S Transportation Discipline Report

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SR 502 CORRIDOR WIDENING

IMPROVING SAFETY • INCREASING CAPACITY • REDUCING CONGESTION

I-5 TO BATTLE GROUND

Transportation
Discipline Report - Revised

Prepared for:

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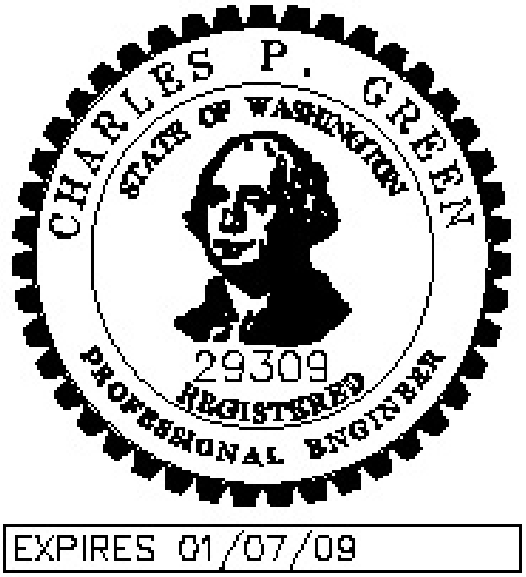

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Table of Contents

1.0 Executive Summary 1

2.0 Studies, Coordination, and Methods 1

3.0 Affected Environment 6

3.1 ROAD NETWORK 7

3.2 BICYCLE, PEDESTRIAN, AND TRANSIT FACILITIES 8

3.3 EXISTING TRAFFIC VOLUMES 11

3.4 EXISTING OPERATING CONDITIONS 12

3.4.1 SR 502 Corridor Intersection Operating Conditions 12

3.4.2 Off-Corridor Intersection Operating Conditions 15

3.5 ACCIDENT ANALYSIS – SAFETY AND CRASHES 17

4.0 Effects and Benefits 18

4.1 TEMPORARY EFFECTS AND BENEFITS 18

4.1.1 2015 No Build Alternative 18

4.1.2 2015 Build Alternative 21

4.2 LONG TERM EFFECTS AND BENEFITS 27

4.2.1 2033 No Build Alternative 27

4.2.2 2033 Build Alternative 30

4.3 SAFETY 39

4.4 INTERSECTION CONTROL 40

4.4.1 Traffic Signal Warrant Analysis 40

4.4.2 Roundabout Analysis 41

4.5 STORAGE LENGTH REQUIREMENTS 41

4.5.1 Left Turn Lane Storage Requirements 42

4.5.2 Right Turn Lane Storage Requirements 42

4.6 AVERAGE CORRIDOR SPEEDS AND TRAVEL TIMES 44

4.7 ACCESS MANAGEMENT 45

4.8 PEDESTRIAN AND BICYCLE ACCESS 47

4.9 EMERGENCY SERVICES AND RESPONSE TIMES 47

4.10 TRANSIT 50

4.11 TRANSPORTATION SYSTEMS MANAGEMENT STRATEGIES 52

4.11.1 Future Road Network at the 2033 Horizon 53

4.11.2 Operational Analysis 55

4.11.3 Park-and-Ride Analysis 57

4.11.4 Summary 58

4.12 DATA FOR NOISE ANALYSIS 58

5.0 Mitigation 59

6.0 References 59

List of Exhibits

Exhibit 1. 2015 No Build Alternative Peak Hour Traffic Volumes 2
Exhibit 2. 2015 Build Alternative Peak Hour Traffic Volumes 3
Exhibit 3. 2033 No Build Alternative Peak Hour Traffic Volumes 4
Exhibit 4. 2033 Build Alternative Peak Hour Traffic Volumes 5
Exhibit 5. SR 502 Corridor Widening Project Study Area and Transportation Study Area 9
Exhibit 6. Existing Lane Configurations 10
Exhibit 7. Existing (2006) Peak Hour LOS & Delay Summary – SR 502 Corridor 12
Exhibit 8. Existing (2006) Peak Hour Traffic Volumes 14
Exhibit 9. Existing (2006) PM Peak Hour LOS & Delay Summary – Off-Corridor 15
Exhibit 10. Collision Rates along SR 502 from 2001 to 2005 17
Exhibit 11. 2015 No Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor 19
Exhibit 12. 2015 No Build Alternative PM Peak Hour LOS & Delay Summary – Off-Corridor 20
Exhibit 13. 2015 Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor 22
Exhibit 14. 2015 No Build and Build Alternative LOS Comparison – SR 502 Corridor 23
Exhibit 15. 2015 Build Alternative Recommended Lane Configurations 24
Exhibit 16. 2015 No Build and Build Alternative PM Peak LOS Comparison – Off-Corridor 27
Exhibit 17. 2033 No Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor 28
Exhibit 18. 2033 No Build Alternative PM Peak Hour LOS & Delay Summary – Off-Corridor 30
Exhibit 19. 2033 Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor 31
Exhibit 20. 2033 No-Build and Build Alternative LOS Comparison – SR 502 Corridor 32
Exhibit 21. 2033 Build Alternative Recommended Lane Configurations 33
Exhibit 22. Level of Service Summary 37
Exhibit 23. 2033 Build & No Build Alternative PM Peak Hour LOS & Delay Summary – Off Corridor 38
Exhibit 24. Traffic Signal Warrant Analysis 41
Exhibit 25. Recommended Left Turn Lane Storage Lengths 42
Exhibit 26. Recommended Right Turn Storage Lengths 43
Exhibit 27. Average AM Peak Hour Corridor Speeds 44
Exhibit 28. Average PM Peak Hour Corridor Speeds 44
Exhibit 29. Average AM Peak Hour Travel Times 45
Exhibit 30. Average PM Peak Hour Travel Times 45
Exhibit 31. Percentage of Driveway Collisions By Movement at Unsignalized Intersections 46
Exhibit 32. 2033 No Build – Five Minute Emergency Response Time 48
Exhibit 33. 2033 Build – Five Minute Emergency Response Time 49
Exhibit 34. Emergency Response Times 50
Exhibit 35. Emergency Vehicle Travel Path 51

Exhibit 36. Vicinity Map 54
Exhibit 37. TSM/TDM Option 1: 2033 Build & No Build Peak Hour LOS & Delay Summary 56
Exhibit 38. TSM/TDM Option 2: 2033 Build & No Build Peak Hour LOS & Delay Summary 57

List of Appendices

Appendix A. SR 502 Corridor Modeling Analysis Methodology (January 23, 2007)
Appendix B. SR 502 Baseline Conditions Report (February 27, 2007)
Appendix C. Factor to Determine Daily Traffic Volumes – Calculations
Appendix D. Level of Service Definitions
Appendix E. Field Notes and Inventory of Existing Conditions
Appendix F. Transit Route Map
Appendix G. Existing - Synchro and SimTraffic Outputs
Appendix H. 2015 No Build Alternative - Synchro and SimTraffic Outputs
Appendix I. 2015 Build Alternative - Synchro and SimTraffic Outputs
Appendix J. 2033 No Build Alternative - Synchro and SimTraffic Outputs
Appendix K. 2033 Build Alternative - Synchro and SimTraffic Outputs
Appendix L. Detailed Drop Lane Calculations
Appendix M. Traffic Signal Warrant Analysis
Appendix N. Roundabout Analysis
Appendix O. Data for Noise Analysis

1.0 Executive Summary

The 2003 "Nickel" package and the 2005 Transportation Partnership Act resulted in funding being programmed to improve the SR 502 Corridor between Battle Ground and I-5. The Washington State Department of Transportation is proposing to widen SR 502 from a two lane cross section to a four lane cross section in this corridor. When completed, SR 502 will be a four-lane state highway from I-5 to SR 503 in Battle Ground.

The SR 502 Corridor Widening Project is located west of Battle Ground, Washington in unincorporated Clark County. The project corridor extends east of NW 15th Avenue to NE 102nd Avenue. This report summarizes the transportation analysis conducted for this widening project, and includes adjacent and intersecting arterial corridors that are potentially impacted by the widening.

2.0 Studies, Coordination, and Methods

Volume Forecasting Methodology

The Washington State Department of Transportation (WSDOT) Design Manual, Figure 440-6, Design Data for Principal Arterial, defines "design year" as "20 years after construction is scheduled to begin". For the SR 502 Corridor Widening Project, at the time of the initiation of the traffic analysis, construction was expected to start in the 2013-2014 time frame (subsequent to the analysis, the project start was moved up to the 2011-2012 time frame; the change in start year would not have a substantial impact on the design year traffic volumes); thus, the Year 2033 was selected as the analysis and design horizon year for the transportation analysis. This represents an estimation of traffic conditions 20 years past the year of construction start year, which is 2014.

The Southwest Washington Regional Transportation Council's (RTC) EMME/2 regional travel demand model was used as the basis to generate future 2033 year travel demand volumes. The model was calibrated and validated for the study area. The 2033 traffic volumes were developed based on extrapolating the latest 2024 RTC model run using a growth factor of approximately 2% per year. PB had submitted the Modeling Methodology Memo in January 2007 and the Baseline Conditions Report in February 2007 to WSDOT. These documents further discuss how the future traffic volumes were developed and are included in Appendix A and Appendix B.

Opening year (2015) modeling was developed by interpolation based on existing plus committed transportation projects expected to be completed by 2015 (with the exception of the SR 502 corridor which is the subject of this analysis), and based on current (2005-2006), 2024 and 2033 modeling.

The 2015 No Build Alternative and the 2015 Build Alternative peak hour traffic volumes are presented in Exhibits 1 and 2, respectively. The 2033 No Build Alternative and the 2033 Build Alternative peak hour traffic volumes are presented in Exhibits 3 and 4, respectively.

Also, shown in the exhibits are the average daily traffic volumes. In order to determine the daily traffic volumes a factor of 11.5 was applied to the PM peak hour traffic volumes. This factor was determined by reviewing recent traffic counts at certain locations along the SR 502 corridor. Detailed calculations are included in Appendix C.

Exhibit 1. 2015 No Build Alternative Peak Hour Traffic Volumes

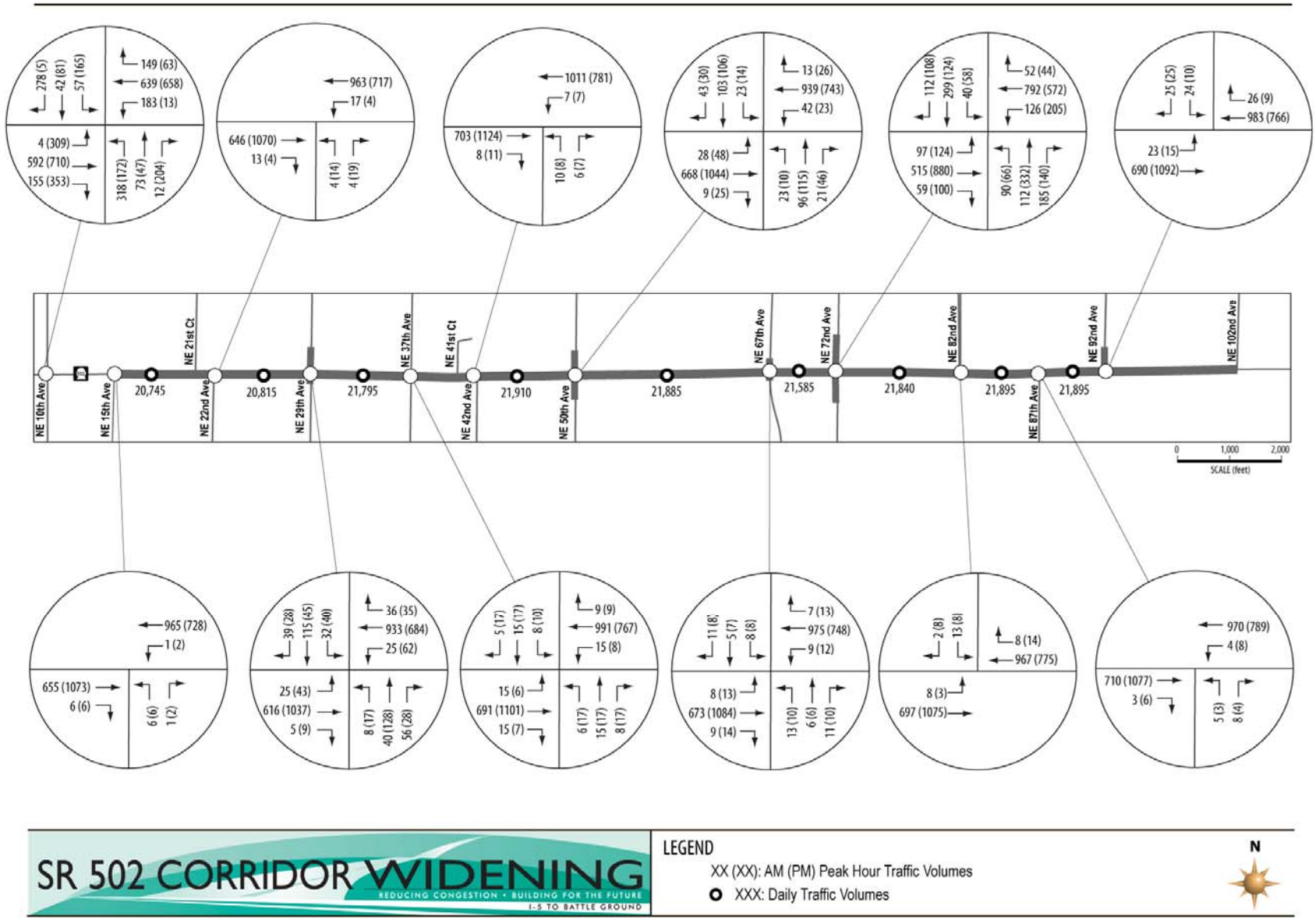


Exhibit 2. 2015 Build Alternative Peak Hour Traffic Volumes

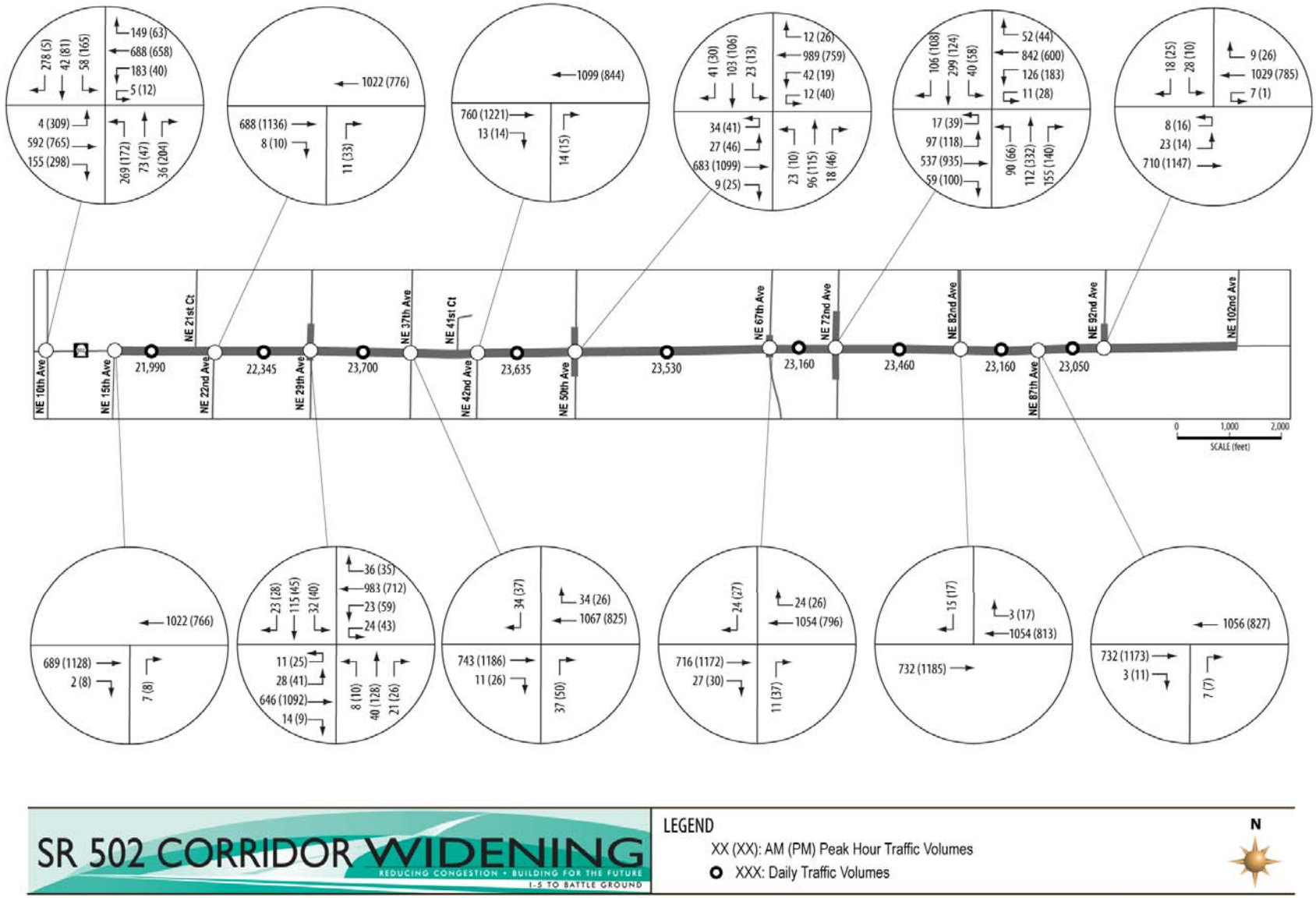


Exhibit 3. 2033 No Build Alternative Peak Hour Traffic Volumes

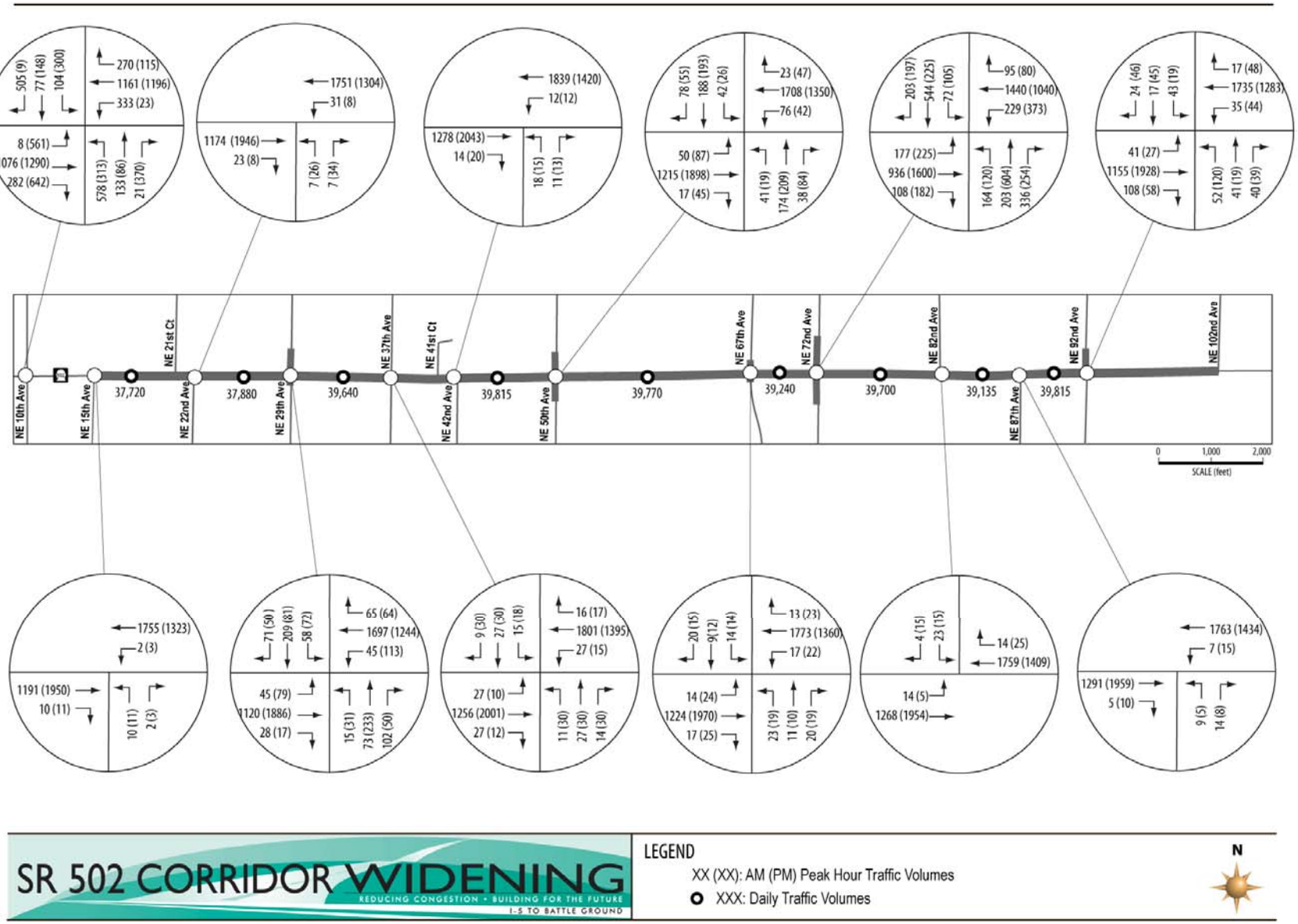
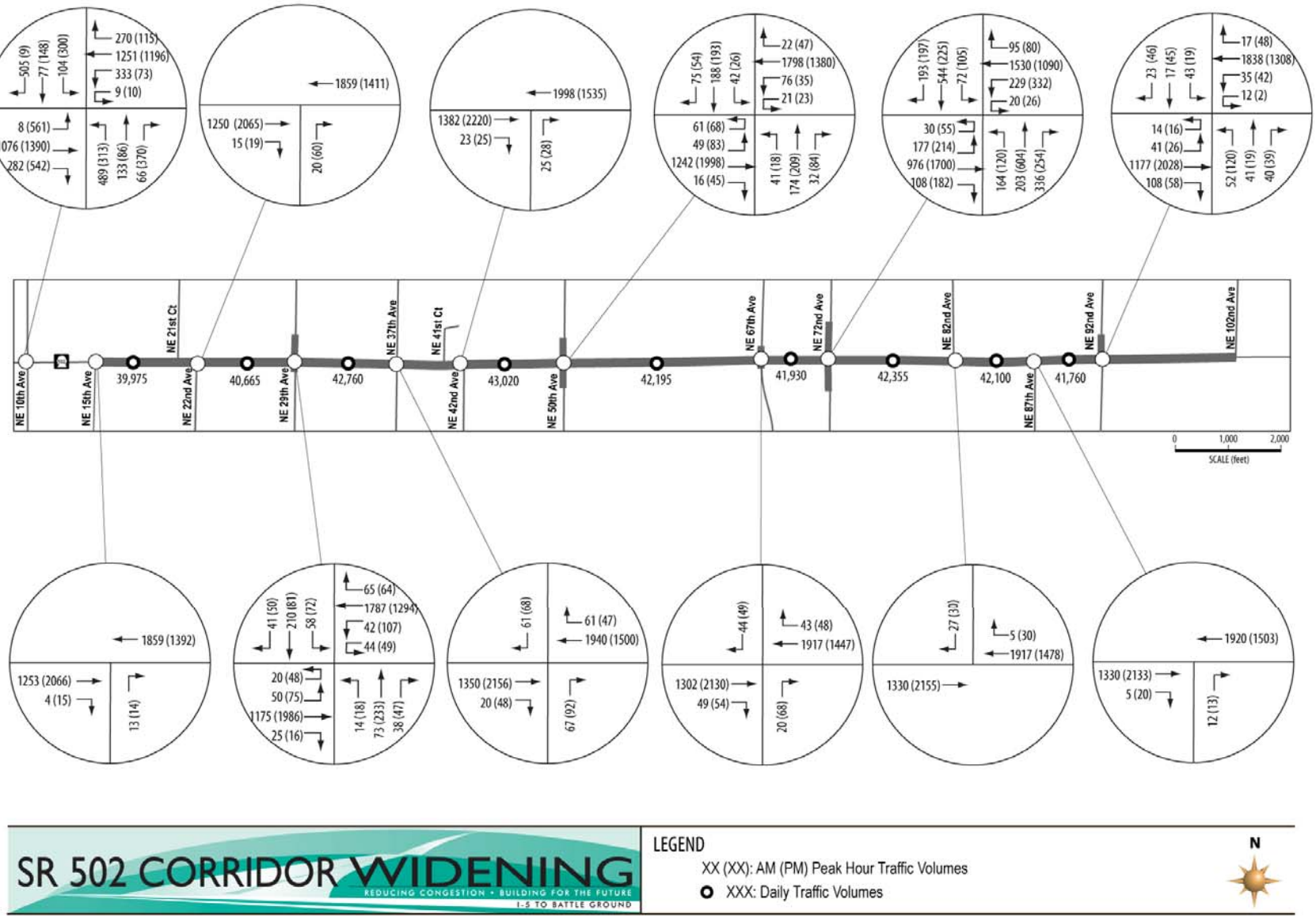


Exhibit 4. 2033 Build Alternative Peak Hour Traffic Volumes



Traffic Operations Analysis Methodology

The intersection analysis will be undertaken using the Synchro/SimTraffic software package, which is based on the Highway Capacity Manual (HCM 2000).

For the purposes of this analysis the following were the Synchro / SimTraffic setting assumptions:

- Saturation Flow Rate = 1900 vehicles per hour per lane (vphpl)
- Lane Width = 12 feet
- Vehicle Length = 25 feet
- Peak Hour Factor = 0.90 (Existing Conditions), 0.95 (Future Conditions)
- Heavy Vehicle Percentage = 5%
- Pedestrian Walking Speed = 4.0 ft/s

For unsignalized intersections, the methodology considers the intersection geometry, the traffic volumes, the posted speed limit and the type of intersection control. The average delay for each individual movement from the minor street, the major street left-turn movements and the overall intersection are calculated. An operation level of service (LOS) is then assigned based on the calculated average delay.

For signalized intersections, the methodology considers the intersection geometry, the traffic volumes, the posted speed limit, the traffic signal phasing/timing plan as well as pedestrian volumes. The average delay for each lane group and the overall intersection are calculated. An operation LOS is then assigned based on the calculated average delay. Level of service definitions applied to this study is contained are Appendix D.

The SimTraffic software will produce the traffic simulations of the road network. Traffic simulations give a spatial representation to traffic, and graphically animate that traffic flow. Traffic simulations will be summarized by running five iterations of the peak hour model changing the initial random number seed for each run, and then averaging the five runs using SimTraffic's "Create Report" function. The model will be seeded for 10 minutes, then run for 15 minutes using peak-hour factor adjust, and then 45 minutes using anti-peak-hour factor adjust. The model will be used to estimate concurrency corridor speeds under the various alternatives.

3.0 Affected Environment

The SR 502 Corridor Widening Project is located west of Battle Ground, Washington in unincorporated Clark County. Land uses include rural residential, rural center commercial and retail services; some historical light industrial or manufacturing; and agricultural. The SR 502 corridor is heavily utilized by motorists and trucks traveling between I-5 and Battle Ground, northeast Clark County, and rural areas east of Battle Ground.

There are two study areas included in the overall environmental review process:

- Project Study Area, which is the area in which the proposed project would take place; this study area extends from of NE 15th Avenue to NE 102nd Avenue, approximately five miles in length.

- Transportation Study Area, which includes those transportation facilities that may be impacted, or benefit from, completion of the SR 502 Corridor Widening project. Based on agreement of the traffic team (WSDOT, Clark County, RTC, and PB staff), besides the SR 502 corridor, this study area includes the NE 239th Street, NE 199th Street, and NE 179th Street corridors. The transportation study area is defined at NE 10th Avenue on the west, NE 239th Street on the north, SR 503 on the east, and NE 179th Street on the south.

Approximately 60 percent of the traffic using the SR 502 corridor travels to and from Battle Ground; approximately 25 percent travels to areas north of Battle Ground; and the remaining 15 percent travels to outlying areas east and south of Battle Ground.

The project study area and transportation study area for the SR 502 Corridor Widening Project are shown in Exhibit 5.

3.1 Road Network

The SR 502 is currently a two lane undivided roadway with numerous at-grade intersections/driveways spaced in close proximity to each other and to intersecting public roadways. Based on data collected in the field, there are approximately 150 driveways on the SR 502. The field notes and inventory of existing conditions are included in Appendix E. This was based on the project study area from just east of NE 15th Avenue to NE 102nd Avenue. The SR 502 is heavily utilized by motorists and trucks traveling between I-5 and Battle Ground, northeast Clark County, and rural areas east of Battle Ground. The existing lane configurations are shown in Exhibit 6.

The SR 502/NE 10th Avenue intersection and the SR 502/NE 72nd Avenue intersection operate as signalized intersections. The remaining intersections along the corridor operate with stop control on the side streets only.

SR 502 currently has a managed access classification, and is planned to be reclassified as a Modified Limited Access corridor. The reclassification would be implemented through an improvement project. In addition, SR 502 is a designated Emergency Transportation Route by the region and WSDOT. Considered critical infrastructure, in the event of an earthquake or other emergency, WSDOT is required to assess the damage to SR 502, and report on its accessibility and functionality as a travel route within four hours of the event. This route would receive priority funding should repairs be needed.

Subsequent to the initiation of the Environmental Assessment for this project, the NE 10th Avenue/NE 199th Street intersection was signalized. This change was included in the future-year no-build networks, and the unsignalized and signalized levels-of-service will be summarized for “existing conditions”.

At the SR 502 intersection with NE 92nd Avenue, this intersection is currently a “three-legged” intersection with only a north leg of the intersection in existence today. For opening year (2015),

this same configuration was assumed to be in place. However, the City of Battle Ground's long-range Transportation System Plan identifies a future south leg of this intersection to occur at some point over the next twenty years. For the SR 502 project analysis, this was assumed to occur at some point after the project is completed and prior to the design year (2033), and is assumed to be built by an entity other than WSDOT.

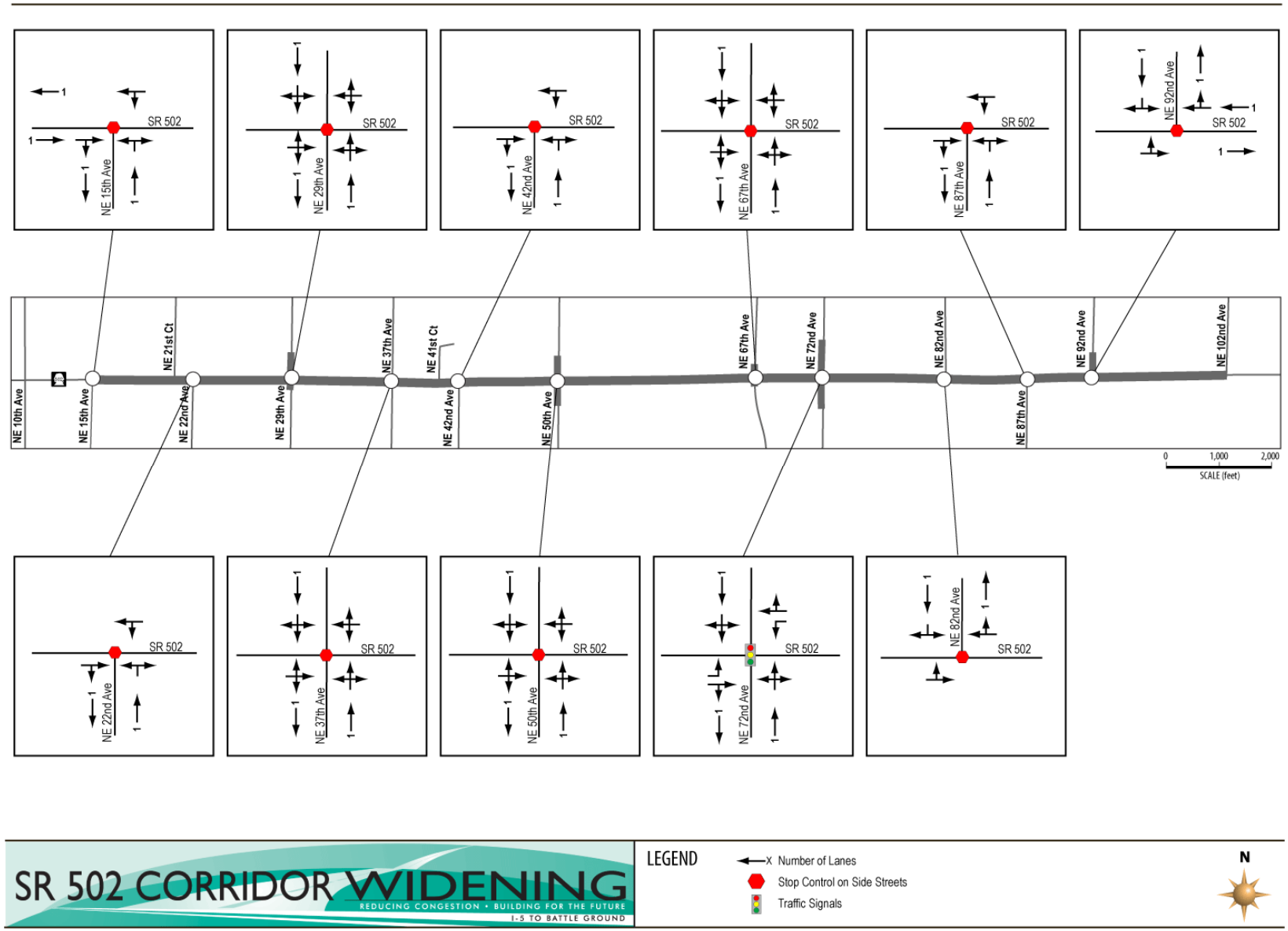
3.2 Bicycle, Pedestrian, and Transit Facilities

There are no designated bicycle lanes located within the study area, although bikes have been observed to ride on the narrow shoulders that do exist along SR 502. A few sidewalks are located in the SR 502 / NE 72nd Avenue intersection (Dollars Corner), but nowhere else along SR 502; however, shoulders on the roadway serve as pedestrian walkways and bikeways. Crosswalks in the study area are limited to the signalized intersection at NE 72nd Avenue.

Clark County Public Transportation Benefit District (C-TRAN) provides transit for Clark County. Route 47 is the only transit service in the study area and provides peak hour commute connections into downtown Vancouver. For the morning commute, Route 47 runs from Battle Ground Transit Center west along SR 502/NE 219th Street and then south along SR 502/NE 10th Avenue to the I-5/NE 179th Interchange where the route continues along I-5 and terminates at the Vancouver 7th Street Transit Center. In the afternoon, the return commuter route travels from the Vancouver 7th Street Transit Center to the Battle Ground Transit Center along the same route. The transit route map is included in Appendix F. Transit service is provided only once during morning and afternoon peak hours.

Exhibit 5. SR 502 Corridor Widening Project Study Area and Transportation Study Area

Exhibit 6. Existing Lane Configurations



3.3 Existing Traffic Volumes

Traffic counts for the PM peak hour were gathered throughout the study area. Traffic counts consisted primarily of intersection peak hour turning movements but also include the mid-block volume counts ("tube counts") and vehicle classification counts. The primary source of the traffic counts was RTC's website. Additional traffic counts were supplied by WSDOT and Clark County. Where 2006 counts were not available but counts from 2002, 2003, 2004 or 2005 were available, those counts were factored by 3% per year to reach a year 2006 estimated count. In addition PB conducted manual traffic counts to verify some of the count locations.

The AM peak hour traffic volumes were either compiled by using 2006 traffic counts, or estimated by reversing the PM peak direction and multiplying by a factor of 0.90. Exhibit 8 illustrates the existing (2006) AM and PM peak traffic volumes for the SR 502 corridor study area.

The highest volumes along SR 502 are experienced on the east half of the project corridor (east of NE 72nd Avenue).

Comparison to Recent Counts: since the SR 502 Corridor Existing and Baseline Transportation Conditions work and report were issued in 2007 (summarizing Year 2006 traffic volumes), a few of the counts along the SR 502 corridor have been updated. These have been summarized from the RTC Traffic Count Database website[1] and include:

- East of NE 10th Avenue: AM and PM peak hour counts in 2007 are 30-50 percent lower than 2006 counts
- East and West of NE 72nd Avenue: AM and PM peak hour counts in 2007 are 8-40 percent lower than 2006 counts
- West of NE 102nd Avenue: AM and PM peak hour counts are 12-46 percent lower than 2006 counts.

The substantial decrease in traffic volumes in 2007 is due to the acceleration of construction for the new I-5 at SR 502 interchange (which opened to traffic in 2008). During 2007, the SR 502 corridor from NE 10th Avenue east to NE 22nd Avenue experienced a number of construction impacts which resulted in traffic delays, which in turn resulted in the decrease in traffic volumes along SR 502 and diversion onto other routes. Thus, the 2006 volumes, which are higher, are considered to be more conservative in the traffic capacity and operations analyses produced for this project. Because of the construction impacts, traffic counts were not collected in 2008 but are expected to continue to be lower than 2006 due to the economic downturn.

[1] SR 502 counts are found at: http://rtc.wa.gov/data/traffic/arterial.asp?id=39

3.4 Existing Operating Conditions

3.4.1 SR 502 Corridor Intersection Operating Conditions

The existing operating conditions at the intersections within the SR 502 corridor study area were reviewed for the morning and afternoon peak hours based on the existing lane configurations and traffic control using the Synchro software package. SimTraffic was used for a more-detailed review of queuing and storage requirements at critical locations. The storage requirements are discussed in detail in Section 4.4. The results of the analyses are summarized in Exhibit 7.The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix G.

Exhibit 7. Existing (2006) Peak Hour LOS & Delay Summary – SR 502 Corridor

	AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	C	29	B	13
SR 502/NE 15th Avenue*	C	21	D	25
SR 502/NE 22nd Avenue*	C	18	C	23
SR 502/NE 29th Avenue*	F	56	F	64
SR 502/NE 37th Avenue*	D	28	F	51
SR 502/NE 50th Avenue*	E	50	E	43
SR 502/NE 67th Avenue*	D	32	E	37
SR 502/NE 72nd Avenue	C	32	E	59
SR 502/NE 92nd Avenue*	D	30	D	28
SR 502/NW 20th Avenue	B	17	C	26
SR 502/SR 503	D	44	C	31

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

The results summarized in Exhibit 7 indicate the following:

- The SR 502/NE 10th Avenue signalized intersection currently operates at an acceptable level of service in both the AM and PM peak hours.
- The SR 502/NE 15th Avenue and SR 502/NE 22nd Avenue intersections are currently operating at an acceptable level of service in both the AM and PM peak hours with stop control on the side street.
- The SR 502/NE 29th Avenue stop control intersection currently operates at a level of service F in both peak periods. The overall level of service of the intersection is based on the worst movement. The critical movements at this intersection are the northbound and southbound movements. Based on observations of the SimTraffic simulation run, it is difficult for vehicles traveling on NE 29th Avenue to access SR 502 due to the heavy traffic on SR 502 and the lack of traffic gaps.

- The SR 502/NE 37th Avenue intersection is currently operating at a level of service D in the AM peak hour and at a level of service F in the PM peak hour with stop control on NE 37th Avenue. Based on the analysis, the movement that is failing is the northbound movement.

- The SR 502/NE 50th Avenue intersection is currently operating at a level of service E in both peak hours.

- The SR 502/NE 67th Avenue intersection is operating satisfactorily with stop control on NE 67th Avenue. The critical peak hour is the afternoon, where this intersection is operating at a level of service E.

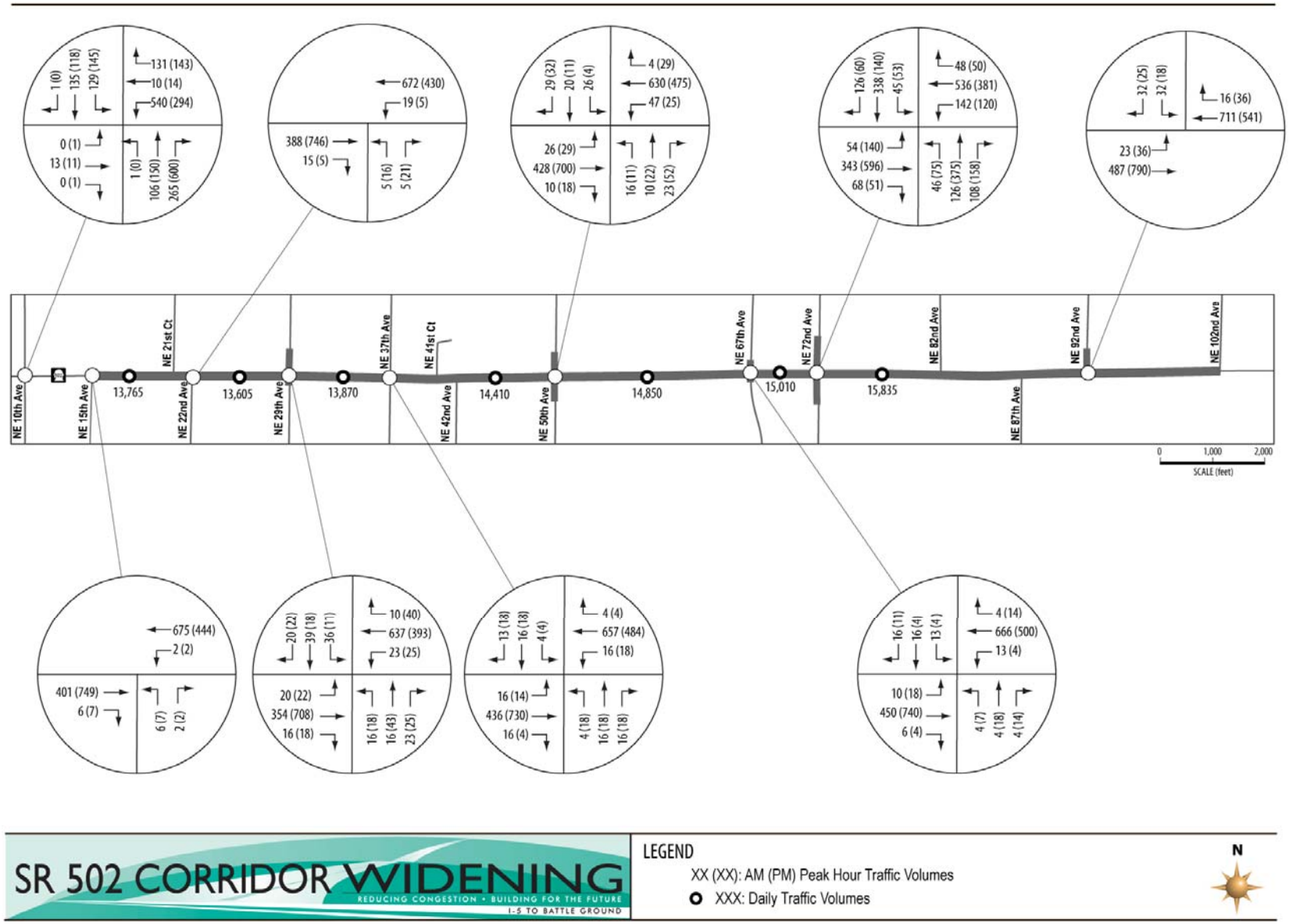
- The SR 502/NE 72nd Avenue signalized intersection is operating satisfactorily. The intersection is operating at a level of service C in the AM peak hour and level of service E in the PM peak hour. However, based on observations of the SimTraffic simulation runs, the intersection is experiencing significant queuing on all approaches.

- The SR 502/NE 92nd Avenue intersection is operating satisfactorily in both peak hours with stop control on the side street.

- The SR 502/NW 20th Avenue signalized intersection is operating is operating at an acceptable level of service in both peak hours.

- The SR 502/SR 503 signalized intersection is currently operating is operating at a level of service D in the AM peak hour.

Exhibit 8. Existing (2006) Peak Hour Traffic Volumes



Based on observations of the SimTraffic simulation runs, the SR 502 corridor shows significant congestion. In the PM peak hour, the analysis shows congestion along SR 502 primarily in the eastbound direction. Due to delays at the SR 502/NE 72nd Avenue intersection, the eastbound movement queues back to the SR 502/NE 67th Avenue intersection. The SimTraffic results were verified in the field. In addition, comments received at public meetings confirmed these observations.

3.4.2 Off-Corridor Intersection Operating Conditions

The existing operating conditions at the intersections along the NE 239th Street, NE 199th Street, and NE 179th Street corridors were reviewed for the afternoon peak hour based on the existing lane configurations and traffic control using the Synchro and SimTraffic software package. The afternoon peak hour was selected for these corridors, as this represents the "worst case" scenario. The existing (2006) traffic volumes for the intersections along these corridors are included in Synchro outputs in Appendix G. The results of the analysis are summarized in Exhibit 9. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix G.

Exhibit 9. Existing (2006) PM Peak Hour LOS & Delay Summary – Off-Corridor

	PM Peak Hour	
	LOS	Delay
NE 239th Street/NE 72nd Avenue*	F	> 300
NE 239th Street/NE 92nd Avenue*	B	11
NE 239th Street/NW 20th Avenue*	B	13
NE 244th Street/SR 503	B	14
NE 199th Street/NE 10th Avenue* (1)	F	>300
NE 199th Street/NE 29th Avenue*	E	46
NE 199th Street/NE 50th Avenue*	C	18
NE 199th Street/NE 72nd Avenue	B	17
NE 199th Street/NW 20th Avenue*	D	32
NE 199th Street/SR 503	B	17
NE 179th Street/NE 10th Avenue	A	9
NE 179th Street/NE 29th Avenue*	F	107
NE 179th Street/NE 50th Avenue*	C	18
NE 179th Street/NE 72nd Avenue	C	22
NE 179th Street/NE 112 Avenue*	C	24
NE 179th Street/SR 503	A	8

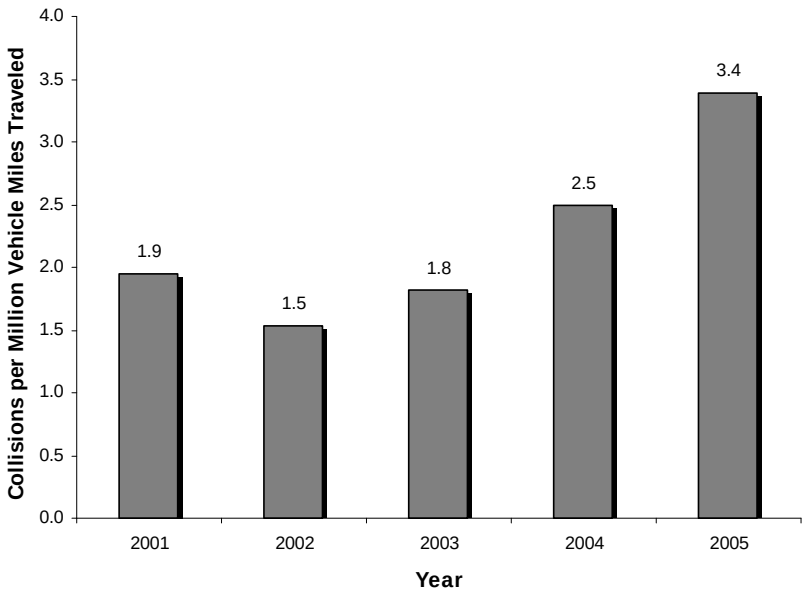
Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In most cases, the worst movement is the side street.
(1) Traffic signals were implemented at the NE 199th Street/NE 10th Avenue intersection in 2007. Traffic analysis has been conducted to reflect this improvement. Based on the Synchro results this intersection is operating at LOS F with a delay of 108 seconds in the signalized condition.

As shown in Exhibit 9, most of the intersections are operating at an acceptable level of service with the existing lane configuration and traffic control, with the exception of the NE 239th Street/NE 72nd Avenue intersection, the NE 199th Street/NE 10th Avenue intersection, and the NE 179th Street/NE 29th Avenue intersection, which is operating at a level of service F.

3.5 Accident Analysis – Safety and Crashes

SR 502 between NE 37th Avenue and just east of NE 50th Avenue[2] is designated as a High Accident Corridor. The remainder of SR 502 continues to be monitored but is not considered a High Accident Corridor. As shown in Exhibit 10, the rate of collisions on SR 502 in the study area has increased since 2001. Over a five year period from 2001 to 2005[3], there were a total of 184 collisions in the study area. Of the total number of collisions 47 percent were injury or possible injury, two percent included fatalities, and one percent did not report if the collision was injury or non-injury. Fifty percent involved property damage only.

Exhibit 10. Collision Rates along SR 502 from 2001 to 2005



The SR 502 corridor has a number of collisions at major intersections within the study area. Between the years of 2001 to 2005 there were 14 collisions at NE 29th Avenue, 15 collisions at NE 50th Avenue, and 27 collisions at NE 72nd Avenue. The total of these collisions make up approximately 30 percent of the collisions in the study area.

During peak traffic hours vehicles attempting to turn left onto SR 502 would experience delays exceeding five minutes per vehicle at unsignalized intersections. In these situations, drivers wait long periods of time, becoming increasingly frustrated with the intolerable delays, and take higher risks to enter the roadway, which may exacerbate safety concerns. Drivers would look for alternative routes such as NE 199th Street or NE 179th Street to bypass the congestion.

As more traffic diverts to alternate corridors, such as NE 199th Street or NE 179th Street, with less-than-state highway design standards, the overall collision rate of the alternate corridors

[2] As identified for the 2007-2009 biennium.
[3] Source: WSDOT records, January 1, 2001 through December 31, 2005.

would likely increase. The collision history along NE 199th Street and NE 179th Street indicate that the intersections of NE 179th Street and Union Road, NW 179th Street at NW 11th Avenue, NE 199th Street at NE 29th Avenue, and NE 199th Street at NE 50th Avenue all experience a high number of collisions. Traffic diversions off of SR 502 due to traffic congestion would exacerbate the high collision condition at all of these intersections except for NE 170th Street at NE 11th Avenue.

Pedestrians would face increasingly hazardous conditions along the corridor. The lack in traffic gaps would make it difficult for pedestrians to cross SR 502 at unsignalized intersections.

4.0 Effects and Benefits

4.1 Temporary Effects and Benefits

Based on the project's current construction timeline, opening year for the corridor is assumed to be the Year 2015. As mentioned earlier, the 2015 Opening Year scenario was developed as an interpolation of existing and comprehensive planning year (2024) land use, and the transportation network is based on existing plus committed transportation projects expected to be completed by 2015.

4.1.1 2015 No Build Alternative

Future Road Network

The No Build Alternative is defined as actions that would occur should the build alternative not occur. The 2015 No Build Alternative road network will include existing plus committed projects plus financially-constrained improvements not associated with the SR 502 corridor project. The proposed I-5 crossing near S. 15th Street in Ridgefield, south of the Pioneer Street/I-5 interchange will not be included in the no build (or build) alternatives as it is not included in the financially-constrained Clark County Comprehensive Plan Capital Facilities Plan.

The major additions to the existing network in the study area to get to 2015 No Build Alternative include:

- I-5/SR 502 Interchange
- Short term improvements to Ridgefield interchange and SR 501
- Safety improvements to the SR 502 corridor at NE 29th Avenue and NE 50th Avenue, which include channelizing the intersections to gain exclusive left-turn lanes on SR 502 in each direction. Signalization will not be included.

2015 No Build Alternative SR 502 Corridor Intersection Operating Conditions

The 2015 No Build Alternative operating conditions were reviewed at the intersections within the study area during the morning and afternoon peak hours, using the volumes shown in Exhibit 1. Exhibit 11 summarizes the results of the analysis for the 2015 No Build Alternative morning and afternoon peak hour traffic volumes. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix H.

Exhibit 11. 2015 No Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor

	AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	C	29	C	24
SR 502/NE 15th Avenue*	C	18	D	31
SR 502/NE 22nd Avenue*	E	46	E	40
SR 502/NE 29th Avenue*	F	>300	F	>300
SR 502/NE 37th Avenue*	F	97	F	232
SR 502/NE 42nd Avenue*	E	40	F	52
SR 502/NE 50th Avenue*	F	>300	F	>300
SR 502/NE 67th Avenue*	F	66	F	102
SR 502/NE 72nd Avenue	E	63	F	109
SR 502/NE 82nd Avenue*	E	48	E	42
SR 502/NE 87th Avenue*	D	28	E	38
SR 502/NE 92nd Avenue*	F	52	E	36
SR 502/NW 20th Avenue	C	29	C	33
SR 502/SR 503	C	31	C	30

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

The results in Exhibit 11 indicate that most of the intersections will be operating at level of service of D or worse, with few exceptions.

The SR 502/NE 10th Avenue intersection has been analyzed based on the intersection design provided by WSDOT as part of the I-5/SR 502 interchange project (which was under construction at the time of this report). This intersection is being improved to accommodate the following geometry:

- Dual northbound and southbound left turn lanes on NE 10th Avenue, and single eastbound and westbound left turn lanes on SR 502
- Designated eastbound, northbound and southbound right turn lanes
- An additional travel lane in each direction on SR 502.

The SR 502 corridor east of NE 15th Avenue is expected to experience significant congestion and delays. At the unsignalized intersections, the majority of the delays occur on the side streets. Based on the SimTraffic simulation runs, it is difficult for vehicles traveling on the side street to access SR 502 due to the minimal gaps in traffic. In additions, the SR 502/NE 72nd Avenue intersection is also expected to experience significant delays. Based on observations of the SimTraffic simulation runs, the eastbound and westbound movements at this intersection are expected to queue past adjacent intersections.

2015 No Build Alternative Off-Corridor Intersection Operating Conditions

The 2015 No Build Alternative operating conditions were reviewed at the intersections along the NE 239th Street, NE 199th Street, and NE 179th Street corridors for the afternoon peak hour. It has been assumed that the existing infrastructure along these corridors will exist at the 2015 horizon, with the exception of the NE 179th Street/NE 10th Avenue intersection: NE 10th Avenue north of NE 179th Street is assumed to be realigned to meet the new NE 15th Avenue/Union Road corridor south of NE 179th Street, approximately ¼ mile to the east of the current NE 10th Avenue/179th Street/I-5 northbound off-ramp intersection. NE 179th Street from I-5 to west of NE 29th Avenue will be widened to a four lane cross-section.

The 2015 No Build Alternative traffic volumes for the intersections along these corridors are included in Synchro outputs in Appendix H. The results of the analysis are summarized in Exhibit 12. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix H.

Exhibit 12. 2015 No Build Alternative PM Peak Hour LOS & Delay Summary – Off-Corridor

	PM Peak Hour	
	LOS	Delay
NE 239th Street/NE 72nd Avenue*	F	81
NE 239th Street/NE 92nd Avenue*	B	10
NE 239th Street/NW 20th Avenue*	B	12
NE 244th Street/SR 503	B	11
NE 199th Street/NE 10th Avenue	C	20
NE 199th Street/NE 29th Avenue*	F	73
NE 199th Street/NE 50th Avenue*	C	22
NE 199th Street/NE 72nd Avenue	B	12
NE 199th Street/NW 20th Avenue*	F	180
NE 199th Street/SR 503	B	18
NE 179th Street/NE 10th Avenue	B	20
NE 179th Street/NE 29th Avenue*	F	>300
NE 179th Street/NE 50th Avenue*	F	97
NE 179th Street/NE 72nd Avenue	B	19
NE 179th Street/NE 112 Avenue*	E	43
NE 179th Street/SR 503	B	20

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In most cases, the worst movement is the side street.

As shown in Exhibit 12, five intersections are expected to operate at a level of service F. As compared to the existing conditions, these intersections are expected to experience more delay and congestion.

4.1.2 2015 Build Alternative

The 2015 Build Alternative road network reflects the existing plus committed improvements as well as the recommended improvements to SR 502.

The widening of SR 502 will be designed to accommodate a 14-16 foot center median near intersections, and a narrower, 10-12 foot median between intersections. The SR 502 corridor has many driveways connecting to businesses and homes. Therefore, with this median in place, access into these sites will be converted to right-in/right-out. Through discussions with the WSDOT project team, it has been decided that u-turns will be accommodated at NE 10th Avenue, NE 29th Avenue, NE 50th Avenue, NE 72nd Avenue, and NE 92nd Avenue. This will provide for a spacing of approximately one mile between these intersections. Median breaks to allow for u-turns will not be provided between these intersections.

2015 Build Alternative SR 502 Corridor Intersection Operating Conditions

The 2015 Build Alternative operating conditions were reviewed at the intersections within the study area during the morning and afternoon peak hours, using the volumes previously shown in Exhibit 2. Exhibit 13 summarizes the results of the analyses for the 2015 Build Alternative morning and afternoon peak hour traffic volumes, while Exhibit 14 compares 2015 No-build and Build alternative LOS for the PM peak hour. Note that the Build alternative results in a slight increase in delay at the SR 502/NE 10th Avenue intersection, due to a higher level of traffic traveling through that intersection in the Build scenario compared to the no-build.

The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix I.

Exhibit 15 illustrates the recommended lane configurations for the 2015 Build Alternative. Exhibit 15 also shows the recommended storage lengths for the left turn and right turn lanes. The storage lengths are discussed in detail in Section 4.4.

Exhibit 13. 2015 Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor

	AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	D	35	C	26
SR 502/NE 15th Avenue*	A	9	A	9
SR 502/NE 22nd Avenue*	B	11	B	14
SR 502/NE 29th Avenue	B	13	B	14
SR 502/NE 37th Avenue*	B	13	B	15
SR 502/NE 42nd Avenue*	B	11	B	14
SR 502/NE 50th Avenue	B	12	B	12
SR 502/NE 67th Avenue*	B	13	B	14
SR 502/NE 72nd Avenue	C	22	C	22
SR 502/NE 82nd Avenue*	B	13	B	12
SR 502/NE 87th Avenue*	B	11	B	14
SR 502/NE 92nd Avenue	A	4	A	4
SR 502/NW 20th Avenue	C	23	C	32
SR 502/SR 503	C	29	C	30

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

Exhibit 14. 2015 No Build and Build Alternative LOS Comparison – SR 502 Corridor

	2015 PM Peak No Build		2015 PM Peak Build	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	C	24	C	26
SR 502/NE 15th Avenue*	D	31	A	9
SR 502/NE 22nd Avenue*	E	40	B	14
SR 502/NE 29th Avenue	F	>300	B	14
SR 502/NE 37th Avenue*	F	232	B	15
SR 502/NE 42nd Avenue*	F	52	B	14
SR 502/NE 50th Avenue	F	>300	B	12
SR 502/NE 67th Avenue*	F	102	B	14
SR 502/NE 72nd Avenue	F	109	C	22
SR 502/NE 82nd Avenue*	E	42	B	12
SR 502/NE 87th Avenue*	E	38	B	14
SR 502/NE 92nd Avenue	E	36	A	4
SR 502/NW 20th Avenue	C	33	C	32
SR 502/SR 503	C	30	C	30

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

The results summarized in this analysis indicate the following:

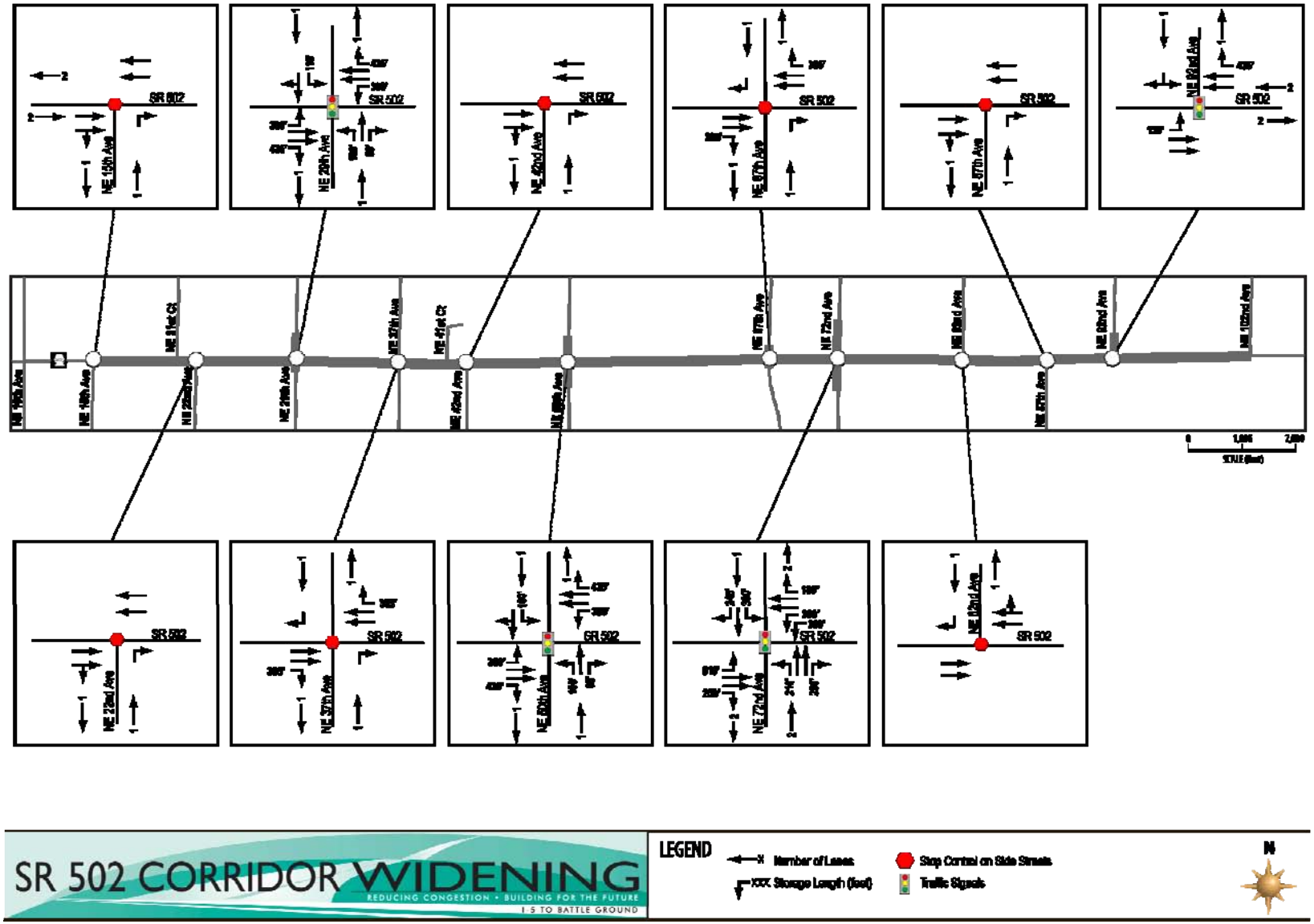
- The Build alternative results in a slight increase in delay at the SR 502/NE 10th Avenue intersection, due to a higher level of traffic traveling through that intersection in the Build scenario compared to the no-build. However, this intersection is expected to operate at an acceptable level of service in the Build alternative based on the intersection design provided by WSDOT.

- The SR 502/NE 15th Avenue and SR 502/NE 22nd Avenue intersections will become right-in/right-out intersections. A median break will not be provided at these intersections. The intersections are expected to operate at an acceptable level of service with minimal delays on the side street.

- The SR 502/NE 29th Avenue intersection will meet signal warrants based on the traffic signal warrant analysis. The traffic signal warrant analysis is further discussed in Section 4.2. Based on the analysis, designated left turn lanes are recommended on all approaches. In addition, designated right turn lanes are recommended on the eastbound and westbound approaches.

- The SR 502/NE 37th Avenue and SR 502/NE 42nd Avenue intersections will become right-in/right-out intersections. A median break will not be provided at these

Exhibit 15. 2015 Build Alternative Recommended Lane Configurations



intersections. The intersections are expected to operate at acceptable levels of service with minimal delays on the side streets.

- The SR 502/NE 50th Avenue intersection requires signalization based on the traffic signal warrant analysis. Based on the analysis, designated left turn lanes are recommended on all approaches. In addition, designation right turn lanes are recommended on the northbound, eastbound, and westbound approaches.

- The SR 502/NE 67th Avenue intersection will operate as a right-in/right-out intersection. A median break will not be provided at this intersection. The intersection is expected to operate at an acceptable level of service with minimal delays on the side street.

- The SR 502/NE 72nd Avenue intersection will require improvements in order to accommodate the projected traffic volumes. The following are the recommended improvements:

    - Dual westbound left turn lanes
    - Two northbound travel lanes through the intersection
    - Two southbound travel lanes south of the intersection

  These improvements are based on the 2033 design year, and are included in the 2015 "build" alternative model.

  Initially, dual eastbound left turn lanes were proposed at this intersection. The RTC model and the traffic simulation both indicated that dual eastbound left turn lanes would be warranted at this intersection. However, through discussions with WSDOT, it has been determined that the widening on the north side of SR 502, to accommodate u-turn movements with dual left turn lanes, would have substantial impacts on the existing gas station, which is located in the northwest corner of this intersection. An analysis was undertaken to determine the implications of revising the design to a single eastbound left turn lane with a 12 foot median. Trucks would still be able to make a u-turn with a single left turn lane with a median and this configuration would not have impacts on the existing gas station. In addition, it is important to note that the 12 foot median could be converted to a second left turn lane if needed in the future (which would require completion of a local street circulation system by Clark County).

  The WSDOT Design Manual was reviewed to determine the length of the drop lanes. It is recommended that the total length of the drop lane, including the taper, be 730 feet (detailed calculations are included in Appendix L).This length is for both the northbound and southbound movements. In addition, the two northbound lanes approaching the intersection will have a length of approximately 800 feet.

- The SR 502/NE 82nd Avenue and SR 502/NE 87th Avenue intersections will operate as right-in/right-out intersections. A median break will not be provided at these locations. The intersections are expected to operate at an acceptable level of service with minimal delays on the side street.

- The SR 502/NE 92nd Avenue intersection has been analyzed with the addition of traffic signals. A designated eastbound left turn lane and a designated westbound right turn lane are recommended. With these improvements in place, the intersection is expected to operate at an acceptable level of service with minimal delays.

- The SR 502/NW 20th Avenue intersection is expected to operate at an acceptable level of service in both peak hours with the existing lane configurations.

- The SR 502/SR 503 intersection is expected to operate at an acceptable level of service in both peak hours with the existing lane configurations.

2015 Build Alternative Off-Corridor Intersection Operating Conditions

The 2015 Build Alternative operating conditions were reviewed at the intersections along the NE 239th Street, NE 199th Street and NE 179th Street corridors for the afternoon peak hour. The lane configurations and traffic control identified at the 2015 No Build Alternative was used in this analysis.

The 2015 Build Alternative traffic volumes for the intersections along these corridors are included in the Synchro outputs in Appendix I. The results of the analysis are summarized in Exhibit 16 and compared to the 2015 No-build alternative. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix I.

Exhibit 16. 2015 No Build and Build Alternative PM Peak LOS Comparison – Off-Corridor

	No Build PM Peak Hour		Build PM Peak Hour	
	LOS	Delay	LOS	Delay
NE 239th Street/NE 72nd Avenue*	F	81	F	81
NE 239th Street/NE 92nd Avenue*	B	10	B	10
NE 239th Street/NW 20th Avenue*	B	12	B	12
NE 244th Street/SR 503	B	11	B	11
NE 199th Street/NE 10th Avenue	C	20	B	17
NE 199th Street/NE 29th Avenue*	F	73	F	60
NE 199th Street/NE 50th Avenue*	C	22	C	19
NE 199th Street/NE 72nd Avenue	B	12	B	12
NE 199th Street/NW 20th Avenue*	F	180	F	160
NE 199th Street/SR 503	B	18	B	18
NE 179th Street/NE 10th Avenue	B	20	C	21
NE 179th Street/NE 29th Avenue*	F	>300	F	>300
NE 179th Street/NE 50th Avenue*	F	97	F	79
NE 179th Street/NE 72nd Avenue	B	19	B	18
NE 179th Street/NE 112 Avenue*	E	43	E	39
NE 179th Street/SR 503	B	20	B	20

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In most cases, the worst movement is the side street.

As shown in Exhibit 16, the intersections along these corridors are expected to operate somewhat better based on delay than in the 2015 No Build Alternative. This is due to the diversion of traffic from these corridors to the SR 502 corridor, as the SR 502 will become a more desirable route in the 2015 Build Alternative. Even with the SR 502 improvements and diversion of traffic to that corridor, there will continue to be a few intersections which are still projected to operate at a level of service F.

4.2 Long Term Effects and Benefits

4.2.1 2033 No Build Alternative

Future Road Network

The No Build Alternative is defined as actions that would occur should the build alternative not occur. The 2033 No Build Alternative road network will include existing plus committed, plus financially-constrained improvements not associated with the SR 502 corridor that are expected to be completed by the Year 2033.

The major additions to the transportation network in the study area between existing conditions and 2033 no build conditions include:

- Pioneer Street extension to Union Ridge (two lane core road)
- Completion of 10th Avenue improvements to S 5th Street in Ridgefield
- NE 179th Street from I-5 to west of NE 29th Avenue will be widened to a four lane cross-section.
- Long term improvements to Ridgefield interchange and SR 501.

2033 No Build Alternative SR 502 Corridor Intersection Operating Conditions

The 2033 No Build Alternative operating conditions were reviewed at the intersections within the study area during the morning and afternoon peak hour, using the volumes previously shown in Exhibit 3. Exhibit 17 summarizes the results of the analysis for the 2033 No build Alternative morning and afternoon peak hour traffic volumes. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix J.

Exhibit 17. 2033 No Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor

	AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	F	104	F	103
SR 502/NE 15th Avenue*	F	90	F	>300
SR 502/NE 22nd Avenue*	F	>300	F	>300
SR 502/NE 29th Avenue*	F	>300	F	>300
SR 502/NE 37th Avenue*	F	>300	F	>300
SR 502/NE 42nd Avenue*	F	>300	F	>300
SR 502/NE 50th Avenue*	F	>300	F	>300
SR 502/NE 67th Avenue*	F	>300	F	>300
SR 502/NE 72nd Avenue	F	>300	F	>300
SR 502/NE 82nd Avenue*	F	>300	F	>300
SR 502/NE 87th Avenue*	F	>300	F	>300
SR 502/NE 92nd Avenue*	F	>300	F	>300
SR 502/NW 20th Avenue	F	83	F	174
SR 502/SR 503	E	78	F	117

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

The analysis indicates that the SR 502 corridor will experience substantial delays at the 2033 horizon if no improvements to SR 502 are implemented. The SR 502 corridor is expected to operate at grid lock conditions.

The SR 502/NE 10th Avenue intersection has been analyzed based on the intersection design provided by WSDOT as part of the I-5/SR 502 interchange project. This intersection is expected to operate at LOS F in the AM and PM peak hours at the 2033 No Build scenario with the proposed lane configurations.

The SR 502/NE 10th Avenue intersection has also been analyzed with the addition of a designated westbound right turn lane to determine if this has an affect on the intersection level of service. With the addition of a westbound right turn lane the intersection is expected to operate at a LOS E in both the AM and PM peak hours.

2033 No Build Alternative Off-Corridor Intersection Operating Conditions

The 2033 No Build Alternative operating conditions were reviewed at the intersections along the NE 239th Street, NE 199th Street, and NE 179th Street corridors for the afternoon peak hour. At the 2033 horizon, it has been assumed that NE 179th Street will be widened to a four lane cross-section from I-5 to SR 503. In addition, signalization has been assumed at the major intersections along the NE 199th Street corridor and the NE 179th Avenue corridor.

The 2033 No Build Alternative traffic volumes for the intersections along these corridors are included in the Synchro outputs in Appendix J. The results of the analysis are summarized in Exhibit 18. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix J.

Exhibit 18. 2033 No Build Alternative PM Peak Hour LOS & Delay Summary – Off-Corridor

	PM Peak Hour	
	LOS	Delay
NE 239th Street/NE 72nd Avenue*	F	>300
NE 239th Street/NE 92nd Avenue*	D	25
NE 239th Street/NW 20th Avenue*	E	40
NE 244th Street/SR 503	D	51
NE 199th Street/NE 10th Avenue	F	86
NE 199th Street/NE 29th Avenue	B	15
NE 199th Street/NE 50th Avenue	B	14
NE 199th Street/NE 72nd Avenue	E	69
NE 199th Street/NW 20th Avenue	F	269
NE 199th Street/SR 503	E	70
NE 179th Street/NE 10th Avenue	E	73
NE 179th Street/NE 29th Avenue	E	68
NE 179th Street/NE 50th Avenue	A	9
NE 179th Street/NE 72nd Avenue	E	74
NE 179th Street/NE 112 Avenue	B	14
NE 179th Street/SR 503	D	44

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In most cases, the worst movement is the side street.

As shown in Exhibit 18, most of the intersections are operating at a level of service D or worse. Based on observations of the SimTraffic runs, these corridors are expected to operate with some congestion especially along the side streets.

4.2.2 2033 Build Alternative

The 2033 Build Alternative road network reflects the existing plus committed improvements as well as the recommended improvements to SR 502. The improvements identified at the 2015 Build Alternative have been reflected in this analysis.

As mentioned earlier, the widening of SR 502 will be designed to accommodate a 14-16 foot center median near intersections, and a narrower, 10-12 foot median between intersections. The SR 502 corridor has many driveways connecting to businesses and homes. Therefore, with this median in place, access into these sites will be converted to right-in/right-out. Through discussions with the WSDOT project team, it has been decided that u-turns will be accommodated at NE 10th Avenue, NE 29th Avenue, NE 50th Avenue, NE 72nd Avenue, and NE 92nd Avenue. This will provide for a spacing of approximately one mile between these intersections. Median breaks to allow for u-turns will not be provided between these intersections.

2033 Build Alternative SR 502 Corridor Intersection Operating Conditions

The 2033 Build Alternative operating conditions were reviewed at the intersections within the study area during the morning and afternoon peak hours, using the volumes previously shown in Exhibit 4.

Exhibit 19 summarizes the results of the analyses for the 2033 Build Alternative morning and afternoon peak hour traffic volumes, while Exhibit 20 compares the 2033 no-build and build PM peak hour LOS. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix K. Exhibit 21 illustrates the recommended lane configurations for the 2033 Build Alternative as well as the recommended storage lengths for the left turn and right turn lanes. The storage lengths are discussed in detail in Section 4.4.

Exhibit 19. 2033 Build Alternative Peak Hour LOS & Delay Summary – SR 502 Corridor

	AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	D	55	D	52
SR 502/NE 15th Avenue*	A	10	B	11
SR 502/NE 22nd Avenue*	B	15	D	31
SR 502/NE 29th Avenue	C	30	C	30
SR 502/NE 37th Avenue*	D	27	E	42
SR 502/NE 42nd Avenue*	C	16	D	29
SR 502/NE 50th Avenue	C	29	C	28
SR 502/NE 67th Avenue*	C	24	D	34
SR 502/NE 72nd Avenue	E	69	D	51
SR 502/NE 82nd Avenue*	C	23	C	17
SR 502/NE 87th Avenue*	B	15	D	25
SR 502/NE 92nd Avenue	A	7	A	10
SR 502/NW 20th Avenue	F	91	F	154
SR 502/SR 503	F	94	F	125

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

Exhibit 20. 2033 No-Build and Build Alternative LOS Comparison – SR 502 Corridor

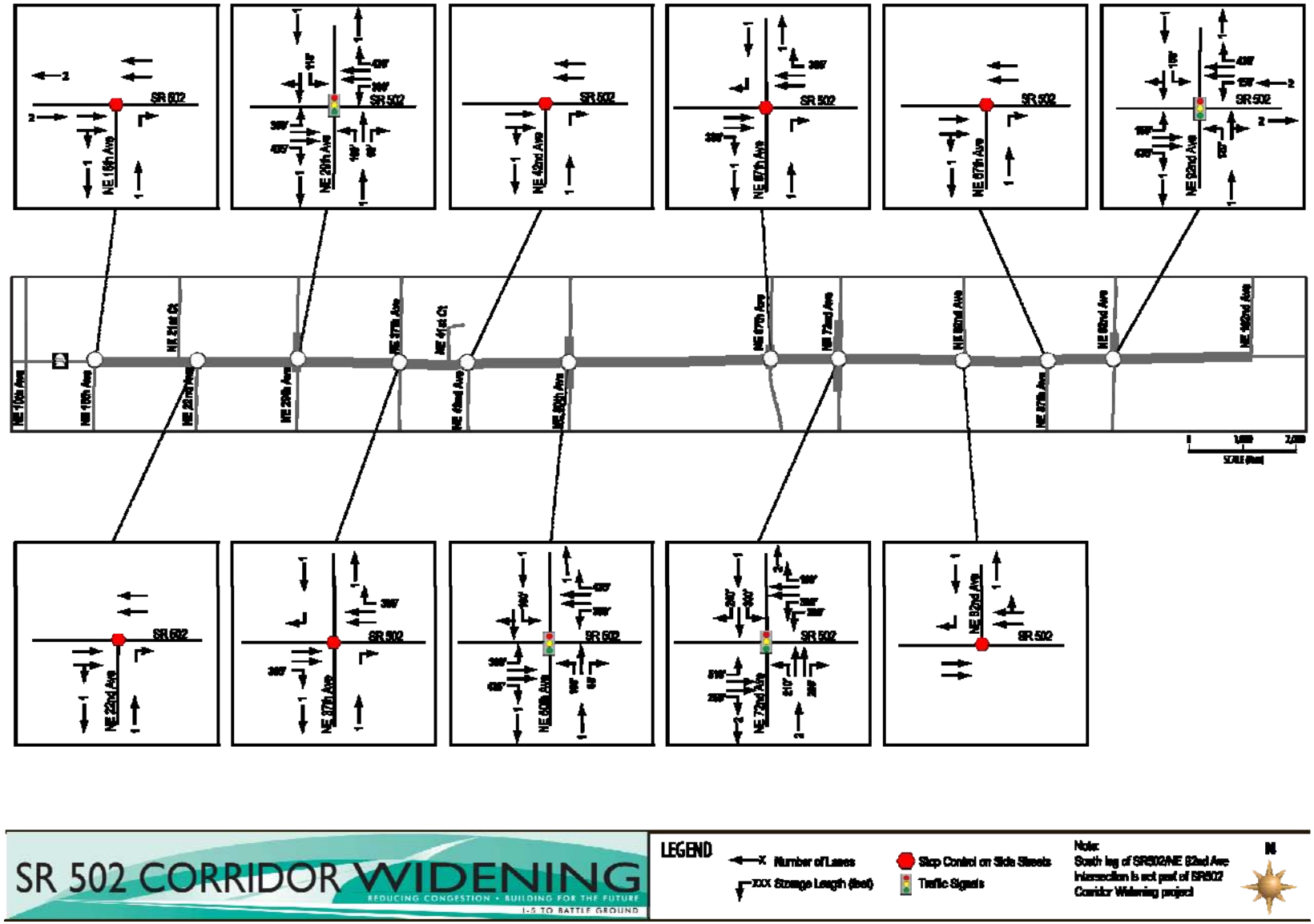
	2033 PM Peak No Build		2033 PM Peak Build	
	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	F	80	D	52
SR 502/NE 15th Avenue*	F	>300	B	11
SR 502/NE 22nd Avenue*	F	>300	D	31
SR 502/NE 29th Avenue	F	>300	D	51
SR 502/NE 37th Avenue*	F	>300	E	42
SR 502/NE 42nd Avenue*	F	>300	D	29
SR 502/NE 50th Avenue	F	>300	C	28
SR 502/NE 67th Avenue*	F	>300	D	34
SR 502/NE 72nd Avenue	F	>300	D	52
SR 502/NE 82nd Avenue*	F	>300	C	17
SR 502/NE 87th Avenue*	F	>300	D	25
SR 502/NE 92nd Avenue	F	>300	A	10
SR 502/NW 20th Avenue	F	174	F	154
SR 502/SR 503	F	117	F	125

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street.

The 2033 Build Alternative analysis indicates the following:

- The SR 502/NE 15th Avenue and SR 502/NE 22nd Avenue intersections will continue to operate at an acceptable level of service with right-in/right-out access for the side streets.
- The SR 502/NE 29th Avenue intersection will continue to operate at an acceptable level of service with the lane configurations recommended at the 2015 Build Alternative.
- The SR 502/NE 37th Avenue and SR 502/NE 42nd Avenue intersections will continue to operate at an acceptable level of service with right-in/right-out access on the side streets.
- The SR 502/NE 50th Avenue intersections will continue to operate at an acceptable level of service with the lane configurations recommended at the 2033 Build Alternative.

Exhibit 21. 2033 Build Alternative Recommended Lane Configurations



- The SR 502/NE 67th Avenue intersection will continue to operate at an acceptable level of service as a right-in/right-out access.

- As indicated in Section 4.1.2 the following are the recommended improvements required to accommodate the projected traffic volumes at the SR 502/ NE 72nd intersection:

    - Dual eastbound and westbound left turn lanes
    - Two northbound travel lanes through the intersection
    - Two southbound travel lanes south of the intersection

  Initially, dual eastbound left turn lanes were proposed at this intersection. The RTC model and the traffic simulation both indicated that dual eastbound left turn lanes would be warranted at this intersection. However, through discussions with WSDOT, it has been determined that the widening on the north side of SR 502, to accommodate u-turn movements with dual left turn lanes, would have substantial impacts on the existing gas station, which is located in the northwest corner of this intersection. An analysis was undertaken to determine the implications of revising the design to a single eastbound left turn lane with a 12 foot median. Trucks would still be able to make a u-turn with a single left turn lane with a median and this configuration would not have impacts on the existing gas station. In addition, it is important to note that the 12 foot median could be converted to a second left turn lane if needed in the future (which would require completion of a local street circulation system by Clark County).

  Based on observing the SimTraffic simulation model run, the vehicle storage for the single EB left turn lane would require a left turn lane extended back toward the NE 67th Avenue intersection, and would increase the southbound delay somewhat over the dual-left option. However, the remainder of the movements would operate satisfactorily and the intersection operates at a satisfactory LOS in the PM peak hour. The revised design would accommodate a future decision, if traffic warrants, to convert to a dual-left turn option.

  The WSDOT Design Manual was reviewed to determine the length of the drop lanes. It is recommended that the total length of the drop lane, including the taper, be 730 feet (detailed calculations are included in Appendix L).This length is for both the northbound and southbound movements. In addition, the two northbound lanes approaching the intersection will have a length of approximately 800 feet.

- The SR 502/NE 82nd Avenue and SR 502/NE 87th Avenue intersections will continue to operate at an acceptable level of service as right-in/right-out accesses.

- It has been assumed that the SR 502/NE 92nd Avenue intersection will operate as a four-legged intersection by 2033; a south leg will be added to this intersection at some point between 2015 and 2033 either by the City of Battle Ground, or by a developer as the area urbanizes. Based on the traffic signal warrant analysis, signals are warranted at this intersection. In addition, designated left turn lanes are recommended on all approaches,

as well as designated right turn lanes on the eastbound and westbound approaches. With these improvements in place, the intersection is expected to operate at an acceptable level of service.

- The SR 502/NW 20th Avenue intersection is expected to operate at a level of service F in both peak hours. Based on the SimTraffic simulation runs, this intersection is expected to experience significant queuing and congestion for all movements. The eastbound movement queues up to NE 92nd Avenue and the westbound movement queues past SR 503.

- The SR 502/SR 503 intersection is expected to operate at a level of service F in both peak hours. Based on the SimTraffic simulation runs, this intersection is expected to experience significant queuing and congestion for the northbound and westbound movements.

Based on the SimTraffic simulation runs, the SR 502 corridor within the study area is expected to operate with minimal delays. The SR 502/NE 72nd Avenue intersection is expected to operate at an acceptable level of service with the recommended lane configurations; the southbound movement in the AM peak hour and the northbound movement in the PM peak hour are expected to experience some delays.

It is important to note that the SR 502/NE 10th Avenue intersection as well as the I-5 off ramp intersection has been analyzed. Based on the analysis, these intersections are expected to experience significant delays and congestion.

Exhibit 22 graphically illustrates the level of service summary for each alternative that was analyzed.

As indicated in the analysis, most of the intersections in the 2033 Build Alternative are expected to operate at a better level of service as compared to the 2033 No Build Alternative, with the exception of one intersection (SR 502/SR 503). This is due to the diversion of traffic to SR 502 in the 2033 Build Alternative. The intersection delay increases slightly (less than 10 seconds) but not to a level that requires mitigation. A sensitivity analysis was conducted to determine the type of improvements that would alleviate congestion at these intersections. At the SR 502/NW 20th Avenue intersection, the addition of eastbound, westbound and northbound right turn lanes will alleviate congestion and improve the level of service to E in both peak hours. At the SR 502/SR 503 intersection, the addition of eastbound and westbound right turn lanes and dual southbound left turn lanes will alleviate congestion and improve the level of service to E in both peak hours.

2033 Build Alternative Off-Corridor Intersection Operating Conditions

The 2033 Build Alternative operating conditions were reviewed at the intersections along the NE 239th Street, NE 199th Street and NE 179th Street corridors for the afternoon peak hour. The lane configurations and traffic control identified at the 2033 No Build Alternative were used in this analysis.

The 2033 No Build Alternative traffic volumes for the intersections along these corridors are included in Synchro outputs in Appendix K. The results of the analysis are summarized in Exhibit 23. In addition, for comparative purposes the 2033 No Build results are also included in this exhibit. The more detailed Synchro and SimTraffic outputs and summaries are included in Appendix K.

As shown in Exhibit 23, the intersections along these corridors are expected to operate somewhat better based on delay than in the 2033 No Build Alternative. This is due to the diversion of traffic from these corridors to the SR 502 corridor, as the SR 502 will become a more desirable route in the 2033 Build Alternative. Based on observations of the SimTraffic simulations runs, the intersections will be operating with minimal queues along the corridors in 2033. There are three intersections in the 2033 Build Alternative that are expected to operate with slightly higher delays as compared to the 2033 No Build Alternative. The intersection delay increases slightly (less than 15 seconds) but not to a level that requires mitigation.

Exhibit 22. Level of Service Summary

NE 10th Avenue	AM Peak	PM Peak
2006 Existing	○	○
2015 No Build	○	○
2015 Build	●	○
2033 No Build	●	●
2033 Build	●	●

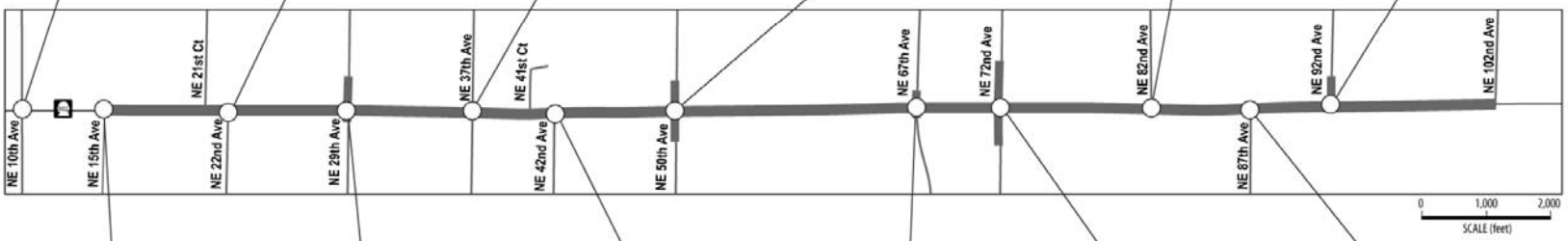
NE 22nd Avenue	AM Peak	PM Peak
2006 Existing	○	○
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	●

NE 37th Avenue	AM Peak	PM Peak
2006 Existing	●	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	●	●

NE 50th Avenue	AM Peak	PM Peak
2006 Existing	●	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	○

NE 82nd Avenue	AM Peak	PM Peak
2006 Existing	–	–
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	○

NE 92nd Avenue	AM Peak	PM Peak
2006 Existing	●	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	○



NE 15th Avenue	AM Peak	PM Peak
2006 Existing	○	●
2015 No Build	○	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	○

NE 29th Avenue	AM Peak	PM Peak
2006 Existing	●	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	●

NE 42nd Avenue	AM Peak	PM Peak
2006 Existing	–	–
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	●

NE 67th Avenue	AM Peak	PM Peak
2006 Existing	●	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	●	●

NE 72nd Avenue	AM Peak	PM Peak
2006 Existing	○	●
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	●	●

NE 87th Avenue	AM Peak	PM Peak
2006 Existing	–	–
2015 No Build	●	●
2015 Build	○	○
2033 No Build	●	●
2033 Build	○	●

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I-5 TO BATTLE GROUND

LEGEND
○ Level of Service A–C
● Level of Service D
● Level of Service E–F

N

Exhibit 23. 2033 Build & No Build Alternative PM Peak Hour LOS & Delay Summary – Off Corridor

	2033 No Build		2033 Build	
	LOS	Delay	LOS	Delay
NE 239th Street/NE 72nd Avenue*	F	>300	F	>300
NE 239th Street/NE 92nd Avenue*	D	25	D	25
NE 239th Street/NW 20th Avenue*	E	40	E	40
NE 244th Street/SR 503	D	51	D	51
NE 199th Street/NE 10th Avenue	F	86	E	70
NE 199th Street/NE 29th Avenue	B	15	B	14
NE 199th Street/NE 50th Avenue	B	14	B	13
NE 199th Street/NE 72nd Avenue	E	69	E	63
NE 199th Street/NW 20th Avenue	F	269	F	249
NE 199th Street/SR 503	E	70	E	70
NE 179th Street/NE 10th Avenue	E	73	E	74
NE 179th Street/NE 29th Avenue	E	68	E	61
NE 179th Street/NE 50th Avenue	A	9	A	9
NE 179th Street/NE 72nd Avenue	E	74	E	70
NE 179th Street/NE 112 Avenue	B	14	A	10
NE 179th Street/SR 503	D	44	D	45

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In most cases, the worst movement is the side street.

4.3 Safety

The Build alternative is expected to improve safety on the corridor. By providing access management, a center median, improved design and geometry, and signals at the major intersections, the types of accidents which have made portions of the SR 502 corridor a "High Accident Corridor" are expected to be reduced. The accident rate overall should decrease with the improvements.

Influence of increased volumes on SR 502 and accident rate: Reduced congestion on the SR 502 corridor would attract some trips that might otherwise divert to alternate routes such as 179th Street or 199th Street. These alternate routes are generally designed to a less stringent standard and have higher collision rates, so some reduction in collision rates for these trips may be realized as well when they shift to SR 502.

Collision data compiled by WSDOT indicate that an improved facility such as SR 502, which would have a center median and a reduction in driveway access, would have lower collision rates compared to local, county roads designed to a lesser standard. For example, the statewide average collision rate (from the WSDOT 2006 State Collision Data Summary) indicates that when completed, facilities such as the improved SR 502 would have an average collision rate of 1.13 collisions per million vehicle miles traveled, a 37% reduction in rate compared to the current condition of SR 502 and also roadways such as 199th and 179th Streets (Clark County rural collector roads) from which some traffic would be diverted when SR 502's improvements are completed.

Influence of increased speed on safety: during the SR 502 project reviews, there was a question as to whether the increase in overall speed on SR 502 that is expected with the build alternative, compared to the no-build alternative, would contribute to a decrease in safety (increase in accident rate). While it is true that the prevailing speeds under the build alternative will increase to near the posted 50-55 mph speed (35 mph within Dollars Corner), based on case studies in Washington and elsewhere, there is no correlation that this increase in speed will serve to increase the accident rate. In fact, agencies base their design standards on a "design speed" which balances the roadway function with sight distance, driveway densities, and adjacent land uses with the goal of reducing the number of accidents along a corridor such as SR 502.

A check of accident history as summarized in the "SR 502 Baseline Transportation Conditions Report" indicates that 31 percent of the accidents along the corridor in the period 2001 through 2005 were attributable to driveways and side street access (angle accidents), and another 42 percent were rear end/same direction accidents. This indicates that accidents along the corridor are attributable more to congestion and the high number of access points and less to speed.

A number of case studies were consulted with regard to access and accident rate: "Average Accident Rates, 2006-2007", New York State Department of Motor Vehicles, update June 2008; National Cooperative Highway Research Project (NCHRP) Report #420, "Impacts of access management techniques", among others, that compared accident rates before and after improvements which reduced or modified direct access to highways (in order to improve safety and traffic speeds along corridors) and each study indicated that accident rates were reduced after

access management improvements compared to before, even though speeds were increased 10-15 percent or more along these corridors.

Other case studies concluded that either there is no correlation between average speed and accident rates, or that allowing continued or increased congestion (lower or stop-and-go speeds) actually contributes to a higher accident rate:

- "There is no strong correlation between accident rates and average speed for any given type of highway... This tends to support the theory that higher speeds do not necessarily result in higher accident rates." N. J. Garber and R. Gadiraju. "Factors Affecting Speed Variance and Its Influence on Accidents." Transportation Research Record, 1213 (1989), p. 69.

- "All current safety campaigns … imply that the slower driver is the virtuous one and is helping protect himself and other drivers. It isn't so. To reduce fatalities, it is important that everyone drive at about the same speed. Thus the major consideration in choosing a speed limit is that it be obeyed. And the major consideration for police is to reduce variation, not speed, because slow drivers are as much a public hazard as fast ones." Charles A. Lave. "Speeding, Coordination, and the 55 MPH Limit." The American Economic Review, 75.5 (1985 December), p. 1163 [this indicates that designing to a proper design speed such as SR 502 and enforcing the posted limit under that design speed is more appropriate than continuing to plan for slow speeds along the corridor].

- “Traffic congestion contributes to highway crashes…while accidents are more likely fatal at higher speeds, fixing bottlenecks can nevertheless reduce the number of all types of crashes, thereby saving lives and preventing injuries”. NCHRP Project 8-36, Task 22, “The Benefits of Reducing Congestion”, January 2002.[4]

4.4 Intersection Control

4.4.1 Traffic Signal Warrant Analysis

The traffic signal warrant analysis is based on Figure 4C-4 Warrant 3, Peak Hour of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways, 2003 Edition. The analysis was based on the PM peak hour as this is the critical period for the study area. Exhibit 24 summarizes the results of the signal warrant analysis. The detailed results of the analyses are included in Appendix M.

[4] http://www.transportation.org/sites/planning/docs/nchrp22_4.pdf.

Exhibit 24. Traffic Signal Warrant Analysis

	Horizon	Minor Street Higher Volume Approach	Major Street Total of Both Approaches	Is it Warranted?
SR 502/NE 29th Avenue	Existing	82	1206	Yes
	2015 Build	219	2016	Yes
SR 502/NE 37th Avenue	Existing	54	1254	No
SR 502/NE 50th Avenue	Existing	85	1276	Yes
	2015 Build	171	2055	Yes
SR 502/NE 67th Avenue	Existing	39	1280	No
SR 502/NE 92nd Avenue	Existing	43	1203	No
	2015 Build	74	1989	No but close
	2033 Build	178	3528	Yes

If traffic does not warrant a signal, WSDOT's policy is to not install unwarranted signals; however, the SR 502 improvements will be designed to accommodate a future signal if the 2033 analysis indicates a signal will be warranted by the year 2033. As shown in Exhibit 24, traffic signals are currently warranted at the NE 29th Avenue and NE 50th Avenue intersections. The SR 502/NE 92nd Avenue intersection will operate as a "T" intersection at the 2015 Build Alternative and traffic signals are not warranted at this time for the year 2015; however, the intersection should be re-evaluated during final design to determine if it will meet signal warrants in 2015. For the purpose of this study it has been assumed that this intersection will be signalized. At 2033 Build Alternative, this intersection will operate as a four-leg intersection, with the addition of a south leg. Based on the analysis traffic signals are warranted at the SR 502/NE 92nd Avenue intersection at the 2033 Build Alternative.

4.4.2 Roundabout Analysis

As requested by WSDOT, the SR 502 corridor was also analyzed with the addition of roundabouts at NE 29th Avenue, NE 50th Avenue, NE 72nd Avenue, and NE 92nd Avenue.

Based on the analysis, it was concluded that roundabouts at NE 29th Avenue, NE 50th Avenue and NE 72nd Avenue experience substantial delays and do not meet level of service objectives. The roundabout at NE 92nd Avenue experiences minimal delays; however based on the volume to capacity ratios this roundabout also does not meet the level of service objectives. Therefore, it is recommended that roundabouts should not be implemented into the road network.

The memo discussing the detailed analyses and recommendations submitted to WSDOT is included in Appendix N.

4.5 Storage Length Requirements

In order to determine the storage length requirements for the left and right turn lanes, the WSDOT design manual was reviewed as well as the outputs from the SimTraffic analysis. An

extensive queuing analysis was conducted using the SimTraffic software. The 95th percentile queues are based on an average of five SimTraffic simulation runs. The detailed summary of the queuing analysis is included in the Appendices G through J for each alternative. The recommended storage lengths are based on the longer queue determined from the SimTraffic analysis for the 2015 Build Alternative and the 2033 Build Alternative. The recommended storage lengths were previously illustrated in Exhibits 14 and 19 for the 2015 and 2033 Build Alternative.

4.5.1 Left Turn Lane Storage Requirements

Exhibit 25 summarizes the recommended left turn lane storage lengths for the intersections within the study area.

Exhibit 25. Recommended Left Turn Lane Storage Lengths

	Eastbound	Westbound	Northbound	Southbound
SR 502/NE 29th Avenue	300'(1)	300'(1)	100'	115'
SR 502/NE 50th Avenue	300'(1)	300'(1)	100'	100'
SR 502/NE 72nd Avenue	510'	300' per lane	210'	300'
SR 502/NE 92nd Avenue(2)	150'	150'	120'	100'

Note: (1) SR 502 Corridor design standard based on WSDOT Design Manual for higher-speed corridors, which exceeds 95th percentile queue storage requirement.

(2) The ultimate configuration of the SR 502/NE 92nd Avenue intersection is assumed to be a four-leg intersection.

It is important to note that for the purposes of the report, the minimum storage length for state routes is 150 feet and 100 feet for county routes. The recommended left turn lane storage lengths for the intersections are based on the results of the 2033 Build Alternative model.

4.5.2 Right Turn Lane Storage Requirements

The WSDOT Design Manual was reviewed to determine if a right turn lane is warranted at the intersections within the study area. As per Figure 910-11 Right-Turn Lane Guidelines from the WSDOT Design Manual it was determined that a right turn lane, right turn pocket/taper, or radius only is warranted at each intersection within the study area. Exhibit 26 summarizes the results of the warrant analysis

It is important to note that the need for a right turn lane is not only dictated by the WSDOT design standards. The Synchro/SimTraffic queuing results were also reviewed to determine if a right turn lane would alleviate any queuing or delay issues. The Synchro/SimTraffic queuing results were used as a guide to determine the right turn storage lengths at the signalized intersections along SR 502. Since the SR 502 is a high speed state highway, it is recommended that the unsignalized right-turn lane length, which includes deceleration and queuing distances, be used for the signalized intersections in higher-speed conditions outside of Dollars Corner (NE 29th Avenue, NE 50th Avenue, and NE 92nd Avenue).

Exhibit 26. Recommended Right Turn Storage Lengths

	Movement	Warrant?	Storage Length
SR 502/NE 15th Avenue*	Eastbound	Radius Only	-
SR 502/NE 22nd Avenue*	Eastbound	Radius Only	-
SR 502/NE 29th Avenue	Eastbound	Right Turn Lane	435'*
	Westbound	Right Turn Lane	435'*
	Northbound	Right Turn lane	150'
	Southbound	Synchro/SimTraffic indicated right turn lane is not required	-
SR 502/NE 37th Avenue*	Eastbound	Right Turn Lane	385'
	Westbound	Right Turn lane	385'
SR 502/NE 42nd Avenue*	Eastbound	Right Turn Pocket or Taper	Pocket = 60'
			Taper = 100'
SR 502/NE 50th Avenue	Eastbound	Right Turn Lane	435'*
	Westbound	Right Turn Lane	435'*
	Northbound	Right Turn Lane	65'
	Southbound	Synchro/SimTraffic indicated right turn lane is not required	-
SR 502/NE 67th Avenue*	Eastbound	Right Turn Lane	385'
	Westbound	Right Turn Lane	385'
SR 502/NE 72nd Avenue	Eastbound	Right Turn Lane	250'
	Westbound	Right Turn Lane	180'
	Northbound	Right Turn Lane	200'
	Southbound	Right Turn Lane	240'
SR 502/NE 82nd Avenue	Westbound	Radius Only	-
SR 502/NE 87th Avenue	Eastbound	Radius Only	-
SR 502/NE 92nd Avenue	Eastbound	Right Turn Lane	435'*
	Westbound	Right Turn Lane	435'*
	Northbound	Radius Only	-
	Southbound	Radius Only	-

Notes: For the unsignalized intersections (*) and higher-speed signalized intersections (Design Speed >45 mph), the right turn lane storage lengths were determined from Figure 910-13 of the WSDOT Design Manual. If these locations become urbanized prior to final design, a revised Synchro/SimTraffic analysis will be required to establish right-turn lane lengths for the urban condition.

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4.6 Average Corridor Speeds and Travel Times

The average AM and PM peak travel speeds along the SR 502 corridor were estimated using the SimTraffic simulation model averaged over five successive iterations of the model for the one hour peak period. The model reports the average speed of a corridor-length trip from I-5 to Battle Ground (the SR 503/SR 502 intersection) during the peak hour. The posted speed for the corridor is assumed to be 50 mph, except in Dollars Corner where the posted speed is 35 mph. The detailed outputs form the SimTraffic simulation model is included in Appendices G through J for each alternative.

Exhibit 27 and Exhibit 28 summarize the average travel speeds along the SR 502 corridor for each alternative for the AM and PM peak hours, respectively.

Exhibit 27. Average AM Peak Hour Corridor Speeds

	Average Speed				
	Existing	2015 No Build Alternative	2015 Build Alternative	2033 No Build Alternative	2033 Build Alternative
SR 502 Eastbound (I-5 - Battle Ground)	38 mph	30 mph	35 mph	17 mph	27 mph
SR 502 Westbound (I-5 - Battle Ground)	35 mph	25 mph	37 mph	12 mph	23 mph

Exhibit 28. Average PM Peak Hour Corridor Speeds

	Average Speed				
	Existing	2015 No Build Alternative	2015 Build Alternative	2033 No Build Alternative	2033 Build Alternative
SR 502 Eastbound (I-5 - Battle Ground)	31 mph	18 mph	35 mph	10 mph	32 mph
SR 502 Westbound (I-5 - Battle Ground)	35 mph	26 mph	37 mph	10 mph	26 mph

As shown in the above exhibits, the average speeds along the SR 502 corridor will significantly decrease over time if the No Build Alternative was selected as the Preferred Alternative. The majority of the delay occurs at the SR 502/NE 72nd Avenue signalized intersection, which queues traffic in all directions. In the 2015 Build Alternative, the average speeds along SR 502 are approximately 35-37 mph in both AM and PM peak hours, a substantial improvement over 2015 No-Build. In the 2033 Build Alternative, the average speeds decrease slightly compared to the 2015 Build scenario, but are still substantially higher than the 2033 no-build alternative speeds.

In addition to evaluating the average speeds, average travel times were also calculated along the corridor. Exhibit 29 and Exhibit 30 summarize the average travel times along the SR 502 corridor for each alternative for the AM and PM peak hours, respectively.

Exhibit 29. Average AM Peak Hour Travel Times

	Average Travel Time (minutes)				
	Existing	2015 No Build Alternative	2015 Build Alternative	2033 No Build Alternative	2033 Build Alternative
SR 502 Eastbound (I-5 - Battle Ground)	8	12	9	19	14
SR 502 Westbound (I-5 - Battle Ground)	9	14	9	28	16

Exhibit 30. Average PM Peak Hour Travel Times

	Average Travel Time (minutes)				
	Existing	2015 No Build Alternative	2015 Build Alternative	2033 No Build Alternative	2033 Build Alternative
SR 502 Eastbound (I-5 - Battle Ground)	11	18	9	30	14
SR 502 Westbound (I-5 - Battle Ground)	10	13	9	32	13

The analysis shows that the travel times from I-5 to Battle Ground (SR 503/SR 502 intersection) would approximately triple from 2006 to 2033 in the No Build Alternative. The projected increase in travel time along the SR 502 corridor would adversely affect regional freight mobility and commerce between I-5 and Battle Ground, northeast Clark County, and east Clark County, and would increase the cost of delivering goods due to the added delays. The projected increase in travel time may deter development of industrial and office land uses in the Battle Ground urban growth area since these lands and development would be less accessible when compared to the more accessible, competing land uses at the adjacent Ridgefield Junction and Salmon Creek interchanges on I-5.

At the 2015 Build Alternative, the travel times along the corridor average approximately nine minutes in the AM and PM peak hours. At the 2033 Build Alternative, the travel times increase to approximately 13-14 minutes but are still substantially less than the corresponding no-build travel times.

4.7 Access Management

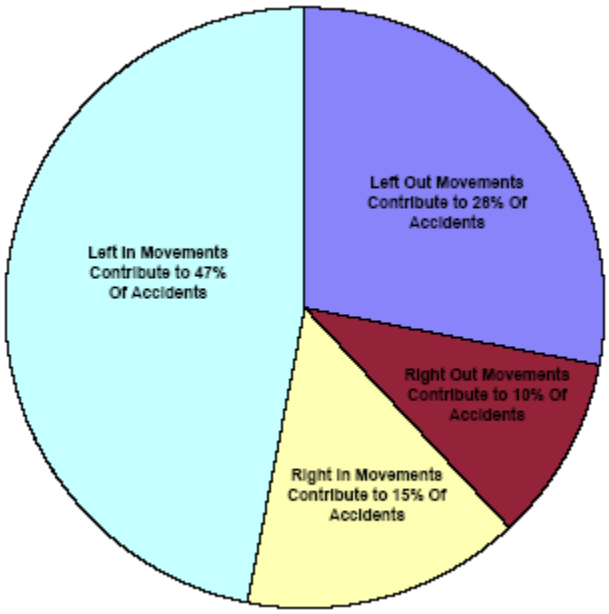
SR 502 currently has a managed access classification, and is planned to be reclassified as a Modified Limited Access corridor. The reclassification would be implemented through an improvement project. The WSDOT standard for such a classification is full, signalized access every 1 mile, with intersection spacing not less than ½ mile.

The SR 502 project will be constructing a center median for the entire length of the project corridor. All side street intersections will be restricted to right-in/right-out access, with the

exception of NE 29th Avenue, NE 50th Avenue, NE 72nd Avenue, NE 92nd Avenue, and NE 101st/102nd Avenue, which will all be full access intersections and will be signalized when warranted.

Research has been conducted to determine the impacts of converting all turn driveways to right-in/right-out accesses. Exhibit 31 illustrates the percentage of driveway collisions by movement at unsignalized intersections.

Exhibit 31. Percentage of Driveway Collisions By Movement at Unsignalized Intersections[5]



Based on the research, by eliminating only left turn movements, the conflict points will be reduced and collisions will reduce by 30% over full access. Converting to right-in/right-out driveways reduces collision by 75% compared to a full access intersection. In addition, for driveways and minor unsignalized side streets, right turns accompanied by u-turns at a downstream intersection can provide comparable travel times than direct left turns from driveways and other unsignalized side streets under heavy volume conditions (as in the case with SR 502), provided that the out-of-direction travel distances are one mile or less.

As per the WSDOT Design Manual, u-turns at signal-controlled intersections do no require acceleration lanes. When designing the traffic signal, it must be ensured that the right turning vehicles from the side street do not conflict with the u-turning vehicles, meaning that right-turn overlaps cannot be implemented into the signal design. In addition, warning signs may be recommended on the cross street.

[5] Source: Right-In Right-Out Channelization Discussion Paper No. 13.

SR 502 is a designated Emergency Transportation Route by the Washington and Oregon Departments of Transportation (WSDOT and ODOT). Considered critical infrastructure, in the event of an earthquake or other emergency, WSDOT is required to assess the damage to SR 502, and report on its accessibility and functionality as a travel route within four hours of a seismic event. This route would receive priority funding should repairs be needed.

4.8 Pedestrian and Bicycle Access

The Clark County Trails and Bikeway System Plan (adopted 2006), has identified a future regional trail along the SR 502 corridor for bicycle and pedestrian access from I-5 to Battle Ground. This will represent a new trail corridor connecting the I-5 Corridor Trail and the Battle Ground/Fisher's Landing Trail.

At this time, the SR 502 corridor widening project is not including a separated bicycle and pedestrian trail as part of the project. Wide shoulders will be provided for bicycle and pedestrian mobility in the sections of the corridor not in Dollars Corner, and in Dollars Corner, sidewalks and on-street bike lanes.

The widening project will construct shoulders for side road connections in the project vicinity, which will accommodate bicycles and pedestrians near the SR 502 corridor.

Where signals are planned (29th Avenue, 50th Avenue, and 92nd Avenue), crosswalks and ADA-accessible facilities will be provided.

4.9 Emergency Services and Response Times

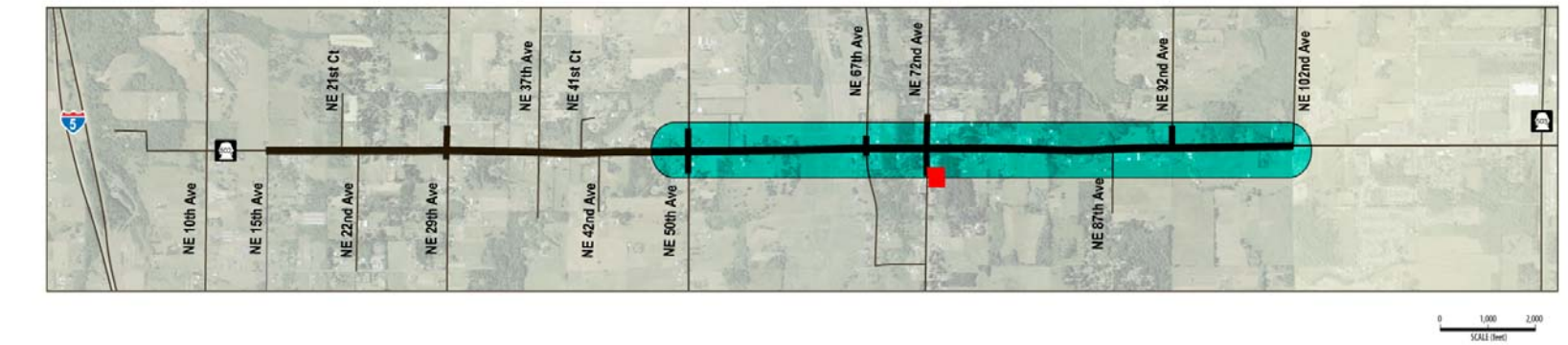
The future 2033 emergency response times were estimated for three scenarios: 2033 No Build Alternative, 2033 Build Alternative without center median and 2033 Build Alternative with center median along the SR 502 corridor. The study area falls under the Clark Country Fire District 11. A fire station (Station 11-1) is located in the on NE 72nd Avenue approximately ¼ mile south of the SR 502/NE 72nd Avenue intersection.

The travel speeds for the emergency vehicles in the 2033 No Build Alternative have been assumed to be approximately 20 mph. This speed accounts for congestion levels and lack of shoulders (for vehicles to pull over and yield to oncoming emergency response vehicles) that may cause delay to emergency vehicles. Exhibit 32 illustrates the five minute emergency response time area for the 2033 No Build Alternative. The five minute response time represents the most critical response time for life threatening situations.

The travel speeds for the emergency vehicles in the 2033 Build Alternative has been assumed to be approximately 45 mph. The speed has increased due to the improvements along the SR 502 corridor including additional capacity and shoulders for vehicles to pull off and yield to oncoming emergency vehicles. Emergency response times may differ between the scenarios with median and without raised center median, as the travel paths for the emergency vehicles will change. Exhibit 33 illustrates the five minute emergency response time for the 2033 Build Alternative along the SR 502 corridor.

Two locations within the study area were chosen to measure the emergency response times for the 2033 Build Alternative with and without a center median. These locations are NE 37th Street.

Exhibit 32. 2033 No Build – Five Minute Emergency Response Time



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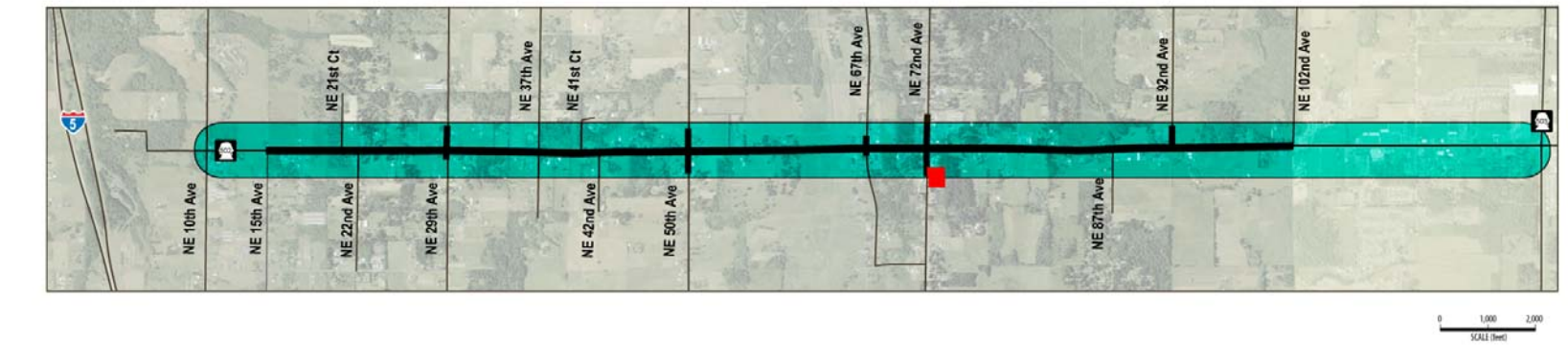
LEGEND
Fire Station
Five Minute Response Time Area
Project Corridor
N

Exhibit 33. 2033 Build – Five Minute Emergency Response Time



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south of SR 502 and NE 82nd Street north of SR 502. The locations were chosen because in the "with center median" scenario, left turns are not permitted at these locations, therefore u-turn maneuvers will have to made at the downstream major intersection. Exhibit 34 shows the response times for the 2033 No Build Alternative and 2033 Build Alternative with and without a center median. The travel paths are shown in Exhibit 35.

Exhibit 34. Emergency Response Times

	2033 No Build	2033 Build Alternative With Center Median	2033 Build Alternative Without Center Median
Fire Station to NE 37th Street south of SR 502	6-7 minutes	3-4 minutes	2-3 minutes
Fire Station to NE 82nd Street north of SR 502	3-4 minutes	1-2 minutes	1-1 ½ minutes

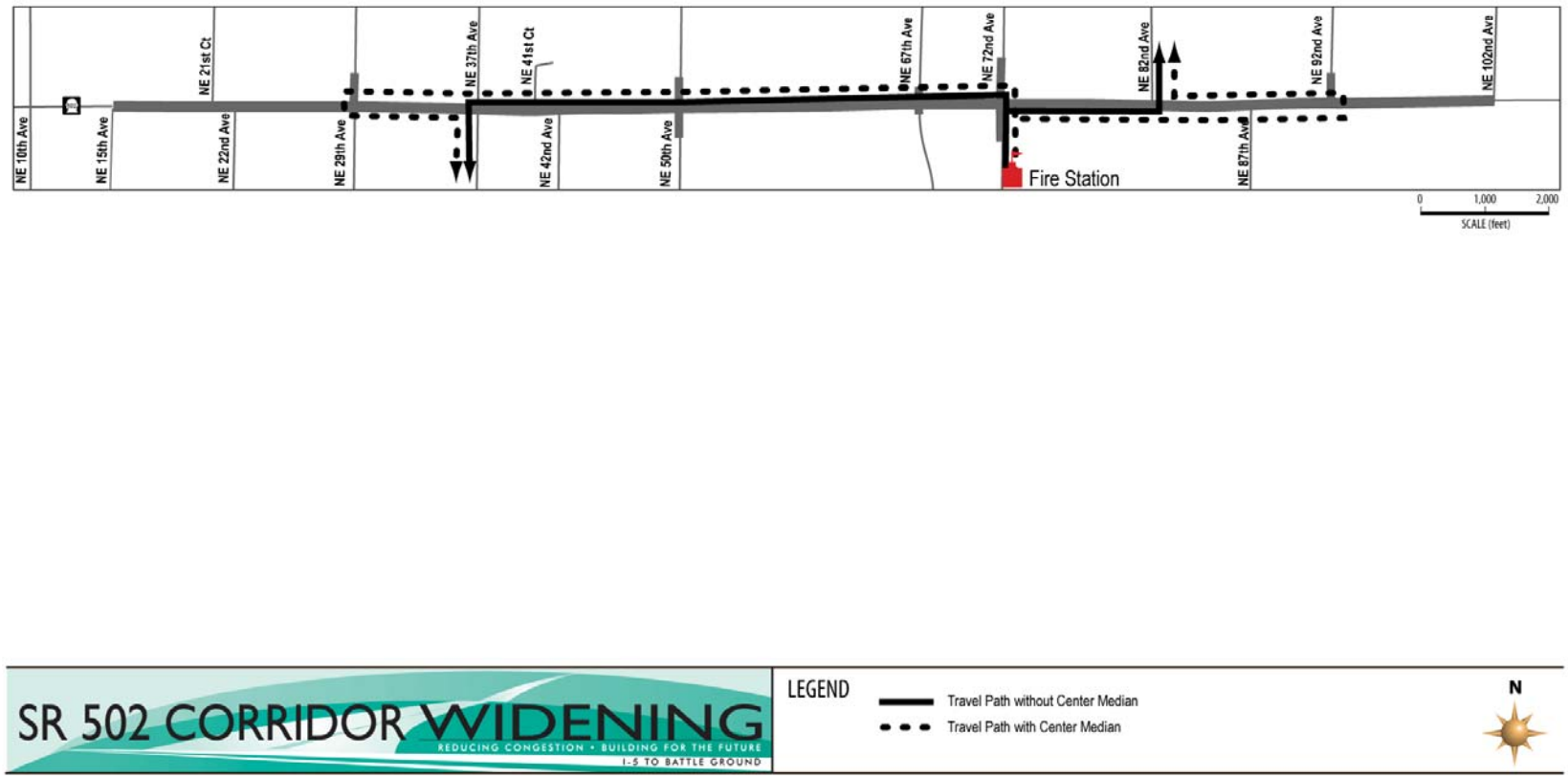
As shown in Exhibit 34, the response times for the 2033 Build Alternative with a center median is approximately 30 seconds longer, on average, than for the 2033 Build Alternative without median; the center median along the SR 502 corridor has minimal impact on the emergency response times. Note that in both cases, the response times are substantially improved compared to the no-build times.

4.10 Transit

As indicated in Section 3.2, Route 47 is the only transit service in the study area and provides peak hour commute connections into downtown Vancouver from Battle Ground. For the morning commute, Route 47 runs from Battle Ground Transit Center west along SR 502/NE 219th Street and then south along SR 502/NE 10th Avenue to the I-5/NE 179th Interchange where the route continues along I-5 and terminates at the Vancouver 7th Street Transit Center. In the afternoon, the return commuter route travels from the Vancouver 7th Street Transit Center to the Battle Ground Transit Center along the same route. The transit route map is included in Appendix F. Transit service is provided only once during morning and afternoon peak hours.

The 2030 RTC model assumes that the future transit service on the SR 502 corridor will include a small increase in service provided during peak hours. There are no plans for new transit infrastructure or off-peak service.

Exhibit 35. Emergency Vehicle Travel Path



4.11 Transportation Systems Management Strategies

A TSM option was developed and analyzed (in lieu of roadway widening); a TDM option was developed and qualitatively analyzed. Both the TSM and TDM options were eliminated as they did not fully comply with the project's purpose and need statement.

While TSM and TDM options themselves are not fully consistent with the project's purpose and need statement, some of the components of these options will be considered for inclusion into the design of the preferred alternative. These include:

- Walkways and bike lanes along SR 502 in "urban" settings such as Dollars Corner (approximately NE 67th Avenue through NE 82nd Avenue)
- Wide shoulders to allow for bicycle and pedestrian mobility and safety in rural areas (outside of Dollars Corner)
- Allowance for future, local fixed-route bus service that would use the SR 502 corridor (provisions for future bus stops and bus pullouts based on coordination with C-TRAN, the transit provider)
- Inclusion in the analysis of a potential park-and-ride at some location along the corridor (C-TRAN has not identified a site at this time)
- Intersection channelization to reduce the amount of roadway pedestrians would need to cross (primarily at the SR 502/NE 72nd Avenue intersection).

The purpose of the project is to improve mobility and safety along the SR 502 corridor between NE 15th Avenue and NE 102nd Avenue and improve regional connectivity between Battle Ground, north Clark County, and I-5.

The need for the project is based on the current and projected congestion, and collision history and projected collision risk.

The transportation systems management options will identify and analyze options that may add capacity without adding travel lanes to the corridor. Transportation systems management strategies used for the SR 502 Corridor Widening project include signal improvements, intersection lane configuration improvements as well as the addition of increased transit service to the existing road system.

Transportation demand management options are those which test enhanced transit, carpooling, and travel demand reduction strategies without adding lanes to the corridor.

Two TSM/TDM options were analyzed for the SR 502 Corridor Widening Project. The following describes each option:

- TSM/TDM Option 1: existing road network, as discussed in the SR 502 Corridor Transportation Discipline Report (February 2008), with the addition of new or improved traffic signals and intersection turn lanes. The roadway network for SR 502 would remain at the existing two through lanes but the roadway would be widened for safety shoulders;

signals and designated eastbound and westbound left turn lanes at NE 29th Avenue, NE 50th Avenue and NE 92nd Avenue; additional turn lanes and signal improvements at NE 72nd Avenue; and full access management including a raised median to restrict left turn movements at the remaining intersections along the corridor (they would become right-in/right-out with u-turns at the signalized intersections).

- TSM/TDM Option 2: TSM/TDM Option 1, along with substantially increased transit service along the corridor including local service (the only service now is non-stop, express commuter service), with the addition of bus stops/pullouts within the project area.

High capacity transit and high-occupancy vehicle lanes were considered for the corridor. The Regional Transportation Council is currently undertaking a regional High Capacity Transit (HCT) study for Clark County, which included a consideration of Bus Rapid Transit for SR 502 and HCT corridors along I-5 up to SR 502. The HCT study has since eliminated HCT corridors from consideration along SR 502 and has terminated the I-5 corridor in the Salmon Creek area near I-5 at NE 134thStreet/NE 139th Street, approximately four miles south of the west end of the SR 502 study corridor. Thus, HCT-only options for SR 502 were eliminated.

The Clark County region implemented an I-5 HOV Lane Pilot Project in the fall of 2001. This project was implemented by WSDOT as part of the I-5 widening project and was initially proposed by RTC. This included a southbound 2-plus-person HOV lane along I-5 from NE 99th Street to Mill Plain Boulevard, with plans to extend the HOV lane further north. The HOV Lane Pilot Project was terminated in August 2005 and the HOV lane removed; no further consideration is being given by RTC or WSDOT for new HOV lanes in Clark County other than possibly as part of the Columbia River Crossing Project (south of SR 500 across the Columbia River).

The vicinity map is shown in Exhibit 36.

Constructing an HOV lane along the SR 502 corridor would not provide the mobility or safety improvements needed as defined by the Purpose and Need statement, and would not connect to any other HOV lane system since none is planned. Congestion levels would be slightly less than the no-build option, and would continue to experience substantial delays along the SR 502 corridor. Additionally, HOV lanes would increase weaving traffic along the corridor, as non-HOV vehicles which are making turns onto or off of the corridor (including those at the more-than-100 driveways along the corridor) must cross the lane in order to continue their trip, which increases the risk of sideswipe and rear-end collisions on a corridor that already has high accident locations on it. Thus, an HOV-lane only option was eliminated from consideration.

The following will provide a summary of the modeling analysis for TSM/TDM option 1 and TSM/TDM option 2 at the 2033 horizon.

4.11.1 Future Road Network at the 2033 Horizon

At the 2033 horizon the road network will include the existing facility plus committed, financially-constrained improvements not associated with the SR 502 corridor that are expected to be completed between now and the Year 2033.

Exhibit 36. Vicinity Map

The major additions to the transportation network in the study area between existing conditions and 2033 include:

- Pioneer Street extension to Union Ridge (two lane core road)
- Completion of 10th Avenue improvements to S 5th Street in Ridgefield
- NE 179th Street from I-5 to west of NE 29th Avenue will be widened to a four lane cross-section
- Long term improvements to Ridgefield interchange and SR 501.

Additionally, separate transportation analysis was conducted which included a proposed extension of NE 219th Street west to NW 31st Avenue/Hillhurst Road (the modeling showed that this extension had little impact on traffic projections along the SR 502 study corridor).

These improvements will be included in the analysis of the 2033 TSM/TDM options.

4.11.2 Operational Analysis

TSM/TDM Option 1 – Intersection Improvements to the Existing Road Network

The TSM/TDM Option 1 operating conditions were reviewed at the intersections within the study area during the morning and afternoon peak hours using the volumes shown previously in Exhibit 3. The Synchro/SimTraffic software package was used to analyze each intersection. Exhibit 37 summarizes the results of the analysis at the 2033 horizon for the morning and afternoon peak hour volumes.

Exhibit 37. TSM/TDM Option 1: 2033 Build & No Build Peak Hour LOS & Delay Summary

	TSM/TDM Option 1 Build				No Build			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	F	118	F	109	F	118	F	109
SR 502/NE 15th Avenue*	F	90	F	>300	F	90	F	>300
SR 502/NE 22nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 29th Avenue	F	152	F	210	F	>300	F	>300
SR 502/NE 37th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 42nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 50th Avenue	F	160	F	193	F	>300	F	>300
SR 502/NE 67th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 72nd Avenue	F	>300	F	>300	F	>300	F	>300
SR 502/NE 82nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 87th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 92nd Avenue	F	85	F	148	F	>300	F	>300
SR 502/NW 20th Avenue	E	80	F	164	E	80	F	164
SR 502/SR 503	E	74	F	108	E	74	F	108

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street. The intersections at NE 29th Avenue, NE 50th Avenue and NE 92nd Avenue are unsignalized in the No Build scenario.

The analysis indicates that the while the full access management component will improve safety along the corridor, the SR 502 corridor with the TSM/TDM Option 1 improvements will experience substantial delays at all intersections in the 2033 horizon and show little or no improvements in LOS compared to the 2033 No-Build alternative. Even with turn lane and signal improvements at the major intersections, the SR 502 corridor is expected to operate at grid lock conditions and would not result in any substantial mobility or safety improvements as prescribed in the Purpose and Need statement.

TSM/TDM Option 2 – Increased Transit Service

Clark County Public Transportation Benefit District (C-TRAN) provides transit for Clark County. Route 47 is the only transit service in the study area and provides peak hour commute connections into downtown Vancouver from the Battle Ground park-and-ride in central Battle Ground. The transit route map is included in Appendix F.

For the morning commute, Route 47 runs from Battle Ground Transit Center west along SR 502/NE 219th Street and then south along SR 502/NE 10th Avenue to the I-5/NE 179th Interchange where the route continues along I-5 and terminates at the Vancouver 7th Street Transit Center. In the afternoon, the return commuter route travels from the Vancouver 7th Street Transit Center to the Battle Ground Transit Center along the same route. The transit route map is

attached to this memorandum. Transit service is provided only once during morning and afternoon peak hours and there are no bus stops within the project area.

The increased transit option will assume the Battle Ground park-and-ride would be expanded and bus service would be increased in the peak hours to 3 buses/peak hour with provisions for bus stops approximately every half-mile along SR 502. With the increase in bus service, a projected reduction of 3% vehicular traffic demand was made and incorporated into the traffic analysis model. The results are shown in Exhibit 38.

Exhibit 38. TSM/TDM Option 2: 2033 Build & No Build Peak Hour LOS & Delay Summary

	TSM/TDM Option 2 Build				No Build			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
SR 502/NE 10th Avenue	F	118	F	99	F	118	F	109
SR 502/NE 15th Avenue*	F	76	F	>300	F	90	F	>300
SR 502/NE 22nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 29th Avenue	F	149	F	206	F	>300	F	>300
SR 502/NE 37th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 42nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 50th Avenue	F	141	F	182	F	>300	F	>300
SR 502/NE 67th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 72nd Avenue	F	>300	F	>300	F	>300	F	>300
SR 502/NE 82nd Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 87th Avenue*	F	>300	F	>300	F	>300	F	>300
SR 502/NE 92nd Avenue	E	80	F	140	F	>300	F	>300
SR 502/NW 20th Avenue	E	74	F	147	E	80	F	164
SR 502/SR 503	E	68	F	97	E	74	F	108

Note: * represents an unsignalized intersection. The level of service and delay for an unsignalized intersection is based on the worst movement. In all cases, the worst movement is the side street. The intersections at NE 29th Avenue, NE 50th Avenue and NE 92nd Avenue are unsignalized in the No Build scenario.

As indicated in Exhibit 3, the analysis indicates that the SR 502 corridor will experience substantial delays at the 2033 horizon and show little or no improvements in LOS compared to the 2033 No-Build alternative. The SR 502 corridor is expected to operate at grid lock conditions and would not result in any substantial mobility or safety improvements as prescribed in the Purpose and Need statement.

4.11.3 Park-and-Ride Analysis

At this time, C-TRAN has discussed the need for an additional park-and-ride along the SR 502 corridor but has not yet identified a site. The RTC HCT study considered a park-and-ride near the I-5 at SR 502 interchange, but since the I-5 HCT corridor was terminated to the south of the

I-5/SR 502 interchange, no further planning for a park-and-ride near the interchange has been undertaken. Additionally, C-TRAN has not identified any short- or long-term plans to substantially increase service along the SR 502 corridor.

Preliminary and final design efforts will continue to coordinate with C-TRAN on potential bus stops and bus pullouts along the SR 502 corridor.

4.11.4 Summary

Two TSM/TDM options were developed and analyzed (in lieu of roadway widening). Both options were eliminated as they did not fully comply with the project's purpose and need statement.

While TSM and TDM options themselves are not fully consistent with the project's purpose and need statement, some of the components of these options are being incorporated into the design of the preferred alternative. These include:

- Walkways and bike lanes along SR 502 in "urban" settings such as Dollars Corner (approximately NE 67th Avenue through NE 82nd Avenue)
- Wide shoulders to allow for bicycle and pedestrian mobility and safety in rural areas (outside of Dollars Corner)
- Access management provisions including a raised, center median along much of the corridor
- Allowance for future, local fixed-route bus service that would use the SR 502 corridor (provisions for future bus stops and bus pullouts based on coordination with C-TRAN, the transit provider)
- Inclusion in the analysis of a potential park-and-ride at some location along the corridor (C-TRAN has not identified a site at this time).
- Intersection channelization to reduce the amount of roadway pedestrians would need to cross (primarily at the SR 502/NE 72nd Avenue intersection).

4.12 Data for Noise Analysis

Traffic data was provided to complete the noise analysis. The noise peak hour was determined for the SR 502 corridor. The noise peak hour essentially corresponds to the truck peak hour. Recent traffic and vehicle classification counts were reviewed to determine the truck peak hour for a typical weekday. Based on recent traffic count information it was determined that the truck peak hour falls between 2:00 pm and 3:00 pm. A factor of 0.77 was calculated to convert the PM peak hour traffic volumes to the truck peak hour traffic volumes. The vehicle mix was determined by reviewing the vehicle classification counts. The traffic data for the noise analysis is included in Appendix O.

5.0 Mitigation

The build alternatives will improve operations along the SR 502 corridor. Based on the transportation analysis, the SR 502 corridor project study area is expected to operate acceptably with the proposed improvements at Year 2015 and Year 2033.

The widening of SR 502 will be designed to accommodate a center median. As discussed, the SR 502 corridor has many driveways connected to businesses and homes. Therefore, with this median in place, access into these sites will be converted to right-in/right-out accesses. U-turns will be accommodated at the major intersections along SR 502, which are, NE 29th Avenue, NE 50th Avenue, NE 72nd Avenue, and NE 92nd Avenue. Therefore, the design of these major intersections must accommodate for u-turns along SR 502.

In addition to evaluating the SR 502 corridor, the 239th Street, NE 199th Street, and NE 179th Street corridors were also analyzed to determine if these corridors would be impacted by the widening of SR 502. When comparing the no build and build alternatives for both 2015 and 2033 horizons, there is a slight improvement in delay at some of the intersections in the Build Alternative. This is due to the diversion of traffic from these corridors to the SR 502 corridor, as the SR 502 corridor will become a more desirable route in the Build Alternative. No mitigation is required for these intersections due to the SR 502 Corridor Widening project.

It is important to note that at the 2033 horizon, the NE 10th Avenue, NW 20th Avenue and the SR 503 intersections along SR 502 are expected to operate at a level of service F in both the no build and build alternatives. Improvements may be required at these intersections in the long term but these improvements are beyond the scope of the SR 502 Corridor Widening project.

6.0 References

Washington State Department of Transportation. 2007. Design Manual.

Federal Highway Administration. 2003. Manual on Uniform Traffic Control Devices for Streets and Highways.

Aksan, Ahmet; Layton, Robert. 1998. Right-In Right-Out Channelization Discussion Paper No. 13.