MEMO

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FROM: Brian Woodburn (Parametrix)

CC: Michael Horntvedt (Parametrix)

SUBJECT: 05.03.01 Preliminary Transportation Methods and Assumptions

DATE: December 13, 2018

TEAM PARTICIPANTS

EXECUTIVE TEAM MEMBERS, ROLES, AND RESPONSIBILITIES

Work underway as part of this phase of the project will involve an executive advisory group that will be composed of elected officials from the state government and high-level management staff from the affected jurisdictions and agencies. This team will be responsible for participating in the executive advisory group (EAG) meetings as representatives of their constituents. They will identify key issues that the project team should consider as they outline the needs of the project and develop alternatives.

TECHNICAL TEAM MEMBERS, ROLES, AND RESPONSIBILITIES

Similar to the executive advisory group, a technical working group (TWG) will convene to discuss technical issues related to the project team's outline of the needs, development of the alternatives, and description about potential outcomes. This group will consist of staff from the jurisdictions and agencies that will be able to discuss the technical details and provide suggestions that could improve the alternatives' efficiency and cost effectiveness.

PLANNING LINKAGE

It is essential to link the transportation planning processes, outputs, and improvements considered in this study with the planning processes in other agencies, including addressing multimodal connectivity. The improvements considered should be consistent with local land use plans and local, regional, and state transportation plans.

PERTINENT PLANNING DOCUMENTS

The analysis described in this methods and assumptions document will consider the regional plans listed below to account for and ensure consistency with anticipated growth, development, and transportation network improvements described in the regional plans:

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- US 2 Corridor Study
- SR 9/SR 204/20th Street Interchange Justification Report (IJR)
- US 2 West Trestle Funding and Finance Study
- US 2 – Everett Port/Naval Station to SR 9 Corridor Planning Study
- Comprehensive Plans and Transportation Improvement Programs for the following:
    - Snohomish County
    - City of Everett
    - City of Lake Stevens
    - City of Marysville
    - City of Snohomish
- Puget Sound Regional Council (PSRC) Transportation 2040
- Washington State Department of Transportation (WSDOT) 2017 – 2020 Statewide Transportation Improvement Program
- Community Transit 2016 – 2021 Transit Development Plan
- Sound Transit 2 and 3 funding packages

PRIOR COMMUNITY ENGAGEMENT

The SR 9/SR 204/20th Street IJR included a community engagement work element and gathered input from key stakeholders and the general population through interviews and a public survey. The stakeholders included surrounding municipalities, public transportation officials, and bicycle and trucking interest groups. Several key themes were consistent throughout the interviews:

- The current interchange operations are poor during peak travel times, and stakeholders are supportive of a study to identify near-term improvements to relieve congestion.
- The desired priority of improvements varied, but all agreed that the near-term improvements must not adversely impact local streets and communities or hinder potential for long-term improvements; i.e., the recommended improvements should consider and complement regional and future transportation planning.
- Potential future improvements that reduce travel time and increase speed and reliability are key indicators that the study is successful.

In addition to individual stakeholder interviews, a public survey was conducted to solicit input directly from the general population regarding the issues at the study interchange. More than 2,700 surveys were collected, of which the majority represented daily users of the interchange. The survey results included the following:

- 73 percent of respondents reported that travel time through this interchange has increased by more than 5 minutes in the last 5 years.
- 77 percent of respondents reported traveling through the interchange as a single vehicle occupant.
- 56 percent of respondents reported avoiding using the interchange to access U.S. Highway 2 (US 2) at least some of the time, instead using an alternate route to westbound US 2.

CONTINUED COMMUNITY ENGAGEMENT

This project will include ongoing community engagement efforts, and the analysis will be updated as appropriate based on information and input from the community.

ENVIRONMENTAL LINKAGE

The processes used in this study will be aligned with the environmental documentation process to reduce duplication of effort. Environmental staff will be engaged in the process to ensure compliance with the National Environmental Policy Act (NEPA)/State Environmental Policy Act (SEPA) as the project progresses and a preferred alternative is identified.

COMMUNITY ENGAGEMENT

Maintaining a transparent outreach process is important for keeping the public engaged in the project and informed about project findings.

Traffic operations data, evaluation, screening information, and results developed throughout the project will be used to create community engagement materials. All community engagement materials will follow the Quality Control (QC) process and be reviewed internally with the state to ensure accuracy before being shared with the public.

ALTERNATIVES SELECTION

This section describes the process for determining reasonable alternatives (non-access and access), including alternative development and screening.

PROJECT NEED AND PERFORMANCE MEASURES

The first step in the alternatives selection process is to establish the project need, which would then be used toidentify performance measures or metrics for the transportation system. The performance measures will be applied to determine the extent by which existing and future no-build conditions fall short of meeting the project need (i.e. performance gaps), along with input from project stakeholders. The evaluation of needs will consider the following:

- Trip and travel characteristics of people who use the US 2 Trestle
- General purpose traffic, freight traffic, and transit operations
- Transit and HOV access
- Nonmotorized (bicycle, pedestrian) connectivity and access
- Safety
- Environmental impacts

ALTERNATIVES DEVELOPMENT

Reasonable non-access and access alternatives that address the performance gaps and support the project need will identified and developed through coordination with WSDOT and project stakeholders. This includes confirming assumptions about the benefits and implementation of proposed alternatives.

A workshop will be held to determine the applicability of alternatives identified in previous workshops, develop potential revisions to previously identified alternatives, and develop new alternatives. This project will consider the interdependence of US 2 with other surrounding roadways, and previously developed concepts that either meet the purpose and need, or can be revised to meet the purpose and need, are open for evaluation.

ALTERNATIVES SCREENING

Following the alternatives development, the alternatives screening process will be conducted so that a preliminary preferred alternative can be selected. The screening process will consist of three levels, with the amount of detail evaluated increasing at each level. The alternatives may be revised or redefined as they are being evaluated to better meet the purpose and need.

FIRST-LEVEL SCREENING – QUALITATIVE

The first-level screening will be used to eliminate from further consideration alternatives determined to have physical or operational fatal flaws, or that do not meet the project need. No quantitative analysis will be performed during the first-level screening. General purpose traffic, transit and nonmotorized access, nonmotorized connectivity, and environmental impacts will be qualitatively assessed. Up to 12 alternatives will pass through the first-level screening.

SECOND-LEVEL SCREENING – DYNAMIC TRAFFIC ASSIGNMENT MODEL

In the second-level screening, the alternatives will be evaluated quantitatively using the Dynameq traffic model. The performance metrics used to screen the alternatives in Dynameq will be developed in coordination with WSDOT and are anticipated to include the following:

- Person throughput
- Vehicle throughput and demand
- Travel times
- Speeds
- Lengths of queue
- Duration of congestion

Transit and nonmotorized access, nonmotorized connectivity, and environmental impacts will be qualitatively evaluated. Up to four alternatives will pass through the second-level screening.

THIRD-LEVEL SCREENING – MICROSIMULATION MODEL

The third-level screening process will further define and evaluate, at a more detailed level, the remaining alternatives. All motorized traffic operations (general purpose, high-occupancy vehicle [HOV], transit, and freight) will be quantitatively analyzed using the VISSIM traffic model. The performance metrics used to screen the alternatives in VISSIM will be developed in coordination with WSDOT and are anticipated to include the following:

- Person throughput
- Vehicle throughput
- Travel times
- Speeds
- Queues[1]
- Extents and duration of congestion[2]

TRAFFIC OPERATIONAL ANALYSIS SCOPE AND SCALE

STUDY YEARS

The study years include existing year (2018) and horizon year (2040).

DATA COLLECTION

Data collected in October 2018 will be used to validate, and update as necessary, the travel demand model (EMME), dynamic traffic assignment model (Dynameq), and microsimulation model (VISSIM) developed as part of the US 2/SR 204/20th Street IJR. Data collected in October 2018 includes the following:

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[1] Queues refer to the length of fully stopped traffic, e.g. at stop signs, traffic signals, or ramp meters.

[2] Speeds will inform the extents and duration of congestion on highway corridor segments. Per WSDOT’s Handbook for Corridor Capacity Evaluation (2nd edition, 2016) roadways are congested when speeds are less than 75 percent of the posted speed, and severely congested when speeds are less than 60 percent of the posted speed.

- 24-hour roadway segment volumes
  - State Route (SR) 531 west of 67th Avenue NE
  - 88th Street NE west of State Avenue
  - 4th Street east of State Avenue
  - SR 204 south of Sunnyside Boulevard
  - 20th Street west of Cavalero Road
  - US 2 west of SR 9
  - SR 9 north of 30th Street
  - US 2 east of Interstate 5 (I-5)
  - SR 9 south of Cathcart Way
- 2-hour AM and 2-hour PM peak period turn movement counts
  - I-5 northbound off-ramp and 4th Street
  - I-5 southbound on-ramp and Marine View Drive NE
  - SR 9 and 64th Street (SR 528)
  - SR 9 and Granite Falls Highway (SR 92)
  - SR 9 and SR 204
  - Avenue D and 15th Street
  - SR 9 and 108th Street SE
- Floating Car Travel Times were collected during the 5-hour morning (4:00–9:00 AM) and evening (1:30–6:30 PM) commute periods between the following origins/destinations (three locations west of the trestle and three locations east of the trestle equates to nine origin/destination pairs and 18 pathways):
  - I-5 north of Marine View Drive
  - US 2 ramps to and from Downtown Everett
  - I-5 at the SR 526 interchange
  - SR 204 at 81st Avenue
  - 20th Street at SR 9
  - US 2 at Bickford Avenue

The floating car travel time runs were recorded with a dash camera and the videos will be reviewed to observe locations and durations of congestion. The trips were also tracked using a Global Positioning System (GPS) application to record the speed along the pathway. The speed data will be reviewed in tandem with the dash camera video to determine the actual speed at each point on the corridor during congested conditions.

- Streetlight data will be collected at a zone-group level to support travel demand model validation by providing a general origin and destination pattern for traffic that uses the

US 2 trestle and connecting facilities. This level of model validation will provide the team with a better understanding of how people are making travel choices.

In addition to the data collection described above, this study will utilize data collected for the US 2/SR 204/20th Street IJR, listed below.

- Peak Hour Queuing was observed in November 2016, and January and February 2017 during the AM and PM peak periods at the following locations:
  - I-5 and US 2 interchange
  - US 2 and SR 204 interchange
  - 20th Street SE corridor
  - SR 204 corridor
- Travel Time Runs were conducted during the peak periods on the following corridors:

Table 1. Peak Period Travel Time Runs

Corridor	Description	Data Collection Dates
SR 204	I-5 from 41st Street across US 2 trestle to 81st Avenue NE on SR 204	November 16 and 17, 2016
20th Street SE	I-5 from 41st Street across US 2 trestle to 83rd Avenue SE on 20th Street SE	November 16 and 17, 2016
US 2	I-5 from 41st Street across US 2 trestle to US 2/SR 9 interchange	January 31 and February 1, 2017

- Seven-day Tube and Vehicle Classification Counts were collected at the following locations:

Table 2. Seven-day Tube and Vehicle Classification Counts

Location	Tube Count Location	Dates of Collection
1	WB US 2 to SB I-5	11/17/16 – 1/23/16
2	WB US 2 to NB I-5	12/1/16 – 12/7/16
3	WB US 2 to California Street	11/17/16 – 11/23/16
4	WB US 2 to Walnut Street	11/14/16 – 11/19/16
5	NB I-5 to EB US 2	11/30/16 – 12/7/16
6	SB I-5 to EB US 2	11/17/16 – 11/23/16
7	Hewitt Avenue to EB US 2	12/1/16 – 12/7/16
8	NB I-5 to Pacific Avenue	11/13/16 – 11/20/16
9	Pacific Avenue to SB I-5	11/14/16 – 11/19/16
10	Everett Avenue to NB I-5	11/14/16 – 11/19/16
11	SB I-5 to Everett Avenue	11/17/16 – 11/23/16
12	EB US 2 on trestle	WSDOT PTR (Oct. 2016)
13	WB US 2 on trestle	WSDOT PTR (Oct. 2016)

Table 2. Seven-day Tube and Vehicle Classification Counts (continued)

Location	Tube Count Location	Dates of Collection
14	EB US 2 East of Bickford Interchange	11/30/16 – 12/7/16
15	WB US 2 East of Bickford Interchange	11/30/16 – 12/7/16
16	Bickford to WB US 2	11/14/16 – 11/19/16
17	EB US 2 to Bickford	11/17/16 – 11/23/16
18	Bickford to EB US 2	11/14/16 – 11/19/16
19	WB US 2 to SR 204	12/11/16 – 12/17/16
20	SR 204 to EB US 2	12/11/16 – 12/17/16
21	EB US 2 to 20th Street SE (at west end of trestle and at US 2/SR 204 interchange)	12/1/16 – 12/7/16
22	EB US 2 to SR 204	11/27/16 – 12/4/16
23	20th Street SE to WB US 2 (at US 2/SR 204 interchange and on west end of trestle)	11/27/16 – 12/4/16
24	SR 204 to WB US 2	11/27/16 – 12/4/16
25 EB	20th Street east of SR 204	11/30/16 – 12/7/16
25 WB	20th Street east of SR 204	11/30/16 – 12/7/16
26 NB	SR 204 north of 9th Street SE	12/8/16 – 12/14/16
26 SB	SR 204 north of 9th Street SE	11/28/16 – 12/4/16
27 SB	Sunnyside Boulevard SE south of 9th Street SE	11/27/16 – 12/4/16
27 NB	Sunnyside Boulevard SE south of 9th Street SE	11/27/16 – 12/4/16
28 EB	20th Street SE east of Cavalero Road	11/27/16 – 12/4/16
28 WB	20th Street SE east of Cavalero Road	11/27/16 – 12/4/16

NB = northbound; SB = southbound; WB = eastbound; EB = eastbound

- Daily boardings and alightings by stop were provided by Community Transit for routes 280 and 425.
- Vanpool program information provided by Community Transit
- WSDOT collected occupancy data at two locations on I-5
- Peak period turning movement counts were collected at the following locations:

Table 3. Peak Period Turning Movement Counts

Intersection #	Intersection Location	Count Date	
		AM	PM
1	SR 204 and 20th Street SE	11/29/16	12/6/16
2	SR 204 and Sunnyside Boulevard SE	12/7/16	12/1/16
3	SR 204 and 9th Street SE	11/17/16	12/1/16
4	20th Street SE and Cavalero Road	12/13/16	12/7/16
5	51st Avenue SE and 20th Street WB ramps	11/30/16	12/1/16
6	51st Avenue SE and 20th Street EB ramps	12/1/16	12/1/16
7	20th Street SE and 79th Avenue SE	11/17/16	12/7/16
8	83rd Avenue SE and 20th Street SE	2/2/17	2/2/17
9	91st Avenue SE and 20th Street SE	2/9/17	2/1/17
10	S Lake Stevens Road and 87th Avenue SE	2/9/17	2/1/17
11	S Lake Stevens Road and SR 9	2/1/17	1/31/17
12	Sinclair Avenue and Bickford Avenue	2/9/17	2/1/17
13	SR 9 and 4th Street SE	2/1/17	1/31/17
14	SR 9 and 20th Street SE	2/1/17	1/31/17

WB = westbound; EB = eastbound

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TRAFFIC FORECASTING METHODOLOGY

Future year traffic volumes will be forecast using the procedures outlined in the National Cooperative Highway Research Program (NCHRP) reports 255 and 765. The existing year and future year no-build travel demand model and dynamic traffic assignment model will be validated and finalized. The difference between the existing year and future year dynamic traffic assignment model volumes will be applied to the existing count data to develop the forecasted future year no-build traffic volumes.

During the alternatives development and screening processes, additional travel demand model and dynamic traffic assignment model runs will be completed for some alternatives. The volumes from the alternative model runs will be compared to the volumes from the no-build model runs, and the forecasted no-build volumes will be post-processed to develop forecasted volumes for the alternatives.

VALUE OF TIME

It is recommended that value of travel time (VOT) estimates adopted for the Puget Sound Gateway Program be used in the modeling analysis. These values of time would be used in the travel demand model and dynamic traffic assignment model, and are shown in the table below.

Table 4. Value of Travel Time Estimates

Trip Type	VOT (dollars/hour), 2015 dollars
Home-Based Work (HBW) Single-Occupancy Vehicle (SOV) Income Group 1	$ 8.20
HBW SOV Income Group 2	$ 15.45
HBW SOV Income Group 3	$ 20.90
HBW SOV Income Group 4	$ 31.00
Non-Work SOV	$ 19.95
HOV: 2 occupants	$ 25.05
HOV: 3+occupants	$ 25.05
Light Truck	$ 22.25
Medium Truck	$ 57.35
Large Truck	$ 57.35

TOOLS

This section describes the modeling tools that will be used to develop forecast volumes and analyze traffic operations.

TRAVEL DEMAND MODEL

- The PSRC EMME model will be used to produce travel demand forecasts for the US 2 Westbound Trestle project. This ensures consistency with the most recently adopted regional travel demand (EMME) model developed by the PSRC. The most recent PSRC travel demand model was adopted in June 2018 as part of the Regional Transportation

Plan update. The updated PSRC model has a horizon year of 2040, compared to the Snohomish County EMME model used for the earlier IJR analysis that had a horizon year of 2035. The updated PSRC model for 2040 includes a per-mile vehicle pricing assumption for all facilities. The demand modeling-related undertakings include the following:

- Review the latest PSRC model for existing conditions within the study area and make necessary network refinements to produce reasonable results for existing conditions. This involves comparison of actual vehicle count data to model estimated vehicle volumes for key locations within the study area. The targeted accuracy of the travel demand model will be the industry standard of +/- 10 percent of the existing count data across screenlines.
- Perform a base year (2017/2018) model validation analysis and prepare necessary summary results. This will likely include using StreetLight origin-destination data to adjust base year trip tables produced by the PSRC model. StreetLight data was obtained conforming to 48 districts as shown in Figure 1 and was compared to the synthetic origin-destination data from the PSRC model to confirm modest differences in some regional travel. In addition to adjusting trip tables with StreeLight data, the base year validation will include a matrix adjustment process using actual vehicle counts data to better match estimated volumes.
- The outcome of the base year validation analysis will determine how to proceed in developing 2040 traffic forecasts. Should the base year model validation require using StreetLight data to adjust trip tables then the process of producing 2040 trip tables should be dependent on base year trip tables. This will include using pertinent origin- and destination-level growth rates from the base year to 2040 from the PSRC full demand model applied to the Streetlight-adjusted base year trip tables to provide 2040 trip tables for each alternative. This data will be used for assignment in the travel demand model to produce 2040 traffic forecasts.
- Coordinate with WSDOT and Snohomish County regarding consistency between demographic forecasts prepared by PSRC and Snohomish County for the City of Everett, which have been used in previous modeling efforts. The PSRC model uses Land Use Vision (LUV.2) Forecast for 2040, currently available at the PSRC website.
- Prepare networks for no-build and build alternatives. For the alternatives involving tolling, a series of demand model runs will be performed for both intermediate and horizon years to achieve appropriate toll rates. Subsequently, final model runs will be performed for all alternatives and necessary model results will be prepared.
- Prepare necessary trip matrix inputs for the Dynamic Traffic Assignment (DTA) modeling analyses. This will include use of Streetlight origin-destination data to refine external/internal trip movements.

Planned screenline locations are shown in Figure 2, and the model study area focus for modeling analysis is also shown in that figure.

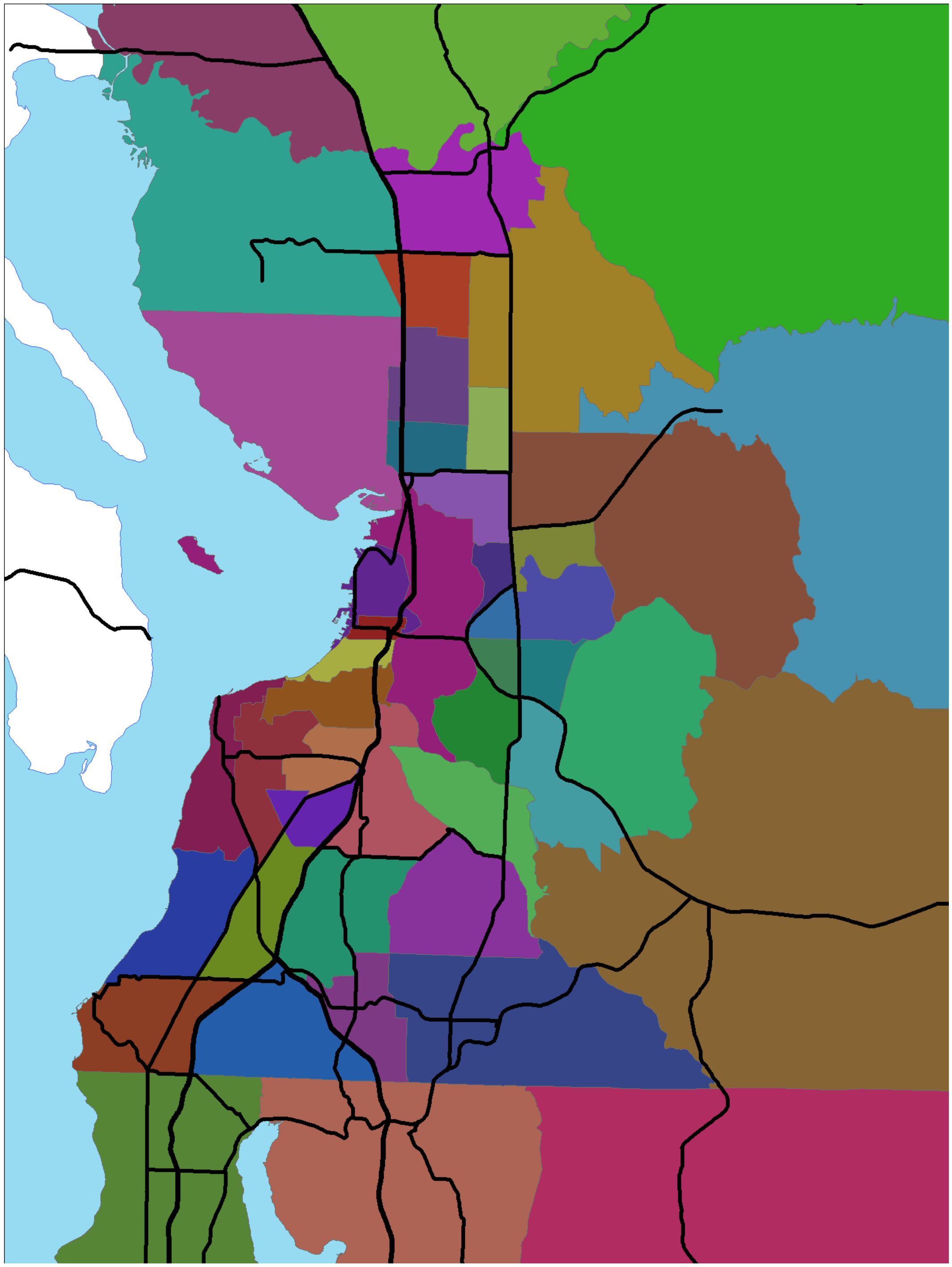

Figure 1. StreetLight Data Districts

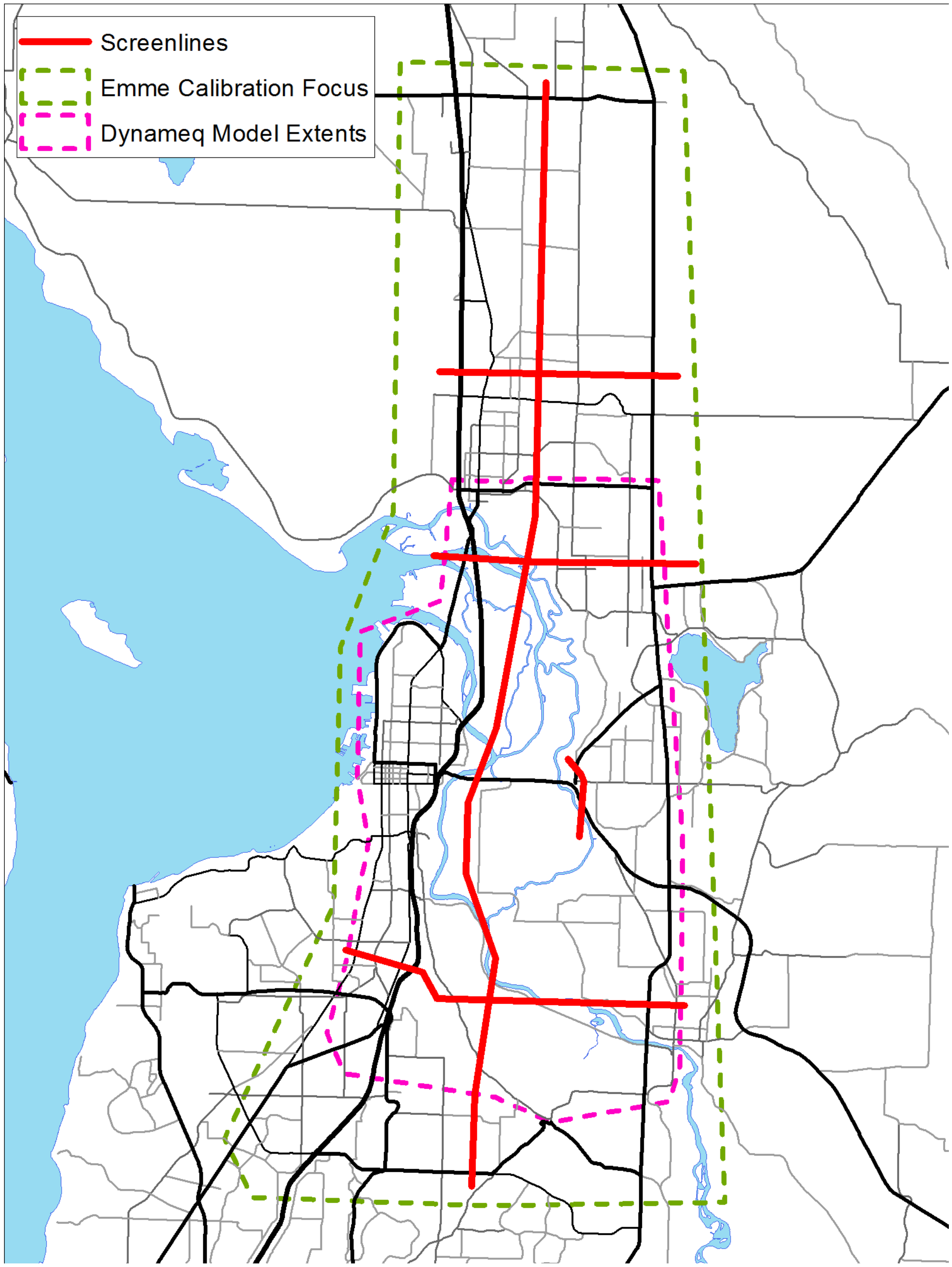

Figure 2. Travel Demand Model Validation Limits

STUDY TIME PERIODS

The travel demand model analysis will include output for the following study periods: AM peak period, PM peak period, and average weekday. The AM and PM peak periods will align with those in the PSRC model: 6:00–9:00 a.m. and 3:00–6:00 p.m., respectively. The existing 5-hour

AM (4:00 – 9:00 a.m.) and PM (1:30 – 6:30 p.m.) peak period volume profiles will be used to develop future traffic volume forecasts.

BACKGROUND PROJECTS

Relevant roadway and transit projects will be documented for inclusion in the demand and DTA models, after reviewed and agreed upon by the project team. Project lists will be developed for both the representative year of opening and the horizon year. The projects included on these lists should be in the Regional Transportation Plan, be funded, and expected to be open by the modeled year, though some exceptions could be made to include additional projects as determined by the project team.

DYNAMIC TRAFFIC ASSIGNMENT MODEL

The DTA model will be developed using the Dynameq software program. This will be based on extending the existing DTA model network (previously developed and used in the IJR project) north to Marysville, south to Lowell River Road, and east to cover SR 9 between the north and south ends of the DTA network. The existing 5-hour peak periods will be used to develop traffic volume inputs for the VISSIM modeling. The DTA model development and application includes the following:

- Refine the existing DTA model network, including transportation analysis zone (TAZ) structure conforming to the PSRC 4K zone system, vehicle classes, channelization, intersection control type, and signal timings.
- Prepare trip matrices from the validated base year demand model for input to DTA model (in 15-min intervals *for two 5-hour peak periods and six vehicle classes)*
- Calibrate and validate for the base year (2017/2018) models to the observed conditions. Calibration/validation standards are assumed to be targeting +/- 10 percent in vehicle volumes and travel speeds along the freeway segments and interchange ramps. The validation will focus on the following metrics:
  - Vehicle volumes
  - Travel time and travel speed (speed contour map comparisons on I-5; other data elsewhere)
  - Approximate queue lengths on freeway segments and ramp terminals, including ramp metered on-ramp sections
- Prepare networks and run the DTA model for existing conditions. Simulation runs for each of these scenarios will be presented to and reviewed with/by WSDOT.
- Prepare model summary results and maps of modal volumes and travel times for internal discussions and presentation. These model plots will be used to determine how the DTA

model is shifting traffic related to congestion and tolls. Further metrics will be developed as part of the first- and second-level screening process.

- Prepare demand matrices required for VISSIM modeling analysis.

STUDY TIME PERIODS

The DTA models will be developed for and produce results for 5 hours for each peak period: AM from 4:00–9:00 and PM from 13:30–18:30. The models will have warm-up and cool-down periods of 60 minutes each that will be added before and after each day period with factored demand based on available counts.

VEHICLE CLASSES AND MULTIMODAL PRIORITIES

The classes that will be modeled in the DTA are SOV, HOV 2, HOV 3+, Light Trucks, Medium Trucks, and Heavy Trucks.

Additionally, the DTA model will reflect the existing bus routes operating on US 2, I-5, and arterials in the model area. The model does not reflect occupancy of buses, so any reporting of transit passenger volumes will be determined outside of the model. Where several transit routes use the same stopping pattern, multiple routes may be combined into one for coding simplification.

MEASURES OF EFFECTIVENESS

The key outputs and performance metrics for future year application of the US 2 trestle DTA model will be the following:

- Person throughput volumes based on Average Vehicle Occupancy (AVO) values that will be determined in the agreement from WSDOT
- Vehicle volumes
- Travel speeds
- Travel times
- Duration of congestion on highway corridor segments
- Length of queues for ramps

VISSIM – MICROSIMULATION MODEL

VISSIM version 10 will be used to model the study area outlined below and shown in Figure 3:

- I-5 from 41st Street to Marine View Drive
- US 2 from I-5 to Bickford Avenue
- 20th Street SE from US 2 to SR 9
- SR 204 from US 2 to 81st Avenue
- I-5 and US 2 ramp terminal intersections in Everett

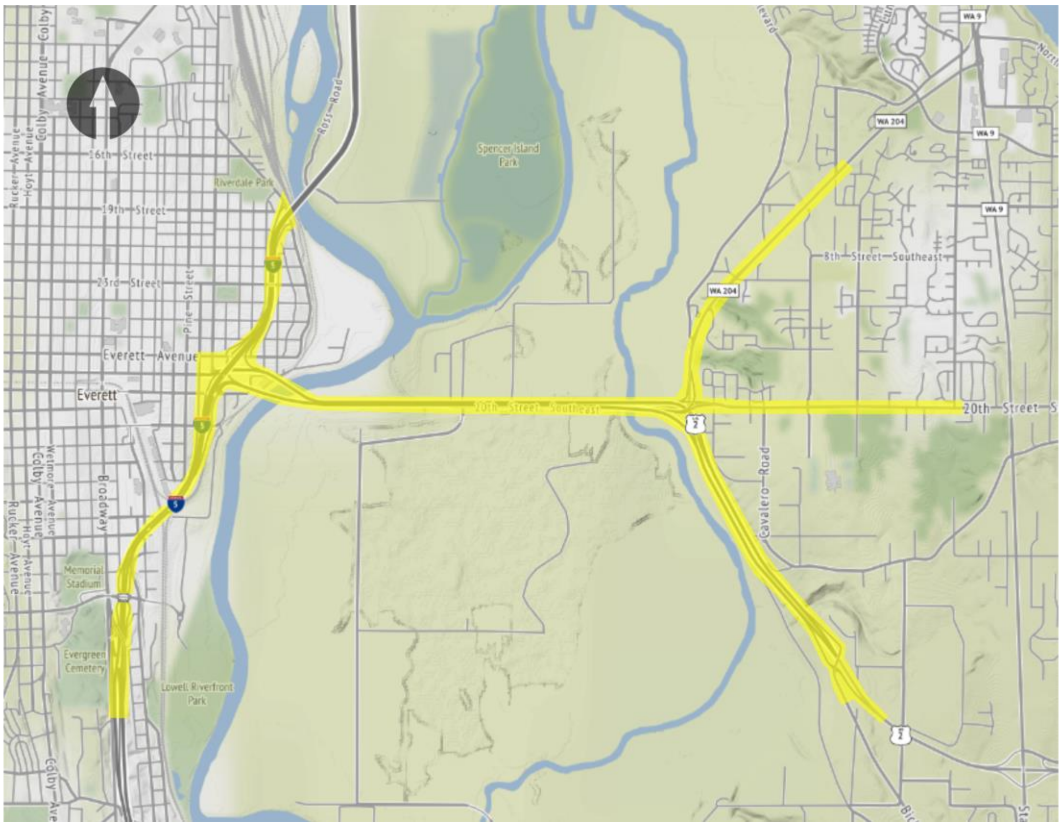

Figure 3. VISSIM Model Extents

The VISSIM network from the US 2/SR 204/20th Street SE IJR was modeled using VISSIM version 8 and only includes I-5 as far south as the Pacific Avenue ramps.

VISSIM simulation models will be developed for the AM and PM peak periods. Model network coding, parameters, and data input will be developed according to the WSDOT VISSIM Protocol (September 2014), which provides in-depth instructions for freeway and urban street simulation networks.

Two separate criteria must be met to justify the validity of a particular model and its usefulness in evaluating the transportation system:

- Confidence – Ensuring that the reported model results are representative of the model
- Calibration – Matching the model results to real-world conditions

CONFIDENCE

Given the varying results that inherently exist between micro-simulation runs (due to the random seed number), every model is required to evaluate its reported results in a way that conveys they are representative of the model and not skewed toward a statistical outlier. Per the WSDOT VISSIM Protocol, the VISSIM model runs will use a simulation resolution of 10 time steps per second. The analysis results will be based on an average of at least 11 model runs, each using a different random seed value. These seed values will be reported so that the results can be verified. For the existing conditions model, the statistical significance of 11 simulation runs will be confirmed for model throughput volume outputs using a 95 percent confidence level at the US 2/SR 204 interchange.

CALIBRATION

Calibration is the process used to achieve adequate reliability of validity of the model by establishing suitable parameter values so the model replicates local traffic conditions as closely as possible. The existing conditions VISSIM model will be calibrated to traffic counts and speeds/travel times. As a proxy for replication of throughput volumes, the GEH Statistics shall be calculated for all entry/exit locations, freeway ramps, and roadway segments in the calibration area of the model. Peak hour volume outputs will be broken down into four 15-minute intervals. Tables 5 and 6 provide the recommended calibration criteria for GEH Statistics.

Table 5 GEH Statistic Guidelines

GEH Statistic	Calibration Guideline
< 3.0	Acceptable fit
3.0 to 5.0	Acceptable for local roadway facilities
> 5.0	Unacceptable

Table 6 Throughput Traffic Volume (vehicle/hour/lane) Calibration Criteria

Criteria	Acceptable Target
GEH < 3.0	All entry and exit locations within the calibration area
GEH < 3.0	All entry and exit ramps within the calibration area
GEH < 5.0	At least 85% of applicable local roadway segments
Sum of all segment flows within the calibration area	Within 5 percent of traffic counts

The key corridors measured by floating car travel times will be calibrated to the observed travel times. The travel time calibration criteria are separated into two types of facilities: uninterrupted flow (e.g., freeways and ramps) and interrupted flow (e.g., signalized arterials). As described in Figure 7 below, the amount of allowable travel time variation will be calculated for each time interval as speeds (travel times) fluctuate through the analysis period. For interrupted flow facilities, the allowable travel time variation is established using the free flow speed of the corridor. If the free flow speed is unknown, the posted speed limit will be used.

Figure 7. Travel Time Calibration Criteria Equations

Criteria	Acceptable Target
Free-flowing	$\Delta = \dfrac{1}{\frac{1}{t} - \frac{4.4}{L}} - t$
Interrupted Flow	$\Delta = \dfrac{1}{\frac{1}{t} - \frac{0.1 * 5280 * S}{3600 * L}} - t$

Δ = Allowable travel time variation (+/- seconds)
t = Observed travel time (Seconds) – from floating car survey
L = Length (Feet)
S = Free flow speed (mph); Posted speed may be used for FFS if unknown

The visual inspection of freeway queuing will be compared with the VISSIM model to validate that the model is reasonably replicating field queuing conditions.

Calibration according to the criteria described above will require the adjustment of several VISSIM input parameters to reflect study-area driving conditions. These adjustments are described below:

- The vehicle composition will be updated to reflect the North American vehicle model distribution.
- Lane change distances will be adjusted to reflect driver behavior observed in the field during the floating car travel time runs. This typically involves increasing the distance that drivers will anticipate a downstream lane change. Adjustments to the lane change distance will be documented in the confidence and calibration memo.
- Driving behavior will be modified to reflect the appropriate capacity using throughput at known bottleneck locations as a guide.

Intersection timing parameters will be specified using the ring barrier controller method in VISSIM. Signal timing plans will be adjusted as necessary to reflect changes proposed in the alternatives.

Traffic volumes will be entered in 15-minute intervals, and routing decisions will be defined for 15-minute intervals.

Desired speeds in the model will be set based on the GPS data collected during free flow conditions.

Simulation runs for every scenario that VISSIM is used will be presented to and reviewed with/by WSDOT.

STUDY TIME PERIODS

The study time periods for the traffic analysis are anticipated to include up to a 5-hour AM peak period and a 5-hour PM peak period. The anticipated peak periods are 4:00–9:00 AM and 1:30–6:30 PM.

MULTIMODAL PRIORITIES AND ACCOMMODATION

The following modes will be explicitly modeled and analyzed in VISSIM:

- General purpose traffic
- HOV traffic
- Transit (bus) traffic
- Heavy vehicle (freight truck) traffic

MEASURES OF EFFECTIVENESS

The measures of effectiveness will be developed in coordination with WSDOT and are anticipated to include:

- Person throughput by mode (vehicle throughput volumes by mode will be output from VISSIM and occupancy factors will be applied to the various modes to estimate person throughput)
- Vehicle throughput
- Freeway segment density and speed by lane
- Corridor travel times by mode
- 50th and 95th percentile queues at intersections
- Lengths of queue on highway segments

SAFETY PERFORMANCE ANALYSIS SCOPE AND SCALE

The safety analysis will follow the procedure for the basic crash analysis outlined in the Safety Guidance for Corridor Planning Studies. This consists of analyzing the existing safety performance and corridor characteristics, summarizing the findings, and reviewing the findings with WSDOT and the stakeholders. The focus of the analysis is to provide the historic safety performance of the corridor, including reporting on major contributing factors to fatal and serious crashes.

It is anticipated that more detailed safety analysis will be completed at later stages of the project to guide potential design revisions to the preferred alternative, including recommending countermeasures for common fatal and serious injury crashes, and applying crash modification factors to identify the effectiveness of recommended countermeasures.

STUDY AREA

The study area for the safety analysis consists of US 2 between I-5 and Bickford Avenue, including the ramps and ramp terminal intersections, 20th Street between US 2 and SR 9 including intersections, and SR 204 between US 2 and 81st Avenue including intersections.

STUDY YEARS

Safety data will be collected for the most recent 5-year period available.

CHANGE MANAGEMENT

Frequent communication will limit the potential for changes that substantially impact the agreed-upon methods and assumptions, and will allow the project team to anticipate possible changes and outline a strategy to move forward prior to any rework. These strategies will be developed on an ongoing basis to address issues as they are identified. Unanticipated changes will still occur, and will need to be evaluated on a case-by-case basis to determine the extent of the impacts to the methods and assumptions outlined in this document.