Appendix I

Future No Build Traffic Forecasting Memo

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FEHR PEERS

DRAFT MEMORANDUM

Date: July 7, 2019 (Updated)

To: Alex Atchison, Parametrix

From: Carmen Kwan and Jeff Pierson, Fehr & Peers

Subject: SR 303 Corridor Traffic Forecasting

SE19-0678

This document summarizes the traffic forecasting methodology for the SR 303 Corridor Study.

Travel Model

The Kitsap County travel demand model, developed in the TransCAD software, was acquired from the County in 2017 for the Silverdale TIS Study, and is the same model referenced for the City of Bremerton's 2016 Comprehensive Plan Update. A model review was completed and adjustments were made so that the model better reflects 2019 conditions. The review included the following:

- Update street network in the corridor study area to reflect current conditions
- Develop time of day factors to generate AM peak hour demand
- Revise land use inputs for this corridor study's analysis years (2030 and 2040)

The memo also includes a description of the traffic forecasting methodology for this study.

Existing Year Network Modifications

The traffic model street network coding was reviewed against available GoogleEarth aerial imagery from May 2018 within the study area. Modifications to the street network included incorporating a new intersection layout at the SR 303 and Callahan Drive on/off-ramps. Additional network edits included incorporating turn restrictions at study intersections to reflect existing conditions, such as the center median that restricts left turns on SR 303 at 4th and 5th Streets. Lastly, link speeds were adjusted on 6th Street and SR 303 south of 11th Street so that traffic volumes on the corridors better reflected existing 2019 counts.

AM Peak Hour Analysis

The Kitsap County travel demand model was developed to estimate the 5 PM peak hour and did not include an AM peak hour assignment. While the PM peak hour generally has higher volumes than the AM peak hour based on counts collected, an AM peak hour traffic assignment estimate was developed in the model specifically for this project. Demand volumes for individual hours are created by applying time of day factors to the daily vehicle trip matrices estimated by the model.

The original model input files included time of day factors for each of the 24 hours in a day even though only the factors for the 5 PM peak hour were used for the vehicle assignment.. The AM peak hour assignment was created by applying the initial time of day factors for the 7 AM hour that were already included in the model. Since the 7 AM factors were likely unadjusted from their original source when the Kitsap County model was first developed, these factors were then iteratively adjusted until the model volumes generally reflected the observed AM peak hour volumes. The final adjustment factor was approximately 40 % lower than the initial values.

Table 1 summarizes the time of day factors that are used in the model for the PM peak hour and the original and adjusted values for the AM peak hour. Different factors are used for each of the trip purposes in the model: home-based work (HBW), home-based other (HBO), non-home-based (NHB), and college.

Table 1. Traffic Model Time of Day Factors

	PM (5 PM)	AM Original (7 AM)	AM Adjusted (7 AM)
Depart HBW	0.80	19.2	11.5
Return HBW	14.0	0.0	0.0
Depart HBO	3.5	2.9	1.7
Return HBO	3.9	2.9	1.7
Depart NHB	5.7	3.3	2.0
Return NHB	5.7	3.3	2.0
Depart College	0.09	11.4	7.8
Return College	11.4	0.09	0.05

Source: Fehr & Peers, 2019

Model Validation

The model validation process reviewed the approach volumes at seven major intersection along SR 303 and compared them against model link volumes for the AM and PM peak hours. Since the

travel model was initially calibrated and validated to an evening peak hour between 5 and 6 PM, the traffic count data at the seven intersections was calculated for this same time period. It should be noted that this hour is not consistent with the actual peak demand periods at several of these intersections, especially in downtown Bremerton, where the peak hour can start as early as 2:30 PM.

The model inputs were iteratively adjusted as described above to calibrate the volume estimates to existing conditions. **Table 2** shows a comparison of the northbound and southbound volumes on the Warren Avenue bridge crossing North Washington Narrows. The results show that the AM peak hour volumes are within approximately 5% of the observed volume while there is more variation in the PM peak hour volume comparison. The demand estimate in the model is closer to the observed volume between 4-5 PM (approximately 3,500 vehicles) than the volume between 5-6 PM.

Table 2. Warren Avenue Bridge

	NB **Model / Count / Ratio**	**SB** **Model / Count / Ratio**	**Total** **Model / Count / Ratio**
AM Peak Hour	990 / 1,070 / 0.93	1,470 / 1,400 / 1.05	2,460 / 2,460 / 1.00
PM Peak Hour	2,100 / 1,650 / 1.27	1,690 / 1,540 / 1.10	3,800 / 3,190 / 1.19

Source: Fehr & Peers, 2019

Tables 3 and 4 on the following pages show the observed counts, base year model volumes, the difference between the model and observed counts, and the ratio of the model to observed counts for each analysis period. NCHRP Report 255 provides recommendations for maximum desirable deviation when comparing a model volume to a count volume. The deviation is based on the count volume and varies from 60% for lower volume roads to 15% for higher volume roads. The locations within the desirable deviation are shaded green in following tables. Those outside are shaded red.

Compared with the PM peak hour, there is more variation in the AM peak hour when comparing the model intersection volumes with observed counts. While the AM variation is as much as 30%, the PM variation is generally within 10% when comparing the total intersection volume. The north-south volumes along SR 303 are generally closer to the observed volumes than on the east-west side streets.

While the calibration adjustments improved the model validation, there are some structural limitations in the model that are not able to be addressed during this study. These are discussed in the next section.

Table 3. AM Peak Hour Validation Table

	NB	SB	EB	WB	Total
Observed Count					
1 - SR 303 & SR 304	15	460	810	210	1,495
2 - SR 303 & 6th St	240	740	630	165	1,775
3 - SR 303 & 11th St	640	945	755	260	2,600
6 - SR 303 & Sheridan Rd	860	1,170	225	270	2,525
7 - SR 303 & Sylvan Wy	765	1,060	260	225	2,310
9 - SR 303 & NE Riddell Rd	650	1,025	300	165	2,140
12 - SR 303 & NE McWilliams Rd	890	1,060	255	310	2,515
Model Volume					
1 - SR 303 & SR 304	0	582	297	191	1,070
2 - SR 303 & 6th St	293	608	234	89	1,224
3 - SR 303 & 11th St	342	1,030	762	93	2,227
6 - SR 303 & Sheridan Rd	682	1,489	132	225	2,528
7 - SR 303 & Sylvan Wy	674	1,294	142	167	2,277
9 - SR 303 & NE Riddell Rd	573	1,337	201	204	2,315
12 - SR 303 & NE McWilliams Rd	666	1,152	150	278	2,246
Model - Count Difference					
1 - SR 303 & SR 304	-15	122	-513	-19	-425
2 - SR 303 & 6th St	53	-132	-396	-76	-551
3 - SR 303 & 11th St	-298	85	7	-167	-373
6 - SR 303 & Sheridan Rd	-178	319	-93	-45	3
7 - SR 303 & Sylvan Wy	-91	234	-118	-58	-33
9 - SR 303 & NE Riddell Rd	-77	312	-99	39	175
12 - SR 303 & NE McWilliams Rd	-224	92	-105	-32	-269
Model to Count Ratio					
1 - SR 303 & SR 304	0.00[1]	1.27	0.37	0.91	0.72
2 - SR 303 & 6th St	1.22	0.82	0.37	0.54	0.69
3 - SR 303 & 11th St	0.53	1.09	1.01	0.36	0.86
6 - SR 303 & Sheridan Rd	0.79	1.27	0.59	0.83	1.00
7 - SR 303 & Sylvan Wy	0.88	1.22	0.55	0.74	0.99
9 - SR 303 & NE Riddell Rd	0.88	1.30	0.67	1.24	1.08
12 - SR 303 & NE McWilliams Rd	0.75	1.09	0.59	0.90	0.89

[1]Low-volume driveway. Source: Fehr & Peers, 2019

Table 4. PM Peak Hour Validation Table

	NB	SB	EB	WB	Total
Observed Count					
1 - SR 303 & SR 304	4	442	632	478	1,556
2 - SR 303 & 6th St	634	560	381	423	1,998
3 - SR 303 & 11th St	731	1,287	783	430	3,231
6 - SR 303 & Sheridan Rd	1,929	1,224	229	360	3,742
7 - SR 303 & Sylvan Wy	1,710	1,250	280	345	3,585
9 - SR 303 & NE Riddell Rd	1,461	1,297	378	309	3,445
12 - SR 303 & NE McWilliams Rd	1,668	1,513	409	370	3,960
Model Volume					
1 - SR 303 & SR 304	0	538	344	656	1,538
2 - SR 303 & 6th St	646	969	146	687	2,448
3 - SR 303 & 11th St	958	1,625	867	191	3,641
6 - SR 303 & Sheridan Rd	1,803	1,366	184	523	3,876
7 - SR 303 & Sylvan Wy	1,812	1,121	211	276	3,420
9 - SR 303 & NE Riddell Rd	1,572	1,446	208	356	3,582
12 - SR 303 & NE McWilliams Rd	1,931	1,149	160	288	3,528
Model - Count Difference					
1 - SR 303 & SR 304	-4	96	-288	178	-18
2 - SR 303 & 6th St	12	409	-235	264	450
3 - SR 303 & 11th St	227	338	84	-239	410
6 - SR 303 & Sheridan Rd	-126	142	-45	163	134
7 - SR 303 & Sylvan Wy	102	-129	-69	-69	-165
9 - SR 303 & NE Riddell Rd	111	149	-170	47	137
12 - SR 303 & NE McWilliams Rd	263	-364	-249	-82	-432
Model to Count Ratio					
1 - SR 303 & SR 304	0.00[1]	1.22	0.54	1.37	0.99
2 - SR 303 & 6th St	1.02	1.73	0.38	1.62	1.23
3 - SR 303 & 11th St	1.31	1.26	1.11	0.44	1.13
6 - SR 303 & Sheridan Rd	0.93	1.12	0.80	1.45	1.04
7 - SR 303 & Sylvan Wy	1.06	0.90	0.75	0.80	0.95
9 - SR 303 & NE Riddell Rd	1.08	1.11	0.55	1.15	1.04
12 - SR 303 & NE McWilliams Rd	1.16	0.76	0.39	0.78	0.89

[1]Low-volume driveway. Source: Fehr & Peers, 2019.

Travel Model Recommendations

There are several areas where the model could be enhanced to improve the validation within this project's study area. These include reviewing land use assumptions, splitting traffic analysis zones (TAZs), verifying trip generation rates, adding trip purposes, and forecasting additional hours during the evening peak period. These adjustments were outside the scope of work for this project.

Figures 1 and 2 show the model roadway network, TAZs, and zone connectors within the study area for this project. The blue dots highlight the study intersections. Within the northern study area (Figure 1) there is generally enough detail for both the roadway networks and TAZs. Several study intersections are represented by connectors though, which is not ideal. In the southern portion of the study area (Figure 2) there is generally more network detail than zonal detail. This leads to some streets without any zone connections. The traffic assignment could be enhanced by adding more zones along SR 303 which would improve the distribution of east-west traffic flow in this area. As part of the model calibration several zone connections were updated to assign the traffic onto arterials instead of local streets. This primarily affected zones east of SR 303.

As part of updating the zone system, the land use and daily trip generation rates in the model could also be reviewed to ensure that these are consistent with existing conditions. The model is generally showing lower traffic volumes east-west which could indicate that either the land use estimates or trip generation rates are too low. However, this level of effort would only typically be undertaken when developing a new validated version of the model for a city or county and would not be performed for a corridor study.

The final recommendation would be to make improvements to the model to better capture travel patterns in this area between 2-6 PM. The travel patterns within downtown Bremerton are also unique in that the peak hour does not occur during the typical window between 4-6 PM. This is caused by work schedules at Naval Base Kitsap as well the ferry arrival schedule from downtown Seattle. Updating the model would include adding a separate trip purpose for the Naval Base since the departure and arrival patterns are unique to other land uses and trip purposes. The Naval Base could also be split into separate zones to better assign trips to individual gates. Since there is a longer peak period in this area, it would also be beneficial to assign each hour between 2-6 PM to ensure that the model volumes are consistent with the total demand during this time period and are also distributed correctly throughout the peak period.

Figure 1. Model TAZs, Connectors, and Roadway Network (North Study Area)

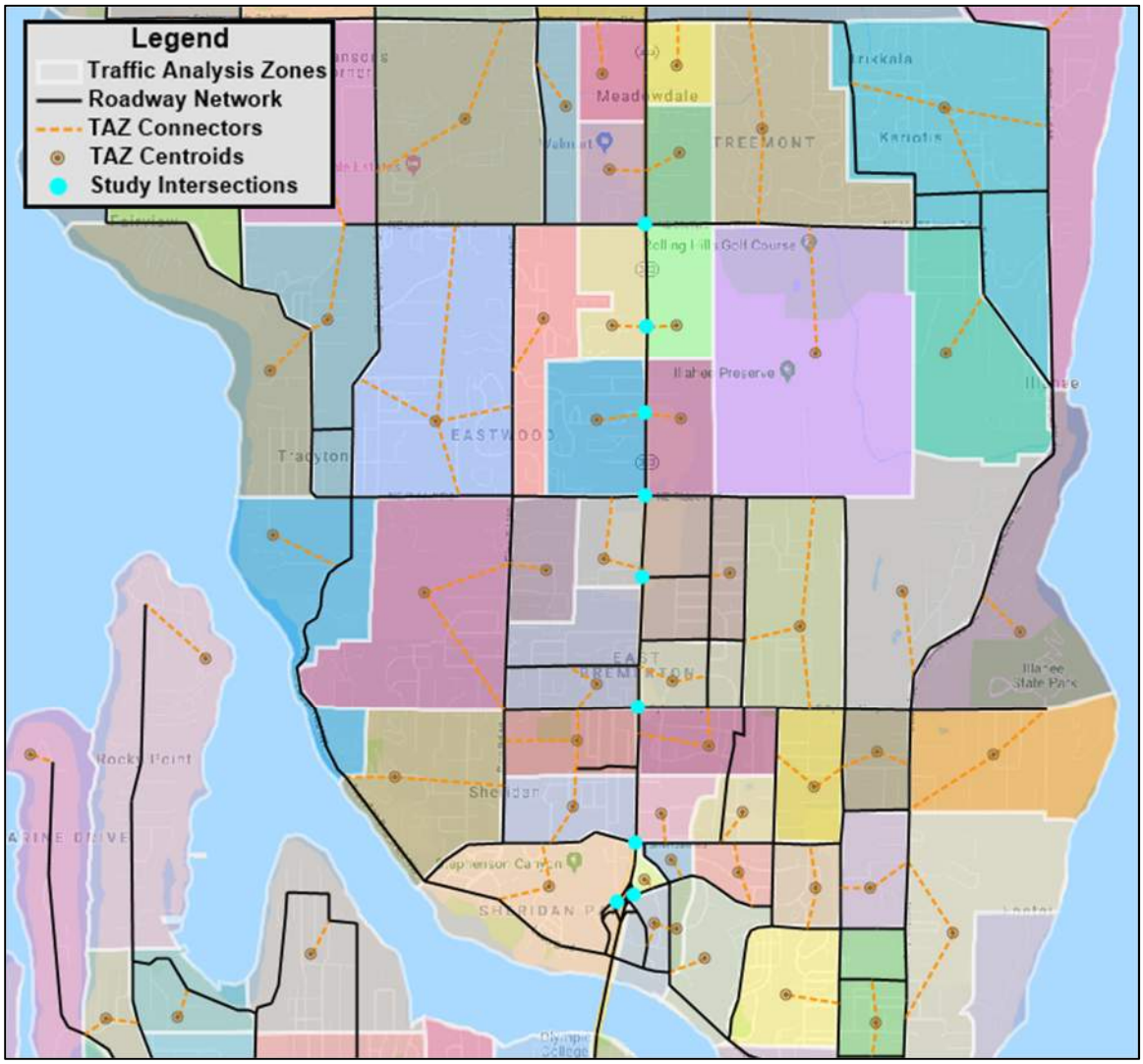
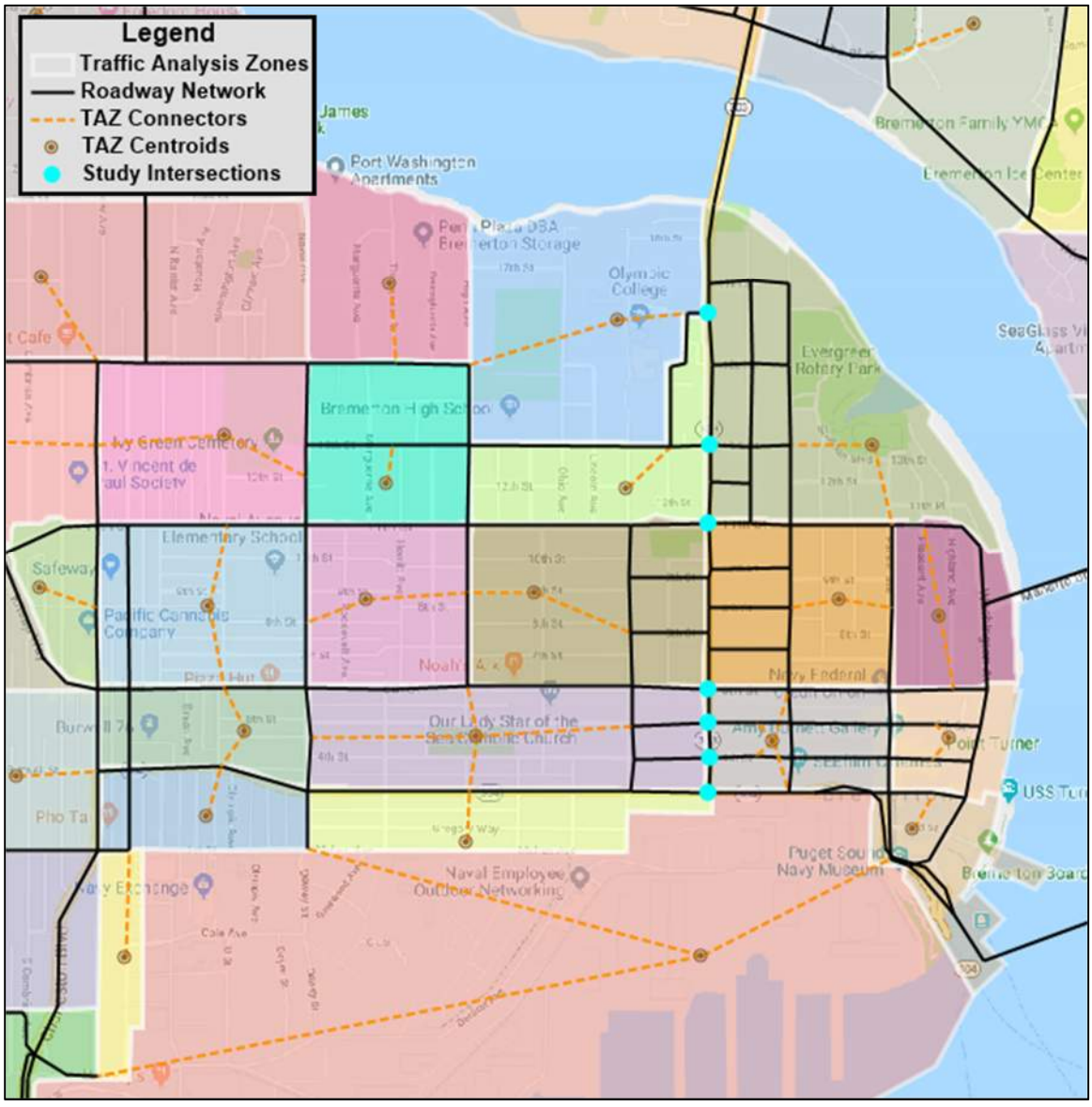


Figure 2. Model TAZs, Connectors, and Roadway Network (South Study Area)



Future Year Land Use and Network Review

The Kitsap County model includes land use information for 2016 and 2036 analysis years. The land growth in the Bremerton area between these scenarios is approximately 8,000 new households and 20,000 new jobs. This is consistent with the growth targets in the City's Comprehensive Plan. In order to develop land use inputs for this study's 2030 and 2040 analysis years, the 2016 and 2036 data was linearly interpolated for each TAZ to the required year.

Table 5 shows the land use growth assumptions between 2016 and 2040 for the study area. The northern area is defined as all TAZs north of the Warren Avenue bridge and south of NE McWilliams Rd. The southern area is defined as all TAZs south of the Warren Avenue bridge and east of SR 3. The total number of households increases by 36% and the number of employees increases by 50%. The growth is distributed fairly evenly north and south of the Warren Avenue bridge.

Table 5. Land Use Growth Assumptions

	2016	2040	Difference	Percent Growth
North Study Area				
Households	10,300	14,500	4,200	41%
Employment	8,200	15,100	6,900	84%
South Study Area				
Households	9,600	12,600	3,000	31%
Employment	20,000	27,100	7,100	36%
Total Study Area				
Households	19,900	27,100	7,200	36%
Employment	28,200	42,200	14,000	50%

Source: Fehr & Peers, 2019

Figures 3 and 4 on the next pages illustrate the absolute changes in household and employment by TAZ. Generally, land use growth is occurring along SR 303 and is especially concentrated east of SR 303 in downtown Bremerton.

The traffic model does not include any transportation network improvement projects along SR 303 within the study area, consistent with the City's Comprehensive Plan.

Figure 3. Total Household Change (2016-2040)

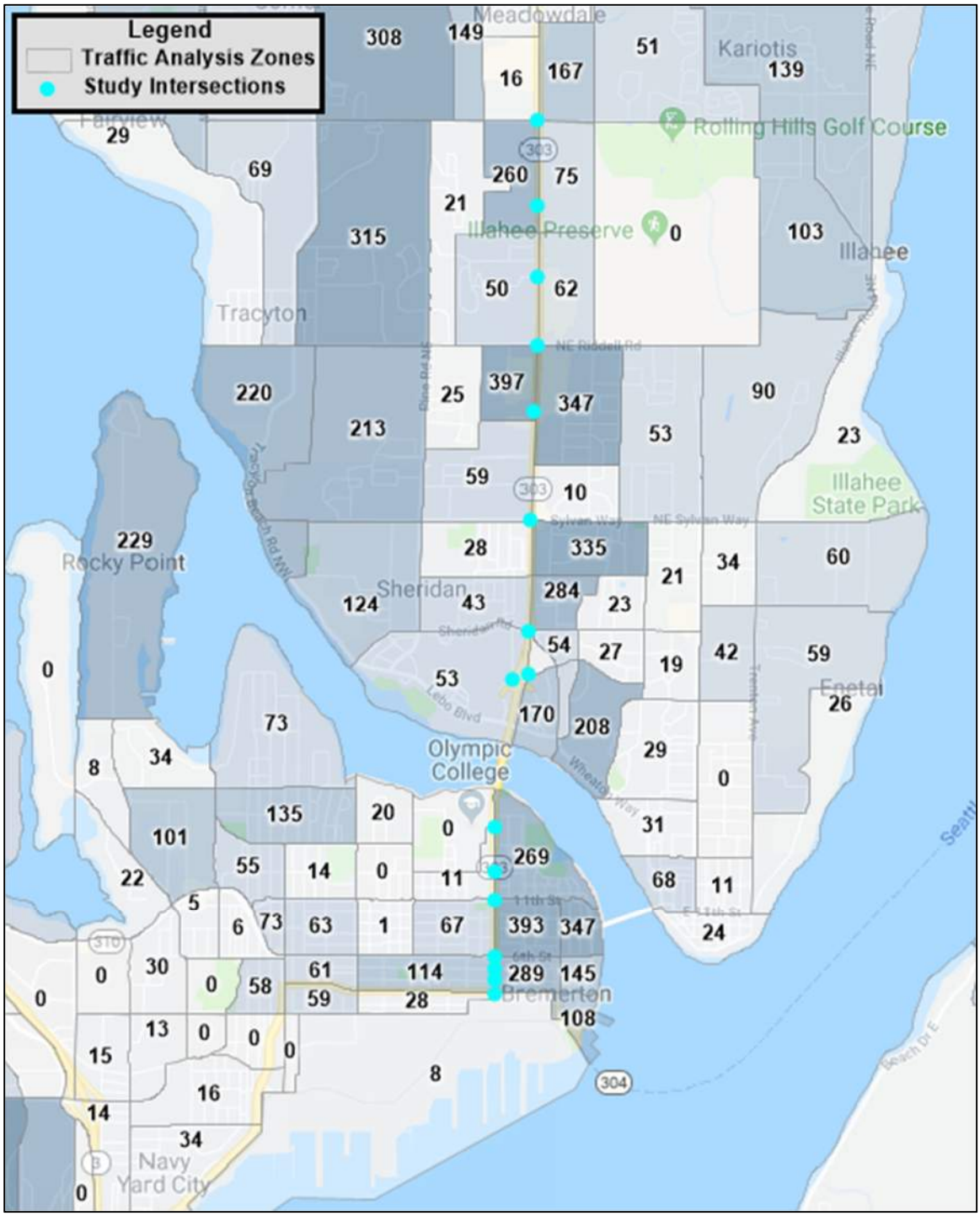
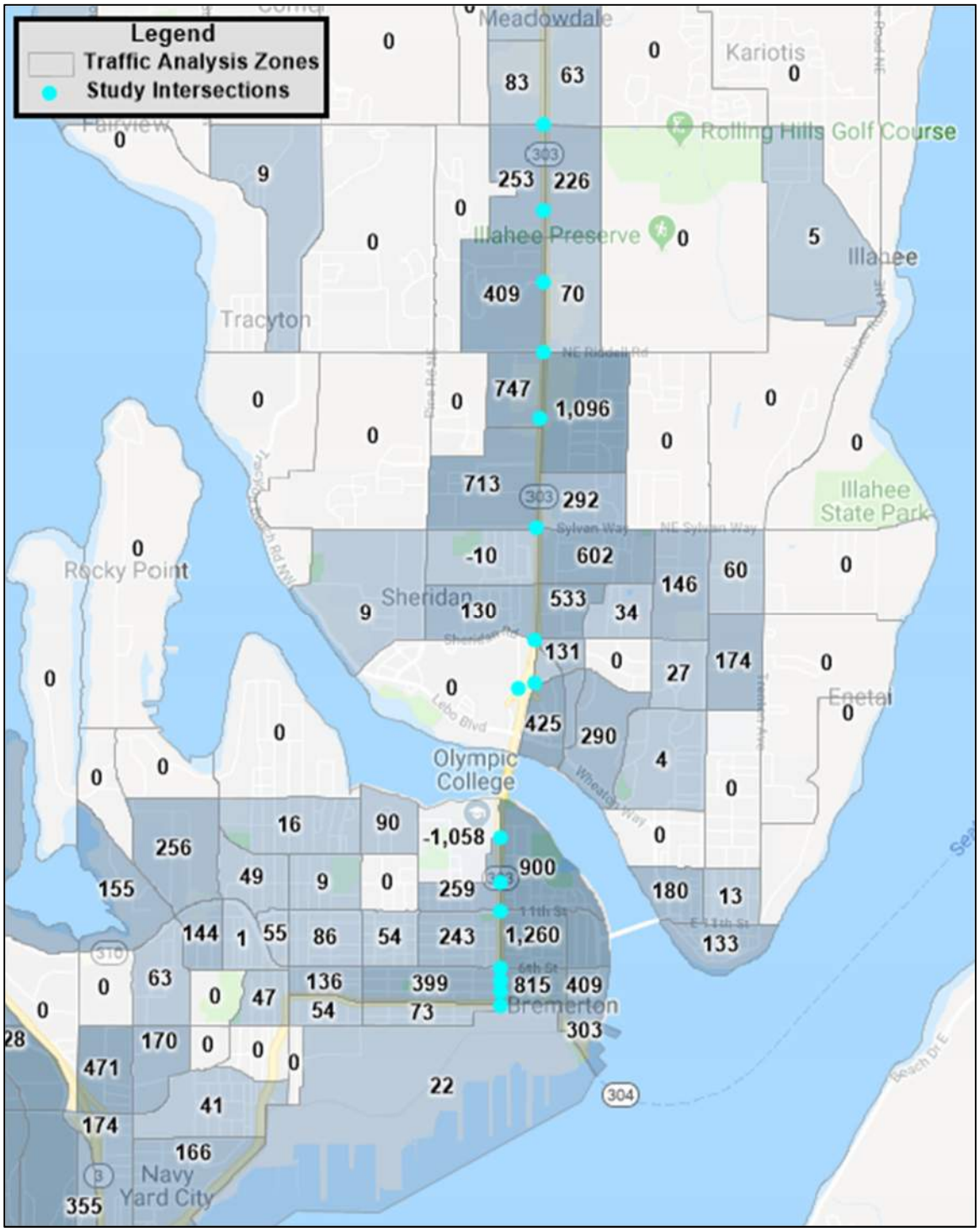


Figure 4. Total Employment Change (2016-2040)



Forecast Methodology

The difference method will be used to forecast demand volumes at the study intersections for travel conditions in 2030 and 2040. This method uses the existing 2019 turning movement volumes and adds the growth between the base year and future year model scenarios onto the count volumes. Some post-processing adjustments will be necessary for driveways with low volumes which are not accurately reflected in the travel model. Particular attention will be focused in downtown Bremerton between 11th St and SR 304 to ensure that the forecasted volumes are consistent with the existing travel patterns and volumes since the model was under-estimating trips in this location.

Though there is a discrepancy between when the PM peak hour occurs within the study area and the PM peak hour that is estimated in the model, the difference method will still be used. Consideration was given to applying an adjustment factor to the PM model volumes to account for the difference in the peak hours, but this was not implemented since there is not forecasted to be changes in the two main generators of the earlier demand: employment levels at the Naval Base and ferry arrival schedules. Increasing the model volumes further would likely overestimate the anticipated volume growth. The difference in model volumes was applied to existing peak hour count at each study intersection regardless of when the peak hour began.

The forecasted volumes at the study intersections show approximately 30% growth by 2040 and 20% growth by 2030. These percent increases are consistent with the forecasted land use growth.