 616 |
| 8:35 AM | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 0 | 20 | 0 | 0 | 34 | 586 |
| 8:40 AM | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 11 | 0 | 0 | 11 | 0 | 0 | 42 | 567 |
| 8:45 AM | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 6 | 0 | 0 | 14 | 0 | 0 | 37 | 536 |
| 8:50 AM | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 5 | 0 | 1 | 12 | 0 | 0 | 41 | 509 |
| 8:55 AM | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 8 | 0 | 0 | 24 | 0 | 0 | 41 | 509 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 184 | 164 | 0 | 12 | 328 | 0 | 0 | 788 |
| Heavy Trucks | 4 | 0 | 0 | | 0 | 0 | 0 | | 0 | 36 | 8 | | 0 | 16 | 0 | | 64 |
| Pedestrians | | 0 | | | | 0 | | | | 0 | | | | 0 | | | 0 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Railroad | | | | | | | | | | | | | | | | | |
| Stopped Buses | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 5/8/2017 1:55 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

**LOCATION:** NE 199th Ave -- NE 58th St

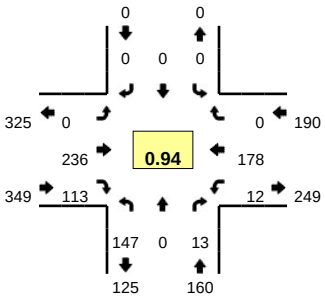
**CITY/STATE:** Vancouver, WA

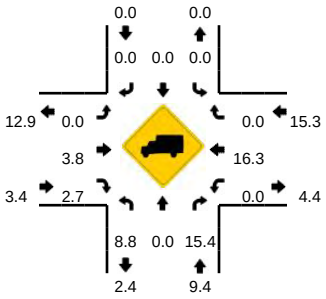
**QC JOB #:** 14399102

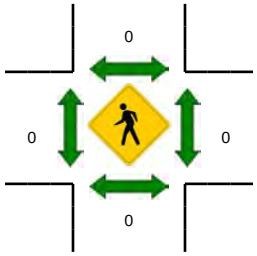
**DATE:** Tue, May 02 2017

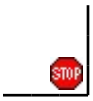
**Peak-Hour: 4:05 PM -- 5:05 PM**

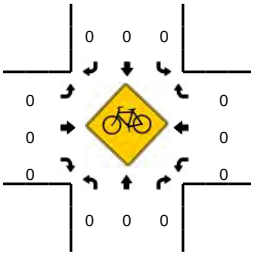
**Peak 15-Min: 4:35 PM -- 4:50 PM**

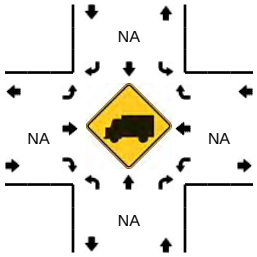


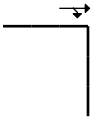



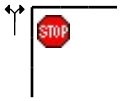



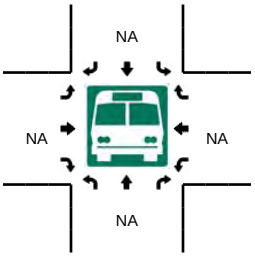






| 5-Min Count Period Beginning At | NE 199th Ave (Northbound) | | | | NE 199th Ave (Southbound) | | | | NE 58th St (Eastbound) | | | | NE 58th St (Westbound) | | | | Total | Hourly Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | | |
| 4:00 PM | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 8 | 0 | 0 | 12 | 0 | 0 | 47 | |
| 4:05 PM | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 7 | 0 | 2 | 21 | 0 | 0 | 59 | |
| 4:10 PM | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 6 | 0 | 2 | 19 | 0 | 0 | 52 | |
| 4:15 PM | 6 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 13 | 0 | 0 | 15 | 0 | 0 | 62 | |
| 4:20 PM | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 8 | 0 | 1 | 14 | 0 | 0 | 58 | |
| 4:25 PM | 23 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 8 | 0 | 0 | 14 | 0 | 0 | 64 | |
| 4:30 PM | 16 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 7 | 0 | 2 | 7 | 0 | 0 | 56 | |
| 4:35 PM | 13 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 10 | 0 | 2 | 15 | 0 | 0 | 57 | |
| 4:40 PM | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 7 | 0 | 1 | 16 | 0 | 0 | 54 | |
| 4:45 PM | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 14 | 0 | 1 | 19 | 0 | 0 | 74 | |
| 4:50 PM | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 8 | 0 | 0 | 15 | 0 | 0 | 46 | |
| 4:55 PM | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 15 | 0 | 1 | 10 | 0 | 0 | 64 | 693 |
| 5:00 PM | 17 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 10 | 0 | 0 | 13 | 0 | 0 | 53 | 699 |
| 5:05 PM | 11 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 7 | 0 | 0 | 18 | 0 | 0 | 58 | 698 |
| 5:10 PM | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 8 | 0 | 0 | 17 | 0 | 0 | 51 | 697 |
| 5:15 PM | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 11 | 0 | 1 | 10 | 0 | 0 | 56 | 691 |
| 5:20 PM | 14 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 12 | 0 | 3 | 9 | 0 | 0 | 62 | 695 |
| 5:25 PM | 17 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 14 | 0 | 1 | 13 | 0 | 0 | 63 | 694 |
| 5:30 PM | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 12 | 0 | 0 | 15 | 0 | 0 | 57 | 695 |
| 5:35 PM | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 16 | 0 | 0 | 12 | 0 | 0 | 60 | 698 |
| 5:40 PM | 15 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 7 | 0 | 0 | 11 | 0 | 0 | 52 | 696 |
| 5:45 PM | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 14 | 0 | 2 | 10 | 0 | 0 | 57 | 679 |
| 5:50 PM | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 14 | 0 | 0 | 16 | 0 | 0 | 61 | 694 |
| 5:55 PM | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 15 | 0 | 1 | 12 | 0 | 0 | 56 | 686 |

| Peak 15-Min Flowrates | Northbound | | | | Southbound | | | | Eastbound | | | | Westbound | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | Left | Thru | Right | U | |
| All Vehicles | 160 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 236 | 124 | 0 | 16 | 200 | 0 | 0 | 740 |
| Heavy Trucks | 4 | 0 | 0 | | 0 | 0 | 0 | | 0 | 8 | 0 | | 0 | 32 | 0 | | 44 |
| Pedestrians | | 0 | | | | 0 | | | | 0 | | | | 0 | | | 0 |
| Bicycles | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 |
| Railroad | | | | | | | | | | | | | | | | | |
| Stopped Buses | | | | | | | | | | | | | | | | | |

*Comments:*

Report generated on 5/8/2017 1:55 PM

SOURCE: Quality Counts, LLC (http://www.qualitycounts.net) 1-877-580-2212

# Appendix E In-Process Developments

## Kelly Laustsen

**From:** Curleigh (Jim) Carothers <jcarothers@cityofcamas.us>
**Sent:** Monday, May 15, 2017 11:58 AM
**To:** Kelly Laustsen
**Cc:** Norm Wurzer
**Subject:** FW: In process traffic for Green Mountain Phase 3

Kelly,
Here is the list that you requested. Do you have the trip distribution information for all of the below listed developments?

James E. Carothers, P.E.
Engineering Manager/City Engineer
City of Camas WASHINGTON
616 NE 4th Avenue
Camas, WA 98607
360-817-7230
360-834-1535 FAX
jcarothers@cityofcamas.us

---

**From:** Norm Wurzer
**Sent:** Friday, May 12, 2017 3:31 PM
**To:** Curleigh (Jim) Carothers <jcarothers@cityofcamas.us>
**Cc:** Wes Heigh <WHeigh@cityofcamas.us>
**Subject:** RE: In process traffic for Green Mountain Phase 3

Curleigh,
Please let me know if you need additional.

| Name | % build-out Oct 2016 | % build-out May 2017 |
|---|---|---|
| Lake Hills | 60% | Same |
| Two Creeks | 50% | Same |
| Summit at Columbia Vista | 82% | Same |
| Parker Village | 45% | Same |
| Hills at Round Lake | 50% | Same |
| North Hills Subdivision | 10% | 30% |
| Brady Rd Sub (Kates Cove) | 86% | 100% |
| Deerhaven Subdivision | 22% | 50% |
| Hadley's Glen | 73% | 100% |
| Windust | 0% | 0% |
| Fisher Crk Camp. Bldgs 1,2&3 | 100% | 100% (building 4 proposed) |
| CJ Dens | 0% | 0% |

**Norm Wurzer**
Engineer I

City of Camas
Office: 360.817.7235
Cell: 360.772.2945
nwurzer@cityofcamas.us

**From:** Curleigh (Jim) Carothers
**Sent:** Wednesday, May 10, 2017 10:05 AM
**To:** Wes Heigh
**Cc:** Norm Wurzer
**Subject:** FW: In process traffic for Green Mountain Phase 3

Wes,
Are you or Norm able to check on updated in-process traffic for GM PRD Phase 3?

James E. Carothers, P.E.
Engineering Manager/City Engineer
616 NE 4th Avenue
Camas, WA 98607
360-817-7230
360-834-1535 FAX
jcarothers@cityofcamas.us

**From:** Kelly Laustsen [mailto:klaustsen@kittelson.com]
**Sent:** Tuesday, May 09, 2017 7:14 PM
**To:** Curleigh (Jim) Carothers <jcarothers@cityofcamas.us>
**Subject:** In process traffic for Green Mountain Phase 3

Hi Curleigh,

We are now working on the Phase 3 Green Mountain study and I wanted to check if there are any changes in the in-process development we assumed for Phase 2. I've attached the appendix from Phase 2 detailing our assumptions.

Best,

Kelly M Laustsen, PE
Senior Engineer

Kittelson & Associates, Inc.
Transportation Engineering / Planning
503.535.7439 (direct)
214.886.5338 (cell)

**From:** Curleigh (Jim) Carothers [mailto:jcarothers@cityofcamas.us]
**Sent:** Tuesday, October 18, 2016 9:37 AM
**To:** Kelly Laustsen
**Cc:** Chris Brehmer; Wes Heigh; Norm Wurzer
**Subject:** RE: In process traffic for Green Mountain Phase 2

289 Single Family dwelling units.

James E. Carothers, P.E.
Engineering Manager/City Engineer
616 NE 4th Avenue
Camas, WA 98607
360-817-7230
360-834-1535 FAX
jcarothers@cityofcamas.us

---

**From:** Kelly Laustsen [mailto:klaustsen@kittelson.com]
**Sent:** Monday, October 17, 2016 8:19 AM
**To:** Curleigh (Jim) Carothers <jcarothers@cityofcamas.us>
**Cc:** Chris Brehmer <CBREHMER@kittelson.com>; Wes Heigh <WHeigh@cityofcamas.us>; Norm Wurzer <NWurzer@cityofcamas.us>
**Subject:** RE: In process traffic for Green Mountain Phase 2

Thanks for this information – it is very helpful. What is the unit count/type of the CJ Dens development? We'll use this to estimate the AM trip distribution.

Best,

Kelly M Laustsen
Senior Engineer

Kittelson & Associates, Inc.
Transportation Engineering / Planning
503.535.7439 (direct)
214.886.5338 (cell)

---

**From:** Curleigh (Jim) Carothers [mailto:jcarothers@cityofcamas.us]
**Sent:** Thursday, October 13, 2016 2:23 PM
**To:** Kelly Laustsen
**Cc:** Chris Brehmer; Wes Heigh; Norm Wurzer
**Subject:** RE: In process traffic for Green Mountain Phase 2

Kelly,
Please see the % buildout information in the attached email.

Please note the following:

- Lacamas Prairie is in the County. On GoogleEarth, there are 56 housed built in the latest aerial. You may check with Clark County if you want a more updated buildout number.
- It appears as though two buildings have been constructed in Lake 1 Plaza (if I have the right development (between 15th and 20th east side of SE 192nd)). Vancouver might be able to tell you the % buildout of this development.
- I notice that you did not have CJ Dens on the list. Please see the attached PM peak hour trip distribution. They preceded Green Mountain PRD with their decision and should be counted as in-process. They have yet to start their development.

Please let me know if you need any additional information.

James E. Carothers, P.E.
Engineering Manager/City Engineer
City of Camas WASHINGTON
616 NE 4th Avenue
Camas, WA 98607
360-817-7230
360-834-1535 FAX
jcarothers@cityofcamas.us

---

**From:** Kelly Laustsen [mailto:klaustsen@kittelson.com]
**Sent:** Monday, October 10, 2016 3:07 PM
**To:** Curleigh (Jim) Carothers <jcarothers@cityofcamas.us>
**Cc:** Chris Brehmer <CBREHMER@kittelson.com>
**Subject:** In process traffic for Green Mountain Phase 2

Hi Curleigh,

We are working on the supplemental analysis for Phase 2 of the Green Mountain Master Plan we recently discussed with you. Could you provide an update on which of the following in-process developments have been completed since our original TIA and no longer need to be included? We'll plan to use the same growth rates applied in the original TIA.

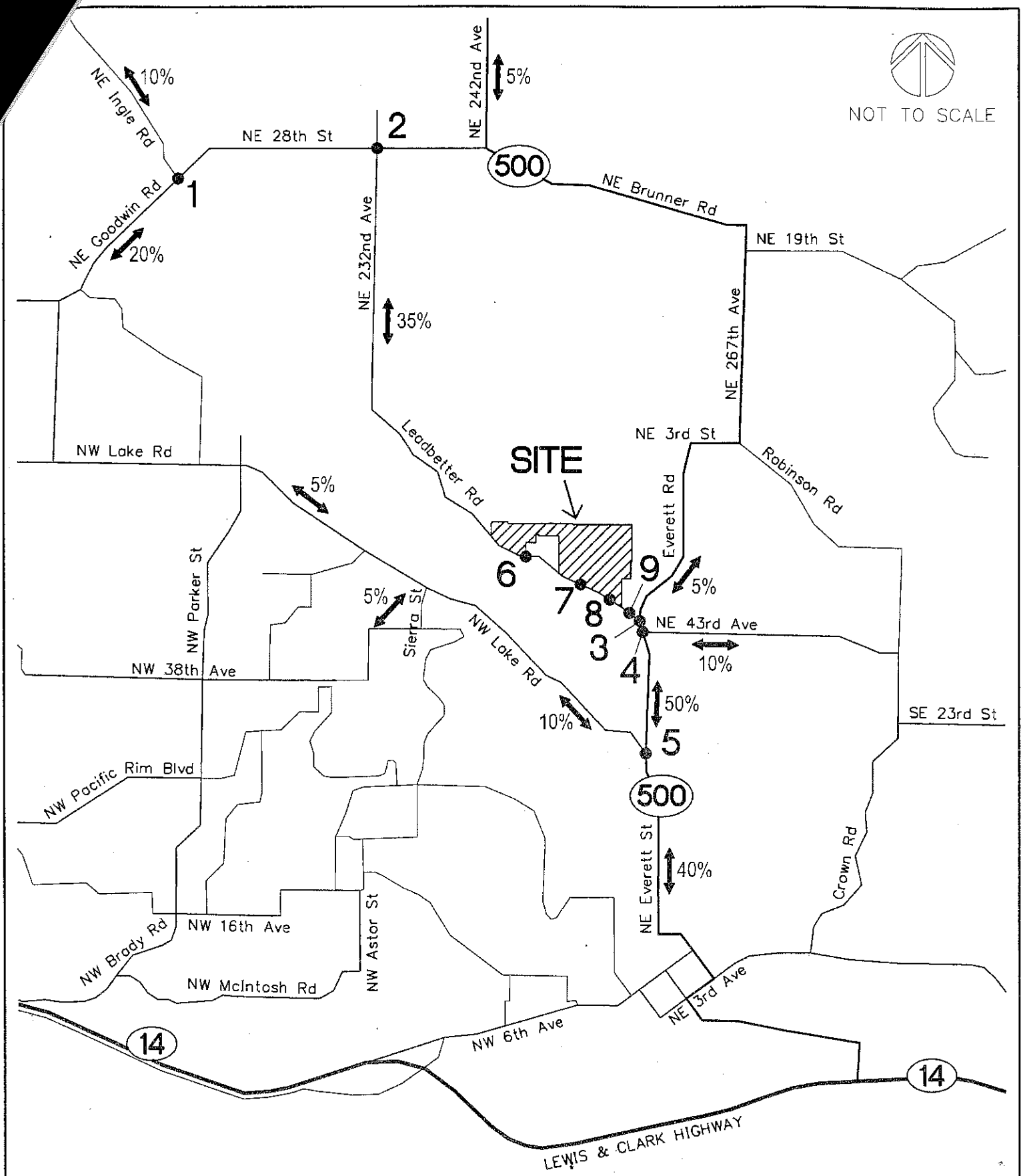
- Lake Hills
- Two Creeks
- The Summit at Columbia Vista
- Parker Village
- The Hills at Round Lake
- North Hills Subdivision
- Brady Road Subdivision
- Deerhaven Subdivision
- Hadley's Glen
- Millshore Downs
- Fisher Creek Campus
- Lacamas Prairie
- 192nd Plaza West

Thanks!

Kelly M Laustsen
Senior Engineer

Kittelson & Associates, Inc.
Transportation Engineering / Planning
610 SW Alder St, Suite 700
Portland, Oregon 97205
503.228.5230
503.535.7439 (direct)
214.886.5338 (cell)

Streetwise Twitter Facebook




GROUP MACKENZIE

Portland OR 503.224.9560 Vancouver WA 360.695.7879 Seattle WA 206.749.9963

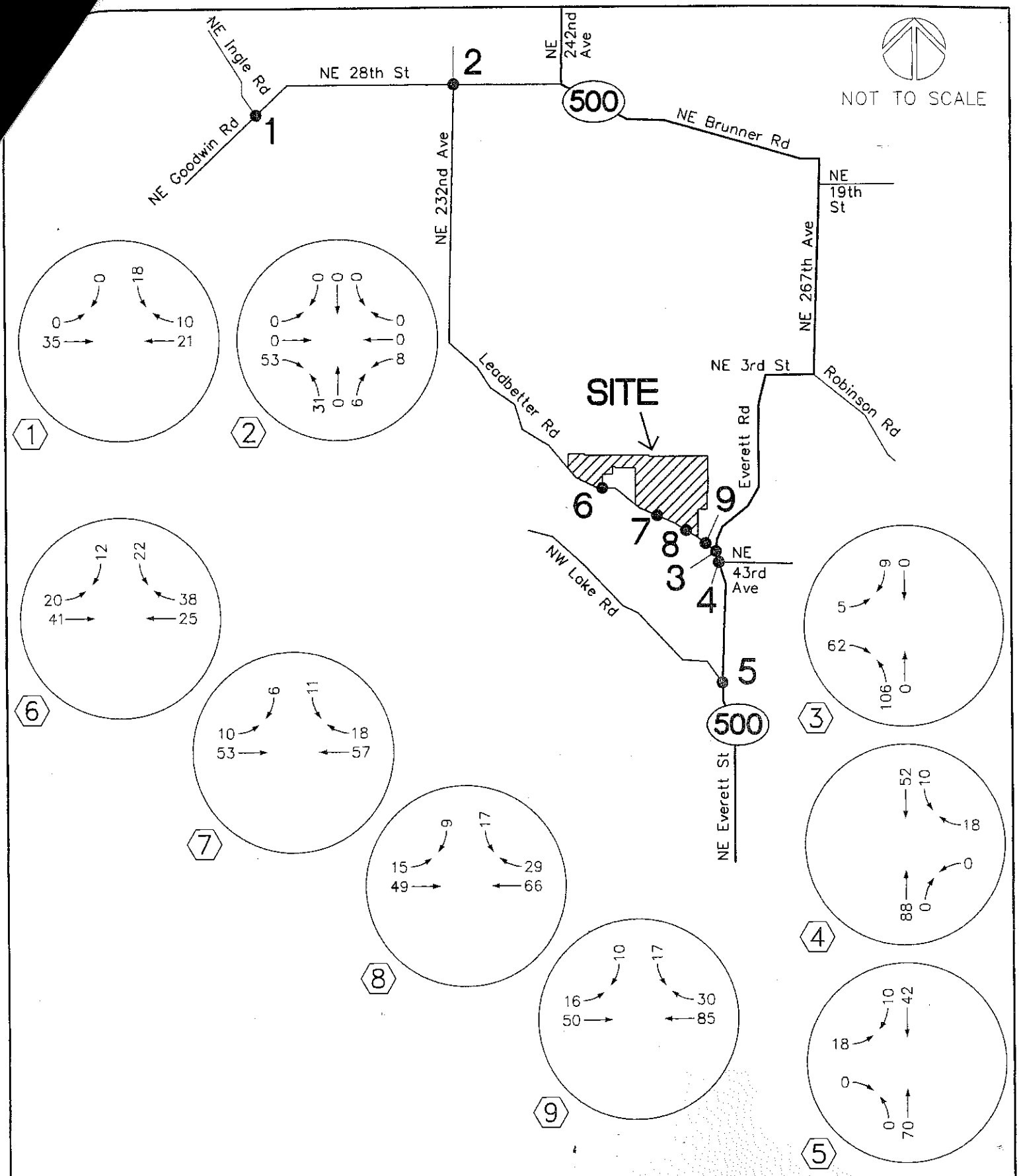


DATE: 08.03.10
DRAWN BY: DAH
CHECKED BY: BTA
JOB NO: 2050186.01

# SITE TRIP DISTRIBUTION

CJ DENS RESIDENTIAL SUBDIVISION
CAMAS, WASHINGTON

FIGURE 8




GROUP MACKENZIE

Portland OR 503.224.9560 | Vancouver WA 360.695.7879 | Seattle WA 206.749.9993



DATE: 08.03.10
DRAWN BY: DAH/KLA
CHECKED BY: BTA
JOB NO: 2050186.01

# SITE TRIP ASSIGNMENTS - PM PEAK HOUR

CJ DENS RESIDENTIAL SUBDIVISION
CAMAS, WASHINGTON

FIGURE 9B

# Appendix F 2022 Total Traffic Conditions Worksheets

| Intersection | |
|---|---|
| Int Delay, s/veh | 5.6 |

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 155 | 202 | 11 | 288 | 192 | 5 |
| Future Vol, veh/h | 155 | 202 | 11 | 288 | 192 | 5 |
| 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 | 85 | 85 | 85 | 85 | 85 | 85 |
| Heavy Vehicles, % | 23 | 6 | 20 | 5 | 5 | 50 |
| Mvmt Flow | 182 | 238 | 13 | 339 | 226 | 6 |

| Major/Minor | Major1 | | Major2 | | Minor1 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 0 | 0 | 420 | 0 | 666 | 301 |
| Stage 1 | - | - | - | - | 301 | - |
| Stage 2 | - | - | - | - | 365 | - |
| Critical Hdwy | - | - | 4.3 | - | 6.45 | 6.7 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.45 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.45 | - |
| Follow-up Hdwy | - | - | 2.38 | - | 3.545 | 3.75 |
| Pot Cap-1 Maneuver | - | - | 1049 | - | 420 | 639 |
| Stage 1 | - | - | - | - | 744 | - |
| Stage 2 | - | - | - | - | 696 | - |
| Platoon blocked, % | - | - | | - | | |
| Mov Cap-1 Maneuver | - | - | 1049 | - | 414 | 639 |
| Mov Cap-2 Maneuver | - | - | - | - | 414 | - |
| Stage 1 | - | - | - | - | 744 | - |
| Stage 2 | - | - | - | - | 686 | - |

| Approach | EB | WB | NB |
|---|---|---|---|
| HCM Control Delay, s | 0 | 0.3 | 23.8 |
| HCM LOS | | | C |

| Minor Lane/Major Mvmt | NBLn1 | EBT | EBR | WBL | WBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | 418 | - | - | 1049 | - |
| HCM Lane V/C Ratio | 0.554 | - | - | 0.012 | - |
| HCM Control Delay (s) | 23.8 | - | - | 8.5 | 0 |
| HCM Lane LOS | C | - | - | A | A |
| HCM 95th %tile Q(veh) | 3.3 | - | - | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 6.4 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 103 | 129 | 332 | 68 | 91 | 291 |
| Future Vol, veh/h | 103 | 129 | 332 | 68 | 91 | 291 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 100 | 50 | 0 |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 93 | 93 | 93 | 93 | 93 | 93 |
| Heavy Vehicles, % | 10 | 6 | 5 | 6 | 15 | 5 |
| Mvmt Flow | 111 | 139 | 357 | 73 | 98 | 313 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 357 | 0 | - | 0 | 717 | 357 |
| Stage 1 | - | - | - | - | 357 | - |
| Stage 2 | - | - | - | - | 360 | - |
| Critical Hdwy | 4.2 | - | - | - | 6.55 | 6.25 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.55 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.55 | - |
| Follow-up Hdwy | 2.29 | - | - | - | 3.635 | 3.345 |
| Pot Cap-1 Maneuver | 1159 | - | - | - | 378 | 680 |
| Stage 1 | - | - | - | - | 680 | - |
| Stage 2 | - | - | - | - | 678 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1159 | - | - | - | 342 | 680 |
| Mov Cap-2 Maneuver | - | - | - | - | 449 | - |
| Stage 1 | - | - | - | - | 680 | - |
| Stage 2 | - | - | - | - | 613 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Control Delay, s | 3.7 | 0 | 14.8 |
| HCM LOS | | | B |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 | SBLn2 |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1159 | - | - | - | 449 | 680 |
| HCM Lane V/C Ratio | 0.096 | - | - | - | 0.218 | 0.46 |
| HCM Control Delay (s) | 8.4 | - | - | - | 15.2 | 14.7 |
| HCM Lane LOS | A | - | - | - | C | B |
| HCM 95th %tile Q(veh) | 0.3 | - | - | - | 0.8 | 2.4 |

| Intersection | |
|---|---|
| Int Delay, s/veh | 8.4 |

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 268 | 265 | 11 | 183 | 242 | 11 |
| Future Vol, veh/h | 268 | 265 | 11 | 183 | 242 | 11 |
| 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 | 88 | 88 | 88 | 88 | 88 | 88 |
| Heavy Vehicles, % | 4 | 2 | 0 | 6 | 4 | 0 |
| Mvmt Flow | 305 | 301 | 13 | 208 | 275 | 13 |

| Major/Minor | Major1 | | Major2 | | Minor1 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 0 | 0 | 606 | 0 | 688 | 455 |
| Stage 1 | - | - | - | - | 455 | - |
| Stage 2 | - | - | - | - | 233 | - |
| Critical Hdwy | - | - | 4.1 | - | 6.44 | 6.2 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.44 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.44 | - |
| Follow-up Hdwy | - | - | 2.2 | - | 3.536 | 3.3 |
| Pot Cap-1 Maneuver | - | - | 982 | - | 409 | 609 |
| Stage 1 | - | - | - | - | 635 | - |
| Stage 2 | - | - | - | - | 801 | - |
| Platoon blocked, % | - | - | | - | | |
| Mov Cap-1 Maneuver | - | - | 982 | - | 403 | 609 |
| Mov Cap-2 Maneuver | - | - | - | - | 403 | - |
| Stage 1 | - | - | - | - | 635 | - |
| Stage 2 | - | - | - | - | 789 | - |

| Approach | EB | WB | NB |
|---|---|---|---|
| HCM Control Delay, s | 0 | 0.5 | 32.1 |
| HCM LOS | | | D |

| Minor Lane/Major Mvmt | NBLn1 | EBT | EBR | WBL | WBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | 409 | - | - | 982 | - |
| HCM Lane V/C Ratio | 0.703 | - | - | 0.013 | - |
| HCM Control Delay (s) | 32.1 | - | - | 8.7 | 0 |
| HCM Lane LOS | D | - | - | A | A |
| HCM 95th %tile Q(veh) | 5.3 | - | - | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 8.2 |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 289 | 436 | 259 | 103 | 116 | 203 |
| Future Vol, veh/h | 289 | 436 | 259 | 103 | 116 | 203 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Stop | Stop |
| RT Channelized | - | None | - | None | - | None |
| Storage Length | 200 | - | - | 100 | 50 | 0 |
| Veh in Median Storage, # | - | 0 | 0 | - | 0 | - |
| Grade, % | - | 0 | 0 | - | 0 | - |
| Peak Hour Factor | 89 | 89 | 89 | 89 | 89 | 89 |
| Heavy Vehicles, % | 3 | 2 | 2 | 3 | 1 | 2 |
| Mvmt Flow | 325 | 490 | 291 | 116 | 130 | 228 |

| Major/Minor | Major1 | | Major2 | | Minor2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 291 | 0 | - | 0 | 1430 | 291 |
| Stage 1 | - | - | - | - | 291 | - |
| Stage 2 | - | - | - | - | 1139 | - |
| Critical Hdwy | 4.13 | - | - | - | 6.41 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | 5.41 | - |
| Critical Hdwy Stg 2 | - | - | - | - | 5.41 | - |
| Follow-up Hdwy | 2.227 | - | - | - | 3.509 | 3.318 |
| Pot Cap-1 Maneuver | 1265 | - | - | - | 149 | 748 |
| Stage 1 | - | - | - | - | 761 | - |
| Stage 2 | - | - | - | - | 307 | - |
| Platoon blocked, % | | - | - | - | | |
| Mov Cap-1 Maneuver | 1265 | - | - | - | ~ 111 | 748 |
| Mov Cap-2 Maneuver | - | - | - | - | 192 | - |
| Stage 1 | - | - | - | - | 761 | - |
| Stage 2 | - | - | - | - | 228 | - |

| Approach | EB | WB | SB |
|---|---|---|---|
| HCM Control Delay, s | 3.5 | 0 | 28 |
| HCM LOS | | | D |

| Minor Lane/Major Mvmt | EBL | EBT | WBT | WBR | SBLn1 | SBLn2 |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1265 | - | - | - | 192 | 748 |
| HCM Lane V/C Ratio | 0.257 | - | - | - | 0.679 | 0.305 |
| HCM Control Delay (s) | 8.8 | - | - | - | 56.1 | 11.9 |
| HCM Lane LOS | A | - | - | - | F | B |
| HCM 95th %tile Q(veh) | 1 | - | - | - | 4.1 | 1.3 |

| Notes | | | |
|---|---|---|---|
| ~: Volume exceeds capacity | $: Delay exceeds 300s | +: Computation Not Defined | *: All major volume in platoon |

# MOVEMENT SUMMARY

## Site: 101 [Weekday AM PeakHour]

NE 199th/58th
Roundabout

| Movement Performance - Vehicles | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance ft | Prop. Queued | Effective Stop Rate per veh | Average Speed mph |
| South: NE 199th St | | | | | | | | | | | |
| 3 | L2 | 209 | 5.0 | 0.204 | 10.9 | LOS B | 1.0 | 25.6 | 0.37 | 0.66 | 34.0 |
| 18 | R2 | 5 | 50.0 | 0.204 | 6.5 | LOS A | 1.0 | 25.6 | 0.37 | 0.66 | 32.0 |
| Approach | | 214 | 6.1 | 0.204 | 10.8 | LOS B | 1.0 | 25.6 | 0.37 | 0.66 | 34.0 |
| East: NE 58th | | | | | | | | | | | |
| 1 | L2 | 12 | 20.0 | 0.315 | 11.6 | LOS B | 1.8 | 46.2 | 0.44 | 0.52 | 35.9 |
| 6 | T1 | 313 | 5.0 | 0.315 | 5.1 | LOS A | 1.8 | 46.2 | 0.44 | 0.52 | 36.4 |
| Approach | | 325 | 5.6 | 0.315 | 5.4 | LOS A | 1.8 | 46.2 | 0.44 | 0.52 | 36.4 |
| West: NE 58th | | | | | | | | | | | |
| 2 | T1 | 168 | 23.0 | 0.339 | 4.1 | LOS A | 2.1 | 58.8 | 0.12 | 0.41 | 37.4 |
| 12 | R2 | 220 | 6.0 | 0.339 | 4.0 | LOS A | 2.1 | 58.8 | 0.12 | 0.41 | 36.5 |
| Approach | | 388 | 13.4 | 0.339 | 4.0 | LOS A | 2.1 | 58.8 | 0.12 | 0.41 | 36.9 |
| All Vehicles | | 927 | 9.0 | 0.339 | 6.1 | LOS A | 2.1 | 58.8 | 0.29 | 0.50 | 36.0 |

Site Level of Service (LOS) Method: Delay & v/c (HCM 6). 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 6).
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.

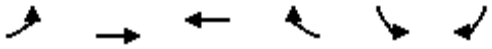
# MOVEMENT SUMMARY

## Site: 101 [Weekday PM PeakHour]

NE 199th/58th
Roundabout

| Movement Performance - Vehicles | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance ft | Prop. Queued | Effective Stop Rate per veh | Average Speed mph |
| South: NE 199th St | | | | | | | | | | | |
| 3 | L2 | 263 | 4.0 | 0.269 | 11.4 | LOS B | 1.4 | 35.5 | 0.46 | 0.70 | 33.9 |
| 18 | R2 | 12 | 0.0 | 0.269 | 5.4 | LOS A | 1.4 | 35.5 | 0.46 | 0.70 | 33.0 |
| Approach | | 275 | 3.8 | 0.269 | 11.2 | LOS B | 1.4 | 35.5 | 0.46 | 0.70 | 33.9 |
| East: NE 58th | | | | | | | | | | | |
| 1 | L2 | 12 | 0.0 | 0.211 | 11.0 | LOS B | 1.1 | 28.9 | 0.46 | 0.53 | 36.5 |
| 6 | T1 | 199 | 6.0 | 0.211 | 5.3 | LOS A | 1.1 | 28.9 | 0.46 | 0.53 | 36.3 |
| Approach | | 211 | 5.7 | 0.211 | 5.6 | LOS A | 1.1 | 28.9 | 0.46 | 0.53 | 36.3 |
| West: NE 58th | | | | | | | | | | | |
| 2 | T1 | 291 | 4.0 | 0.451 | 3.9 | LOS A | 3.4 | 86.8 | 0.12 | 0.40 | 37.8 |
| 12 | R2 | 288 | 2.0 | 0.451 | 4.0 | LOS A | 3.4 | 86.8 | 0.12 | 0.40 | 36.6 |
| Approach | | 579 | 3.0 | 0.451 | 3.9 | LOS A | 3.4 | 86.8 | 0.12 | 0.40 | 37.2 |
| All Vehicles | | 1065 | 3.7 | 0.451 | 6.1 | LOS A | 3.4 | 86.8 | 0.27 | 0.50 | 36.1 |

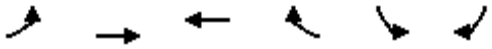
Site Level of Service (LOS) Method: Delay & v/c (HCM 6). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: Same as Signalised Intersections.
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement.
LOS F will 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 6).
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.



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 103 | 129 | 332 | 68 | 91 | 291 |
| Future Volume (veh/h) | 103 | 129 | 332 | 68 | 91 | 291 |
| Number | 7 | 4 | 8 | 18 | 1 | 16 |
| 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 |
| Adj Sat Flow, veh/h/ln | 1727 | 1792 | 1810 | 1792 | 1652 | 1810 |
| Adj Flow Rate, veh/h | 111 | 139 | 357 | 73 | 98 | 313 |
| Adj No. of Lanes | 1 | 1 | 1 | 1 | 1 | 1 |
| Peak Hour Factor | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 |
| Percent Heavy Veh, % | 10 | 6 | 5 | 6 | 15 | 5 |
| Cap, veh/h | 451 | 887 | 545 | 459 | 425 | 415 |
| Arrive On Green | 0.08 | 0.49 | 0.30 | 0.30 | 0.27 | 0.27 |
| Sat Flow, veh/h | 1645 | 1792 | 1810 | 1524 | 1573 | 1538 |
| Grp Volume(v), veh/h | 111 | 139 | 357 | 73 | 98 | 313 |
| Grp Sat Flow(s),veh/h/ln | 1645 | 1792 | 1810 | 1524 | 1573 | 1538 |
| Q Serve(g_s), s | 1.4 | 1.4 | 5.8 | 1.2 | 1.7 | 6.3 |
| Cycle Q Clear(g_c), s | 1.4 | 1.4 | 5.8 | 1.2 | 1.7 | 6.3 |
| Prop In Lane | 1.00 | | | 1.00 | 1.00 | 1.00 |
| Lane Grp Cap(c), veh/h | 451 | 887 | 545 | 459 | 425 | 415 |
| V/C Ratio(X) | 0.25 | 0.16 | 0.66 | 0.16 | 0.23 | 0.75 |
| Avail Cap(c_a), veh/h | 616 | 1685 | 1169 | 985 | 924 | 904 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 6.8 | 4.7 | 10.4 | 8.7 | 9.7 | 11.4 |
| Incr Delay (d2), s/veh | 0.3 | 0.1 | 1.3 | 0.2 | 0.3 | 2.8 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.6 | 0.7 | 3.1 | 0.5 | 0.7 | 0.3 |
| LnGrp Delay(d),s/veh | 7.1 | 4.8 | 11.7 | 8.9 | 9.9 | 14.2 |
| LnGrp LOS | A | A | B | A | A | B |
| Approach Vol, veh/h | | 250 | 430 | | 411 | |
| Approach Delay, s/veh | | 5.8 | 11.2 | | 13.2 | |
| Approach LOS | | A | B | | B | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | | | 4 | | 6 | 7 | 8 |
| Phs Duration (G+Y+Rc), s | | | | 20.8 | | 13.2 | 6.6 | 14.2 |
| Change Period (Y+Rc), s | | | | 4.0 | | 4.0 | 4.0 | 4.0 |
| Max Green Setting (Gmax), s | | | | 32.0 | | 20.0 | 6.0 | 22.0 |
| Max Q Clear Time (g_c+I1), s | | | | 3.4 | | 8.3 | 3.4 | 7.8 |
| Green Ext Time (p_c), s | | | | 2.9 | | 1.0 | 0.1 | 2.4 |

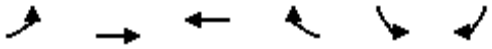
| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 10.7 |
| HCM 2010 LOS | B |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 289 | 436 | 259 | 103 | 116 | 203 |
| Future Volume (veh/h) | 289 | 436 | 259 | 103 | 116 | 203 |
| Number | 7 | 4 | 8 | 18 | 1 | 16 |
| 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 |
| Adj Sat Flow, veh/h/ln | 1845 | 1863 | 1863 | 1845 | 1881 | 1863 |
| Adj Flow Rate, veh/h | 325 | 490 | 291 | 116 | 130 | 228 |
| Adj No. of Lanes | 1 | 1 | 1 | 1 | 1 | 1 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| Percent Heavy Veh, % | 3 | 2 | 2 | 3 | 1 | 2 |
| Cap, veh/h | 652 | 1060 | 529 | 445 | 372 | 328 |
| Arrive On Green | 0.17 | 0.57 | 0.28 | 0.28 | 0.21 | 0.21 |
| Sat Flow, veh/h | 1757 | 1863 | 1863 | 1568 | 1792 | 1583 |
| Grp Volume(v), veh/h | 325 | 490 | 291 | 116 | 130 | 228 |
| Grp Sat Flow(s),veh/h/ln | 1757 | 1863 | 1863 | 1568 | 1792 | 1583 |
| Q Serve(g_s), s | 4.0 | 5.5 | 4.7 | 2.0 | 2.2 | 4.8 |
| Cycle Q Clear(g_c), s | 4.0 | 5.5 | 4.7 | 2.0 | 2.2 | 4.8 |
| Prop In Lane | 1.00 | | | 1.00 | 1.00 | 1.00 |
| Lane Grp Cap(c), veh/h | 652 | 1060 | 529 | 445 | 372 | 328 |
| V/C Ratio(X) | 0.50 | 0.46 | 0.55 | 0.26 | 0.35 | 0.69 |
| Avail Cap(c_a), veh/h | 937 | 1719 | 886 | 745 | 952 | 841 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 6.2 | 4.5 | 10.9 | 9.9 | 12.1 | 13.1 |
| Incr Delay (d2), s/veh | 0.6 | 0.3 | 0.9 | 0.3 | 0.6 | 2.6 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 1.9 | 2.8 | 2.6 | 0.9 | 1.1 | 4.3 |
| LnGrp Delay(d),s/veh | 6.8 | 4.8 | 11.8 | 10.2 | 12.7 | 15.8 |
| LnGrp LOS | A | A | B | B | B | B |
| Approach Vol, veh/h | | 815 | 407 | | 358 | |
| Approach Delay, s/veh | | 5.6 | 11.3 | | 14.6 | |
| Approach LOS | | A | B | | B | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | | | 4 | | 6 | 7 | 8 |
| Phs Duration (G+Y+Rc), s | | | | 24.3 | | 11.4 | 10.2 | 14.1 |
| Change Period (Y+Rc), s | | | | 4.0 | | 4.0 | 4.0 | 4.0 |
| Max Green Setting (Gmax), s | | | | 33.0 | | 19.0 | 12.0 | 17.0 |
| Max Q Clear Time (g_c+I1), s | | | | 7.5 | | 6.8 | 6.0 | 6.7 |
| Green Ext Time (p_c), s | | | | 4.9 | | 0.9 | 0.5 | 3.4 |

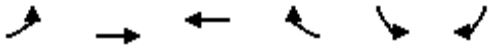
| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 9.1 |
| HCM 2010 LOS | A |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 103 | 129 | 332 | 68 | 91 | 291 |
| Future Volume (veh/h) | 103 | 129 | 332 | 68 | 91 | 291 |
| Number | 7 | 4 | 8 | 18 | 1 | 16 |
| 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 |
| Adj Sat Flow, veh/h/ln | 1727 | 1792 | 1807 | 1900 | 1652 | 1810 |
| Adj Flow Rate, veh/h | 111 | 139 | 357 | 73 | 98 | 313 |
| Adj No. of Lanes | 1 | 1 | 1 | 0 | 1 | 1 |
| Peak Hour Factor | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 |
| Percent Heavy Veh, % | 10 | 6 | 5 | 5 | 15 | 5 |
| Cap, veh/h | 423 | 928 | 489 | 100 | 418 | 408 |
| Arrive On Green | 0.07 | 0.52 | 0.34 | 0.34 | 0.27 | 0.27 |
| Sat Flow, veh/h | 1645 | 1792 | 1456 | 298 | 1573 | 1538 |
| Grp Volume(v), veh/h | 111 | 139 | 0 | 430 | 98 | 313 |
| Grp Sat Flow(s),veh/h/ln | 1645 | 1792 | 0 | 1754 | 1573 | 1538 |
| Q Serve(g_s), s | 1.4 | 1.5 | 0.0 | 8.0 | 1.8 | 6.9 |
| Cycle Q Clear(g_c), s | 1.4 | 1.5 | 0.0 | 8.0 | 1.8 | 6.9 |
| Prop In Lane | 1.00 | | | 0.17 | 1.00 | 1.00 |
| Lane Grp Cap(c), veh/h | 423 | 928 | 0 | 589 | 418 | 408 |
| V/C Ratio(X) | 0.26 | 0.15 | 0.00 | 0.73 | 0.23 | 0.77 |
| Avail Cap(c_a), veh/h | 569 | 1554 | 0 | 1045 | 853 | 833 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 7.2 | 4.7 | 0.0 | 10.8 | 10.6 | 12.5 |
| Incr Delay (d2), s/veh | 0.3 | 0.1 | 0.0 | 1.8 | 0.3 | 3.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.7 | 0.8 | 0.0 | 4.1 | 0.8 | 5.8 |
| LnGrp Delay(d),s/veh | 7.6 | 4.7 | 0.0 | 12.5 | 10.9 | 15.5 |
| LnGrp LOS | A | A | | B | B | B |
| Approach Vol, veh/h | | 250 | 430 | | 411 | |
| Approach Delay, s/veh | | 6.0 | 12.5 | | 14.4 | |
| Approach LOS | | A | B | | B | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | | | 4 | | 6 | 7 | 8 |
| Phs Duration (G+Y+Rc), s | | | | 23.1 | | 13.8 | 6.7 | 16.4 |
| Change Period (Y+Rc), s | | | | 4.0 | | 4.0 | 4.0 | 4.0 |
| Max Green Setting (Gmax), s | | | | 32.0 | | 20.0 | 6.0 | 22.0 |
| Max Q Clear Time (g_c+I1), s | | | | 3.5 | | 8.9 | 3.4 | 10.0 |
| Green Ext Time (p_c), s | | | | 3.2 | | 1.0 | 0.1 | 2.4 |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 11.8 |
| HCM 2010 LOS | B |



| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Volume (veh/h) | 289 | 436 | 259 | 103 | 116 | 203 |
| Future Volume (veh/h) | 289 | 436 | 259 | 103 | 116 | 203 |
| Number | 7 | 4 | 8 | 18 | 1 | 16 |
| 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 |
| Adj Sat Flow, veh/h/ln | 1845 | 1863 | 1858 | 1900 | 1881 | 1863 |
| Adj Flow Rate, veh/h | 325 | 490 | 291 | 116 | 130 | 228 |
| Adj No. of Lanes | 1 | 1 | 1 | 0 | 1 | 1 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| Percent Heavy Veh, % | 3 | 2 | 2 | 2 | 1 | 2 |
| Cap, veh/h | 596 | 1110 | 419 | 167 | 360 | 318 |
| Arrive On Green | 0.16 | 0.60 | 0.33 | 0.33 | 0.20 | 0.20 |
| Sat Flow, veh/h | 1757 | 1863 | 1265 | 504 | 1792 | 1583 |
| Grp Volume(v), veh/h | 325 | 490 | 0 | 407 | 130 | 228 |
| Grp Sat Flow(s),veh/h/ln | 1757 | 1863 | 0 | 1769 | 1792 | 1583 |
| Q Serve(g_s), s | 4.1 | 5.7 | 0.0 | 7.9 | 2.5 | 5.3 |
| Cycle Q Clear(g_c), s | 4.1 | 5.7 | 0.0 | 7.9 | 2.5 | 5.3 |
| Prop In Lane | 1.00 | | | 0.29 | 1.00 | 1.00 |
| Lane Grp Cap(c), veh/h | 596 | 1110 | 0 | 586 | 360 | 318 |
| V/C Ratio(X) | 0.55 | 0.44 | 0.00 | 0.70 | 0.36 | 0.72 |
| Avail Cap(c_a), veh/h | 890 | 1657 | 0 | 809 | 774 | 684 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 1.00 |
| Uniform Delay (d), s/veh | 6.9 | 4.4 | 0.0 | 11.4 | 13.5 | 14.7 |
| Incr Delay (d2), s/veh | 0.8 | 0.3 | 0.0 | 1.5 | 0.6 | 3.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 1.9 | 2.9 | 0.0 | 4.0 | 1.3 | 4.7 |
| LnGrp Delay(d),s/veh | 7.6 | 4.6 | 0.0 | 13.0 | 14.2 | 17.7 |
| LnGrp LOS | A | A | | B | B | B |
| Approach Vol, veh/h | | 815 | 407 | | 358 | |
| Approach Delay, s/veh | | 5.8 | 13.0 | | 16.4 | |
| Approach LOS | | A | B | | B | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | | | 4 | | 6 | 7 | 8 |
| Phs Duration (G+Y+Rc), s | | | | 27.5 | | 11.9 | 10.4 | 17.0 |
| Change Period (Y+Rc), s | | | | 4.0 | | 4.0 | 4.0 | 4.0 |
| Max Green Setting (Gmax), s | | | | 35.0 | | 17.0 | 13.0 | 18.0 |
| Max Q Clear Time (g_c+I1), s | | | | 7.7 | | 7.3 | 6.1 | 9.9 |
| Green Ext Time (p_c), s | | | | 5.4 | | 0.8 | 0.5 | 3.2 |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 10.1 |
| HCM 2010 LOS | B |

# Appendix G Signal Warrant Worksheets

## Signal Warrant Assessment

| | |
|---|---|
| Project #: | 21282 |
| Project Name: | Gr Mt Phase 3 |
| Analyst: | KML |
| Date: | 9/29/2017 |
| Intersection: | Ingle/Goodwin |
| Scenario: | 2022 TT Volumes |

| | |
|---|---|
| Volume Adjustment Factor = | 1.0 |
| North-South Approach = | Minor |
| East-West Approach = | Major |
| Major Street Thru Lanes = | 1 |
| Minor Street Thru Lanes = | 1 |
| Speed > 40 mph? | Yes |
| Population < 10,000? | No |
| Warrant Factor | 70% |
| Peak Hour or Daily Count? | Peak Hour |

Note: Add'l data input on sheet "Warrant 3".

**Warrant Summary**

| Warrant | Name | Analyzed? | Met? |
|---|---|---|---|
| #1 | Eight-Highest | Yes | Yes |
| #2 | Four-Hour | Yes | Yes |
| #3 | Peak Hour | Yes | Yes |

**This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.*

Select Type Of Major Street Approach From Dropdown Menu: Rural Minor Arterial

Select Type Of Minor Street Approach From Dropdown Menu: Rural Major Collector

Note: traffic volume profile for weekday (if weekend is desired, tab "vol profile" needs to be adjusted)

**Traffic Volumes**

| Hour | | Major Street | | Minor Street | | Major St. | Minor St. |
|---|---|---|---|---|---|---|---|
| Begin | End | EB | WB | NB | SB | Adj. Factor | Adj. Factor |
| 5:00 PM | 6:00 PM | 725 | 362 | 0 | 218 | 1.00 | 1.00 |
| 2nd | Highest Hour | 717 | 358 | 0 | 194 | 0.99 | 0.89 |
| 3rd | Highest Hour | 652 | 325 | 0 | 168 | 0.90 | 0.77 |
| 4th | Highest Hour | 587 | 293 | 0 | 166 | 0.81 | 0.76 |
| 5th | Highest Hour | 489 | 244 | 0 | 147 | 0.67 | 0.68 |
| 6th | Highest Hour | 481 | 240 | 0 | 145 | 0.66 | 0.67 |
| 7th | Highest Hour | 456 | 228 | 0 | 140 | 0.63 | 0.65 |
| 8th | Highest Hour | 407 | 203 | 0 | 129 | 0.56 | 0.59 |
| 9th | Highest Hour | 147 | 73 | 0 | 28 | 0.20 | 0.13 |
| 10th | Highest Hour | 391 | 195 | 0 | 117 | 0.54 | 0.54 |
| 11th | Highest Hour | 375 | 187 | 0 | 115 | 0.52 | 0.53 |
| 12th | Highest Hour | 367 | 183 | 0 | 115 | 0.51 | 0.53 |
| 13th | Highest Hour | 358 | 179 | 0 | 112 | 0.49 | 0.52 |
| 14th | Highest Hour | 358 | 179 | 0 | 94 | 0.49 | 0.43 |
| 15th | Highest Hour | 293 | 146 | 0 | 91 | 0.40 | 0.42 |
| 16th | Highest Hour | 253 | 126 | 0 | 65 | 0.35 | 0.30 |
| 17th | Highest Hour | 212 | 106 | 0 | 65 | 0.29 | 0.30 |
| 18th | Highest Hour | 163 | 81 | 0 | 44 | 0.22 | 0.20 |
| 19th | Highest Hour | 147 | 73 | 0 | 28 | 0.20 | 0.13 |
| 20th | Highest Hour | 98 | 49 | 0 | 23 | 0.13 | 0.11 |
| 21st | Highest Hour | 49 | 24 | 0 | 12 | 0.07 | 0.05 |
| 22nd | Highest Hour | 41 | 20 | 0 | 9 | 0.06 | 0.04 |
| 23rd | Highest Hour | 24 | 12 | 0 | 9 | 0.03 | 0.04 |
| 24th | Highest Hour | 24 | 12 | 0 | 7 | 0.03 | 0.03 |

**Data Input**

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

**Project #:** 21282
**Project Name:** Gr Mt Phase 3
**Analyst:** KML
**Date:** 9/29/2017
**File:** C:\Users\klaustsen\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.MSO\[Copy of Signal Warrant Analysis goodwin&ingle.xls]Data Input
**Intersection:** Ingle/Goodwin
**Scenario:** 2022 TT Volumes

## Warrant Summary

| Warrant | Name | Analyzed? | Met? |
|---|---|---|---|
| #1 | Eight-Hour Vehicular Volume | Yes | Yes |
| #2 | Four-Hour Vehicular volume | Yes | Yes |
| #3 | Peak Hour | Yes | Yes |
| #4 | Pedestrian Volume | No | - |
| #5 | School Crossing | No | - |
| #6 | Coordinated Signal System | No | - |
| #7 | Crash Experience | No | - |
| #8 | Roadway Network | No | - |

## Analysis Traffic Volumes

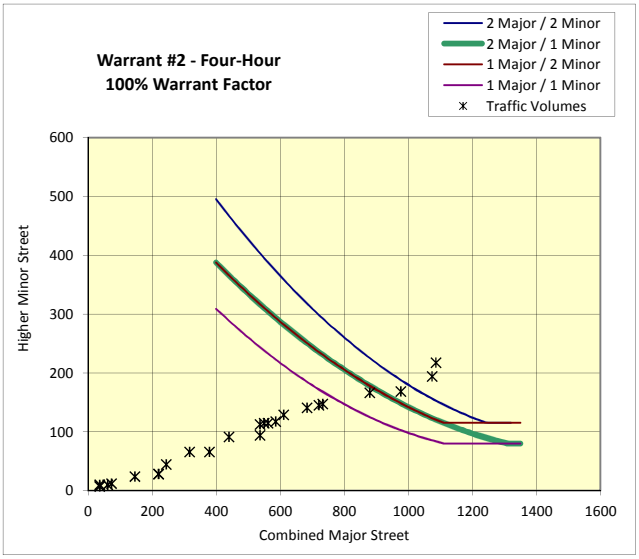
| Hour | | Major Street | | Minor Street | |
|---|---|---|---|---|---|
| Begin | End | EB | WB | NB | SB |
| 5:00 PM | 6:00 PM | 725 | 362 | 0 | 218 |
| 2nd | Highest Hour | 717 | 358 | 0 | 194 |
| 3rd | Highest Hour | 652 | 325 | 0 | 168 |
| 4th | Highest Hour | 587 | 293 | 0 | 166 |
| 5th | Highest Hour | 489 | 244 | 0 | 147 |
| 6th | Highest Hour | 481 | 240 | 0 | 145 |
| 7th | Highest Hour | 456 | 228 | 0 | 140 |
| 8th | Highest Hour | 407 | 203 | 0 | 129 |
| 9th | Highest Hour | 147 | 73 | 0 | 28 |
| 10th | Highest Hour | 391 | 195 | 0 | 117 |
| 11th | Highest Hour | 375 | 187 | 0 | 115 |
| 12th | Highest Hour | 367 | 183 | 0 | 115 |
| 13th | Highest Hour | 358 | 179 | 0 | 112 |
| 14th | Highest Hour | 358 | 179 | 0 | 94 |
| 15th | Highest Hour | 293 | 146 | 0 | 91 |
| 16th | Highest Hour | 253 | 126 | 0 | 65 |
| 17th | Highest Hour | 212 | 106 | 0 | 65 |
| 18th | Highest Hour | 163 | 81 | 0 | 44 |
| 19th | Highest Hour | 147 | 73 | 0 | 28 |
| 20th | Highest Hour | 98 | 49 | 0 | 23 |
| 21st | Highest Hour | 49 | 24 | 0 | 12 |
| 22nd | Highest Hour | 41 | 20 | 0 | 9 |
| 23rd | Highest Hour | 24 | 12 | 0 | 9 |
| 24th | Highest Hour | 24 | 12 | 0 | 7 |

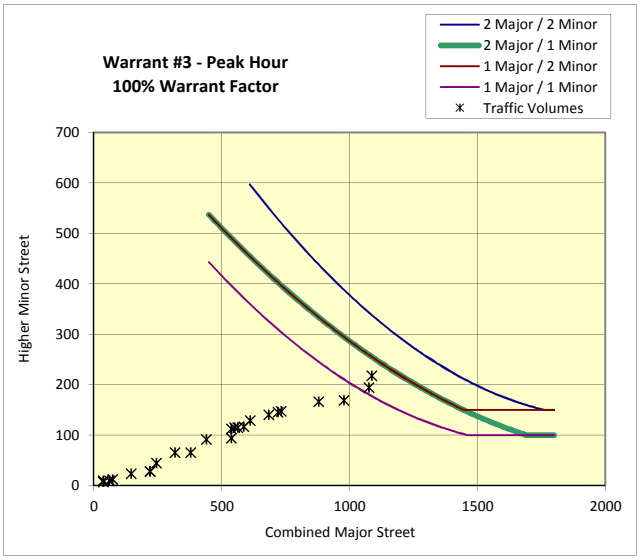
## Input Parameters

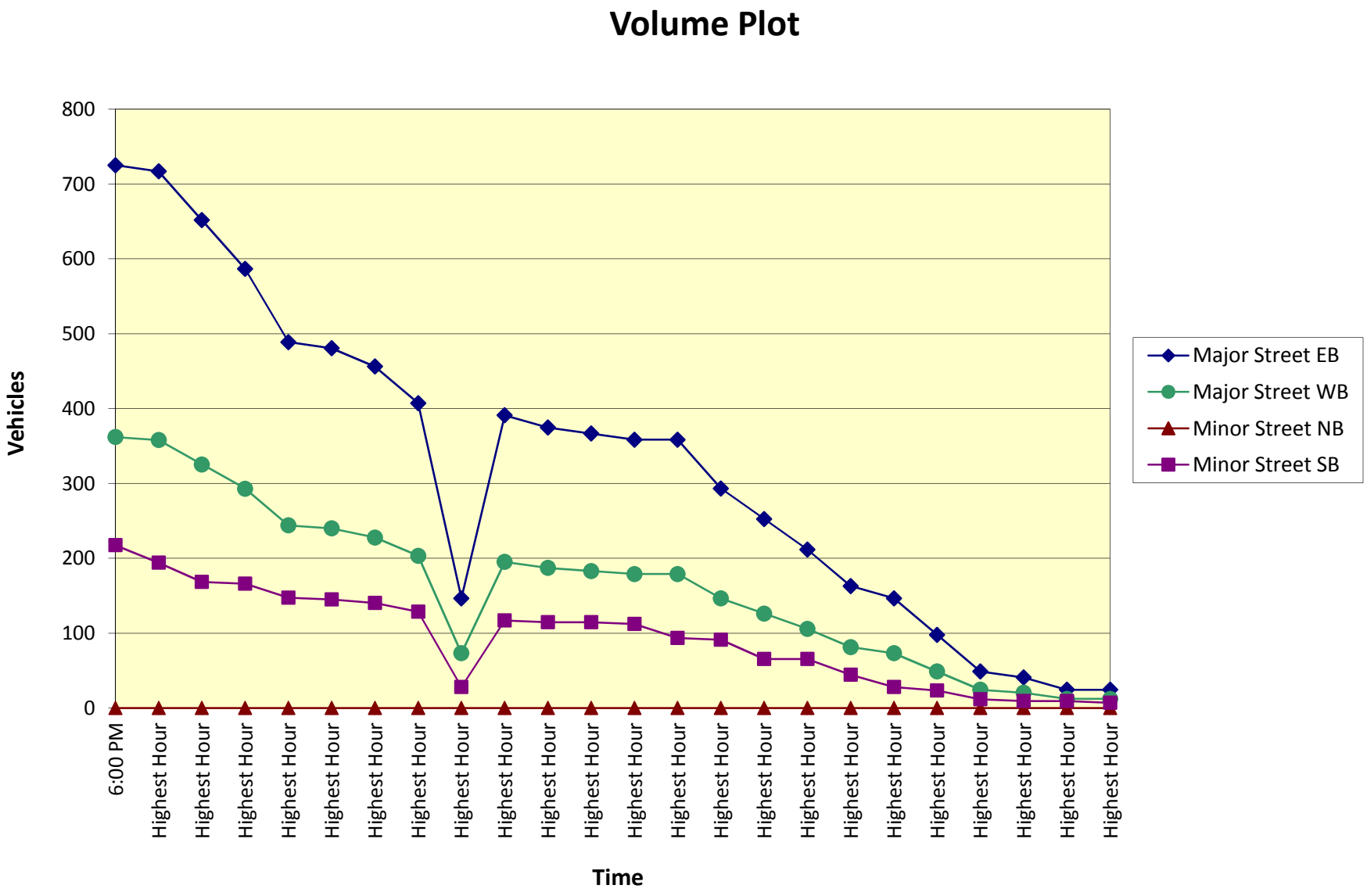
| | |
|---|---|
| Volume Adjustment Factor = | 1.0 |
| North-South Approach = | Minor |
| East-West Approach = | Major |
| Major Street Thru Lanes = | 1 |
| Minor Street Thru Lanes = | 1 |
| Speed > 40 mph? | Yes |
| Population < 10,000? | No |
| Warrant Factor | 70% |
| Peak Hour or Daily Count? | Peak Hour |
| | |
| Major Street: 4th-Highest Hour / Peak Hour | 81% |
| Major Street: 8th-Highest Hour / Peak Hour | 56% |
| Minor Street: 4th-Highest Hour / Peak Hour | 76% |
| Minor Street: 8th-Highest Hour / Peak Hour | 59% |

## Warrant #1 - Eight Hour

| Warrant Factor | Condition | Major Street Requirement | Minor Street Requirement | Hours That Condition Is Met | Condition for Warrant Factor Met? | Signal Warrant Met? |
|---|---|---|---|---|---|---|
| 100% | A | 500 | 150 | 4 | No | **No** |
| | B | 750 | 75 | 4 | No | |
| 80% | A | 400 | 120 | 8 | Yes | **Yes** |
| | B | 600 | 60 | 8 | Yes | |
| 70% | A | 350 | 105 | 12 | Yes | **Yes** |
| | B | 525 | 53 | 13 | Yes | |




Volume Plot
800
700
600
500
400
300
200
100
0
Vehicles
6:00 PM
Highest Hour
Time
Major Street EB
Major Street WB
Minor Street NB
Minor Street SB

Volume Plot

## Traffic Volumes

| Hour | | Major Street | | Minor Street | |
|---|---|---|---|---|---|
| Begin | End | EB | WB | NB | SB |
| 5:00 PM | 6:00 PM | 725 | 362 | 0 | 218 |
| 2nd | Highest Hour | 717 | 358 | 0 | 194 |
| 3rd | Highest Hour | 652 | 325 | 0 | 168 |
| 4th | Highest Hour | 587 | 293 | 0 | 166 |
| 5th | Highest Hour | 489 | 244 | 0 | 147 |
| 6th | Highest Hour | 481 | 240 | 0 | 145 |
| 7th | Highest Hour | 456 | 228 | 0 | 140 |
| 8th | Highest Hour | 407 | 203 | 0 | 129 |
| 9th | Highest Hour | 147 | 73 | 0 | 28 |
| 10th | Highest Hour | 391 | 195 | 0 | 117 |
| 11th | Highest Hour | 375 | 187 | 0 | 115 |
| 12th | Highest Hour | 367 | 183 | 0 | 115 |
| 13th | Highest Hour | 358 | 179 | 0 | 112 |
| 14th | Highest Hour | 358 | 179 | 0 | 94 |
| 15th | Highest Hour | 293 | 146 | 0 | 91 |
| 16th | Highest Hour | 253 | 126 | 0 | 65 |
| 17th | Highest Hour | 212 | 106 | 0 | 65 |
| 18th | Highest Hour | 163 | 81 | 0 | 44 |
| 19th | Highest Hour | 147 | 73 | 0 | 28 |
| 20th | Highest Hour | 98 | 49 | 0 | 23 |
| 21st | Highest Hour | 49 | 24 | 0 | 12 |
| 22nd | Highest Hour | 41 | 20 | 0 | 9 |
| 23rd | Highest Hour | 24 | 12 | 0 | 9 |
| 24th | Highest Hour | 24 | 12 | 0 | 7 |

100% Warrant Met

70% Warrant Met

## Calculations

| Combined Major Street | Higher Minor Street | Major Plus Minor | Hourly Rank | Condition A | | | Condition B | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 100% | 80% | 70% | 100% | 80% | 70% |
| 1087 | 218 | 1305 | 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 1075 | 194 | 1269 | 2 | Yes | Yes | Yes | Yes | Yes | Yes |
| 977 | 168 | 1145 | 3 | Yes | Yes | Yes | Yes | Yes | Yes |
| 879 | 166 | 1045 | 4 | Yes | Yes | Yes | Yes | Yes | Yes |
| 733 | 147 | 880 | 5 | N | Yes | Yes | N | Yes | Yes |
| 721 | 145 | 866 | 6 | N | Yes | Yes | N | Yes | Yes |
| 684 | 140 | 824 | 7 | N | Yes | Yes | N | Yes | Yes |
| 611 | 129 | 739 | 8 | N | Yes | Yes | N | Yes | Yes |
| 220 | 28 | 248 | 18 | N | N | N | N | N | N |
| 586 | 117 | 703 | 9 | N | N | Yes | N | N | Yes |
| 562 | 115 | 676 | 10 | N | N | Yes | N | N | Yes |
| 550 | 115 | 664 | 11 | N | N | Yes | N | N | Yes |
| 537 | 112 | 650 | 12 | N | N | Yes | N | N | Yes |
| 537 | 94 | 631 | 13 | N | N | N | N | N | Yes |
| 440 | 91 | 531 | 14 | N | N | N | N | N | N |
| 379 | 65 | 444 | 15 | N | N | N | N | N | N |
| 318 | 65 | 383 | 16 | N | N | N | N | N | N |
| 244 | 44 | 289 | 17 | N | N | N | N | N | N |
| 220 | 28 | 248 | 18 | N | N | N | N | N | N |
| 147 | 23 | 170 | 20 | N | N | N | N | N | N |
| 73 | 12 | 85 | 21 | N | N | N | N | N | N |
| 61 | 9 | 70 | 22 | N | N | N | N | N | N |
| 37 | 9 | 46 | 23 | N | N | N | N | N | N |
| 37 | 7 | 44 | 24 | N | N | N | N | N | N |
| | | | | 4 | 8 | 12 | 4 | 8 | 13 |

| | |
|---|---|
| Number of lanes for moving traffic on each approach (Major Street) | 1 |
| Number of lanes for moving traffic on each approach (Minor Street) | 1 |
| Warrant Factor | 70% |
| Row Index for VLOOKUP | 1 |

## Lookup Table

**Condition A - Minimum Vehicular Volume**

| | Lanes | | Combined Major Street | | | Higher Minor Street | | |
|---|---|---|---|---|---|---|---|---|
| Index | Major Street | Minor Street | 100% | 80% | 70% | 100% | 80% | 70% |
| 1 | 1 | 1 | 500 | 400 | 350 | 150 | 120 | 105 |
| 2 | 2 or more | 1 | 600 | 480 | 420 | 150 | 120 | 105 |
| 3 | 2 or more | 2 or more | 600 | 480 | 420 | 200 | 160 | 140 |
| 4 | 1 | 2 or more | 500 | 400 | 350 | 200 | 160 | 140 |

**Condition B - Interruption of Continuous Traffic**

| | Lanes | | Combined Major Street | | | Higher Minor Street | | |
|---|---|---|---|---|---|---|---|---|
| Index | Major Street | Minor Street | 100% | 80% | 70% | 100% | 80% | 70% |
| 1 | 1 | 1 | 750 | 600 | 525 | 75 | 60 | 53 |
| 2 | 2 or more | 1 | 900 | 720 | 630 | 75 | 60 | 53 |
| 3 | 2 or more | 2 or more | 900 | 720 | 630 | 100 | 80 | 70 |
| 4 | 1 | 2 or more | 750 | 600 | 525 | 100 | 80 | 70 |

| | |
|---|---|
| Vehicles per hour on major street (100% Volume) | 500 |
| Vehicles per hour on major street (80% Volume) | 400 |
| Vehicles per hour on major street (70% Volume) | 350 |
| Vehicles per hour on higher-volume minor-street approach (100% Volume) | 150 |
| Vehicles per hour on higher-volume minor-street approach (80% Volume) | 120 |
| Vehicles per hour on higher-volume minor-street approach (70% Volume) | 105 |
| Vehicles per hour on major street (100% Volume) | 750 |
| Vehicles per hour on major street (80% Volume) | 600 |
| Vehicles per hour on major street (70% Volume) | 525 |
| Vehicles per hour on higher-volume minor-street approach (100% Volume) | 75 |
| Vehicles per hour on higher-volume minor-street approach (80% Volume) | 60 |
| Vehicles per hour on higher-volume minor-street approach (70% Volume) | 53 |

## Warrant Summary

| Warrant Factor | Condition | Major Street Requirement | Minor Street Requirement | Hours That Condition Is Met | Threshold | Condition for Warrant Factor Met? | Signal Warrant Met? |
|---|---|---|---|---|---|---|---|
| 100% | A | 500 | 150 | 4 | 8 | No | **No** |
| | B | 750 | 75 | 4 | 8 | No | |
| 80% | A | 400 | 120 | 8 | 8 | Yes | **Yes** |
| | B | 600 | 60 | 8 | 8 | Yes | |
| 70% | A | 350 | 105 | 12 | 8 | Yes | **Yes** |
| | B | 525 | 53 | 13 | 8 | Yes | |

**Is Warrant #1 met based on the applicable warrant factor?**

**Yes**

## Traffic Volumes

| Hour | | Major Street | | Minor Street | |
|---|---|---|---|---|---|
| Begin | End | EB | WB | NB | SB |
| 5:00 PM | 6:00 PM | 725 | 362 | 0 | 218 |
| 2nd | Highest Hour | 717 | 358 | 0 | 194 |
| 3rd | Highest Hour | 652 | 325 | 0 | 168 |
| 4th | Highest Hour | 587 | 293 | 0 | 166 |
| 5th | Highest Hour | 489 | 244 | 0 | 147 |
| 6th | Highest Hour | 481 | 240 | 0 | 145 |
| 7th | Highest Hour | 456 | 228 | 0 | 140 |
| 8th | Highest Hour | 407 | 203 | 0 | 129 |
| 9th | Highest Hour | 147 | 73 | 0 | 28 |
| 10th | Highest Hour | 391 | 195 | 0 | 117 |
| 11th | Highest Hour | 375 | 187 | 0 | 115 |
| 12th | Highest Hour | 367 | 183 | 0 | 115 |
| 13th | Highest Hour | 358 | 179 | 0 | 112 |
| 14th | Highest Hour | 358 | 179 | 0 | 94 |
| 15th | Highest Hour | 293 | 146 | 0 | 91 |
| 16th | Highest Hour | 253 | 126 | 0 | 65 |
| 17th | Highest Hour | 212 | 106 | 0 | 65 |
| 18th | Highest Hour | 163 | 81 | 0 | 44 |
| 19th | Highest Hour | 147 | 73 | 0 | 28 |
| 20th | Highest Hour | 98 | 49 | 0 | 23 |
| 21st | Highest Hour | 49 | 24 | 0 | 12 |
| 22nd | Highest Hour | 41 | 20 | 0 | 9 |
| 23rd | Highest Hour | 24 | 12 | 0 | 9 |
| 24th | Highest Hour | 24 | 12 | 0 | 7 |

## Calculations

| Combined Major Street | Higher Minor Street | Threshold | Is Threshold Met? |
|---|---|---|---|
| 1087 | 218 | 60 | Yes |
| 1075 | 194 | 60 | Yes |
| 977 | 168 | 60 | Yes |
| 879 | 166 | 60 | Yes |
| 733 | 147 | 69 | Yes |
| 721 | 145 | 71 | Yes |
| 684 | 140 | 76 | Yes |
| 611 | 129 | 91 | Yes |
| 220 | 28 | 249 | No |
| 586 | 117 | 97 | Yes |
| 562 | 115 | 103 | Yes |
| 550 | 115 | 107 | Yes |
| 537 | 112 | 110 | Yes |
| 537 | 94 | 110 | No |
| 440 | 91 | 144 | No |
| 379 | 65 | 169 | No |
| 318 | 65 | 197 | No |
| 244 | 44 | 235 | No |
| 220 | 28 | 249 | No |
| 147 | 23 | 294 | No |
| 73 | 12 | 343 | No |
| 61 | 9 | 351 | No |
| 37 | 9 | 369 | No |
| 37 | 7 | 369 | No |
| | | | 12 |

| | |
|---|---|
| Number of lanes for moving traffic on each approach (Major Street) | 1 |
| Number of lanes for moving traffic on each approach (Minor Street) | 1 |
| Warrant Factor | 70% |
| Row Index for VLOOKUP | 5 |

## Lookup Table

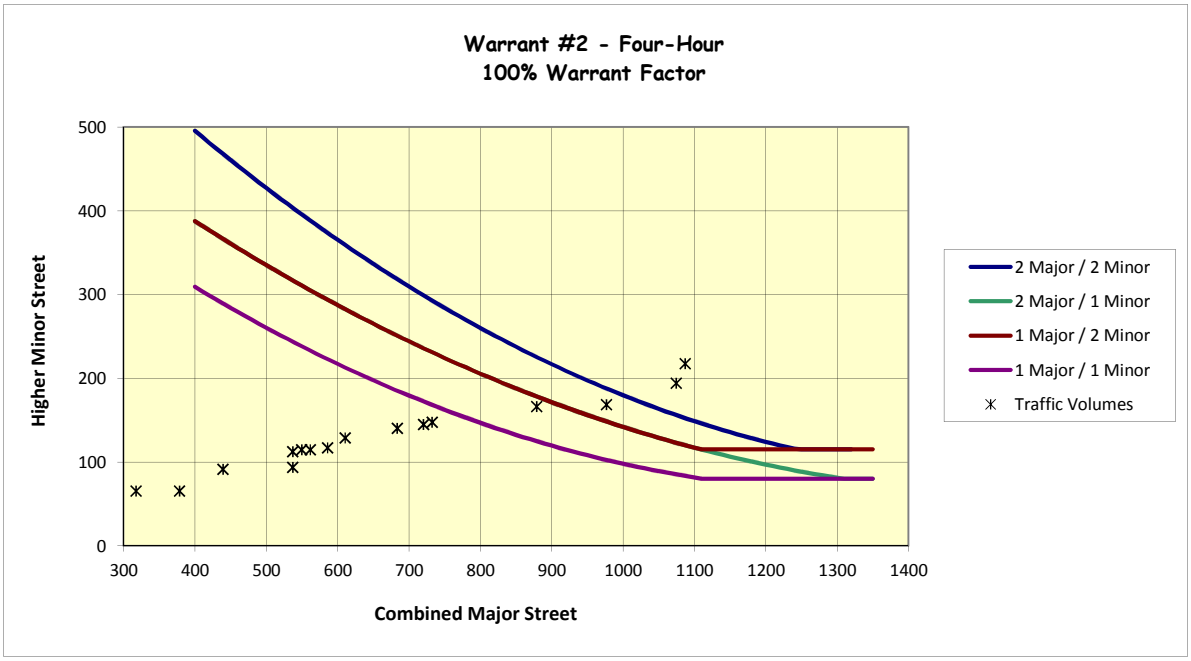
| Index | Major Street | Minor Street | Break Point | $x^2$ | x | c | alt |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1110 | 0.00027 | 0.73003 | 557.978 | 80 |
| 2 | 2 or more | 1 | 1310 | 0.00023 | 0.73144 | 643.445 | 80 |
| 3 | 2 or more | 2 or more | 1280 | 0.00031 | 0.97877 | 858.973 | 115 |
| 4 | 1 | 2 or more | 1110 | 0.00023 | 0.73144 | 643.445 | 115 |
| 5 | 1 | 1 | 790 | 0.00044 | 0.76930 | 396.803 | 60 |
| 6 | 2 or more | 1 | 930 | 0.00037 | 0.76954 | 457.134 | 60 |
| 7 | 2 or more | 2 or more | 860 | 0.00049 | 1.03083 | 614.734 | 80 |
| 8 | 1 | 2 or more | 790 | 0.00037 | 0.76954 | 457.134 | 80 |

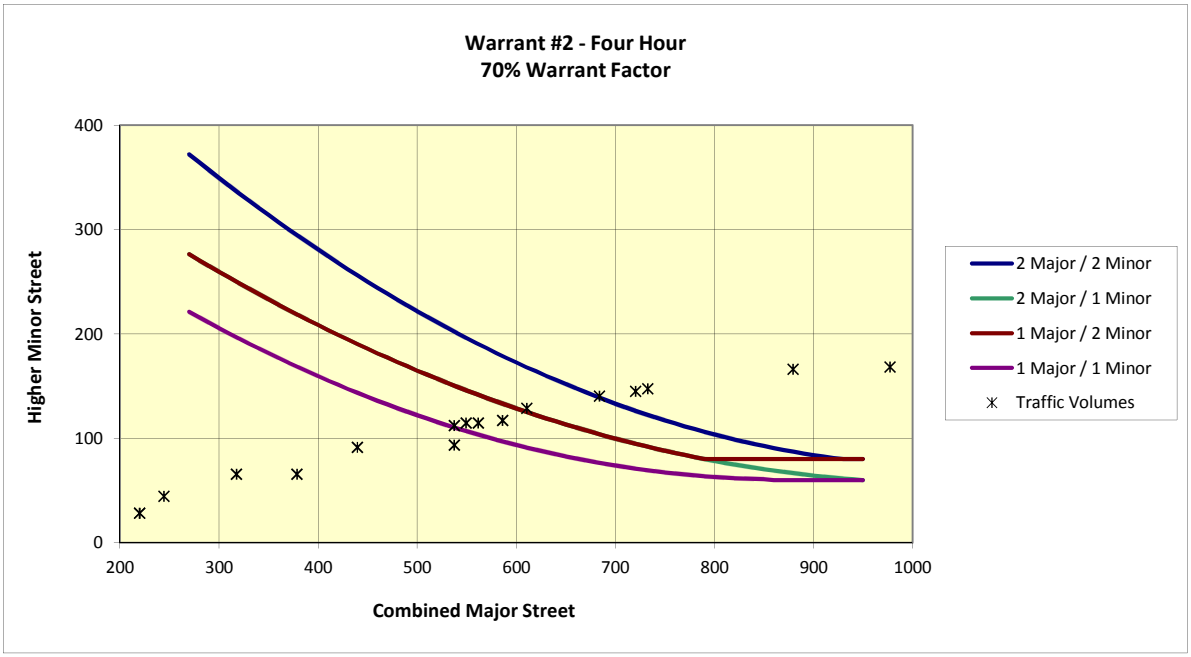
100% Factor

70% Factor

**Is Warrant #2 met based on the applicable warrant factor?**

**Yes**




War #2 - 4 HR (Graph)

## Traffic Volumes

| Hour | | Major Street | | Minor Street | |
|---|---|---|---|---|---|
| Begin | End | EB | WB | NB | SB |
| 5:00 PM | 6:00 PM | 725 | 362 | 0 | 218 |
| 2nd | Highest Hour | 717 | 358 | 0 | 194 |
| 3rd | Highest Hour | 652 | 325 | 0 | 168 |
| 4th | Highest Hour | 587 | 293 | 0 | 166 |
| 5th | Highest Hour | 489 | 244 | 0 | 147 |
| 6th | Highest Hour | 481 | 240 | 0 | 145 |
| 7th | Highest Hour | 456 | 228 | 0 | 140 |
| 8th | Highest Hour | 407 | 203 | 0 | 129 |
| 9th | Highest Hour | 147 | 73 | 0 | 28 |
| 10th | Highest Hour | 391 | 195 | 0 | 117 |
| 11th | Highest Hour | 375 | 187 | 0 | 115 |
| 12th | Highest Hour | 367 | 183 | 0 | 115 |
| 13th | Highest Hour | 358 | 179 | 0 | 112 |
| 14th | Highest Hour | 358 | 179 | 0 | 94 |
| 15th | Highest Hour | 293 | 146 | 0 | 91 |
| 16th | Highest Hour | 253 | 126 | 0 | 65 |
| 17th | Highest Hour | 212 | 106 | 0 | 65 |
| 18th | Highest Hour | 163 | 81 | 0 | 44 |
| 19th | Highest Hour | 147 | 73 | 0 | 28 |
| 20th | Highest Hour | 98 | 49 | 0 | 23 |
| 21st | Highest Hour | 49 | 24 | 0 | 12 |
| 22nd | Highest Hour | 41 | 20 | 0 | 9 |
| 23rd | Highest Hour | 24 | 12 | 0 | 9 |
| 24th | Highest Hour | 24 | 12 | 0 | 7 |

## Calculations

| Combined Major Street | Higher Minor Street | Threshold | Is Threshold Met? |
|---|---|---|---|
| 1087 | 218 | 75 | Yes |
| 1075 | 194 | 75 | Yes |
| 977 | 168 | 81 | Yes |
| 879 | 166 | 96 | Yes |
| 733 | 147 | 130 | Yes |
| 721 | 145 | 134 | Yes |
| 684 | 140 | 145 | No |
| 611 | 129 | 171 | No |
| 220 | 28 | 370 | No |
| 586 | 117 | 180 | No |
| 562 | 115 | 190 | No |
| 550 | 115 | 195 | No |
| 537 | 112 | 200 | No |
| 537 | 94 | 200 | No |
| 440 | 91 | 245 | No |
| 379 | 65 | 276 | No |
| 318 | 65 | 310 | No |
| 244 | 44 | 354 | No |
| 220 | 28 | 370 | No |
| 147 | 23 | 419 | No |
| 73 | 12 | 472 | No |
| 61 | 9 | 482 | No |
| 37 | 9 | 500 | No |
| 37 | 7 | 500 | No |
| | | | 6 |

| | |
|---|---|
| Number of lanes for moving traffic on each approach (Major Street) | 1 |
| Number of lanes for moving traffic on each approach (Minor Street) | 1 |
| Warrant Factor | 70% |
| Row Index for VLOOKUP | 5 |

## Lookup Table

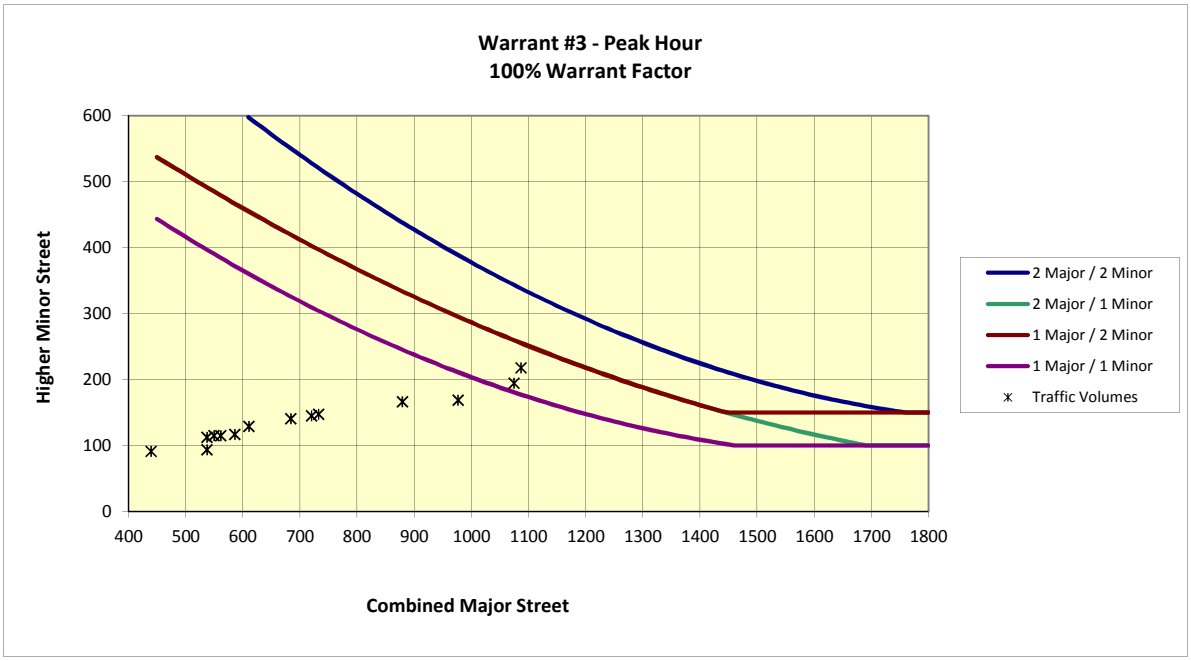
| Index | Major Street | Minor Street | Break Point | $x^2$ | x | c | alt | |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1460 | 0.00021 | 0.74072 | 734.125 | 100 | 100% Factor |
| 2 | 2 or more | 1 | 1760 | 0.00015 | 0.67328 | 809.779 | 100 | |
| 3 | 2 or more | 2 or more | 1690 | 0.00023 | 0.93419 | 1081.658 | 150 | |
| 4 | 1 | 2 or more | 1450 | 0.00015 | 0.67328 | 809.779 | 150 | |
| 5 | 1 | 1 | 1040 | 0.00035 | 0.80083 | 529.197 | 75 | |
| 6 | 2 or more | 1 | 1160 | 0.00025 | 0.73111 | 586.099 | 75 | 70% Factor |
| 7 | 2 or more | 2 or more | 1130 | 0.00033 | 0.95887 | 762.050 | 100 | |
| 8 | 1 | 2 or more | 1020 | 0.00025 | 0.73111 | 586.099 | 100 | |

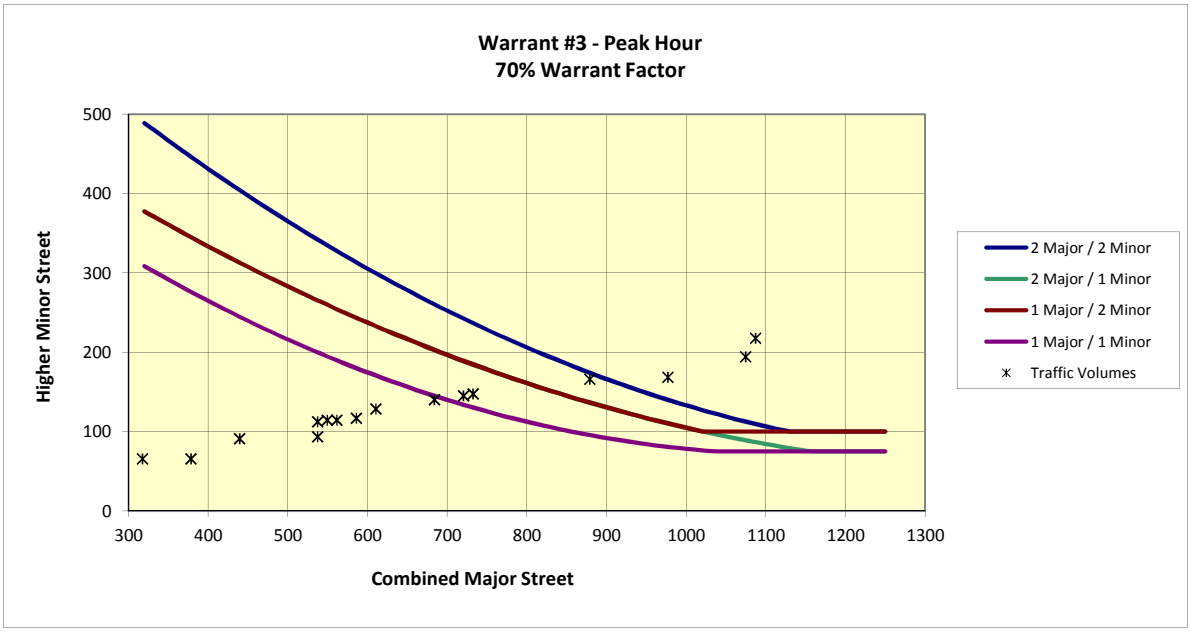
**Is Warrant #3 met based on the applicable warrant factor?** **Yes**

## Condition A Criteria

| | NB | SB |
|---|---|---|
| Total Stopped Delay Per Vehicle On Minor Approach (sec) | 0.0 | 24.0 |
| Number Of Lanes On Minor Street Approach | 0 | 1 |
| Vehicle-Hours Of Stopped Delay On Minor Approach | 0.00 | 1.45 |
| | No | No |
| Volume on Minor Street Approach During Same Hour | 0 | 218 |
| | No | Yes |
| Total Entering Volume On All Approaches During Same Hour | 1304.5 | |
| Number of Approaches to Intersection | 3 | |
| | Yes | |

**Is Warrant #3 met based on Condition A criteria?** **No**




War #3 - Peak HR (Graph)

# Appendix H Proportion Share Calculations at NE 192nd Avenue/NE 13th Street

**Proposed Proportionate Share Contribution at NE 192nd Avenue/NE 13th Avenue**

**Cost Estimate:**

| Item | Unit Cost | Length | Cost | Notes |
|---|---|---|---|---|
| Northbound right-turn lane and westbound right-turn lane | $ 280,000 | 1 | $ 280,000 | Cost estimate attached. |
| | | **Total** | **$ 280,000** | |

*Note: Cost estimate may not account for all ROW impacts*

**Proportionate Share Calculation:**

| | |
|---|---|
| Intersection volume without development (2029 Background Scenario) | 1901 |
| Intersection volume with development (2029 Total Traffic Scenario) | 2346 |
| Trips added by development (2346-1901) | 445 |
| Capacity of intersection with improvement (see attached Synchro output sheet) | 2487 |
| Additional volume accomodated with improvements (2487-1901) | 586 |
| Proportionate share cost per trip ($280,000/586) | $ 478 |
| Proportionate share of capacity used by development (445/586) | 0.759 |
| Proposed proportionate share contribution ($478 per trip * 445 trips) | **$ 212,600** |

*Note: Assumed proportion of total volume by movement stays consistent with 2029*

# *OLSON ENGINEERING INC.*

1111 BROADWAY, VANCOUVER, WA 98660 (360) 695-1385

## Green Mtn. - Right Turn Lane @ NE 192nd Avenue & NE 13th Street - Cost Estimate (Option I)
## North Bound Right & West Bound Right

| Item # | Description | Unit Of Measure | Quantity | Unit Price | Total Price |
|---|---|---|---|---|---|
| | **GENERAL CONDITIONS** | | | | |
| 1 | Mobilization | LS | 1 | $ 10,000.00 | $ 10,000.00 |
| 2 | Clearing & Grubbing (Remove Hedge & Trees, etc.) | LS | 1 | $ 2,400.00 | $ 2,400.00 |
| 3 | Stripping 6" & Haul Off | CY | 235 | $ 9.00 | $ 2,115.00 |
| | | | | Total | $ 14,515.00 |
| | **DEMOLITION** | | | | |
| 4 | AC Removal (Exist'g Edge Road & Exist'g Driveways To Ba | SF | 2,070 | $ 1.00 | $ 2,070.00 |
| 5 | Remove Exist'g Driveway Culvert (24 LF) | LS | 1 | $ 300.00 | $ 300.00 |
| 6 | Relocate Exist'g Mail Boxes | EA | 5 | $ 125.00 | $ 625.00 |
| 7 | Relocate Exist'g Signs | EA | 3 | $ 125.00 | $ 375.00 |
| | | | | Total | $ 3,370.00 |
| | **EROSION CONTROL** | | | | |
| 8 | Silt Fence | LF | 700 | $ 1.75 | $ 1,225.00 |
| 9 | Hydroseed & Mulch Right - Of - Way | SF | 14,000 | $ 0.30 | $ 4,200.00 |
| 10 | Erosion Control Maintenance | LS | 1 | $ 1,600.00 | $ 1,600.00 |
| | | | | Total | $ 7,025.00 |
| | **SITEWORK** | | | | |
| | North Bound Right & West Bound Right | | | | |
| 11 | Sawcut | LF | 930 | $ 2.00 | $ 1,860.00 |
| 12 | Mass Grading & Haul Off | CY | 480 | $ 10.00 | $ 4,800.00 |
| 13 | Finish Grade | SF | 6,345 | $ 0.30 | $ 1,903.50 |
| 14 | Geotextile Fabric | SY | 765 | $ 0.90 | $ 688.50 |
| 15 | 1¼"- Crushed Rock (0.85') | TN | 385 | $ 20.00 | $ 7,700.00 |
| 16 | Asphaltic Concrete (0.85') Class ½" 64-22 HMA | TN | 410 | $ 135.00 | $ 55,350.00 |
| 17 | Curb & Gutter | LF | 840 | $ 10.00 | $ 8,400.00 |
| 18 | Sidewalk / Pedestrian Ramp | SF | 4,275 | $ 4.00 | $ 17,100.00 |
| 19 | Detectable Warning Surface | SF | 10 | $ 25.00 | $ 250.00 |
| 20 | Driveway Drop | EA | 5 | $ 25.00 | $ 125.00 |
| 21 | Driveway Approach (5) | SF | 560 | $ 4.50 | $ 2,520.00 |
| 22 | Pedestrian/Signal Modifications | LS | 1 | $ 33,000.00 | $ 33,000.00 |
| 23 | Traffic Control | LS | 1 | $ 10,000.00 | $ 10,000.00 |
| | | | | Total | $ 143,697.00 |
| | **SITEWORK** | | | | |
| | Pave Existing Driveways To Right - Of -Way | | | | |
| 24 | Removal AC / Gravel (Back Of Sidewalk To Right - Of - Wa | SF | 1,435 | $ 1.00 | $ 1,435.00 |
| 25 | Finish Grade | SF | 1,435 | $ 0.30 | $ 430.50 |
| 26 | Geotextile Fabric | SY | 175 | $ 0.90 | $ 157.50 |
| 27 | 1¼"- Crushed Rock (0.67') | TN | 70 | $ 20.00 | $ 1,400.00 |
| 28 | Asphaltic Concrete (0.25') Class ½" 64-22 HMA | TN | 30 | $ 135.00 | $ 4,050.00 |
| | | | | Total | $ 7,473.00 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **STORM** | | | | | | |
| 29 | Stormfilter Catch Basin (2 - Cart.) | EA | 2 | $ | 12,000.00 | $ | 24,000.00 |
| 30 | Infiltration Trench (50 LF) | EA | 2 | $ | 2,500.00 | $ | 5,000.00 |
| | | | | | Total | $ | 29,000.00 |
| | **STRIPING & SIGNAGE** | | | | | | |
| 31 | Solid Double Yellow Line | LF | 470 | $ | 1.00 | $ | 470.00 |
| 32 | Solid White Line | LF | 810 | $ | 0.50 | $ | 405.00 |
| 33 | White Thermoplastic Stop Bar (Extend Existing) | EA | 1 | $ | 660.00 | $ | 660.00 |
| 34 | Crosswalk Marking (Extend Existing | EA | 1 | $ | 750.00 | $ | 750.00 |
| | | | | | Total | $ | 2,285.00 |

| | | |
|---|---|---|
| Subtotal Construction Costs | $ | 207,365.00 |
| Soft Cost (20%) | $ | 41,473.00 |
| Contingency (15%) | $ | 31,104.75 |
| **Total Construction Costs** | **$** | **279,942.75** |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 262 | 217 | 730 | 445 | 318 | 515 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.8 | 5.7 | 5.4 | 5.8 | 5.7 | 5.4 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frpb, ped/bikes | 1.00 | 0.99 | 1.00 | 0.96 | 1.00 | 1.00 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | 1.00 | 0.85 | 1.00 | 1.00 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 |
| Satd. Flow (prot) | 1770 | 1595 | 1863 | 1527 | 1787 | 1863 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 |
| Satd. Flow (perm) | 1770 | 1595 | 1863 | 1527 | 1787 | 1863 |
| Peak-hour factor, PHF | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| Adj. Flow (vph) | 305 | 252 | 849 | 517 | 370 | 599 |
| RTOR Reduction (vph) | 0 | 54 | 0 | 41 | 0 | 0 |
| Lane Group Flow (vph) | 305 | 198 | 849 | 476 | 370 | 599 |
| Confl. Peds. (#/hr) | | 2 | | 8 | 8 | |
| Heavy Vehicles (%) | 2% | 0% | 2% | 2% | 1% | 2% |
| Turn Type | | pm+ov | | pm+ov | Prot | |
| Protected Phases | 6 | 3 | 4 | 6 | 3 | 8 |
| Permitted Phases | | 6 | | 4 | | |
| Actuated Green, G (s) | 25.6 | 55.5 | 63.7 | 89.3 | 29.9 | 99.3 |
| Effective Green, g (s) | 25.6 | 55.5 | 63.7 | 89.3 | 29.9 | 99.3 |
| Actuated g/C Ratio | 0.19 | 0.41 | 0.47 | 0.66 | 0.22 | 0.73 |
| Clearance Time (s) | 5.8 | 5.7 | 5.4 | 5.8 | 5.7 | 5.4 |
| Vehicle Extension (s) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | 333 | 650 | 872 | 1002 | 393 | 1359 |
| v/s Ratio Prot | c0.17 | 0.07 | c0.46 | 0.09 | c0.21 | 0.32 |
| v/s Ratio Perm | | 0.06 | | 0.22 | | |
| v/c Ratio | 0.92 | 0.30 | 0.97 | 0.48 | 0.94 | 0.44 |
| Uniform Delay, d1 | 54.2 | 27.3 | 35.4 | 11.7 | 52.2 | 7.3 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 28.3 | 0.1 | 23.9 | 0.1 | 30.5 | 0.1 |
| Delay (s) | 82.4 | 27.4 | 59.3 | 11.8 | 82.7 | 7.4 |
| Level of Service | F | C | E | B | F | A |
| Approach Delay (s) | 57.5 | | 41.3 | | | 36.2 |
| Approach LOS | E | | D | | | D |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 42.7 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.95 | | |
| Actuated Cycle Length (s) | 136.1 | Sum of lost time (s) | 16.9 |
| Intersection Capacity Utilization | 84.7% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 252 | 209 | 674 | 428 | 306 | 476 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.8 | 5.7 | 5.4 | 5.8 | 5.7 | 5.4 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frpb, ped/bikes | 1.00 | 0.99 | 1.00 | 0.97 | 1.00 | 1.00 |
| Flpb, ped/bikes | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | 1.00 | 0.85 | 1.00 | 1.00 |
| Flt Protected | 0.95 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 |
| Satd. Flow (prot) | 1770 | 1595 | 1863 | 1531 | 1787 | 1863 |
| Flt Permitted | 0.95 | 1.00 | 1.00 | 1.00 | 0.95 | 1.00 |
| Satd. Flow (perm) | 1770 | 1595 | 1863 | 1531 | 1787 | 1863 |
| Peak-hour factor, PHF | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| Adj. Flow (vph) | 293 | 243 | 784 | 498 | 356 | 553 |
| RTOR Reduction (vph) | 0 | 65 | 0 | 46 | 0 | 0 |
| Lane Group Flow (vph) | 293 | 178 | 784 | 452 | 356 | 553 |
| Confl. Peds. (#/hr) | | 2 | | 8 | 8 | |
| Heavy Vehicles (%) | 2% | 0% | 2% | 2% | 1% | 2% |
| Turn Type | | pm+ov | | pm+ov | Prot | |
| Protected Phases | 6 | 3 | 4 | 6 | 3 | 8 |
| Permitted Phases | | 6 | | 4 | | |
| Actuated Green, G (s) | 23.9 | 51.8 | 56.8 | 80.7 | 27.9 | 90.4 |
| Effective Green, g (s) | 23.9 | 51.8 | 56.8 | 80.7 | 27.9 | 90.4 |
| Actuated g/C Ratio | 0.19 | 0.41 | 0.45 | 0.64 | 0.22 | 0.72 |
| Clearance Time (s) | 5.8 | 5.7 | 5.4 | 5.8 | 5.7 | 5.4 |
| Vehicle Extension (s) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lane Grp Cap (vph) | 337 | 658 | 843 | 984 | 397 | 1342 |
| v/s Ratio Prot | c0.17 | 0.06 | c0.42 | 0.09 | c0.20 | 0.30 |
| v/s Ratio Perm | | 0.05 | | 0.21 | | |
| v/c Ratio | 0.87 | 0.27 | 0.93 | 0.46 | 0.90 | 0.41 |
| Uniform Delay, d1 | 49.3 | 24.4 | 32.5 | 11.3 | 47.4 | 7.0 |
| Progression Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 19.9 | 0.1 | 16.3 | 0.1 | 21.6 | 0.1 |
| Delay (s) | 69.2 | 24.4 | 48.8 | 11.5 | 69.0 | 7.1 |
| Level of Service | E | C | D | B | E | A |
| Approach Delay (s) | 48.9 | | 34.3 | | | 31.3 |
| Approach LOS | D | | C | | | C |

| Intersection Summary | | | |
|---|---|---|---|
| HCM Average Control Delay | 36.2 | HCM Level of Service | D |
| HCM Volume to Capacity ratio | 0.91 | | |
| Actuated Cycle Length (s) | 125.5 | Sum of lost time (s) | 16.9 |
| Intersection Capacity Utilization | 80.5% | ICU Level of Service | D |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

# Appendix I Phase 3 Access Operations Worksheets

| Intersection | |
|---|---|
| Int Delay, s/veh | 2.1 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 70 | 17 | 159 | 23 | 6 | 230 |
| Future Vol, veh/h | 70 | 17 | 159 | 23 | 6 | 230 |
| 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 | 0 | - | - | 100 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 0 | 0 | 0 | 0 | 0 | 0 |
| Mvmt Flow | 78 | 19 | 177 | 26 | 7 | 256 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 458 | 189 | 0 | 0 | 202 | 0 |
| Stage 1 | 189 | - | - | - | - | - |
| Stage 2 | 269 | - | - | - | - | - |
| Critical Hdwy | 6.4 | 6.2 | - | - | 4.1 | - |
| Critical Hdwy Stg 1 | 5.4 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.4 | - | - | - | - | - |
| Follow-up Hdwy | 3.5 | 3.3 | - | - | 2.2 | - |
| Pot Cap-1 Maneuver | 565 | 858 | - | - | 1382 | - |
| Stage 1 | 848 | - | - | - | - | - |
| Stage 2 | 781 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 562 | 858 | - | - | 1382 | - |
| Mov Cap-2 Maneuver | 562 | - | - | - | - | - |
| Stage 1 | 848 | - | - | - | - | - |
| Stage 2 | 777 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 11.8 | 0 | 0.2 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 562 | 858 | 1382 | - |
| HCM Lane V/C Ratio | - | - | 0.138 | 0.022 | 0.005 | - |
| HCM Control Delay (s) | - | - | 12.4 | 9.3 | 7.6 | - |
| HCM Lane LOS | - | - | B | A | A | - |
| HCM 95th %tile Q(veh) | - | - | 0.5 | 0.1 | 0 | - |

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

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 2 | 1 | 181 | 1 | 0 | 300 |
| Future Vol, veh/h | 2 | 1 | 181 | 1 | 0 | 300 |
| 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 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 0 | 0 | 0 | 0 | 0 | 0 |
| Mvmt Flow | 2 | 1 | 201 | 1 | 0 | 333 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 535 | 202 | 0 | 0 | 202 | 0 |
| Stage 1 | 202 | - | - | - | - | - |
| Stage 2 | 333 | - | - | - | - | - |
| Critical Hdwy | 6.4 | 6.2 | - | - | 4.1 | - |
| Critical Hdwy Stg 1 | 5.4 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.4 | - | - | - | - | - |
| Follow-up Hdwy | 3.5 | 3.3 | - | - | 2.2 | - |
| Pot Cap-1 Maneuver | 510 | 844 | - | - | 1382 | - |
| Stage 1 | 837 | - | - | - | - | - |
| Stage 2 | 731 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 510 | 844 | - | - | 1382 | - |
| Mov Cap-2 Maneuver | 510 | - | - | - | - | - |
| Stage 1 | 837 | - | - | - | - | - |
| Stage 2 | 731 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 11.2 | 0 | 0 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 587 | 1382 | - |
| HCM Lane V/C Ratio | - | - | 0.006 | - | - |
| HCM Control Delay (s) | - | - | 11.2 | 0 | - |
| HCM Lane LOS | - | - | B | A | - |
| HCM 95th %tile Q(veh) | - | - | 0 | 0 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 1.4 |

| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 46 | 11 | 234 | 78 | 20 | 258 |
| Future Vol, veh/h | 46 | 11 | 234 | 78 | 20 | 258 |
| 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 | 0 | - | - | 100 | - |
| Veh in Median Storage, # | 0 | - | 0 | - | - | 0 |
| Grade, % | 0 | - | 0 | - | - | 0 |
| Peak Hour Factor | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 0 | 0 | 0 | 0 | 0 | 0 |
| Mvmt Flow | 51 | 12 | 260 | 87 | 22 | 287 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 634 | 303 | 0 | 0 | 347 | 0 |
| Stage 1 | 303 | - | - | - | - | - |
| Stage 2 | 331 | - | - | - | - | - |
| Critical Hdwy | 6.4 | 6.2 | - | - | 4.1 | - |
| Critical Hdwy Stg 1 | 5.4 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.4 | - | - | - | - | - |
| Follow-up Hdwy | 3.5 | 3.3 | - | - | 2.2 | - |
| Pot Cap-1 Maneuver | 446 | 741 | - | - | 1223 | - |
| Stage 1 | 754 | - | - | - | - | - |
| Stage 2 | 732 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 438 | 741 | - | - | 1223 | - |
| Mov Cap-2 Maneuver | 438 | - | - | - | - | - |
| Stage 1 | 754 | - | - | - | - | - |
| Stage 2 | 719 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 13.5 | 0 | 0.6 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | WBLn2 | SBL | SBT |
|---|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 438 | 741 | 1223 | - |
| HCM Lane V/C Ratio | - | - | 0.117 | 0.016 | 0.018 | - |
| HCM Control Delay (s) | - | - | 14.3 | 9.9 | 8 | - |
| HCM Lane LOS | - | - | B | A | A | - |
| HCM 95th %tile Q(veh) | - | - | 0.4 | 0 | 0.1 | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 0 |

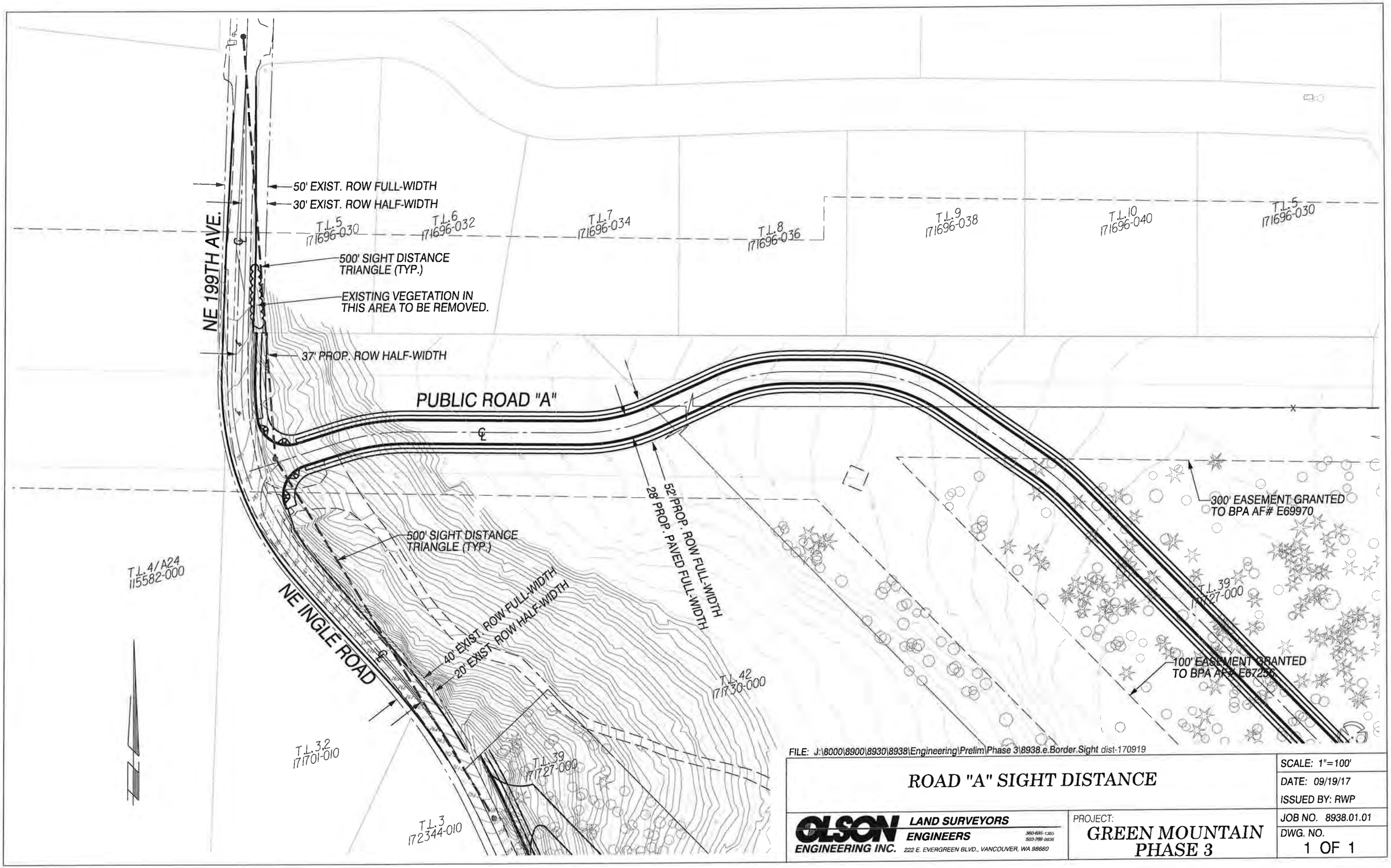
| Movement | WBL | WBR | NBT | NBR | SBL | SBT |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Traffic Vol, veh/h | 1 | 1 | 311 | 2 | 0 | 304 |
| Future Vol, veh/h | 1 | 1 | 311 | 2 | 0 | 304 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Stop | Stop | Free | 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 | 90 | 90 | 90 | 90 | 90 | 90 |
| Heavy Vehicles, % | 0 | 0 | 0 | 0 | 0 | 0 |
| Mvmt Flow | 1 | 1 | 346 | 2 | 0 | 338 |

| Major/Minor | Minor1 | | Major1 | | Major2 | |
|---|---|---|---|---|---|---|
| Conflicting Flow All | 685 | 347 | 0 | 0 | 348 | 0 |
| Stage 1 | 347 | - | - | - | - | - |
| Stage 2 | 338 | - | - | - | - | - |
| Critical Hdwy | 6.4 | 6.2 | - | - | 4.1 | - |
| Critical Hdwy Stg 1 | 5.4 | - | - | - | - | - |
| Critical Hdwy Stg 2 | 5.4 | - | - | - | - | - |
| Follow-up Hdwy | 3.5 | 3.3 | - | - | 2.2 | - |
| Pot Cap-1 Maneuver | 417 | 701 | - | - | 1222 | - |
| Stage 1 | 720 | - | - | - | - | - |
| Stage 2 | 727 | - | - | - | - | - |
| Platoon blocked, % | | | - | - | | - |
| Mov Cap-1 Maneuver | 417 | 701 | - | - | 1222 | - |
| Mov Cap-2 Maneuver | 417 | - | - | - | - | - |
| Stage 1 | 720 | - | - | - | - | - |
| Stage 2 | 727 | - | - | - | - | - |

| Approach | WB | NB | SB |
|---|---|---|---|
| HCM Control Delay, s | 11.9 | 0 | 0 |
| HCM LOS | B | | |

| Minor Lane/Major Mvmt | NBT | NBR | WBLn1 | SBL | SBT |
|---|---|---|---|---|---|
| Capacity (veh/h) | - | - | 523 | 1222 | - |
| HCM Lane V/C Ratio | - | - | 0.004 | - | - |
| HCM Control Delay (s) | - | - | 11.9 | 0 | - |
| HCM Lane LOS | - | - | B | A | - |
| HCM 95th %tile Q(veh) | - | - | 0 | 0 | - |

# Appendix J  Sight Distance Exhibits




FILE: J:\8000\8900\8930\8938\Engineering\Prelim\Phase 3\8938.e.Border.Sight dist-170919

# ROAD "A" SIGHT DISTANCE

SCALE: 1"=100'
DATE: 09/19/17
ISSUED BY: RWP

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PROJECT:
GREEN MOUNTAIN PHASE 3

JOB NO. 8938.01.01
DWG. NO. 1 OF 1