APPENDIX A

SR 3/SR 304 Bremerton Interchange Improvements Project

Methods and Assumption Document

May 19, 2015

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SR 3/SR 304 Bremerton Interchange Improvements Project

Draft Methods and Assumptions Document

Appendix A

May 19, 2015

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Stakeholder Acceptance

The undersigned parties, including all members of the team from WSDOT, concur with the Interchange Justification Report Methods and Assumptions for the SR 3/SR 304 Bremerton Interchange Improvements project as presented in this document:

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Scott Zeller
Assistant State Design Engineer

6/4/15
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5/18/2015
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WSDOT – OR Planning

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Olympic Region Planning Manager

5/18/15
Date

(1) Participation on the Stakeholders Committee and/or signing of this document does not constitute approval of the SR 3/SR 304 Bremerton Interchange Improvements project Interchange Justification Report.

(2) All members of the Stakeholder Committee will accept this document as a guide and reference as the study progresses through the various stages of project development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the stakeholders.

At the time this Methods and Assumptions Document was signed, the latest version of the WSDOT Design Manual Chapter 550 was dated July 2014.

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Acronyms

EB	Eastbound
FHWA	Federal Highway Administration
GP	General Purpose
HCM	Highway Capacity Manual
HOV	High Occupancy Vehicle
HQ	WSDOT's Headquarters Office
HSP	Highway System Plan
IJR	Intersection Justification Report
LEAP	Legislative Evaluation and Accountability Program
LOS	Level of Service
M/A	Methods and Assumptions Document
MOE	Measures of Effectiveness
NB	Northbound
OR	Olympic Region
PSNS	Puget Sound Naval Shipyard
SB	Southbound
SR	State Route
TDM	Transportation Demand Management
WSF	Washington State Ferries
WB	Westbound

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Policy Point #1 – Need For the Access Point Revision

Introduction

Project leads, proponents, and other team members

As sponsors of the project, the following individual groups set the goals and requirements for the project and its deliverables. WSDOT's OR Planning office is the study lead. The study's structure consisted of a working group and an internal technical team.

The working group committee is comprised of technical level representatives from:

Communities

- Bremerton
- Kitsap County
- Kitsap Transit
- Naval Base Kitsap
- Port Orchard

WSDOT

- HQ Design
- HQ Highway Access
- HQ Traffic
- OR Project Development
- OR Planning
- OR Traffic.

The internal technical team consists of members from WSDOT's HQ and OR Traffic, and OR Planning with VISSIM traffic analysis consultant support from Parametrix.

The study lead also coordinated with the Suquamish Tribe and the West Sound Cycling Club.

Background Information

The SR 3/SR 304 interchange is located in Bremerton, Washington; the SR 3/SR 304 interchange provides an important freeway to freeway connection between two major highways. The interchange is an important connection which moves people and goods via commuter, freight, and other multimodal traffic through the City of Bremerton, Kitsap County and communities and regions beyond. SR 3 is a north-south highway approximately sixty miles in length that runs between the City of Shelton in Mason County and SR 104 in the vicinity of the Hood Canal in Kitsap County. SR 3 provides a critically important north-south link in the regional transportation system in Kitsap and Mason counties serving as a primary regional transportation principle arterial, a key freight route and a commuter highway.

SR 304 is an east-west highway three miles in length, located within the City of Bremerton, connecting SR 3 with downtown Bremerton and the WSF's Bremerton ferry terminal. SR 304 also provides access to the PSNS. The naval shipyard with its intermediate maintenance facility is the Pacific Northwest's largest naval shore facility, and one of Washington State's largest industrial installations. Besides the WSF terminal, the major traffic generator along this route is the PSNS.

While serving as a major regional freight corridor, SR 3 is also a vital link for the urban communities of Silverdale, Chico and Gorst along the corridor as well as the primary commuter route for the three naval bases on the Kitsap Peninsula (PSNS, Bangor and Keyport).

Policy Point #1 – Need for the Access Point Revision

Introduction

Background Information continued

The current corridor geometric configurations contribute to the PM peak congestion that is being experienced along these corridors. SR 3 SB prior to the interchange merges from two lanes to one lane and SR 304 WB merges from two lanes to one lane. After SR 3 SB and SR 304 WB merge, SR 3 continues as a 2-lane facility. With the anticipated growth in traffic volumes in the opening year (2020) and future year (2040), congestion levels are anticipated to increase, and travel time in the corridor will worsen.

Facilities that will be affected by the project

The SR 3 and SR 304 interchange and the Loxie Eagans Boulevard SB on-ramp will be directly affected by this project.

Project Description

The purpose of this study is to improve mobility by eliminating the bottleneck along SB SR 3 in the vicinity of the SR 3/SR 304 interchange where two lanes merge into one.

The 2012 Supplemental Budget identified a proviso as part of LEAP to begin environmental documentation and preliminary design to expedite project delivery.

The legislature appropriated funds for the SR 3/SR 304 Bremerton Interchange Improvements project to be used to advance the design, preliminary engineering and rights of way acquisition. Funds are to be used to advance the emergent, initial development of the project for the purpose of expediting delivery.

The WSDOT's 2007-2026 HSP and the 2011-2030 HSP identifies the SR 3/SR 304 interchange as a bottleneck where congestion conditions currently occur in the PM peak hours along SR 3 SB in the vicinity of the SR 3/SR 304 interchange where the two SB lanes merge into one. The SR 3/SR 304 interchange was also identified as a 2013 unfunded system investment by WSDOT. The mobility LOS is also below the adopted service objective in the PM peak period at this location. The resulting congestion increases delay and travel time affecting safety and imposing inconvenience for motorized travelers, and creates challenges for non-motorized travelers using the state highway.

Existing Roadway Configuration

SR 3 is a four-lane (two lanes each direction) divided highway in the vicinity of the Loxie Eagans Boulevard interchange. SR 3 SB has an auxiliary lane between the SR 310/Auto Center Way on-ramp and the Loxie Eagans Boulevard off-ramp, and SR 3 NB has an auxiliary lane between the SR 304 WB on-ramp and the Loxie Eagans Boulevard off-ramp.

At the SR 3/SR 304 interchange, SR 3 SB merges from two lanes to one lane. The SR 304 on-ramp connects to SR 3 SB as an add-lane, and SR 3 SB maintains two lanes between SR 304 and SR 16. SR 3 NB is also two lanes between SR 16 and SR 304.

Policy Point #1 – Need For the Access Point Revision

Project Description

Existing Roadway Configuration continued

North of Farragut Avenue, SR 304 is four-lane arterial with a landscaped center median. South of Farragut Avenue to Charleston Boulevard, SR 304 is a six-lane arterial with a landscaped center median. In the WB direction, the inside lane is a high occupancy vehicle (HOV) lane.

The HOV lane designation ends east of the SR 3/SR 304 interchange, and the right lane drops at the on-ramp to SR 3 NB. The two remaining WB lanes merge to one lane prior to the SR 304 WB undercrossing.

Existing Traffic Operations

Findings from the analysis demonstrate that there are two locations in the study area where vehicle volumes exceed available roadway capacity during the PM commute period as follows:

- Where SR 3 SB merges from two lanes to one lane south of the Loxie Eagans interchange; this location is congested for approximately 2 hours 45 minutes, and queuing extends through the Loxie Eagans interchange.
- Where SR 304 WB merges from two lanes to one lane east of the SR 3/SR 304 interchange: This location is congested for approximately 1 hour 45 minutes. Queuing in the GP lane extends back to the Charleston Boulevard intersection. The HOV lane allows transit, vanpools and carpools to bypass the congested GP lane, but HOV vehicles experience congestion once the HOV lane terminates. There is no substantial congestion on SR 3 NB or SR 304 EB in the PM peak.

  All intersections operate a LOS D or better with the following two exceptions:

  1. Loxie Eagans Boulevard and SR 3 SB ramps – the SB approach to this stop-controlled intersection operates at LOS E during the PM peak hour.
  2. SR 3 and Sam Christopherson Boulevard – This signalized intersection operates at LOS E during the PM peak hour.

  Note: In some cases, congestion extends beyond the limits of the model, and vehicles are effectively queuing outside of the model.

Facilities that will be affected by the project

The SR 3 and SR 304 interchange and the Loxie Eagans Boulevard SB on-ramp will be directly affected by this project.

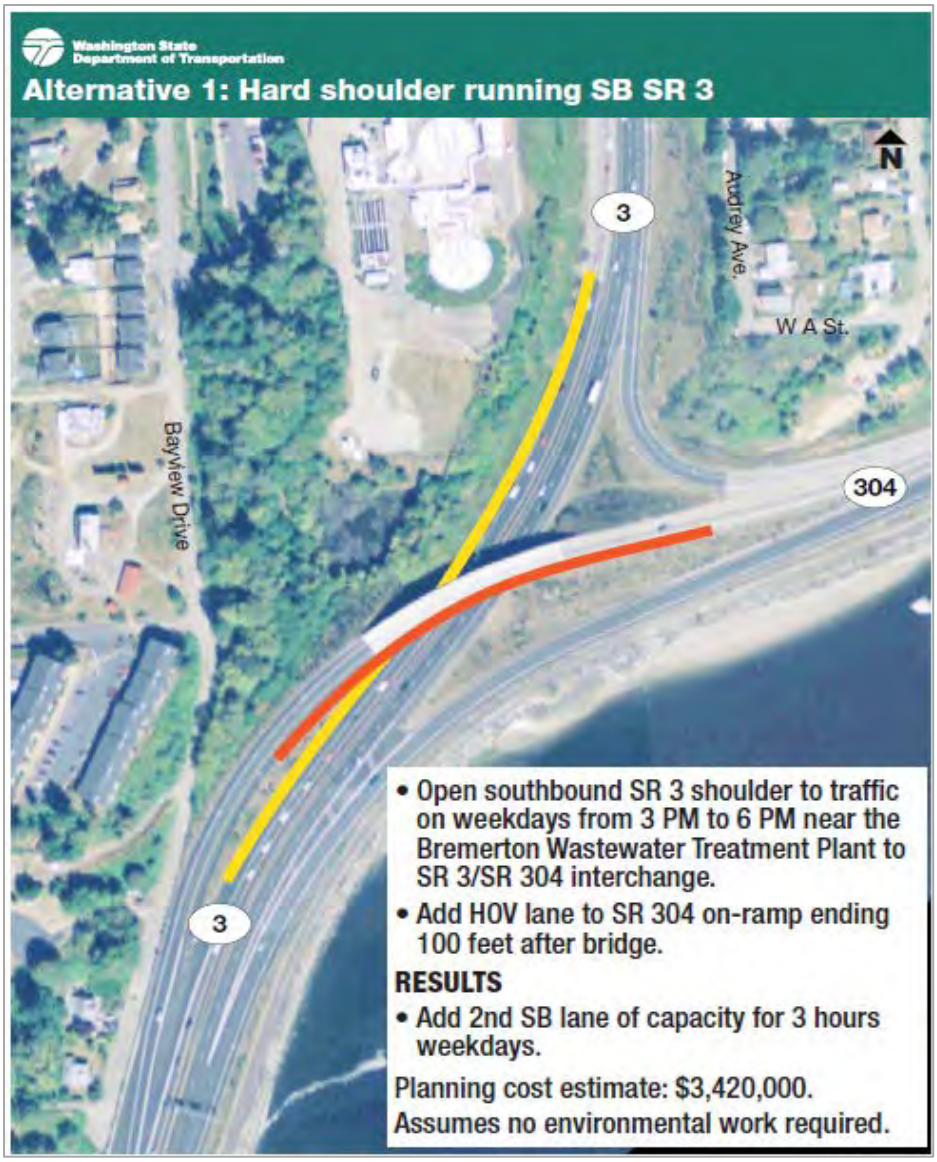
Policy Point #2 Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated.

The following five alternatives were identified to improve the traffic flow at the SR 3/SR 304 interchange.

Alternative 1: Southbound SR 3: Hard Shoulder Running

This alternative investigates opening the SB SR 3 shoulder to traffic on weekdays from 3-6 PM. Those hours often see the heaviest traffic volumes. The shoulder along SR 3 SB would be open to traffic during those hours in the vicinity of the SR 3/SR 304 interchange where the two SB lanes merge into one. This alternative was removed from further considered because it doesn't provide a 24-hour solution; it moves the merge points further downstream; and bike capacity is lost through the SR 3/SR 304 interchange curve.

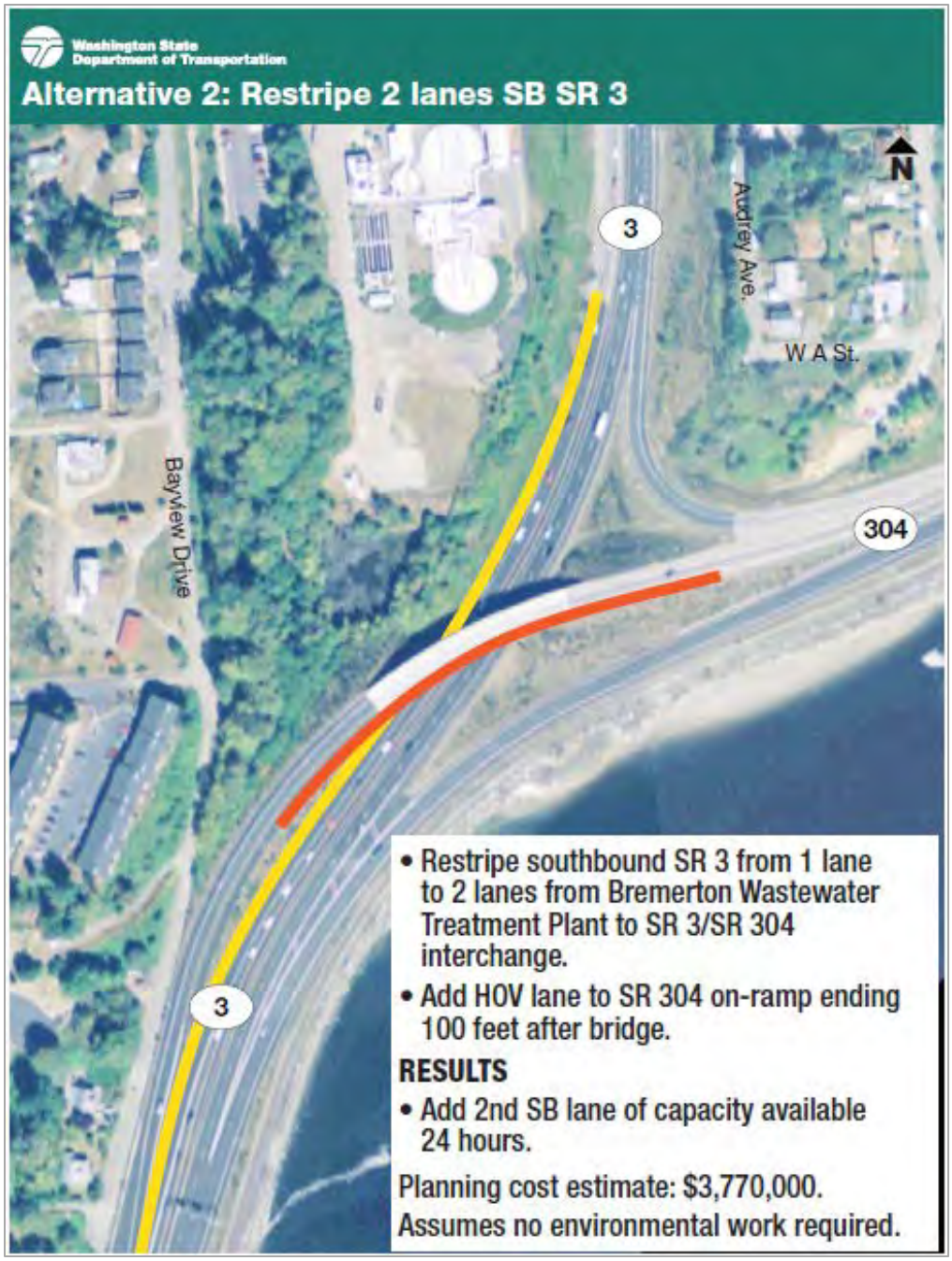


Policy Point #2 Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated continued

Alternative 2: Restripe to 2 Lanes

This alternative restripes the existing roadway to create two lanes on SR 3 SB in the area between the Bremerton Wastewater Treatment Plan and the SR 3/SR 304 interchange merge. Two lanes currently merge into one at this location. This alternative was identified as the low cost and short term solution with a planning level cost of $3.77 million.

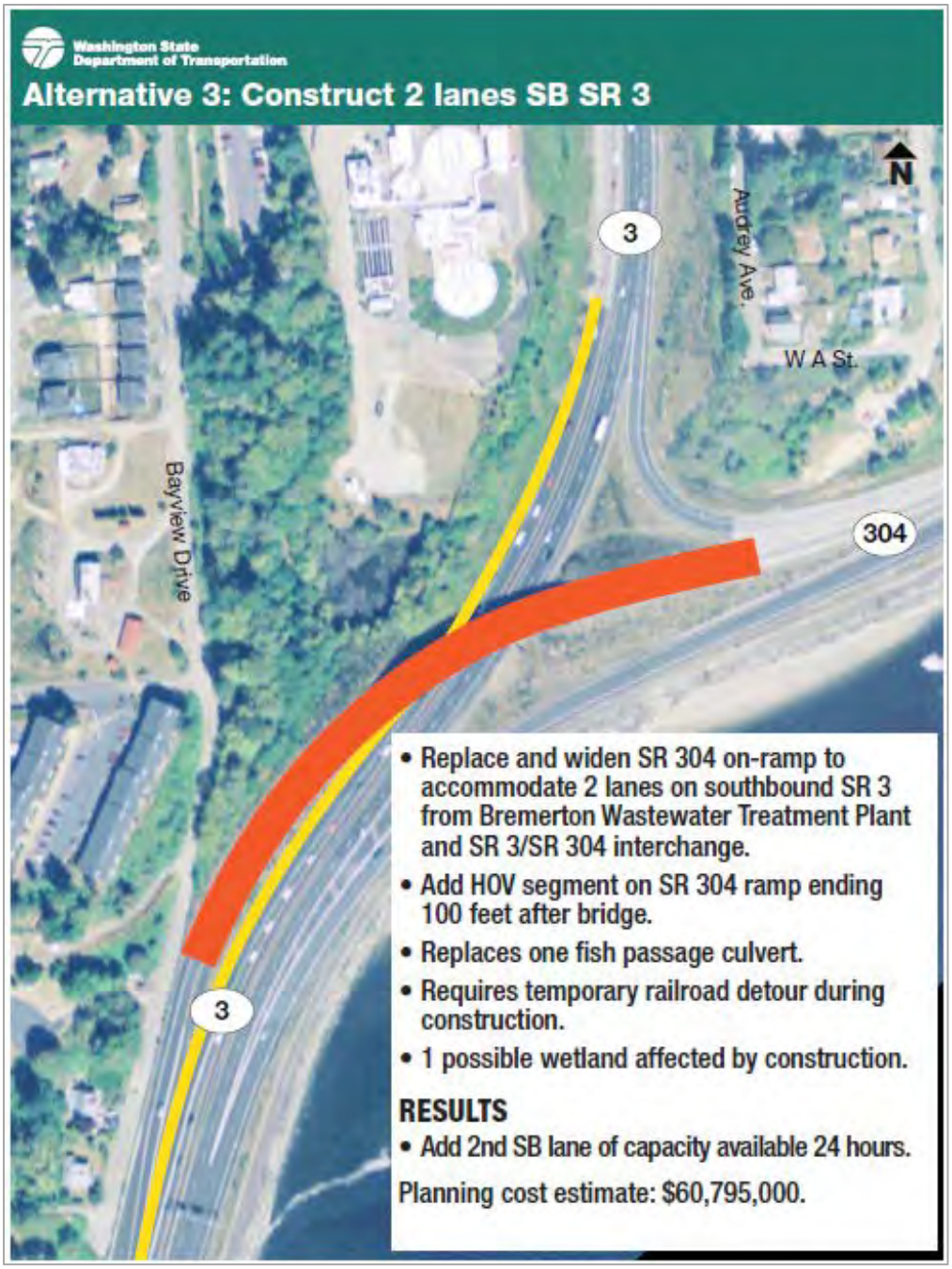


Policy Point #2 Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated continued

Alternative 3: Construct to 2 Lanes

This alternative demolishes and rebuilds the SR 304 on-ramp over SR 3 to accommodate two lanes on SR 3 SB in the area between the Bremerton Wastewater Treatment Plant and the SR 3/SR 304 interchange merge. This alternative has a planning level cost estimate of $6.80 million. Alternative 2 is more cost effective for the same benefit.



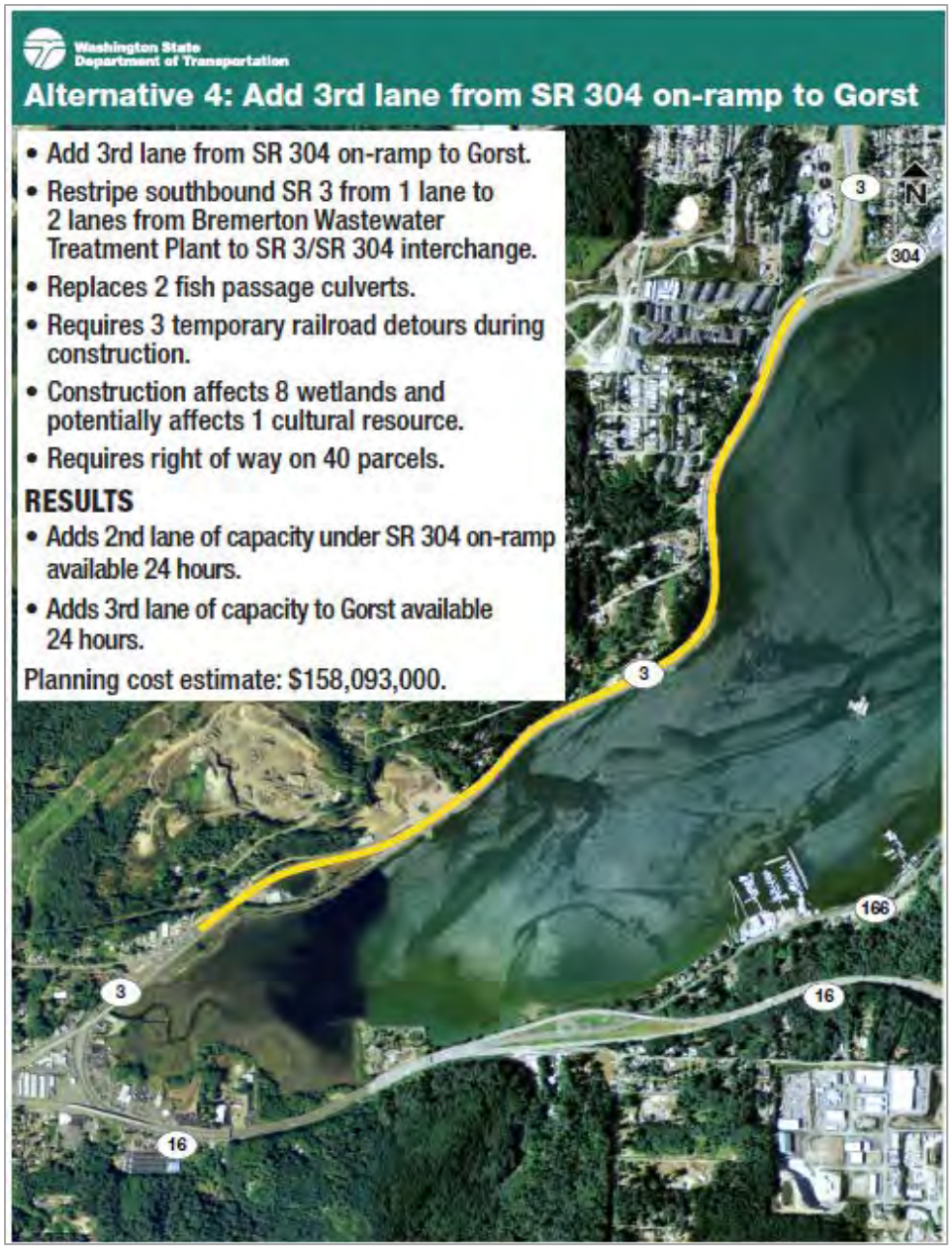
Policy Point #2 Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated continued

Alternative 4: Southbound SR 3: Add Third Lane from SR 304 to Gorst

This alternative would add a 3rd Lane from the SR 304 on-ramp to Gorst. SB SR 3 from the SR 304 on-ramp to Gorst would be widened to create three at grade lanes. At Gorst the 3rd lane would tie into the existing three lane section leading to SR 16. Crews would also restripe SR 3 SB to two lanes in the area between the Bremerton Wastewater Treatment Plant.

This alternative is the ultimate solution, however it's expensive. The planning level cost estimate is $158 million.



Policy Point #2 Reasonable Alternatives

Describe the reasonable alternatives that have been evaluated. continued

Alternative 5: Transportation Demand Management (TDM)

This alternative assumed a reduction in future traffic volumes through the implementation of TDM strategies. The focus of the traffic analysis was not on the specific strategies used, but on the effect of removing trips from the transportation network. The opening year (2020) analysis assumed a five percent reduction in traffic volumes, and the future year (2040) analysis assumed a 10 percent reduction in traffic volumes.

The TDM alternative was modified from a 2% reduction of vehicle to a proposed 5% reduction in 2020 and a 10% proposed reduction in 2040. The preliminary 2% reduction of vehicle matched the growth rate of 1.5%. Also noted was that the SR 3 SB and SR 304 WB may experience up to a 30 percent of vehicles carrying two or more people resulting in 51% of total person-trips during peak traffic periods. The main reason for this high figure may be the result of a combination of the rideshare programs being sponsored by Kitsap Transit and the restrictive parking at the region's defense facilities (Puget Sound Naval Shipyard, Navy Supply Center, Naval Base Kitsap at Bangor and the Kitsap Keyport Naval Base. Note: TDM was dropped as a stand-alone alternative due to the difficulty and the prohibitive cost of implementing an additional 5-10% vehicle reduction. Instead, the preferred alternatives are assumed to include TDM strategies.

Policy Point #3 Operational and Collision Analysis

Analysis Years and Analysis Periods

Analysis Period(s):

The operational analysis results will be reported for the average weekday PM peak hour condition. Traffic data collection was performed along SR 3 and SR 304 during the week of April 15-18, 2013. Traffic data was collected for 5.5 hours from 1:30 to 7:00 PM. Twenty roadway tube counters were placed measuring rolling slow-downs; license plate reader cameras were placed at 4 locations to measure travel time; and manual turning movement counts were recorded along SR 304 at Charleston and Farragut Avenue gates.

Current Year:

Existing year traffic volumes were developed for all roadways and intersections in the study area using information from turning movement counts and tube counts collected between February 2010 and May 2014. Collision data was collected for the period of January 1, 2008 through December 31, 2012. The existing year for this study was assumed to be 2013, and collected traffic volumes were factored to 2013 traffic volumes.

Policy Point #3 Operational and Collision Analysis

Analysis Years and Analysis Periods

Current Year continued

Note: opening year (2020) and future year (2040) traffic volumes were developed by assuming a 1.5 percent annual growth rate in traffic volumes between 2013 and the respective analysis year. The annual growth rate was based on a review of the following:

- Kitsap County 2010 and 2025 Travel Demand Models.
- Puget Sound Regional Council 2006 and 2040 Travel Demand Models.
- Bremerton Economic Development Study.
- City of Bremerton Comprehensive Plan.
- WSDOT Highway Segment Analysis Program historical trend line growth rates.

The alternatives analyzed in this study were not assumed to significantly change existing traffic patterns on a regional scale or how people travel. One traffic volume forecast was developed for the opening year (2020) and another for the future year (2040) analysis. This allowed for a conservative comparison that described how well each of the alternatives performed with a given set of volumes.

Opening Year (2020) Traffic Operations

No Build Alternative

Vehicle congestion is anticipated where SR 3 SB merges from two lanes to one lane, and where SR 304 WB merges from two lanes to one lane. The increased traffic volume modeled for the opening year (2020) results in substantially more congestion compared to 2013 existing conditions in the PM peak.

On SR 3 SB the duration of congestion is anticipated to increase from 2 hours 45 minutes with existing conditions to 4 hours 15 minutes with the No Build Alternative. Congestion would also extend beyond the limits of the study area, leaving approximately 460 unserved vehicles. This PM queuing also results in the Loxie Eagans on-ramp to SR 3 SB being blocked. Queuing along the on-ramp would extend back onto Loxie Eagans Boulevard.

At the Loxie Eagans Boulevard and the SR 3 SB ramps intersection, the stop-controlled SB approach would be over capacity due to left turn delay, and the resulting queue is anticipated to extend back to the auxiliary lane on SR 3 SB.

The duration of congestion on SR 304 WB would increase from 1 hour 45 minutes with existing conditions to 2 hours 30 minutes with the No Build Alternative, and congestion would extend beyond the limits of the study area, leaving approximately 175 unserved vehicles. Congestion on SR 3 NB and SR 304 EB in the PM peak would not change with the No Build Alternative compared to existing conditions. SR 3 NB between SR 16 and SR 304 would change from LOS E to LOS F in the AM peak (6:15 to 7:15 AM).

Policy Point #3 Operational and Collision Analysis

Analysis Years and Analysis Periods

Opening Year (2020) Traffic Operations

SR 3 Build Alternatives

Note: Since the roadway configuration for the build alternatives on SR 3 NB and SR 304 EB do not change compared to the No Build Alternative, the traffic operations focus on the PM peak alternatives that reduce the bottleneck along SR 3 SB where two lanes currently merge into one lane.

The following alternatives are anticipated to experience congestion similar to the No Build alternative (this is due to the alternatives maintaining the merge condition from two lanes to one lane that is the source of PM peak congestion on SR 3 SB).

- SR 3 SB: *Hard Shoulder Running*: The merge location would be moved south, reducing the number of unserved vehicles compared to the *No Build* Alternative.
- Transportation Demand Management (TDM): the number of unserved vehicles would be reduced, because the traffic volumes are 5% lower compared to the *No Build* Alternative.

Travel times on SR 3 SB with the *Hard Shoulder Running* and TDM alternatives are similar to the No Build alternative.

For the *Construct or Restripe* and the *Add Third Lanes* alternatives, the merge condition on SR 3 SB would be eliminated, and congestion on SR 3 SB would be reduced. The *Construct or Restripe Two Lanes* alternatives with no ramp meter is anticipated to result in some congestion at the SR 304 on-ramp merge area due to the high volume of vehicles on the ramp. Average travel times on SR 3 SB with the *Construct or Restripe*, and *Add Third Lane* alternatives are modeled at over two minutes, compared to almost 10 minutes with the No Build alternative.

With all build alternatives, the queue from the SB off-ramp to Loxie Eagans Boulevard is anticipated to extend into the auxiliary lane on the SR 3 SB mainline, similar to the No Build Alternative.

SR 304 Build Alternatives

On SR 304 WB, the *Add Third Lane* Alternative would maintain two travel lanes to an add lane connection with SR 3 SB. This would relocate the HOV merge location that is the main source of congestion in the *No Build* Alternative, and substantially reduce congestion compared to the No Build alternatives. The GP and HOV travel times would improve compared to the *No Build* alternative due to the reduced congestion levels and the relocated HOV merge occurring at the add lane merge.

The *Hard Shoulder Running* and *Construct* or *Restripe* alternatives (no meter) would have similar congestion levels, congestion duration and unserved vehicles similar to the *No Build* Alternative with the SR 304 WB HOV merge relocated to 100 ft. west of the bridge.

Policy Point #3 Operational and Collision Analysis

Analysis Years and Analysis Periods

Opening Year (2020) Traffic Operations

SR 304 Build Alternatives continued

With the *Construct* or *Restripe* alternative (with ramp meter), the duration of congestion would increase to 5 hours, and the number of unserved vehicles would increase to over 1,300. This is because the ramp meter restricts the number of vehicles able to pass through the ramp meter to well below the vehicle demand. The on-ramp meter was modeled to be activated for 5.5 hours for a worst case scenario.

Vehicle Hours of Delay and Throughput

Vehicle Hours of Delay provides a simple comparison across alternatives by summing the delay experienced by each driver in the network. In the opening year (2020), the *Construct*, or *Restripe* without a ramp meter and the *Add Third Lane* alternatives perform the best. The remaining alternatives perform similar to the *No Build* alternative. Vehicle throughput just south of the SR 3/SR 304 interchange is over 90 percent for all alternatives.

Intersection Operations

Opening year (2020), intersection LOS is anticipated to be better than a LOS D Urban threshold with the exceptions of the Loxie Eagans Boulevard and the SR 3 SB off-ramp intersection. The stop-controlled SR 3 SB off-ramp worsens from LOS E to F, and is over capacity during the peak hour. The resulting queue is anticipated to extend to the SR 3 mainline auxiliary lane. The Sam Christopherson intersection located at the end of the study area in Gorst is LOS E in 2020.

Design Year (2040) Traffic Operations

Corridor Operations

No Build Alternative

The *No Build* Alternative is anticipated to experience congestion and queuing beyond the study limits where SR 3 SB merges from two lanes to one, and where SR 304 WB merges from two lanes to one. The assumed increase in traffic volumes for the future year (2040) would result in increased congestion compared to existing conditions and the opening year (2020).

On SR 3 SB, the duration of congestion is anticipated to increase to 5 hours with the *No Build* alternative. Congestion would also extend beyond the study area, leaving over 4,500 unserved vehicles. It is likely that congestion would not reach such severe conditions, as people would divert or eliminate trips to avoid congestion. Note: This study assumed traffic volumes and traffic patterns to be the same across all alternatives. This allows for a conservative comparison that describes how well each of the alternatives performs with a given set of volumes.

Policy Point #3 Operational and Collision Analysis
Analysis Years and Analysis Periods
Design Year (2040) Traffic Operations
Corridor Operations

No Build Alternative continued

At the Loxie Eagans Boulevard and SR 3 SB ramps intersection, the stop-controlled SB left turn approach would be over capacity, and the resulting queue would extend back to the auxiliary lane on SR 3 SB, and impact the two travel lanes as drivers slow to enter the queue in the auxiliary lane.

The duration of congestion on SR 304 WB would also increase to 4 hours 45 minutes with the *No Build* alternative, and congestion would extend beyond the limits of the study area, leaving approximately 1,900 unserved vehicles. Congestion in the non-peak direction, on SR 3 NB and on SR 304 EB, is not anticipated to change with the *No Build* Alternative compared to existing PM peak conditions.

SR 3 Build Alternatives

With all build alternatives, the roadway configuration on SR 3 NB and SR 304 EB would not be modified compared to the No Build Alternative, and traffic operations in the PM peak would not change.

The following two alternatives are anticipated to experience congestion similar to the *No Build* Alternative since each alternative maintains the source of congestion which is the merge condition from two lanes to one lane along SR 3 SB.

- SR 3 SB *Hard Shoulder Running* moves the merge location south, reducing the number of unserved vehicles compared to the No Build alternative.
- TDM alternative reduces the number of unserved vehicles because traffic volumes are 10% lower.

The *Construct* or *Restripe* (with and without a ramp meter), and the *Add Third Lane* alternatives would eliminate the merge condition on SR 3 SB, and reduce congestion on SR 3 SB compared to the *No Build* Alternative. The *Construct* or *Restripe Two Lanes* (both with and without a ramp meter) would result in congestion and queuing at the SR 304 on-ramp merge area due to the high expected vehicle volume on the ramp. The average travel times on SR 3 SB with the *Construct* or *Restripe*, and *Add Third Lane* alternatives are anticipated to range from approximately 3 to 7 minutes, compared to over 14 minutes with the *No Build* alternative.

With all build alternatives, the queue from the SB off-ramp to Loxie Eagans Boulevard is anticipated to extended into the auxiliary lane on the SR 3 SB mainline similar to the No Build alternative.

Policy Point #3 Operational and Collision Analysis

Analysis Years and Analysis Periods

Design Year (2040) Traffic Operations

Corridor Operations

SR 304 Build Alternatives

On SR 304, the Add Third Lane alternative would maintain two travel lanes to the connection with SR 3 SB. This would relocate the HOV merge which is the main source of congestion in the *No Build* alternative.

The *Hard Shoulder Running* and *Construct* or *Restripe* without a ramp meter have similar congestion levels, congestion duration, and unserved vehicles similar to the *No Build* alternative since the HOV merge location is extended to the beginning of the bridge. Since the ramp meter restricts throughput of GP lanes below the vehicle demand, the duration of congestion increases to 5 hours and the number of unserved vehicles increases to approximately 4,400.

Intersection LOS is anticipated to worsen compared to existing and opening year conditions at all study intersections. Vehicle hours of delay increases substantially compared to the opening year (2020) for all alternatives except for the *Add Third Lane*. Vehicle throughput just south of the SR 3/SR 304 interchange drops below 90 percent with all alternatives except the *Add Third Lane* alternative.

Study Area and Project Limits

The study area includes; SR 3 in Kitsap County and SR 304 in Bremerton. SR 3 between Werner Road/Loxie Eagans interchange to the north, and the Sam Christopherson Avenue intersection to the south; the SR 3/SR 16 interchange; and SR 304 between Farragut Avenue and SR 3.

SR 3/SR 304 Bremerton Interchange Improvements Study Area

Numbered Locations

1. Werner Road/Loxie Eagans Blvd & Auto Center Way/Oyster Bay Ave.
2. Loxie Eagans Blvd & SR 3 SB Ramps
3. Loxie Eagans Blvd & SR 3 NB Ramps
4. Farragut Ave/Cambrian Ave & SR 304
5. Charleston Beach Road & SR 304
6. Sam Christopherson Ave & SR 3

Policy Point #3 Operational and Collision Analysis continued

Traffic Operations Analysis

Methodology:

The traffic analysis focused on three periods with a straight line growth rate of 1.5% in the PM peak period.

- Existing Year 2013
- Opening Year 2020
- Forecast Year 2040

Software:

The following traffic models were used to analyze traffic operations:

1. Synchro (version 8.0) is a deterministic model used to calculate peak hour vehicle delay and LOS at intersections, similar to the methodologies outlined in the HCM. The model included all mainline sections, ramps, and intersections in the study area. Vehicle throughput, travel times, speeds and queues in the AM and PM peak.
2. VISSIM (version 5.4-9 and/or 5.4-10) is a stochastic model (microsimulation) that accounts for variability in driver behavior and is used to calculate travel times, speeds, and congestion levels for multiple modes of travel over long periods of time. VISSIM was used for the PM peak period.
3. Highway Capacity Manual Software (HCM 2010) was used for the AM peak on SR 3 mainline and SR 304 mainline.

Results to be reported:

A VISSIM model was used to analyze the mainline sections of SR 3 from just north of Werner Road/Loxie Eagans Blvd. interchange to the SR 16 ramp in Gorst to account for mainline queuing and SR 304 from the interchange with SR 3 to Farragut Avenue. A Synchro model was used to evaluate intersection operations at 1) Charleston Blvd/SR 304, Farragut Avenue/SR 304, Loxie Eagans/Auto Center, Loxie Eagans/SR 3 SB ramp terminal, and Loxie Eagans/SR 3 NB ramp terminal. The following alternatives were analyzed:

Existing Year 2013

- No Build

Opening Year 2020

- No Build
- Hard Shoulder
- Restripe/Construct
- Add 3rd Lane
- TDM 2% & 5%

Design Year 2040

- No Build
- Hard Shoulder
- Restripe/Construct
- Add 3rd Lane
- TDM 2% & 10%

Policy Point #3 Operational and Collision Analysis continued

Travel Forecast

A 1.5% straight line growth rate for mainline volumes was used (closely matching Kitsap County's land use model rates). This growth rate is approximately a 10% overall growth from 2013 to 2020. This rate was chosen after reviewing applicable historical trends and land use travel demand models.

The Kitsap County land use model forecasts a negative growth rate of the SR 304 WB on-ramp to SR 3 SB. The consultant used a positive annual growth rate rather than a negative for this specific ramp. The historical AADT from 2004 to 2013 for this ramp shows a positive growth. The prior City of Bremerton's Comprehensive Plan growth rates were not considered as they appear high for existing count data.

Network Assumptions

The local network was assumed to have no changes in 2013, 2020, and 2040.

For the preferred Stage 1 *Restripe* Alternative, Year 2020 would include SR 3 SB mainline being 2 lanes and the SR 304 WB HOV merge being relocated to 100 ft. west of the bridge.

For the preferred Stage 2 *Add Lane* Alternative, Year 2020 and 2040 would include SR 3 WB mainline being 3 lanes between Gorst and Bremerton and SR 304 WB HOV merge being relocated to the beginning of the SB add lane merge.

Traffic Volume Development

Tube counts were used for current year analysis and were performed in April of 2013 during the weekday (Wednesday, April 17). Turning movement counts were also done in 2013. The Loxie Eagans Boulevard turning movements and tube counts were conducted in 2014. Other available counts would have been used and factored to Year 2013 volumes (within 3 years of 2013). Forecast years assumed a 1.5 % growth rate.

Selection of Measures of Effectiveness

The following matrices were used to demonstrate how each alternative will accomplish its stated objectives.

- **Vehicle Throughput**
- **Travel Time**
- **Vehicle Hours of Delay**
- **Duration of Congestion**
- **Unserved Vehicles**

Policy Point #3 Operational and Collision Analysis continued

Collision Analysis

SR 3: Summary and Assumptions

The alternatives likely to impact the safety performance of SR 3 from SR 16 to SR 310 are:

- Transportation Demand Management (TDM)
- All Day Hard Shoulder Running (Restripe early merge into late merge on SR 3 SB and SR 304 WB lane reductions)
- Restripe or Widen to create SR 304 WB parallel on ramp merge and 2 lanes SB under the SR 304 WB bridge
- Add lane on SR 3 SB between SR 16 and SR 304

SR 3 was analyzed using the Highway Safety Manual freeway model **I**nterchange **S**afety **A**nalysis **T**ool **e**nhanced (ISATe) software. It was divided into the following eight segments that totaled **3.46 miles** (see attachments):

- Segment 1: SR 3/SR 16 Interchange to Sherman Heights Road/Railroad Bridge Vicinity (0.30 mile)
- Segment 2: Sherman Heights Road/Railroad Bridge to Sinclair Inlet Vicinity (0.65 mile)
- Segment 3: Sinclair Inlet Vicinity to Wright Creek Vicinity/SR 304 WB merge (0.64 mile)
- Segment 4: SR 304 WB Merge Vicinity (0.34 mile)
- Segment 5: SR 3/SR 304 Interchange Vicinity (0.29 mile)
- Segment 6: SR 3/SR 304 Interchange to Werner/Loxie Eagans Interchange (0.30 mile)
- Segment 7: Werner/Loxie Eagans Interchange Vicinity (0.58 mile)
- Segment 8: Werner/Loxie Eagans Interchange to SR 310 Interchange (0.36 mile)

Assumptions:

Reducing existing 2013 volumes by 10% and 5% and assuming traffic volume will not change over a 5 year analysis period, will simulate the effect of the TDM alternative(s).

To analyze short-term build and no build effects, the build analyses was performed with a 10% and 5% reduction and no traffic growth over a 5-year period even though traffic may increase at a rate of 1.5% straight line.

The 5-year historical crash record (January 1, 2009 to December 31, 2013) had a total of 273 crashes which would average out to 54.6 crashes per year. There was a total of 119 multiple rear-end and 70 sideswipe crashes on the 3.46 mile mainline.

The predicted crash results are summarized **below** in the table (more detailed report summaries are attached). The “Predicted Widen or Restripe Crashes” would be most similar to a “Predicted No Build” Scenario (4-lane verses existing 3-lane in Segment 5).

Policy Point #3 Operational and Collision Analysis
Collision Analysis continued

SR 3 Summary and Assumptions continued

	Predicted and Observed Crashes for the TDM and Add Lane Alternatives			
	Predicted 10% TDM Crashes	Predicted 5% TDM Crashes	Predicted Widen or Restripe Crashes (Close to No Build)	Predicted Add Lane Crashes
5-Year Total Estimated Crashes	420.6	449.5	**478.7**	436.3
Estimated Average Crashes/Year	70.1	74.9	**79.8**	72.7
Estimated Multiple rear-ends	147.3	164.0	**181.0**	157.5
Estimated Multiple sideswipes	49.8	55.5	**61.3**	53.2

The build alternatives ranked in relative order by total predicted crashes are:

1. 10% TDM Alternative
2. Add Lane Alternative(s)
3. 5% TDM Alternative
4. Widen or Restripe Alternative (and Hard Shoulder Alternative)

SR 304: Summary and Assumptions

The build alternative likely to impact the safety performance of the SR 304 Urban Arterial from SR 3 to Farragut intersection is the Transportation Demand Management (TDM) alternative.

SR 304 was analyzed as a 4-lane divided urban arterial with no commercial access breaks using Highway Safety Manual (HSM) Urban and Suburban arterial software. In addition to 4 lanes for GP, SR 304 has two inside High Occupancy Vehicle (HOV) lanes.

SR 304 was segmented into two parts with each having one signalized intersection. The first segment is from SR 3 to Charleston intersection with 45 mph posted speed (Milepost 0.00 to Milepost 0.75). The second segment is from Charleston to Farragut intersection with 30 mph posted speed (Milepost 0.75 to Milepost 1.25).

Policy Point #3 Operational and Collision Analysis
Collision Analysis continued

SR 304 Summary and Assumptions continued

Assumptions:

To analyze short-term and no build effects, the build analysis was performed with a 10% and 5% reduction and assumed no traffic growth over a 5-year period even though traffic may increase at a rate of 1.5% straight line. The 5-year historical crash record (January 1, 2009 to December 31, 2013) averaged 25 crashes per year. The total average crashes per year results are summarized below in the table (more detailed report summaries are attached).

Summary of total anticipated safety performance (average crashes per year)					
Predicted 10% TDM Crashes per Year	Predicted 5% TDM Crashes per Year	Predicted No Build Crashes per Year	Expected No Build Crashes per Year	Potential for No Build Safety Improvement	Actual 5-Yr Averaged Crashes per Year History
12.5	**13.4**	**14.3**	**22.1**	**7.8**	**25.0**

The TDM Alternative(s) would reduce crashes, but since SR 304 is already experiencing more crashes than predicted for similar type facilities the crash reduction would be low.

Because the prior 5-year crash history and expected crashes over the next 5 years with zero traffic growth are greater than the predicted crashes (other similar facilities), the TDM alternatives will likely experience more crashes than predicted.

Policy Point #4 Access Connections and Design

When WSDOT performed the traffic data collection in April 2013, no aircraft carriers were in port at the Bremerton Shipyard. WSDOT in consultation with the consultant and stakeholders decided that no adjustments to the traffic count data were needed to capture the additional traffic demand out of the Bremerton Shipyard when one or two aircraft carriers are in port.

Excerpts from the Navy's 2012 Vehicle and Pedestrian Safety Study indicates that one aircraft carrier in port may produce between 173-221 additional vehicles leaving the Charleston Boulevard gate turning onto SR 304 WB.

Because the existing year (2013) PM peak volumes on SR 304 WB toward SR 3 SB is already approaching or at capacity for the SR 3/SR 304 interchange, the additional traffic from one or more aircraft carriers will not significantly change no build throughput results.

Policy Point #4 Access Connections and Design continued

For example, the GP lane queuing on SR 304 WB blocks the signalized SR 304/Charleston intersection from about 4-4:14 PM in the 2013 simulation. When this signalized intersection is blocked by the SR 304 WB queue, no additional GP left turn traffic can proceed out of Charleston Gate intersection.

Even though the data indicates one additional carrier will generate about 200 additional left turn vehicles out of the Charleston Gate towards SR 304 WB, not much more GP traffic can "get through" in a one hour PM peak under the no build scenario(s).

However, an exception would be an extended SR 304 WB HOV lane on-ramp into an add lane build scenario. A SR 304 WB HOV lane may attract additional HOV traffic, but up to 30 % measured HOV volumes on SR 304 WB already appears to be a high percentage.

Policy Point #5 Land Use and Transportation Plans

The following comprehensive plans, studies or documents will be discussed and summarized:

- WSDOT's 2007-2026 Highway System Plan (HSP
- 1996 SR 3/SR 304 Bremerton Ferry Terminal to Vicinity Gorst FEIS.
- 1999 VE study SR 3 Gorst Railroad Bridge to SR 3/SR 304 interchange
- 2004 Bremerton Comprehensive Plan
- 2006 Kitsap County Comprehensive Plan
- 2010 Bremerton Economic Development Study (BEDS)
- 2011 Scoping SR 3/SR 304 Interchange SB Improvements
- 2012 Naval Base Kitsap's vehicle and Pedestrian Safety study
- 2013-2019 Kitsap Transit Development Plan
- SR 3/SR 16 Gorst Feasibility Study

Policy Point #6 Future Interchanges

This policy point is not applicable since the proposal is not expected to create new access points.

Policy Point #7 Coordination

Initially no assumptions regarding coordination were considered beyond the funds appropriated by the legislature for initial development of the project, however, current transportation revenue legislation that is currently in front of the legislature proposes further funds for the SR 3/SR 304 project.

Policy Point #8 Environmental Processes

Based on the degree of impacts associated with the planned improvement, it is envisioned that the assumed environmental document type for the proposed improvement would be a documented Categorical Exclusion (CE).

APPENDIX B

SR 3 and SR 304: Additional Traffic Information

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Appendix B
SR 3 and SR 304: Additional Traffic Information

Below is a summary table for intersections located with the project limits (5 signalized intersections and 1 unsignalized intersection).

SR 3 and SR 304 Bremerton Interchange Improvement Project
Synchro LOS and Delay (seconds/vehicle)

Intersection		2013 AM	2020 AM	2040 AM		2013 PM	2020 PM	2040 PM
SR 3 and Christopherson	LOS	C	C	D		E	E	F
	Delay	26.7	30.8	46.0		64.3	65.7	151.4
SR 304 and Charleston	LOS	B	B	C		C	C	E
	Delay	16.2	17.4	28.5		27.9	29.2	73.4
SR 304 and Farragut	LOS	B	B	C		C	C	F
	Delay	17.4	20.0	31.2		31.8	34.6	108.4
Auto Center and Loxie Eagans	LOS	C	B	C		C	C	D
	Delay	21.3	19.5	24.1		28.4	32.8	49.1
SR 3 and Loxie Eagans NB off and on	LOS	A	A	B		A	B	B
	Delay	9.4	9.9	14.9		9.7	10.1	15.0
SR 3 and Loxie Eagans SB off and on (unsignalized)	LOS	F	F	F		F	F	F
	Delay	222.6	3567.2	3562.5		43.8 (170.9)	2460.2	2459.1

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Timing: 2013 AM Existing

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Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	97	80	6	183	41	4	700	223	2	258
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	20.8	29.1	29.1	21.0	29.3	8.6	56.3	56.3	8.6	56.3
Total Split (%)	18.1%	25.3%	25.3%	18.3%	25.5%	7.5%	49.0%	49.0%	7.5%	49.0%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	13.5	9.7	9.7	16.4	12.2	4.1	48.3	48.3	4.1	48.8
Actuated g/C Ratio	0.15	0.11	0.11	0.18	0.14	0.05	0.54	0.54	0.05	0.55
v/c Ratio	0.44	0.48	0.03	0.73	0.39	0.06	0.80	0.27	0.03	0.31
Control Delay	44.8	48.5	0.2	52.9	30.4	48.0	26.0	3.2	47.0	13.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.8	48.5	0.2	52.9	30.4	48.0	26.0	3.2	47.0	13.4
LOS	D	D	A	D	C	D	C	A	D	B
Approach Delay		45.0			46.1		20.6			13.6
Approach LOS		D			D		C			B

Intersection Summary

Cycle Length: 115
Actuated Cycle Length: 88.8
Natural Cycle: 115
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 26.7 Intersection LOS: C
Intersection Capacity Utilization 62.2% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	95	6	1	9	1495	69	464
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	12.0	30.5	30.5	10.5	37.0	10.5	37.0
Total Split (%)	13.3%	33.9%	33.9%	11.7%	41.1%	11.7%	41.1%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	7.4	6.2	6.2	6.0	35.2	6.0	41.7
Actuated g/C Ratio	0.11	0.10	0.10	0.09	0.54	0.09	0.64
v/c Ratio	0.79	0.06	0.12	0.06	0.69	0.45	0.15
Control Delay	58.4	29.8	19.8	30.0	14.1	38.4	6.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	58.4	29.8	19.8	30.0	14.1	38.4	6.3
LOS	E	C	B	C	B	D	A
Approach Delay	58.4		23.2		14.2		10.4
Approach LOS	E		C		B		B

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 64.8
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.79
Intersection Signal Delay: 16.2 Intersection LOS: B
Intersection Capacity Utilization 66.2% ICU Level of Service C
Analysis Period (min) 15

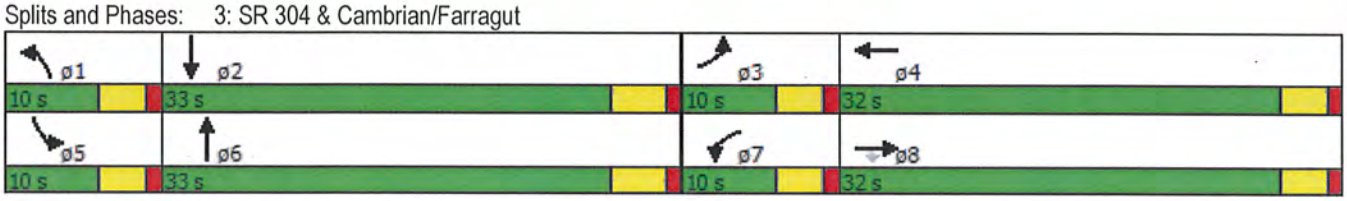
Splits and Phases: 8: SR 304 & Charleston

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	43	218	27	44	13	8	11	1125	477	67	467
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	10.0	32.0	32.0	10.0	32.0		10.0	33.0		10.0	33.0
Total Split (%)	11.8%	37.6%	37.6%	11.8%	37.6%		11.8%	38.8%		11.8%	38.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	9.8	13.7	13.7	6.2	13.8	66.2	6.2	30.7	66.2	6.2	36.7
Actuated g/C Ratio	0.15	0.21	0.21	0.09	0.21	1.00	0.09	0.46	1.00	0.09	0.55
v/c Ratio	0.18	0.61	0.07	0.20	0.04	0.01	0.07	0.75	0.19	0.45	0.27
Control Delay	29.1	31.8	0.3	33.9	23.6	0.0	33.4	22.3	0.2	42.7	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.1	31.8	0.3	33.9	23.6	0.0	33.4	22.3	0.2	42.7	11.0
LOS	C	C	A	C	C	A	C	C	A	D	B
Approach Delay		28.5			27.6			15.8			14.9
Approach LOS		C			C			B			B

Intersection Summary

Cycle Length: 85
Actuated Cycle Length: 66.2
Natural Cycle: 85
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.75
Intersection Signal Delay: 17.4 Intersection LOS: B
Intersection Capacity Utilization 65.3% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: SR 304 & Cambrian/Farragut

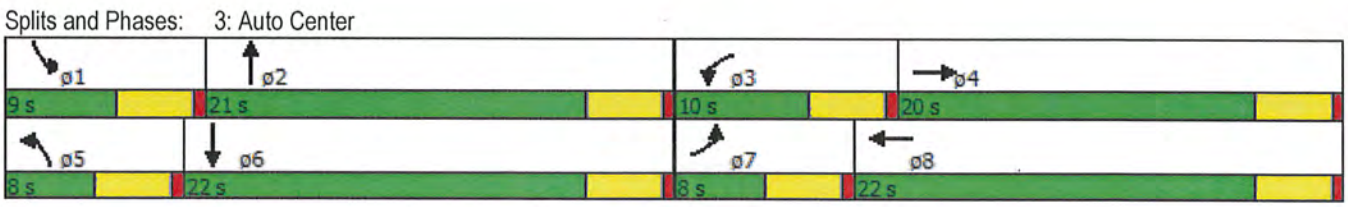


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	17	248	92	466	13	9	77	16
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	20.0	10.0	22.0	8.0	21.0	9.0	22.0
Total Split (%)	13.3%	33.3%	16.7%	36.7%	13.3%	35.0%	15.0%	36.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.1	11.6	6.2	17.7	4.1	17.7	5.1	23.1
Actuated g/C Ratio	0.08	0.22	0.12	0.34	0.08	0.34	0.10	0.45
v/c Ratio	0.15	0.39	0.62	0.68	0.13	0.17	0.62	0.08
Control Delay	27.9	20.0	41.0	18.3	27.3	6.0	46.9	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.9	20.0	41.0	18.3	27.3	6.0	46.9	7.0
LOS	C	B	D	B	C	A	D	A
Approach Delay		20.5		21.5		9.1		32.2
Approach LOS		C		C		A		C

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 51.8
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 21.3 Intersection LOS: C
Intersection Capacity Utilization 40.7% ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

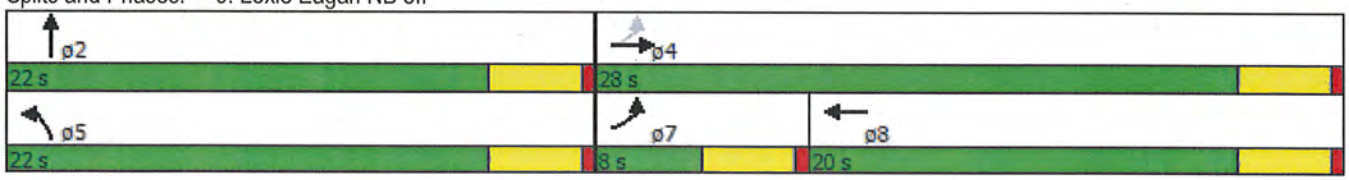


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	80	374	272	391	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	28.0	20.0	22.0	22.0
Total Split (%)	16.0%	56.0%	40.0%	44.0%	44.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		12.9	12.9	13.6	13.6
Actuated g/C Ratio		0.37	0.37	0.39	0.39
v/c Ratio		0.51	0.33	0.65	0.37
Control Delay		10.8	6.7	14.8	2.7
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		10.8	6.7	14.8	2.7
LOS		B	A	B	A
Approach Delay		10.8	6.7		9.9
Approach LOS		B	A		A

Intersection Summary

Cycle Length: 50
Actuated Cycle Length: 35
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 9.4 — Intersection LOS: A
Intersection Capacity Utilization 55.1% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: Loxie Eagan NB off



HCM Unsignalized Intersection Capacity Analysis
6: Loxie Eagans SB off

5/26/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	258	135	142	521	0	0	0	0	369	0	216
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	280	147	154	566	0	0	0	0	401	0	235
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	566			427			946	1229	214	1015	1302	283
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	566			339			875	1168	118	947	1244	283
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			87			100	100	100	0	100	67
cM capacity (veh/h)	1002			1177			142	161	881	188	145	714

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	187	240	343	378	636
Volume Left	0	0	154	0	401
Volume Right	0	147	0	0	235
cSH	1700	1700	1177	1700	277
Volume to Capacity	0.11	0.14	0.13	0.22	2.29
Queue Length 95th (ft)	0	0	11	0	1241
Control Delay (s)	0.0	0.0	4.5	0.0	622.0
Lane LOS			A		F
Approach Delay (s)	0.0		2.2		622.0
Approach LOS					F

Intersection Summary			
Average Delay	222.6		
Intersection Capacity Utilization	60.4%	ICU Level of Service	B
Analysis Period (min)	15		

Timing: 2020 AM Existing

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Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	107	88	7	202	45	4	774	246	2	285
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	21.4	29.1	29.1	24.0	31.7	8.6	63.3	63.3	8.6	63.3
Total Split (%)	17.1%	23.3%	23.3%	19.2%	25.4%	6.9%	50.6%	50.6%	6.9%	50.6%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	11.7	10.3	10.3	19.0	17.5	4.0	56.8	56.8	4.0	57.3
Actuated g/C Ratio	0.11	0.10	0.10	0.18	0.17	0.04	0.55	0.55	0.04	0.55
v/c Ratio	0.59	0.53	0.03	0.81	0.36	0.06	0.84	0.28	0.03	0.34
Control Delay	57.0	55.9	0.3	62.6	32.0	53.5	29.7	3.9	52.5	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.0	55.9	0.3	62.6	32.0	53.5	29.7	3.9	52.5	14.6
LOS	E	E	A	E	C	D	C	A	D	B
Approach Delay		54.5			53.4		23.6			14.8
Approach LOS		D			D		C			B

Intersection Summary

Cycle Length: 125
Actuated Cycle Length: 103.3
Natural Cycle: 125
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 30.8 Intersection LOS: C
Intersection Capacity Utilization 67.2% ICU Level of Service C
Analysis Period (min) 15

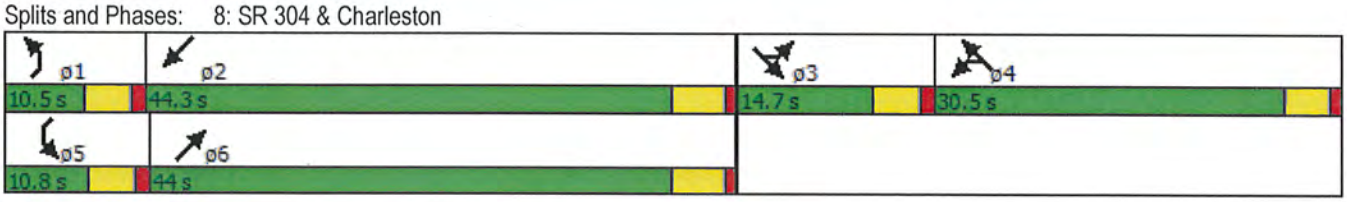
Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	105	7	1	10	1652	76	513
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	14.7	30.5	30.5	10.5	44.0	10.8	44.3
Total Split (%)	14.7%	30.5%	30.5%	10.5%	44.0%	10.8%	44.3%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	10.2	6.3	6.3	6.0	41.6	6.3	48.3
Actuated g/C Ratio	0.14	0.09	0.09	0.08	0.56	0.09	0.65
v/c Ratio	0.74	0.08	0.15	0.08	0.74	0.54	0.17
Control Delay	51.5	35.3	22.3	35.4	15.9	48.8	6.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.5	35.3	22.3	35.4	15.9	48.8	6.6
LOS	D	D	C	D	B	D	A
Approach Delay	51.5		26.6		16.0		11.9
Approach LOS	D		C		B		B

Intersection Summary

Cycle Length: 100
Actuated Cycle Length: 74.1
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 17.4 Intersection LOS: B
Intersection Capacity Utilization 70.7% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 8: SR 304 & Charleston

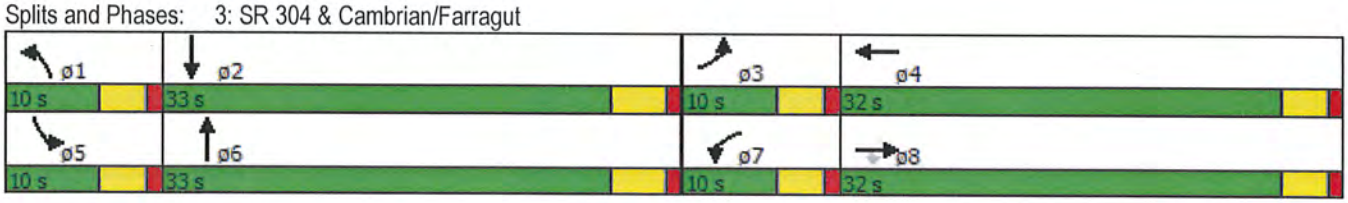


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	48	241	30	49	14	9	12	1243	527	74	516
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	10.0	32.0	32.0	10.0	32.0		10.0	33.0		10.0	33.0
Total Split (%)	11.8%	37.6%	37.6%	11.8%	37.6%		11.8%	38.8%		11.8%	38.8%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	10.1	14.7	14.7	6.2	14.5	66.5	6.2	30.2	66.5	6.2	36.1
Actuated g/C Ratio	0.15	0.22	0.22	0.09	0.22	1.00	0.09	0.45	1.00	0.09	0.54
v/c Ratio	0.19	0.63	0.07	0.22	0.04	0.01	0.08	0.85	0.21	0.49	0.30
Control Delay	29.7	31.9	0.3	34.8	23.6	0.0	34.2	27.4	0.2	45.4	11.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	31.9	0.3	34.8	23.6	0.0	34.2	27.4	0.2	45.4	11.7
LOS	C	C	A	C	C	A	C	C	A	D	B
Approach Delay		28.6			28.1			19.4			15.9
Approach LOS		C			C			B			B

Intersection Summary

Cycle Length: 85
Actuated Cycle Length: 66.5
Natural Cycle: 85
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 20.0 Intersection LOS: B
Intersection Capacity Utilization 70.7% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: SR 304 & Cambrian/Farragut

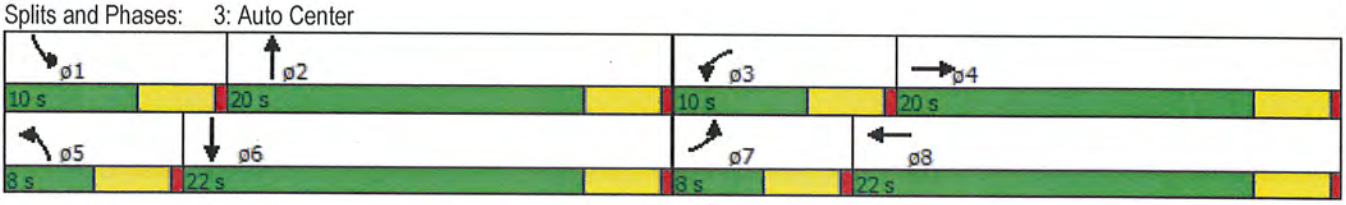


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	19	274	102	515	14	10	85	18
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	20.0	10.0	22.0	8.0	20.0	10.0	22.0
Total Split (%)	13.3%	33.3%	16.7%	36.7%	13.3%	33.3%	16.7%	36.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.1	11.2	6.2	17.3	4.1	17.2	6.2	23.2
Actuated g/C Ratio	0.08	0.22	0.12	0.34	0.08	0.33	0.12	0.45
v/c Ratio	0.16	0.42	0.53	0.61	0.11	0.16	0.52	0.08
Control Delay	28.2	20.3	36.4	16.4	27.1	6.4	37.1	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.2	20.3	36.4	16.4	27.1	6.4	37.1	7.0
LOS	C	C	D	B	C	A	D	A
Approach Delay		20.8		19.1		9.3		26.1
Approach LOS		C		B		A		C

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 51.5
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.61
Intersection Signal Delay: 19.5 — Intersection LOS: B
Intersection Capacity Utilization 42.8% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

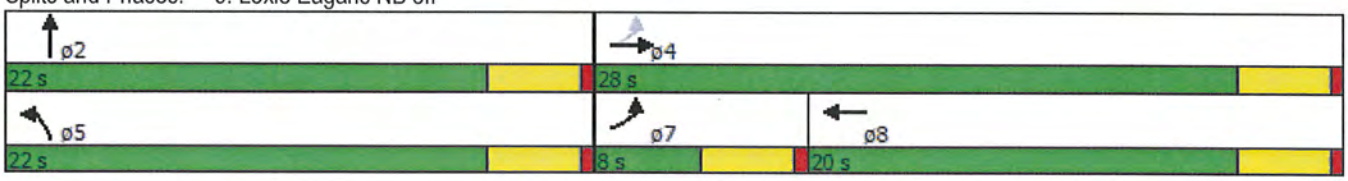


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	88	413	301	432	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	28.0	20.0	22.0	22.0
Total Split (%)	16.0%	56.0%	40.0%	44.0%	44.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		13.1	13.1	14.3	14.3
Actuated g/C Ratio		0.37	0.37	0.40	0.40
v/c Ratio		0.52	0.34	0.68	0.39
Control Delay		11.1	7.1	15.9	3.0
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		11.1	7.1	15.9	3.0
LOS		B	A	B	A
Approach Delay		11.1	7.1		10.7
Approach LOS		B	A		B

Intersection Summary

Cycle Length: 50
Actuated Cycle Length: 35.8
Natural Cycle: 50
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.68
Intersection Signal Delay: 9.9 — Intersection LOS: A
Intersection Capacity Utilization 59.8% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 9: Loxie Eagans NB off



HCM Unsignalized Intersection Capacity Analysis
6: Loxie Eagans SB off

5/26/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	285	149	157	576	0	0	0	0	408	0	239
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	310	162	171	626	0	0	0	0	443	0	260
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked				0.95			0.95	0.95	0.95	0.95	0.95	
vC, conflicting volume	626			472			1045	1358	236	1122	1439	313
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	626			339			943	1272	91	1024	1357	313
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			85			100	100	100	0	100	62
cM capacity (veh/h)	951			1156			113	135	901	160	120	683

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	207	265	379	417	703
Volume Left	0	0	171	0	443
Volume Right	0	162	0	0	260
cSH	1700	1700	1156	1700	232
Volume to Capacity	0.12	0.16	0.15	0.25	3.03
Queue Length 95th (ft)	0	0	13	0	Err
Control Delay (s)	0.0	0.0	4.7	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		2.2		Err
Approach LOS					F

Intersection Summary			
Average Delay	3567.2		
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		

Timing: 2040 AM Existing

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Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	136	112	8	257	58	6	984	313	3	362
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	26.7	29.1	29.1	26.0	28.4	8.6	81.3	81.3	8.6	81.3
Total Split (%)	18.4%	20.1%	20.1%	17.9%	19.6%	5.9%	56.1%	56.1%	5.9%	56.1%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	15.5	13.3	13.3	21.0	18.6	4.0	76.1	76.1	4.0	76.6
Actuated g/C Ratio	0.12	0.10	0.10	0.16	0.15	0.03	0.60	0.60	0.03	0.60
v/c Ratio	0.70	0.64	0.04	0.98	0.45	0.13	0.98	0.34	0.06	0.37
Control Delay	72.0	70.7	0.2	102.0	45.7	68.7	49.6	6.0	65.7	15.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.0	70.7	0.2	102.0	45.7	68.7	49.6	6.0	65.7	15.2
LOS	E	E	A	F	D	E	D	A	E	B
Approach Delay		69.1			85.0		39.2			15.6
Approach LOS		E			F		D			B

Intersection Summary

Cycle Length: 145
Actuated Cycle Length: 127.6
Natural Cycle: 145
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 46.0 Intersection LOS: D
Intersection Capacity Utilization 81.3% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	133	8	1	13	2101	97	652
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	23.8	30.6	30.6	10.6	81.0	14.6	85.0
Total Split (%)	15.9%	20.4%	20.4%	7.1%	54.0%	9.7%	56.7%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	19.2	6.7	6.7	6.1	76.2	9.9	86.5
Actuated g/C Ratio	0.15	0.05	0.05	0.05	0.60	0.08	0.69
v/c Ratio	0.84	0.14	0.27	0.17	0.89	0.76	0.21
Control Delay	78.5	64.1	34.9	64.8	26.8	89.9	8.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	78.5	64.1	34.9	64.8	26.8	89.9	8.5
LOS	E	E	C	E	C	F	A
Approach Delay	78.5		44.0		27.0		18.8
Approach LOS	E		D		C		B

Intersection Summary

Cycle Length: 150
Actuated Cycle Length: 126.2
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 28.5 Intersection LOS: C
Intersection Capacity Utilization 83.9% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 8: SR 304 & Charleston

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	60	306	38	62	18	11	15	1581	670	94	656
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	10.0	32.0	32.0	10.0	32.0		10.0	53.0		10.0	53.0
Total Split (%)	9.5%	30.5%	30.5%	9.5%	30.5%		9.5%	50.5%		9.5%	50.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	15.9	21.8	21.8	6.1	16.0	97.1	6.1	49.0	97.1	6.1	55.3
Actuated g/C Ratio	0.16	0.22	0.22	0.06	0.16	1.00	0.06	0.50	1.00	0.06	0.57
v/c Ratio	0.22	0.79	0.09	0.41	0.07	0.01	0.15	0.97	0.26	0.94	0.36
Control Delay	43.4	49.9	0.4	54.7	32.8	0.0	49.7	41.7	0.2	123.1	14.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.4	49.9	0.4	54.7	32.8	0.0	49.7	41.7	0.2	123.1	14.4
LOS	D	D	A	D	C	A	D	D	A	F	B
Approach Delay		44.3			43.6			29.5			28.0
Approach LOS		D			D			C			C

Intersection Summary

Cycle Length: 105
Actuated Cycle Length: 97.1
Natural Cycle: 105
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 31.2 Intersection LOS: C
Intersection Capacity Utilization 83.8% ICU Level of Service E
Analysis Period (min) 15

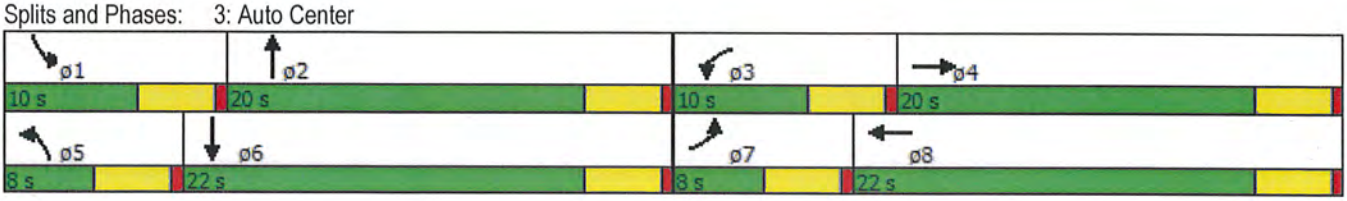
Splits and Phases: 3: SR 304 & Cambrian/Farragut

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	24	348	129	655	18	13	108	22
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	20.0	10.0	22.0	8.0	20.0	10.0	22.0
Total Split (%)	13.3%	33.3%	16.7%	36.7%	13.3%	33.3%	16.7%	36.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.1	12.1	6.1	19.3	4.1	16.7	6.1	22.9
Actuated g/C Ratio	0.07	0.22	0.11	0.35	0.07	0.31	0.11	0.42
v/c Ratio	0.21	0.52	0.72	0.73	0.15	0.21	0.67	0.10
Control Delay	30.5	21.5	50.8	21.1	28.8	6.6	48.5	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.5	21.5	50.8	21.1	28.8	6.6	48.5	7.2
LOS	C	C	D	C	C	A	D	A
Approach Delay		22.1		25.2		9.8		33.2
Approach LOS		C		C		A		C

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 54.7
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.73
Intersection Signal Delay: 24.1 — Intersection LOS: C
Intersection Capacity Utilization 49.0% — ICU Level of Service A
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

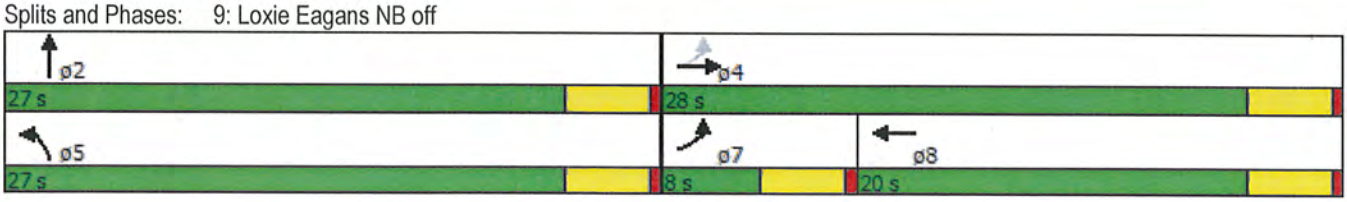


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	112	525	382	549	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	28.0	20.0	27.0	27.0
Total Split (%)	14.5%	50.9%	36.4%	49.1%	49.1%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		18.9	18.9	19.8	19.8
Actuated g/C Ratio		0.40	0.40	0.42	0.42
v/c Ratio		0.63	0.40	0.82	0.52
Control Delay		14.6	9.3	25.0	8.6
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		14.6	9.3	25.0	8.6
LOS		B	A	C	A
Approach Delay		14.6	9.3		18.3
Approach LOS		B	A		B

Intersection Summary

Cycle Length: 55
Actuated Cycle Length: 47.1
Natural Cycle: 55
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 14.9 Intersection LOS: B
Intersection Capacity Utilization 73.3% ICU Level of Service D
Analysis Period (min) 15

Splits and Phases: 9: Loxie Eagans NB off



HCM Unsignalized Intersection Capacity Analysis
6: Loxie Eagans SB off

5/26/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	362	190	200	732	0	0	0	0	518	0	303
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	393	207	217	796	0	0	0	0	563	0	329
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked				0.92			0.92	0.92	0.92	0.92	0.92	
vC, conflicting volume	796			600			1329	1727	300	1427	1830	398
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	796			392			1185	1617	66	1291	1729	398
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			80			100	100	100	0	100	45
cM capacity (veh/h)	822			1070			51	75	905	94	64	602

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	262	338	483	530	892
Volume Left	0	0	217	0	563
Volume Right	0	207	0	0	329
cSH	1700	1700	1070	1700	137
Volume to Capacity	0.15	0.20	0.20	0.31	6.51
Queue Length 95th (ft)	0	0	19	0	Err
Control Delay (s)	0.0	0.0	5.4	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		2.6		Err
Approach LOS					F

Intersection Summary			
Average Delay	3562.5		
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

Timing: 2013 PM Existing

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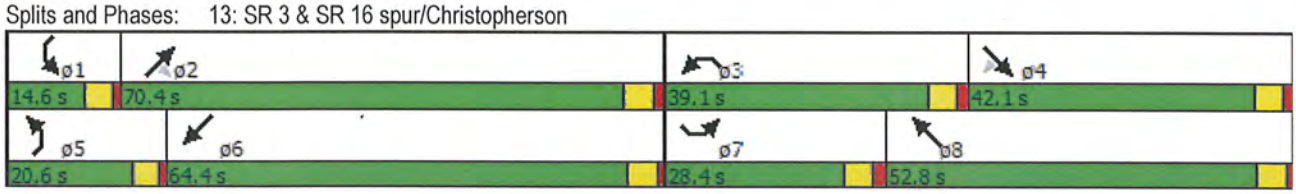
Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	77	257	105	275	108	14	412	252	8	705
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	28.4	42.1	42.1	39.1	52.8	20.6	70.4	70.4	14.6	64.4
Total Split (%)	17.1%	25.3%	25.3%	23.5%	31.8%	12.4%	42.4%	42.4%	8.8%	38.7%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	12.8	28.3	28.3	34.2	49.5	6.4	61.9	61.9	5.9	60.0
Actuated g/C Ratio	0.09	0.20	0.20	0.24	0.35	0.05	0.44	0.44	0.04	0.42
v/c Ratio	0.60	0.86	0.30	0.85	0.30	0.21	0.59	0.34	0.13	1.11
Control Delay	79.5	77.6	6.5	71.6	34.8	75.7	35.9	4.4	74.5	105.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.5	77.6	6.5	71.6	34.8	75.7	35.9	4.4	74.5	105.2
LOS	E	E	A	E	C	E	D	A	E	F
Approach Delay		60.9			59.0		25.0			104.9
Approach LOS		E			E		C			F

Intersection Summary	
Cycle Length: 166.2	
Actuated Cycle Length: 142.2	
Natural Cycle: 145	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.11	
Intersection Signal Delay: 64.3	Intersection LOS: E
Intersection Capacity Utilization 79.4%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

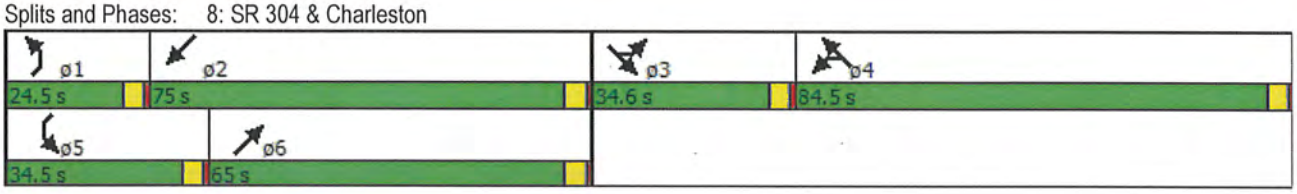


Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	3	343	20	15	682	10	1803
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	34.6	84.5	84.5	24.5	65.0	34.5	75.0
Total Split (%)	15.8%	38.7%	38.7%	11.2%	29.7%	15.8%	34.3%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	9.6	24.8	24.8	6.5	71.3	6.2	71.1
Actuated g/C Ratio	0.08	0.20	0.20	0.05	0.58	0.05	0.57
v/c Ratio	0.57	0.76	0.76	0.17	0.25	0.12	0.67
Control Delay	43.6	62.8	61.0	67.1	15.4	66.8	22.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.6	62.8	61.0	67.1	15.4	66.8	22.4
LOS	D	E	E	E	B	E	C
Approach Delay	43.6		61.9		16.5		22.6
Approach LOS	D		E		B		C

Intersection Summary

Cycle Length: 218.6
Actuated Cycle Length: 123.9
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 27.9 Intersection LOS: C
Intersection Capacity Utilization 61.7% ICU Level of Service B
Analysis Period (min) 15

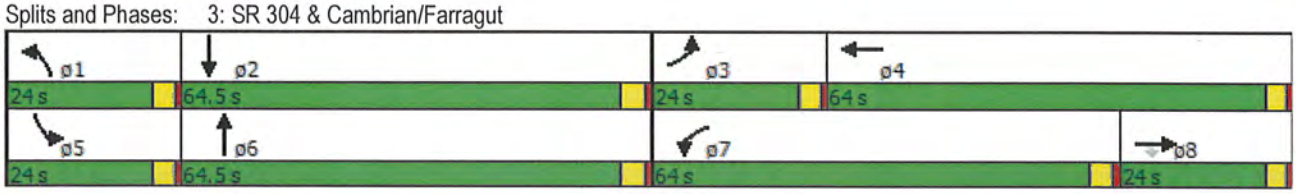
Splits and Phases: 8: SR 304 & Charleston



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	38	47	36	443	190	64	17	676	52	29	1379
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	24.0	24.0	24.0	64.0	64.0		24.0	64.5		24.0	64.5
Total Split (%)	13.6%	13.6%	13.6%	36.3%	36.3%		13.6%	36.5%		13.6%	36.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	8.7	9.1	9.1	29.8	30.2	114.6	6.6	58.9	114.6	7.3	61.6
Actuated g/C Ratio	0.08	0.08	0.08	0.26	0.26	1.00	0.06	0.51	1.00	0.06	0.54
v/c Ratio	0.33	0.37	0.20	0.81	0.48	0.05	0.18	0.40	0.02	0.29	0.80
Control Delay	62.4	62.4	2.3	50.9	40.1	0.1	62.7	21.5	0.0	63.8	29.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	62.4	62.4	2.3	50.9	40.1	0.1	62.7	21.5	0.0	63.8	29.3
LOS	E	E	A	D	D	A	E	C	A	E	C
Approach Delay		44.5			43.3			20.9			30.0
Approach LOS		D			D			C			C

Intersection Summary	
Cycle Length: 176.5	
Actuated Cycle Length: 114.6	
Natural Cycle: 95	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.81	
Intersection Signal Delay: 31.8	Intersection LOS: C
Intersection Capacity Utilization 66.2%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 3: SR 304 & Cambrian/Farragut

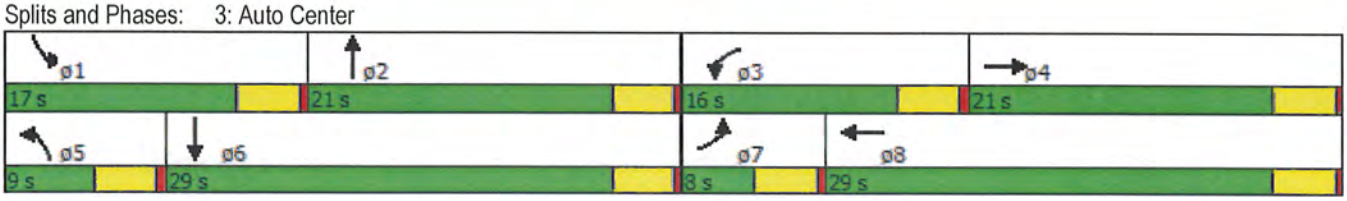


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	15	443	141	863	23	13	239	26
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	21.0	16.0	29.0	9.0	21.0	17.0	29.0
Total Split (%)	10.7%	28.0%	21.3%	38.7%	12.0%	28.0%	22.7%	38.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.0	17.1	10.2	27.4	5.0	17.1	12.9	30.6
Actuated g/C Ratio	0.06	0.24	0.14	0.39	0.07	0.24	0.18	0.43
v/c Ratio	0.16	0.55	0.59	0.80	0.24	0.33	0.85	0.16
Control Delay	37.7	27.5	38.9	25.5	38.1	8.0	56.2	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.7	27.5	38.9	25.5	38.1	8.0	56.2	6.8
LOS	D	C	D	C	D	A	E	A
Approach Delay		27.9		27.2		12.5		40.8
Approach LOS		C		C		B		D

Intersection Summary

Cycle Length: 75
Actuated Cycle Length: 70.9
Natural Cycle: 75
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 28.4 Intersection LOS: C
Intersection Capacity Utilization 65.9% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

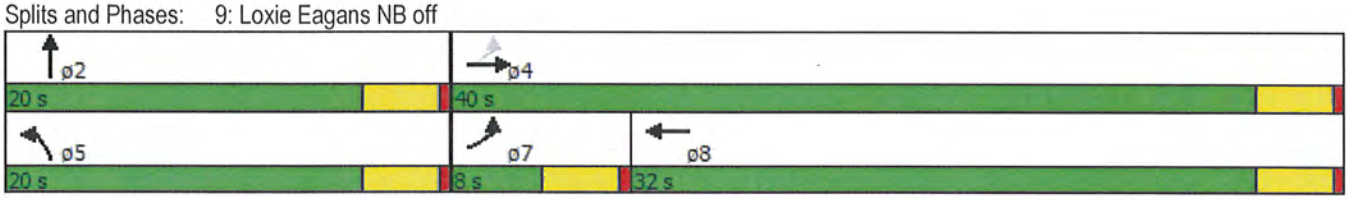


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	209	427	747	216	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	40.0	32.0	20.0	20.0
Total Split (%)	13.3%	66.7%	53.3%	33.3%	33.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		25.5	25.5	11.6	11.6
Actuated g/C Ratio		0.56	0.56	0.25	0.25
v/c Ratio		1.55dl	0.67	0.55	0.32
Control Delay		11.6	7.8	21.7	1.2
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		11.6	7.8	21.7	1.2
LOS		B	A	C	A
Approach Delay		11.6	7.8		12.1
Approach LOS		B	A		B

Intersection Summary

Cycle Length: 60
Actuated Cycle Length: 45.6
Natural Cycle: 60
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.70
Intersection Signal Delay: 9.7 Intersection LOS: A
Intersection Capacity Utilization 73.2% ICU Level of Service D
Analysis Period (min) 15
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 9: Loxie Eagans NB off



HCM Unsignalized Intersection Capacity Analysis
6: Loxie Eagans SB off

5/26/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	479	319	285	678	0	0	0	0	120	0	453
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	521	347	310	737	0	0	0	0	130	0	492
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked				0.89			0.89	0.89	0.89	0.89	0.89	
vC, conflicting volume	737			867			1682	2051	434	1617	2224	368
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	737			614			1525	1938	129	1453	2132	368
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			64			100	100	100	0	100	22
cM capacity (veh/h)	865			859			11	37	802	59	28	629

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	347	520	555	491	623
Volume Left	0	0	310	0	130
Volume Right	0	347	0	0	492
cSH	1700	1700	859	1700	281
Volume to Capacity	0.20	0.31	0.36	0.29	2.22
Queue Length 95th (ft)	0	0	41	0	1191
Control Delay (s)	0.0	0.0	8.6	0.0	170.9
Lane LOS			A		F
Approach Delay (s)	0.0		4.6		170.9
Approach LOS					F

Intersection Summary			
Average Delay	43.8		
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	15		

Timing: 2020 PM Existing

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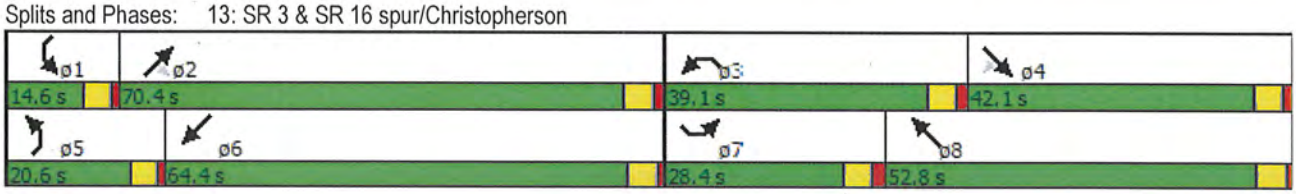
Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	85	285	117	305	120	16	457	280	9	782
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	28.4	42.1	42.1	39.1	52.8	20.6	70.4	70.4	14.6	64.4
Total Split (%)	17.1%	25.3%	25.3%	23.5%	31.8%	12.4%	42.4%	42.4%	8.8%	38.7%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	13.0	29.0	29.0	34.3	50.2	6.6	60.2	60.2	6.0	60.3
Actuated g/C Ratio	0.09	0.20	0.20	0.24	0.35	0.05	0.42	0.42	0.04	0.42
v/c Ratio	0.59	0.85	0.30	0.86	0.30	0.22	0.63	0.36	0.14	1.12
Control Delay	79.7	76.6	6.9	73.5	35.3	76.7	39.3	5.2	75.7	108.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.7	76.6	6.9	73.5	35.3	76.7	39.3	5.2	75.7	108.0
LOS	E	E	A	E	D	E	D	A	E	F
Approach Delay		60.3			60.2		27.4			107.6
Approach LOS		E			E		C			F

Intersection Summary

Cycle Length: 166.2
Actuated Cycle Length: 143.4
Natural Cycle: 145
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.12
Intersection Signal Delay: 65.7 Intersection LOS: E
Intersection Capacity Utilization 86.7% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

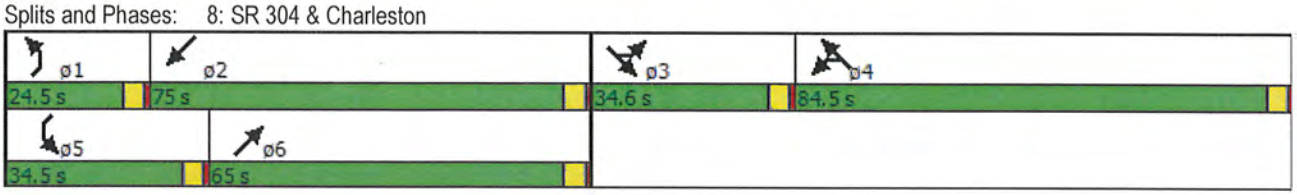


Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	3	381	22	17	757	11	2001
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	34.6	84.5	84.5	24.5	65.0	34.5	75.0
Total Split (%)	15.8%	38.7%	38.7%	11.2%	29.7%	15.8%	34.3%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	10.0	25.1	25.1	6.5	71.5	6.3	71.2
Actuated g/C Ratio	0.08	0.20	0.20	0.05	0.57	0.05	0.57
v/c Ratio	0.58	0.76	0.76	0.20	0.27	0.13	0.75
Control Delay	44.4	63.0	61.5	68.1	15.9	67.4	25.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	44.4	63.0	61.5	68.1	15.9	67.4	25.0
LOS	D	E	E	E	B	E	C
Approach Delay	44.4		62.3		17.1		25.2
Approach LOS	D		E		B		C

Intersection Summary

Cycle Length: 218.6
Actuated Cycle Length: 124.7
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.76
Intersection Signal Delay: 29.2 Intersection LOS: C
Intersection Capacity Utilization 66.9% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 8: SR 304 & Charleston

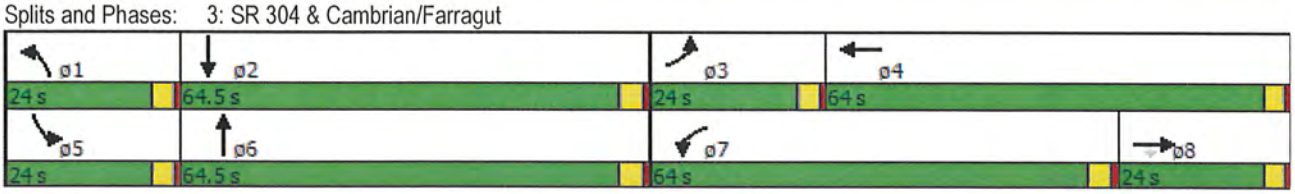


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	42	52	40	492	211	71	19	717	58	32	1530
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	24.0	24.0	24.0	64.0	64.0		24.0	64.5		24.0	64.5
Total Split (%)	13.6%	13.6%	13.6%	36.3%	36.3%		13.6%	36.5%		13.6%	36.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	8.8	9.3	9.3	30.8	31.2	117.7	6.7	60.8	117.7	7.4	61.5
Actuated g/C Ratio	0.07	0.08	0.08	0.26	0.27	1.00	0.06	0.52	1.00	0.06	0.52
v/c Ratio	0.35	0.39	0.21	0.82	0.48	0.05	0.20	0.41	0.02	0.31	0.87
Control Delay	64.5	64.6	2.8	52.3	41.1	0.1	64.7	21.9	0.0	66.0	34.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.5	64.6	2.8	52.3	41.1	0.1	64.7	21.9	0.0	66.0	34.5
LOS	E	E	A	D	D	A	E	C	A	E	C
Approach Delay		46.1			44.5			21.3			35.2
Approach LOS		D			D			C			D

Intersection Summary

Cycle Length: 176.5
Actuated Cycle Length: 117.7
Natural Cycle: 105
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.87
Intersection Signal Delay: 34.6 Intersection LOS: C
Intersection Capacity Utilization 71.8% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: SR 304 & Cambrian/Farragut

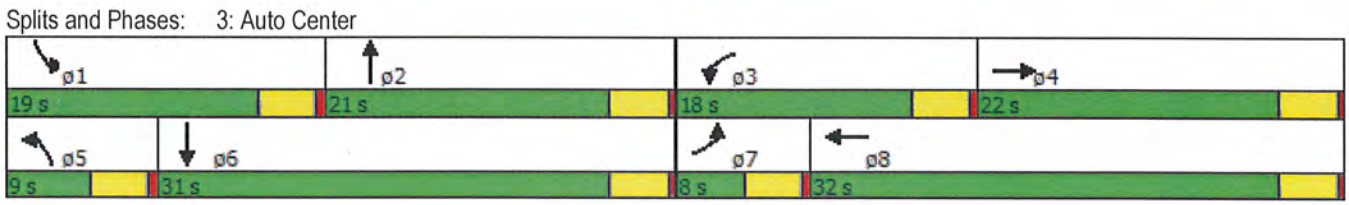


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	17	490	156	954	25	14	264	29
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	22.0	18.0	32.0	9.0	21.0	19.0	31.0
Total Split (%)	10.0%	27.5%	22.5%	40.0%	11.3%	26.3%	23.8%	38.8%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.0	16.9	11.5	29.4	5.0	17.1	14.6	32.2
Actuated g/C Ratio	0.05	0.22	0.15	0.39	0.07	0.22	0.19	0.42
v/c Ratio	0.20	0.68	0.61	0.88	0.24	0.33	0.86	0.18
Control Delay	41.7	32.4	40.8	31.7	40.9	8.7	57.2	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.7	32.4	40.8	31.7	40.9	8.7	57.2	7.0
LOS	D	C	D	C	D	A	E	A
Approach Delay		32.7		32.9		13.5		41.4
Approach LOS		C		C		B		D

Intersection Summary

Cycle Length: 80
Actuated Cycle Length: 76.1
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.88
Intersection Signal Delay: 32.8 Intersection LOS: C
Intersection Capacity Utilization 71.0% ICU Level of Service C
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

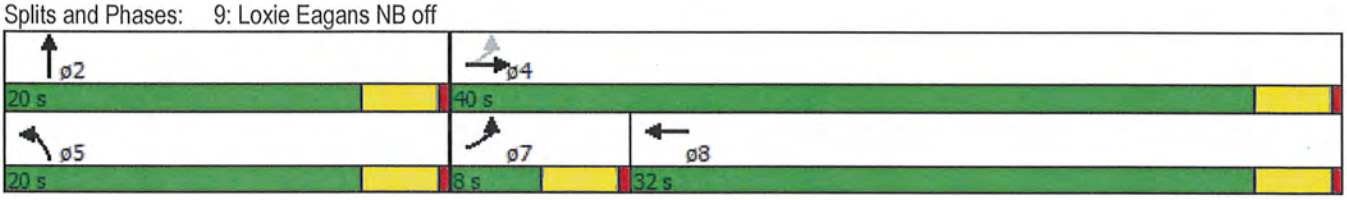


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	231	472	825	239	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	40.0	32.0	20.0	20.0
Total Split (%)	13.3%	66.7%	53.3%	33.3%	33.3%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		26.7	26.7	12.0	12.0
Actuated g/C Ratio		0.57	0.57	0.25	0.25
v/c Ratio		1.59dl	0.69	0.59	0.34
Control Delay		11.5	8.3	22.9	1.5
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		11.5	8.3	22.9	1.5
LOS		B	A	C	A
Approach Delay		11.5	8.3		12.9
Approach LOS		B	A		B

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 47.1	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.69	
Intersection Signal Delay: 10.1	Intersection LOS: B
Intersection Capacity Utilization 79.8%	ICU Level of Service D
Analysis Period (min) 15	

dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 9: Loxie Eagans NB off



HCM Unsignalized Intersection Capacity Analysis
6: Loxie Eagans SB off

5/26/2015

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	529	352	315	749	0	0	0	0	133	0	501
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	575	383	342	814	0	0	0	0	145	0	545
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked	0.99			0.87			0.88	0.88	0.87	0.88	0.88	0.99
vC, conflicting volume	814			958			1858	2265	479	1786	2457	407
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	798			657			1657	2122	107	1575	2341	387
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			58			100	100	100	0	100	10
cM capacity (veh/h)	814			808			4	25	807	43	18	606

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	383	574	614	543	689
Volume Left	0	0	342	0	145
Volume Right	0	383	0	0	545
cSH	1700	1700	808	1700	190
Volume to Capacity	0.23	0.34	0.42	0.32	3.62
Queue Length 95th (ft)	0	0	53	0	Err
Control Delay (s)	0.0	0.0	9.9	0.0	Err
Lane LOS			A		F
Approach Delay (s)	0.0		5.3		Err
Approach LOS					F

Intersection Summary			
Average Delay	2460.2		
Intersection Capacity Utilization	73.1%	ICU Level of Service	D
Analysis Period (min)	15		

Timing: 2040 PM Existing

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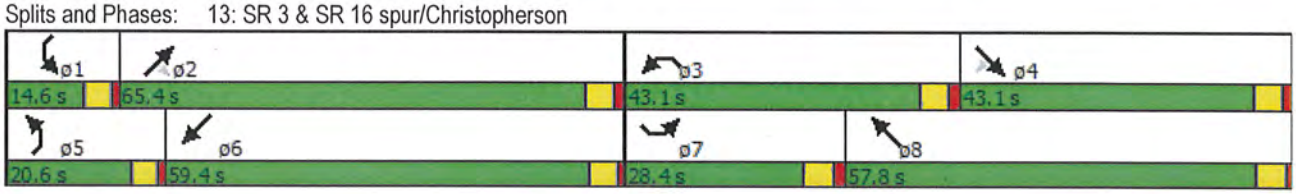
Lane Group	SEL	SET	SER	NWL	NWT	NEL	NET	NER	SWL	SWT
Lane Configurations										
Volume (vph)	115	384	157	411	161	21	616	377	12	1054
Turn Type	Prot	NA	Perm	Prot	NA	Prot	NA	Perm	Prot	NA
Protected Phases	7	4		3	8	5	2		1	6
Permitted Phases			4					2		
Detector Phase	7	4	4	3	8	5	2	2	1	6
Switch Phase										
Minimum Initial (s)	4.0	4.0	4.0	6.0	4.0	4.0	10.0	10.0	4.0	10.0
Minimum Split (s)	9.4	29.1	29.1	11.1	8.9	8.6	35.4	35.4	8.6	32.9
Total Split (s)	28.4	43.1	43.1	43.1	57.8	20.6	65.4	65.4	14.6	59.4
Total Split (%)	17.1%	25.9%	25.9%	25.9%	34.8%	12.4%	39.4%	39.4%	8.8%	35.7%
Yellow Time (s)	3.9	3.6	3.6	3.6	3.9	3.6	3.9	3.9	3.6	3.9
All-Red Time (s)	1.5	1.5	1.5	1.5	1.0	1.0	1.5	1.5	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.4	5.1	5.1	5.1	4.9	4.6	5.4	5.4	4.6	4.9
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	None	Min	Min	None	Min
Act Effct Green (s)	16.0	37.1	37.1	38.1	59.2	7.0	60.6	60.6	6.3	58.3
Actuated g/C Ratio	0.10	0.24	0.24	0.24	0.38	0.04	0.39	0.39	0.04	0.37
v/c Ratio	0.68	0.93	0.34	1.02	0.34	0.28	0.91	0.52	0.19	1.67
Control Delay	87.4	87.1	12.4	106.7	36.6	83.1	64.1	14.0	80.8	340.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	87.4	87.1	12.4	106.7	36.6	83.1	64.1	14.0	80.8	340.9
LOS	F	F	B	F	D	F	E	B	F	F
Approach Delay		69.3			82.6		45.9			337.9
Approach LOS		E			F		D			F

Intersection Summary

Cycle Length: 166.2
Actuated Cycle Length: 156.1
Natural Cycle: 145
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.67
Intersection Signal Delay: 151.4 Intersection LOS: F
Intersection Capacity Utilization 112.6% ICU Level of Service H
Analysis Period (min) 15

Splits and Phases: 13: SR 3 & SR 16 spur/Christopherson

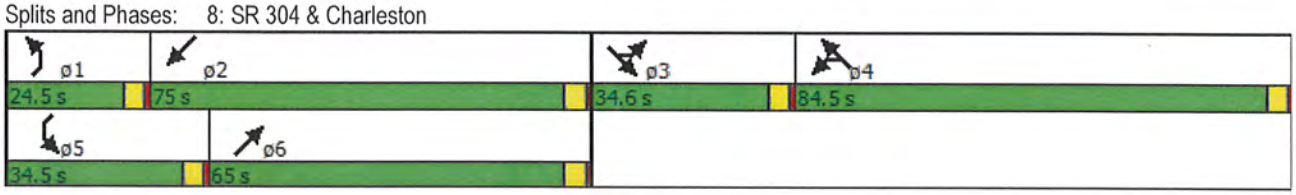


Lane Group	SET	NWL	NWT	NEL	NET	SWL	SWT
Lane Configurations							
Volume (vph)	4	513	30	22	1019	15	2695
Turn Type	NA	Split	NA	Prot	NA	Prot	NA
Protected Phases	3	4	4	1	6	5	2
Permitted Phases							
Detector Phase	3	4	4	1	6	5	2
Switch Phase							
Minimum Initial (s)	6.0	6.0	6.0	6.0	10.0	6.0	10.0
Minimum Split (s)	10.6	30.5	30.5	10.5	37.0	10.5	21.0
Total Split (s)	34.6	84.5	84.5	24.5	65.0	34.5	75.0
Total Split (%)	15.8%	38.7%	38.7%	11.2%	29.7%	15.8%	34.3%
Yellow Time (s)	3.6	3.5	3.5	3.5	4.0	3.5	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.6	4.5	4.5	4.5	5.0	4.5	5.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	Min	None	Min
Act Effct Green (s)	14.0	33.5	33.5	7.0	74.0	6.6	71.5
Actuated g/C Ratio	0.10	0.24	0.24	0.05	0.53	0.05	0.51
v/c Ratio	0.69	0.80	0.80	0.26	0.40	0.19	1.12
Control Delay	57.6	66.6	65.0	78.9	23.3	77.8	94.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.6	66.6	65.0	78.9	23.3	77.8	94.3
LOS	E	E	E	E	C	E	F
Approach Delay	57.6		65.8		24.4		94.2
Approach LOS	E		E		C		F

Intersection Summary

Cycle Length: 218.6
Actuated Cycle Length: 140
Natural Cycle: 150
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.12
Intersection Signal Delay: 73.4 Intersection LOS: E
Intersection Capacity Utilization 85.0% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 8: SR 304 & Charleston

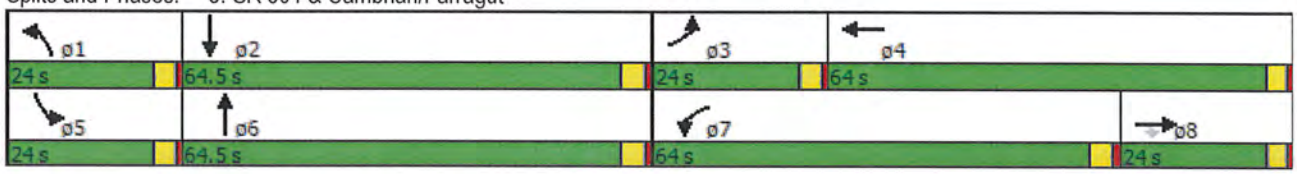


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT
Lane Configurations											
Volume (vph)	57	70	54	662	284	96	25	966	78	43	2061
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA
Protected Phases	3	8		7	4		1	6		5	2
Permitted Phases			8			Free			Free		
Detector Phase	3	8	8	7	4		1	6		5	2
Switch Phase											
Minimum Initial (s)	6.0	6.0	6.0	6.0	6.0		6.0	10.0		6.0	10.0
Minimum Split (s)	10.0	10.0	10.0	10.0	32.0		10.0	14.5		10.0	32.5
Total Split (s)	24.0	24.0	24.0	64.0	64.0		24.0	64.5		24.0	64.5
Total Split (%)	13.6%	13.6%	13.6%	36.3%	36.3%		13.6%	36.5%		13.6%	36.5%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.5		3.0	3.5
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.5		4.0	4.5
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Recall Mode	None	None	None	None	None		None	Min		None	Min
Act Effct Green (s)	10.5	11.3	11.3	41.5	45.0	134.0	7.2	58.4	134.0	8.4	61.9
Actuated g/C Ratio	0.08	0.08	0.08	0.31	0.34	1.00	0.05	0.44	1.00	0.06	0.46
v/c Ratio	0.45	0.49	0.28	0.87	0.48	0.06	0.28	0.66	0.03	0.41	1.33
Control Delay	75.3	74.4	8.1	56.2	39.7	0.1	75.8	35.9	0.0	77.6	183.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	75.3	74.4	8.1	56.2	39.7	0.1	75.8	35.9	0.0	77.6	183.4
LOS	E	E	A	E	D	A	E	D	A	E	F
Approach Delay		54.9			46.5			34.2			181.2
Approach LOS		D			D			C			F

Intersection Summary

Cycle Length: 176.5
Actuated Cycle Length: 134
Natural Cycle: 145
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.33
Intersection Signal Delay: 108.4 Intersection LOS: F
Intersection Capacity Utilization 91.4% ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 3: SR 304 & Cambrian/Farragut

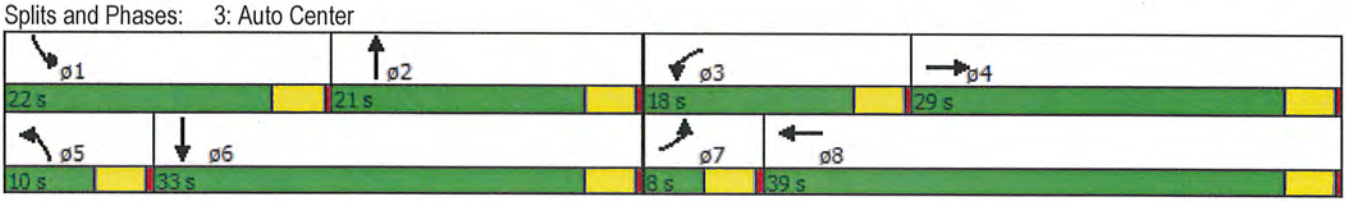


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations								
Volume (vph)	21	622	198	1213	32	18	336	37
Turn Type	Prot	NA	Prot	NA	Prot	NA	Prot	NA
Protected Phases	7	4	3	8	5	2	1	6
Permitted Phases								
Detector Phase	7	4	3	8	5	2	1	6
Switch Phase								
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	8.0	20.0	8.0	20.0	8.0	20.0
Total Split (s)	8.0	29.0	18.0	39.0	10.0	21.0	22.0	33.0
Total Split (%)	8.9%	32.2%	20.0%	43.3%	11.1%	23.3%	24.4%	36.7%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	Max	None	Max
Act Effct Green (s)	4.0	22.8	13.1	36.8	5.9	17.0	18.0	33.2
Actuated g/C Ratio	0.05	0.26	0.15	0.42	0.07	0.20	0.21	0.38
v/c Ratio	0.28	0.73	0.78	1.02	0.30	0.43	1.02	0.24
Control Delay	50.7	34.5	57.3	54.7	47.0	10.2	88.6	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.7	34.5	57.3	54.7	47.0	10.2	88.6	8.0
LOS	D	C	E	D	D	B	F	A
Approach Delay		35.1		55.0		15.8		63.3
Approach LOS		D		D		B		E

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 87
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.02
Intersection Signal Delay: 49.1 — Intersection LOS: D
Intersection Capacity Utilization 85.8% — ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 3: Auto Center

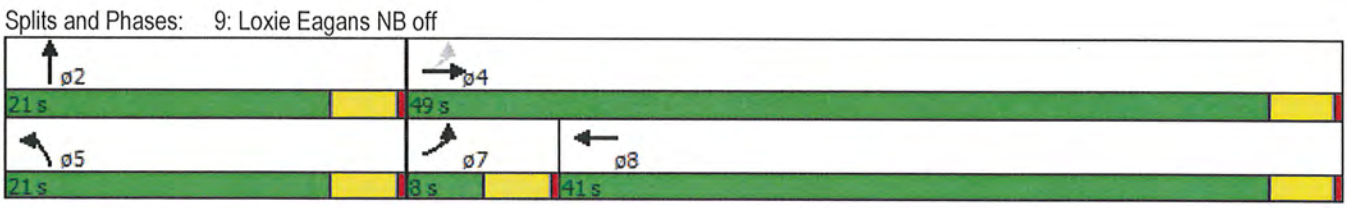


Lane Group	EBL	EBT	WBT	NBL	NBT
Lane Configurations					
Volume (vph)	294	600	1050	303	0
Turn Type	pm+pt	NA	NA	Prot	NA
Protected Phases	7	4	8	5	2
Permitted Phases	4				
Detector Phase	7	4	8	5	2
Switch Phase					
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0
Minimum Split (s)	8.0	20.0	20.0	8.0	20.0
Total Split (s)	8.0	49.0	41.0	21.0	21.0
Total Split (%)	11.4%	70.0%	58.6%	30.0%	30.0%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5
Lost Time Adjust (s)		0.0	0.0	0.0	0.0
Total Lost Time (s)		4.0	4.0	4.0	4.0
Lead/Lag	Lead		Lag		
Lead-Lag Optimize?	Yes		Yes		
Recall Mode	None	None	None	None	Min
Act Effct Green (s)		39.0	39.0	15.3	15.3
Actuated g/C Ratio		0.62	0.62	0.25	0.25
v/c Ratio		2.69dl	0.81	0.77	0.47
Control Delay		16.3	11.5	37.5	5.8
Queue Delay		0.0	0.0	0.0	0.0
Total Delay		16.3	11.5	37.5	5.8
LOS		B	B	D	A
Approach Delay		16.3	11.5		22.6
Approach LOS		B	B		C

Intersection Summary

Cycle Length: 70
Actuated Cycle Length: 62.4
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.81
Intersection Signal Delay: 15.0 Intersection LOS: B
Intersection Capacity Utilization 98.7% ICU Level of Service F
Analysis Period (min) 15
dl Defacto Left Lane. Recode with 1 though lane as a left lane.

Splits and Phases: 9: Loxie Eagans NB off



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	673	448	400	953	0	0	0	0	169	0	636
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	732	487	435	1036	0	0	0	0	184	0	691
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												32
Median type		None			None							
Median storage veh)												
Upstream signal (ft)		265			655							
pX, platoon unblocked	0.79			0.83			0.88	0.88	0.83	0.88	0.88	0.79
vC, conflicting volume	1036			1218			2362	2880	609	2271	3124	518
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	522			861			1414	2005	129	1309	2283	0
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			33			100	100	100	0	100	20
cM capacity (veh/h)	825			647			8	17	747	47	11	860

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1
Volume Total	488	731	780	691	875
Volume Left	0	0	435	0	184
Volume Right	0	487	0	0	691
cSH	1700	1700	647	1700	201
Volume to Capacity	0.29	0.43	0.67	0.41	4.35
Queue Length 95th (ft)	0	0	129	0	Err
Control Delay (s)	0.0	0.0	19.7	0.0	Err
Lane LOS			C		F
Approach Delay (s)	0.0		10.5		Err
Approach LOS					F

Intersection Summary			
Average Delay	2459.1		
Intersection Capacity Utilization	90.3%	ICU Level of Service	E
Analysis Period (min)	15		

APPENDIX C

Collision Data Analysis for SR 3 Freeway Alternatives Safety Analysis Documentation

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Collision Data Analysis for SR 3 Freeway
Alternatives Safety Analysis Documentation

Prepared by: Forest Sutmiller
Washington State Department of Transportation
WSDOT Olympic Region Planning

UNDER 23 U.S. CODE § 409, SAFETY DATA, REPORTS, SURVEYS, SCHEDULES, LISTS COMPILED OR COLLECTED FOR THE PURPOSE OF IDENTIFYING, EVALUATING, OR PLANNING THE SAFETY ENHANCEMENTS OF POTENTIAL CRASH SITES, HAZARDOUS ROADWAY CONDITIONS, OR RAILWAY-HIGHWAY CROSSINGS ARE NOT SUBJECT TO DISCOVERY OR ADMITTED INTO EVIDENCE IN A FEDERAL OR STATE COURT PROCEEDING OR CONSIDERED FOR OTHER PURPOSES IN ANY ACTION FOR DAMAGES ARISING FROM ANY OCCURRENCE AT A LOCATION MENTIONED OR ADDRESSED IN SUCH REPORTS, SURVEYS, SCHEDULES, LISTS, OR DATA.

SR 3: Summary and Conclusions

The alternatives likely to impact the safety performance of SR 3 from SR 16 to SR 310 are:

- Transportation Demand Management (TDM)
- All Day Hard Shoulder Running (Restripe early merge into late merge on SR 3 SB and SR 304 WB lane reductions)
- Restripe or Widen to create SR 304 WB parallel on ramp merge and 2 lanes SB under the SR 304 WB bridge
- Add lane on SR 3 Southbound between SR 16 and SR 304

SR 3 was analyzed using the Highway Safety Manual freeway model **I**nterchange **S**afety **A**nalysis **T**ool **e**nhanced (ISATe) software. It was divided into the following eight segments that totaled **3.46 miles** (see attachments):

- Segment 1: SR 3/SR 16 Interchange to Sherman Heights Road/Railroad Bridge Vicinity (0.30 mile)
- Segment 2: Sherman Heights Road/Railroad Bridge to Sinclair Inlet Vicinity (0.65 mile)
- Segment 3: Sinclair Inlet Vicinity to Wright Creek Vicinity/SR 304 Westbound merge (0.64 mile)
- Segment 4: SR 304 Westbound Merge Vicinity (0.34 mile)
- Segment 5: SR 3/SR 304 Interchange Vicinity (0.29 mile)
- Segment 6: SR 3/SR 304 Interchange to Werner/Loxie Eagans Interchange (0.30 mile)
- Segment 7: Werner/Loxie Eagans Interchange Vicinity (0.58 mile)
- Segment 8: Werner/Loxie Eagans Interchange to SR 310 Interchange (0.36 mile)

Assumptions:

Reducing existing 2013 volumes by 10% and 5% and assuming traffic volume will not change over a 5 year analysis period, will simulate the effect of the TDM alternative(s). To analyze short-term build and no build effects, I performed the build analyses with a 10% and 5% reduction and no traffic growth over a 5-year period even though traffic may increase at a rate of 1.5% straight line (no growth in past 4-years and over capacity condition on SR 3 SB and SR 304 WB in PM peak may limit growth).

The 5-year historical crash record (January 1, 2009 to December 31, 2013) had a total of 273 crashes which would average out to 54.6 crashes per year. There were a total of 119 rear-ends and 70 sideswipe crashes on the 3.46 mile mainline.

The predicted crash results are summarized **below** in the table (more detailed report summaries are attached). The "Predicted Widen or Restripe Crashes" would be most similar to a "Predicted No Build" Scenario (4-lane verses existing 3-lane in Segment 5).

	Predicted and Observed Crashes for the TDM and Add Lane Alternatives			
	Predicted 10% TDM Crashes	Predicted 5% TDM Crashes	Predicted Widen or Restripe Crashes (Close to No Build)	Predicted Add Lane Crashes
5-Year Total Estimated Crashes	420.6	449.5	**478.7**	436.3
Estimated Average Crashes/Year	70.1	74.9	**79.8**	72.7
Estimated Rear-ends	147.3	164.0	**181.0**	157.5
Estimated Sideswipes	49.8	55.5	**61.3**	53.2

Conclusions:

The build alternatives ranked in relative order by total predicted crashes are:

1. 10% TDM Alternative.
2. Add Lane Alternative(s).
3. 5% TDM Alternative.
4. Widen or Restripe Alternative (and Hard Shoulder Alternative)

SR 3 and SR 304 Alternatives
Safety Information (by analysis segment)

UNDER 23 U.S. CODE § 409, SAFETY DATA, REPORTS, SURVEYS, SCHEDULES, LISTS COMPILED OR COLLECTED FOR THE PURPOSE OF IDENTIFYING, EVALUATING, OR PLANNING THE SAFETY ENHANCEMENTS OF POTENTIAL CRASH SITES, HAZARDOUS ROADWAY CONDITIONS, OR RAILWAY-HIGHWAY CROSSINGS ARE NOT SUBJECT TO DISCOVERY OR ADMITTED INTO EVIDENCE IN A FEDERAL OR STATE COURT PROCEEDING OR CONSIDERED FOR OTHER PURPOSES IN ANY ACTION FOR DAMAGES ARISING FROM ANY OCCURRENCE AT A LOCATION MENTIONED OR ADDRESSED IN SUCH REPORTS, SURVEYS, SCHEDULES, LISTS, OR DATA.

SR 3 Mainline is broken down into eight segments for analysis. The segments are:

- Segment 1, Milepost 34.51 to Milepost 34.81, 5-lane segment between SR 3/SR 16 Interchange to Sherman Heights Road/Railroad Bridge Vicinity.
- Segment 2, Milepost 34.81 to Milepost 35.46, 4-lane segment with 3 horizontal curves in Sinclair Inlet Vicinity.
- Segment 3, Milepost 35.46 to Milepost 36.10, 4-lane segment in Sinclair Inlet Vicinity ending at the SR 304 Westbound merge.
- Segment 4, Milepost 36.10 to Milepost 36.44, 4-lane segment at SR 304 Westbound Merge.
- Segment 5, Milepost 36.44 to Milepost 36.73, 3-lane segment in SR 3/SR 304 Interchange Vicinity.
- Segment 6, Milepost 36.73 to Milepost 37.03, 4-lane segment between SR 3/SR 304 Interchange and Werner/Loxie Eagans Interchange.
- Segment 7, Milepost 37.03 to Milepost 37.61, 4-lane segment in Werner/Loxie Eagans Interchange Vicinity.
- Segment 8, Milepost 37.61 to Milepost 37.97, 4-lane segment between Werner/Loxie Eagans Interchange and SR 310 Interchange.

Segment 1, SR 3 SB: Milepost 34.51 to Milepost 34.81 (& SR16 NB: MP 29.06 to MP 29.19)

There were a total of 50 collisions between January 1, 2009 and December 31, 2013. There were 18 rear-ends, 16 sideswipes, 11 guardrail/jersey face/attenuator, 2 enter at angles, and 3 other. Rear-ends and sideswipes account for 68% of crashes over a 5-year period in this segment.

Segment 1	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	11				
Year 2010	9	3	1		
Year 2011	6	1	1		
Year 2012	4	1			1
Year 2013	8	3	1		

Segment 1, SR 3 SB: Milepost 34.51 to Milepost 34.81 (& SR16 NB: MP 29.06 to MP 29.19)

Segment 1	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009			8	3
2010	4		7	2
2011	1	1	4	2
2012	1	1	3	1
2013	3	1	7	1

Segment 2, SR 3 Milepost 34.81 to Milepost 35.46

There were a total of 54 collisions between January 1, 2009 and December 31, 2013. There were 19 rear-ends, 13 sideswipes, 7 guardrail/jersey face/attenuator, 5 underside of bridge, and 10 other. Rear-ends and sideswipes account for 59% of crashes over a 5-year period in this segment.

Segment 2	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	7		4		
Year 2010	9	2			2
Year 2011	8	1			
Year 2012	5	1	1	1	
Year 2013	13				

Segment 2	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009		3	3	5
2010	2	2	5	4
2011	1		6	2
2012	1	2	4	1
2013			12	1

Segment 3, SR 3 Milepost 35.46 to Milepost 36.10

There were a total of 50 collisions between January 1, 2009 and December 31, 2013. There were 15 rear-ends, 15 sideswipes, 8 guardrail/jersey face/attenuator, and 12 other. Rear-ends and sideswipes account for 60% of crashes over a 5-year period in this segment.

Segment 3	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	6	1	1		
Year 2010	9				
Year 2011	6	2			
Year 2012	11		1		
Year 2013	10	2	1		

Segment 3	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009	2		4	2
2010			7	2
2011	2		6	
2012		1	6	5
2013	1	6	6	

Segment 4, SR 3 Milepost 36.10 to Milepost 36.44

There were a total of 13 collisions between January 1, 2009 and December 31, 2013. There were 6 rear-ends, 4 sideswipes, 1 jersey face, and 2 other. Rear-ends and sideswipes account for 77% of crashes over a 5-year period in this segment.

Segment 4	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	1	2			
Year 2010	2				
Year 2011		1			
Year 2012	3				
Year 2013	3		1		

Segment 4, SR 3 Milepost 36.10 to Milepost 36.44 continued

Segment 4	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009	2			1
2010			2	
2011	1			
2012			3	
2013	1		2	1

Segment 5, SR 3 Milepost 36.44 to Milepost 36.73

There were a total of 30 collisions between January 1, 2009 and December 31, 2013. There were 11 rear-ends, 11 sideswipes, 3 jersey face, and 5 other. Rear-ends and sideswipes account for 73% of crashes over a 5-year period in this segment.

Segment 5	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	1				
Year 2010	4	2			
Year 2011	8				
Year 2012	5			1	
Year 2013	8	1			

Segment 5	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009			1	
2010	2		3	1
2011			5	3
2012		1	4	1
2013	1		6	2

Segment 6, SR 3 Milepost 36.73 to Milepost 37.03

There were a total of 23 collisions between January 1, 2009 and December 31, 2013. There were 13 rear-ends, 5 sideswipes, 2 jersey face, and 3 other. Rear-ends and sideswipes account for 78% of crashes over a 5-year period in this segment.

Segment 6	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	4	1			
Year 2010	1				
Year 2011	5	2	1		1
Year 2012	3	1			
Year 2013	4				

Segment 6	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009			3	2
2010			1	
2011	3		6	
2012	1		3	
2013			3	1

Segment 7, SR 3 Milepost 37.03 to Milepost 37.61

There were a total of 36 collisions between January 1, 2009 and December 31, 2013. There were 28 rear-ends, 2 sideswipes, 1 jersey face, and 5 other. Rear-ends and sideswipes account for 83% of crashes over a 5-year period in this segment.

Segment 7	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	1	2	1		
Year 2010	9	2	1		
Year 2011	4				
Year 2012	7	2			
Year 2013	3	1	2	1	

Segment 7, SR 3 Milepost 37.03 to Milepost 37.61

Segment 7	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009	3		1	
2010	3		6	3
2011			4	
2012	2		7	
2013	4		3	

Segment 8, SR 3 Milepost 37.61 to Milepost 37.97

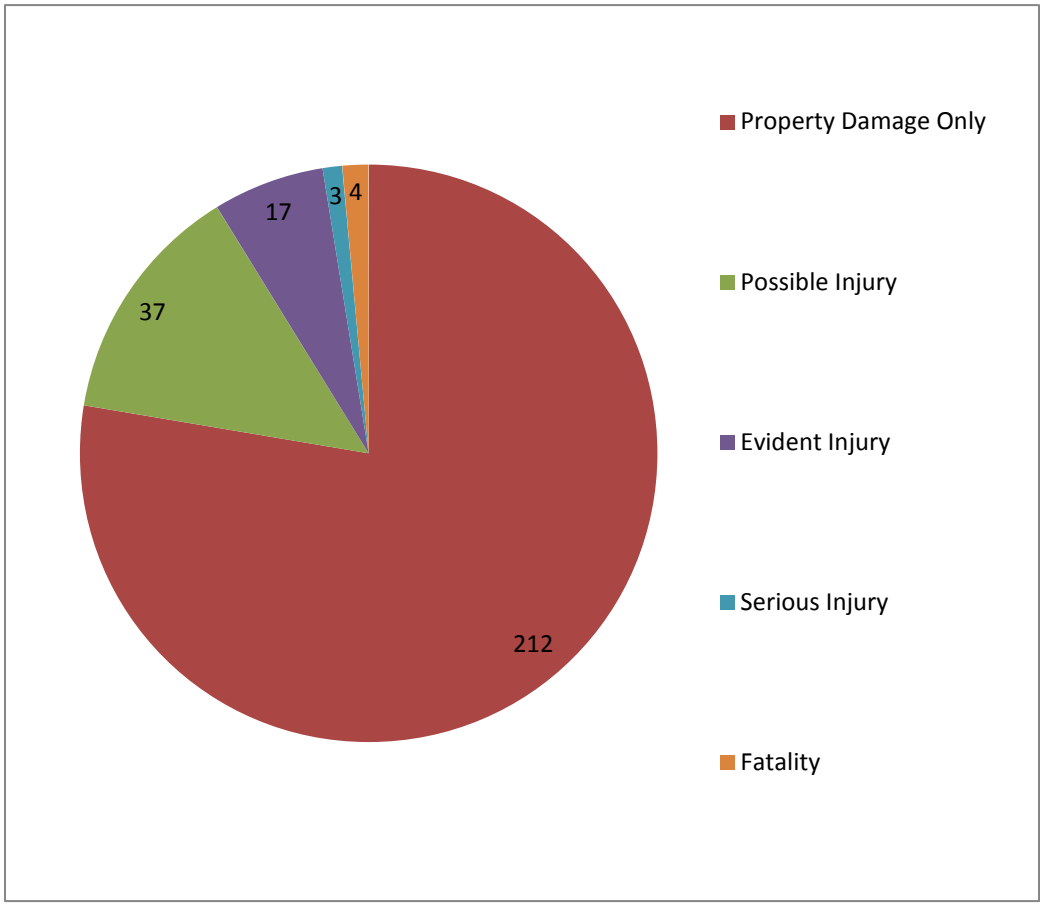
There were a total of 17 collisions between January 1, 2009 and December 31, 2013. There were 9 rear-ends, 4 sideswipes, and 4 other. Rear-ends and sideswipes account for 76% of crashes over a 5-year period in this segment.

Segment 8	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	2	1			
Year 2010	3	2			
Year 2011	2				
Year 2012	3				
Year 2013	4				

Segment 8	Multiple-vehicle injury (not ramp)	Single-vehicle injury (not ramp)	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO (not ramp)
2009	1		1	1
2010	2		3	
2011			1	1
2012			3	
2013			4	

The chart below depicts severity type of collisions for SR 3 over a 5-year period from 2009 – 2013. Out of a total of 273 collisions recorded over the 5-year period; 4 resulted in a fatality; 212 were property damage only; 37 collisions resulted in a possible injury; 17 collisions recorded an evident injury; and 3 collisions recorded a serious injury.

5-Year Collision History for SR 3



Collision Data Analysis for SR 304 Urban Arterial
Alternatives Safety Analysis Documentation

Prepared by: Forest Sutmiller
Washington State Department of Transportation
WSDOT Olympic Region Planning

UNDER 23 U.S. CODE § 409, SAFETY DATA, REPORTS, SURVEYS, SCHEDULES, LISTS COMPILED OR COLLECTED FOR THE PURPOSE OF IDENTIFYING, EVALUATING, OR PLANNING THE SAFETY ENHANCEMENTS OF POTENTIAL CRASH SITES, HAZARDOUS ROADWAY CONDITIONS, OR RAILWAY-HIGHWAY CROSSINGS ARE NOT SUBJECT TO DISCOVERY OR ADMITTED INTO EVIDENCE IN A FEDERAL OR STATE COURT PROCEEDING OR CONSIDERED FOR OTHER PURPOSES IN ANY ACTION FOR DAMAGES ARISING FROM ANY OCCURRENCE AT A LOCATION MENTIONED OR ADDRESSED IN SUCH REPORTS, SURVEYS, SCHEDULES, LISTS, OR DATA.

SR 304: Summary and Conclusions

The build alternative likely to impact the safety performance of the SR 304 Urban Arterial from SR 3 to Farragut intersection is the Transportation Demand Management (TDM) alternative.

SR 304 was analyzed as a 4-lane divided urban arterial with no commercial access breaks using Highway Safety Manual (HSM) Urban and Suburban arterial software. In addition to 4 lanes for general purpose, SR 304 has two inside High Occupancy Vehicle (HOV) lanes.

I segmented SR 304 into two parts with each having one signalized intersection. The first segment is from SR 3 to Charleston intersection with 45 mph posted speed (Milepost 0.00 to Milepost 0.75). The second segment is from Charleston to Farragut intersection with 30 mph posted speed (Milepost 0.75 to Milepost 1.25).

Assumptions:

To analyze short-term and no build effects, I performed the build analysis with a 10% and 5% reduction and assumed no traffic growth over a 5-year period even though traffic may increase at a rate of 1.5% straight line. The 5-year historical crash record (January 1, 2009 to December 31, 2013) averaged 25 crashes per year. The total average crashes per year results are summarized below in the table (more detailed report summaries are attached).

Summary of total anticipated safety performance (average crashes per year)					
Predicted 10% TDM Crashes per Year	Predicted 5% TDM Crashes per Year	Predicted No Build Crashes per Year	Expected No Build Crashes per Year	Potential for No Build Safety Improvement	Actual 5-Yr Averaged Crashes per Year History
12.5	**13.4**	**14.3**	**22.1**	**7.8**	**25.0**

Conclusions:

The TDM Alternative(s) would reduce crashes, but since SR 304 is already experiencing more crashes than predicted for similar type facilities the crash reduction would be low. Because the prior 5-year crash history and expected crashes over the next 5 years with zero traffic growth are greater than the predicted crashes (other similar facilities), the TDM alternatives will likely experience more crashes than predicted. There has been no traffic growth in the past 4 years and the over-capacity condition of SR 3 SB and SR 304 WB in the PM peak may limit growth.

SR 304 Alternatives
Safety Information (by analysis segment and signal location)

UNDER 23 U.S. CODE § 409, SAFETY DATA, REPORTS, SURVEYS, SCHEDULES, LISTS COMPILED OR COLLECTED FOR THE PURPOSE OF IDENTIFYING, EVALUATING, OR PLANNING THE SAFETY ENHANCEMENTS OF POTENTIAL CRASH SITES, HAZARDOUS ROADWAY CONDITIONS, OR RAILWAY-HIGHWAY CROSSINGS ARE NOT SUBJECT TO DISCOVERY OR ADMITTED INTO EVIDENCE IN A FEDERAL OR STATE COURT PROCEEDING OR CONSIDERED FOR OTHER PURPOSES IN ANY ACTION FOR DAMAGES ARISING FROM ANY OCCURRENCE AT A LOCATION MENTIONED OR ADDRESSED IN SUCH REPORTS, SURVEYS, SCHEDULES, LISTS, OR DATA.

SR 304 Mainline is broken down into two segments and two intersections for analysis. The segments and intersection locations are:

- Segment 1, Milepost 0.00 to Milepost 0.75, 4-lane segment (and HOV) from SR 3/SR 304 Interchange to City of Bremerton Incorporation limits where speed changes from 45 mph to 30 mph.

- Charleston Beach Road Intersection/Shipyard at Milepost 0.73 Vicinity.

- Segment 2, Milepost 0.75 to Milepost 1.25, 4-lane segment (and HOV) from City of Bremerton Incorporation limits (Charleston Beach Road Intersection Vicinity) to Rodgers Street Vicinity (Farragut Street-Cambrian Avenue Vicinity).

- Farragut Street-Cambrian Avenue Intersection at Milepost 1.15.

Segment 1, SR 304: Milepost 0.00 to Milepost 0.75 (Excluding intersection crashes)

There were a total of 45 collisions between January 1, 2009 and December 31, 2013. There were 25 rear-ends, 15 sideswipes, and 5 other. Rear-ends and sideswipes account for 89% of crashes over a 5-year period in this segment.

Segment 1	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	14				
Year 2010	8	2			
Year 2011	8	2			
Year 2012	5		1		
Year 2013	5				

Segment 1	Multiple-vehicle injury	Single-vehicle injury	Multiple-vehicle PDO	Single-vehicle PDO
2009			14	
2010	1	1	8	
2011	1	1	7	1
2012	1		5	
2013			5	

Segment 1, SR 304: Milepost 0.00 to Milepost 0.75 (Excluding intersection crashes) Continued

Charleston Beach Road Intersection, SR 304 Milepost 0.73

There were a total of 19 collisions between January 1, 2009 and December 31, 2013. There were 14 rear-ends, 2 sideswipes, and 3 other. Rear-ends and sideswipes account for 84% of crashes over a 5-year period in this segment.

Charleston Beach Road	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009		1			
Year 2010	2	1	1		
Year 2011	1				
Year 2012	4	3		1	
Year 2013	3	2			

Charleston Beach Road	Multiple-vehicle injury	Single-vehicle injury	Multiple-vehicle PDO (not ramp)	Single-vehicle PDO
2009	1			
2010	1	1	2	
2011			1	
2012	4	1	3	
2013	2		2	1

Segment 2, SR 304 Milepost 0.75 to Milepost 1.25

There were a total of 32 collisions between January 1, 2009 and December 31, 2013. There were 13 rear-ends, 13 sideswipes, and 6 other. Rear-ends and sideswipes account for 81% of crashes over a 5-year period in this segment.

Segment 2	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	4	2			
Year 2010	4			1	
Year 2011	4	2			
Year 2012	2	2	1		
Year 2013	8	1	1		

Segment 2, SR 304 Milepost 0.75 to Milepost 1.25 continued

Segment 2	Multiple-vehicle injury	Single-vehicle injury	Multiple-vehicle PDO	Single-vehicle PDO
2009	1	1	4	
2010		1	4	
2011	1	1	3	1
2012	2	1	2	
2013	2		8	

Farragut Street-Cambrian Avenue Intersection, SR 304 Milepost 1.15

There were a total of 29 collisions between January 1, 2009 and December 31, 2013. There were 16 rear-ends, 6 sideswipes, and 7 other. Rear-ends and sideswipes account for 76% of crashes over a 5-year period in this segment.

Farragut-Cambrian	Property Damage Only	Possible Injury	Evident Injury	Serious Injury	Fatality
Year 2009	5	1			
Year 2010	7	2			
Year 2011	3				
Year 2012	6	1			
Year 2013	2	2			

Farragut St. – Cambrian Ave.	Multiple-vehicle injury	Single-vehicle injury	Multiple-vehicle PDO	Single-vehicle PDO
2009	1		5	
2010	2		7	
2011			3	
2012	1		6	
2013	1	1	2	

Output Summary								
General Information								
Project description:	SR 3 Mainline from SR 16 to Loxie Eagans TDM 10% Volume Reduction - Freeway Scenario							
Analyst:	Forest Sutmiller		Date:	6/27/2014		Area type:		Urban
First year of analysis:	2013							
Last year of analysis:	2018							
Crash Data Description								
Freeway segments	Segment crash data available?				No	First year of crash data:		
	Project-level crash data available?				No	Last year of crash data:		
Ramp segments	Segment crash data available?				No	First year of crash data:		
	Project-level crash data available?				No	Last year of crash data:		
Ramp terminals	Segment crash data available?				No	First year of crash data:		
	Project-level crash data available?				No	Last year of crash data:		
Estimated Crash Statistics								
Crashes for Entire Facility			Total	K	A	B	C	PDO
Estimated number of crashes during Study Period, crashes:			420.6	2.3	6.1	38.1	84.4	289.6
Estimated average crash freq. during Study Period, crashes/yr:			70.1	0.4	1.0	6.4	14.1	48.3
Crashes by Facility Component		Nbr. Sites	Total	K	A	B	C	PDO
Freeway segments, crashes:		8	420.6	2.3	6.1	38.1	84.4	289.6
Ramp segments, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crossroad ramp terminals, crashes:		0	0.0	0.0	0.0	0.0	0.0	0.0
Crashes for Entire Facility by Year		Year	Total	K	A	B	C	PDO
Estimated number of crashes during		2013	70.1	0.4	1.0	6.4	14.1	48.3

Crash Type	Crash Type Category	Estimated Number of Crashes During the Study Period					
		Total	K	A	B	C	PDO
Multiple vehicle	Head-on crashes:	0.8	0.0	0.0	0.1	0.3	0.3
	Right-angle crashes:	4.5	0.0	0.1	0.5	1.2	2.6
	Rear-end crashes:	147.3	0.8	2.2	13.5	30.1	100.8
	Sideswipe crashes:	49.8	0.2	0.5	3.3	7.3	38.4
	Other multiple-vehicle crashes:	5.3	0.0	0.1	0.5	1.2	3.4
	···Total multiple-vehicle crashes:	207.6	1.1	2.9	18.0	40.1	145.5
Single vehicle	Crashes with animal:	3.4	0.0	0.0	0.1	0.2	3.2
	Crashes with fixed object:	153.0	0.9	2.3	14.5	32.0	103.3
	Crashes with other object:	23.6	0.1	0.2	1.0	2.3	20.1
	Crashes with parked vehicle:	3.3	0.0	0.0	0.3	0.7	2.3
	Other single-vehicle crashes	29.6	0.3	0.7	4.2	9.2	15.3
	···Total single-vehicle crashes:	212.9	1.2	3.2	20.1	44.3	144.1

Estimated Crash Statistics			
Crashes for Entire Facility			Total
Estimated number of crashes during Study Period, crashes:			449.5
Estimated average crash freq. during Study Period, crashes/yr:			74.9

Crash Type Category		Es
		Total
Head-on crashes:		0.9
Right-angle crashes:		5.0
Rear-end crashes:		164.0
Sideswipe crashes:		55.5
Other multiple-vehicle crashes:		5.9

Estimated Crash Statistics			
Crashes for Entire Facility			Total
Estimated number of crashes during Study Period, crashes:			478.7
Estimated average crash freq. during Study Period, crashes/yr:			79.8

Crash Type Category		E
		Total
Head-on crashes:		0.9
Right-angle crashes:		5.5
Rear-end crashes:		181.0
Sideswipe crashes:		61.3
Other multiple-vehicle crashes:		6.5

Estimated Crash Statistics			
Crashes for Entire Facility			Total
Estimated number of crashes during Study Period, crashes:			436.3
Estimated average crash freq. during Study Period, crashes/yr:			72.7

Crash Type Category			E
			Total
Head-on crashes:			0.8
Right-angle crashes:			4.8
Rear-end crashes:			157.5
Sideswipe crashes:			53.2
Other multiple-vehicle crashes:			5.6
Total multiple-vehicle crashes:			221.9

Fatal and injury (KABC)	
Property damage only (PDO)	
Total (KABCO)	

Discussion of Results

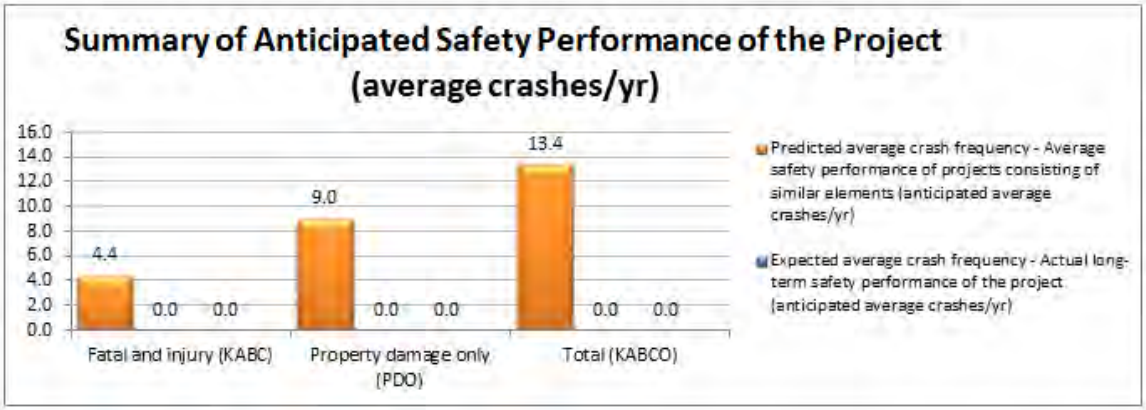
Given the potential effects of project characteristics on safety performance, results indicate that:

1. It is anticipated that the project will, on average, experience 0 crashes per year (0 fatal and injury crashes per year; and 0 pro

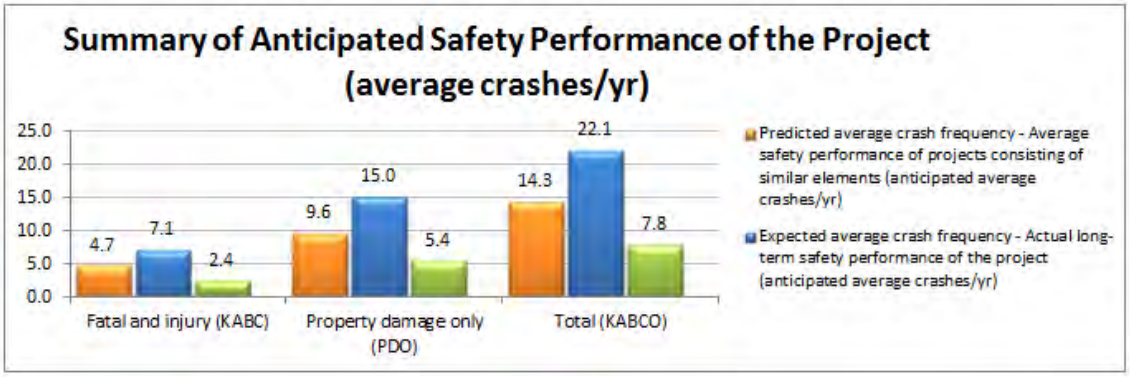
2. A similar project is anticipated, on average, to experience 12.5 crashes per year (4.1 fatal and injury crashes per year; and 8.4

PROJECT SAFETY PERFORMANCE SUMMARY REPORT

General Information	
Project Name	SR 304
Project Description	5% TDM Reduction
Reference Number	STARS Report A-1
Analyst	Forest Sutmiller
Agency/Company	WSDOT Olympic Region Planning
Contact Email	sutmilf@wsdot.wa.gov
Contact Phone	(360) 459-4981
Date Completed	06/26/14



Project Element	Total Crashes/yr (KABCO)			Fatal and Injury Crashes/yr (KABC)			Property Damage Onl (PDO)	
	Predicted average crash frequency $N_{predicted\ (KABCO)}$	Expected average crash frequency $N_{expected\ (KABCO)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (KABC)}$	Expected average crash frequency $N_{expected\ (KABC)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (O)}$	Expected average crash frequency $N_{expected\ (O)}$
INDIVIDUAL SEGMENTS								
Segment 1	3.9	0.0	0.0	1.1	0.0	0.0	2.8	0.0
Segment 2	2.7	0.0	0.0	0.8	0.0	0.0	1.8	0.0
INDIVIDUAL INTERSECTIONS								
Intersection 1	3.1	0.0	0.0	1.1	0.0	0.0	2.0	0.0
Intersection 2	3.8	0.0	0.0	1.4	0.0	0.0	2.4	0.0
COMBINED (sum of column)	13.4	0.0	0.0	4.4	0.0	0.0	9.0	0.0



Project Element	Total Crashes/yr (KABCO)			Fatal and Injury Crashes/yr (KABC)			Property Damage Only (PDO)	
	Predicted average crash frequency $N_{predicted\ (KABCO)}$	Expected average crash frequency $N_{expected\ (KABCO)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (KABC)}$	Expected average crash frequency $N_{expected\ (KABC)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (O)}$	Expected average crash frequency $N_{expected\ (O)}$
INDIVIDUAL SEGMENTS								
Segment 1	4.1	8.2	4.1	1.1	2.3	1.1	3.0	5.9
Segment 2	2.8	5.3	2.5	0.9	1.7	0.8	1.9	3.7
INDIVIDUAL INTERSECTIONS								
Intersection 1	3.3	3.4	0.1	1.2	1.2	0.0	2.1	2.2
Intersection 2	4.1	5.2	1.2	1.5	1.9	0.4	2.6	3.3
COMBINED (sum of column)	14.3	22.1	7.8	4.7	7.1	2.4	9.6	15.0

PROJECT SUMMARY --- Site-Specific EB Method Summary Results for Urban and Suburban Arterial Project

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APPENDIX D

SR 3 / SR 304 Bremerton Interchange Improvement Project
Traffic Analysis Technical Memorandum

WSDOT

Parametrix

May 18, 2015

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SR 3 / SR 304 Bremerton Interchange Improvement Project
Traffic Analysis Technical Memorandum

WSDOT

Parametrix

May 18, 2015

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Introduction

State Route (SR) 3 is a north-south highway in Kitsap County. The corridor provides a connection between Poulsbo to the north, and Shelton to the south and access to the Kitsap Naval Base, Silverdale, and Bremerton. SR 304 is an east-west arterial in Bremerton providing a connection between SR 3 to the west and the shipyard and ferry terminal to the east. These two state routes experience heavy weekday peak period congestion.

The purpose of this interchange improvement project is to evaluate modifications to the SR 3 / SR 304 interchange area to improve mobility and enhance safety. This study evaluates ways to reduce recurring congestion on SR 3 southbound and SR 304 westbound.

Methodology

This section provides the methodology and assumptions used to evaluate the project's effects on transportation operations. This section also includes the study area, existing year and future year transportation analysis, and evaluation criteria.

Study Area

The study area includes; SR 3 between the Werner Road/Loxie Eagans interchange to the north, and the Sam Christopherson Avenue intersection to the south; the SR 3 / SR 16 interchange; and, SR 304 between Farragut Avenue and SR 3. Figure 1 illustrates the roadways and intersections analyzed in the study area, and Table 1 lists the study intersections.

Figure 1. Study Area

1	Werner Road/Loxie Eagans Boulevard and Auto Center Way/Oyster Bay Avenue
2	Loxie Eagans Boulevard and SR 3 Southbound Ramps
3	Loxie Eagans Boulevard and SR 3 Northbound Ramps
4	Farragut Avenue/Cambrian Avenue and SR 304
5	Charleston Beach Road and SR 304
6	Sam Christopherson Avenue and SR 3

Traffic Volume Forecasts

Existing year traffic volumes for the 5-hour p.m. peak period (2:00 – 7:00 p.m.) were developed for all roadways and intersections in the study area using information from turn movement counts and tube counts collected between February 2010 and May 2014. Volumes were also developed for the 1:30 to 2:00 p.m. time period. This 30-minute period is included in the model to allow vehicles time to populate the network. The existing year for this study was assumed to be 2013, and collected traffic volumes were factored to match traffic volumes for 2013.

Opening year (2020), and future year (2040) traffic volumes were developed by assuming a 1.5 percent annual growth rate in traffic volumes between 2013 and the respective analysis year. The annual growth rate was based on a review of the following:

- Kitsap County 2010 and 2025 Travel Demand Models
- Puget Sound Regional Council 2006 and 2040 Travel Demand Models
- Bremerton Economic Development Study (WSDOT, 2012)
- City of Bremerton Comprehensive Plan

The alternatives analyzed in this study were not assumed to significantly change existing traffic patterns on a regional scale or how people travel. Some localized traffic pattern changes may occur as congestion increases, but were not analyzed to provide a conservative estimate. One traffic volume forecast was developed for the opening year (2020) and another for the future year (2040) analysis. This allows for a conservative comparison that describes how well each of the alternatives performs with a given set of volumes.

Traffic Operations Models

Two traffic models were used to analyze traffic operations as follows:

- Synchro (version 8) is a deterministic model used to calculate peak hour vehicle delay and level of service (LOS) at intersections, similar to the methodologies outlined in the Highway Capacity Manual (HCM). LOS is expressed as a letter grade from A through F, and is used to measure how well, or how poorly an intersection operates. LOS A indicates the least amount of delay and best operations. LOS F indicates the highest amount of delay and worst operations.
- VISSIM (version 5.4) is a stochastic model (microsimulation) that accounts for variability in driver behavior and is used to calculate travel times, speeds, and congestion levels for multiple modes of travel over long periods of time.

Existing Conditions

This section summarizes the existing transportation characteristics within the study area. This includes a description of the existing road network, traffic volumes, and existing roadway and intersection performance.

Existing Roadway Configuration

SR 3 is a four-lane (two lanes each direction) separated highway in the vicinity of the Loxie Eagans Boulevard interchange. SR 3 southbound has an auxiliary lane between the Auto Center Way on ramp and the Loxie Eagans Boulevard off ramp, and SR 3 northbound has an auxiliary lane between the SR 304 westbound on ramp and the Loxie Eagans Boulevard off ramp.

At the SR 3 / SR 304 interchange, SR 3 southbound merges from two lanes to one lane. The SR 304 on ramp connects to SR 3 southbound as an add-lane, and SR 3 southbound maintains two lanes between SR 304 and SR 16. SR 3 northbound is also two lanes between SR 16 and SR 304.

North of Farragut Avenue, SR 304 is a four-lane arterial with a landscaped center median. South of Farragut Avenue, SR 304 is a six-lane arterial with a landscaped center median. In the westbound direction, the inside lane is a high occupancy vehicle (HOV) lane.

The HOV lane designation ends east of the SR 3 / SR 304 interchange, and the right lane drops at the off ramp to SR 3 northbound. The two remaining westbound lanes merge to one lane prior to the SR 304 westbound undercrossing.

Existing Traffic Operations

Corridor Operations

Findings from the analysis demonstrate that there are two locations in the study area where vehicle volumes exceed available roadway capacity during the p.m. commute period as follows:

- Where SR 3 southbound merges from two lanes to one lane south of the Loxie Eagans interchange: this location is congested for approximately 2 hours 45 minutes, and congestion extends back to the Loxie Eagans interchange.
- Where SR 304 westbound merges from two lanes to one lane east of the SR 3 / SR 304 interchange: This location is congested for approximately 1 hour 45 minutes. Congestion in the general purpose lane extends back to the Charleston Beach Road intersection. The HOV lane allows transit, vanpools and carpools to bypass much of the congested general purpose (GP) lane, but HOV vehicles experience some congestion once the HOV lane terminates.

There is no substantial congestion on SR 3 northbound or SR 304 eastbound.

Congestion diagrams for SR 3 and SR 304 are shown in Appendix B. The congestion diagrams illustrate the lane configuration, travel speeds during the peak 15-minute period, and the duration of congestion.

In some cases, congestion extends to the limits of the model, and vehicles are effectively queuing outside of the model. When this occurs, the number of unserved vehicles is shown to the right of the congestion diagram

Intersection Operations

Intersection LOS is summarized in Appendix A. All intersections operate at LOS D with two exceptions:

- Loxie Eagans Boulevard and SR 3 Southbound Ramps – the southbound approach to this stop-controlled intersection operates at LOS E during the p.m. peak hour.
- SR 3 and Sam Christopherson Boulevard – This signalized intersection operates at LOS E during the p.m. peak hour.

Alternatives Evaluated

This section describes the roadway configuration for each of the five alternatives. One Alternative, the Construct or Restripe Two Lanes, was analyzed both with and without a ramp meter for the SR 304 GP lane, bringing the total number of alternatives to six.

Southbound SR 3: Hard Shoulder Running

This alternative would provide hard shoulder running during peak travel times at the existing SR 3 merge from two lanes to one lane north of the SR 304 on-ramp. This alternative would still merge north of the SR 304 westbound add-lane, but the merge would take place south of the existing location.

Southbound SR 3: Construct or Restripe Two Lanes

This alternative would modify the SR 3 / SR 304 interchange by maintaining two travel lanes on SR 3 southbound and changing the SR 304 on ramp from an add-lane to a merge lane. This modification could be accomplished through either a restripe, or constructing an additional lane—there is no difference between the traffic operations resulting from the two methods. This alternative was analyzed with and without a ramp meter for the SR 304 GP lane.

Southbound SR 3: Add Third Lane from SR 304 to Gorst

This alternative would maintain two travel lanes on SR 3 southbound, and maintain the SR 304 ramp as an add-lane by adding a third southbound lane to SR 3 between the SR 304 interchange and Gorst, where it would tie into the existing three lane section leading to SR 16.

Transportation Demand Management

This alternative provided a reduction in future traffic volumes through the implementation of transportation demand management (TDM) strategies. The focus of the traffic analysis was not on the specific strategies used, but on the effect of removing trips from the transportation network. The opening year (2020) analysis assumed a five percent reduction in traffic volumes, and the future year (2040) analysis assumed a 10 percent reduction in traffic volumes. Reference Figure 2 on Page 12.

SR 304: Convert HOV Lane to GP Lane

This alternative would convert the SR 304 westbound HOV lane to a GP lane. No other changes were made to the merge location on SR 304 or SR 3.

Opening Year (2020) Traffic Operations

Corridor Operations

No Build Alternative

Vehicle congestion is anticipated where SR 3 southbound merges from two lanes to one lane, and where SR 304 westbound merges from two lanes to one lane, as illustrated by the congestion diagrams in Appendix A. The increased traffic volume modeled for the opening year (2020) results in substantially more congestion compared to existing conditions.

On SR 3 southbound the duration of congestion is anticipated to increase from 2 hours 45 minutes with existing conditions to 4 hours 15 minutes with the No Build Alternative. Congestion would also extend to the start of the study area, leaving approximately 460 unserved vehicles.

At the Loxie Eagans Boulevard and SR 3 southbound ramps intersection, the stop-controlled southbound approach would be over capacity, and the resulting queue is anticipated to extend back to the auxiliary lane on SR 3 southbound.

The duration of congestion on SR 304 westbound would increase from 1 hour 45 minutes with existing conditions to 2 hours 30 minutes with the No Build Alternative, and congestion would extend to the start of the study area, leaving approximately 175 unserved vehicles.

Congestion on SR 3 northbound and SR 304 eastbound would not change with the No Build Alternative compared to existing conditions.

Build Alternatives

SR 3

Because all the roadway configuration for all build alternatives on SR 3 northbound and SR 304 eastbound does not change compared to the No Build Alternative, the traffic operations are not anticipated to change and not included in this section.

As illustrated by the congestion diagrams in Appendix B, on SR 3 southbound, the following three alternatives are anticipated to experience congestion similar to the No Build Alternative (this is because the alternatives maintain the merge condition from two lanes to one lane that is the source of congestion on SR 3 southbound):

- SR 3 Southbound: Hard Shoulder Running: The merge location would be moved south, reducing the number of unserved vehicles compared to the No Build Alternative.
- Transportation Demand Management (TDM): the number of unserved vehicles would be reduced, because the traffic volumes are lower compared to the No Build Alternative.
- SR 304: Convert HOV Lane to GP Lane.

As summarized in Appendix 4, travel times on SR 3 southbound with the Hard Shoulder Running, TDM, and Convert HOV Lane Alternatives are similar to the No Build Alternative.

For the Construct or Restripe (with and without a ramp meter), and the Add Third Lane alternatives, the merge condition on SR 3 southbound would be eliminated, and congestion on SR 3 southbound would be reduced. The Construct or Restripe Two Lanes (no meter) is anticipated to result in some congestion at the SR 304 on-ramp merge area due to the high volume of vehicles on the ramp. Average travel times on SR 3 southbound with the Construct or Restripe, and Add Third Lane Alternatives are modeled at over two minutes, compared to almost ten minutes with the No Build Alternative.

With all build alternatives, the queue from the southbound off ramp to Loxie Eagans Boulevard is anticipated to extend into the auxiliary lane on the SR 3 southbound mainline, similar to the No Build Alternative.

SR 304

On SR 304 the Add Third Lane Alternative would maintain two travel lanes to the connection with SR 3 southbound. This would eliminate the merge location that is the main source of congestion in the No Build Alternative, and substantially reduce congestion compared to the No Build Alternative. GP and HOV travel times would improve compared to the No Build Alternative due to the reduced congestion levels.

The Hard Shoulder Running and Construct or Restripe (without a ramp meter) alternatives would have similar congestion levels, congestion duration, and unserved vehicles similar to the No Build Alternative.

With the Construct or Restripe (with a ramp meter) alternative, the duration of congestion would increase to 5 hours, and the number of unserved vehicles would increase to over 1,300. This is because the ramp meter restricts the number of vehicles able to pass through the ramp meter to well below the vehicle demand.

With the TDM Alternative, the number of unserved vehicles would be reduced because traffic volumes are lower compared to the No Build Alternative.

The Convert HOV Lane Alternative would reduce the number of unserved vehicles because GP vehicles would use the converted HOV lane, but the two GP lanes would still merge to one GP lane, resulting in congestion occurring on SR 304.

Vehicle Hours of Delay and Throughput

Vehicle Hours of Delay provides a simple comparison across alternatives by summing the delay experienced by each driver in the network. As shown in Appendix 5, in the opening year (2020), the Construct, or Restripe without a ramp meter, and the Add Third Lane Alternatives perform the best. The remaining alternatives perform similar to the No Build Alternative.

As shown in Appendix 3, vehicle throughput just south of the SR 3 / SR 304 interchange is over 90 percent for all alternatives.

Intersection Operations

As illustrated in Appendix A, opening year (2020), intersection LOS is anticipated to remain the same compared to existing conditions at all six study intersections with the exception of the Loxie Eagans Boulevard and SR 3 southbound ramps intersection. The stop-controlled SR 3 southbound off ramp worsens from LOS E to F, and is over capacity during the peak hour. The resulting queue is anticipated to extend to the SR 3 mainline auxiliary lane.

Future Year (2040) Traffic Operations

Corridor Operations

No Build Alternative

As illustrated in Appendix 2, the No Build Alternative is anticipated to experience congestion where SR 3 southbound merges from two lanes to one, and where SR 304 westbound merges from two lanes to one. The assumed increase in traffic volumes for the future year (2040) would result in increased congestion compared to existing conditions and the opening year (2020).

On SR 3 southbound the duration of congestion is anticipated to increase to 5 hours with the No Build Alternative. Congestion would also extend to the start of the study area, leaving over 4,500 unserved vehicles. It is likely that congestion would not reach such severe conditions, as people would divert or eliminate trips to avoid the congestion. As described in the Methodology section above, this study assumed traffic volumes and travel patterns to be the same across all alternatives. This allows for a conservative comparison that describes how well each of the alternatives performs with a given set of volumes.

At the Loxie Eagans Boulevard and SR 3 southbound ramps intersection, the stop-controlled southbound approach would be over capacity, and the resulting queue would extend back to the auxiliary lane on SR 3 southbound, and impact the two travel lanes as drivers slow to enter the queue in the auxiliary lane.

The duration of congestion on SR 304 westbound would also increase to 4 hours 45 minutes with the No Build Alternative, and congestion would extend to the start of the study area, leaving approximately 1,900 unserved vehicles.

Congestion in the non-peak direction, on SR 3 northbound and SR 304 eastbound, is not anticipated to change with the No Build Alternative compared to existing conditions.

Build Alternatives

SR 3

With all build alternatives, the roadway configuration on SR 3 northbound and SR 304 eastbound would not be modified compared to the No Build Alternative, and traffic operations would not change. This section summarizes the traffic operations for SR 3 southbound and SR 304 westbound in the vicinity of the SR 3 / SR 304 interchange area for the year 2040.

As illustrated by the congestion diagrams provided in Appendix B, on SR 3 southbound, the following three alternatives are anticipated to experience congestion similar to the No Build Alternative (this is because each alternative would maintain the merge condition from two lanes to one lane that is the source of congestion on SR 3 southbound):

- SR 3 Southbound Hard Shoulder Running: the merge location would be moved south, reducing the number of unserved vehicles compared to the No Build Alternative.
- TDM: the number of unserved vehicles would be reduced because the traffic volumes are lower; and,
- SR 304: Convert HOV Lane to GP Lane

As summarized in Appendix 4, travel times on SR 3 southbound with the Hard Shoulder Running, TDM, and Convert HOV Lane Alternatives are anticipated to be similar to the No Build Alternative.

The Construct or Restripe (with and without a ramp meter), and the Add Third Lane alternatives would eliminate the merge condition on SR 3 southbound, and reduce congestion on SR 3 southbound compared to the No Build Alternative. The Construct or Restripe Two Lanes (both with and without a ramp meter) would result in some congestion at the SR 304 on-ramp merge area due to the high expected vehicle volume on the ramp. Average travel times on SR 3 southbound with the Construct or Restripe, and Add Third Lane Alternatives are anticipated to range from approximately 3 to 7 minutes, compared to over 14 minutes with the No Build Alternative.

With all build alternatives, the queue from the southbound off ramp to Loxie Eagans Boulevard is anticipated to extend into the auxiliary lane on the SR 3 southbound mainline, similar to the No Build Alternative.

SR 304

On SR 304 the Add Third Lane Alternative would maintain two travel lanes to the connection with SR 3 southbound. This would eliminate the merge location that is the main source of congestion in the No Build Alternative, and substantially reduce congestion compared to the No Build Alternative. GP and HOV travel times are expected to improve compared to the No Build Alternative.

The Hard Shoulder Running and Construct or Restripe without a ramp meter have similar congestion levels, congestion duration, and unserved vehicles similar to the No Build Alternative.

With the Construct or Restripe with a ramp meter the duration of congestion increases to 5 hours, and the number of unserved vehicles increases to approximately 4,400. This is because the ramp meter restricts throughput of GP well below the vehicle demand.

With the TDM Alternative, the number of unserved vehicles is reduced because traffic volumes are lower compared to the No Build Alternative.

The Convert HOV Lane Alternative reduces the number of unserved vehicles compared to the No Build Alternative because GP vehicles are able to utilize the converted HOV lane, but the two GP lanes still merge to one GP lane and congestion still occurs on SR 304.

Intersection Operations

As illustrated in Appendix 1, in the future year (2040), intersection LOS is anticipated to worsen compared to existing conditions and opening year (2020) conditions at all study intersection, except for the Loxie Eagans Boulevard and SR 3 southbound ramps intersection, which is already operating at LOS F in the opening year (2020). The resulting queue spills back to the SR 3 mainline auxiliary lane.

Vehicle Hours of Delay and Throughput

As shown in Appendix 5, vehicle hours of delay increases substantially compared to the opening year (2020) for all alternatives except for the Add Third Lane Alternative.

As shown in Appendix 3, vehicle throughput just south of the SR 3 / SR 304 interchange drops below 90 percent with all alternatives except the Add Third Lane Alternative.

Summary of Findings

With the current corridor geometric configurations, the following locations cause congestion during the p.m. commute period:

- SR 3 southbound at the merge from two lanes to one lane
- SR 304 westbound at the merge from two lanes to one lane

With the anticipated growth in traffic volumes in the opening year (2020) and future year (2040), congestion levels are anticipated to increase, and travel times in the corridor would worsen.

The findings for the alternatives analysis are summarized in Figures 3 and 4, which provide a summary comparison ranking for the performance of each alternative based on throughput, travel time, vehicle hours of delay, duration of congestion, and unserved vehicles.

Figure 2. Transportation Demand Management Results

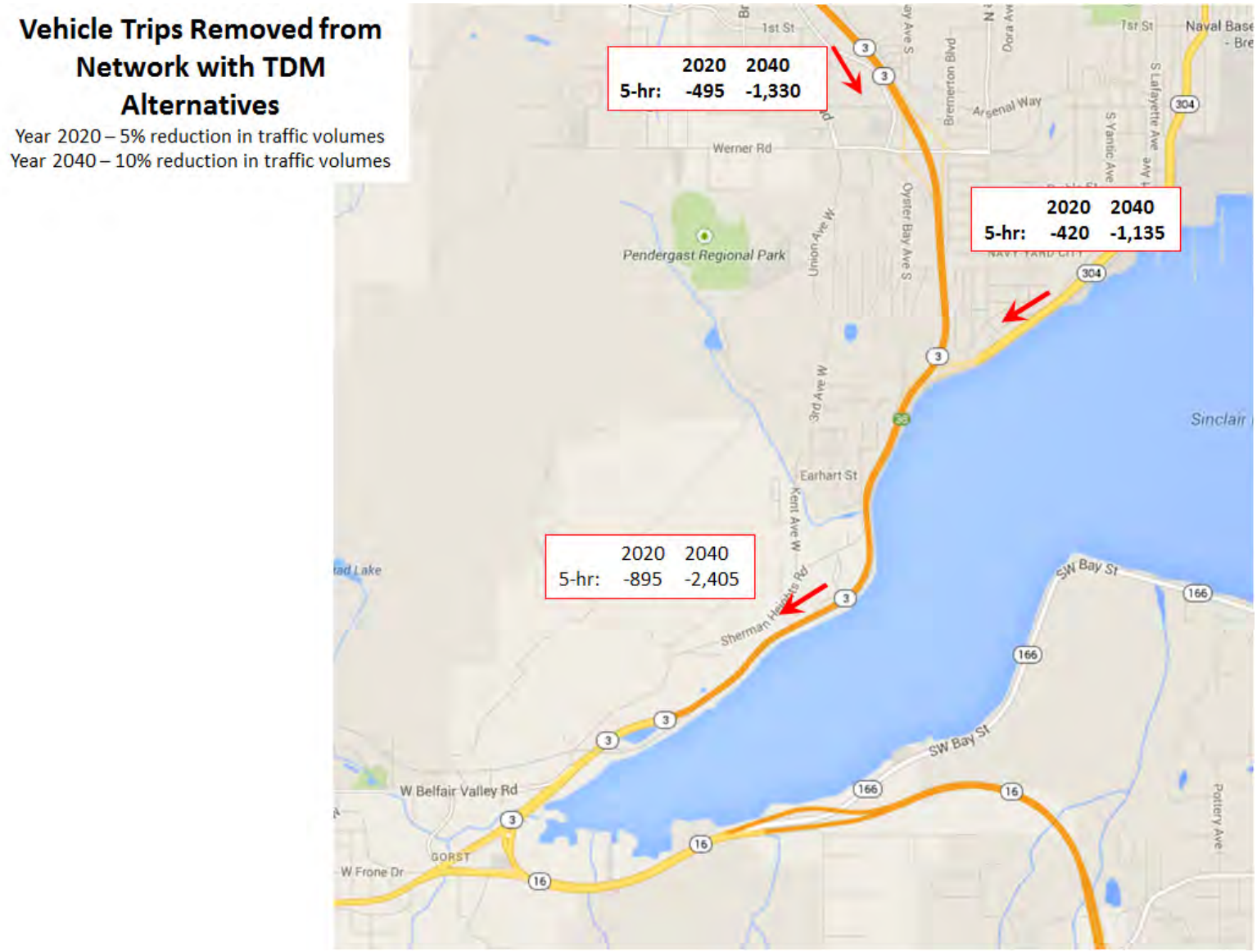
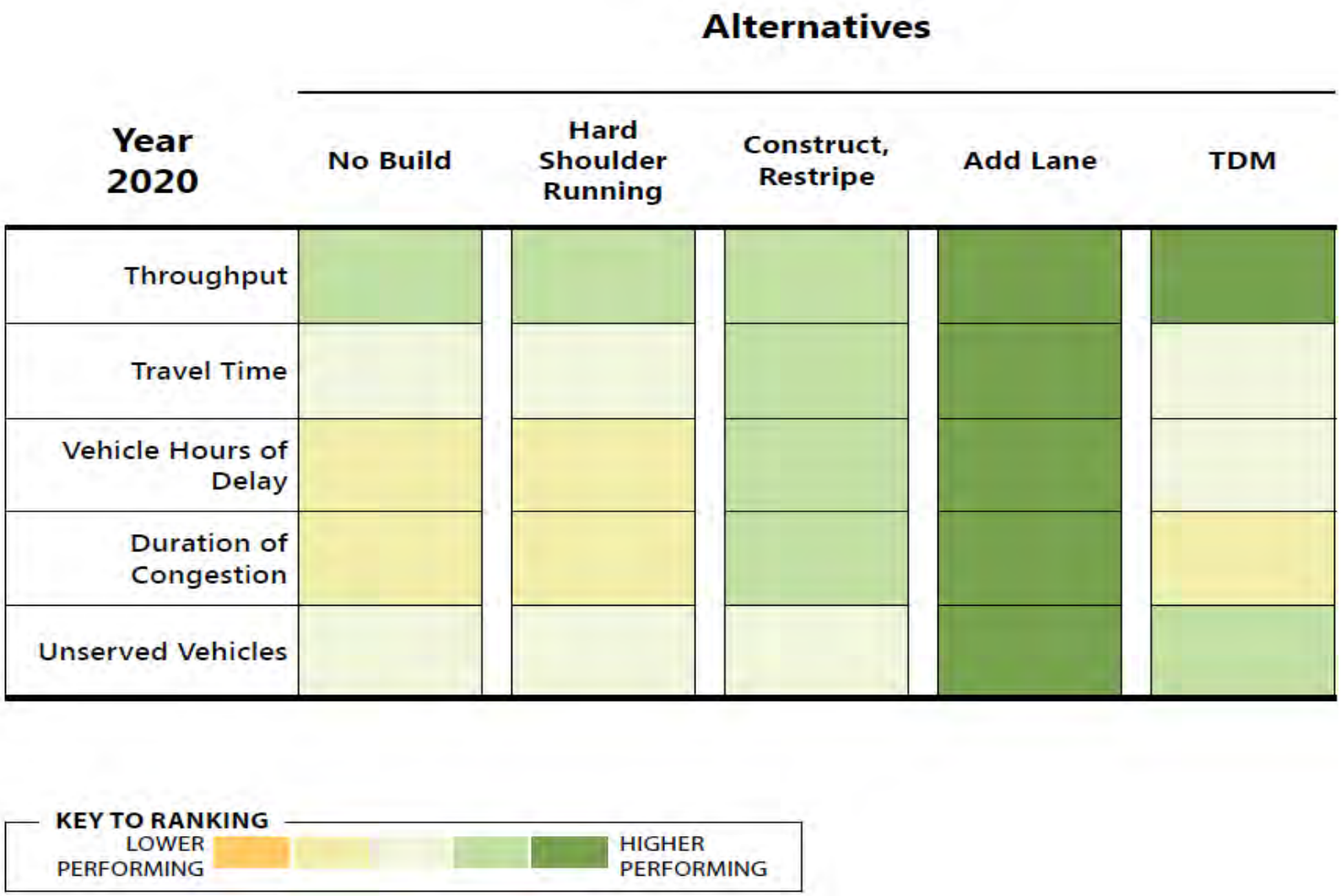
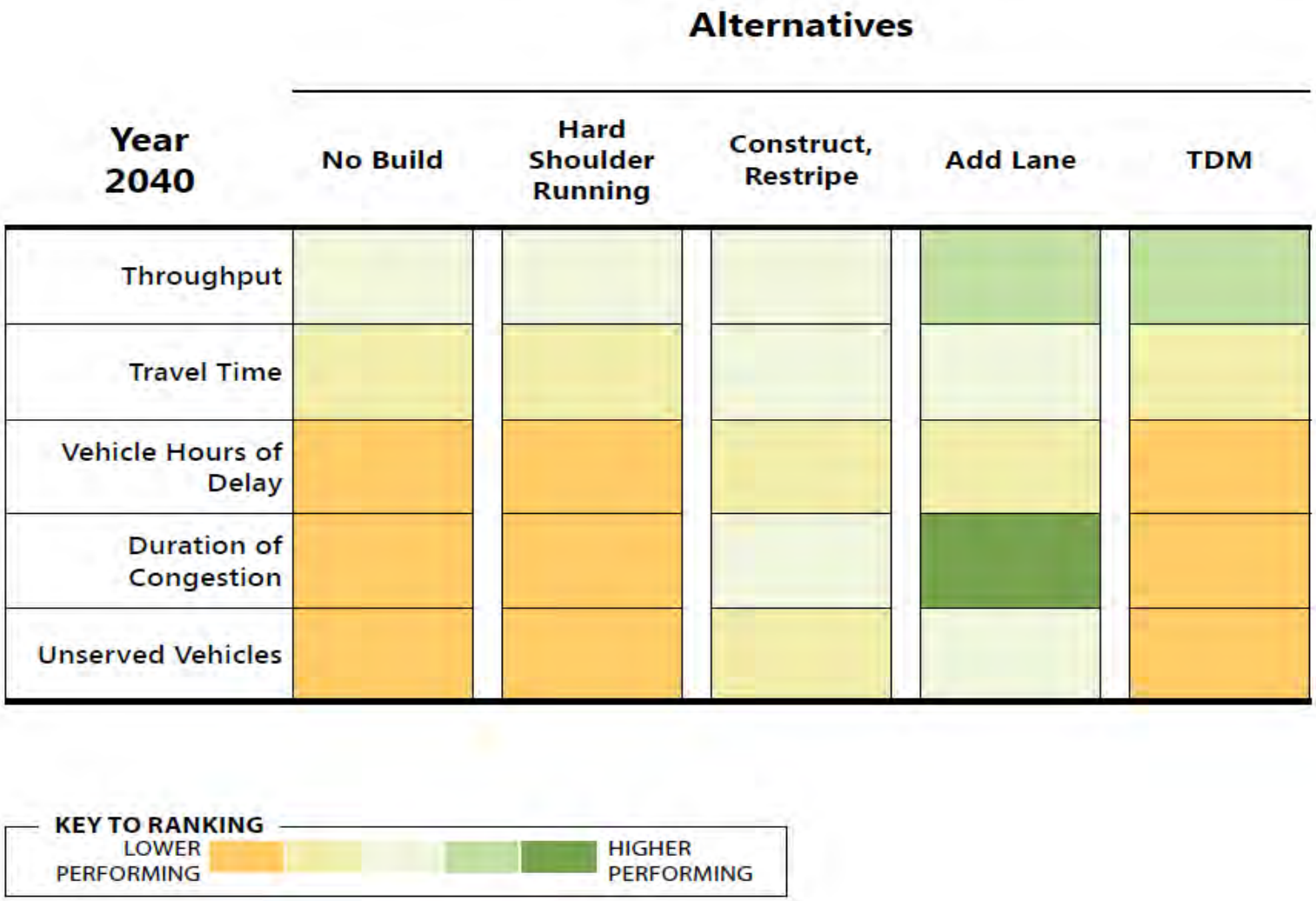


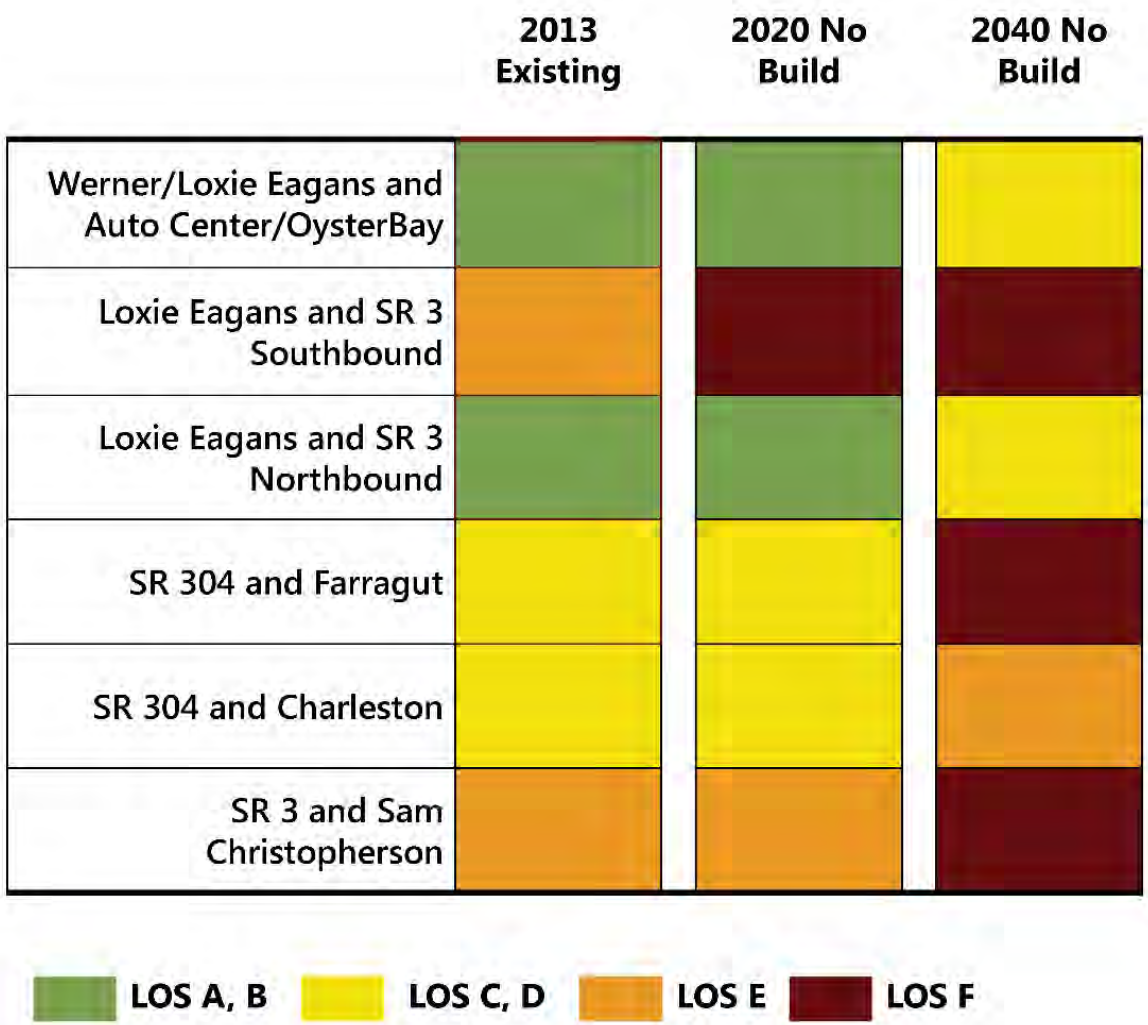
Figure 3. Summary of Findings: Opening Year (2020)



Summary of Findings: Future Year (2040)
Figure 4



Appendix 1: Intersection Level of Service

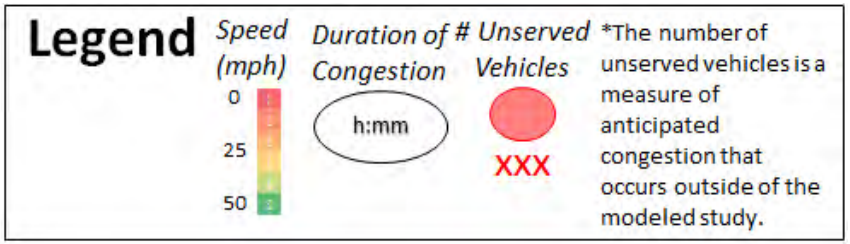


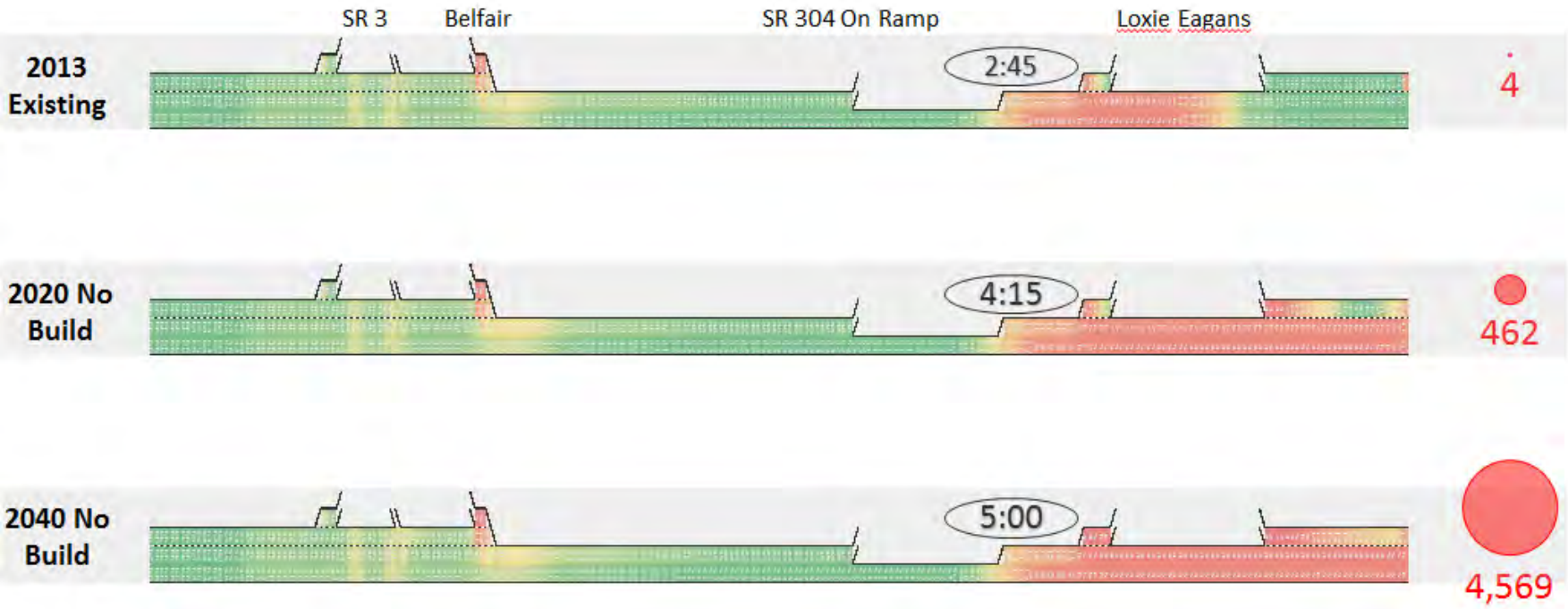
Appendix 2: Congestion Diagrams

SR 3 Southbound

Existing and No Build

5/18/2015

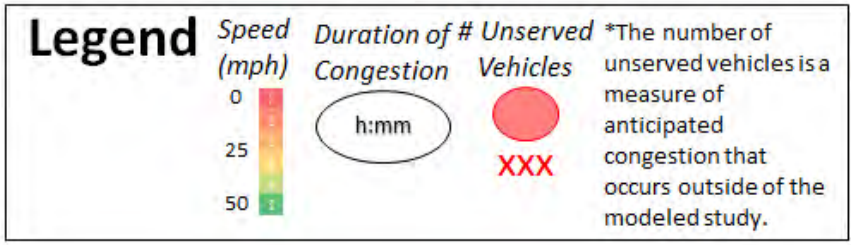


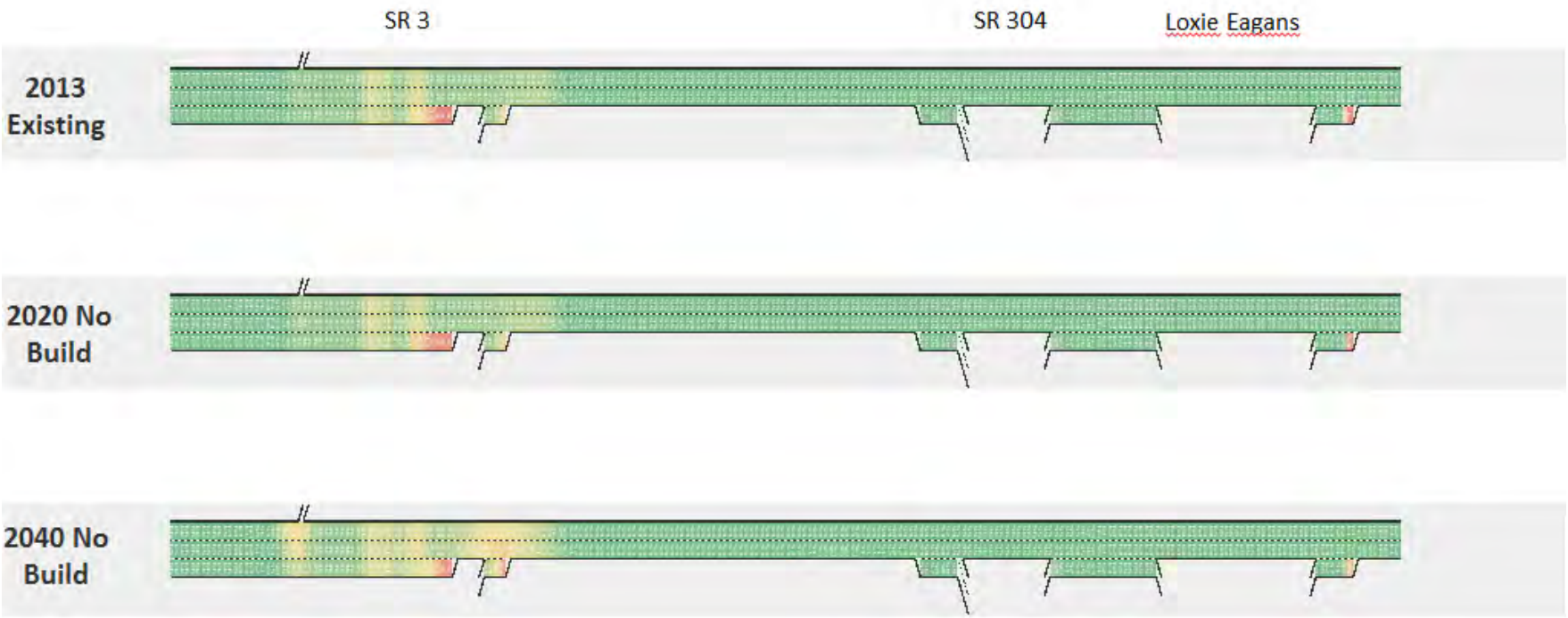


SR 3 Northbound

Existing and No Build

5/18/2015

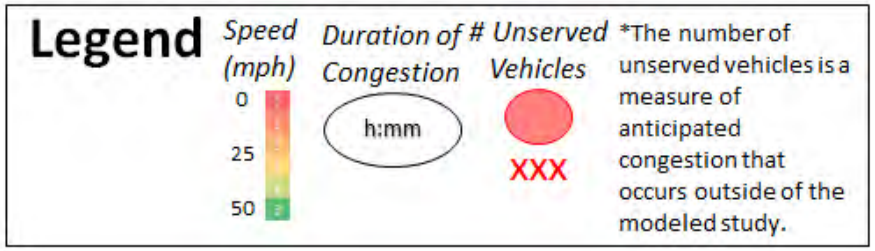


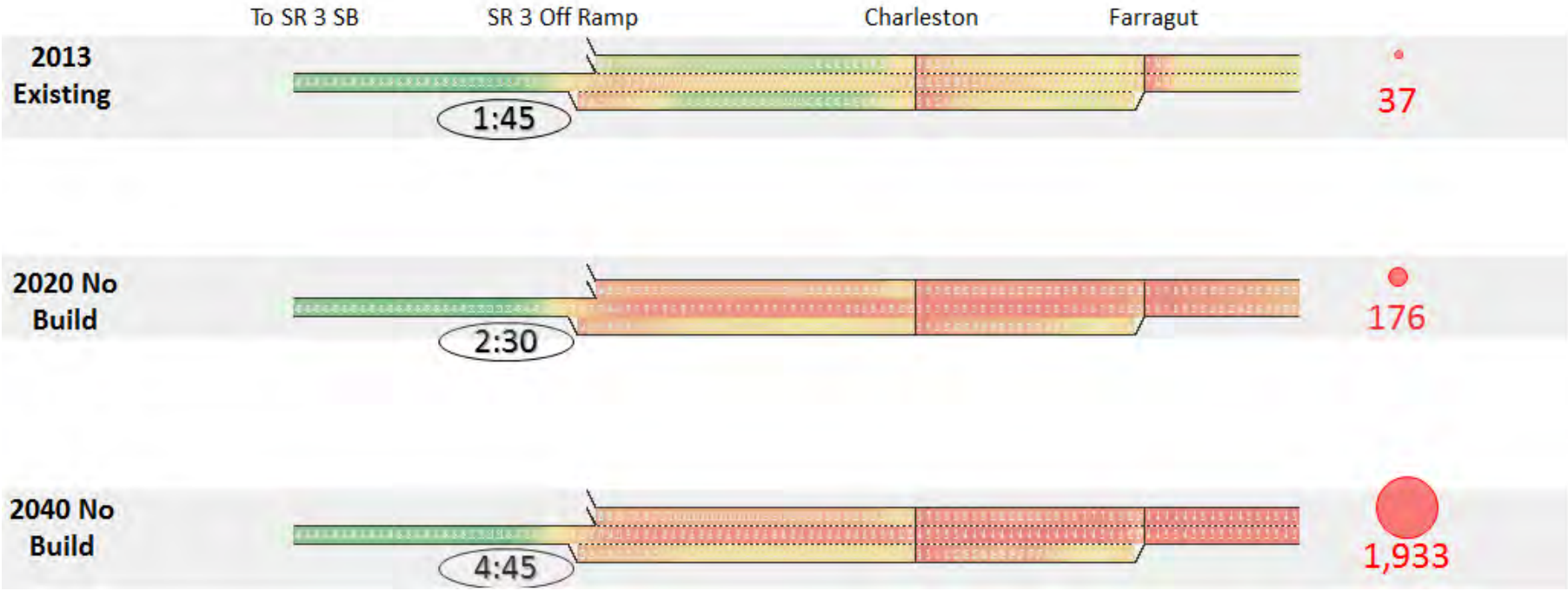


SR 304 Westbound

Existing and No Build

5/18/2015

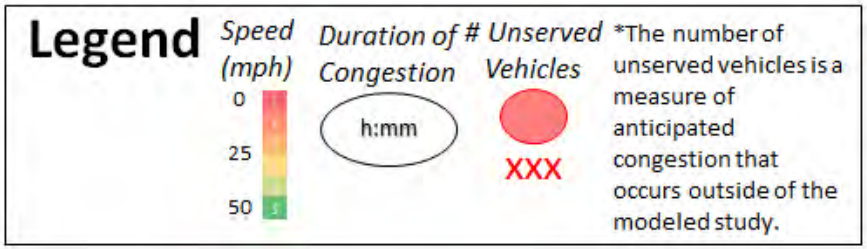


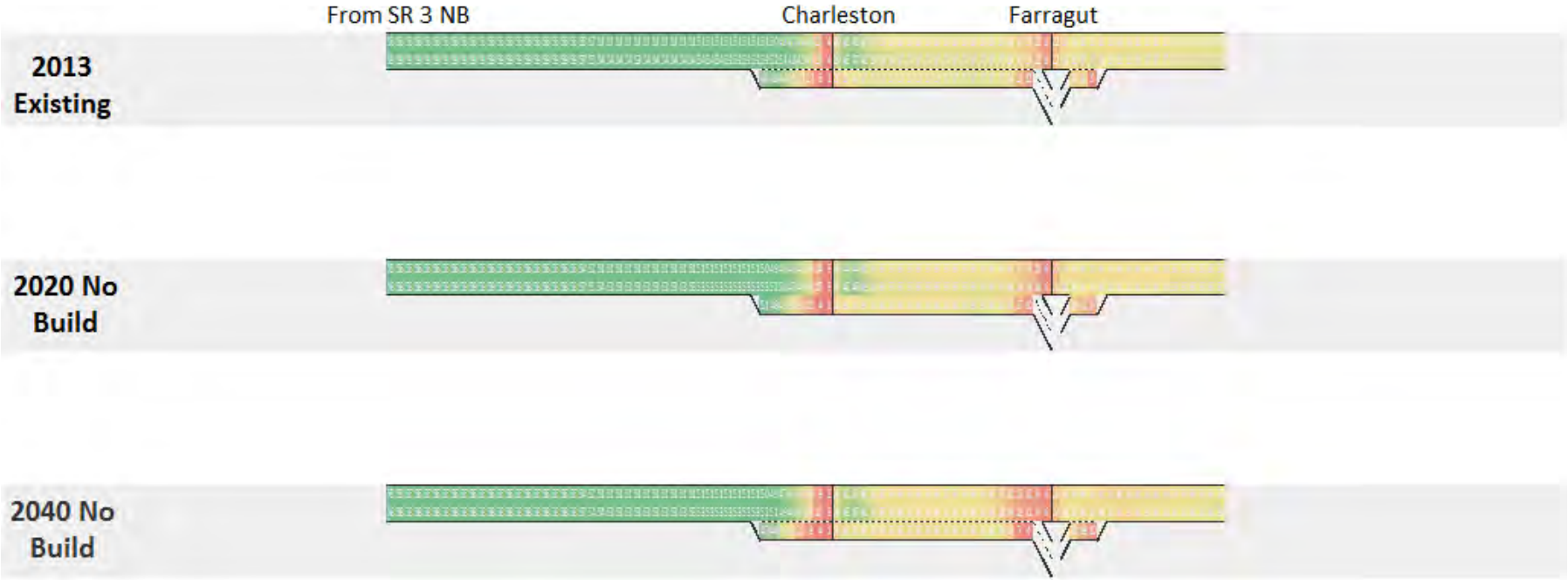


SR 304 Eastbound

Existing and No Build

5/18/2015

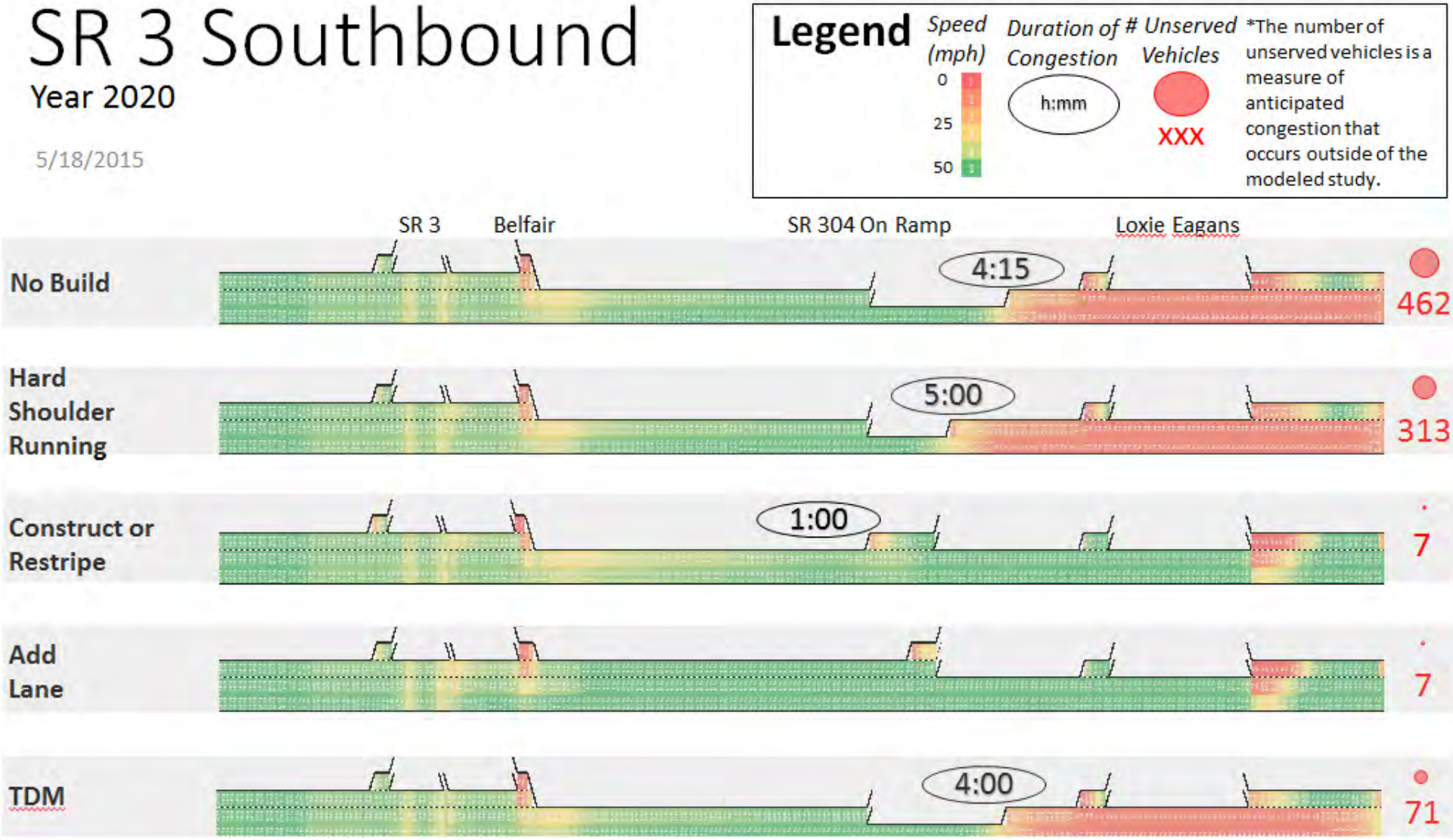




SR 3 Southbound

Year 2020

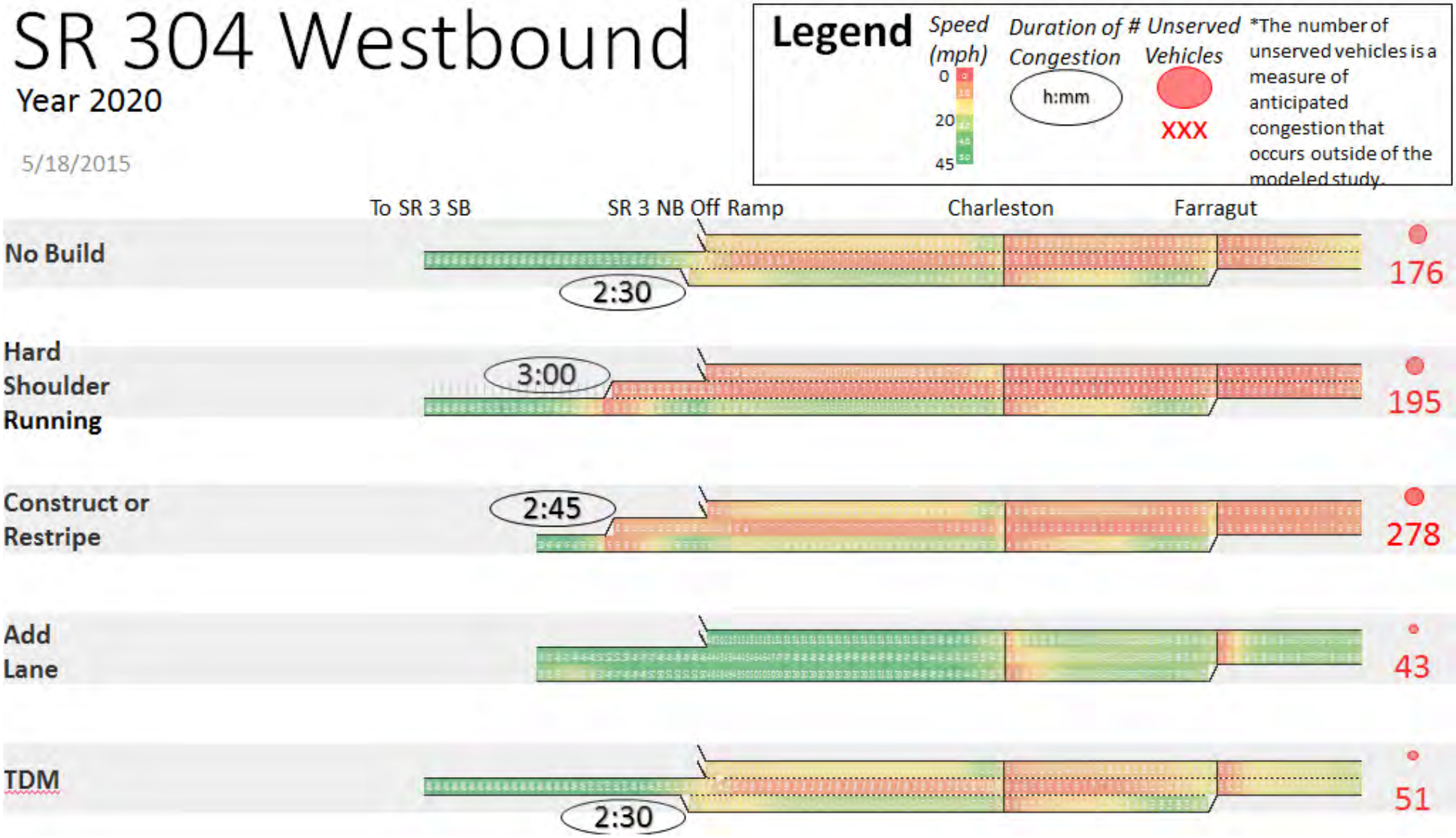
5/18/2015



SR 304 Westbound

Year 2020

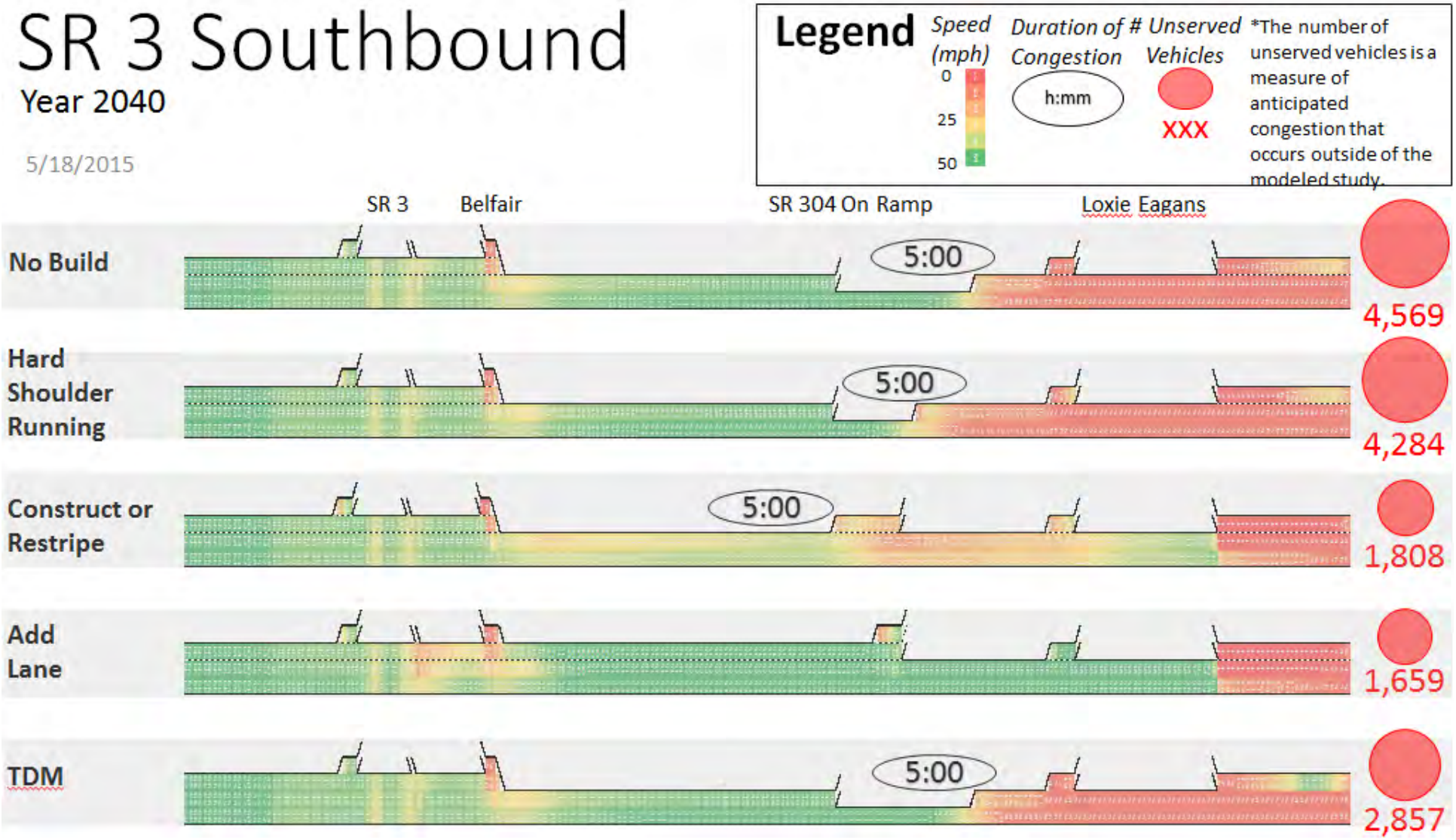
5/18/2015



SR 3 Southbound

Year 2040

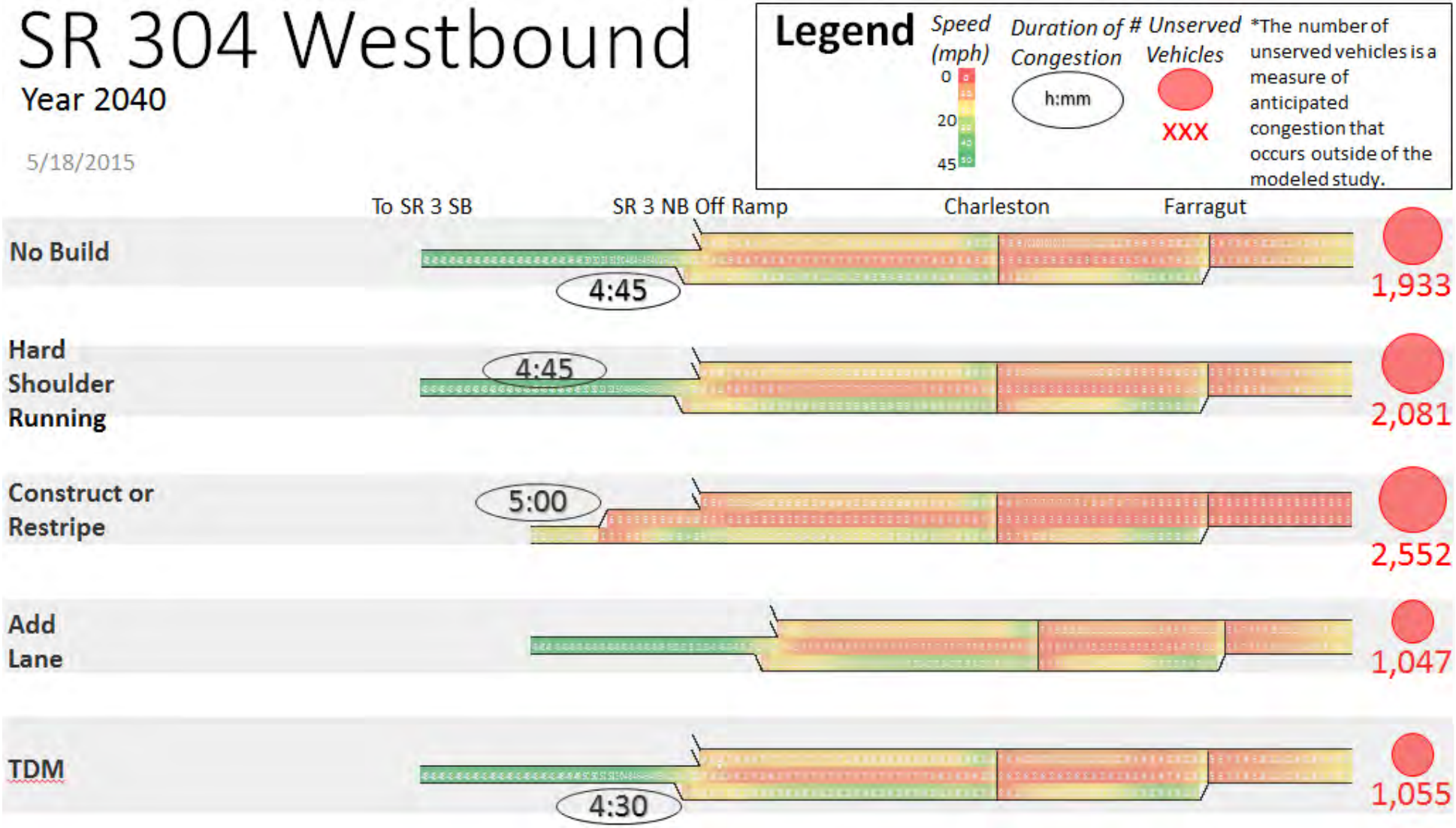
5/18/2015



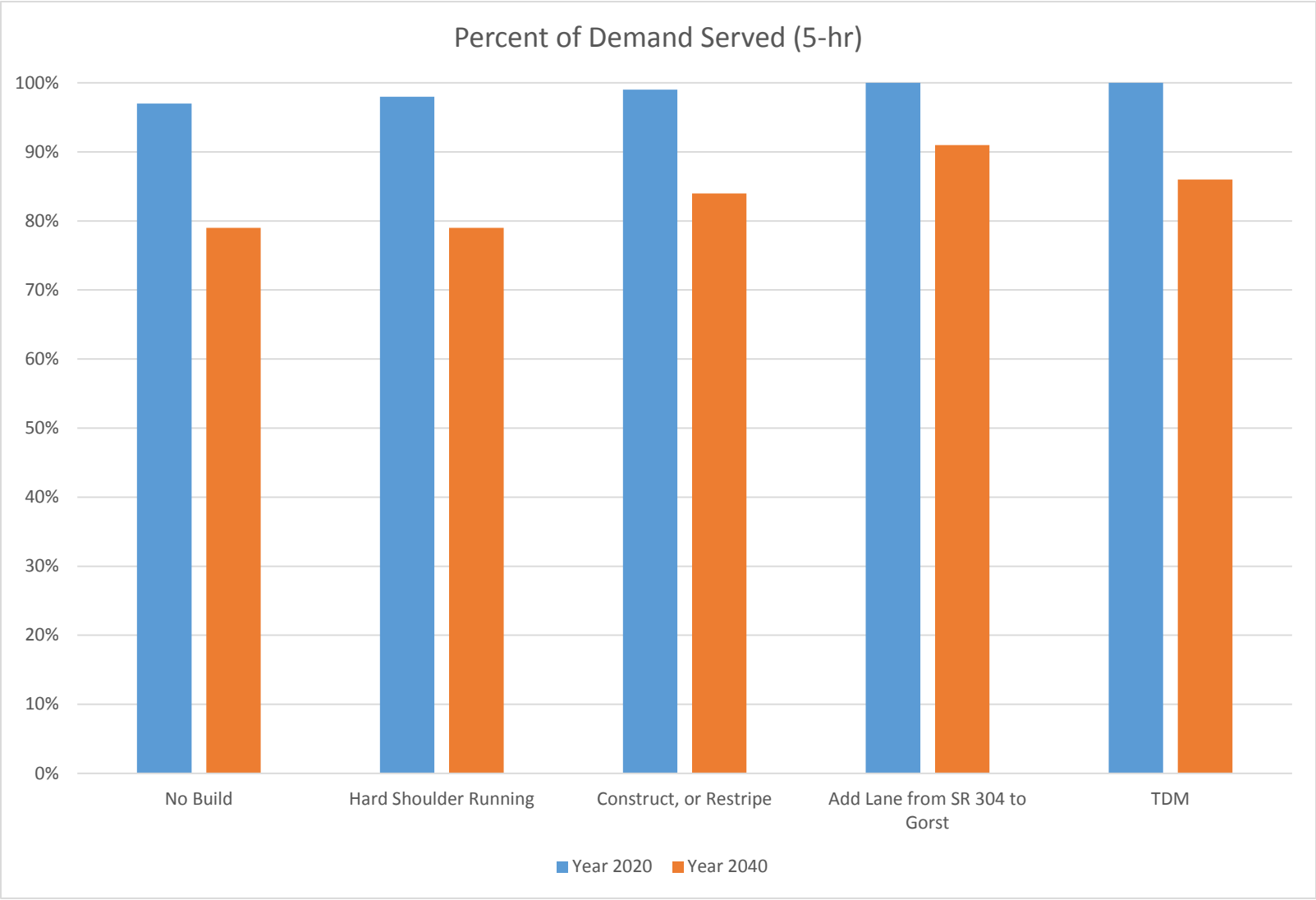
SR 304 Westbound

Year 2040

5/18/2015



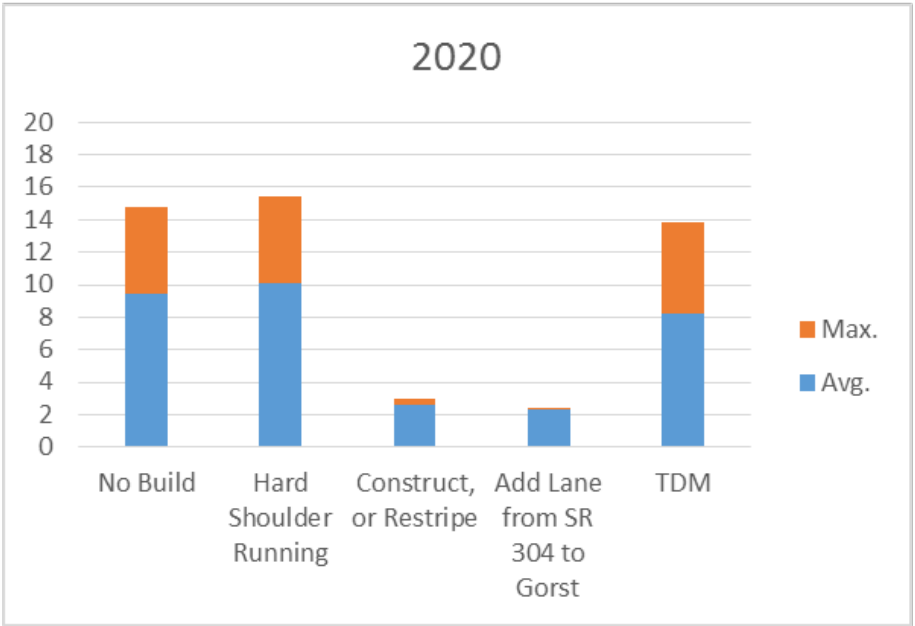
Appendix 3: Vehicle Throughput SR 3 Southbound, South of the SR 304 On-ramp



Appendix 4: Travel Times

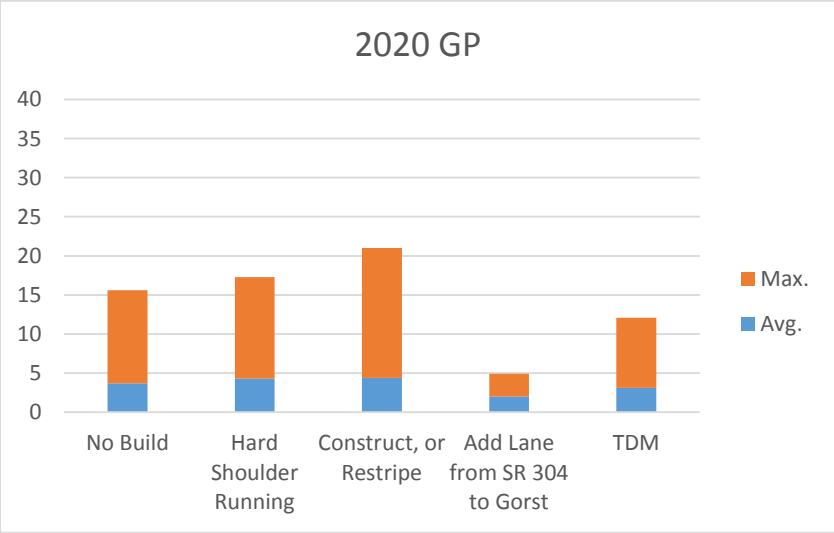
SR 3 Southbound

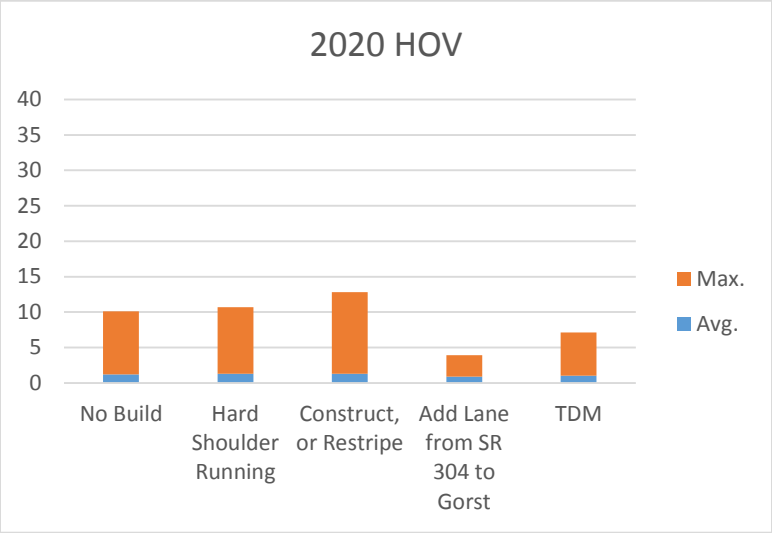
From north of Loxie Eagans to south of the SR 304 on-ramp

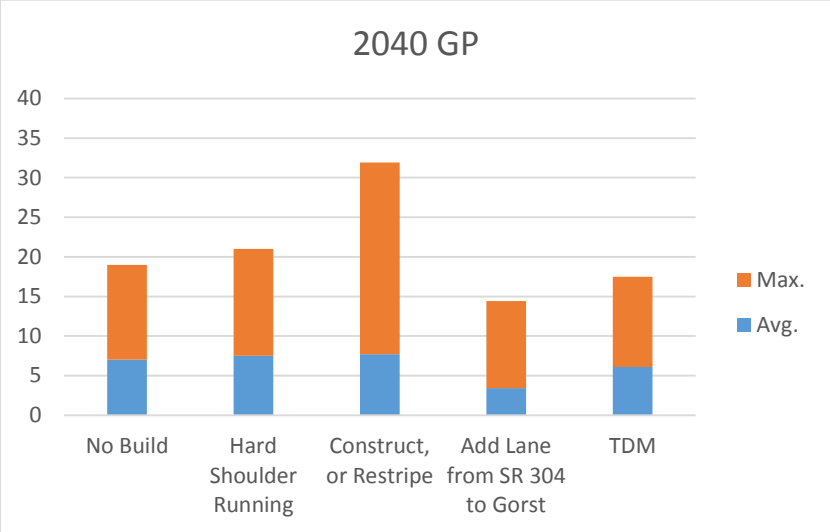


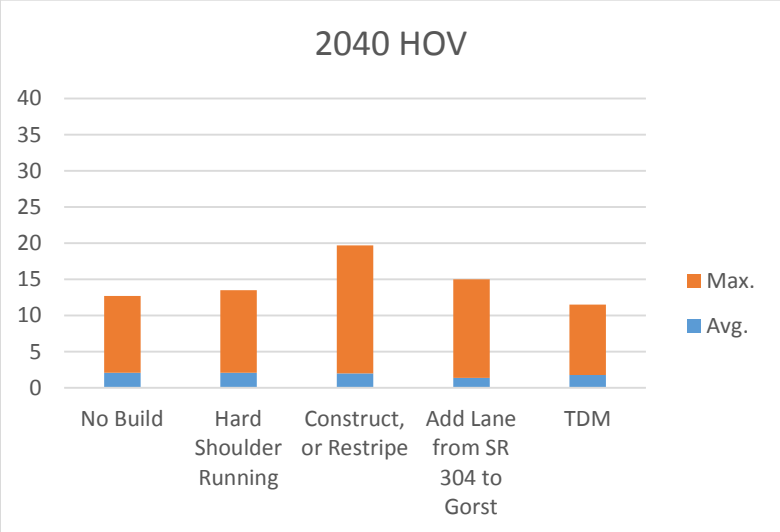
SR 304 Westbound

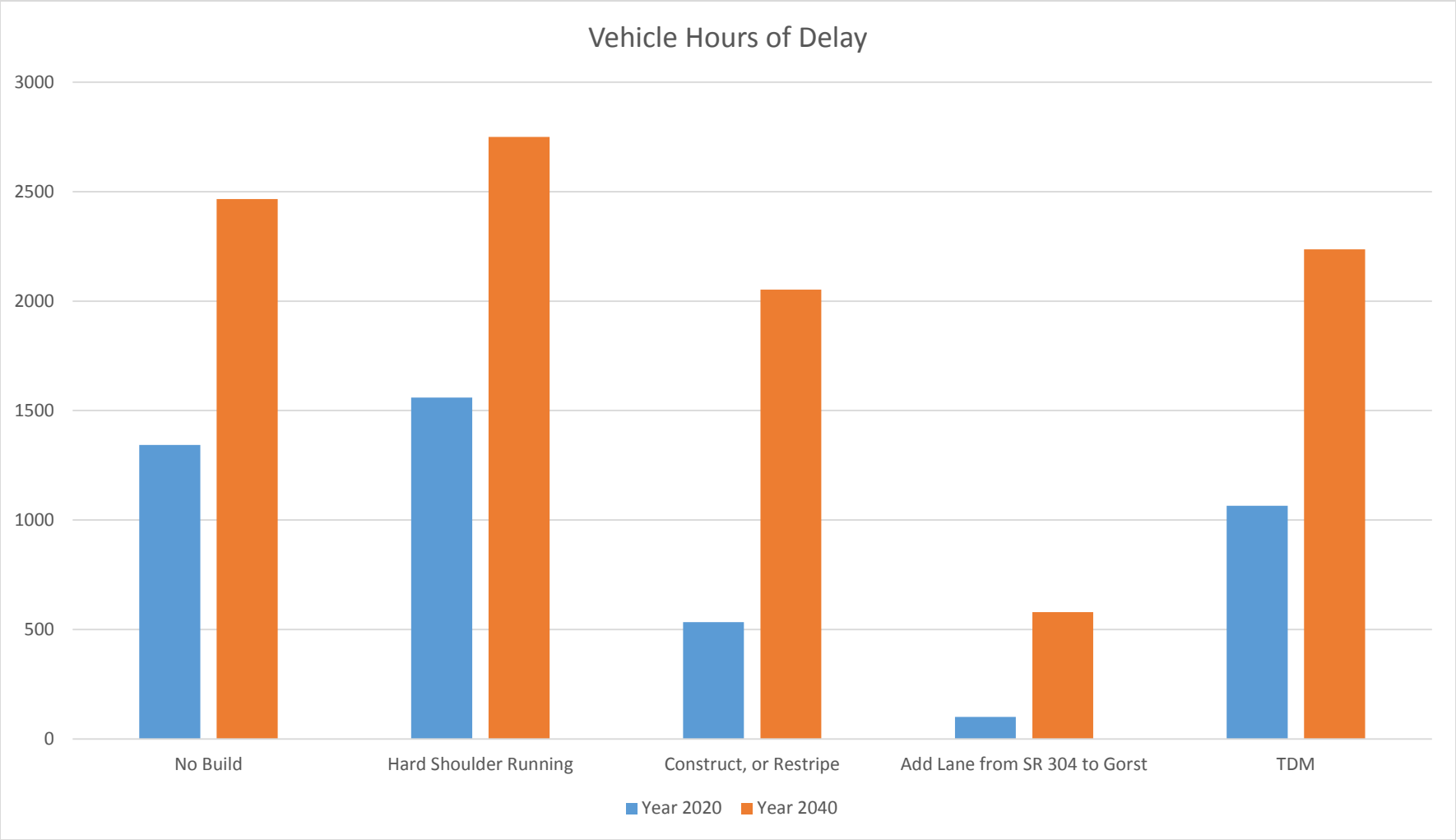
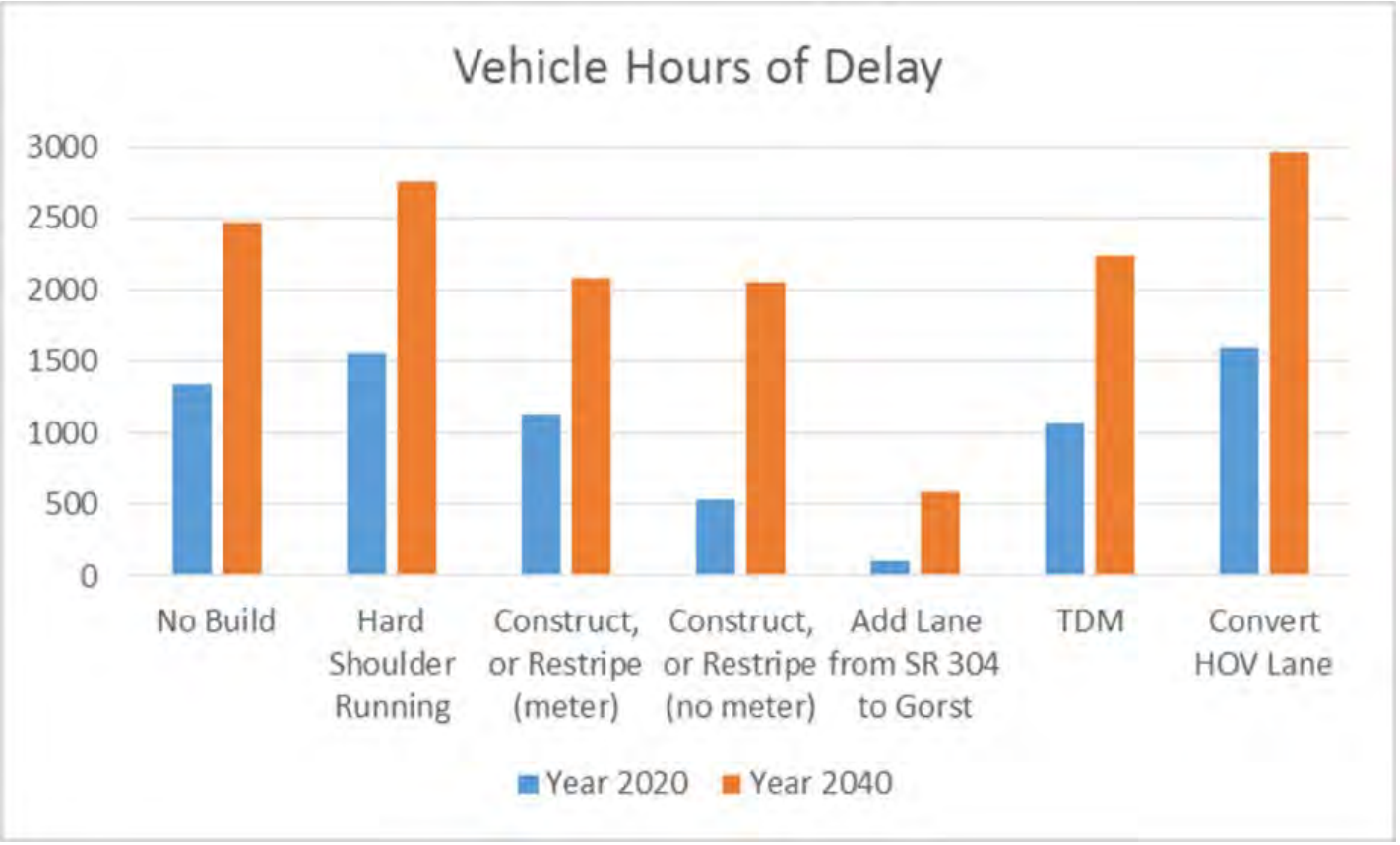
From north of Farragut to SR 3 south of the SR 304 on-ramp










Vehicle Hours of Delay
3000
2500
2000
1500
1000
500
0
No Build
Hard Shoulder Running
Construct, or Restripe
Add Lane from SR 304 to Gorst
TDM
Year 2020
Year 2040

Appendix 5: Vehicle Hours of Delay