City of Sammamish

Sahalee Way Corridor Widening Project

Alternatives Analysis Report

September 2015

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1.0 EXECUTIVE SUMMARY

The Sahalee Way Corridor is comprised of Sahalee Way NE and 228th Avenue NE, which form a continuous roadway that connects SR 202 (NE Redmond-Fall City Road) to the Sammamish city center. The roadway changes names between the intersections of Sahalee Way NE at NE 28th Place / 223rd Avenue NE and 228th Avenue NE at NE 25th Way. The study limits for this project span from SR 202 on the north end to NE 25th Way on the south end.

The existing roadway in the study limits has one lane per direction with turn lanes at select intersections and paved shoulders throughout. Curb, gutter, and sidewalk are not provided.

The City of Sammamish has concurrency standards, which outline how much capacity a roadway must provide based on the traffic volumes that it serves. In all cases, the capacity of the roadway must exceed the traffic volume. Capacity can be increased through the addition of medians or left-turn lanes, paved shoulders, wider travel lanes, bike lanes, or sidewalks.

The 2015 Sammamish Comprehensive Plan identified the Sahalee Way Corridor as not meeting the City's concurrency standards because traffic volumes exceed available capacity, which is a function of geometric elements like number of through travel lanes, use of curbs/gutters/sidewalks, and the presence of center medians or turn lanes. This report documents two base roadway design options to improve Corridor capacity.

Additionally, this report includes preliminary cost estimates for the two base design options, as well as several deviations from City of Sammamish Interim Public Works Standards that could enhance capacity or reduce project cost.

2.0 ROADWAY DESIGN

2.1 Existing Conditions

The Sahalee Way Corridor is comprised of Sahalee Way NE and 228th Avenue NE, which form a continuous roadway that connects the NE Redmond-Fall City Road (SR 202) to the Sammamish city center. The roadway changes names between the intersections of Sahalee Way NE at NE 28th Place / 223rd Avenue NE and 228th Avenue NE at NE 25th Way. The study limits for this project span from SR 202 on the north end to NE 25th Way on the south end. Figure 1 shows the project limits.

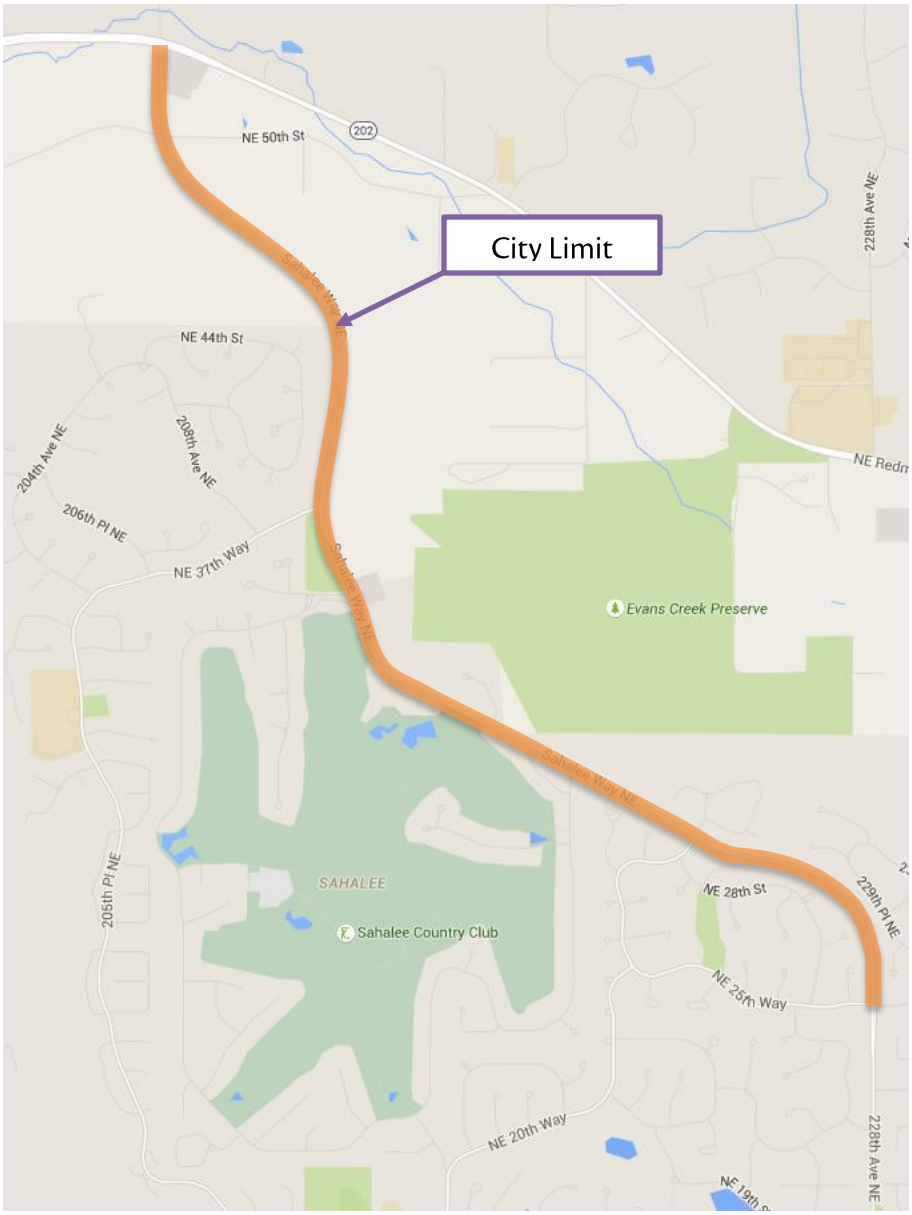

Figure 1 – Study limits

The study limits include approximately 0.75 miles of the Corridor within King County and 1.75 miles within City of Sammamish. The posted speed limit is 45 MPH. The Corridor is classified as a Principal Arterial by both jurisdictions.

The alignment for the Corridor curves in multiple locations within the study limits, resulting in segments that are closer to east-west than north-south. For the purposes of this report, the Corridor will always be considered the north-south roadway at all intersections for consistency.

From south to north, the Corridor intersects the following cross streets within the study limits:

- NE 25th Way
- NE 28th Place / 223rd Avenue NE
- Sahalee Drive E
- 217th Place NE
- 216th Place NE
- NE 36th Street
- NE 37th Way
- NE 50th Street
- SR 202 (NE Redmond-Fall City Road)

2.1.1 Existing Cross Section

The typical existing cross section is shown in Figure 2. One travel lane is provided per direction, with paved shoulders on the outsides of the travelled way. Curb, gutter, and sidewalk are not used except for short segments at intersection curb returns. The paved shoulders on the outside of the travel lanes provide substandard space for pedestrians to walk, bicyclists to ride, and King County Metro buses to stop without interrupting traffic.

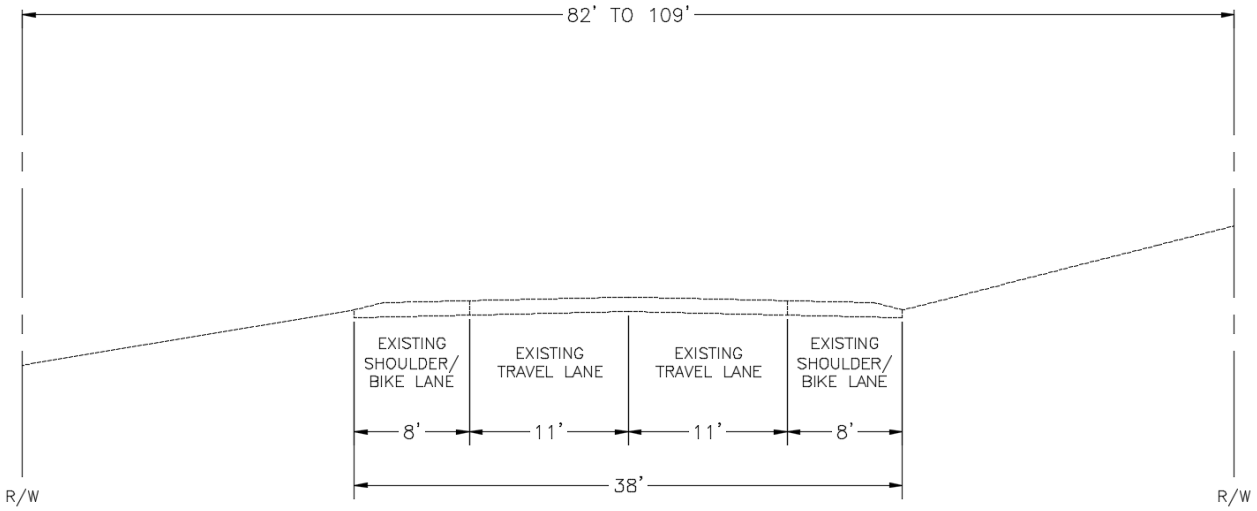

Figure 2 – Existing cross section

The following turn lanes are provided:

- Northbound and southbound left-turns at NE 25th Way
- Northbound and southbound left-turns at NE 28th Place / 223rd Avenue NE
- Northbound left-turn at NE 36th Street
- Center two-way left-turn lane on the north approach at NE 36th Street
- Northbound left-turn lane at NE 37th Way
- Southbound right-turn at NE 37th Way
- Northbound left-turn, shared left-turn/through, and right-turn lanes at SR 202

All other turning movements onto cross streets are made from the through travel lane.
At SR 202, the south approach has two receiving lanes that reduce to one lane approximately 150 feet south of the intersection. This is the only location in the corridor where two through lanes are provided for a direction.

Existing right-of-way (ROW) within Sammamish is 84-feet wide. In King County, ROW ranges from 82-feet to 104-feet wide. The roadway is not centered within ROW in either jurisdiction.

2.1.2 Design Speed

The design speed of the roadway—the speed that governs the size of curves and banking steepness—was reviewed in a memorandum that is attached to this report as Appendix A. Existing slope evaluations were based on aerial base mapping. More precise surveying may reveal different results.

The existing horizontal curves have design speeds ranging from 35 MPH to 50 MPH. Only one curve, located in King County, has a design speed that exceeds the posted speed limit. Curve warning signs and advisory speed plaques are provided at three of the five other curves.

The existing vertical curves have design speeds ranging from 40 MPH to over 80 MPH. Only one curve, located near the southern end of the study limits, has a design speed that does not exceed the posted speed limit. The maximum grade is roughly 10% on the hill between SR 202 and NE 37th Way.

2.1.3 Roadside Development

Illumination is provided for the Corridor through fixtures mounted to power poles that line the roadway. These poles are located within ROW between 8 and 20 feet from the edge of the existing shoulders.

Guardrail is provided at select locations where steep slopes are adjacent to the edge of shoulder.

2.1.4 Environmentally Sensitive Areas

The Sahalee Way Corridor traverses steep topography and is adjacent to very steep slopes in certain places. As a result, much of the study limits are considered as landslide hazard or erosion hazard zones by King County. These locations are shown in Figures 3 and 4, respectively. Additionally, Figure 5 shows the existing wetlands and streams that are adjacent to or intersect the Corridor.

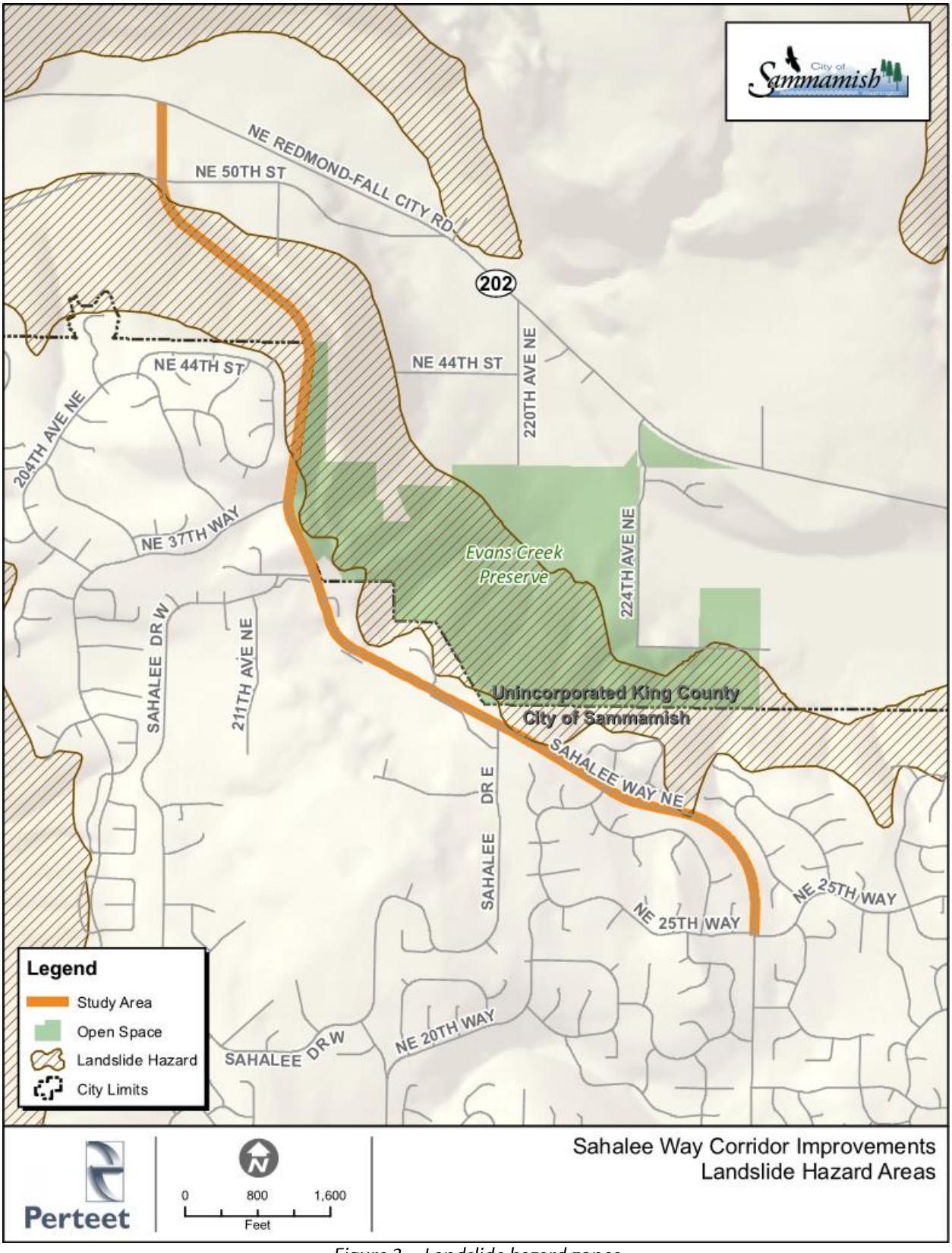

Figure 3 – Landslide hazard zones

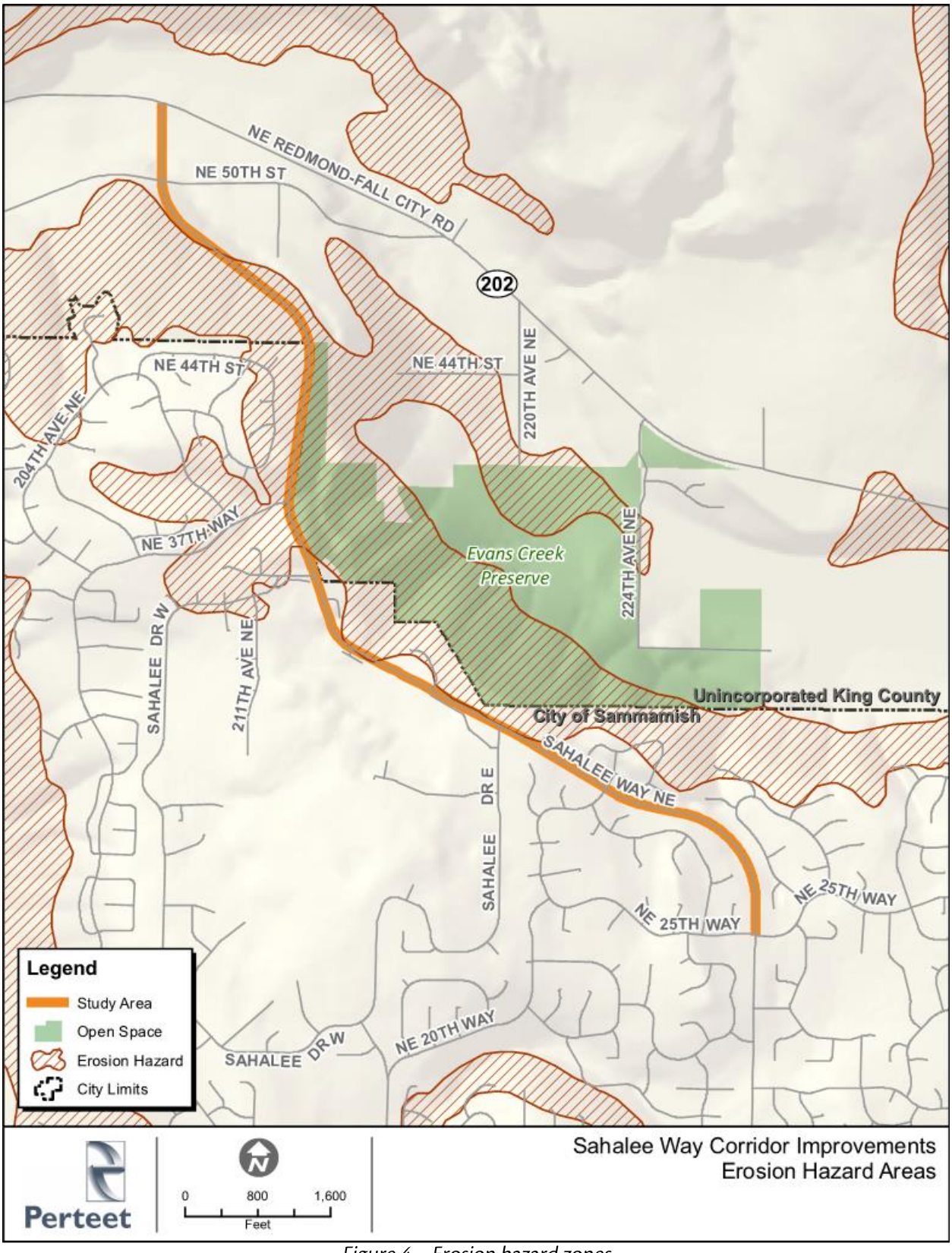

Figure 4 – Erosion hazard zones

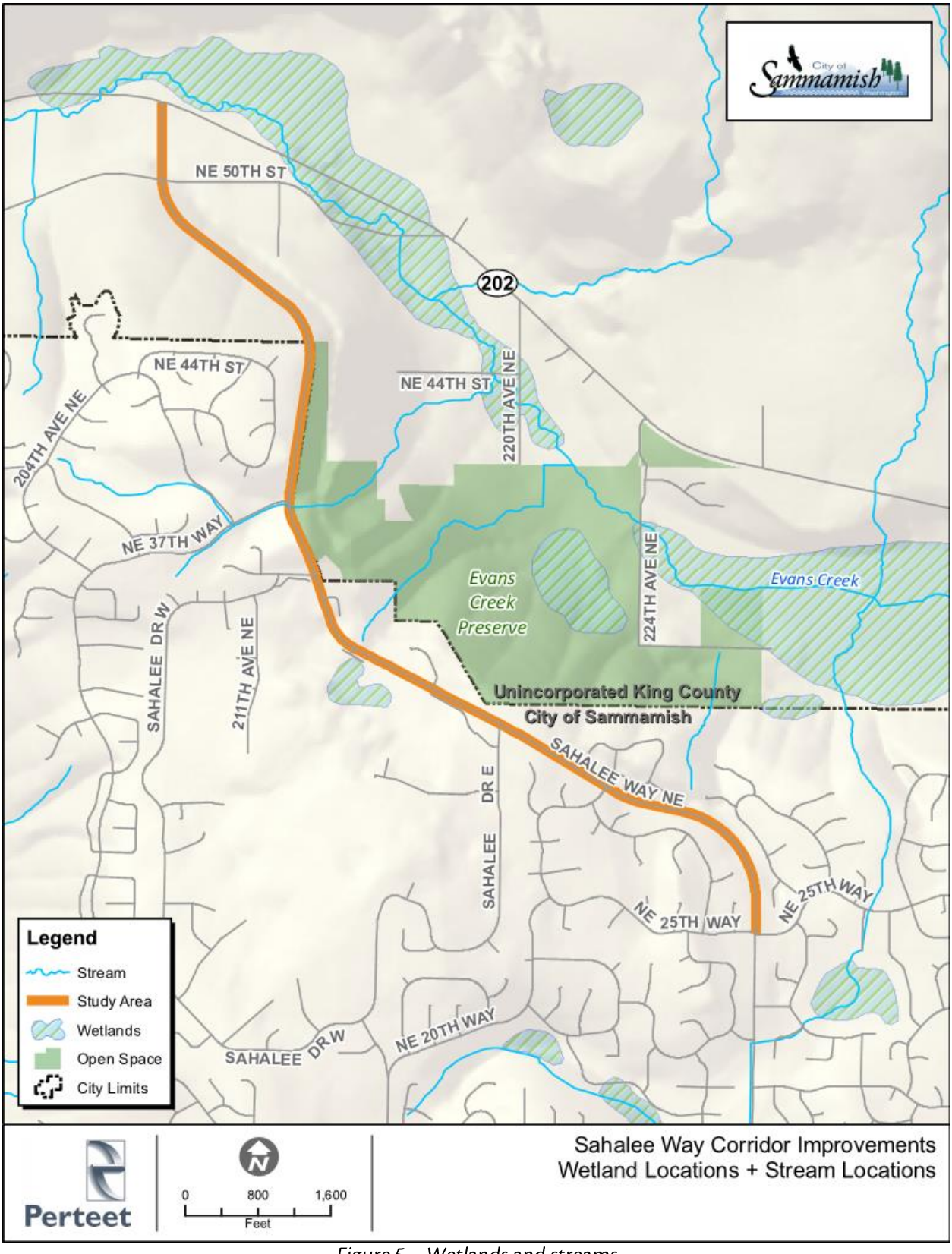

Figure 5 – Wetlands and streams

2.2 Design Alternatives

Two base roadway design alternatives were evaluated for the Corridor. The Three-Lane base design provides one travel lane per direction with a median lane of varying width that allows left-turn access to all cross streets within Sammamish. This design does not impact the Corridor within King County. The Five-Lane base design provides two travel lanes per direction with a wide center turn lane throughout Sammamish. In King County, the Five-Lane design does not employ a center lane; only four lanes are provided. Each option includes bicycle and pedestrian enhancements described in depth below. Corridor design criteria is summarized in Appendix B.

2.2.1 Three-Lane Base Design

2.2.1.1 *Lane Configuration*

The Three-Lane base design option would widen the Sahalee Way Corridor to include a center median lane in Sammamish and would not alter the roadway in King County under the base configuration. At intersections, this center lane would allow for left-turn movements at all cross streets to occur from a turn lane as opposed to the through travel lane. Away from intersections, the center lane would either be striped as a TWLTL to provide adjacent property access or a narrow striped median would be installed to provide for emergency service response. No right-turn lanes would be added to the Corridor; however, the existing right-turn lane at NE 37th Way would be maintained (see Chapter 3 for traffic analysis justification).

On the west side of the roadway, the base design includes installing a bike lane adjacent to curb, gutter, 3-foot planter and 6-foot sidewalk. On the east side, an 8-foot shoulder incorporating the bike lane is installed on the outside of the travel lane. Figure 6 shows the proposed cross section within Sammamish.

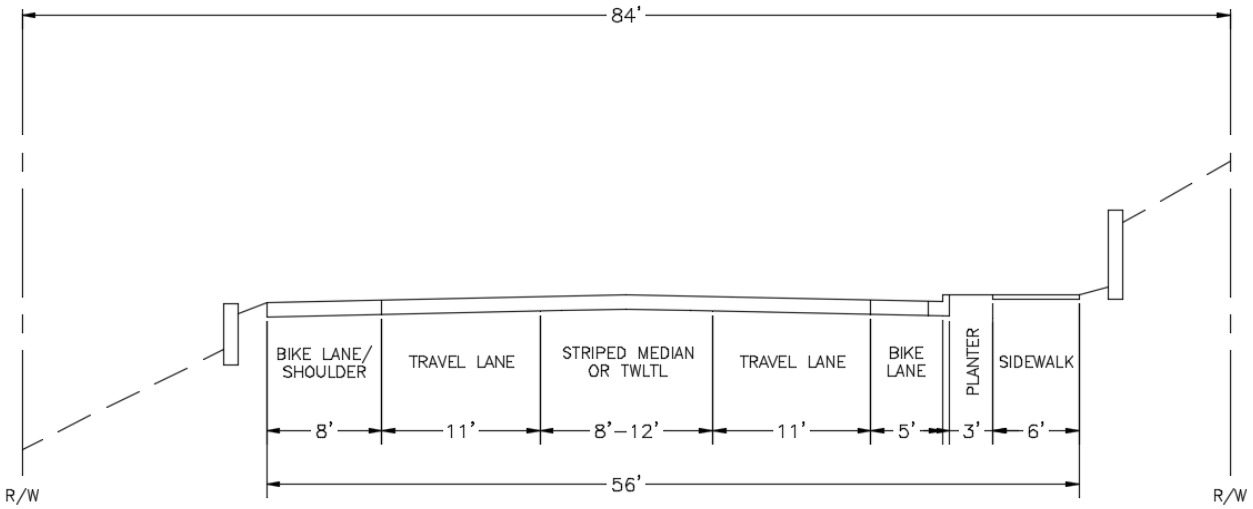

Figure 6 – Three-Lane base design proposed cross section (in Sammamish, facing south)

In King County, this base alternative maintains the existing two-lane highway configuration and the paved shoulders remain in place. The south approach at SR 202 is unchanged.

The proposed Three-Lane base design requires small areas of ROW acquisition, primarily at bus stops (if bus pullout enhancement is selected) and curb returns. While the existing roadway is not centered on ROW, the roadway can be widened and curb, gutter, planter, and sidewalk can be installed without encroaching on any adjacent homes or buildings.

The proposed Three-Lane base design is shown in Appendix C.

2.2.1.2 *Vertical Design*

The existing centerline profile was evaluated and found to have vertical curves that meet or exceed a 40 mile per hour design speed throughout the Corridor. This analysis is summarized in Appendix A. The existing profile will be maintained with the Three-Lane base design.

Due to the steep slopes adjacent to the roadway, retaining walls would be necessary to stay within ROW and match the surrounding elevations beyond the sidewalks. Preliminary wall locations were estimated based on approximate existing elevations. The locations of the walls are shown in Appendix C.

2.2.1.3 *Design Elements*

The Three-Lane design employs several design elements to deliver the concurrency road improvements while keeping wall costs low, some of which are detailed below.

Design Element A: Narrow Medians

Limited adjacent properties require access between the left-turn lanes along the Corridor. The center lanes here are narrowed to 8-feet wide (see Figure 6) due to low turning volumes into and out of the adjacent driveways. Narrowing the median requires re-aligning at least one direction of travel to reduce the overall cross section width. The most effective method in this location is to bring the each travel lane toward the centerline (see Figure 7) to reduce wall and earthwork quantities on both sides of the roadway.

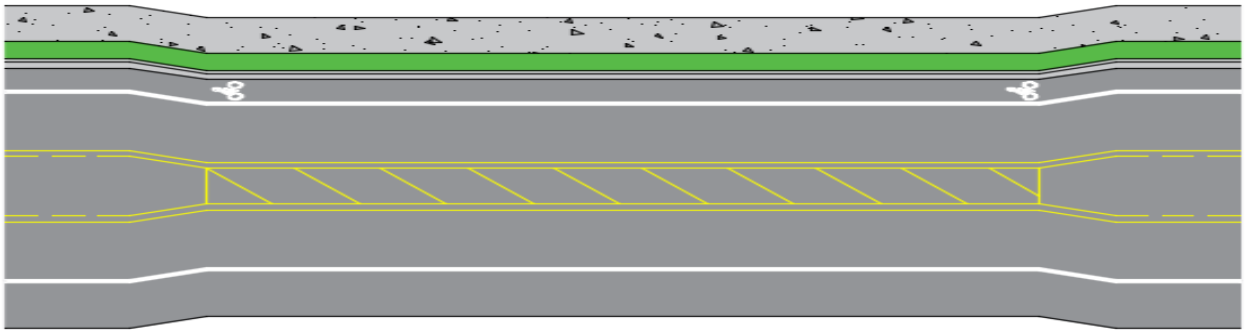

Figure 7 – Narrow median with dual lane re-alignment (not to scale)

Design Element B: No Changes North of NE 37th Way

There are no access points within City Limits north of NE 37th Way that require center turn-lane or sidewalk access. As a result, the existing cross section is sufficient in this location and no improvements are necessary.

Design Element C: Eliminate East Sidewalk

Eliminating sidewalk and the associated planter strip on the east side of the roadway reduces 6.5 feet of the cross section width. Like the other elements, this generally reduces wall heights and earthwork quantities, in addition to sidewalk and landscaping areas, over the length of the Corridor. Curb, gutter, and sidewalk are provided at each curb return at intersections. Between intersections, the east side of the roadway will have an 8-foot asphalt shoulder that also serves as a bicycle lane.

Design Element D: Overlay Existing Roadway

The current roadway alignment is shaped by the surrounding topography and does not follow the center of right-of-way. Maintaining this alignment and widening as necessary with new full-depth pavement requires an overlay to the existing pavement in order to smoothly transition between the existing and proposed pavement.

Design Element E: Maintain Existing Illumination

The existing illumination poles can be maintained because the corridor is not being widening significantly. If any poles are too close to the existing roadway to be maintained, the fixture can be replaced in kind.

Design Element F: Reduce Planter Strip Width

Reducing the planter strip width from 5 feet to 3 feet decreases wall and earthwork costs by narrowing the overall road section. Though the narrower landscape area will not be able to support tree growth, it will be wide enough to trap sidewalk storm water runoff from entering the roadway.

2.2.1.4 Optional Corridor Enhancements

In addition to the design elements, several enhancements were identified to either restore City of Sammamish standard cross section elements or improve the Corridor in other ways.

Optional Corridor Enhancement A: Enhanced Crossings

The Sahalee Way Corridor has transit service, but few locations to cross the roadway within the study limits. Pedestrians from Sahalee Drive E or 217th Place NE would be forced to cross the roadway at an unmarked crosswalk under the Three-Lane design. If low pedestrian volumes are anticipated at this location, a median refuge island could be installed within the crosswalks. Higher pedestrian volumes could warrant an "active" or "enhanced" treatment, such as rapid flashing beacons. Enhanced crossings will need to meet a warrant analysis, to be completed during the design phase.

Optional Corridor Enhancement B: Bus Pullouts

On the west side of the roadway, where curb and gutter is provided instead of the existing shoulder, bus pullouts would provide a dedicated transit space outside of the general travel lane. Without the pullouts, METRO busses will be required to stop and delay following vehicles. Installing pullouts would widen segments of the Corridor on the west side by around 7 feet. This would trigger increased pavement, earthwork, wall, and construction easement costs.

Optional Corridor Enhancement C: Widen Planter Strip (5' Maximum)

The City standard width for planter strips between curb and sidewalk is 5 feet. The Three-Lane design uses 3-foot wide planters to reduce wall cost. Restoring these to the full width (with deviations as necessary to avoid extreme slopes) would increase wall, earthwork, and pavement quantities and allow enough space to plant street trees between the curb and sidewalk.

Optional Corridor Enhancement D: Southbound Right-Turn Lane at NE 28th Place

A southbound right-turn lane at NE 28th Place would allow drivers travelling on a downhill slope to exit the general travel lane before slowing down to turn. This would reduce the speed variation near the intersection, but the performance of the intersection would see minimal improvements and the level of service would not change; this would not be a concurrency improvement. Installing this enhancement would require partial property acquisition at the southwest corner of the intersection in addition to additional pavement, earthwork, drainage, and wall quantities.

Optional Corridor Enhancement E: Raised Median Islands

City standards include landscaped, raised median islands at locations where turning movements are not provided from the center lane. The base Three-Lane design includes 8-foot wide striped medians in locations south of NE 37th Way. Replacing the pavement in the median with curb and landscaping would increase the project cost to add those features, but a cost savings would be provided for the drainage detention and pavement costs. Figure 8 shows a cross section of the corridor with a raised median island.

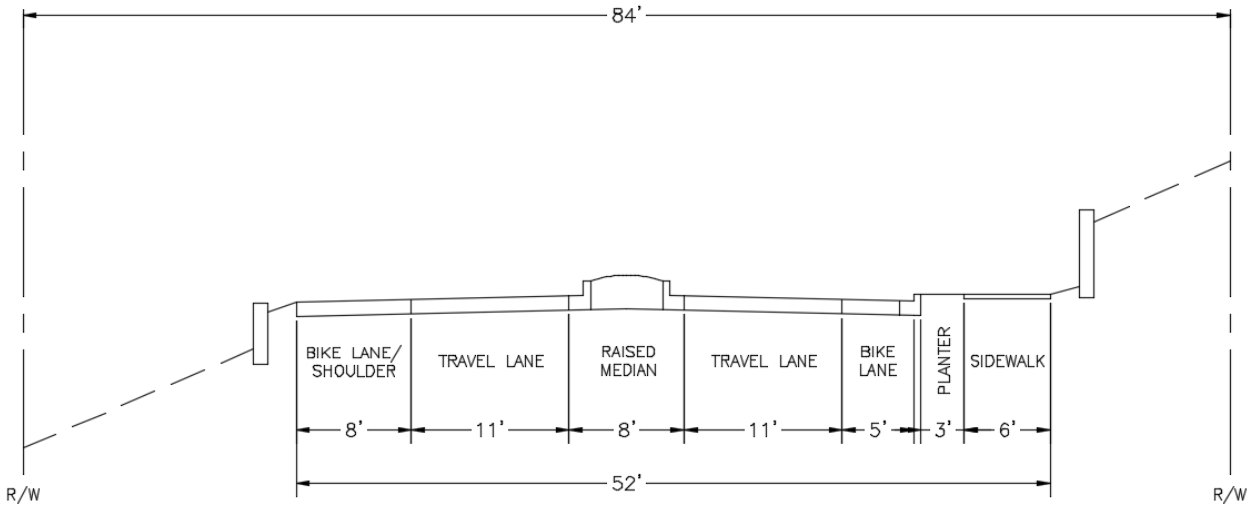

Figure 8 – Raised median island typical section (facing south)

Optional Corridor Enhancement F: Full-Width Painted Medians

The Sammamish standard is to provide a 10-foot to 12-foot wide median lane. Providing a full-width striped median would require additional pavement, and, as a result of the widening, the wall and earthwork savings identified by Element A would be negated. This enhancement would also install a full-width painted median between NE 37th Way and the City Limit.

Optional Corridor Enhancement G: Truck Climbing Lane

On roadways that provide a single lane per direction and traverse steep grades, heavy vehicles like trucks and buses can cause delays to following drivers because they are forced to progress more slowly up hills than passenger cars. Observations have noted that this phenomena occurs currently north of NE 37th Way in the southbound (uphill) direction. The Three-Lane base design would not improve or eliminate this. However, a truck climbing lane could be installed in the southbound direction in between SR 202 and NE 37th Way. This lane would allow for heavy vehicles to travel more slowly in the right lane, while passenger cars would have an opportunity to pass in the left lane. Figure 9 shows the proposed climbing lane cross section.

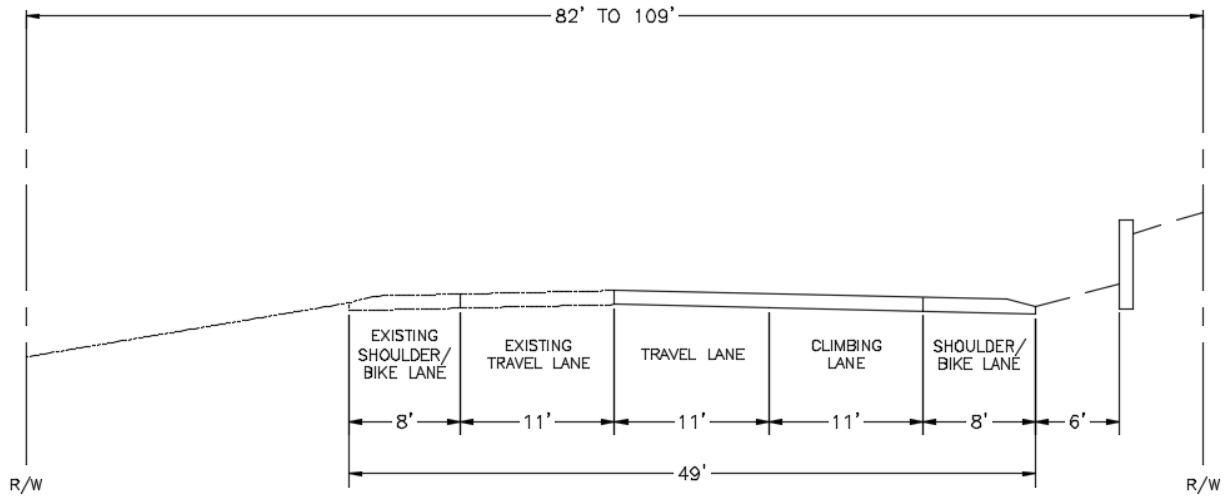

Figure 9 – Three-Lane design with truck climbing lane cross sections (facing south)

See Chapter 3 for a detailed traffic analysis of the impacts of this alternative on operations. The truck climbing lane would cause changes to the King County portion of the Corridor, as it would start at the bottom of the

steepest portion of the upgrade. From there, it would continue until becoming the right-turn only lane at NE 37th Way. The roadway centerline would not be adjusted. The climbing lane would impact wall and earthwork quantities, in addition to pavement.

The segment of the Corridor within King County would only be impacted if the climbing lane enhancement is pursued. Enhancements D and F would trigger changes to the road within Sammamish north of NE 37th Way.

2.2.1.5 *Cost Estimates*

Cost estimates were prepared for the Three-Lane base option as well as all of the optional corridor enhancements. These preliminary estimates include a 30% contingency in order to account for unknown project costs that will be reduced and refined as final design progresses. Bid item costs were determined based on past project experiences. Civil, drainage, structural, and traffic quantities are included in the estimate. The costs are summarized in Table 1. Detailed bid item costs and quantities are shown in Appendix D. The following assumptions were used when constructing cost estimates:

- The corridor was not surveyed. LIDAR data provided rough elevation data, including existing profiles and slopes. Aerial imagery and GIS right-of-way, building outlines, and environmental hazard areas were used as a base map.
- Wall heights and earthwork quantities were modeled using AutoCad Civil 3D 2015.
- Existing asphalt pavement and shoulder are full depth and can accommodate future traffic loadings.
- 10% mobilization.
- 12% preliminary design engineering (not including contingency).
- 12% construction engineering.
- 30% construction contingency to cover additional project costs to be identified during final design.
- $50/SF right-of-way acquisition cost from adjacent property samples from King County iMap.
- No inflation.

Table 1 shows the cost breakdown for the base configuration of the Three-Lane design. This configuration includes all of the Elements described above but none of the Enhancements.

Table 1 – Base Configuration Breakdown

	Cost
Roadway	$4,111,800
Drainage	$3,177,050
Walls	$825,000
Mobilization	$812,000
Construction Engineering	$1,072,000
Construction Contingency	$2,678,000
Subtotal	**$12,675,850**
Preliminary Engineering	$1,393,000
R/W	$83,500
Total	**$14,160,000**

Each individual Three-Lane Enhancement has an associated cost. Those are presented in Table 2.

Table 2 – Three-Lane Enhancement Cost Estimates

Enhancement	Description	City of Sammamish Cost	King County Cost
A	Enhanced Crossings	$45,000 each	-
B	Bus Pullouts	$320,000	-
C	Widen Planter Strip	$820,000	-
D	Right-Turn Lane	$480,000	-
E	Raised Median Island	$160,000	-
F	Full-Width Painted Medians	$2,730,000	-
G	Truck Climbing Lane	$3,420,000	$2,390,000

2.2.2 Five-Lane Base Design

2.2.2.1 *Lane Configuration*

The Five-Lane base design option would widen the Sahalee Way Corridor to include two travel lanes per direction and a center two-way left-turn lane inside Sammamish City Limits. At intersections, this center lane would allow for left-turn movements at all cross streets to occur from a turn lane as opposed to the through travel lane. Away from intersections, the center lane would either be striped as a TWLTL to provide adjacent property access, or a landscaped median island would be installed in the lane.

In the northbound direction, the two through travel lanes would begin at the intersection of NE 25th Way and would continue until splitting into three lanes at SR 202. In the southbound direction, the existing two southbound receiving lanes at SR 202 would be maintained and the outside lane would be extended and continue until becoming a right-turn only lane at NE 25th Way. No right-turn lanes would be provided at any intersection in between; right-turn movements would be served using the outside travel lane.

Per City standards, a marked bicycle lane would be installed on the outside of the travelled way in both directions. Curb, gutter, planter strip, and sidewalk would also be installed instead of a paved shoulder. Transit pullouts would not be necessary with the five-lane configuration; buses would stop in-lane.

In King County, one additional lane would be added per direction, but the center turn lane would not. Paved shoulders would be installed on the outside of the travelled way on both sides.

The roadway would be realigned to the center of existing ROW within Sammamish to minimize acquisition costs. Even with the centered alignment, this base design option would require acquiring approximately 7 feet on either side of the roadway within Sammamish. A preliminary evaluation of the surrounding buildings and houses shows that the proposed ROW acquisition should not require taking any complete properties. Minor ROW acquisitions within King County would be necessary.

The Five-Lane cross sections are shown in Figure 10. The proposed Five-Lane design layout is shown in Appendix E.

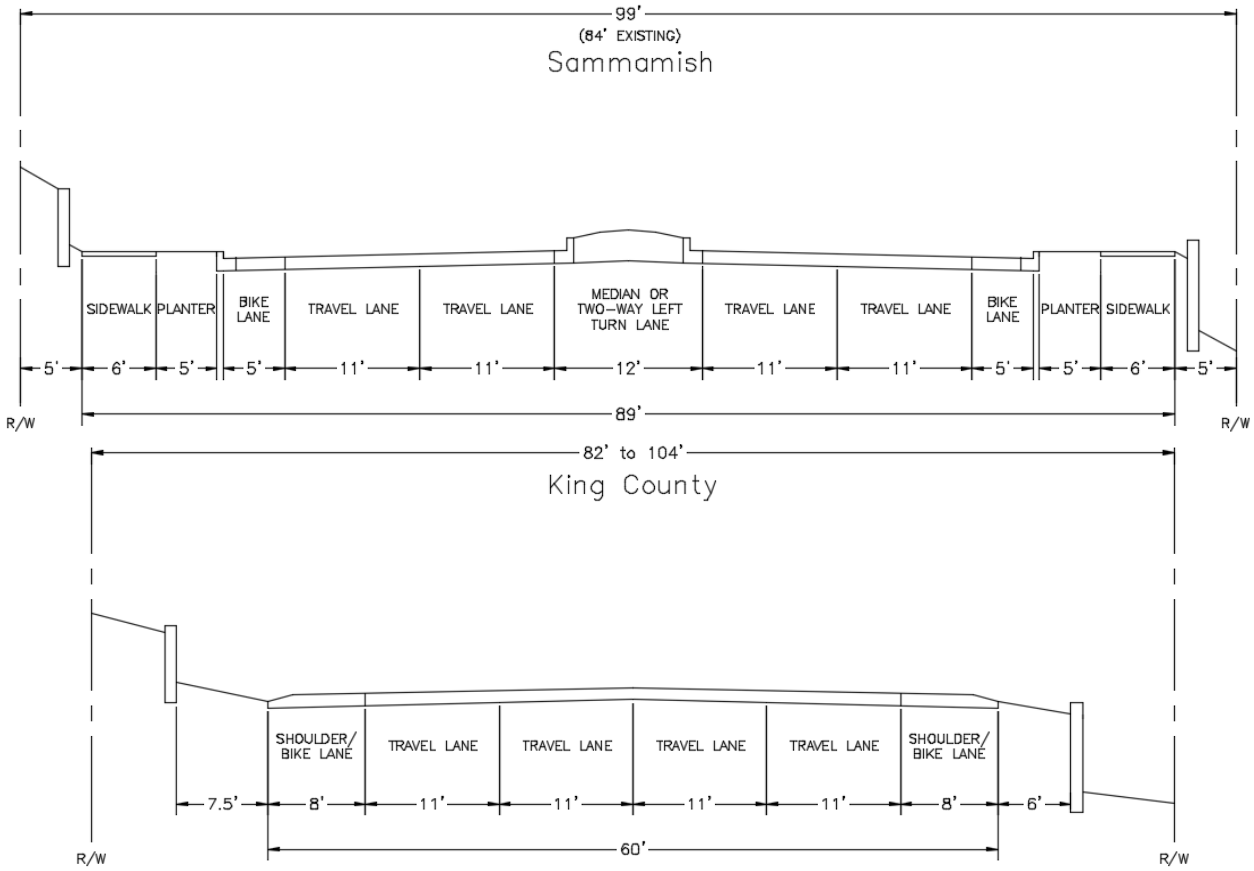

Figure 10 - Five-Lane design proposed cross sections (facing south)

2.2.2.2 *Vertical Design*

Because the roadway centerline would be altered for the Five-Lane design, the vertical profile would need to be reestablished. This would be a process for final design. However, it is likely that grades would be similar to existing.

A similar vertical analysis was performed for the Five-Lane design. In general, due to the increased roadway width, the edges of sidewalk appeared to cut further into adjacent earthwork, and extend further over adjacent steep slopes. As a result, the walls for this design are generally taller than the walls for the Three-Lane design and the associated earthwork cost is larger.

2.2.2.3 *Cost Estimates*

Five-Lane cost estimates were prepared in the same fashion as Three-Lane estimates. The costs are summarized in Table 3, below. Detailed bid item costs and quantities are shown in Appendix F. The same assumptions detailed for the Three-Lane option were used for the Five-Lane estimates. Because the project cost for the Five-Lane design is so high, deviations from City standards and project enhancements were not identified.

Table 3 – Five-Lane Design Cost Estimates

	Project Cost
City of Sammamish	$67,460,000
King County	$12,420,000

3.0 TRAFFIC ANALYSIS

3.1 Introduction

The Sahalee Way Corridor is the primary north-south roadway that passes through the City of Sammamish. The City is investigating if improvements to the corridor should maintain the current number of travel lanes or expand to a four/five-lane section. Additionally, the proposed project will enhance pedestrian and bicycle facilities along the corridor. To support the decision-making process, traffic analysis of the existing conditions and design alternatives was performed. This chapter details the findings from that effort.

3.2 Existing Conditions

The Sahalee Way Corridor is comprised of Sahalee Way NE and 228th Avenue NE, which form a continuous roadway. The roadway changes names between the intersections of Sahalee Way NE at NE 28th Place / 223rd Avenue NE and 228th Avenue NE at NE 25th Way. The study limits for this project span from SR 202 on the north end to NE 25th Way on the south end. The Sammamish City Limit is located between NE 37th Way and NE 50th Street. North of that, Sahalee Way NE is located in unincorporated King County. Both the City and the County classify the Sahalee Way Corridor as a Principal Arterial. The posted speed limit through the study segment is 45 MPH.

The Corridor curves in multiple locations within the study limits, resulting in segments that are closer to an east-west than north-south alignment. For the purposes of this analysis, the Corridor will always be considered the north-south roadway at all intersections for consistency.

3.2.1 Lane Configuration

The Sahalee Way Corridor is typically a two-lane roadway throughout the project limits with turn pockets at select intersections. At SR 202, two southbound lanes merge into one approximately 150 feet south of the intersection. Left-turn lanes are provided in both directions at NE 25th Way, at NE 28th Place / 223rd Avenue NE, and at NE 36th Street, and in the northbound direction at Sahalee Drive E, NE 37th Way, and SR 202. At Sahalee Drive E, the eastbound to northbound movement has an acceleration/merge lane. Right-turn lanes are provided in the southbound direction at NE 37th Way and in the northbound direction at SR 202.

This analysis reviewed five study intersections within the Corridor: NE 25th Way, NE 28th Place / 223rd Avenue NE, NE 36th Street, NE 37th Way, and SR 202. The lane configuration and traffic control at these five locations is shown in Figure 11.

There are limited non-motorized facilities along the corridor. A shoulder is provided on the outside of each travel lane except at some intersections where sidewalks replace the shoulder. These shoulders are used by pedestrians and bicyclists throughout the corridor.

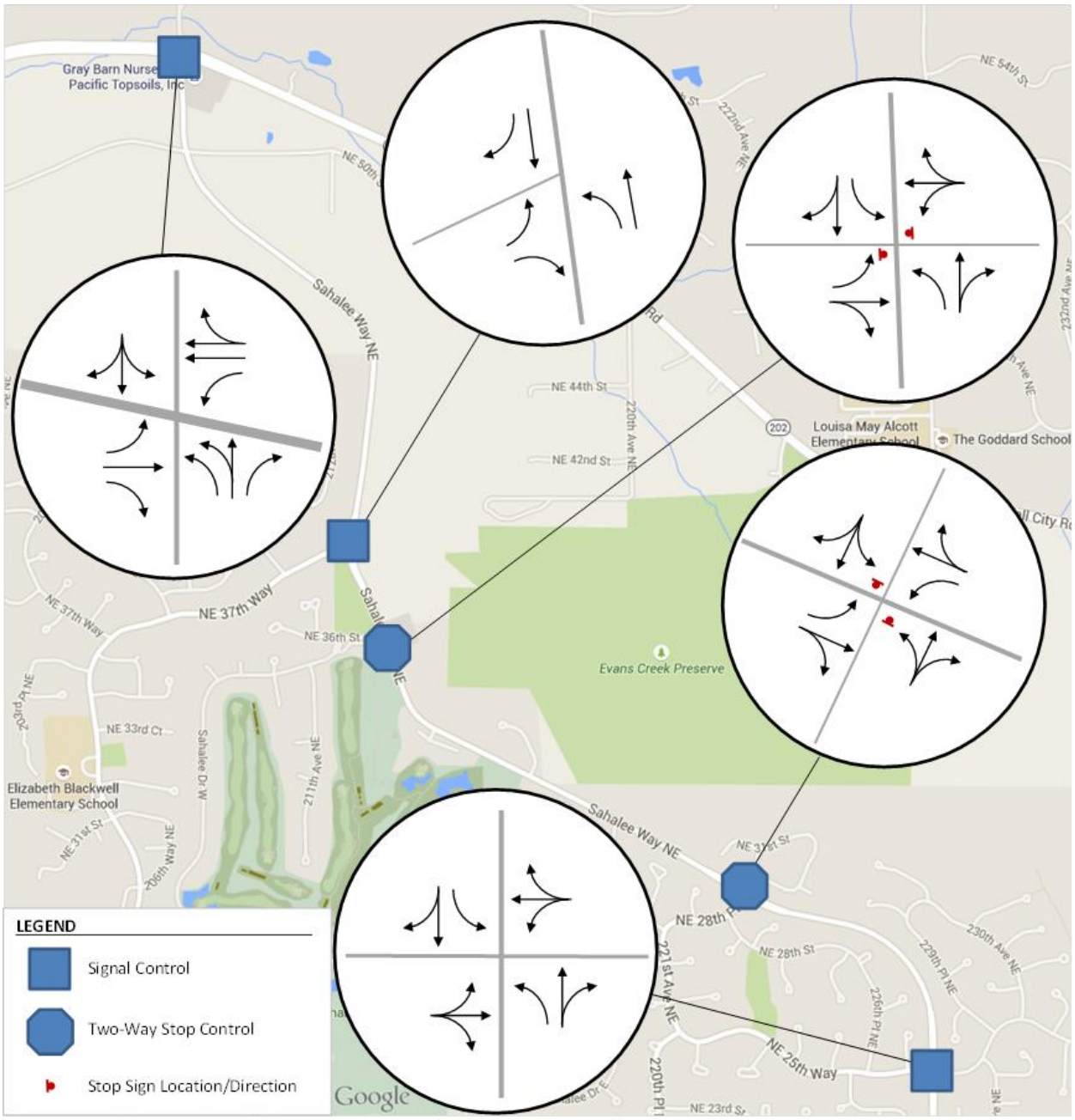

Figure 11 – Existing Lane Configuration and Traffic Control at Study Intersections

3.2.2 Traffic Volumes

Afternoon (PM) peak hour traffic volumes for the study intersections were recorded on Tuesday, March 25, 2014 between 4:30 PM and 6:30 PM. Two different peak hours within that timeframe were observed across the five study intersections. The earlier peak hour—4:45 PM to 5:45 PM—had the highest volumes at the intersections at NE 28th Place / 223rd Avenue NE and SR 202. The later peak hour—5:30 PM to 6:30 PM—had higher entering volumes at the remaining three locations. The two-hour count volumes are included in Appendix G.

The early peak hour was selected as the standard for analysis because total volumes along the corridor and at cross streets then are higher than during the later peak hour. (However, the volume differences between the early and late peak hours are not extreme and will not change the level of service at any location.) The existing peak hour volumes are included in Figure 12.

3.2.3 Traffic Control

Three intersections within the Corridor—NE 25th Way, NE 37th Way, and SR 202—are signalized. All other intersections are stop-controlled with the Corridor having free, or uncontrolled, movements. Left-turn phasing at the signalized locations are summarized in Table 4.

Table 4 – Existing Left-Turn Phasing

Intersection	Northbound	Southbound	Eastbound	Westbound
SR 202	Split	Split	Protected	Protected
NE 37th Way	Protected/Permissive	n/a	Protected	n/a
NE 25th Way	Protected/Permissive	Protected/Permissive	Permissive	Permissive

An eastbound to southbound right-turn overlap phase is provided at NE 37th Way. This phase runs with the northbound to westbound left-turn protected phase. The same type of overlap phasing is used for the eastbound right-turn at SR 202. However, the northbound right-turn movement at SR 202 runs with the northbound through and left-turn movements.

Signal timing plans at the signalized locations were provided by City of Sammamish and Washington State Department of Transportation (WSDOT) and used in the analysis.

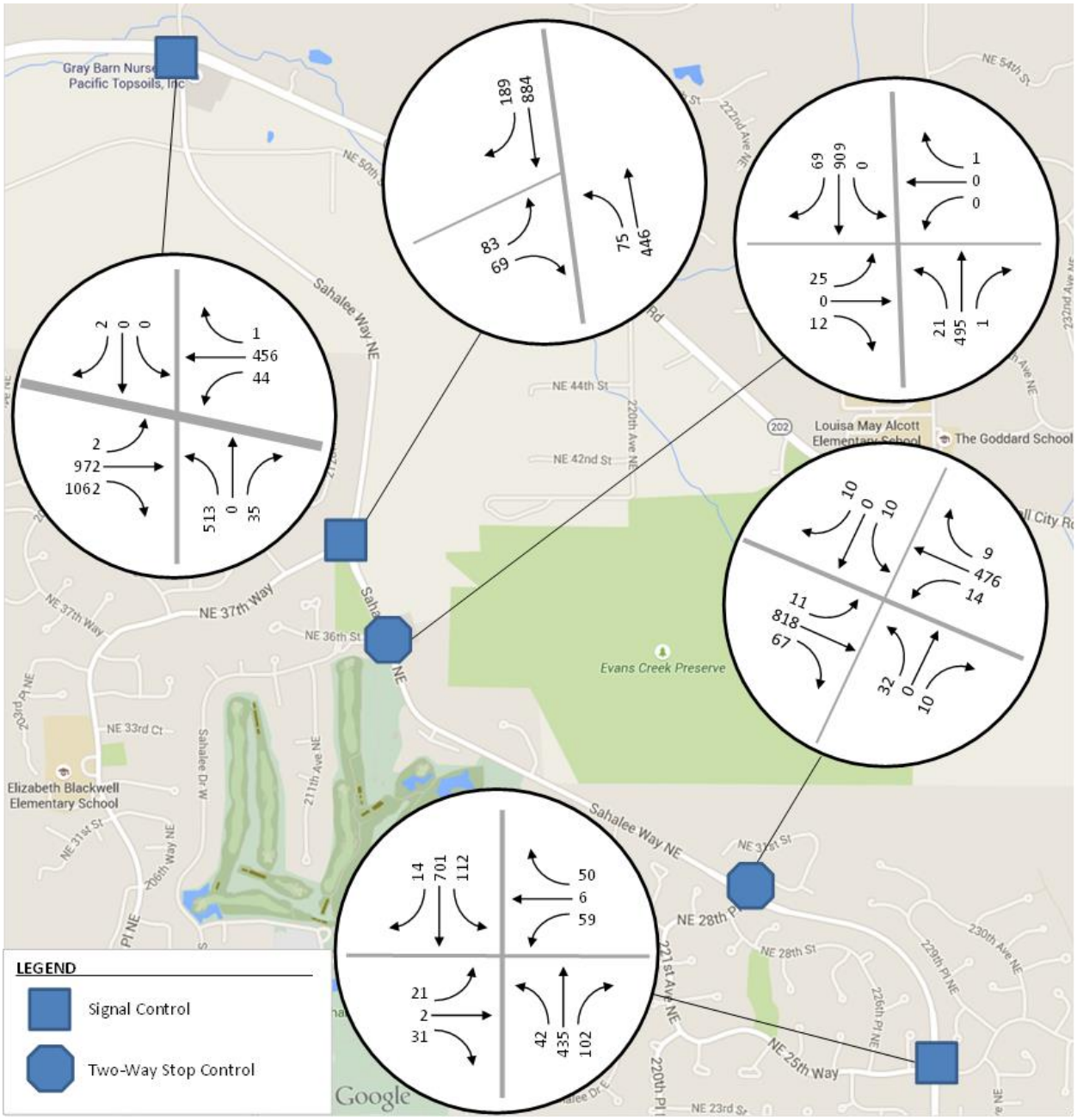

Figure 12 – 2014 Existing PM Peak Hour Volumes at Study Intersections

3.3 2035 Forecast Conditions

3.3.1 Lane Configuration

2035 was selected as the forecast (design) year for this project. The two base roadway configurations detailed in the Roadway Design chapter were analyzed for traffic performance.

Under Option 1 (referred to as the "Three-Lane" option in this chapter), one through lane would be provided in each direction throughout the Corridor. The center lane (in Sammamish only) would provide left-turn lanes at all intersections within the City Limits. Just south of SR 202, the southbound lanes would continue to merge and the northbound right-turn lane would develop as they do now. The right-turn only lane at NE 37th Way would still be provided (see Level of Service Analysis section for justification).

Under Option 2 (referred to as the "Five-Lane" option in this chapter), two through lanes would be provided in each direction throughout the Corridor. The center lane (in Sammamish only) would provide left-turn lanes at all intersections within the City Limits. In the northbound direction, the second through lane would be added immediately north of NE 25th Way as a second receiving lane. This lane would become a northbound right-turn only trap lane at SR 202. In the southbound direction, the merge south of SR 202 would be removed and two lanes would continue until NE 25th Way, where the outside lane would become a right-turn only trap lane. Right turns onto NE 37th Way would be from the shared through/right-turn lane.

3.3.2 Traffic Volumes

Traffic volumes for the 2035 design year are different for the two alternatives being considered, but the methodology for developing the turning movement counts was the same for each.

David Evans and Associates, Inc. (DEA) performed traffic modelling to project the number of trips that would occur along most links within the study corridor and cross streets. A separate model run was performed for each design alternative, with higher volumes along the Corridor generally occurring with the five-lane section. This is likely due to increased corridor capacity from having two travel lanes per direction instead of one.

The 2035 DEA model does not include forecast turning movement count volumes. Three techniques were used to forecast individual turning movements based on link volumes:

1. Where link volumes were provided for an entering approach, that volume was compared to the 2014 existing entering approach volume to determine a scale factor, which was applied uniformly to each movement on that approach. This was applicable to at least one direction at each study intersection.
2. Where link volumes were provided at some, but not all, intersection legs, the unknown link volumes and scale factors were calculated based on a system of equations that incorporated adjacent intersection volumes and existing condition turning movement ratios. The calculations that led to these scale factors are shown in Appendix H. This was applicable to at least one direction at each study intersection, except for Sahalee Way NE at NE 37th Way.
3. Where link volumes were found to be dramatically different than existing volumes, a manual adjustment was performed. This occurred at only one location—NE 36th Street—where volumes were projected to grow 700% by 2035. A review of the available land in this area showed that there is no additional room for sizeable developments along or to use NE 36th Street. However, the review showed that the additional traffic volume would use NE 37th Way. The future additional volumes were shifted to NE 37th Way accordingly. NE 36th Street volumes were assumed to increase at a 2% annual growth rate.

Truck and heavy vehicle percentages from the existing counts were assumed to remain constant at the design year. To reflect the project goal to increase pedestrian and bicycle volumes on the Sahalee Way Corridor, non-motorized volumes were assumed to increase to 15 per hour in all directions. Figures 13 and 14 show the projected turning movement volumes at the study intersections in 2035 under the three-lane and five-lane design alternatives, respectively.

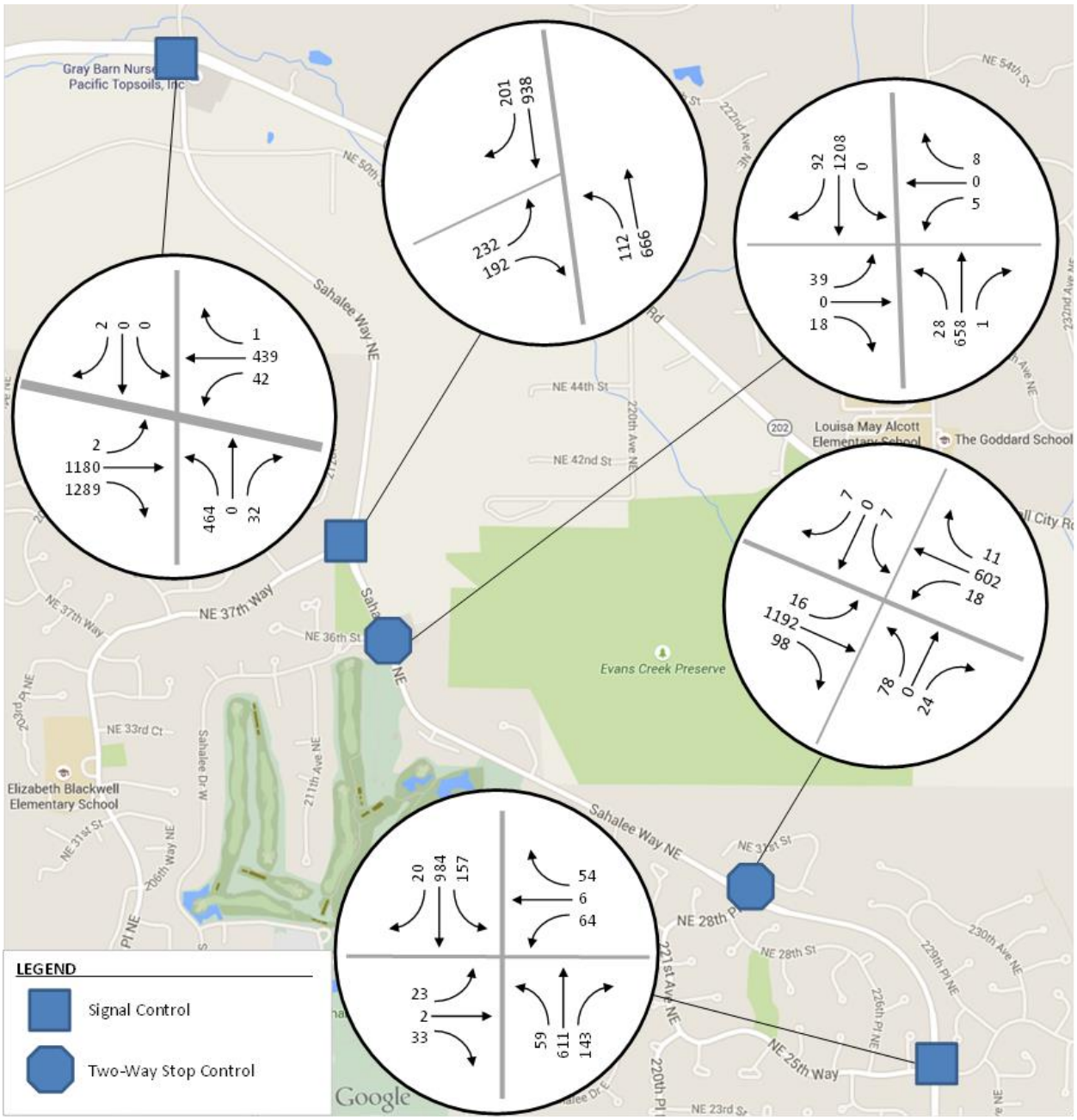

Figure 13 – 2035 Three-Lane Forecast PM Peak Hour Volumes at Study Intersections

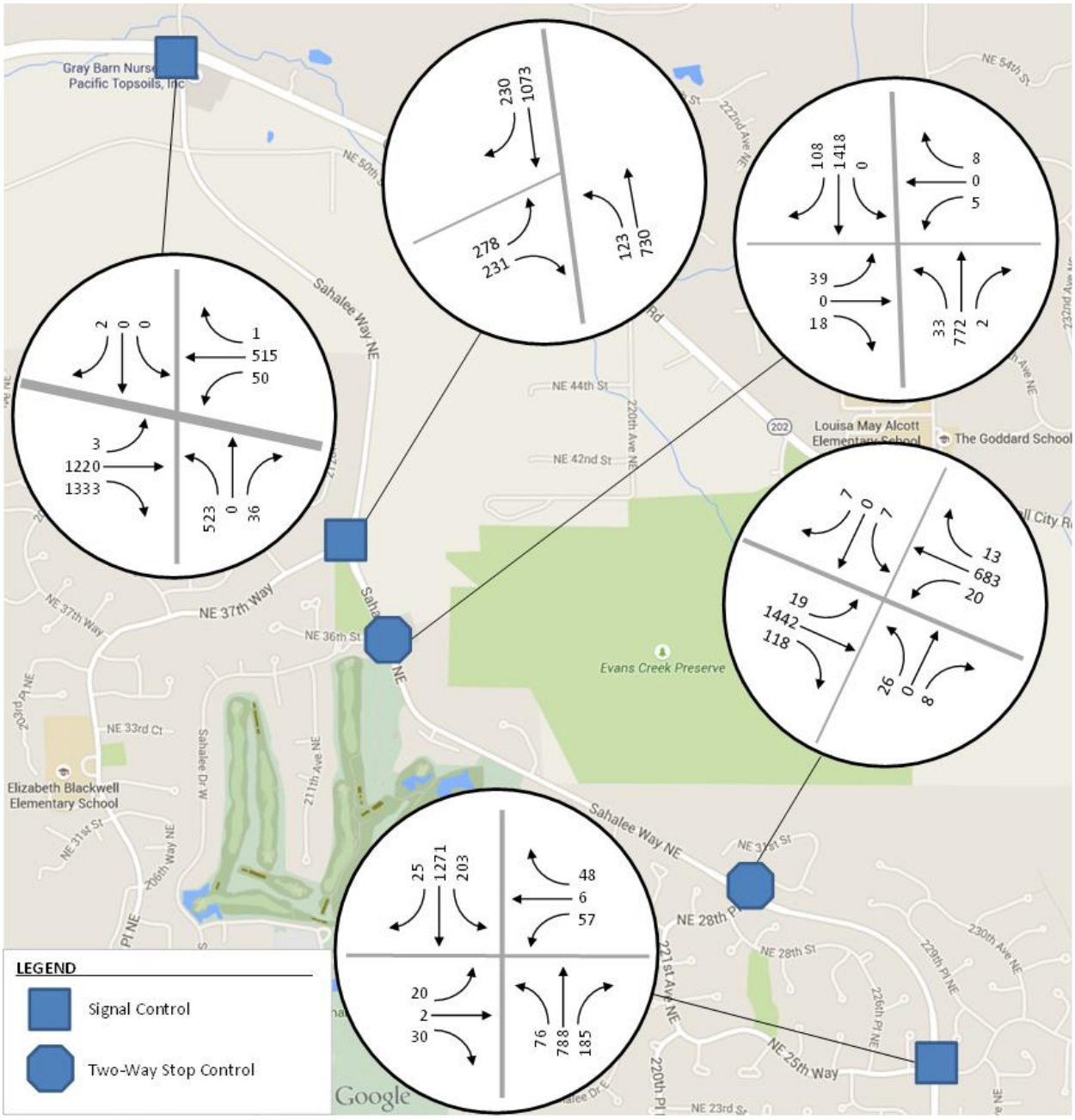

Figure 14 – 2035 Five-Lane Forecast PM Peak Hour Volumes at Study Intersections

3.3.3 Traffic Control

Existing traffic signals are expected to remain at three out of the five study intersections. Three traffic control options were evaluated at Sahalee Way NE at NE 28th Place / 223rd Avenue NE and Sahalee Way NE at NE 36th Street. These intersections are currently two-way stop controlled. An analysis was conducted to compare the delay of two-way stop control, signal control, and a roundabout treatment at the design year. Intersection control type at either location is not expected to alter traffic volumes.

Left-turn phasing was reviewed at each location to identify possible areas for capacity improvements in accordance with local standards. Per WSDOT Northwest Region's "Current Practices in Electrical Design," protective-permissive left-turn phasing should be installed if the cross product of left-turning and opposing through/right turning vehicles exceeds 60,000 in a peak hour. Table 5 shows the peak hour cross products at the existing signalized intersections, as well as the potential signalized intersections at NE 28th Place / 223rd Avenue NE and at NE 36th Street.

Table 5 – 2035 Cross Product Calculations

Intersection	Direction	Three-Lane Cross Product	Five-Lane Cross Product	Existing Treatment	Warranted Treatment
SR 202	Eastbound	962	1,695	Protected	Protected [1]
	Westbound	103,698	127,650		
NE 37th Way	Northbound	127,568	160,269	Prot. / Perm.	Prot. / Perm.
NE 36th Street	Northbound	36,400	50,358	n/a	Permitted
	Southbound	0	0		
	Eastbound	312	312		Permitted
	Westbound	90	90		
NE 28th Place / 223rd Avenue NE	Northbound	23,220	31,200	n/a	Permitted
	Southbound	9,808	13,224		
	Eastbound	546	182		Permitted
	Westbound	168	56		
NE 25th Way	Northbound	57,466	98,496	Prot. / Perm.	Prot. / Perm.
	Southbound	118,378	197,519		
	Eastbound	1,380	1,080	Permitted	Permitted
	Westbound	2,240	1,824		

[1] Per the WSDOT *Design Manual*, protected phasing is required where volumes exceed the left-turn storage length and opposing speeds exceed 45 mph.

Table 5 does not include the northbound and southbound left-turn maneuvers at SR 202 because the channelization there dictates that split phasing must be used. At NE 37th Way, the left-turn phasing for eastbound traffic was not reviewed because there is no opposing westbound movement. The warranted treatment should be applied to opposing directions equally to create a safer environment.

The warranted future left-turn phasing treatments match the existing treatments at all locations. The analysis assumes that all existing left-turn phasing plans are maintained through the design year. Permissive left-turn phasing from all approaches will be used to evaluate the candidate signals.

3.4 Traffic Signal Warrant Analysis

Traffic signal warrants are used to determine where traffic signals can be installed without causing undue delay or safety reductions to users. Warrants are prescribed by the *Manual on Uniform Traffic Control Devices* (MUTCD).

This study reviewed the Four-Hour Vehicular Volume Warrant and Peak Hour Warrant at the intersections of Sahalee Way NE at NE 36th Street and Sahalee Way NE at NE 28th Place / 223rd Avenue NE. The other warrants in the MUTCD were ruled to be inapplicable to the intersections, some due to a lack of data.

The warrants were evaluated using the two-hour volume counts from the AM and PM peak hours taken on March 24, 2014. Volumes on the cross street were higher in the AM, which is consistent with drivers leaving the residential area to travel to work. In the PM, major street traffic is higher as more people turn into the subdivisions.

The major street (both directions, combined) and minor street (higher-volume approach only) volumes are shown in Table 6. These volumes were compared to the minimum warrant volumes in order to assess if the candidate intersections met either warrant under the different design alternatives. Note that the traffic model volumes for the streets can be different under the difference lane scenarios. This is likely due to changes in the ease of turning movements and associated route selection changes. At NE 28th Place / 223rd Avenue NE, the higher volume minor street approach is on the west side of Sahalee Way NE. This approach can also access the Corridor via the signalized intersection at NE 25th Way. As a result, the volumes are expected to increase at NE 28th Place if the three-lane section is maintained. However, if an additional lane is added, left-turn movements onto and through movements across Sahalee Way NE would become more difficult; therefore, the traffic model shows that some trips would be diverted away from the intersection. This diversion is not possible at NE 36th Street because the properties along that roadway do not have any other nearby access points to the Corridor.

Table 6 – Warrant Evaluation Summary

Alternative	Peak Hour Minimum		Four-Hour Minimum		Hour 1		Hour 2		Hour 3		Hour 4	
	Maj	Min	Maj	Min	Maj	Min	Maj	Min	Maj	Min	Maj	Min
NE 28th Place / 223rd Avenue NE												
Existing	1100	75	800	60	1343	81	1152	88	1349	43	1381	32
2035 Three-Lane	1100	75	800	60	1928	192	1654	209	1937	102	1983	76
2035 Five-Lane	1200	80	925	60	1978	64	1697	69	1987	34	2034	25
NE 36th Street												
Existing	1100	75	800	60	1390	66	1209	82	1438	40	1497	39
2035 Three-Lane	1100	75	800	60	2218	94	1929	118	2295	57	2389	56
2035 Five-Lane	1200	80	925	60	2254	94	1961	118	2332	57	2428	56

Note: Maj – both major street approaches combined Min – higher-volume minor street approach

No Warrants met

Four-Hour Warrant met

Four-Hour and Peak Hour Warrants met

Per the MUTCD, the Peak Hour Warrant is reserved for "unusual cases" like office complexes where minor street traffic suffers undue delay from high volumes on the major street.

As Table 6 shows, the Peak Hour Warrant is met with existing AM volumes. Additionally, the Four-Hour Warrant threshold volumes are met in the AM hours currently at both intersections. However, existing volumes do not meet the Four-Hour Warrant volumes in the PM hours. By 2035, the Four-Hour Warrant is projected to be satisfied completely at the intersection of Sahalee Way NE at NE 28th Place / 223rd Avenue NE if the three-lane alternative is selected. As discussed above, volumes are projected to decrease with the five-lane alternative and the signal would not be warranted.

At the intersection of Sahalee Way NE and NE 36th Street, volumes in the AM hours will continue to meet the Four-Hour Warrant in 2035. Yet, while the PM minor street volumes are projected to come within 10% of the threshold, they will not be strictly warranted by MUTCD standards. As a result, this location is a candidate for further volume monitoring to determine if the signal becomes warranted in the future. In the interim, signal infrastructure—including junction boxes, conduits, and street light poles capable of holding signal mast arms in the future—could be installed in conjunction with the widening project. If future volumes reveal that the signal has become warranted, the installation of the mast arms and signal heads could be done with minimal interruption to the surrounding infrastructure.

An expanded warrant analysis, including the assumptions used to develop future AM volumes, is provided in Appendix I.

3.5 Level of Service Analysis

Level of service (LOS) is the primary way to define operations for segments and intersections. The computational methods for calculating LOS are included in the *Highway Capacity Manual* (HCM), published by the Transportation Research Board. The HCM defines LOS for various roadway and delay types. For this corridor, six analysis types were employed: signalized intersections, two-way stop controlled (TWSC) intersections, roundabouts, urban street segments, two-lane highways, and multilane highways.

3.5.1 Intersection Level of Service

The five study intersections were evaluated through a traffic model developed using Synchro 8, which applies HCM methodology for intersection operations. In the HCM, level of service is a function of average control delay experienced by vehicles at the intersection. The LOS thresholds and approaches included in the analysis vary based on the control type in question. Table 7 summarizes the LOS criteria by type of traffic control.

Table 7 – Intersection Level of Service Criteria

Level of Service	Average Control Delay (seconds/vehicle)		
	Signalized *(All Approaches)*	Two-Way Stop Controlled *(Worst Stop-Controlled Movement)*	Roundabout *(All Approaches)*
A	≤ 10	≤ 10	≤ 10
B	10-20	10-15	10-15
C	20-35	15-25	15-25
D	35-55	25-35	25-35
E	55-80	35-50	35-50
F	> 80	> 50	> 50

The HCM computations rely on variables that can be defined as standard values or adjusted to reflect localized conditions. The existing conditions model was calibrated to reflect the local intersection performance and select locations based on measured travel times. This process is described in depth in Appendix J. The calibrated values were added to the 2035 forecast models under the assumption that driver behavior would not substantially change in the future.

Current signal timing plans were used in both the existing and forecast models.

Figures 15, 16, and 17 present the HCM level of service at each intersection under the different design scenarios.

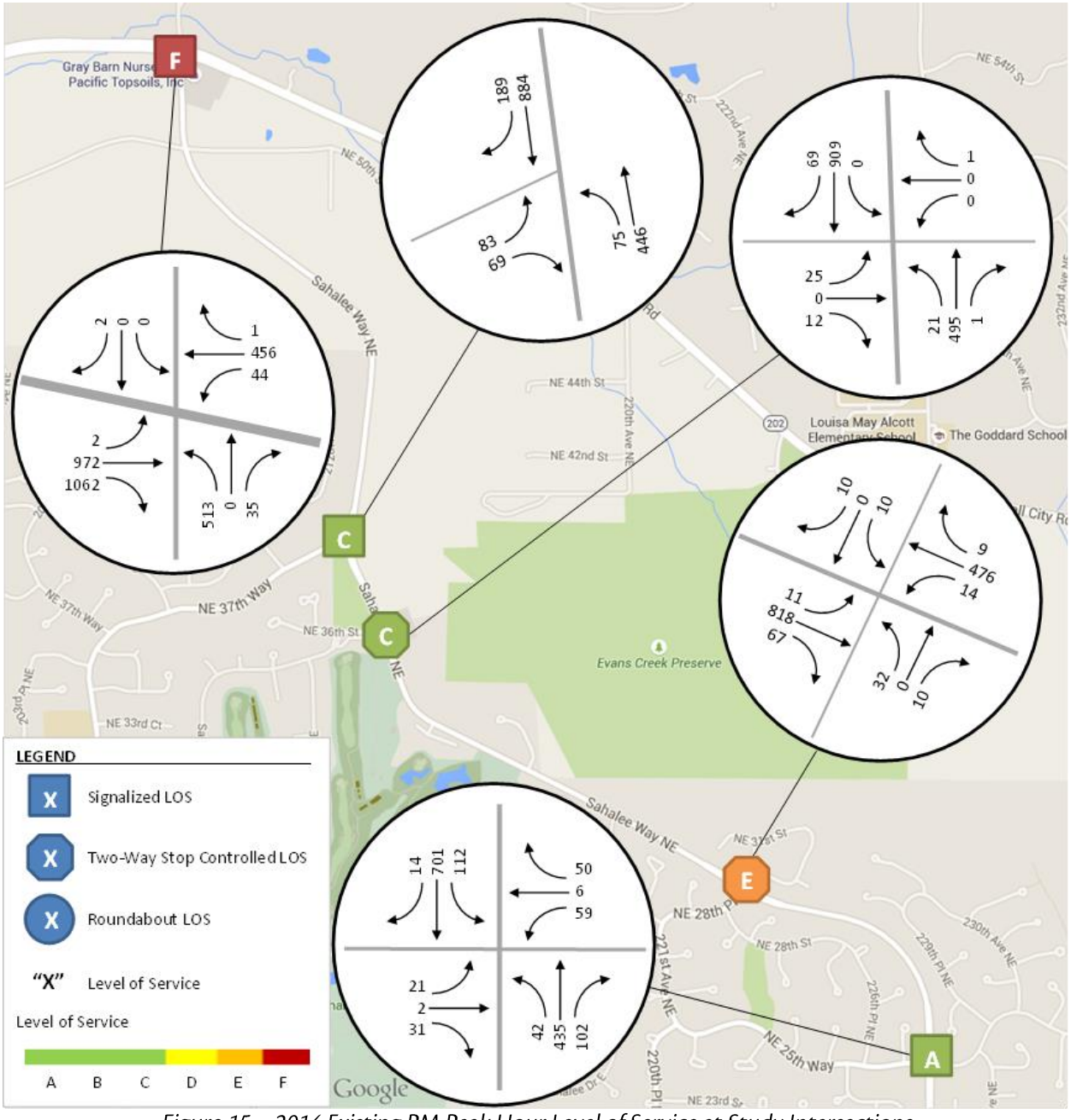

Figure 15 – 2014 Existing PM Peak Hour Level of Service at Study Intersections

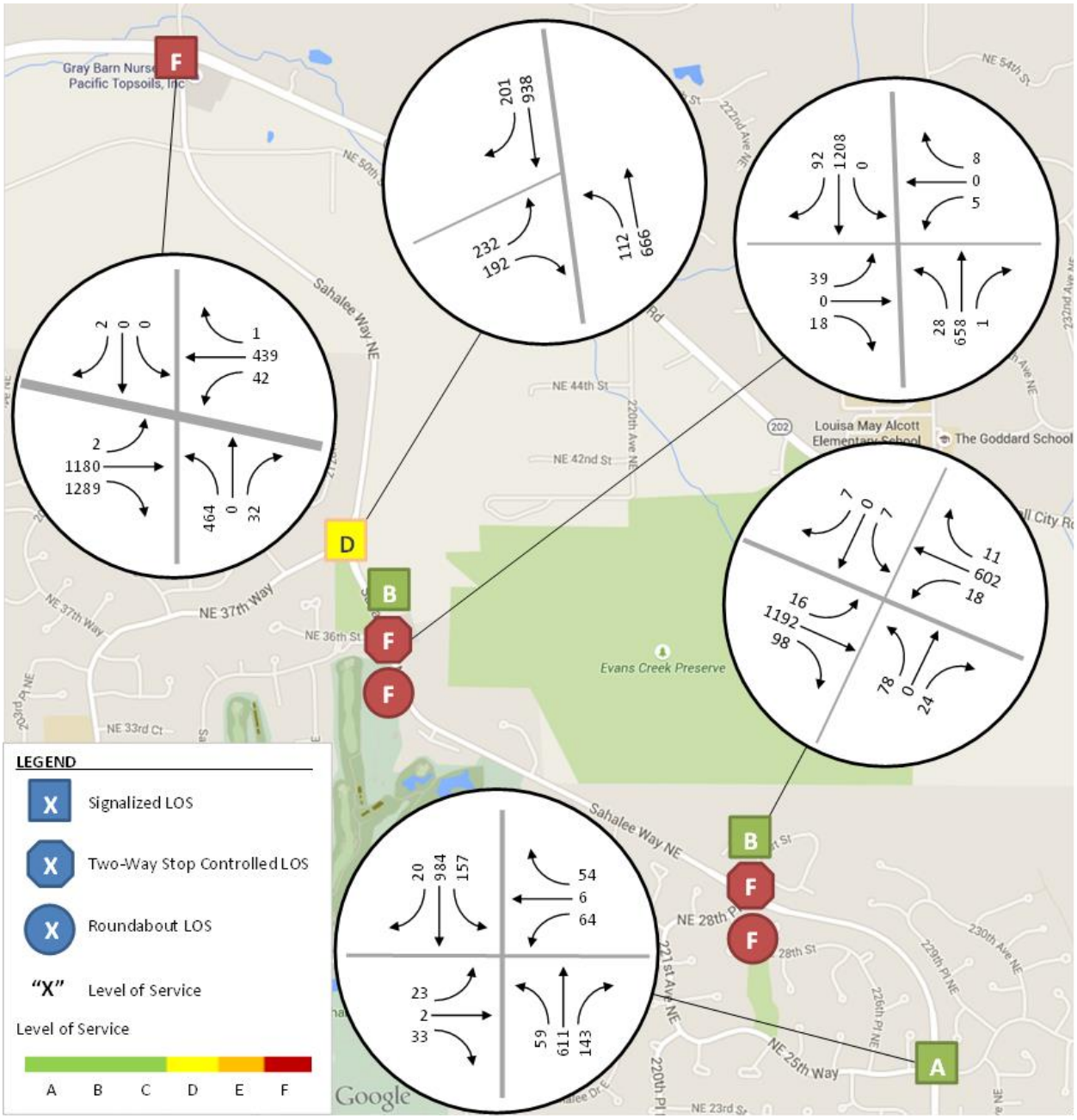

Figure 16 – 2035 Three-Lane Forecast PM Peak Hour Level of Service at Study Intersections

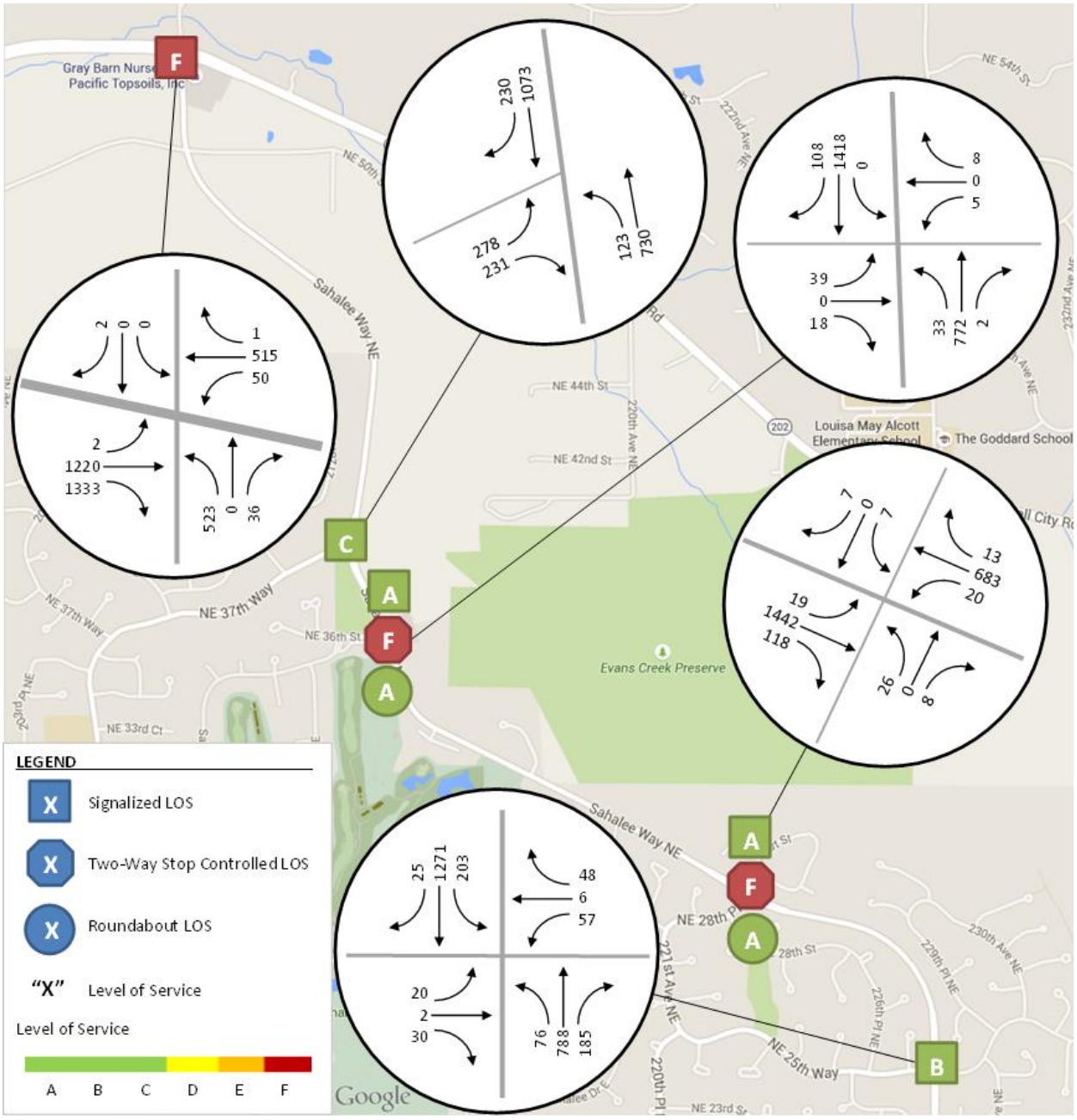

Figure 17 – 2035 Five-Lane Forecast PM Peak Hour Level of Service at Study Intersections

Table 8 provides the control delay and LOS in tabular form.

Table 8 – HCM Study Intersection Performance

Intersection	2014 Existing		2035 Three-Lane		2035 Five-Lane	
	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
SR 202 at Sahalee Way NE	156.8	F	227.7	F	275.0	F
Sahalee Way NE at NE 37th Way						
With SBR turn lane	24.9	C	39.8	D	25.6	C
Without SBR turn lane	n/a		73.5	E	32.2	C
Sahalee Way NE at NE 36th Street						
TWSC	21.6	C	66.5	F	67.4	F
Roundabout	n/a		104.3	F	9.1	A
Signal			11.8	B	4.0	A
Sahalee Way NE at NE 28th Place / NE 223rd Avenue NE						
TWSC	49.8	E	749.4	F	287.5	F
Roundabout	n/a		94.9	F	9.4	A
Signal			16.1	B	5.0	A
228th Avenue NE at NE 25th Way	7.2	A	8.6	A	12.9	B

Note: SBR – Southbound right

At all five study intersections, operations will degrade in the design year compared to existing conditions. At the design year, the five-lane section will generally see better performance than the three-lane alternative. Appendix K includes the Synchro 8 worksheets that were used for this analysis.

SR 202 at Sahalee Way NE

The intersection of SR 202 at Sahalee Way NE operates at LOS F currently and is projected to do so at the design year, regardless of alternative.

Under the three-lane option, adding a second eastbound right-turn lane with overlap phasing would reduce delay to 111.7 seconds per vehicle (LOS F). Further, also adding a second eastbound through lane would reduce delay to 61.1 seconds per vehicle (LOS E). However, because of the merge point south of SR 202, the right-turn movement could be impeded and cause backups at the intersection. This improvement is only recommended under the five-lane design because it would provide two continuous southbound travel lanes. Widening Sahalee Way NE to the west could encroach on an adjacent wetland. Widening SR 202 to provide a second through lane only at this intersection could cause congestion at a downstream merge point.

Under the five-lane option, adding a second eastbound right-turn lane with overlap phasing would reduce delay to 144.4 seconds per vehicle (LOS F). Additionally, adding a second eastbound through lane would further reduce delay to 77.1 seconds per vehicle (LOS E). Providing eastbound dual right-turn only lanes would be acceptable due to the two continuous southbound lanes that would be provided under this alternative. However, widening SR 202 to provide a second through lane could cause congestion at a downstream merge point.

In the AM peak hour, this intersection also operates at LOS F. The largest movement is the northbound left-turn from Sahalee Way NE onto SR 202. The second largest movement is the westbound through movement on SR 202. Using a "flying tee" configuration could improve morning operations.

Sahalee Way NE at NE 37th Way

Under the three-lane option, operations at this intersection will worsen to LOS D by 2035 if the right-turn lane is maintained. Without an exclusive right-turn lane, operations would degrade to LOS E. Conversely, adding one additional lane per direction would result in an average delay almost equal to existing performance in the design year, with the same level of service with or without the turn lane.

Sahalee Way NE at NE 36th Street

By 2035, operations for the west NE 36th Street approach will degrade to LOS F if two-way stop control is maintained. While the traffic model does not project large increases in minor street growth at this location, heavier traffic on Sahalee Way NE will result in fewer gaps for turning movements, resulting in a higher delay of over one minute per vehicle in the PM peak hour.

Installing a roundabout would increase delay under the three-lane alternative and reduce delay under the five-lane option. With the three-lane configuration, the roundabout would have a single circulating lane. Single-lane roundabouts perform best when the ratio of major-street to minor-street volumes is low enough that gaps develop to allow movements from the minor street. Under the five-lane option, more frequent gaps would be provided and the intersection would operate at LOS A. Installing a traffic signal (that would also control movements into and out of the Northeast Sammamish Sewer and Water District driveway across from NE 36th Street) would result in LOS B and LOS A at the intersection under the three-lane and five-lane configurations, respectively.

Sahalee Way NE at NE 28th Place / NE 223rd Avenue NE

By 2035, operations for the minor street approaches at NE 28th Place / NE 223rd Avenue NE will have degraded significantly. Delays at this location will exceed over 10 minutes per eastbound vehicle if the three-lane option is chosen. The large delay difference between 2035 alternatives is a function of different forecast volumes, as travel behavior shifts may prompt more users to access the Corridor via the intersection at NE 25th Way.

Installing a roundabout would improve operations in both alternatives. However, the location would still function at LOS F under the three-lane option because the roundabout will be restricted to a single lane. Under the five-lane alternative, the roundabout could support two lanes, resulting in a LOS A. Single-lane roundabouts perform best when the ratio of major-street to minor-street volumes is low enough that gaps develop to allow movements from the minor street. Here, because Sahalee Way NE through volumes are so high, few gaps will develop if the corridor only provides one lane per direction. Roundabout performance would improve under the five-lane alternative due to less dense traffic and more frequent gaps. Installing a signal would improve the operations to LOS B and A for the three-lane and five-lane options, respectively.

228th Avenue NE at NE 25th Way

This intersection operates well currently and will see minor delay increases over the next twenty years, regardless of the cross section selected. The effect of adding additional lanes is less important at this location because it will only impact the southbound movement. Like at SR 202, the primary difference in performance between the options is a result of changes in forecast traffic volumes.

The outputs shown in Table 8 assume that the current signal timing plans remain in effect, regardless of changes in volumes. Synchro 8 includes a traffic signal timing optimization feature that will theoretically assign the most efficient phase durations to an intersection. This optimization was performed at each signalized study intersection to provide a comparison. Table 9 provides those results.

Table 9 – HCM Study Intersection Performance with Optimized Timings

Intersection	Existing Timing Plan				Optimized Timing Plan			
	2035 Three-Lane		2035 Five-Lane		2035 Three-Lane		2035 Five-Lane	
	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
SR 202 at Sahalee Way NE	227.7	F	171.7	F	171.6	F	165.5	F
Sahalee Way NE at NE 37th Way	39.8	D	25.6	C	35.2	D	20.3	C
Sahalee Way NE at NE 36th Street	n/a				11.8	B	4.0	A
Sahalee Way NE at NE 28th Place / NE 223rd Avenue NE	n/a				15.9	B	5.0	A
228th Avenue NE at NE 25th Way	8.6	A	12.9	B	8.6 [1]	A	11.1	B

[1] Synchro could not produce a timing plan more efficient than the existing timing plan.

As Table 9 shows, timing plan modifications would improve performance at all study intersections except 228th Avenue NE at NE 25th Way under the three-lane alternative. However, these improvements would not improve any level of service designations. At NE 28th Place / NE 223rd Avenue NE and NE 36th Street, the outputs in Table 8 and Figures 16 and 17 are based off on an optimized timing plan; there is no existing plan.

3.5.2 Urban Street Segment Level of Service

The *Highway Capacity Manual* details multiple analysis methods that can be used to assess segment performance and level of service. This analysis reviewed three different tools: urban street segments, two-lane highways, and multilane highways. Urban Street Segment (USS) analysis was employed along the Corridor between NE 25th Way and NE 37th Way because traffic in these areas is affected by signalized intersections and not impacted by significant grades. Per the HCM, USS should be used if signals are spaced less than 2 miles apart.

However, the HCM recognizes that a deficiency of USS LOS is that it does not incorporate any effect of steep grades on travel flow. Observations of the Corridor north of NE 37th Way note that heavy vehicles impact the travel flow due to the 10% grade for approximately 0.75 miles. In order to accurately model this segment of the Corridor, two-lane highway and multilane highway analysis tools were used in place of urban street segments. In addition, the two-lane highway analysis can model the impact of adding an uphill climbing lane. These assessments are detailed later in this chapter.

For a given segment, the USS LOS is a comparison of travel speed to the base free-flow speed. Travel speed through the segment includes the time it takes to drive between the segment termini and the through-movement control delay imposed by an intersection at the endpoint. For example, the analysis of the segment bounded by NE 36th Street and NE 37th Way in the northbound direction includes the time it takes for an average driver to move between the two intersections as well as the delay experienced at the NE 37th Way signal.

Similar to the intersection LOS metrics, the segment LOS scale ranges from A to F. Table 10 summarizes the segment USS LOS criteria.

Table 10 – Urban Street Segments Level of Service Criteria

Level of Service [1]	Travel Speed as a Percentage of Base Free-Flow Speed (%)
A	> 85
B	67-85
C	50-67
D	40-50
E	30-40
F	≤ 30

[1] Applicable if segment boundary intersection volume-to-capacity (v/c) ratio ≤ 1.0; LOS F for all speeds when v/c > 1.0

The 2014 Existing, 2035 Three-Lane, and 2035 Five-Lane PM peak hour models were evaluated using USS LOS. For this analysis, the intersections of Sahalee Way NE at NE 28th Place / 223rd Avenue NE and Sahalee Way NE at NE 36th Street were assumed to be signalized for the 2035 alternatives. Under each alternative, the Corridor was subdivided into segments, with each endpoint at a signalized intersection. Table 11 provides the outputs of this analysis. As noted above, performance between NE 37th Way and SR 202 was not modeled using USS LOS and is not included in Table 11.

Table 11 – PM Peak Hour HCM Urban Street Segment Performance

Segment	2014 Existing		2035 Three-Lane		2035 Five-Lane	
	Travel Speed v. Base Free-Flow Speed	USS LOS	Travel Speed v. Base Free-Flow Speed	USS LOS	Travel Speed v. Base Free-Flow Speed	USS LOS
Northbound						
NE 25th Way to NE 28th Place / 223rd Avenue NE	98%	A	89%	A	91%	A
NE 28th Place / 223rd Avenue NE to NE 36th Street	90%	A	95%	A	96%	A
NE 36th Street to NE 37th Way			43%	D	53%	C
Southbound						
NE 37th Way to NE 36th Street	84%	B	46%	D	76%	B
NE 36th Street to NE 28th Place / 223rd Avenue NE			76%	B	92%	A
NE 28th Place / 223rd Avenue NE to NE 25th Way	93%	A	93%	A	85%	B

As Table 11 shows, all segments evaluated under the USS tool operate at or above LOS D. In 2035, the segment with the lowest average travel speed as a percentage of base free-flow speed is between NE 37th Way and NE 36th Street. Under the three-lane alternative, this operates with LOS D. Under the five-lane option, this operates at LOS C in the northbound direction and LOS B in the southbound.

In general, travel speeds decrease slightly in the 2035 modes as compared to existing. This is due to higher traffic volumes and vehicle density. Similarly, the 2035 five-lane model has higher travel speeds as compared to the three-lane model because of less dense travel lanes. Appendix L contains detailed USS calculations.

3.5.3 Two-Lane and Multilane Highway Level of Service

As discussed above, HCM two-lane and multilane highway analyses were used to evaluate the Corridor between NE 37th Way and SR 202. Five scenarios were evaluated:

1. 2014 Existing,
2. 2014 Existing with truck climbing lane,
3. 2035 Three-Lane,
4. 2035 Three-Lane with truck climbing lane, and
5. 2035 Five-Lane.

With Scenarios 3 and 4, the "third" lane is a striped or landscaped median in City of Sammamish and is not used in King County (see the Roadway Design chapter). The same is true for the "fifth" lane in Scenario 5.

The LOS for the first four scenarios was computed using the two-lane highway LOS analysis, found in Chapter 15 of the HCM. The final scenario was tested using the multi-lane highway LOS analysis from Chapter 14. The two-lane analysis method has different LOS criteria based on the class of the highway being studied. The Corridor north of NE 37th Way is considered a Class II highway because it meets the criteria established in the HCM of serving "the beginning or ending portions of longer trips." For Class II two-lane highways, LOS is a function of the percentage of time-spent-following (PTSF), which translates to the freedom for drivers to maneuver behind slower-moving vehicles. Multilane highways have levels of service that are functions of free-flow speed (FFS) and vehicle density; classification is not considered. Table 12 relays the LOS thresholds from the *Highway Capacity Manual*.

Table 12 – Two-lane and Multilane Highway Level of Service Criteria

Level of Service	Two-Lane Class II Highway	Multilane Highway	
	PTSF (%)	FFS (mph)	Density (pc/mi/ln)
A	≤ 40	All	> 0 – 11
B	> 40 – 55	All	> 11 – 18
C	> 55 – 70	All	> 18 – 26
D	> 70 – 85	All	> 26 – 35
E	> 85	60 55 50 45	> 35 – 40 > 35 – 41 > 35 – 43 > 35 – 45
F	n/a	60 55 50 45	> 40 > 41 > 43 > 45

Scenarios 2 and 4 include a truck climbing lane for southbound traffic travelling uphill. This climbing lane would allow for heavy vehicles to use the right lane to travel up the hill, creating an opportunity for general purpose traffic to pass trucks or buses on the left side.

Calculations of these levels of service can be found in Appendix M. The results of this are summarized in Table 13, below. Additionally, Table 13 includes the average travel speed (ATS) for the two-lane highway calculations. While this metric does not determine LOS for Class II highways, it is still useful for evaluating how quickly traffic is moving in each scenario.

Table 13 - Two-Lane and Multilane Highway Analysis Summary

Two-Lane Highway Scenario	**Southbound (Uphill)**			**Northbound (Downhill)**		
	ATS (mph)	PTSF (%)	LOS	ATS (mph)	PTSF (%)	LOS
2104 Existing	37.7	92.1	E	48.8	69.5	C
2014 Existing with Climbing Lane	42.9	22.0	A			
2035 Three-Lane	37.2	93.5	E	48.5	67.4	C
2035 Three-Lane with Climbing Lane	42.3	22.4	A			
Multilane Highway Scenario	**Southbound (Uphill)**			**Northbound (Downhill)**		
	Density (pc/mi/ln)		LOS	Density (pc/mi/ln)		LOS
2035 Five-Lane	17.01		B	6.72		A

As Table 13 shows, drivers travelling uphill in the southbound direction are frequently forced to wait behind other vehicles. The installation of a climbing lane between SR 202 and NE 37th Way would reduce delays due to slower moving vehicles and increase overall average travel speeds by 5 miles per hour based on current and 2035 traffic volumes. While platooning is frequent in the northbound direction, it is still at a high speed; the average travel speed exceeds the posted speed limit. Installing two continuous travel lanes per direction between SR 202 and NE 37th Way would result in LOS B for the uphill direction and LOS A for the downhill direction.

Note that unlike the USS LOS calculations, the values shown in Table 13 do not include delays imposed by the traffic signals at NE 37th Way or SR 202. Additionally, while the level of service jump from LOS E to LOS A is substantial, it is only applicable over the length of the truck climbing lane. This length—approximately 3100 feet—includes only the steepest portion of the uphill between SR 202 and NE 37th Way. See Chapter 2 for more detail.

3.6 Corridor Travel Times

The *Highway Capacity Manual* does not directly model segment travel times. However, based on the outputs from the USS, two-lane highway, and multilane highway analyses, travel times can be derived for the length of the Corridor. Table 14 summarizes the travel times between NE 25th Way and SR 202 by design alternative. Note that the control delay from the traffic signal at SR 202 is not included in this calculation for the southbound direction. Similarly, the control delay at NE 25th Way is not included in the calculation for the northbound direction. Detailed travel time calculations are provided in Appendix N.

Table 14 – Corridor Travel Time Comparison

Design Elements	Northbound			Southbound		
	2014 Existing	2035 Three-Lane	2035 Five-Lane	2014 Existing	2035 Three-Lane	2035 Five-Lane
Base Travel Time	273.5	290.9	286.0	235.1	256.9	227.7
Traffic Signal at NE 28th Place / 223rd Avenue NE	n/a	+4.2	+3.2	n/a	+20.2	+5.5
Traffic Signal at NE 36th Street		+3.4	+2.7		+15.0	+4.0
Upgrade SR 202		0 to -22.4	0 to -23.2		n/a	
Install Climbing Lane		n/a			-6.9	n/a

Note: All times listed in seconds

The top row in Table 14 reveals that northbound travel times will increase by less than 10% from 2014 to 2035 for both the Three- and Five-Lane alternatives. In the southbound direction, travel times will rise by approximately 10% if the three-lane option is selected and fall by 3% if the five-lane option is chosen.

The design options that are detailed above impact the travel time for northbound and southbound through traffic on the Corridor. The installation of traffic signals at NE 28th Place / 223rd Avenue NE and/or at NE 36th Street would increase travel time for the major street in order to improve the mobility of minor street traffic. The travel time increases for these improvements would be larger on southbound traffic due to higher travel volumes in that direction during the PM peak hour.

A range of values is shown in Table 14 for the Upgrade SR 202 alternative due to different signal timing plans that could be adopted in conjunction with the addition of eastbound lanes. If the lanes are added but the signal timing does not change, then delay will not be reduced for northbound NE Sahalee Way traffic. However, if the timing plan is modified to shift some of the existing eastbound green time to the northbound movement, then delays could improve by over 20 seconds per northbound vehicle.

The installation of a truck climbing lane under the three-lane alternative would improve southbound travel times by 6.9 seconds per vehicle in the PM peak hour. Travel time savings would be greater for vehicles that would otherwise be trapped behind a southbound truck, while cars that would otherwise be unimpeded would see almost no benefit. This improvement is not applicable under the five-lane alternative and would not improve northbound travel times or speeds.

3.7 Conclusions

The intersection of Sahalee Way NE and SR 202 currently operates at LOS F in the PM peak hour. The worst minor-street approach (eastbound) at the intersection of Sahalee Way NE and NE 28th Place / 223rd Avenue NE currently operates at LOS E. All other study intersections operate at LOS C or above.

Existing left-turn phasing along the Corridor matches warranted treatments.

Peak Hour traffic signal warrants are met today at both candidate intersections: Sahalee Way NE at NE 28th Place / 223rd Avenue NE and Sahalee Way NE at NE 36th Street. However, the Peak Hour Warrant is reserved for developments like office complexes that only have one hour of high-volume traffic per day. At NE 28th Place / 223rd Avenue NE, 2035 volumes in the three-lane model are projected to meet the Four-Hour Warrant, while volumes in the five-lane model are not. At NE 36th Street, minor street volumes will come within four vehicles per hour of meeting the Four-Hour Warrant in the 2035 design year, regardless of lane configuration.

By 2035, volumes will increase throughout the Corridor, resulting in higher control delays at all study intersections. If the three-lane design alternative is selected, the intersections at SR 202, NE 36th Street (if unsignalized), and NE 28th Place / 223rd Avenue NE (if unsignalized) would have LOS F. At NE 37th Way, the LOS would degrade slightly to LOS D. Signalizing Sahalee Way NE at NE 28th Place / 223rd Avenue NE or Sahalee Way NE at NE 36th Street would improve operations to LOS B.

The five-lane alternative results in 2035 levels of service one letter grade better at NE 37th Way, NE 36th Street (if signalized), and NE 28th Place / 223rd Avenue NE (if signalized) compared to the three-lane option. Additionally, the roundabout options at NE 36th Street and NE 28th Place / 223rd Avenue NE are projected to perform at LOS A because a two-lane roundabout can be accommodated and process traffic more efficiently.

Alternatives are available to improve operations at the intersection of Sahalee Way NE and SR 202.

Segment performance under the *Highway Capacity Manual*'s Urban Street Segment analysis shows that performance with current conditions will roughly match both the three-lane and five-lane options by 2035. All segments within the City of Sammamish will operate at LOS D or better in 2035.

Between NE 37th Way and SR 202, southbound traffic operates at LOS E due to steep grades that slow heavy vehicles thus metering general purpose traffic. Installation of a truck climbing lane in this direction would allow for vehicles to pass and result in operations at LOS A. Northbound traffic would be unchanged by the installation, continuing to operate at LOS C. Conditions in 2035 are similar to existing and would have the same LOS designation if the three-lane alternative is selected. If the five-lane option is chosen, southbound traffic would operate at LOS B while northbound would operate at LOS A according to the multilane highway analysis in the HCM.

With higher volumes in the 2035 design year, corridor travel times will be slightly higher than existing, unless the 2035 five-lane option is picked (which would decrease southbound times only). Installation of traffic signals at the candidate intersections would increase travel times but allow for better mobility at cross streets. Installation of a climbing lane would reduce 2035 PM peak hour travel times by 6.9 seconds per southbound vehicle. Modification to the signal at SR 202 would alter travel times, but the magnitude of the effects is controlled by the State.

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