Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)

TECHNICAL SUMMARY REPORT

December 2009

Shea, Carr & Jewell, Inc.
Parametrix, Inc.

Lacey Transportation Systems Analysis
and Alternatives Evaluation (LTSAAE)

Technical Summary Report

Project Information

Project: Lacey Transportation System Analysis and Alternatives Evaluation (LTSAAE)

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Lacey Transportation Systems Analysis
and Alternatives Evaluation (LTSAAE)

Technical Summary Report

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The undersigned parties concur with the findings of this technical summary report as follows:

- Travel demand model output distributions assume I-5 mainline improvements are required. Therefore, I-5 widening is included in the "Baseline" scenario.
- The study shows that several intersections will operate at unacceptable levels of service under the 2030 "Baseline" scenario. The baseline scenario includes all planned improvements for the study area under currently proposed land use assumptions. Therefore, it was warranted to consider and evaluate additional local surface street improvements.
- Hence, the Stakeholder Group developed three groups of alternatives of increasing amounts of local surface street improvements (described as Alternatives A, B, and C.) The operational analysis of these groups of improvements does show surface street operational improvement, but no combination of evaluated alternatives was shown to provide acceptable levels of service throughout the study area for the projected 2030 traffic demand.
- Therefore, the Stakeholder Group concluded it was warranted to evaluate the existing I-5 interchanges within the study area. Several options for improvements to the Sleater-Kinney, Martin Way, and Marvin Road interchanges were considered and evaluated. Many of the considered options showed improved operations within the study area, but no combination of planned surface street improvements and interchange improvements was shown to provide acceptable levels of service throughout the study area for the projected 2030 traffic demand.
- Therefore, a preliminary consideration of the addition of a new interchange with I-5 at Carpenter Road was considered by the Stakeholder Group. This analysis indicates that a new interchange at Carpenter Road may provide regional traffic benefit by distributing traffic away from the already congested interchanges at Martin Way and Marvin Road.
- Because no combination of improvements studied in the analysis provides acceptable levels of service throughout the study area, further evaluations of options is warranted to include, but not limited to, the following:
    - Further study of local surface street interconnections within the study area, as well as to abutting regions of the study area.
    - Consideration of more significant improvements or modifications to the existing Sleater-Kinney, Martin Way, and Marvin Road interchanges to be implemented prior to the addition of any new access to I-5.
    - Consideration of the need to increase capacity along I-5 within the study area, by adding mainline capacity in the form of general purpose lanes, auxiliary lanes, or collector-distributor lanes.
    - Consideration and evaluation of the feasibility and potential benefit of adding an interchange with I-5 within the study area.

Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)

Technical Summary Report

Signature Page, continued

STAKEHOLDER ACCEPTANCE

City of Lacey

Signature

DIRECTOR OF PUBLIC WORKS

Title

12/17/09

Date

WSDOT – Olympic Region

Signature

ARA for PROJECT DEVELOPMENT

Title

12-17-2009

Date

WSDOT – Access and Hearings

Signature

ACCESS & HEARINGS MGR

Title

12/17/2009

Date

WSDOT HQ Project Development

Signature

Asst. State Design Engineer

Title

12/17/09

Date

FHWA

Signature

Area Engineer

Title

12/21/2009

Date

Thurston Regional Planning Council

Signature

Senior Planner

Title

13 Dec 2009

Date

Note: Participation on the Stakeholder team and/or signing of this document does not constitute approval of study findings or recommendations.

Table of Contents

Appendices (Appendices B through F are available on disc - enclosed)

EXECUTIVE SUMMARY

Background

This report documents the results of a transportation study started in August 2006 for the Lacey area including Interstate 5 from Nisqually to Sleater-Kinney Road. The objective of this study is to identify future roadway deficiencies and to identify a range of potential projects to improve the operations of the local street and freeway system in the study area. A Stakeholder Group including representatives from the City of Lacey, Thurston County, WSDOT, FHWA and TRPC was assembled to oversee and direct the LTSAAE study.

Existing and Projected Traffic Conditions

Within the study area existing 2007 and "Baseline" 2030 conditions were established. The 2030 "Baseline" included all transportation improvements from the Thurston Regional Planning Council model for areas outside the City of Lacey UGA, and included all improvements from the six-year Transportation Improvement Programs (TIPs) for the City of Lacey and Thurston County for areas inside the City of Lacey UGA. The following roadway improvements are representative of the assumed improvements for the 2030 horizon:

- Carpenter Road widening – Britton Parkway to Pacific Avenue;
- College Street Extension – from 6th Ave NE to 15th Ave NE;
- Constructing interim Martin Way Interchange improvements;
- Britton Parkway widening – Marvin Road to Carpenter Road;
- Constructing roadway grid in Hawks Prairie Business District including an east-west Main Street and three north-south roadways connecting Main street and Britton Parkway;
- Construction of Phase 2 of the Marvin Road Interchange (a Single Point Urban Interchange)

The Existing 2007 condition shows congestion points at Martin Way/Interstate 5 interchange and Martin Way between Interstate 5 and Sleater-Kinney Road. The "Baseline" 2030 condition shows Interstate 5 to be very congested as well as the interchanges at Sleater-Kinney Road, Martin Way, and Marvin Road. Several local road intersections within the study area are also congested.

Given the high levels of congestion shown in the "Baseline" 2030 condition, additional improvements are required within the study area to accommodate future traffic growth.

Analyses and Findings

Given the operational deficiencies identified for the 2030 "Baseline" condition, additional improvements were incrementally considered to improve operations. The

following building block approach was taken to identify potential roadway improvements:

Evaluate Additional Network Improvements to Surface Streets

Three alternative levels of progressively increasing levels of surface street improvements were evaluated and presented to the Stakeholder Group at a meeting on March 31, 2008. At that meeting the Stakeholder Group agreed the surface street improvements evaluated will not accommodate future traffic demand in the study area and additional improvements should be considered.

Evaluate Improvements to Existing Interstate 5 Interchanges

On April 16, 2008 the Stakeholder Group held a design workshop to brainstorm potential improvements to existing interchanges to further mitigate identified congestion in 2030. The various options were evaluated and screened over the course of several Stakeholder Group meetings to determine which options would be carried forward for detailed analyses.

Detailed level of service analyses for improvements to existing interchanges was prepared and presented to the Stakeholder Group on November 25, 2008. The analyses showed improvements to existing interchanges cannot reasonably fully mitigate identified congestion in 2030. The Stakeholder Group determined that evaluating a new interchange access to Interstate 5 in the study area would serve as a meaningful comparison to highly complicated options for improvements to the Marvin Road interchange.

Evaluate a new interchange at Carpenter Road

There are future capacity constraints for each of the arterials serving as existing access points to Interstate 5. The development planned for the City of Lacey and Thurston County generates a level of traffic that cannot be served by planned improvements or additional improvements evaluated for both the local street system and the existing interchanges combined.

Carpenter Road was identified as a potential location for a new interchange with Interstate 5. This interchange would provide additional access into the north-central Lacey area, and it would redistribute trips away from congested corridors at Marvin Road, Martin Way, and College Street and congested interchanges at Marvin Road and Martin Way.

Regional Improvement Scenario

After the building-block approach described above to evaluate improvements within the study area, the *Regional Improvement Scenario* was developed using qualitative cost-benefit judgment as a representative combination of improvement options to mitigate congestion identified for 2030. The *Regional Improvement Scenario* includes (1) "Baseline" 2030 improvements, (2) additional surface street improvements, (3) interchange improvements at Sleater-Kinney Road, Martin Way, and Marvin Road, and (4) a new interchange at Carpenter Road. The following

describes the improvements to existing interchanges and the new interchange at Carpenter Road, and the subsequent six graphics show conceptual geometric layout for these interchanges for the *Regional Improvement Scenario*. Concept level cost estimates for the improvements are shown in Table ES-1 broken down by phases - Preliminary Engineering (PE), Right-of-Way (RW), and Construction (CN). The PE Phase includes all design and environmental work to bring a project to bid advertisement.

Sleater-Kinney Road Interchange

Revise the SB I-5 ramp terminal/Sleater-Kinney Road intersection to allow traffic exiting SB I-5 to turn left onto northbound Sleater-Kinney Road (Option 2A Modified).

Martin Way Interchange

Construct a partial cloverleaf (Option 5) or a Single Point Urban Interchange (SPUI) (Option 6/6A) to mitigate the delays caused by the heavy left-turn volumes from Martin Way to the on-ramps.

Marvin Road Interchange

Construct the planned Phase 2 SPUI configuration with a southbound I-5 slip-ramp to Hogum Bay Road (Option 14), and a southbound I-5 off-ramp to the Hawks Prairie Business District (HPBD) (Option 10A-1).

New Carpenter Road Interchange

Construct a modified diamond at Carpenter Road with the northbound off-ramp configured as a loop ramp and a frontage road connecting Marvin Road and Carpenter Road along the north (west) side of I-5.

TABLE ES-1. CONCEPT COST ESTIMATES FOR THE REGIONAL IMPROVEMENT SCENARIO (Millions)

Interchange	PE Phase	RW Phase	CN Phase	TOTAL
Sleater-Kinney	$0.2-0.4	$0.2-0.4	$1.0-1.2	$1.4-2.0
Martin Way	$1.5-2.0	$1.1-1.5	$12-15	$14-18
Carpenter Road	$2-3	$2-3	$19-23	$23-29
Marvin Road	$6-7	$2-3	$52-62	$60-72
I-5 Auxiliary Lanes	$2-3	$0	$14-17	$16-20
TOTALS				$115-$141

Next Steps

This report demonstrates improvements to surface streets are not sufficient to mitigate 2030 congestion. The report further demonstrates improvements to existing interchanges are not sufficient to reasonably mitigate 2030 congestion. Accordingly, the report evaluates options for a new interchange at Carpenter Road to further mitigate the 2030 congestion in the study area. The report concludes it is warranted to advance the study of improvements to existing interchanges and the study of a new interchange at Carpenter Road to the Interchange Justification Reports (IJR) stage. Study during preparation of IJRs will analyze the solutions

presented in this report in more detail to determine which improvements should advance to the design phase.

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SCALE IN FEET

Option 2A
Sleater Kinney Northbound Connection
Figure 16

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Option 5
Martin Partial Clover
Figure 17

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N

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Carpenter - Marvin C/D Braid South
Sheet 1 of 5
Figure 18

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Carpenter - Marvin C/D Braid South
Sheet 2 of 5
Figure 1

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Carpenter - Marvin C/D Braid South
Sheet 3 of 5
Figure

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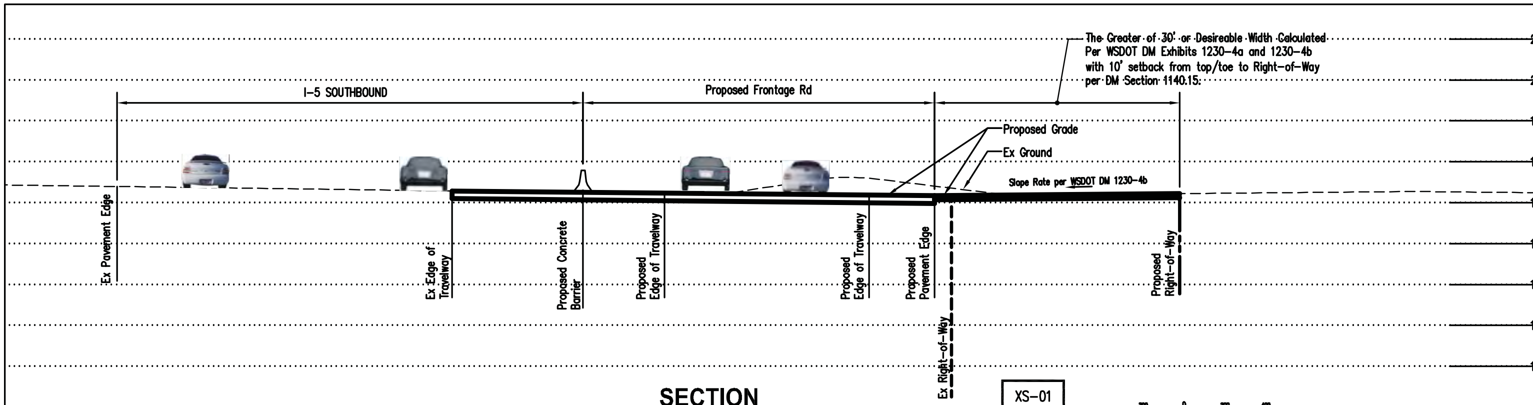
Carpenter - Marvin C/D Braid South
Sheet 4 of 5
Figure 1



SECTION

I-5 AND FRONTAGE IMPROVEMENTS
BETWEEN EXIT 110 AND EXIT 111
LACEY, WA
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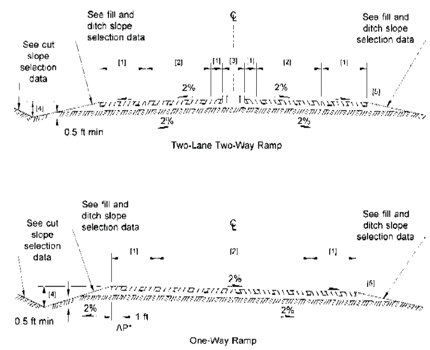
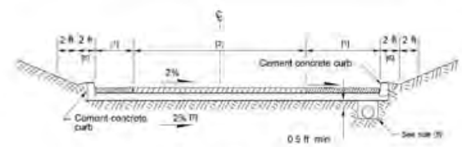
XS-01
SHT 2



*AP = Angle point in the subgrade

Note:
For applicable notes, dimensions, and slope selection tables, see Exhibit 1230-4b.

Ramp Roadway Sections
Exhibit 1230-4a



Special Design

This special design section may be used when restrictions (high right of way costs or physical features) make construction difficult or costly.

Height of fill/depth of ditch (ft)	Slope not steeper than[9]
0 – 10	6H:1V
10 – 20	4H:1V
20 – 30	3H:1V[9]
over 30	2H:1V[9][11]

Fill and Ditch Slope Selection

Height of cut (ft)*	Slope not steeper than
0 – 5	6H:1V
5 – 20	3H:1V
over 20	2H:1V[10]
* From bottom of ditch	

Cut Slope Selection[12]

Notes:

[1] For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder widths, see Chapter 1360.

[2] For minimum ramp lane widths, see Chapter 1360. For turning roadway widths, see Chapter 1240. For two-way ramps, treat each direction as a separate one-way roadway.

[3] The minimum median width of a two-lane two-way ramp is not less than that required for traffic control devices and their respective clearances.

[4] Minimum ditch depth is 2 feet for design speeds over 40 mph and 1.5 feet for design speeds of 40 mph or less. Rounding may be varied to fit drainage requirements when minimum ditch depth is 2 feet.

[5] Widen and round foreslopes steeper than 4H:1V, as shown in Exhibit 1230-5b.

[6] 2-foot widening and rounding may be omitted when slopes are 4H:1V or flatter.

[7] Subgrade may slope to the left if the left edge is in embankment.

[8] Provide drainage unless one edge of the roadway is in embankment or subject material is free draining. Method of drainage pickup is to be determined by the designer.

[9] Where practicable, consider flatter slopes for the greater fill heights and ditch depths.

[10] Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)

[11] Fill slopes as steep as 1½H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)

[12] The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.

Ramp Roadway Sections
Exhibit 1230-4b

Jan 04, 2010 2:12:48pm – User susanh
H:\PROJECTS\0805 PMX SUBCONSULTANT AGREEMENTS\805-04 LACEY TRANS. SYSTEMS ANALYSIS & EVAL\PHASE 01 – CARPENTER ROAD INTERCHANGE\CA

SHEA - CARR - JEWELL

Carpenter - Marvin C/D Braid South
Sheet 5 of 5
Figure

INTRODUCTION

The *Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)* is a detailed study started in August 2006 of the arterial and highway network and future traffic demand in the Lacey area from the Sleater-Kinney/I-5 interchange to the Nisqually/I-5 interchange.

Background

The City of Lacey began planning for significant industrial, commercial and residential growth in the early 1980s. The City's Comprehensive Plan established the land use designations and identified the needed transportation facilities. The population and employment projections for the City of Lacey predicted that significant growth would occur and that the transportation facilities in place would not be able to adequately serve the new growth.

Current traffic levels on both the local and interstate systems have grown significantly over the past ten years, and this growth trend is expected to continue in Lacey and Thurston County. Preliminary travel forecasts indicate that several of the primary arterials (Marvin Road, Martin Way, and Carpenter Road) will experience increases in traffic levels up to a 100% on selected roadway segments by 2030. The projected traffic levels are also expected to affect the interstate system as well: forecasts from the regional travel demand model predict a 50% to 75% increase in volumes on freeway segments and significant increases in ramp volumes at most interchanges serving the Lacey area.

This growth has been anticipated for more than 20 years, and the City has invested significant resources in planning and developing the local transportation infrastructure to help accommodate this growth. Specific examples include:

- Widening of Marvin Road to a four/five-lane section between Willamette Parkway and Pacific Avenue including the installation of three multi-lane roundabout intersections;
- Improving College Street via several projects to improve capacity and operations between Martin Way and Lacey Boulevard;
- Constructing Britton Parkway, a new east-west arterial between Marvin Road and Carpenter Road north of Interstate 5;
- Improving Sleater-Kinney via several projects to improve capacity and operations between Interstate 5 and Pacific Avenue;
- Rebuilding and widening the Marvin Road/Interstate 5 diamond interchange with a planned future Phase 2 to convert the diamond configuration to a "single-point urban interchange" (SPUI);
- Constructing the Pacific Avenue/Lacey Boulevard one-way couplet between Golf Club Road to Homann Drive.

Each of these projects was completed in the early 2000s and is expected to reach the design-year traffic levels within the next five to six years. The City is planning to improve several other arterials and intersections to help alleviate the current traffic conditions on City roadways and anticipated near-term growth patterns. However, even with these other local improvements, traffic flow and access to the interstate system are expected to be constrained to unacceptable service levels.

Project Charter and Assumptions

The LTSAAE is a partnership between the City of Lacey, the Washington State Department of Transportation (WSDOT), the Federal Highway Administration, and the Thurston Regional Planning Council (TRPC). A Stakeholder Group was organized with members of each of the agencies listed. A project charter was prepared and agreed upon by the Stakeholder Group that established the parameters and procedures for conducting the LTSAAE study. Additionally, an assumptions document was put in place to guide analysis for the future Interchange Justification Report (IJR) process. The project charter and assumptions document are included in Appendix B.

Project Study Area

The study area includes the I-5 corridor from the Sleater-Kinney Road interchange (Exit 108) to the Martin Way-Nisqually interchange (Exit 114). The study area also includes primary surface streets and intersections between Sleater-Kinney Road and Marvin Road that serve as feeders to/from Interstate 5 or as alternate routes. The study area and existing transportation network are shown on Figure 1.

Study Objectives

The primary objectives of the study are:

- Refine the Thurston Regional Planning Council (TRPC) travel demand model for the Lacey area in order to predict the future traffic conditions for the local and interstate systems;
- Assess and analyze the adequacy of the future arterial street system;
- Assess and analyze the adequacy of the existing interstate facilities, including each interchange;
- Identify, evaluate, and compare potential improvement strategies based on established performance criteria and environmental considerations; and
- Establish a reasonable package of potential improvements to allow the local surface street, freeway, and interchange system to accommodate future year 2030 traffic projections in the study area.

Evaluation Process

The study evaluated the existing roadway network in the study area to identify existing deficiencies. The study initially evaluated the future year scenarios under "Baseline" conditions. The 2030 "Baseline" scenario includes all transportation improvements built into the 2030 TRPC model for the areas outside the Lacey Urban Growth Area (UGA). Within the Lacey UGA, the 2030 "Baseline" scenario includes

improvements on the current City of Lacey and Thurston County Six-Year Transportation Improvement Programs (TIPs).

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Study Area

Figure 1

Study Area

Transportation Systems Analysis and Alternatives Evaluation

Once roadway deficiencies were identified, additional facility improvements were incrementally considered. This building block approach to identifying potential roadway improvements is described below:

- Identify existing 2007 conditions;
- Evaluate projected 2030 “Baseline” conditions; then
- Consider additional network improvements to surface streets (projects taken from the City of Lacey and Thurston County Comprehensive Transportation Plans or new projects not identified on a current plan).

If all reasonable alternatives and improvements to the street network were exhausted, the study could proceed to:

- Evaluate improvements to existing Interstate 5 access points (interchanges); and
- Explore potential new access points to Interstate 5.

2007 AND 2030 "BASELINE" OPERATING CONDITIONS

The 2007 and 2030 "Baseline" conditions were presented to the Stakeholder Group in a technical memorandum dated February 29, 2008, entitled Lacey Transportation Systems Analysis and Alternatives Evaluation – 2007 and 2030 Baseline Analysis. The technical memorandum is attached in Appendix C. The results of the baseline analysis are summarized in this section.

Existing (2007) Traffic Conditions

Existing Roadway Network

Interstate 5

Interstate 5 runs in its entirety from Canada to Mexico and is the main north-south route through western Washington. In the study area, the interstate is a divided highway with three through lanes in each direction. The study area includes undercrossings at Meridian Road, Carpenter Road, College Street and the following four interchanges:

- Nisqually (Martin Way) Interchange (Exit 114)
  The Nisqually Interchange operates as a modified diamond. The southbound on-ramp from Nisqually Cut-off Road operates as an unsignalized tee intersection. The southbound off-ramp is a flyover ramp that intersects Martin Way at a four-way signalized intersection that also serves Nisqually Cut-off Road and the northbound on-ramp. The northbound off-ramp intersects Nisqually Cut-off Road at an unsignalized intersection located between Martin Way and the Interstate 5 mainline.

- Marvin Road Interchange (Exit 111)
  The Marvin Road Interchange is a diamond configuration with a 6-lane under-crossing and signalized ramp terminals for the northbound and southbound ramps. The Marvin Road/Interstate 5 interchange was designed for completion in two phases. Phase One improvements resulted in the current diamond configuration. Phase Two includes future conversion to a Single Point Urban Interchange (SPUI) configuration. No schedule has been established for completion of Phase Two.

- Martin Way Interchange (Exit 109)
  The Martin Way Interchange is a diamond configuration with a 5-lane over-crossing and traffic signals for the northbound and southbound ramps terminals. There is currently a plan in place to widen Martin Way under the freeway to 6 lanes. The additional lane would be used to allow side-by-side storage of the left-turn lanes for traffic entering the northbound and southbound on-ramps.

- Sleater-Kinney Road Interchange (Exit 108)
  The Sleater-Kinney Road Interchange is a partial cloverleaf with a 6-lane under-crossing. Both ramp terminals at Sleater-Kinney Road are unsignalized. The northbound off-ramp provides three options. The first option is access to southbound Sleater-Kinney Road. The second is a loop ramp that provides access to northbound Sleater-Kinney Road. The third is an extended ramp that connects to 3rd Avenue SE and provides access to College Street. There is no on-ramp access to northbound I-5 from Sleater-Kinney Road. The southbound loop off-ramp provides access to southbound Sleater-Kinney Road but no access to northbound Sleater-Kinney Road.

Major North-South Roadways

The primary north-south roadways in the study area include:

- Sleater-Kinney Road
- College Street
- Carpenter Road
- Marvin Road (SR 510)
- Meridian Road
- Willamette Drive
- Hogum Bay Road
- Draham Road

Major East-West Roadways

Roadways in the area that run primarily in an east-west direction include:

- Hawks Prairie Road
- Britton Parkway
- Orion Drive
- 15th Avenue NE
- Martin Way
- 6th Avenue SE
- Pacific Avenue

Existing Traffic Volumes

Existing AM and PM turning movement counts were collected for the study intersections over 2006 and 2007. WSDOT Traffic Data Office provided the average 2006 AM and PM mid-week peak hour traffic volumes on the I-5 mainline for ADC R060 (permanent traffic recorder located between Marvin Road and Martin Way). Counts collected in 2006 were increased by 4% to represent 2007 base year conditions. These 2007 traffic volume counts were then used for the existing year analysis and as the basis for preparing the 2030 traffic volume projections.

Future Traffic Conditions

Future Land-Use

TRPC has prepared a 2030 model scenario that includes the Office of Financial Management (OFM) adopted household and employment projections for Thurston

County. The 2030 scenario includes all roadway improvements identified in the current Thurston County Regional Transportation Plan (RTP). For this analysis, the 2030 model has been enhanced to include additional detail specific to the City of Lacey. These enhancements involve the addition of traffic analysis zones in the Gateway Town Center area of the Hawks Prairie Business District. Additional household and employment has been added in the Hawks Prairie Business District to reflect the projected land-use identified in the Lacey Gateway Town Center Master Plan.

Future Land-Use Comparison

The land-use projections used for this study reflect the intense growth for the Lacey UGA, specifically the area north of Interstate 5. The area has already experienced a significant amount of residential and employment growth and is projected to continue to grow at a rate higher than the rest of the county.

2030 "Baseline" Network

This study evaluated the existing roadway network in the study area to identify existing deficiencies. The future year scenarios were initially evaluated under "Baseline" conditions. The 2030 "Baseline" condition includes all transportation improvements built into the 2030 TRPC model for the areas outside the Lacey UGA. Within the Lacey UGA, improvements on the current City of Lacey and Thurston County Six-Year Transportation Improvement Programs (TIPs) were included.

Traffic Model Enhancements

The base year 2007 and 2030 regional Emme/2 model from TRPC from early 2008 was used as the basis for 2030 traffic forecasts for the study roadways and intersections. The 2030 TRPC model includes all regional roadway and intersection improvements in the current adopted RTP. Within the study area, the following improvements have been included in the 2030 "Baseline" roadway network:

- Widening Carpenter Road from 2 to 4 lanes – Britton Parkway to Pacific Avenue;
- Constructing College Street Extension (1 lane each direction) from 6th Ave NE to 15th Ave NE;
- Constructing interim Martin Way Interchange improvements. This project involves widening Martin Way at the I-5 ramp terminals to increase left-turn storage for the high volume left-turn operation to the on-ramps;
- Widening Britton Parkway from 2 to 4 lanes, Marvin Road to Carpenter Road;
- Constructing roadway grid in Hawks Prairie Business District. The basic network includes:
    - A new east-west roadway (Main Street) connecting Marvin Road and Carpenter Road between I-5 and Britton Parkway, and
    - Three new north-south roadways connecting Main Street and Britton Parkway;
- Construction of Phase 2 of the Marvin Road Interchange (a Single Point Urban Interchange).

Enhancements to the regional model were implemented to better reflect new development and traffic circulation trends for the Hawks Prairie Area. These include:

Gateway Area Enhancements

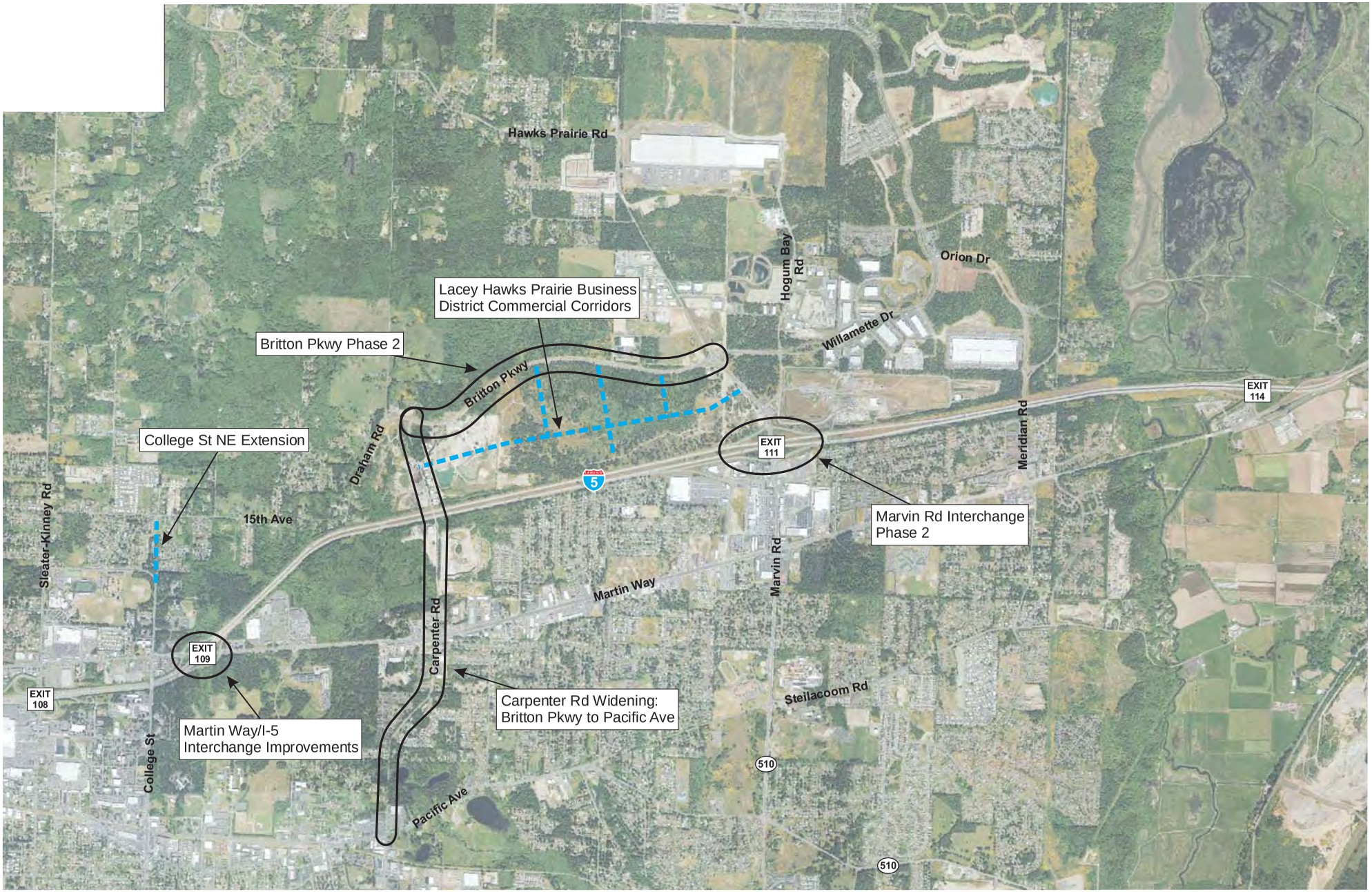
The 2030 model was enhanced to include additional detail for the Lacey Gateway Town Center area, generally bounded by Interstate 5, Britton Parkway, Carpenter Road and Marvin Road. Ten Traffic Analysis Zones (TAZs) were added to the 2030 model to represent the Lacey Gateway Town Center, and population and employment estimates from the currently proposed master plan were built into the model, replacing the previous estimates for the TAZs in that specific area.

The "backbone" roadway network for the Lacey Gateway Town Center area was also built into the enhanced 2030 model, including the new east-west Main Street and three north-south roadways between Main Street and Britton Parkway.

Freeway Segment Enhancements

Forecasted volumes for 2030 far exceed local roadway and freeway system capacity. This constraint significantly impacts travel demand flow and trip assignments in the 2030 model. This skews the results making it difficult to identify deficiencies and solutions. Therefore, in addition to the localized surface street improvements, the travel forecasts were developed assuming one additional general purpose lane in each direction on I-5 between Nisqually and Sleater-Kinney Road. The widening of Interstate 5 through the study area allows the traffic model to distribute regional and local traffic in a more predictable manner. Therefore, the additional capacity lanes provide a means to assess the sensitivity of this improvement and define a more realistic travel forecast and future-year model volumes.

The roadway improvements added to the network and assumed to be in place for the 2030 baseline scenario are shown on Figure 2.



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2030 Baseline Roadway Network Improvements

Figure 2
2030 Baseline Roadway Improvements
Transportation Systems Analysis and Alternatives Evaluation

Model Post-Processing

While the model is calibrated to replicate existing travel patterns, traffic volumes on individual roadways may vary somewhat from existing traffic counts. To account for this variance, the transportation model traffic volume assignments were "post-processed" to align them with existing "ground counts." Specifically, the traffic volume growth predicted by the transportation model was added to the actual 2007 traffic volumes to prepare the 2030 AM and PM peak hour traffic volumes used in the analysis.

The resultant future 2030 AM and PM peak hour "Baseline" traffic volumes are provided in the attached Baseline Technical Memorandum.

Capacity Analysis

The Existing 2007 and Projected 2030 "Baseline" conditions were analyzed to establish existing conditions and projected deficiencies. The 2030 "Baseline" will be used as the basis for comparison of potential improvement scenarios.

Analysis Parameters

Intersection Operations Analysis

The following software was selected for the operations analysis of surface street intersections:

- Synchro 7.0 software for analysis of signalized surface street and ramp terminal intersections operations;
- The Highway Capacity software (HCS) for analysis of unsignalized intersections, including ramp terminals;
- Version 3.2 of the SIDRA software package for analysis of roundabout controlled intersections in the study area; and
- SimTraffic for queuing and turn lane spillover analysis.

Study intersections selected by the project team were analyzed during the AM and PM peak hours.

Year 2007 existing conditions analysis was based on traffic volumes collected in the study area since 2005. Peak hour factors (PHF) and heavy vehicle percentages used in the analysis reflect the conditions of each approach as observed during the turning movement count. For the 2030 scenario, the PHF values of 0.95 were used for all signalized intersections and 0.92 for all unsignalized intersections. Heavy vehicle percentages were increased by 2.0 percent for intersections in the Hawks Prairie area north of Interstate 5 for the 2030 design year.

Freeway Operations Analysis

Highway Capacity Software (HCS) was used to analyze all unsignalized ramp terminals and to validate the merge/diverge connections on all ramps. Vehicle speed and density were used as performance measures for the HCS analysis.

Level of Service Criteria

Roadway and intersection deficiencies were categorized as those facilities that are currently operating or are projected to operate below the adopted level of service (LOS) standard. WSDOT has set an LOS threshold of D for Interstate 5. The City of Lacey has adopted LOS D as the concurrency standard for much of the study area and LOS E for the "downtown core" (defined as the area between and including Martin Way, Lacey Boulevard, the western City limits and Carpenter Road).

Local Street Network Analysis Results

The intersection analysis results are presented in the 2007 and 2030 Baseline Analysis Technical Memorandum. The following is a summary of the key findings:

Sleater-Kinney Road – College Street Corridors

This area includes the Sleater-Kinney Road interchange (Exit 108) and Martin Way interchange (Exit 109). It also includes the Martin Way/College Street intersection which is the busiest intersection in Thurston County. The 2030 analysis includes the extension of College Street to 15th Avenue NE creating a new 'tee' intersection. The analysis also includes additional left-turn lane capacity on Martin Way at the I-5 northbound and southbound ramp terminals.

The following are notable congestion points within the study area:

- The Sleater-Kinney Road/Martin Way intersection operates near capacity during the evening peak hour;
- The southbound I-5 on-ramp from Sleater Kinney Road occasionally backs up to 6th Avenue SE during the evening peak hour;
- The Martin Way/College Street intersection and Martin Way interchange ramp junctions generate queues that impact upstream intersections. Eastbound and westbound left-turn queues on Martin Way between the ramp terminals frequently exceed the available storage capacity;
- Eastbound queuing on Martin Way at College Street occasionally extends to the upstream traffic signal at Kasey Keller Drive; and
- Queuing on the southbound off-ramp at Martin Way occasionally backs up to the Interstate 5 mainline.

With the increase in traffic expected by the 2030 horizon, the operation of the Interstate 5/Martin Way interchange and Martin Way/Sleater-Kinney Road intersection degrade to the point that it affects the flow of most of the other intersections within the area.

Carpenter Road Corridor

This area includes the study intersections along Carpenter Road between Martin Way and Britton Parkway. Under current conditions, each intersection operates acceptably during the morning and evening peak hours.

In the 2030 scenario Carpenter Road has been assumed to be widened to a 5-lane roadway between Pacific Avenue (south of the study area) and Britton Parkway. Britton Parkway has been widened to 2 lanes in each direction. The Martin Way/Carpenter Road intersection reflects planned improvements that involve implementing a dual left-turn lane operation eastbound and westbound on Martin Way and widening the northbound and southbound approaches of Carpenter Road to include two through lanes and exclusive left-turn lanes.

In the 2030 horizon, significant traffic growth is anticipated for Carpenter Road between Martin Way and Britton Parkway. PM peak hour flows are projected to increase from 430 vehicles per hour (vph) (total both directions) to 3,640 vph. Much of the new traffic will use the new Main Street/Carpenter Road intersection to access the Lacey Gateway Town Center area.

The increased traffic loadings will result in a poor LOS and operation at the Martin Way/Carpenter Road intersection in both the AM and PM peak hours. Eastbound queuing at this intersection would occasionally extend several thousand feet toward the Martin Way interchange. In addition, the increase in traffic will result in the need for intersection upgrades at Britton Parkway/Carpenter Road and Draham Road/Carpenter Road.

Marvin Road Corridor

This area includes the Marvin Road interchange (Exit 111), which serves as the main interstate access to the northeast part of the City, the eastern parts of Thurston County south of the City, and the City of Yelm. Under current conditions, the intersections and roadways function acceptably during the morning and evening peak periods.

The 2030 analysis includes conversion of the Marvin Road interchange to a Single Point Urban Interchange (SPUI). The SPUI is the phase 2 improvement identified in the Interstate 5/Marvin Road IJR approved in 1998. The 2030 scenario also includes improvements to the Main Street/Marvin Road intersection.

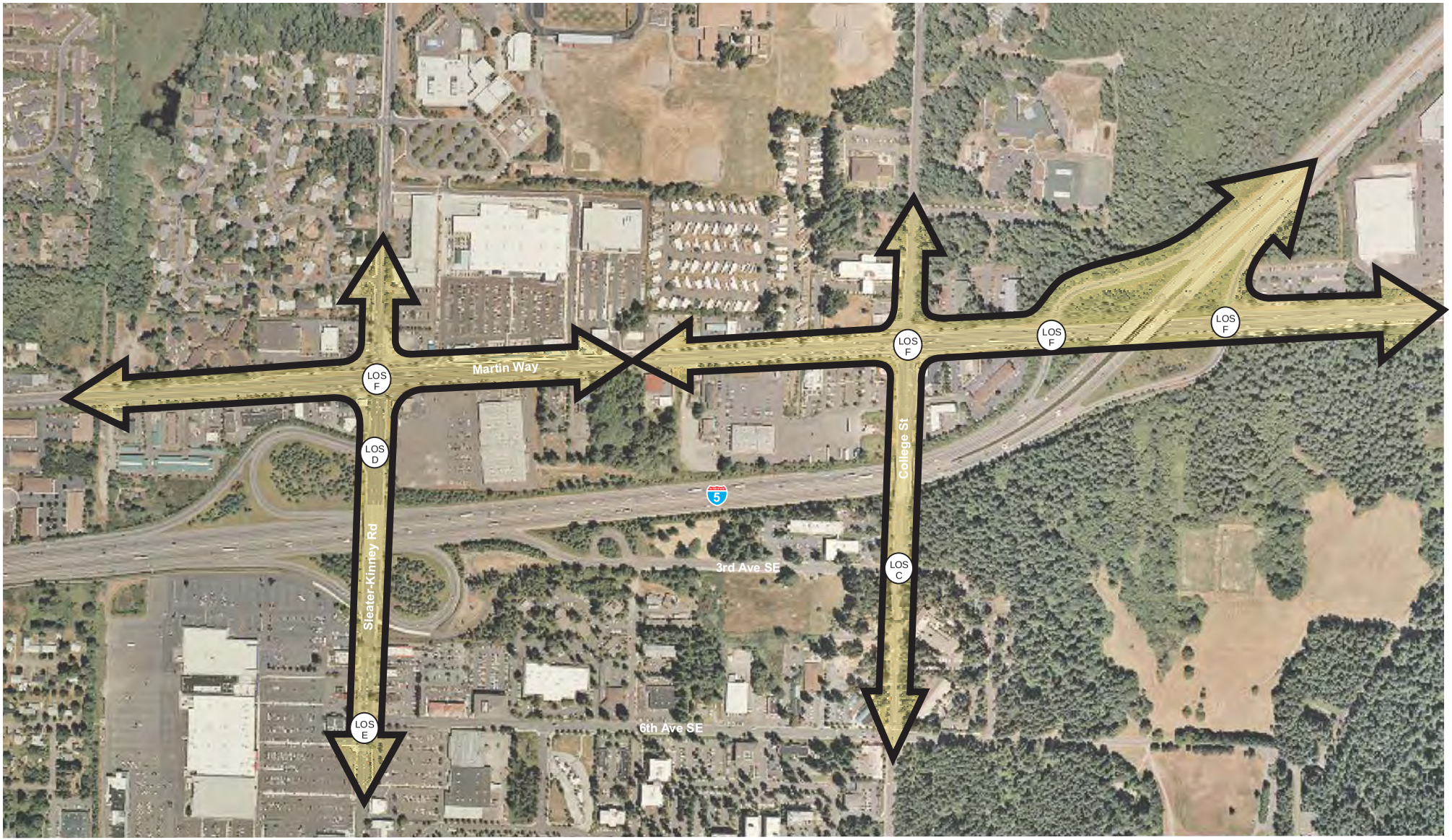
Traffic flows are predicted to increase significantly on the roadways north of Interstate 5 and at the Marvin Road interchange. Currently, between Interstate 5 and Hogum Bay Road, Marvin Road serves approximately 2,000 vehicles during the evening peak hour (total of northbound and southbound movements). For the 2030 scenario that volume is projected to increase to 6,500 peak hour vehicles with an average daily traffic approaching 70,000 vehicles per day on this segment.

Based on the projected traffic flows, the Phase 2 Single Point Urban Interchange would not function acceptably during the morning or evening peak periods. Also, each of the signalized and modern roundabout intersections would be over capacity along the Marvin Road corridor.

Nisqually Interchange

This area includes the Nisqually Interchange (Exit 114) at the eastern terminus of Martin Way. The intersections currently operate at acceptable levels during the AM and PM peak hours. However, under the 2030 scenarios, the signalized intersection at the I-5 northbound on-ramp/southbound off-ramp at Martin Way will degrade to an LOS F condition during both the AM and PM periods as a result of the significant increase in traffic using the Interstate 5 ramps to/from the north.

The results of the 2030 baseline analysis are shown graphically on Figures 3 and 4.



SHEA CARR JEWELL Inc.

2030 Baseline
Areas of Congestion and Queuing
Sleater-Kinney Road and College Street Vicinity

Figure 3
2030 Baseline Queuing Graphic
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation

SHEA CARR JEWELL Inc.

2030 Baseline
Areas of Congestion and Queuing
Marvin Road and Carpenter Road Vicinity

Figure 4
2030 Baseline Queuing Graphic
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation

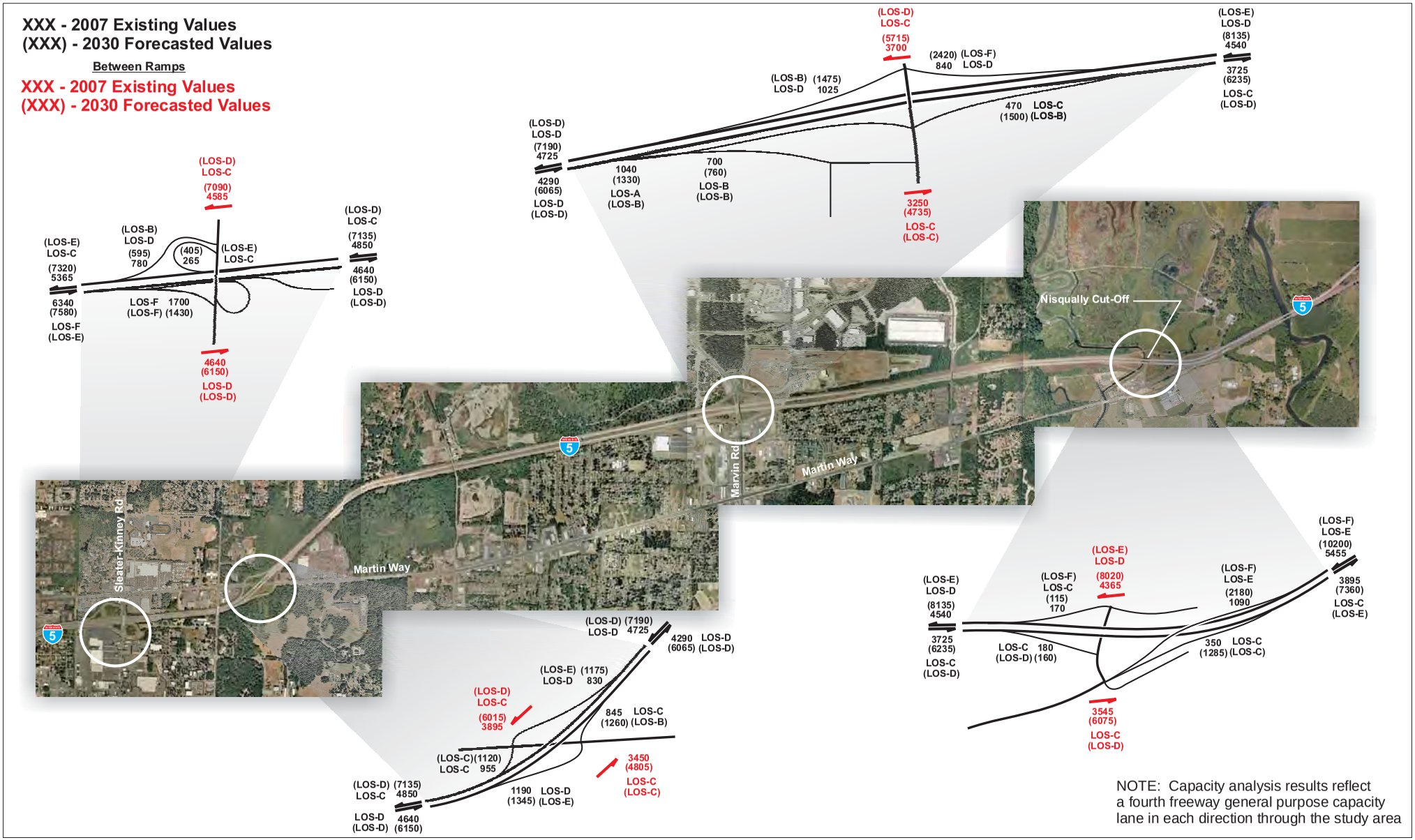
Freeway Mainline and Ramp Analysis Results

The mainline Interstate 5 segments and interchange ramps merge and diverge areas were analyzed using the methodologies outlined in Sections 24 and 25 of the Highway Capacity Manual. The results are presented in terms of level of service and are based on the density of vehicles using the facilities. The analysis is provided for AM and PM peak hour conditions for the existing 2007 and projected 2030 scenarios.

The 2030 freeway segment and ramp analysis includes one additional general purpose lane in each direction between Sleater-Kinney Road and the Nisqually River Bridge. In some instances this has resulted in lower overall vehicle densities at the merge and diverge points and an improvement in the projected ramp operation. The existing 2007 and projected 2030 freeway mainline and ramp merge/diverge volumes and levels of service are shown on Figure 5.

Baseline 2030 Analysis Summary

The results of the analysis show that with the current transportation improvement plans for the study area, several intersections will degrade to unacceptable operations by the 2030 horizon. The "Baseline" analysis results were presented to the Stakeholder Group at a meeting on March 4, 2008. After reviewing and discussing the "Baseline" analysis, it was determined by the Stakeholder Group that the study should proceed to analyzing potential surface street improvement options.



I-5 Mainline and Ramp PM Peak Hour Volumes
and Level of Service
With Additional Freeway Capacity

Figure 5
I-5 Mainline and Ramp Volumes & Analysis
Preliminary 2007 & 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation

SURFACE STREET IMPROVEMENT ALTERNATIVES

Previous analysis described current roadway and intersection operations at all key locations within the study area. Predicted conditions for the "Baseline" 2030 horizon were also prepared, and many future deficiencies were identified on facilities in the study area. Notable deficiencies included the Martin Way corridor between Sleater-Kinney Road and the Martin Way/Interstate 5 interchange and Marvin Road from Martin Way to Britton Parkway.

The Stakeholder Group was tasked with identifying potential surface street improvements that could help alleviate the predicted congestion along those corridors and the rest of the study area. An extensive list of roadway and intersection improvements was proposed by the Stakeholder Group that was taken forward for analysis.

Analysis of the surface street improvement alternatives was described for the Stakeholder Group in a Technical Memorandum dated March 26, 2008, titled Lacey Transportation Systems Analysis and Alternatives Evaluation – 2030 Surface Street Improvement Scenario Testing. The technical memorandum is attached in Appendix D. The results of surface street improvement analysis detailed in the technical memorandum are summarized in this section.

Surface Street Alternative Groupings

The Stakeholder Group identified approximately 15 improvements for potential analysis. The proposed improvements were screened and grouped into three alternative packages to be built into the transportation demand model. The full list of proposed improvements is provided below.

Alternative A

- Bowker Street Extension – new roadway from 7th Avenue to Desmond Drive
- Hoh Street Extension – new roadway from Martin Way to Steilacoom Road
- Non-motorized Interstate 5 over-crossing in vicinity of Stillwell, Whisler and Horne Streets – from Martin Way to Main Street
- Meridian Road Upgrades (increase capacity and structure to accommodate increased truck traffic) – from Martin Way to Willamette Drive
- Draham Road NE/15th Avenue NE widening to four lanes – from Carpenter Road to Sleater-Kinney Road
- Hogum Bay Road Upgrades (increase structural and geometric capability of roadway to accommodate truck traffic) – from Marvin Road to Hawks Prairie Road
- Slip ramp access from I-5 southbound off-ramp directly to Hogum Bay Road
- NE Lacey (Hawks Prairie) Interconnecting Roadways – commercial collector grid between Hogum Bay Road and Carpenter Road north of I-5

Alternative B

- Alternative A improvements plus the following
- 15th Avenue Extension – new roadway from Sleater-Kinney Road to Lilly Road
- College Street Extension – new roadway from 15th Avenue NE to future 26th Avenue Connector
- 26th Avenue Connector – new roadway from Marvin Road to Sleater-Kinney Road
- 31st Avenue Extension – new roadway from Hogum Bay Road to Marvin Road in vicinity of future 26th Avenue Connector

Alternative C

This scenario was added for comparative purposes; however, in the initial screening process it was determined that disruption to an existing neighborhood may prohibit implementation.

- Alternative A and B improvements plus the following
- Vehicular Interstate 5 under-crossing in vicinity of Stillwell, Whisler and Horne Streets – Martin Way to Main Street

Surface Street Improvement Analysis Methodology

The traffic volume projections for Alternatives A, B and C were prepared using the same methodology used for the "Baseline" 2030 traffic assignments. The improvement packages were incrementally added to the 2030 baseline model scenario. Each alternative builds on the previous alternative; the improvements in Alternative A were added to the baseline and model assignments were prepared. Then Alternative B was added and additional assignments were prepared; lastly, the improvement in Alternative C was added.

Surface Street Improvement Options Summary

The LTSAAE study area was analyzed for projected 2030 conditions with a series of potential surface street improvements. The proposed intersection and roadway projects each provide circulation benefits within their own localized area. Some of the improvements also provide regional benefit and result in lower overall congestion levels.

Alternative A

Alternative A improves the regional circulation by providing additional local access connections and enhancing east-west mobility north of Interstate 5. The critical Martin Way/Interstate 5 and Marvin Road/Interstate 5 interchanges receive only marginal benefit. Under Alternative A, additional improvements would be required to accommodate future traffic loadings in the area.

Alternative B

Alternative B significantly improves traffic circulation within the Hawks Prairie area and enhances the east-west connections presented in Alternative A. However, as with Alternative A, the critical Martin Way/Interstate 5 and Marvin Road/Interstate 5

interchanges receive only marginal benefit. Under Alternative B, additional improvements would be required to accommodate future traffic loadings in the area.

Alternative C

Alternative C provides an additional reduction in traffic flows on Carpenter Road and Marvin Road. The reduction in traffic on Marvin Road could provide improvement to the function of the Marvin Road/Interstate 5 interchange. However, the traffic flows at the Martin Way/Interstate 5 interchange are reduced only 6 percent from baseline conditions. Under Alternative C additional improvements would be required to accommodate future traffic loadings in the area.

Surface Street Analysis Summary

The information described in this section was presented to the Stakeholder Group at a meeting on March 31, 2008. At that meeting it was agreed that the surface street improvement alternatives would not accommodate the projected traffic demand at many study intersections, and therefore it was warranted to evaluate improvements to existing interchanges.

EXISTING INTERCHANGE IMPROVEMENT OPTIONS

The next step in evaluating congestion mitigation for the study area was to consider potential improvements to the existing interchanges.

Interchange Improvement Options Considered

On April 16, 2008, the Stakeholder Group held a design workshop to brainstorm potential interchange improvements to address the existing and projected congestion problems at the study interchanges. The various options were evaluated to determine which options would be carried forward for further analysis. The following is a list of the improvement scenarios identified by the Stakeholder Group for screening.

Sleater-Kinney Road Interchange

- Option 1) Tight diamond with frontage roads to Martin Way
- Option 2) Tight diamond and partial cloverleaf in NW quadrant
- Option 2A) Roundabout at existing southbound terminal
- Option 2B) Northbound collector-distributor to Martin Way
- Option 2C) Southbound on-ramp from Martin Way
- Option 3) Partial cloverleaf in NW and SE quadrants
- Option 4) SPUI

Martin Way Interchange

- Option 5) Partial cloverleaf in NW and SE quadrants
- Option 5A) Southbound bypass loop ramp
- Option 5B) Southbound bypass flyover ramp
- Option 5C) Northbound bypass flyover ramp
- Option 5D) Southbound slip ramp to College Street
- Option 6) SPUI – With realignment of Martin Way
- Option 6A) SPUI – With existing alignment of Martin Way (to minimize modifications to existing bridges)

Marvin Road Interchange

- Option 10) New overcrossing and braided ramps
- Option 10A) southbound collector-distributor (C/D) from Marvin Road to Carpenter Road
- Option 11) New undercrossing and northbound left off- / on-ramps
- Option 12) Northbound off/on flyover ramps
- Option 13) New undercrossing – Galaxy Drive extension
- Option 14) Direct southbound off-ramp to Hogum Bay Road
- Option 14A) Flyover ramps to Hogum Bay Road

Nisqually Interchange

No improvements were identified for this location. There is not a significant increase in traffic volumes projected for the Nisqually area, and most of the traffic growth at this interchange is attributed to diversion of traffic from Interstate 5 due to congestion on I-5 and at downstream interchanges.

Conceptual layouts of the interchange options listed above are provided in Appendix E.

Demand Modeling Scenarios

Of the 21 improvement options listed above, many have similar circulation characteristics but different geometric designs. For purposes of travel demand modeling, one volume scenario per each unique circulation pattern was prepared. For example, 5A and 5B both provide a direct access from southbound I-5 to southbound College Street. While the geometry and operational function could be quite different, they would both provide a similar connection in terms of travel demand modeling. Therefore, one traffic volume scenario was created to approximate both geometric options. Additionally, some options were refined (Modified) as the Stakeholder Group moved from screening to evaluation.

The following traffic volume scenarios were prepared for this evaluation:

Sleater-Kinney Road Interchange

- Option 2A (Modified) – Roundabout at existing southbound terminal plus add a southbound I-5 to northbound Sleater-Kinney Road off-ramp
- Option 2A (Modified) and 2B (Modified) – Option 2A (Modified) and Option 2B Northbound collector-distributor to Martin Way plus add a Sleater-Kinney Road to northbound I-5 on-ramp

Martin Way Interchange

- Option 5B – Southbound I-5 to southbound College Street flyover off-ramp
- Option 5C – Northbound College Street to northbound I-5 flyover on-ramp
- Option 5B plus 5C

Marvin Road Interchange

- Option 12 – Northbound off/on flyover ramps
- Option 10A – Northbound collector-distributor from Martin Way or Carpenter Road and southbound collector-distributor road to Carpenter Road
- Option 10A (Modified) – Option 10A with access to Lacey Gateway Town Center
- Option 13 – New undercrossing; Galaxy Drive Extension
- Option 14 – Direct southbound off-ramp to Hogum Bay Road
- Option 14A – Flyover ramps to Hogum Bay Road

The initial review of these scenarios involved producing street and interstate mainline "link" volume comparisons to identify which scenarios provided significant shifts in traffic flows to the benefit of the deficient corridors (Marvin Road, Martin Way and Carpenter Road). The link volume comparisons are provided in Appendix F.

Operational Analysis

Scenarios

The Stakeholder Group reviewed the link volume comparisons and it was requested that additional analysis be provided for comparison between scenarios. PM peak hour turning movement volumes and intersection operational analyses were prepared for selected improvement scenarios involving the Marvin Road and Martin Way interchanges. The intersection analysis was prepared for primary intersections at the two interchanges and along the Marvin Road, Carpenter Road, and Martin Way corridors.

The scenarios that were identified for this level of operational analysis are listed below. The Marvin Road scenarios include further refinements to interchange Option 10A made by the Stakeholder Group as the study progressed from evaluation to scenario comparison.

Sleater-Kinney Road Interchange

Sleater-Kinney Road Interchange options were not included in this round of analysis. However, the most feasible improvement was determined to be a southbound I-5 to northbound Sleater-Kinney Road off-ramp. That improvement was included in the "Baseline" for all subsequent scenarios.

Martin Way Interchange

- Option 6/6A – SPUI option
  NOTE: For successive scenarios (except Option 5) the Martin Way SPUI was assumed in place for operational analysis
- Option 5 – Partial cloverleaf
- Option 5C – Northbound College Street to northbound Interstate 5 flyover ramp

Marvin Road Interchange

- Option 10A-1 – From existing southbound off-ramp, a collector-distributor (C/D) road that extends along the north side of I-5 to Carpenter Road, also allowing access into Gateway Town Center area. The C/D road would allow westbound traffic only.
- Option 10A-2 - Hybrid scenario also providing a flyover on-ramp from new C/D road onto northbound I-5 tying in to existing Marvin Road on-ramp. C/D road allows eastbound and westbound traffic.

- Option 10A-3 - Hybrid scenario also providing a flyover on-ramp from new C/D road onto northbound I-5 tying in to existing Marvin on-ramp with Option 14 (I-5 southbound slip off-ramp to Hogum Bay Road) in place
- Option 10, 11, 12 – Full directional interchange located west of Marvin Road tying in to existing ramps at Marvin Road interchange

Results

The analysis volumes and results of the intersection analysis are provided on Figures 6 through 13. The following is a list of the intersections included for analysis and a brief description of the key findings:

Sleater-Kinney Road/Martin Way

This intersection was over capacity for all scenarios analyzed. In order to maintain acceptable operation, additional improvements or traffic diversion will be required.

College Street/Martin Way

Due to the volume shift on the southbound approach of College Street, the southbound through-right lane was changed to an exclusive right-turn lane for this analysis.

Option 5C allows re-striping of the northbound approach of College Street for a single right-turn lane and re-striping/modification of the eastbound approach to have three through lanes. With these improvements, the intersection almost achieves LOS E; however, for all other scenarios, it operates at a failing LOS.

I-5 Ramp Terminals/Martin Way

Both the partial cloverleaf and SPUI options improve the LOS at ramp terminal intersections to acceptable levels. Low left-turning volumes at northbound and southbound off-ramps work well with the partial cloverleaf option. Adding a northbound College Street to northbound I-5 flyover would provide additional improvement to the interchange operation.

Britton Parkway/Marvin Road

All scenarios evaluated at Britton Parkway/Marvin Road resulted in poor operation. No widening strategies were considered in analysis of the intersection. The City of Lacey is considering constructing an eastbound to southbound right-turn by-pass lane at this intersection that should improve the overall operation.

Hogum Bay Road/Marvin Road

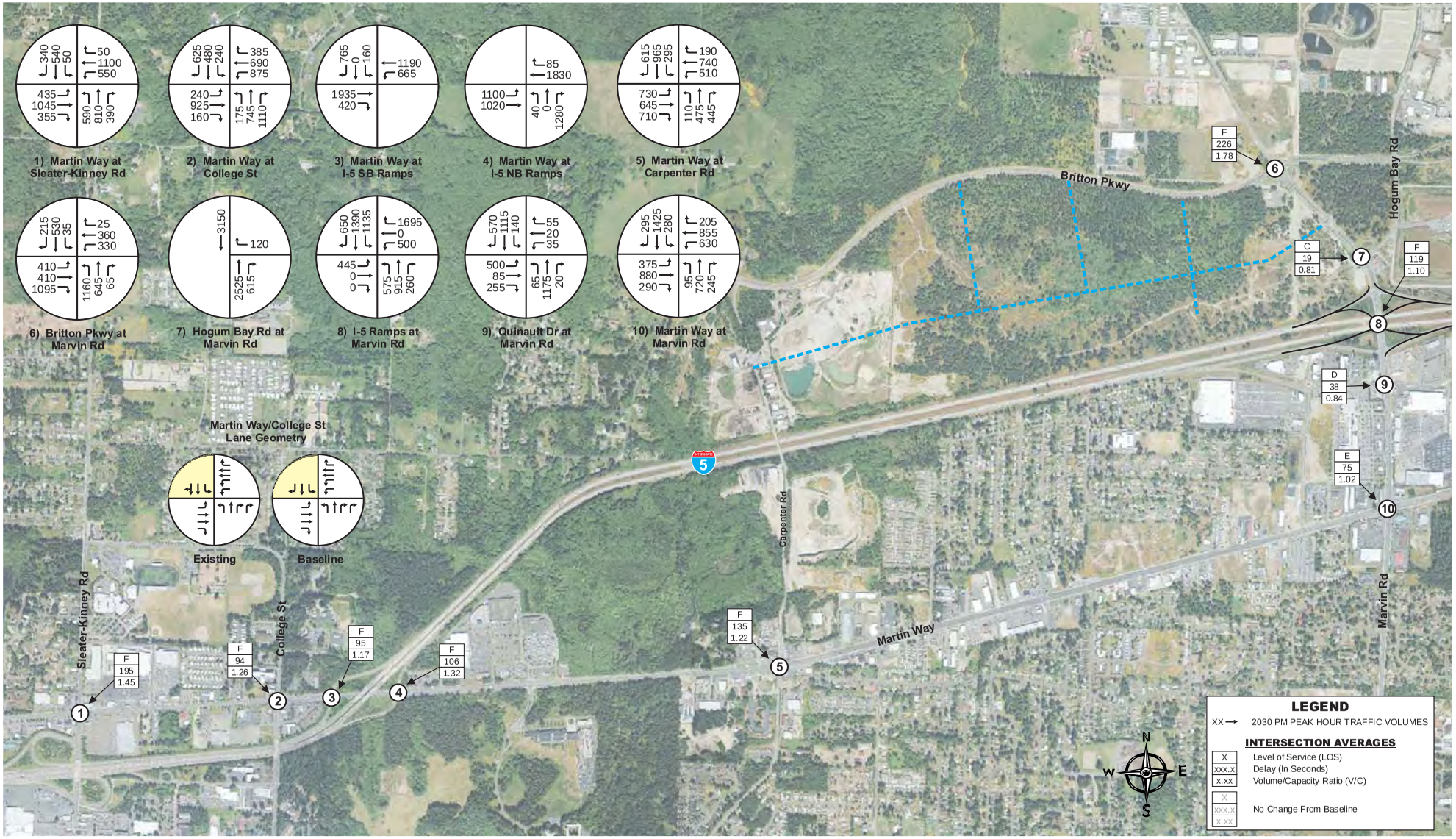
The Hogum Bay Road/Marvin Road intersection operated at an acceptable level of service as a right-in-right-out-only intersection for all scenarios.

I-5 Ramp Terminals/Marvin Road

Analysis of scenarios that included a collector-distributor road from Marvin Road to Carpenter Road showed the road provided improvement to some movements at the

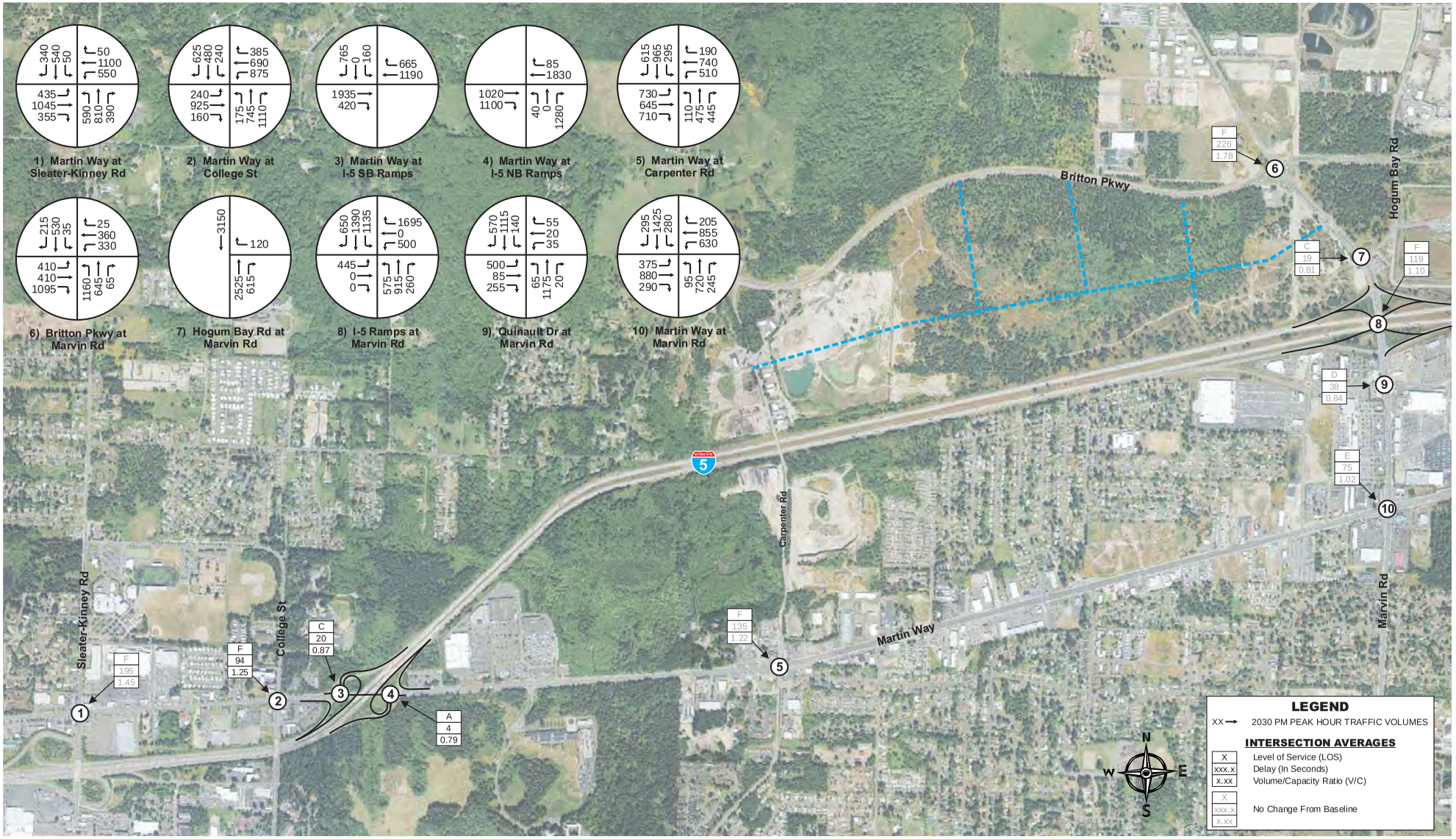
I-5 ramp terminals but did not improve overall intersection operations because traffic volumes moving to new facilities (such as the C/D road) were replaced by other unmet “latent” demand.

The proposed Hogum Bay Slip Ramp (Option 14), funded by the Freight Mobility Strategic Investment Board (FMSIB), reduces traffic to the Marvin Road corridor.



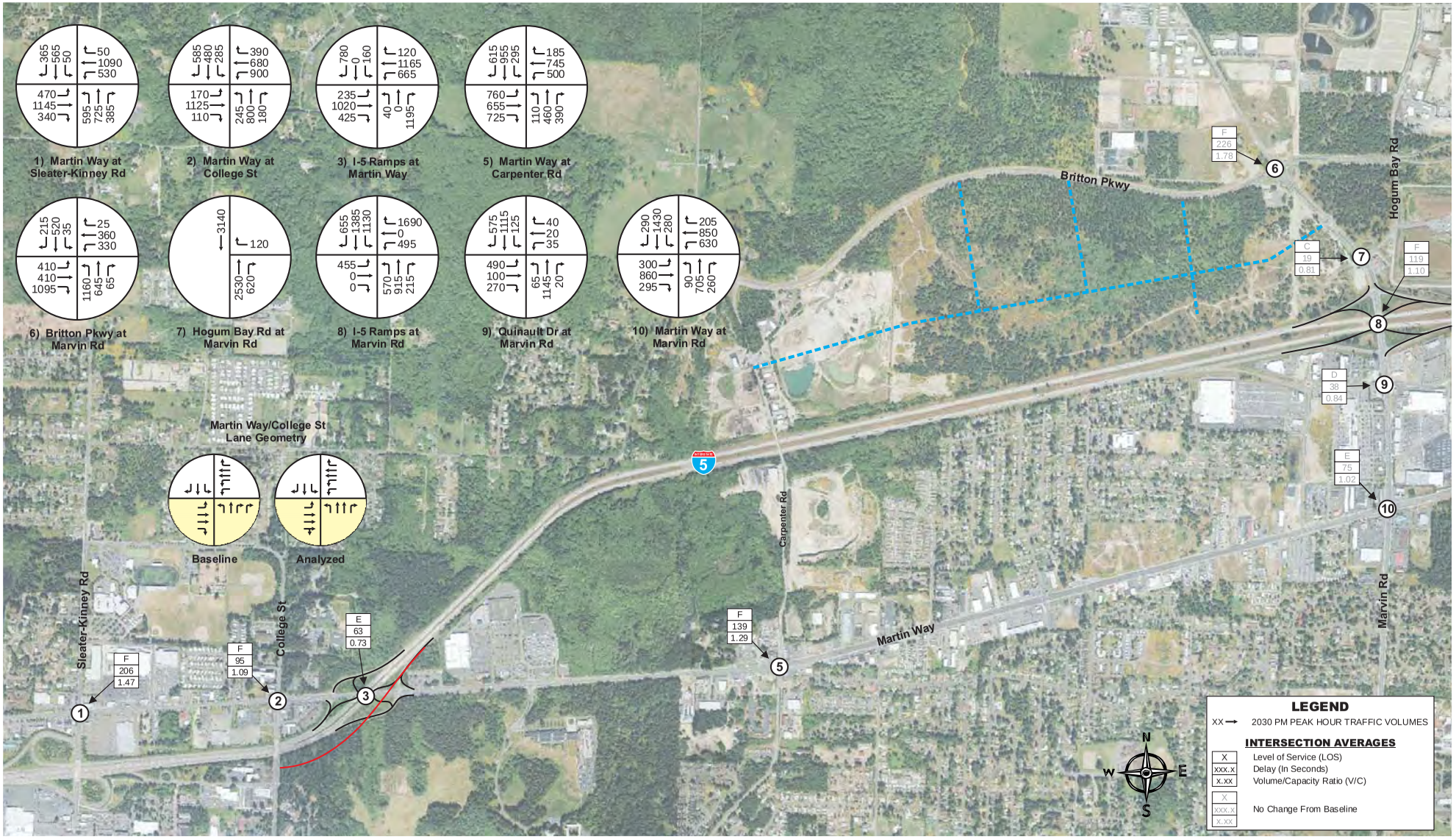
Baseline

Figure 6
Baseline
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



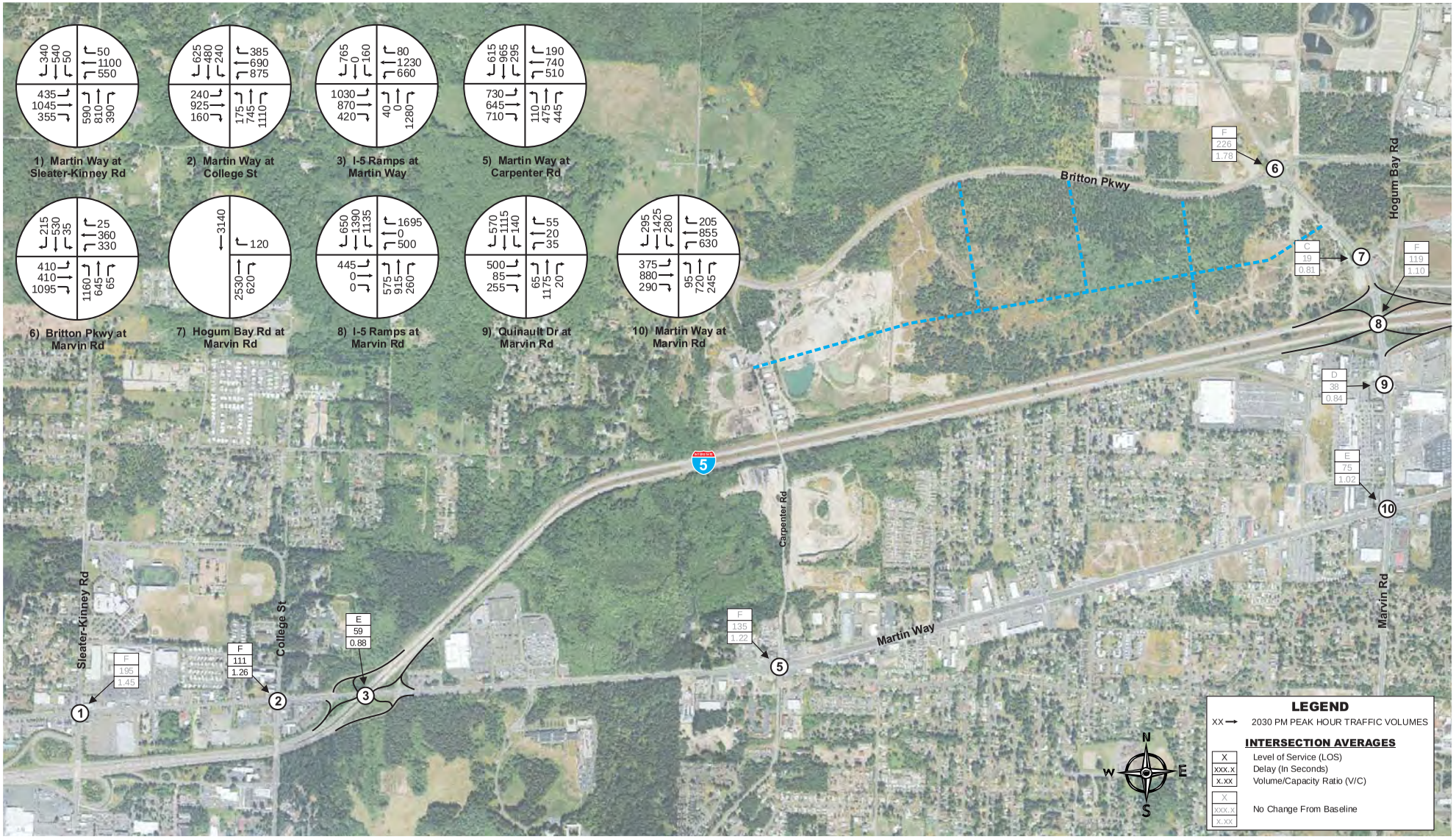
Option 5: Martin Way Partial Cloverleaf Interchange

Figure 7
Option 5
Preliminary 2030 Operations Analysis
Transportation Systems Analysis and Alternatives Evaluation



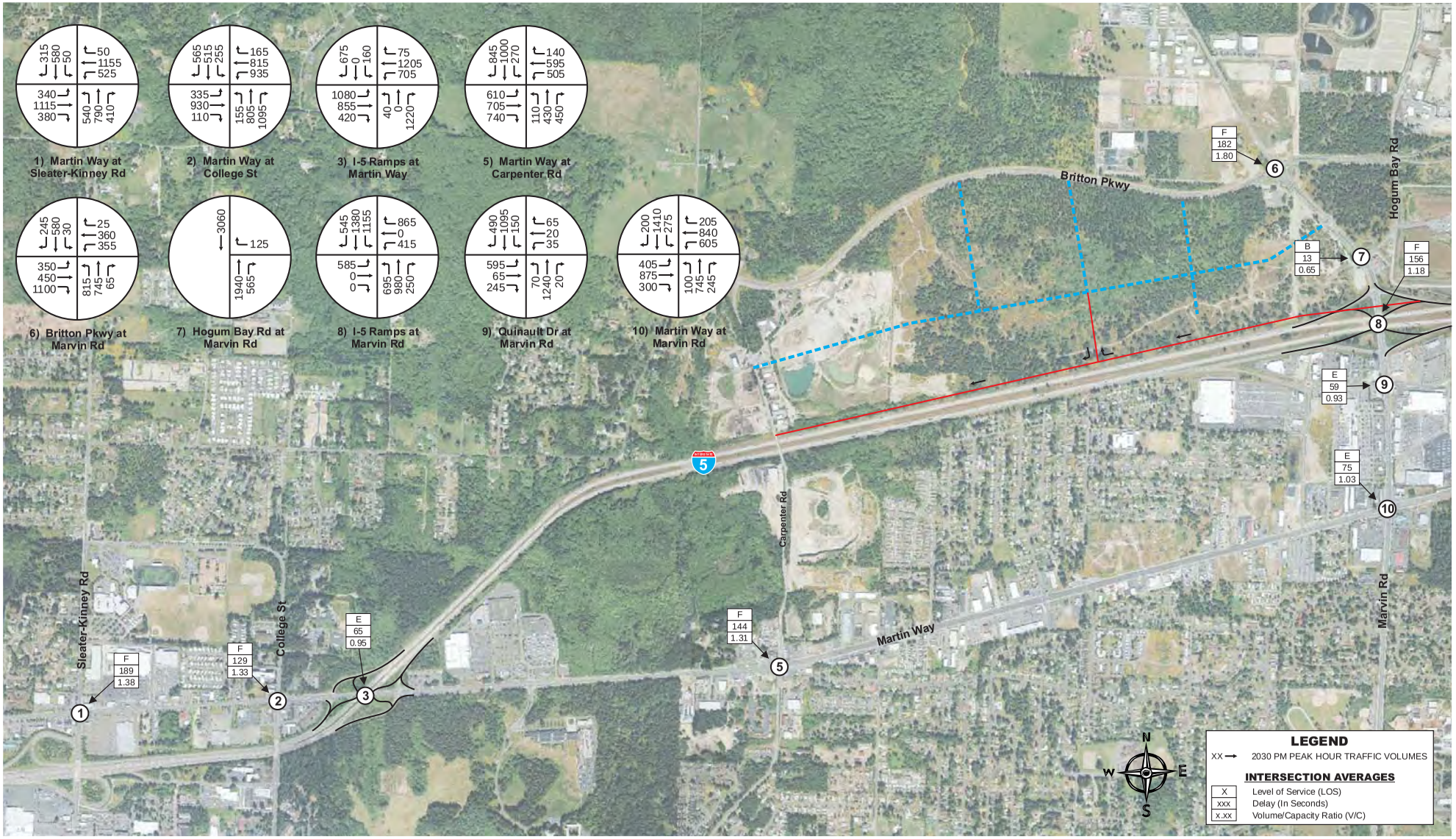
Option 5C: NB College St to NB I-5
Flyover On-Ramp

Figure 8
Option 5C
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



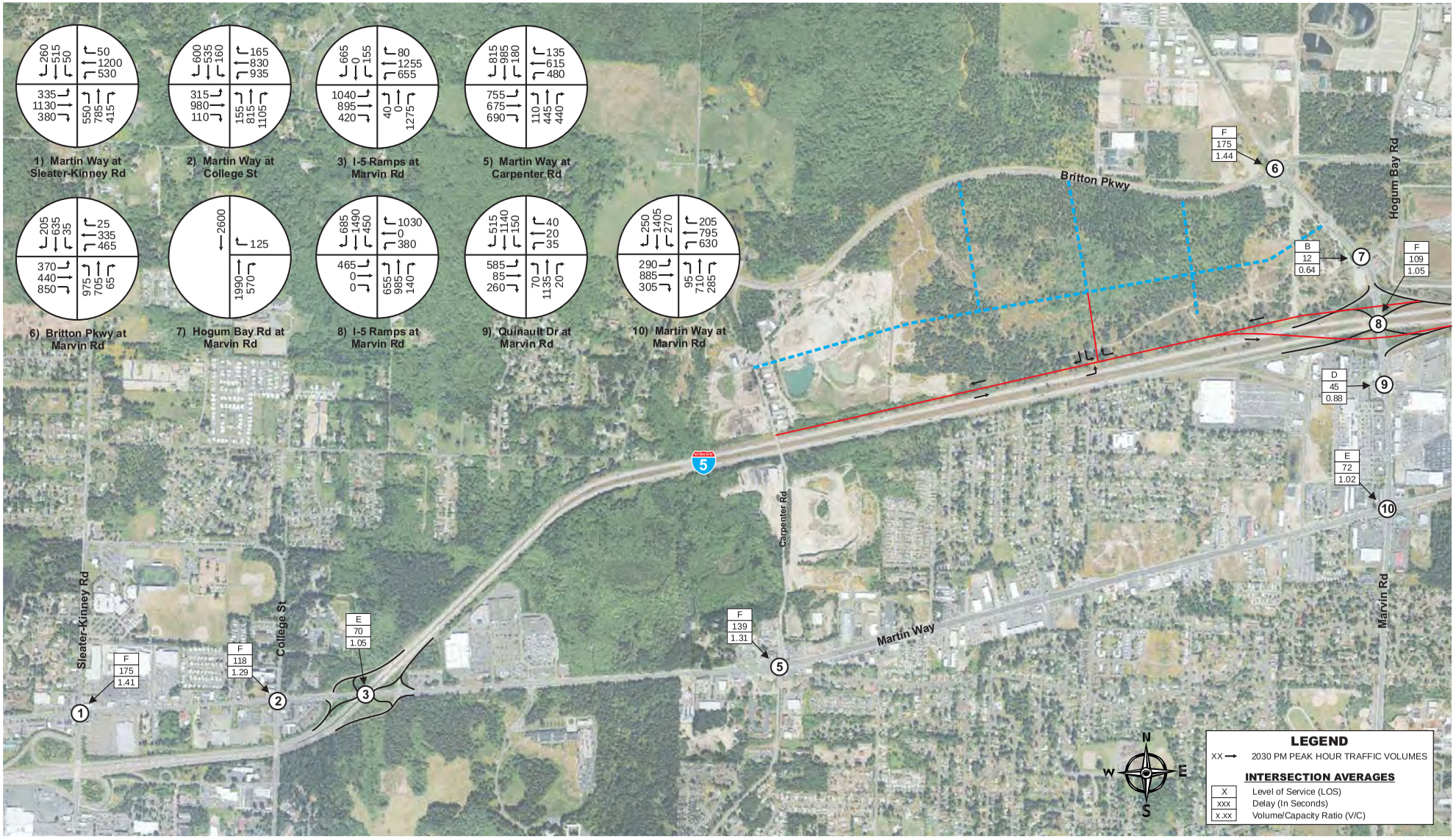
Option 6/6A: Martin Way SPUI Interchange

Figure 9
Option 6/6A
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



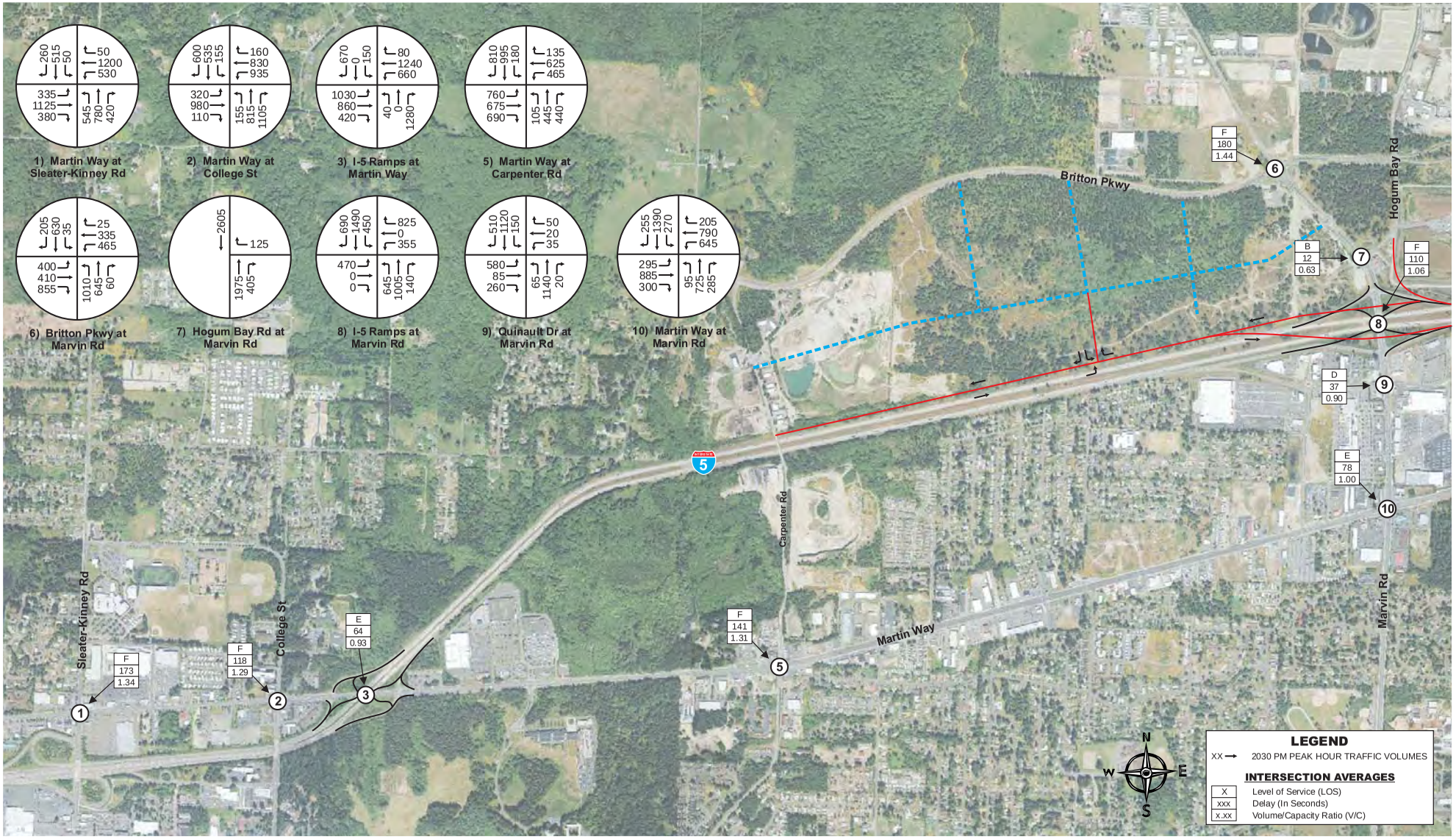
Option 10A - 1: Carpenter Rd CD Road

Figure 10
Option 10A - 1
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



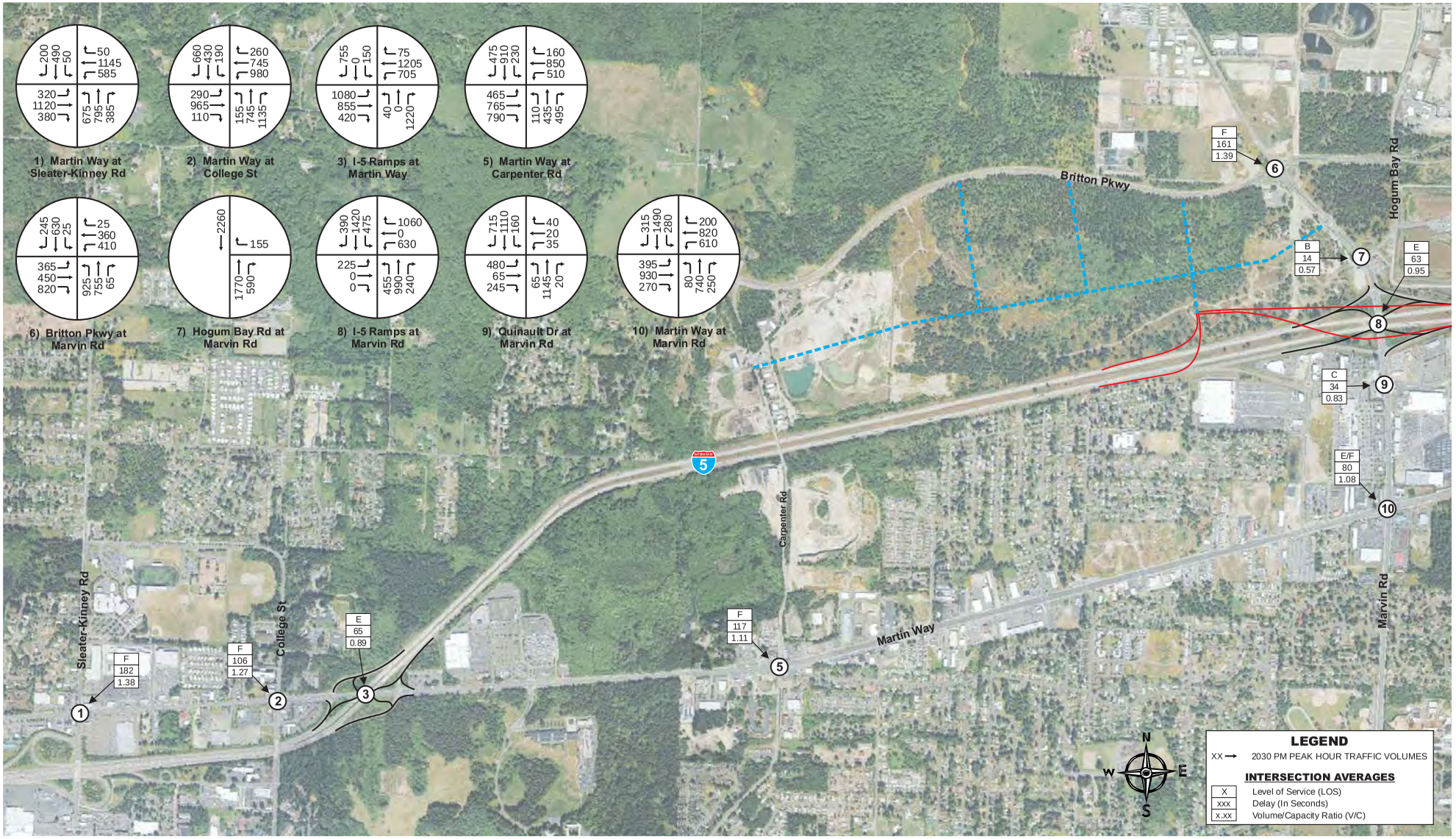
Option 10A - 2: Carpenter Rd CD Road & Flyover On-Ramp From CD Road to NB I-5

Figure 11
Option 10A - 2
Preliminary 2030 Operations Analysis
Transportation Systems Analysis and Alternatives Evaluation



Option 10A - 3: Carpenter Rd CD Road, Flyover On-Ramp
From CD Road to NB I-5 & Hogum Bay Slip Ramp

Figure 12
Option 10A - 3
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



Option 10, 11, 12: Full Directional Interchange Tying into Existing Ramps at Marvin Rd Interchange

Figure 13
Option 10, 11, 12
Preliminary 2030 Operations Analysis
Transportation Systems Analysis and Alternatives Evaluation

Scenarios that included a collector-distributor or frontage road from Marvin Road to Carpenter Road offer the potential to convert the southbound off-ramp to a single free-flow right-turn lane operation. However, this would most likely require widening Marvin Road to allow three northbound lanes from the southbound ramp terminal past Hogum Bay Road. Options 10, 11, and 12 would improve the Marvin Road SPUI interchange operation to LOS E.

Quinault Drive/Marvin Road
This intersection operated at acceptable levels of service for all scenarios.

Martin Way/Marvin Road
Analysis of the Martin Way/Marvin Road intersection resulted in an LOS E/F for all scenarios and no scenario showed a significant change to this intersection.

Martin Way/Carpenter Road
This intersection operated at a failing level of service for all scenarios. Although still operating at a failing condition, the intersection operated most favorably under Options 10, 11, and 12. Traffic flows on Carpenter Road from north of Interstate 5 to/from the Martin Way Interchange are a significant influence at this intersection.

2030 Existing Interchange Improvement Options Summary

Many of the interchange scenarios reviewed in this section show promise in improving the overall operation of the study area roadways. However, no scenario analyzed was shown to provide acceptable operation throughout the study area.

Options 10, 11 and 12 (which include constructing a full directional interchange to/from the north of I-5 via the existing Marvin Road ramps) would allow the Marvin Road interchange to operate at an LOS E condition. However, the cost and constructability of the improvement may be prohibitive relative to the benefit. Additionally, it has been noted that this alternative is a “new” interchange in concept and function, while technically it is not a new interchange because it does not create any new access points onto Interstate 5.

After reviewing the analysis in the this section, the Stakeholder Group determined that evaluating a potential new interchange access in the study area would be valuable as a comparison to the more complicated scenarios at the Marvin Road interchange.

NEW INTERCHANGE OPTIONS

Needs Assessment

Previously in this report it was identified that in the study area the future capacity constraints will be most prominent on Marvin Road and Carpenter Road between Martin Way and Britton Parkway. The intense development planned for the Hawks Prairie Business District and the northeast Lacey area generates a level of traffic that cannot be served with the existing roadway sections. Accommodating the projected traffic flows would require additional facility improvements. The introduction of a new access point onto Interstate 5 between the Marvin Road and Martin Way interchanges would benefit both existing interchanges while reducing traffic demand on Marvin Road and Carpenter Road.

Travel Demand on Marvin Road

The baseline 2030 travel demand forecasts indicate that Marvin Road north of I-5 will draw approximately 6,500 vehicles in the PM peak hour. However, this is influenced by the amount of congestion projected to occur on Marvin Road. An "unconstrained" traffic assignment was also prepared for the 2030 horizon; this analysis shows the preferred route of drivers as if they were the only vehicle on the road and congestion was no consideration. The analysis indicates that the "unconstrained" demand on Marvin Road is approximately 9,500 vph.

Therefore, under constrained conditions, approximately 3,000 vehicles that would use Marvin Road during the PM peak hour divert to less direct routes. In the baseline scenario, traffic volumes on Meridian Road, Carpenter Road, 15th Avenue and portions of Martin Way and other roadways all carry some of the overflow from Marvin Road resulting in increased congestion along these routes.

New Interstate 5 Access Point

The analysis prepared and described to this point indicates that population and employment growth north of Interstate 5 will generate traffic flows that cannot be accommodated by the existing number of through lanes on Marvin Road. Additionally, regional planning policy established by the City of Lacey precludes additional widening of the Marvin Road corridor. With the predicted congestion on Marvin Road, traffic that would use Marvin Road diverts to other corridors to access Interstate 5 and other areas of the County. This is exhibited in significant traffic growth on Meridian Road and Carpenter Road.

Because of the conditions described and the spacing of the corridors, Carpenter Road has been identified as a suitable potential location for a new Interstate 5 access. The following section describes the options evaluated with a new interchange located at Carpenter Road.

Interchange Options

The following interchange options were evaluated to address traffic loading in the vicinity of Marvin Road and Carpenter Road north of Interstate 5. Many of the design elements considered (such as the C/D /frontage road between Marvin Road and Carpenter Road) could be used in each of the various scenarios.

Option 15 – Carpenter Road Diamond Interchange

This scenario would include constructing a full diamond interchange at Carpenter Road allowing on- and off-ramps for both directions of Interstate 5. Under this scenario, no changes or interconnection between the Carpenter Road interchange and Marvin Road interchange are proposed. In each of the Carpenter Road interchange scenarios, geographic and built environment constraints in the southwestern quadrant of the interchange support a NB I-5 off-ramp loop ramp design.

Review of the traffic volume shifts for this scenario indicate that the new interchange would provide benefit to the Martin Way interchange, but it would have minimal effect on constrained traffic flows at the Marvin Road corridor. Traffic volumes indicate that additional improvements would be necessary to reduce traffic flows on Marvin Road north of Interstate 5 to maintain acceptable operation.

Option 15A – Carpenter Road Interchange with C/D Road

This scenario would include a full diamond interchange at Carpenter Road with a C/D or frontage road on the north side of Interstate 5 between Marvin Road and Carpenter Road. The C/D /frontage road would be an option for SB traffic exiting I-5 at the Marvin Road interchange. This scenario has an option of not providing a direct freeway off-ramp for SB traffic onto Carpenter Road. Vehicles wishing to exit SB I-5 onto Carpenter Road would exit the freeway at Marvin Road and take the C/D /frontage road to Carpenter Road.

This scenario results in reduction of traffic flows on Marvin Road for the northbound direction. However, the southbound traffic flows on Marvin Road would still exceed capacity between Britton Parkway and Interstate 5.

Option 15B – Carpenter Road Interchange with C/D Road and NB Flyover On-Ramp onto NB Interstate 5 at Marvin Road

This scenario adds a flyover on-ramp from west of Marvin Road to NB I-5 to Option 15A to address the high traffic volumes on southbound Marvin Road.

Carpenter Road Hybrid

This option was prepared with the strategy of minimizing new access points onto Interstate 5. In this option the southbound I-5 on-ramp from Marvin Road would merge onto the frontage road and would not access the freeway directly. The frontage road would collect additional southbound on-ramp traffic at Carpenter Road

and ultimately merge onto the mainline west of Carpenter Road. Also, the northbound on-ramp from Carpenter Road onto I-5 is removed from this scenario.

This scenario would add freeway access to Carpenter Road and the Lacey Gateway area. However, the scenario would add only one new break in the Interstate 5 mainline: a northbound off-ramp to Carpenter Road.

Input from the Stakeholder Group has indicated that if a new Interstate 5 access is warranted, it is optimum to provide full access (ramps to/from Carpenter Road to Interstate 5 northbound and southbound). Additionally, the traffic volume projections indicate that consolidating ramps between the Marvin Road and Carpenter Road interchanges produce high traffic volumes at the ramps that could create congestion at the merge/diverge points with the I-5 mainline. The strategy of minimizing new access points with the Carpenter Road hybrid option is therefore not considered a preferred option at this time.

Preliminary Operational Assessment

New Interchange Improvement Scenario

PM peak hour traffic projections were prepared for a representative interchange improvement scenario that includes the Carpenter Road interchange. The scenario selected for analysis includes Option 2A (Modified), Option 5, Option 14 and Option 15B. The ramp terminals at the proposed Carpenter Road interchange were analyzed under modern roundabout control. The projected 2030 PM peak hour traffic volumes and intersection operation results are provided on Figure 14. The projected 2030 PM peak hour freeway mainline and ramp merge/diverge volumes and levels of service are shown on Figure 15. The following is a list of the intersections included for analysis and a brief description of the key findings:

Sleater-Kinney Road/Martin Way

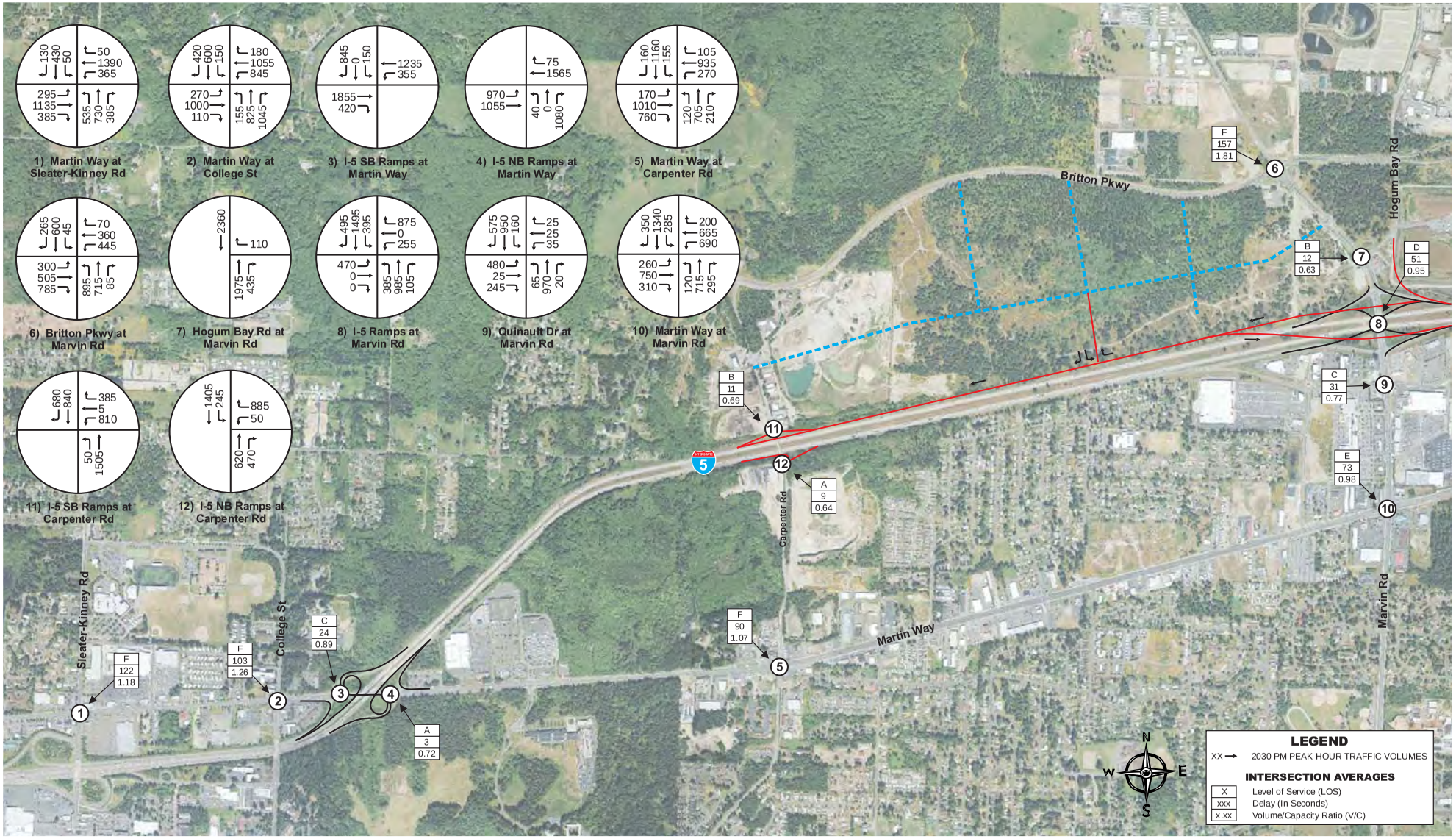
This intersection was over capacity for all previous scenarios analyzed. However, this Scenario improves the delay of this intersection by 70 seconds.

College Street/Martin Way

The intersection is projected to operate at an LOS F condition by the 2030 horizon. The delay under this scenario is slightly worse (9 seconds) than the 2030 baseline scenario.

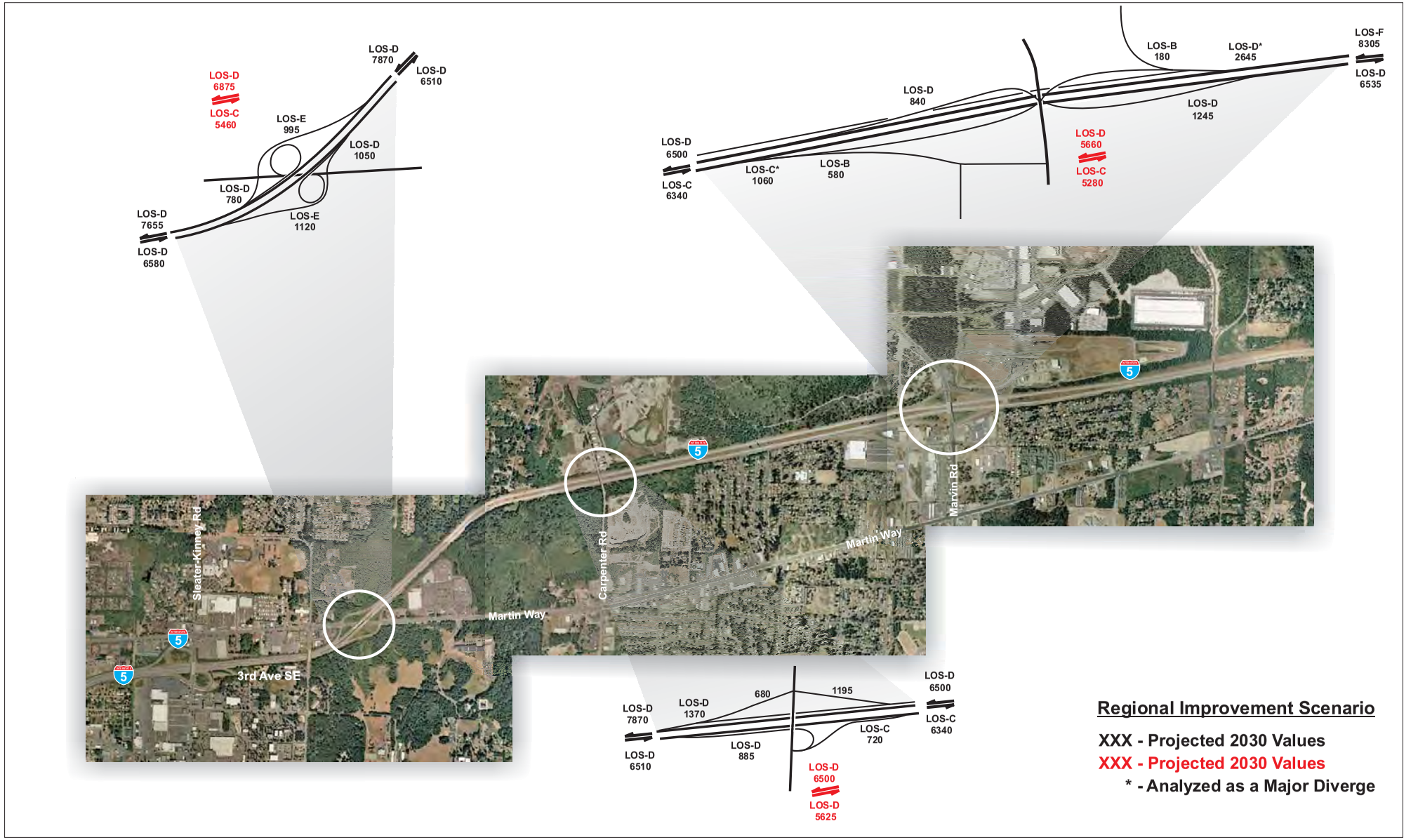
I-5 Ramp Terminals/Martin Way

The new interchange improvement scenario would improve the LOS at ramp terminal intersections to an LOS C and LOS A condition for the southbound and northbound ramp terminals, respectively because of the partial cloverleaf. Low left-turning volumes at northbound and southbound off-ramps work well with the partial cloverleaf option. The partial cloverleaf option would effectively repurpose the widening of Martin Way planned at this location.



Regional Improvement Scenario

Figure 14
Regional Improvement Scenario
Preliminary 2030 Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation



I-5 Mainline and Ramp PM Peak Hour Volumes
and Level of Service

Figure 15
I-5 Mainline and Ramp Volumes & Analysis
2030 Regional Improvement Scenario Operations Analysis
Transportation Systems Analysis
and Alternatives Evaluation

Britton Parkway/Marvin Road

Britton Parkway/Marvin Road is congested. This may be a result of gross assumptions regarding ingress/egress to the Hawks Prairie Business District in the travel demand model. The City will require additional analysis of detailed access points during development of the business district. The City is also developing a project to provide a by-pass, free-right lane from eastbound Britton Parkway to southbound Marvin Road.

I-5 Ramp Terminals/Marvin Road

The Marvin SPUI interchange would operate at an LOS D condition under the new interchange improvement scenario.

Quinault Drive/Marvin Road

This intersection operated at LOS C for this scenario.

Martin Way/Marvin Road

This intersection is projected to operate at an LOS E condition under this new interchange improvement scenario.

Martin Way/Carpenter Road

This intersection is projected to improve by nearly 50 seconds of delay over the baseline scenario, but would remain just above the LOS F threshold.

Carpenter Road Interchange

Under this scenario the ramp terminal intersections were analyzed as two circulating-lane modern roundabouts. Each ramp terminal would operate at LOS C or better during the PM peak hour.

Regional Traffic Benefit

The Carpenter Road interchange Option 15B will improve the Marvin Road and Carpenter Road corridors. Vehicles that would divert to the Martin Way, Marvin Road, Nisqually and Sleater-Kinney Road interchanges will be provided a more direct path to the freeway. Demand modeling prepared for the study indicates that the Carpenter Road interchange will provide a significant reduction in Thurston County vehicle miles traveled (VMT) and vehicle hours traveled (VHT) compared to the 2030 "Baseline" conditions. Table 5-1 illustrates this projected regional benefit.

TABLE 5-1. SYSTEM-WIDE DELAY AND MILES TRAVELED

	Vehicle Miles Traveled (VMT)	Vehicle Hours Traveled (VHT)
Baseline 2030	1,378,311	62,154
Regional Improvement Scenario	1,376,436	61,841
Savings	1,875	313

Preliminary Geometric Analysis of Interchange Improvements

Background of Geometric Design Process

Initial geometric design consisted of layout of line diagrams on aerial photos for the interchange options proposed by the Stakeholder Group on April 16, 2008. The initial geometric design evaluation analyzed the interchange options by identifying the level of adherence to WSDOT highway design guidelines, including roadway safety, identifying impacts to the built and natural environments, major cost items, and construction impacts to I-5 and affected arterials. This evaluation helped to identify options to carry forward. These remaining options were given a more detailed layout with interchange ramp channelization to further evaluate geometric criteria and determine comparative pros and cons.

Design Standards

The analysis and conceptual layout of interchange options follow the guidelines of the WSDOT Design Manual.

Existing Interchange Improvements

Results of the geometric design analysis for the improvement options at the existing interchanges are summarized below.

Sleater-Kinney Road

Alternatives that provided full connectivity of the Sleater-Kinney interchange to I-5 (New SB off-ramp and NB on-ramp) were not favored due to the close spacing (approximately 4,000 feet) between the Sleater-Kinney Road and Martin Way interchange crossings. Although minimum weaving distances between Sleater-Kinney Road and Martin Way would be provided by a new auxiliary lane in both directions, the high entry and exit volumes within the relatively short weaving distance could impact mainline operations and create potential safety issues.

The frontage road alternatives were not favored due to potential impacts to existing commercial development.

The alternative that is currently being advanced will improve the intersection at the existing southbound ramp terminal to allow vehicles from the southbound off-ramp to turn onto either direction of Sleater-Kinney Road.

Martin Way

The bypass ramp alternatives (Options 5A, 5B and 5C) would each remove traffic from the College Street/Martin Way intersection and would improve operations in the area. The new structures required for the bypass ramps would cause major disruptions to College Street and Martin Way during construction. Cost of the bypass

ramps would be substantial due to the amount of structures and retaining walls required along with traffic control needs. Due to cost and property impacts Options 5A and 5B are not favored at this time. Option 5C has minimal impact to built environment and has been retained for future consideration.

Either SPUI alternative (Option 6 or 6A) would require reconstruction of the existing I-5 overcrossing and potentially complicated design to address the skew angle between Martin Way and I-5 at this interchange.

The partial cloverleaf in the NW and SE quadrants of the Martin Way interchange removes the two major left-turn movements from Martin Way onto the on-ramps. Most of the new interchange ramps could be constructed with minimal disruption to the existing interchange traffic. The bridge over Martin Way would need to be widened, but not reconstructed.

Marvin Road

Alternatives at the Marvin Road interchange all assume a SPUI will be constructed in the future. Alternatives at this interchange focus on diverting traffic away from Marvin Road towards the future development at Hawks Prairie Business District (HPBD) and Carpenter Road.

Each of the alternatives developed at the design workshops were found to provide some benefit but also would have potential significant drawbacks. Most alternatives had numerous new and complicated structures and retaining walls, which would raise costs and create extensive construction disruptions to I-5. Impacts to existing commercial development along the northbound side of I-5, and concerns over vertical geometry, vertical clearance, and safe merging with the I-5 mainline reduced the viability of other alternatives.

Option 14, the Hogum Bay Road slip off-ramp, is currently being considered by the City of Lacey to address current freight mobility issues and to address future traffic congestion on Marvin Road.

New Carpenter Road Interchange Improvements

A new interchange at Carpenter Road would require a northbound auxiliary lane on Interstate 5 that connects with the existing drop lane approaching the Marvin Road interchange. This auxiliary lane on I-5 between Carpenter and Marvin Roads provides a long weaving section to reduce weaving impacts to mainline traffic flow.

There are currently three options identified for further geometric analysis and review for the Carpenter Road and Marvin Road interchanges.

Carpenter Road Diamond Interchange

A stand-alone diamond interchange would be constructed at Carpenter Road. The diamond interchange would require an add/drop auxiliary lane to the Marvin Road

interchange. The NB off-ramp would be constructed as a loop ramp to avoid existing commercial development. The diamond interchange would pose few challenges during construction and not significantly disrupt I-5 traffic during the widening of the Carpenter Road bridge. Roundabouts or traffic signals could be considered at the interchange ramp terminals.

Carpenter Road-Marvin Road with SB Collector-Distributor

This would allow SB I-5 traffic to exit to the Hawks Prairie Business District (HPBD) and the new Carpenter Road interchange via a C/D or frontage road without merging with SB on-ramp traffic from Marvin Road. Two alternatives are being considered to accomplish the crossover between the SB off-ramp to HPBD/Carpenter Road and the SB on-ramp from the future Marvin Road SPUI. This is the main vertical design issue for this alternative. A slip-ramp to Hogum Bay Road would also be constructed. Full control limited access would be provided along the frontage road with one access road into HPBD. Cost would be significant with several retaining walls, bridge widening at Carpenter Road, a new bridge for the ramp crossover, and several miles of grading, paving, and related stormwater treatment needs. Most of the C/D ramp system could be constructed with minimal disruption to I-5, and some disruption to the Marvin Road SPUI SB on-ramp.

Carpenter Road-Marvin Road Hybrid Interchange

With this scenario the SB on-ramp from the Marvin Road SPUI merges with the SB off-ramp to Carpenter Road and HPBD resulting in a two-lane C/D or frontage road that continues to HPBD and a new interchange at Carpenter Road. There would be no NB on-ramp from Carpenter Road onto I-5. This alternative only creates one new access onto I-5 (SB off-ramp to Carpenter). A slip-ramp to Hogum Bay Road would also be constructed. Full control limited access would be provided along the C/D roadway with one access road into HPBD. Cost would be significant with several retaining walls, bridge work at Carpenter Road, and several miles of grading and paving which leads to stormwater treatment needs. Most of the C/D road system could be constructed with minimal disruption to I-5 or the Marvin Way SPUI.

Regional Improvement Scenario

After the building-block approach described above to evaluate improvements within the study area, the *Regional Improvement Scenario* was developed using qualitative cost-benefit judgment as a representative combination of improvement options to mitigate congestion identified for 2030. The *Regional Improvement Scenario* includes (1) "Baseline" 2030 improvements, (2) additional surface street improvements, (3) interchange improvements at Sleater-Kinney Road, Martin Way, and Marvin Road, and (4) a new interchange at Carpenter Road. The following describes the improvements to existing interchanges and the new interchange at Carpenter Road, and the subsequent six graphics show conceptual geometric layout for these interchanges for the *Regional Improvement Scenario*.

Sleater-Kinney Road Interchange

Revising the SB I-5 ramp terminal/Sleater-Kinney Road intersection will allow traffic exiting SB I-5 to turn left onto northbound Sleater-Kinney Road (Option 2A Modified) which will redistribute some traffic away from the congested Martin Way interchange.

Martin Way Interchange

The Martin Way interchange currently experiences queuing and delay during the morning and evening peak periods. The interchange has high left-turning volumes onto both on-ramps, which are served by single left-turn lanes arranged back-to-back between the ramp terminals. This arrangement leaves insufficient vehicle storage for left-turning vehicles and queuing impacts the through stream on Martin Way.

The State is developing a project to widen Martin Way between the ramp terminals to allow the left-turn lanes to be constructed side-by-side, which will nearly double the left-turn storage. This project will improve the operation of the interchange but is not projected to accommodate the 2030 traffic growth.

Two improvement options have been identified to serve the 2030 traffic growth:

- *Partial Cloverleaf (Option 5)*
- *Single Point Urban Interchange (SPUI) (Option 6/6A)*

Marvin Road Interchange

This interchange was designed to be converted to a SPUI approximately 10 years after construction in 2001. The 10-year design horizon is approaching and the capacity of the interchange is being reached. The planned Phase 2 SPUI configuration will provide improvement to this interchange; by itself it will not accommodate the projected traffic loadings at this location for the 2030 horizon.

The following is a list and brief description of the improvement options that could be constructed incrementally and would work in concert with the planned Marvin Road SPUI and a new Carpenter Road interchange.

- *Southbound Interstate 5 Slip-ramp to Hogum Bay Road (Option 14)*
- *Southbound Interstate 5 Off-ramp to the Hawks Prairie Business District (HPBD) (Option 10A-1)*
- *Northbound Interstate 5 Flyover On-ramp (Option 10A-2)*

New Carpenter Road Interchange

Construction of a modified diamond at Carpenter Road would provide an additional access into the central Lacey area north and south of I-5, and redistribute trips away from congestion at the Marvin Road interchange, along the Marvin Road corridor, at the Martin Way interchange, along Martin Way between I-5 and Carpenter Road, and along Carpenter Road between Martin Way and I-5.

Several options for a new interchange at Carpenter Road were evaluated. The evaluation indicates the interchange would be configured as a modified diamond with

the northbound off-ramp configured as a loop ramp. A frontage road would also connect Marvin Road and Carpenter Road along the north (west) side of I-5 with southbound vehicles destined for Carpenter Road exiting to the frontage Road at Marvin Road and southbound vehicles destined for I-5 routed below the Carpenter Road under-crossing to merge with the southbound diamond on-ramp from Carpenter Road prior to merging onto the I-5 mainline.

Additional analysis will be required to refine these improvement options. Figures 16 through 22 show conceptual layouts for the *Regional Improvement Scenario*.

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SCALE IN FEET

Option 2A
Sleater Kinney Northbound Connection
Figure 1

Parametrix DATE: $DATE$ FILE: $FILE$

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Option 5
Martin Partial Clover
Figure 1

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Carpenter - Marvin C/D Braid South
Sheet 1 of 5
Figure 18

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Carpenter - Marvin C/D Braid South
Sheet 2 of 5
Figure 1

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Carpenter - Marvin C/D Braid South
Sheet 3 of 5
Figure

Parametrix DATE: $DATE$ FILE: $FILE$

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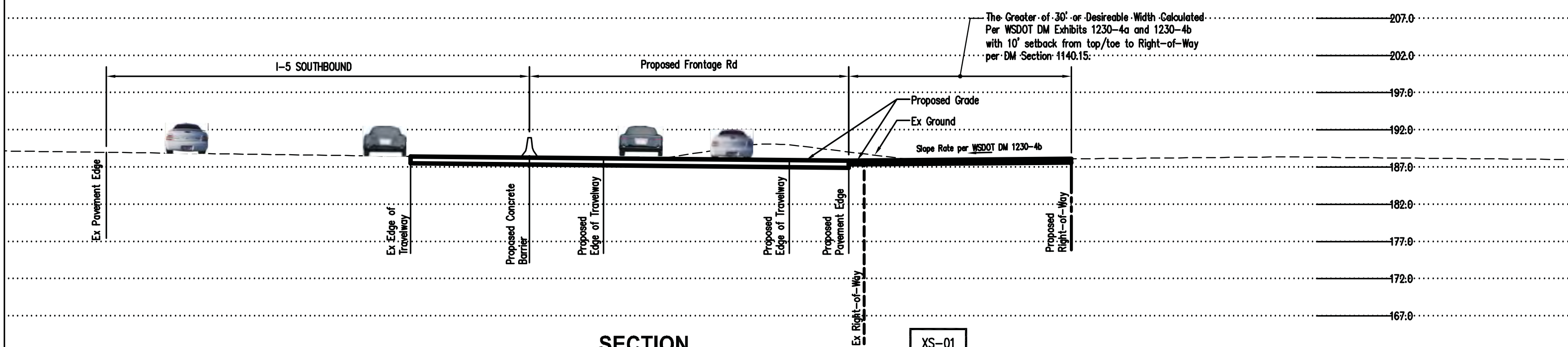
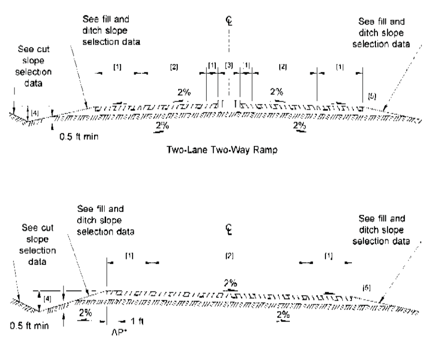
Carpenter - Marvin C/D Braid South
Sheet 4 of 5
Figure 1



SECTION

I-5 AND FRONTAGE IMPROVEMENTS
BETWEEN EXIT 110 AND EXIT 111
LACEY, WA
SCALE: 1"=5'-0"

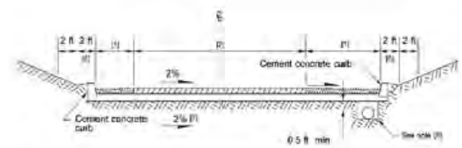
XS-01
SHT 2



*AP = Angle point in the subgrade

Note:
For applicable notes, dimensions, and slope selection tables, see Exhibit 1230-4b.

Ramp Roadway Sections
Exhibit 1230-4a



Special Design

This special design section may be used when restrictions (high right of way costs or physical features) make construction difficult or costly.

Height of fill/depth of ditch (ft)	Slope not steeper than[9]
0 – 10	6H:1V
10 – 20	4H:1V
20 – 30	3H:1V[9]
over 30	2H:1V[10][11]

Fill and Ditch Slope Selection

Height of cut (ft)*	Slope not steeper than
0 – 5	6H:1V
5 – 20	3H:1V
over 20	2H:1V[10]
* From bottom of ditch	

Cut Slope Selection[12]

Notes:
[1] For shoulder details, see Exhibits 1230-5a and 5b. For minimum shoulder widths, see Chapter 1300.
[2] For minimum ramp lane widths, see Chapter 1300. For turning roadway widths, see Chapter 1240. For two-way ramps, treat each direction as a separate one-way roadway.
[3] The minimum median width of a two-lane two-way ramp is not less than that required for traffic control devices and their respective clearances.
[4] Minimum ditch depth is 2 feet for design speeds over 40 mph and 1.5 feet for design speeds of 40 mph or less. Rounding may be varied to fit drainage requirements when minimum ditch depth is 2 feet.
[5] Widen and round fill slopes steeper than 4H:1V, as shown in Exhibit 1230-5b.
[6] 2-foot widening and rounding may be omitted when slopes are 4H:1V or flatter.
[7] Subgrade may slope to the left if the left edge is in embankment.
[8] Provide drainage unless one edge of the roadway is in embankment or subject material is free draining. Method of drainage pickup is to be determined by the designer.
[9] Where practicable, consider flatter slopes for the greater fill heights and ditch depths.
[10] Cut slopes steeper than 2H:1V may be used where favorable soil conditions exist or stepped construction is used. (See Chapter 1600 for clear zone and barrier guidelines.)
[11] Fill slopes as steep as 1.5H:1V may be used where favorable soil conditions exist. (See Chapter 1600 for clear zone and barrier guidelines.)
[12] The values in the Cut Slope Selection table are desirable. Provide justification for the use of steeper slopes, unless the geotechnical report identifies a specific need and recommends them. Do not disturb existing stable slopes just to meet the slope guidelines given in this table.

Ramp Roadway Sections
Exhibit 1230-4b

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H:\PROJECTS\0805 PMX SUBCONSULTANT AGREEMENTS\805-04 LACEY TRANS. SYSTEMS ANALYSIS & EVAL\PHASE 01 – CARPENTER ROAD INTERCHANGE\CA

SHEA - CARR - JEWELL

Carpenter - Marvin C/D Braid South
Sheet 5 of 5
Figure

PRELIMINARY ENVIRONMENTAL SCREENING

A preliminary screening of all interchange improvement options was completed to determine potential environmental impacts and qualitatively assess construction costs. The screening evaluated each environmental element identified in the Washington State Environmental Policy Act. Key findings from the evaluation are summarized below.

Built Environment

The built environment considers impacts to business and residential properties, specifically any displacements that would occur as a result of a specific alternative. The amount of right-of-way that would be required for the improvement is also a consideration in this category. Impacts to recreational, cultural and historic resources, and environmental justice are also evaluated in this category, as well as any impacts related to noise and hazardous materials sites.

Property Impacts/Right-of-Way

At the current level of conceptual design, no residences are to be displaced under any of the options; however, there are possible impacts to existing businesses. The amount of right-of-way that would be acquired for new collector/distributor roads that are required for a number of the options has also not been determined at this time.

Land Use/Recreation

None of the options would impact existing recreational opportunities. Each option will result in the conversion of some amount of land to use as roadways, but land uses in the area will remain as currently designated.

Historic/Cultural Resources

No significant historic or cultural resources are anticipated to be found within the project area. The options will require a cultural and historic resources assessment as a part of the detailed environmental documentation for the project.

Aesthetic and Visual Quality

Construction of any of the options will change the appearance. Specific visual impacts will be identified once the preferred alternatives are selected.

Table 7-1 summarizes potential impacts to the built environment for each option.

Natural Environment

The natural environment category includes issues related to wetlands, surface waters, floodplains, geology and soils, and air quality. It also considers impacts to threatened and endangered species, natural vegetation, and wildlife habitat.

Air Quality

Thurston County and the City of Lacey currently meet all air quality standards. Therefore, none of the interchange options are located in an air quality non-attainment area. The Lacey area is, however, designated as a maintenance area for particulate matter. The maintenance area has a federal limit on the amount of particulate matter (PM10) that can be produced by automobiles. During construction of the interchange improvements, a temporary increase in PM10 levels could result due to grading activity and/or longer vehicle delay; however, it is expected that levels would continue to meet air quality standards following construction.

Water

Thurston County Geodata maps indicate existing wetlands and buffers in the vicinity of all interchanges. Table 7-1 lists the impact each option is anticipated to have on the wetlands and their buffers, as well as any high groundwater areas. High groundwater areas could impact how stormwater is managed, and special construction techniques or studies will likely be required if the project affects these areas. Methods for stormwater management will be identified in the detailed environmental document for the preferred alternative.

Earth

According to information provided by Thurston Geodata, the primary soils in the study area consist of gravelly sandy loam material. Some steep slopes are found in the vicinity of Carpenter Road, primarily associated with the gravel pit on the east side of the road. Impacts to soils and slopes will be limited to grading activities associated with each alternative.

Plants and Animals

No threatened or endangered species are known to exist in the area. Information regarding threatened and endangered plants and animals known to be in the area will be requested from Washington Department of Fish and Wildlife as part of the detailed environmental documentation for the project. If any threatened or endangered species are found to be in the project area, a biological assessment will be prepared to determine the need for mitigation measures or options for avoiding impacts to such species.

Table 7-1 summarizes potential impacts to the natural environment for each option.

Preliminary Cost Screening

The estimated cost of each of the options was not established. However, Table 7-1 lists the major cost items associated with each option.

Concept level cost estimates were prepared for the interchanges in the *Regional Improvement Scenario* as shown in Table 7-2. The cost estimates are broken down by phases—Preliminary Engineering (PE), Right-of-Way (RW), and Construction (CN).

The PE phase includes all design and environmental work to bring a project to bid advertisement.

TABLE 7-1. PRELIMINARY ENVIRONMENTAL/COST SCREENING OF INTERCHANGE OPTIONS

Option	Potential Impacts to Built Environment	Potential Impacts to Natural Environment	Major Cost Items of Alternative
Sleater-Kinney Road Interchange			
Option 1 – Tight Diamond and frontage roads to Martin Way	• Possible commercial impacts along SB C/D.	• Wetland buffer and high groundwater area at NB off-ramp to Sleater-Kinney. • Interchange footprint at S-K is reduced because existing loop ramps would be removed. • Significant amounts of new impervious surface will need stormwater treatment.	• 5000 foot new C/D for both NB and SB. • Abutment work at College Street bridge. • Bridge widening at S-K. • Retaining walls for much of SB C/D to limit commercial property impact. • New signals at S-K. • Stormwater collection and treatment facilities.
Option 2 – Tight Diamond and Partial Cloverleaf	• Possible commercial impact along SB off-ramp.	• Wetland buffer and high groundwater area t NB off-ramp to S-K. • Interchange footprint at S-K is reduced since existing loop ramps would be removed.	• Bridge widening at S-K. • Retaining walls for tight diamond ramps next to I-5.
Option 2A - Roundabout SB Terminal	• Possible impact to commercial parking spaces due to new roundabout.	• Minimal impact to natural systems.	• Cost of roundabout construction.
Option 2B – NB Collector/ Distributor to Martin Way	• Possible commercial impact along NB C/D near College St.	• Wetland buffer and high groundwater area at NB off-ramp to S-K. • Interchange footprint at S-K is reduced since existing loop ramp would be removed.	• 5000 foot new NB C/D. • Abutment work at S-K and College St bridges. • Retaining walls for much of NB C/D to limit impact to commercial properties and St. Martin's University. • New signal at S-K. • Stormwater collection and treatment facilities.
Option 2C – SB On-Ramp from Martin Way	Eliminated from consideration due to limited benefit and high residential impact.		
Option 3 – Partial Cloverleaf (NW and SE Quadrant)	Eliminated from consideration due to limited benefit and high residential impact.		

TABLE 7-1. PRELIMINARY ENVIRONMENTAL/COST SCREENING OF INTERCHANGE OPTIONS

Option	Potential Impacts to Built Environment	Potential Impacts to Natural Environment	Major Cost Items of Alternative
Option 4 – SPUI Interchange	• Possible commercial impact along SB off-ramp	• Wetland buffer near the NB off-ramp. • Increased impervious surface needs stormwater treatment.	• Major bridge reconstruction of S-K overcrossing. • Retaining walls for SPUI ramps next to I-5. • New structure for NB on-ramp over existing NB off-ramp to 3rd Ave.
Martin Way Interchange			
Option 5 – Partial Cloverleaf (NW and SE Quadrant)	• None	• Wetland buffer near the NB off-ramp. • Increased impervious surface needs stormwater treatment.	• Bridge widening of Martin overcrossings. • Some retaining walls to limit interchange footprint. • Stormwater collection and treatment facilities.
Option 5A – SB Bypass Loop Ramp	Eliminated by Stakeholder Group due to commercial impacts and bridge costs		
Option 5B – SB Bypass Flyover Ramp	Eliminated by Stakeholder Group due to commercial impacts and bridge costs		
Option 5C – NB Bypass Ramp	• None	• Wetland buffer near existing NB off-ramp to Martin. • Increased impervious surface needs stormwater treatment.	• New bridges over NB off-ramp and Martin Way. • 3000 foot new ramp between College St. and existing NB on-ramp. • Many retaining walls at the existing interchange. • Stormwater collection and treatment.
Option 5D – SB Slip Ramp	Eliminated by Stakeholder Group due to limited benefit.		
Option 6 – SPUI Realigned	• None	• Wetland buffer near existing NB off-ramp to Martin. • Increased impervious surface needs stormwater treatment	• New SPUI bridge, retaining walls. • Stormwater collection and treatment.
Option 6A – SPUI – Existing Alignment	• None	• Wetland buffer near existing NB off-ramp to Martin. • Increased impervious surface needs stormwater treatment	• New SPUI bridge, retaining walls. • Stormwater collection and treatment.

TABLE 7-1. PRELIMINARY ENVIRONMENTAL/COST SCREENING OF INTERCHANGE OPTIONS

Option	Potential Impacts to Built Environment	Potential Impacts to Natural Environment	Major Cost Items of Alternative
Marvin Road Interchange			
Option 10 – New Overcrossing and Braided Ramps	• Possible commercial impacts in SW quadrant of existing interchange.	• Wetland buffer and high groundwater area near SB off-ramp.	• Three new bridges. • 7,000 foot new C/D roadway. • Retaining walls for much of C/D. • Stormwater collection and treatment.
Option 10A – NB C/D from Martin Way or Carpenter Road; SB C/D to Martin Way or 15th Ave.	• None	• Wetland buffer and high groundwater area along SB C/D near Marvin and Carpenter.	• 18,000 foot new C/D roadways. • New Carpenter interchange. • Stormwater collection and treatment.
Option 11 – New overcrossing and NB Left Off/On Ramps	• None	• Wetland buffer and high groundwater area near SB off-ramp.	• Two new bridges. • 7,000 foot new C/D and ramps. • Retaining walls for most of the C/D and ramps. • Stormwater collection and treatment.
Option 12 – NB Off/On Flyover Ramps	• None	• Wetland buffer and high groundwater area near SB off-ramp.	• Five new bridges. • 5,000 foot new ramps. • Retaining walls. • Stormwater collection and treatment.
Option 13 – New Over-Crossing – Galaxy Drive Extension	• Major impacts to Ram/Harley buildings in the SW quadrant of Marvin interchange.	• None	• New bridge over I-5. • 1,500 new roadway • Stormwater collection and treatment.
Option 14 – Direct SB Off-Ramp to Hogum Bay Road	Per City of Lacey, the SB slip-ramp to Hogum Bay Road will receive funding for construction in 2010.		
Option 14A – Flyover Ramps to Hogum Bay Road	• None	• Wetland buffer and high groundwater area near SB off-ramp.	• Three new bridges. • 4,000 foot new ramps. • Retaining walls. • Stormwater collection and treatment.

TABLE 7-1. PRELIMINARY ENVIRONMENTAL/COST SCREENING OF INTERCHANGE OPTIONS

Option	Potential Impacts to Built Environment	Potential Impacts to Natural Environment	Major Cost Items of Alternative
Carpenter Road Interchange			
Option 15 - Diamond	• None – NB off-ramp would be a loop ramp to avoid existing commercial property.	• None	• Widened Carpenter Road bridge. • New Ramps.
Option 15A - Diamond and SB C/D from Martin Way, SB Slip Ramp to Hogum Bay Road	• Possible commercial impact to future development at interchange.	• Wetland buffer and high groundwater area near SB of-ramp at Marvin.	• Widened Carpenter bridge. • Two new bridges for C/D road over Marvin interchange. • Retaining walls at Marvin interchange. • New ramps. • 8,000 foot new C/D roadway. • Stormwater collection and treatment.
Option 15B - Diamond with SB C/D from Martin Way, NB Flyover Ramp to NB I-5, SB Slip Ramp to Hogum Bay Road	• Possible commercial impact to future development at interchange.	• Wetland buffer and high groundwater area near SB of-ramp at Marvin.	• Widened Carpenter bridge. • Four new bridges for C/D road and NB flyover over Marvin interchange. • Retaining walls at Marvin interchange. • New ramps. • 8,000 foot new C/D roadway. • Stormwater collection and treatment.
Option 15C – No NB On-Ramp, Two-Way C/D to Marvin, NB Flyover Ramp to NB I-5, SB Slip Ramp to Hogum Bay Road	• Possible commercial impact to future development at interchange.	• Wetland buffer and high groundwater area near SB of-ramp at Marvin.	• Widened Carpenter bridge. • Two new bridges for NB Flyover over Marvin interchange. • Retaining walls at Marvin interchange and along C/D roadway. • New ramps. • 8,000 foot new C/D roadway. • Stormwater collection and treatment.

List of Abbreviations:

SB	Southbound
NB	Northbound
C/D	Collector/Distributor
S-K	Sleater-Kinney Road
SPUI	Single Point Urban Interchange

TABLE 7-2. CONCEPT COST ESTIMATES FOR THE REGIONAL IMPROVEMENT SCENARIO (Millions)

Interchange	PE Phase	RW Phase	CN Phase	TOTAL
Sleater-Kinney	$0.2-0.4	$0.2-0.4	$1.0-1.2	$1.4-2.0
Martin Way	$1.5-2.0	$1.1-1.5	$12-15	$14-18
Carpenter Road	$2-3	$2-3	$19-23	$23-29
Marvin Road	$6-7	$2-3	$52-62	$60-72
I-5 Auxiliary Lanes	$2-3	$0	$14-17	$16-20
TOTALS				$115-$141

SUMMARY AND CONCLUSION

This report documents the results of a transportation study of the Lacey area along Interstate 5 from Nisqually to Sleater-Kinney Road. The objective of this study was to identify future roadway deficiencies and to identify potential improvements to mitigate congestion of the local street and freeway systems in the study area.

The work completed by the Stakeholder Group and documented in this report provides the framework for future studies for each of the improvements evaluated and described in this study. The Stakeholder Group provided comments on this report (see Appendix A). Some comments were incorporated into this final report. The Stakeholder Group agreed to address the remaining comments during future studies.

The following is a description of the recommended improvement strategies identified for future study and analysis.

Surface Street Improvements

In the process of evaluating the surface street improvements, several projects were identified that could provide significant benefit to the local street system. While it was determined these improvements alone would not accommodate regional traffic growth, some projects were shown to provide significant benefit to traffic operations.

The following list of improvements were identified for study area and were included in the "Baseline" condition for analyses:

- Widening Carpenter Road from 2 to 4 lanes – Britton Parkway to Pacific Avenue;
- Constructing College Street Extension (1 lane each direction) from 6th Ave NE to 15th Ave NE;
- Widening Britton Parkway from 2 to 4 lanes, Marvin Road to Carpenter Road;
- Constructing roadway grid in Hawks Prairie Business District. The basic network includes:
    - A new east-west roadway (Main Street) connecting Marvin Road and Carpenter Road between I-5 and Britton Parkway
    - Three new north-south roadways connecting Main Street and Britton Parkway
- Widening 15th Avenue to complete a 4/5 lane corridor generally parallel to and north of Interstate 5 between Orion Drive and Sleater-Kinney Road.

Other surface street improvements identified by the Stakeholder Group and documented in the *Surface Street Improvement Alternatives s*ection of this report could be packaged with interchange improvement options to provide the most efficient use of available funds.

Improvements to Existing Interchanges

The following described identified improvements to existing interchanges. Improvements at each of the interchanges should be further evaluated during subsequent IJR studies. The priority for interchange improvements is Martin Way followed by Marvin Road.

Sleater-Kinney Road Interchange

The Sleater-Kinney Road interchange currently does not allow certain movements; there is no on-ramp to northbound Interstate 5 and there is no ability to exit southbound Interstate 5 to northbound Sleater-Kinney Road. In the design workshop, a number of alternatives were identified that would allow all on- and off-ramp movements at this interchange. However, due to geometric constraints and costs associated with adding a northbound on-ramp, those alternatives were not pursued.

However, it was determined that revising the SB I-5 ramp terminal/Sleater-Kinney Road intersection to allow traffic exiting SB I-5 to turn left onto northbound Sleater-Kinney Road (Option 2A Modified) could provide operational benefit with practical construction cost and impact to the built environment. It is noted the roundabout shown in Option 2A Modified includes operational challenges related to access to the existing K-Mart site. A signal at the ramp terminal may not operate effectively given spacing to Martin Way. A more detailed alternatives analysis considering a signal, a roundabout, and/or other means to provide access to northbound Sleater-Kinney Road should be conducted during subsequent IJR studies for this interchange.

Martin Way Interchange

The Martin Way interchange currently experiences queuing and delay during the morning and evening peak periods. The interchange has high left-turning volumes onto both on-ramps, which are served by single left-turn lanes arranged back-to-back between the ramp terminals. This arrangement leaves insufficient vehicle storage for left-turning vehicles and queuing impacts the through stream on Martin Way.

The State is developing a project to widen Martin Way between the ramp terminals to allow the left-turn lanes to be constructed side-by-side, which will nearly double the left-turn storage. This project will improve the operation of the interchange but is not projected to accommodate the 2030 traffic growth at the interchange.

Two improvement options have been identified for this interchange that would serve the 2030 traffic growth:

<u>Single Point Urban Interchange (SPUI) (Option 6/6A)</u>

A SPUI at this location would improve the efficiency of the left-turning traffic flows for the on- and off-ramps. Preliminary analysis indicates that a SPUI would operate at an LOS E through the 2030 horizon. This option could potentially be implemented by either reconstructing the existing over-crossing and re-aligning Martin Way to

cross under I-5 at a lesser skew angle, or by leaving Martin Way in its current alignment and constructing the ramps at an angle to accommodate the geometry required to construct the single-point intersection under the freeway over-crossing. The optimum arrangement would be determined during further study.

Partial Cloverleaf (Option 5)

As noted earlier, the left-turning volumes entering the on-ramps are very high volume movements. However, the off-ramp left-turn volumes are relatively small. This balance of traffic flows is ideal for the function of a partial cloverleaf. Under this arrangement, the westbound Martin Way to southbound I-5 and eastbound Martin Way to northbound I-5 movements would be made as right turns onto loop ramps. Traffic exiting the freeway would continue to use the existing signalized ramp terminals. Under this arrangement, the two off-ramp signals would operate at LOS C or better during the 2030 PM peak hour.

Marvin Road Interchange

This interchange was designed to be converted to a SPUI approximately 10 years after construction in 2001. The 10-year design horizon is approaching and the capacity of the interchange is being reached. The planned Phase 2 SPUI configuration will provide improvement to this interchange; by itself it will not accommodate the projected 2030 traffic.

A range of options has been evaluated that would enhance the capacity of the interchange and allow the Marvin Road corridor and SPUI intersection to function acceptably. The following is a brief description of the improvement options that would be constructed incrementally to work in concert with the planned Marvin Road SPUI and a new interchange at Carpenter Road.

Southbound Interstate 5 Slip-ramp to Hogum Bay Road (Option 14)

This improvement has been identified primarily as a freight mobility project to allow heavy vehicle access to Hogum Bay Road and the industrial areas east of Marvin Road without impacting Marvin Road. It is funded by the Freight Mobility Strategic Investment Board (FMSIB).

Southbound Interstate 5 Off-ramp to the Hawks Prairie Business District (HPBD) (Option 10A-1)

The Lacey Gateway area of the HPBD is planned for high-intensity commercial and residential use. This high-density land-use area between Interstate 5 and Britton Parkway and between Carpenter Road and Marvin Road can be more efficiently accommodated by constructing an additional off-ramp from the Marvin Road off-ramp into the area. The new ramp would weave under the Marvin Road under-crossing and over the southbound on-ramp to a frontage or C/D road that would potentially extend to Carpenter Road. This would allow the high volume of traffic exiting southbound I-5 to enter the HPBD without impacting Marvin Road.

Northbound Interstate 5 Flyover On-ramp (Option 10A-2)

The traffic volume projections indicate eventually the southbound flows on Marvin Road approaching Interstate 5 will exceed the capacity of the roadway. To accommodate these volumes, a direct on-ramp access from west of Marvin Road could be constructed that would fly over the Marvin Road under-crossing and tie into the existing on-ramp to northbound Interstate 5.

New Carpenter Road Interchange

Previous analysis has indicated that traffic growth in the City of Lacey will greatly exceed the capacity of Marvin Road and the Marvin Road SPUI interchange. Travel demand modeling indicates that vehicles that would use Marvin Road are forced to divert to other routes such as Meridian Road, Carpenter Road and 15th Avenue to access other interchanges in the study area from Nisqually to Sleater-Kinney Road. This creates excessive congestion along these other routes and leads to increased travel lengths and delays.

Subsequent to improvements at the Martin Way and Marvin Road interchanges, construction of a modified diamond at Carpenter Road would provide an additional access into the central Lacey area north and south of I-5, and redistribute trips away from congestion at the Marvin Road interchange, along the Marvin Road corridor, at the Martin Way interchange, along Martin Way between I-5 and Carpenter Road, and along Carpenter Road between Martin Way and I-5.

Preliminary design analysis indicates that the interchange could be constructed as a modified diamond with all ramp movements functioning under a diamond configuration, with the exception being the northbound I-5 off-ramp, which could be constructed as a loop ramp.

In addition a frontage road system connecting Marvin Road to Carpenter Road would collect traffic between Marvin Road and Carpenter Road. Southbound vehicles destined for Carpenter Road would exit to the frontage Road at Marvin Road and southbound vehicles destined for I-5 would be routed below the Carpenter Road under-crossing to merge with the southbound diamond on-ramp from Carpenter Road prior to merging onto the I-5 mainline.

Regional Improvement Scenario

After demonstrating the need to improve existing interchanges and the need to a new interchange at Carpenter Road, the *Regional Improvement Scenario* was developed using qualitative cost-benefit judgment as a representative combination of improvement options to mitigate congestion identified for 2030. The *Regional Improvement Scenario* includes (1) "Baseline" 2030 improvements, (2) additional surface street improvements, (3) interchange improvements at Sleater-Kinney Road, Martin Way, and Marvin Road, and (4) a new interchange at Carpenter Road. The following describes the improvements to existing interchanges and the new interchange at Carpenter Road for the *Regional Improvement Scenario*. Concept

phases—Preliminary Engineering (PE), Right-of-Way (RW), and Construction (CN). The PE phase includes all design and environmental work to bring a project to bid advertisement.

Sleater-Kinney Road Interchange

Revise the SB I-5 ramp terminal/Sleater-Kinney Road intersection to allow traffic exiting SB I-5 to turn left onto northbound Sleater-Kinney Road (Option 2A Modified).

Martin Way Interchange

Construct a partial cloverleaf (Option 5) or a Single Point Urban Interchange (SPUI) (Option 6/6A) to mitigate the delays caused by the heavy left-turn volumes from Martin Way to the on-ramps.

Marvin Road Interchange

Construct the planned Phase 2 SPUI configuration with a southbound I-5 slip-ramp to Hogum Bay Road (Option 14), and a southbound I-5 off-ramp to the Hawks Prairie Business District (HPBD) (Option 10A-1).

New Carpenter Road Interchange

Construct a modified diamond at Carpenter Road with the northbound off-ramp configured as a loop ramp and a frontage road connecting Marvin Road and Carpenter Road along the north (west) side of I-5.

TABLE 9-1. CONCEPT COST ESTIMATES FOR THE REGIONAL IMPROVEMENT SCENARIO (Millions)

Interchange	PE Phase	RW Phase	CN Phase	TOTAL
Sleater-Kinney	$0.2-0.4	$0.2-0.4	$1.0-1.2	$1.4-2.0
Martin Way	$1.5-2.0	$1.1-1.5	$12-15	$14-18
Carpenter Road	$2-3	$2-3	$19-23	$23-29
Marvin Road	$6-7	$2-3	$52-62	$60-72
I-5 Auxiliary Lanes	$2-3	$0	$14-17	$16-20
TOTALS				$115-$141

Process and Implementation

This report identifies the need to improve existing Interstate 5 interchanges at Sleater-Kinney Road, Martin Way, and Marvin Road, and the need to add an interchange with Interstate 5 at Carpenter Road between existing interchanges at Martin Way and Marvin Road. WSDOT and the Federal Highway Administration (FHWA) approvals are required for modifications and/or new interchanges on the interstate system in the form an Interchange Justification Report. The following summarizes (1) the recommended process for preparation, review, and approval of an interchange justification report (IJR), and (2) the recommended process for environmental documentation in coordination with an interchange justification report.

Interchange Justification Reports

An interchange justification report is governed by WSDOT Highway Design Manual (HDM), Chapter 1425. The IJR report is a stand-alone document with necessary

supporting documentation to support a request for revised access or new access to a limited access facility (i.e., interstate freeway). A new freeway to crossroad interchange (in Thurston County) requires WSDOT and local FHWA approval. A revised interchange with potential impacts to the mainline also requires WSDOT and local FHWA approval. See WSDOT HDM Figure 1425-1 for additional detail.

IJR reports (new or revised access) typically start with formation of a "Support Team," consisting of representatives from the following agencies:

- FHWA;
- WSDOT Headquarters;
- WSDOT Region;
- Local City(ies);
- Metropolitan Planning Organization (MPO);
- Transit Agency; and
- Consultants

The composition of a support team is essentially identical to the Stakeholder Group formed for this study.

The Support Team guides the preparation of the IJR report. The report is organized into eight (8) policy points:

1. Need for the Access Point Revision
2. Reasonable Alternatives
3. Operational and Accident Analysis
4. Access Connections and Design
5. Land Use and Transportation Plans
6. Future Interchanges
7. Coordination
8. Environmental Processes

The proponent (City of Lacey) submits the draft report to the WSDOT Headquarters Access and Hearings Unit. The Access and Hearings Unit submits the final draft report to the local FHWA office in Olympia.

When the IJR report is ready for approval, FHWA issues a "Finding of Engineering and Operational Acceptability", pending the associated environmental decision (i.e., FONSI). FHWA provides final IJR approval concurrent with the environmental decision.

The following is a brief description of each policy point:

Policy Point 1 – Need for the Access Point Revision

This point answers the following questions:

- *What are the current and projected needs?*
- *Why are the existing access points and the existing or improved local system unable to meet the proposed needs?*

- *Is the anticipated demand short or long trip?*

The work from this study specifically addressed these questions so the Stakeholder Group could make an informed decision about moving forwarding with the preparation of a full IJR report(s). The results described in Sections II, III, and IV demonstrate a clear need, and the need cannot be addressed solely by improvement to existing access points and/or the local street system.

Policy Point 2 – Reasonable Alternatives

This point describes alternatives considered for revised access configurations. The options described in the New Interchange Options section serve as a solid foundation for development of this point. The Stakeholder Group should decide if consideration of additional alternatives is warranted.

Policy Point 3 – Operational and Accident Analysis

This point answers the question, *"How will the proposal affect safety and traffic operations at year of opening and design year?"* The operational evaluations described in this report provide a start to developing this policy point. More detailed analysis is required pending selection of an interchange configuration.

Policy Point 4 – Access Connections and Design

This point answers the question, "*Will the proposal provide fully directional interchanges connected to public streets or roads, spaced appropriately, and designed to full design level geometric control criteria?"*

This study evaluated the geometric layout of the alternative interchange configurations considered within the Preliminary Geometric Analysis of Interchange Improvements section.

Policy Point 5 – Land Use and Transportation Plans

This point answers the question, *"Is the proposed access point revision compatible with all land use and transportation plans for the area?"*

The traffic forecasts for this study incorporated all land use and transportation plans for the area. This point will document the compatibility in detail.

Policy Point 6 – Future Interchanges

This point answers the questions, *"Is the proposed access point revision compatible with a comprehensive network plan? Is the proposal compatible with other known new access points and known revisions to existing points?"*

This study specifically addresses this point by studying the Interstate 5 corridor from Sleater-Kinney Road to Nisqually Road. The results of this study will allow the Study Team to proceed with access revisions and/or new access points along the corridor in a coordinated manner.

Policy Point 7 – Coordination

This point answers the question, *"Are all coordinating projects and actions programmed and funded?"*

This point describes coordination between development infrastructure and interchange improvements to avoid interchange improvements without the associated development infrastructure.

Policy Point 8 – Environmental Processes

This point answers the question, *"What is the status of the proposal's environmental processes?"*

This point provides a brief summary of the environmental documentation and permitting process. It can also include screening-level information similar to the Preliminary Environmental Screening section of this report.

Possible Packaging of Interchange Justification Reports

The interchanges along Interstate 5 within the study area are within close proximity. This proximity creates interplay between adjacent interchanges. This interplay provides opportunities for different approaches to preparing interchange justification reports for the access revision described in Existing Interchange Improvement Options and the new access point at Carpenter Road described in New Interchange Options. The following are possible approaches to packaging IJR reports:

- One Report – prepare one IJR for all of the interchanges - Sleater-Kinney, Martin Way, Carpenter Road, and Marvin Road.
- Two Reports – prepare one IJR for Sleater-Kinney and Martin Way and one IJR for Carpenter Road and Marvin Road.
- Four Reports – prepare a separate IJR report for each interchange – Sleater-Kinney, Martin Way, Carpenter Road, and Marvin Road.

Preparing one report for each interchange (four reports) reduces the risk of schedule delay potentially caused by a point of controversy specific to one of the interchanges. However, it makes it more difficult to document the interplay between adjacent interchanges and it creates economy-of-scale inefficiencies.

Conversely, preparing one report for all interchanges simplifies the documentation of interplay between adjacent interchanges and enjoys economy-of-scale efficiencies, but the risk of schedule delay is great.

Preparing two reports—one for Sleater-Kinney and Martin Way and another for Carpenter Road and Marvin Road—is likely the best approach to balance schedule risk, interplay between adjacent interchange, and economies-of-scale.

Environmental Documentation and Entitlements

In the absence of specific schedule pressures, it is best to defer detailed environmental documentation until there is clarity on whether an IJR report will receive a finding of engineering and operational acceptability. It can be advantageous to perform preliminary environmental documentation (reconnaissance and screening) for use in selecting a final interchange configuration—similar to the work done in the Preliminary Environmental Screening section of this report.

Appendix A

DISPOSITION OF STAKEHOLDER GROUP COMMENTS TO THE AUGUST DRAFT

Olympic Region Traffic Office

Review Comment Form

Project Title:	Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)	Job Charge #:	
Reviewer (name & office): Jim Norman/Olympic Region Traffic Date of Review Comments: 9/10/2009		Responses By: Date of Disposition:	

Comment No.	Sht or Pg.	Review Comment	Status Code	Designer's Response
1.		Please include basic freeway section analyses for freeway sections that are between the off and on ramps at interchanges.	A	Analysis results added to Figures 5 & 15
2.	App B Page 3	95% queues should be based on the average of 5 runs of 20 minute SimTraffic simulations using different random number seeds.	C	This will be addressed during preparation of subsequent IJRs.
3.		Please include a 2030 diverge analyis of the SB Marvin Rd off ramp.	C	Diverge analysis requires a minimum of 2 through lanes and current plans show 1 lane at diverge points, therefore the analysis cannot be performed
4.		Please include a 2030 diverge analyis of the NB Marvin Rd off ramp.	A	Analysis results added to Figures 5 & 15

Status Code Legend: A = Incorporated B = Open/Under Review C = Evaluated/Not Incorporated D = Beyond Scope/Not Evaluated
All "B" and "C" responses require explanatory comments.

Olympic Region Traffic Office

Review Comment Form

Project Title:	Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)	Job Charge #:	
Reviewer (name & office): Michael Villnave/Olympic Region Traffic Date of Review Comments: 9/10/2009		Responses By: Date of Disposition:	

Comment No.	Sht or Pg.	Review Comment	Status Code	Designer's Response
1.	Signature Page	We would like to add the statement *"Given the currently proposed land use assumptions"* to the beginning of bullet item one.	A	The requested language is shown in the second bullet of the revised signature page.
2.	Signature Page	Add another bullet, *The traffic demand model output trip distributions assumes I-5 mainline improvements are required.*	A	The requested language is included as the first bullet of the revised signature page.
3.	Page 9	***2007 and 2030 Baseline Operating Conditions*** Freeway Segment Enhancements - Is this telling us we need to have extra lanes on I-5 in the future for this study to be realistic?	N/A	The improvements recommended by the study are realistic whether I-5 is widened or not. The purpose of the widening of I-5 in the model is to allow for clearer differentiation in performance of the studied alternatives.
4.	Page 18 Figure 5	Does the LOS for 2030 forecasted values include this I-5 widening identified in the travel demand model? If not please clarify as to what was assumed in generating the LOS	N/A	Yes, the forecasted LOS includes the assumed widening of I-5.
5.	Pg. 59-60	***Summary and Conclusion*** *Sleater Kinney Road Interchange* - Providing the left turn may be a cost effective method to provide the northbound direction, but the volume dictates that a signal will be needed, based on spacing and the LOS F to the Martin Way intersection this is not practical and with or without the signal traffic will back up into this intersection and left turns will be impossible.	A	We added language describing the noted challenges.

Status Code Legend: A = Incorporated B = Open/Under Review C = Evaluated/Not Incorporated D = Beyond Scope/Not Evaluated
All "B" and "C" responses require explanatory comments.

Olympic Region Traffic Office

Review Comment Form

Project Title:	Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)		Job Charge #:	
Reviewer (name & office): Michael Villnave/Olympic Region Traffic Date of Review Comments: 9/10/2009			Responses By: Date of Disposition:	

Comment No.	Sht or Pg.	Review Comment	Status Code	Designer's Response
6.	Pg. 59-60	***Summary and Conclusion*** *Sleater Kinney Road Interchange* - The roundabout has issues with the K-mart entrance, this will need to be closed and again the spacing to the adjacent intersection of Martin Way with the LOS, we see operating issues with traffic backing up into the roundabout making all movements next to impossible	A	We added language describing the noted challenges.
7.	Pg. 59-60	This is the first I have seen of these improvements. I do not feel these should be part of the report at this time and should be taken out of the Technical Summary Report.	C	This will be addressed during preparation of an IJR for Sleater Kinney Road and/or Martin Way.

Status Code Legend: A = Incorporated B = Open/Under Review C = Evaluated/Not Incorporated D = Beyond Scope/Not Evaluated
All "B" and "C" responses require explanatory comments.

Olympic Region Traffic Office

Review Comment Form

Project Title:	Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)	Job Charge #:	
Reviewer (name & office): Thera Black/TRPC Date of Review Comments: 9/10/2009		Responses By: Date of Disposition:	

Comment No.	Sht or Pg.	Review Comment	Status Code	Designer's Response
1.		**Slip Ramp Access to New Park and Ride** Please consider the relationship of the new slip ramp to Hogum Bay Road and the new regional park-and-ride Intercity Transit is building at the landfill. I hope there'll be an opportunity for the new slip ramp to enhance ingress / egress to the new park-and-ride. At the very least we have to be sure that the design of one does not preclude access to the other.	C	This will be addressed during preparation of an IJR for Marvin Road.
2.		**Consistency with Regional Transportation Plan** We'll want to brief the TPB on the findings / recommendations when they are approved by the City Council since much of this is definitely in the category of 'regionally significant' and then integrate this as appropriate into the Regional Transportation Plan. Maybe a presentation of the issues, process, and recommendations?	N/A	Noted. We would be happy to make a presentation to the TPB.
3.		**Integration of Gateway EIS and Regional Improvement Scenario** I appreciate the forward-thinking approach on the part of the City to preserve the frontage road ROW described in the RIS as a part of the Gateway project. It will be much easier to secure that now than 10 years from now.	N/A	
4.		**Sleater-Kinney Interchange** While I appreciate the addition of northbound turn movements to the I-5 SB interchange at Sleater-Kinney I think Lacey will want to engage Olympia on this well before the IJR process is finalized.	N/A	Noted. Lacey will engage Olympia during subsequent study of improvements to the Sleater Kinney interchange.

Status Code Legend: A = Incorporated B = Open/Under Review C = Evaluated/Not Incorporated D = Beyond Scope/Not Evaluated
All "B" and "C" responses require explanatory comments.

Appendix B

LTSAAE CHARTER AND ASSUMPTIONS DOCUMENT

The technical appendices are included as published at their time. In some instances subsequent analyses refined the results of the published material. Any such refinements are reflected in the subsequent materials, but the published material is unchanged.

City of Lacey

Transportation Systems Analysis and Alternatives Evaluation Charter

A partnership between

City of Lacey
WSDOT
FHWA
TRPC

Prepared by

Parametrix
Shea, Carr & Jewell, Inc.
W & H Pacific

(updated) **September 2007**

TEAM ROLES & RESPONSIBILITIES

The TEAM

Scott Egger – City of Lacey
Roger Schoessel – City of Lacey
Martin Hoppe - City of Lacey
Angelea Miller – City of Lacey
Lee Padilla – City of Lacey
Jerry Litt – City of Lacey

Troy Cowan – WSDOT OR
Dick Albin – WSDOT State Design Engineer
Rebecca Hawkins – Access, WSDOT HQ
Barb De Ste. Croix – Access, WSDOT HQ
Steve Kim – Traffic Engineer, WSDOT OR
Mike Villnave – Traffic Engineer, WSDOT OR
Vicki Steigner – Planning, WSDOT OR

Don Petersen – FHWA (technical assistance as needed)
Bryan Dillon - FHWA

Thera Black – Regional Transportation Planning Coordination, TRPC

Dale Rancour – Thurston County Roads and Transportation Services

Dennis Bloom – Intercity Transit

Perry Shea – Project Management, Shea, Carr & Jewell, Inc.
Kirk Wilcox – Design Engineer, Parametrix
Josh Diekmann – Project Management/Planning/Operations, Parametrix
Scott Sawyer – Strategy, W&H Pacific

Responsibilities – Overall Team responsibilities are captured in this work plan; and Team Member roles and responsibilities are captured in the task planning worksheets.

City of Lacey

- Funding the Analysis Phase; funding for subsequent phases not secured
- Manage consultant work
- Look to WSDOT for policy decisions on process and design
- Continue to look for funding (securing of funds does not obligate others to a specific solution)
- Provide communication and coordination with development community and property owners

WSDOT – Olympic Region

- Troy Cowan
  - Provide policy assistance
  - Serve as a project advocate
  - Day to day contact/communication at the project level

- Steve Kim, Mike Villnave – Traffic
  - Review/advise/approve technical operations analysis
  - Provide traffic data
  - Coordinate with TRPC
- Vicki Steigner – Planning
  - Regional consistency with other processes and projects
- Environmental – TBD
  - Determine lead agency/level of documentation
  - Review/advise/approve environmental documents

WSDOT – HQ

- Provide technical assistance and policy direction
  - Rebecca Hawkins, Barb de Ste Croix– Access issues
  - Dick Albin– Design
- Liaison between Olympic Region & FHWA
- Look at alternatives and design criteria
- Review of project documentation prior to submittal to FHWA
- Commitment to key decisions
- Coordinate with Region traffic office

FHWA – Bryan Dillon, Don Petersen

- Concurrence on design engineering and operational acceptability; (potential) IJR and NEPA
  - Traffic
  - Design

TRPC – Thera Black

- Provide land use data
- Ensure consistency with regional assumptions
- Ask questions/identify travel demand model related issues
- Coordinate land use changes if proposed
- Help City identify and secure funding

Thurston County – Dale Rancour

- Provide input and data regarding County facilities and planning
- Identify opportunities for inter-jurisdictional cooperation

Intercity Transit – Dennis Bloom

- Provide input regarding future transit facilities and operations plans

Consultant Team

- Prepare deliverables
- Conduct analysis
- Manage scope/schedule/budget/MPD
- Facilitate decisions
  - Overall – Perry
  - Design – Kirk
  - Planning – Josh
  - Policy Points - Scott

PROJECT DESCRIPTION:

Features

There are currently no "project features" identified, as the City has only conducted preliminary needs assessment. The preliminary analysis indicates that there will need to be enhancements to the transportation network in order to accommodate planned growth.

During the project process, additional analysis will be conducted; traffic methodology, study area, and other key project elements will be coordinated closely with WSDOT and FHWA staff. This team intends to identify a range of improvement alternatives and, through the analysis, develop a recommendation for a preferred solution.

History

- Carpenter Road Corridor Study, Carpenter Road Capacity and Safety Project and Carpenter Road Interchange Feasibility Study identified in TRPC 2025 Regional Transportation Plan, Lacey Transportation Plan
- Martin Way and I-5 Interchange Improvements, Phases 1 and 2 identified in TRPC 2025 Regional Transportation Plan, Lacey Transportation Plan
- Northeast Lacey Sensitivity Study conducted by City of Lacey in 2005

Current Challenges

- Environmental issues such as slopes, wetlands and critical habitat may create design constraints
- Project has not been identified on official WSDOT project list
- City of Lacey has begun collecting mitigation funds for corridor study and analysis; no direct project funding available at this time

Project Objective

The study will include a 3-step traffic evaluation:

- Improvements to local network; if issues still exist, then
- Improvements to existing interchanges; if operational issues remain, then
- Adding new access to interstate system

Prior to that process, the "Baseline Network" will be established and concurrence with the stakeholder team reached.

Ad Date

- No Construction phase is currently funded.

BOUNDARIES

Budget

- Funding opportunities to be identified
- WSDOT will provide in-kind services in form of project stakeholder involvement, policy oversight, and technical assistance, review, and approval.

Authority

- The project manager and team have the authority, in accordance with good engineering practice to make this project a success.
- In the event issues arise which exceed the authority of the project team, these will be presented to the City of Lacey for resolution.

MEASURES OF SUCCESS

Success Goal	Measurement
Overall project budget and schedule met	On-Time/On-Budget Delivery
Approved Study	Approval documented, received
Project development moving forward	"Project" has been defined Development community/City Council sees progress in project development

RISK ASSESSMENT

List of risk items that could delay project or increase project cost, including solutions to minimize risk:

Risk	Solutions
Changes in Project Team or Stakeholder membership	Commitment of team and stakeholders to documented decisions
Timeline	Aggressively seek additional funding sources at all levels, including local, regional, and state sources; Define "project"
Changes in Key Decisions	Commitment to document decisions as they are made through Technical Memorandum submittal process
Design Approval	Mitigate risk of changes in criteria by seeking approvals to interim decisions
Policy Changes	Discuss with WSDOT and FHWA to determine course change; document

OPERATING GUIDELINES

Team Decision-Making Process

Decision Making Styles:

- Autocratic: At times the City of Lacey will make decisions and report decisions to project team and staff.
- Group Decisions: The project manager will bring other issues for discussion and analysis to the project team meetings or meeting specifically called for the issue. The City of Lacey, WSDOT and their consultant will jointly make the decisions based on the input from the team.

Team Meetings (structure, timing & location)

The project team recognizes the importance and value of well-organized meetings in which participants are well prepared. Meetings are vehicles for team communication, decision-making and project status reporting. To that end the following expectations are established for all meetings:

- START ON TIME: meetings will start at the scheduled time, those arriving late can catch-up during breaks or as opportunity allows;
- FINISH ON TIME: when the meeting is over, it's over. The length of a meeting may be extended if the team desires, those who must leave may do so.
- ARRIVE PREPARED: each team member is expected to be current on his or her portion of the project and arrive with all materials necessary for sharing information at the meeting (handouts, displays, etc.).
- PARTICIPATE: each team member recognizes that valuable time is being spent at these meetings; to get the most value out of the meeting time requires sincere participation and open communication by all who are attending the meeting. Speak the truth. Give everyone an opportunity to speak.
- BE SMART & FLEXIBLE: if a meeting is not necessary, or if not enough people or information are available to make the meeting useful, cancel it and reschedule, or postpone until the next regularly scheduled meeting.
- MEETING SCHEDULE: No regular meeting schedule is anticipated. Meetings by topic will be scheduled as needed and may not require the presence of all stakeholders; however, major project decisions will involve input from all team members. It is expected that, should the recommended alternative from this study include an IJR, regular meetings with the stakeholder group will be arranged.

Communication

Good communication is the key to working together and the project team is committed to good communication, including:

- Monthly Project Reports: the Project Manager will distribute a monthly project report to all team members via e-mail, the first week of each month. The report should include an analysis of actual progress versus planned progress for each deliverable. All changes or anticipated changes will be reported to the City of Lacey. Report will be provided in PDF format.
- Communication: team members are free to communicate to any and all other members of the team as they deem necessary.

Cooperation & Accountability

- Team members understand accountability measures for this Project.
- Team Members commit to produce their deliverables endorsed in the Schedule.
- Unanticipated issues or other basis for inability to meet Scope, Schedule or Budget will be communicated promptly to the City of Lacey for Change Management.
- Issues will be collaboratively resolved. Project sponsors will be notified of unresolved issues affecting Master Schedule deliverables.
- Communication will be prompt, i.e. calls returned within 24 hours by recipient or designated alternate.

CHANGE MANAGEMENT PLAN

- Frequent and meaningful communication regarding changes in scope, schedule via regular team and leadership/management meetings,
- Evaluate changes for impacts to schedule and budget,
- No surprises!

COMMUNICATION PLAN

Project Level:

- City of Lacey, Parametrix, Shea, Carr & Jewell, Inc.

Internal (within the project and within each group) - *See Operating Guidelines, Communication for details.*

- Whom:
  - Project Team
- Methods:
  - Email, phone calls

External (Stakeholders, Media, Community)

STAKEHOLDER ACCEPTANCE

The undersigned parties concur with the Charter for the City of Lacey Transportation Systems Analysis and Alternatives Evaluation presented in this document.

City of Lacey

_____
Signature

_____
Title

_____
Date

WSDOT – Olympic Region

_____
Signature

_____
Title

_____
Date

WSDOT –Access and Hearings

_____
Signature

_____
Title

_____
Date

FHWA

_____
Signature

_____
Title

_____
Date

Thurston Regional Planning Council

_____
Signature

_____
Title

_____
Date

Note: Participation on the Stakeholder team and/or signing of this document does not constitute approval of study findings or recommendations.

City of Lacey
Transportation Systems Analysis and Alternatives Evaluation

Assumptions Document for:
Traffic Operations & Model Forecasting Methodology

Prepared by:
Shea, Carr & Jewell, Inc. and Parametrix

Updated – May 1, 2008

TABLE OF CONTENTS

Stakeholder Acceptance

The undersigned parties concur with the assumptions for the *City of Lacey Transportation Systems Analysis and Alternatives Evaluation* presented in this document

WSDOT - Headquarters Traffic

Signature

Title

Date

FHWA

Signature

Area Engineer

Title

Date

WSDOT – Olympic Region Traffic

Signature

Title

Date

Note: Participation on the Stakeholders Committee and/or signing of this document does not constitute approval of the *Transportation Systems Analysis and Alternatives Evaluation* Report.

1. Introduction and Project Description

The City of Lacey is in the early stages of preparing a study that will involve a detailed evaluation of the arterial and highway network and future traffic demand in the north Lacey area. Current traffic levels on both the local and interstate systems have grown significantly over the past ten years and this growth trend is expected to continue in both the Lacey and Thurston County regions. Preliminary travel forecasts indicate that several of the primary arterials (Marvin Road, Martin Way, and Carpenter Road) will experience increases in traffic levels by more than 50% by 2015 and up to 100% increase on selected roadway segments by 2030. The projected traffic levels are also expected to affect the interstate system as well; forecasts from the regional travel demand model predict a 40-50% increase in freeway segments and a 70-80% increase in ramp volumes for several of the interchange junctions serving the Lacey area.

This growth has been anticipated for some time, and the City has invested significant resources in developing the local transportation infrastructure to help accommodate this growth. Specific examples include:

- Widening Marvin Road to a four-lane boulevard between I-5 and Willamette Parkway including the installation of two multi-lane roundabout intersections
- Constructing Britton Parkway, a new east-west arterial between Marvin Road and Carpenter Road
- Rebuilding and widening the Marvin Road/Interstate 5 diamond interchange with a future Phase 2 to convert the diamond configuration to a “single point urban interchange” (SPUI)

Each of these projects was completed in the early 2000s and is expected to reach the design-year traffic levels within the next 5 to 6 years. The City is planning to improve several other arterials and intersections to help alleviate the current traffic conditions and near-term growth patterns. However, even with these other local improvements, it is expected that traffic flow and access to the interstate system will be constrained to unacceptable service levels. These operational conditions will be summarized and identified in this study and the results will enable the City of Lacey and project stakeholders to assess options and opportunities to improve the transportation system through the Lacey urban area.

This study will also refine the Thurston Regional Planning Council (TRPC) travel demand model for the Lacey area. The enhanced traffic model will be used to predict the future traffic conditions expected to use the local and interstate systems. These future-year forecasts will be used to assess and analyze the adequacy of the existing interstate facilities and future arterial street system, including each interchange junction.

The following sections of this Traffic Analysis Assumptions Document will define and confirm the study area, and document concurrence on model forecast methodology and analytical parameters.

2. Project Study Area

The study area pictured below will include the I-5 corridor from the Sleater-Kinney Road interchange (Exit 108) to the Martin Way-Nisqually interchange (Exit 114). The study area will also include primary surface street and intersections between Sleater-Kinney Road and Marvin Road as well as corridors north and south of Interstate 5.

Figure 1 highlights the study area as approved by the project stakeholders.

SHEA CARR JEWELL Inc.

Study Area

Figure 1

Study Area

Transportation Systems Analysis and Alternatives Evaluation

3. Evaluation Process/Modeling

3.1 Analysis Horizon Years

For this study, the team will evaluate base year 2007 conditions and estimated conditions for the 2013 and 2030 horizon years. The 2013 horizon corresponds with the six-year Transportation Improvement Program horizon. This year was selected as being a reasonable implementation year for potential improvements based on corridor priorities and assumed funding availability.

The design year 2030 is consistent with the regional strategic planning horizon and environmental documentation. It is approximately 20 years past the year of opening and is the forecast year evaluated by the TRPC for the current Regional Transportation Plan (RTP), adopted in June 2007.

3.2 Evaluation Process

This study will evaluate the existing roadway network in the study area to identify existing deficiencies. The future year scenarios will initially be evaluated under "baseline" conditions. The baseline roadway network will include the roadway improvements identified in the 2030 RTP for areas outside of the Lacey UGA, but only projects on the current 6-Year Transportation Improvement Program (6-yr TIP) will be included in the baseline network for roadways within the City of Lacey UGA.

Roadway and intersection deficiencies will be categorized as those facilities that are currently operating or are projected to operate below the adopted level of service (LOS) standard. WSDOT has set a LOS threshold of D for Interstate-5. The LOS for City transportation facilities is LOS D, with the exception of the Martin Way corridor intersections which have a LOS E threshold. In addition, the City has adopted specific ordinances addressing the limitation of expanding their arterial network beyond five travel lanes in width. The City's ordinance does not dictate that improvements need to be made on the Interstate to accommodate local traffic. For those intersections or highway segments already operating below the applicable LOS threshold, the time delay associated with the pre-development LOS will be used rather than the applicable deficiency level. Both the LOS criteria and the specific roadway width condition will be considered when evaluating various system alternatives.

If roadway deficiencies are identified, additional facility improvements will be considered incrementally. The following describes the building block approach to the operational analysis that will be used to identify potential roadway improvements to accommodate area traffic growth:

- Identify existing 2007 conditions
- Evaluate future year "baseline" conditions – Includes all improvements identified in the current RTP outside of Lacey and only the Lacey 6-yr TIP transportation projects within the Lacey UGA
- Consider additional network improvements to City of Lacey surface streets (projects could be taken from the City of Lacey Comprehensive Transportation Plan or new projects not identified on a current plan)

Once we have exhausted all reasonable alternatives and improvements to the city street network, we will proceed with the following scenarios:

- Evaluate improvements to existing Interstate 5 access points
- Explore potential new access points to Interstate 5

3.3 Surface Street Intersection Operations Analysis

Synchro 7.0 software was selected to analyze the operations of signalized surface street and ramp terminal intersections operations. The *Highway Capacity* software (HCS) will be used to analyze all unsignalized intersections, including ramp terminals. The current version of the SIDRA software package was selected to analyze roundabout controlled intersections in the study area. SimTraffic will be used for queuing and turn lane spillover analysis. Study intersections selected by the project team and listed below will be analyzed during the AM and PM single peak hours only.

The following local network intersections will be evaluated in this report:

- Martin Way/Sleater-Kinney Rd
- Martin Way/College Street
- Martin Way/Carpenter Rd
- Martin Way/Marvin Rd
- Martin Way/Meridian Road
- 15th Avenue NE/Sleater-Kinney Rd
- 15th Avenue NE/College Street (Future Intersection)
- Draham Rd/Carpenter Rd
- Britton Pkwy/Carpenter Rd
- Britton Pkwy/Marvin Rd
- Hogum Bay Rd/Marvin Rd
- 3rd Avenue SE/College Street
- 6th Avenue SE/Sleater-Kinney Rd
- Orion Drive /Willamette Drive
- Willamette Drive/Hogum Bay Road
- Quinault Drive/Marvin Road
- Main Street/Marvin Road (Future Intersection)
- Orion Drive/Meridian Road

Analysis results are based on the criteria as defined by the 2000 HCM. Results will be summarized into LOS tables. Average intersection delay, intersection LOS, intersection volume/capacity (v/c) ratio, and 95th percentile queuing (compared to actual/effective storage) will be used as performance measures. LOS and queuing results will be taken from Synchro HCM output tables and from SIDRA outputs including intersection and movement summaries.

Year 2007 existing conditions analysis will be based on traffic volumes collected in the study area since 2005. Peak hour factors and heavy vehicle percentages used in the analysis will reflect the conditions of each approach as observed during the turning movement count. Heavy vehicle percentages will be increased by 2.0 percent for intersections in the Hawks Prairie area north of Interstate 5 for the 2030 design year (i.e., an intersection experiencing 4.0 percent heavy vehicles in 2007 and 2013 would be assumed to experience 6.0 percent heavy vehicles in 2030). Specifically the truck percentage increase will be included at following intersections:

- Britton Parkway/Marvin Road
- Main Street/Marvin Road
- Hogum Bay Road/Marvin Road
- Interstate 5 SB Ramps/Marvin Road
- Interstate 5 NB Ramps/Marvin Road
- Willamette Drive/Hogum Bay Road
- Orion Drive/Willamette Drive

When analyzing a signalized improvement to an unsignalized intersection, assumptions for pedestrian crossing time will be made based on pedestrian walking speed and crossing distances from conceptual drawings. If concept drawings do not exist, assumptions will be made based on lane width and number of lanes.

3.4 Freeway Operations Analysis

The HCS will be used to analyze all unsignalized ramp terminals and will be used to validate the merge/diverge connections on all ramps. Vehicle speed and density will be used as performance measures for the HCS analysis.

In addition to the local network intersections listed above, the following interchange junctions will be included in the report:

Exit 108 – Sleater-Kinney Rd Interchange
- I-5 SB Ramps/Sleater-Kinney Rd
- I-5 NB Off-Ramps

Exit 109 – Martin Way Interchange
- I-5 SB Ramps/Martin Way
- I-5 NB Ramps/Martin Way

Exit 111 – Marvin Road Interchange
- I-5 SB Ramps/Marvin Road
- I-5 NB Ramps/Marvin Road
- Quinault Dr/Marvin Road
- Quinault Dr/Galaxy Way

Exit 114 – Martin Way - Nisqually Interchange
- I-5 SB On-Ramp/Nisqually Cut-Off Rd
- I-5 NB Off-Ramp/Nisqually Cut-Off Rd
- I-5 NB On-Ramp/SB Off-Ramp/Martin Way/Nisqually Cut-Off Rd

The project will require a simulation model capable of analyzing freeway and intersection to intersection geometry, including weaving sections and multiple vehicle classes. VISSIM was selected for the simulation of the preferred alternative because it meets these needs while also providing animation graphics.

Operational modeling of the freeway corridor will be conducted over two one-hour peak periods using the VISSIM software. The existing peak one-hour volumes generally fall into the 7:30 - 8:30 AM and 4:30 - 5:30 PM time periods. All traffic analysis will be reported for the AM and PM single peak hours only. The study area will include the I-5 corridor between Sleater-Kinney Road and Martin Way at Nisqually.

The FHWA report “Guidelines for Applying Traffic Microsimulation Modeling Software” will be used to develop and calibrate the VISSIM model. HCS calculations will also be included in the traffic operations section of the study. VISSIM microsimulation results will not be directly interpreted into HCS LOS tables or used as a primary analysis tool. It is important to note that VISSIM will only be used as a secondary analysis tool to validate and illustrate the HCS analysis findings. All results will be based on the AM and PM peak hours.

3.5 Travel Forecast Methodology

For this study, the most current regional Emme/2 model from TRPC will be used as the basis for preparing 2013 and 2030 traffic forecasts for the study roadways and intersection. Enhancements to the regional model will be implemented to better reflect new development and traffic circulation trends for the Hawks Prairie Area.

Planned Roadway Improvements

The 2030 "baseline" scenario will include all transportation improvements built into the 2030 TRPC model for the areas outside the Lacey UGA. Within the Lacey UGA only improvements on the current City of Lacey 6-yr TIP will be included in the baseline scenario modeled network.

Gateway Area Enhancements

The 2030 model has been enhanced to include additional detail representing the land-use and roadway plan for the Lacey Gateway Towncenter area generally bounded by Interstate 5, Britton Parkway, Carpenter Road and Marvin Road. Ten Traffic Analysis Zones (TAZ's) have been added to the 2030 model to represent the Lacey Gateway Towncenter. Population and employment estimates from the currently proposed Lacey Gateway Towncenter Master Plan have been built into the model, replacing the previous population and employment estimates for the TAZ's in that specific area.

The "backbone" roadway network for the Lacey Gateway Towncenter area has also been built into the enhanced 2030 model. The additional roadway network includes the new east-west "Main Street" roadway, and three north-south roadways between Main Street and Britton Parkway.

Freeway Segment Enhancements

In addition to the localized surface street improvements, the travel forecasts will be developed assuming an additional capacity lane on I-5 is in place between Nisqually and Sleater-Kinney. Because the local and highway system will be constrained by the 2030 forecast, travel demand flow and trip assignments will be significantly altered from normal driver tendencies. The widening of I-5 through the study area will allow the traffic model to distribute regional and local traffic in a more predictable manner. Therefore, the additional capacity lanes provide a means to assess the sensitivity of this improvement and to define a more realistic travel forecast and future-year model volumes.

3.6 Travel Forecasts

The resulting enhanced model will be used to generate 2030 baseline traffic volumes. It is anticipated that model "post-processing" will be utilized to account for localized discrepancies between existing "ground counts" and model-generated volumes. The recommended method will be to add the "model growth increment" (the difference between the 2007 and 2030 model volumes) to the existing ground count traffic volumes.

As traffic volumes increase, peaking behavior diminishes because a smaller proportion of motorists drive during the peak fifteen minute period. To reflect this, the peak hour factor (PHF) used for each successive horizon year will be increased. The PHF observed in ground counts will be used for the 2007 conditions with a minimum PHF of 0.75 used. In 2013, signalized intersections will have a minimum

PHF of 0.92 and unsignalized intersections will have a minimum PHF of 0.85. In 2030, all signalized intersections will use a PHF equal to 0.95 and unsignalized intersections a PHF equal to 0.92.

4. Summary

This assumptions document identifies specific criteria, processes and technical methodologies in establishing the baseline traffic conditions and future traffic levels for the north Lacey area. All future results, analyses and recommendations will be predicated on the underlying assumptions described in this document. All members of the Stakeholders Committee will accept this document as a guide and reference as the study progresses through the various stages of project development.

Appendix C

TECHNICAL MEMORANDUM: 2007 AND 2030 BASELINE ANALYSIS

The technical appendices are included as published at their time. In some instances subsequent analyses refined the results of the published material. Any such refinements are reflected in the subsequent materials, but the published material is unchanged.

SHEA CARR JEWELL Inc.

TECHNICAL MEMORANDUM

TO: LTSAAE Stakeholders

FROM: Perry Shea, P.E., Principal

DATE: February 29, 2008

REGARDING: Lacey Transportation Systems Analysis and Alternatives Evaluation – 2007 & 2030 Baseline Analysis
SC&J #0805.04

ENCLOSURES: Traffic Volume Calculation Worksheets

I. Introduction and purpose

The City of Lacey is in the process of preparing the *Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)* that will involve a detailed evaluation of the arterial and highway network and future traffic demand in the north Lacey area. This Technical Memorandum identifies and describes the existing roadway and intersection operations at all key locations within the study area. Predicted conditions for the "baseline" 2030 horizon have also been prepared to determine which facilities may require improvements to accommodate future traffic loading.

This study is being conducted in accordance with the guidelines and methodologies outlined in the *Assumptions Document for Traffic Operations & Model Forecasting Methodology.* Subsequent analysis will include screening various improvement strategies to identify a preferred program of roadway and intersection improvements.

This information has been prepared for Stakeholder review in advance of the LTSAAE meeting on March 4, 2008.

II. Traffic Volume Projections

Existing AM and PM turning movement counts were collected for the study intersections over 2006 and 2007. The average 2006 AM and PM mid-week peak hour traffic volumes on the I-5 mainline were provided by WSDOT Traffic Data Office for ADC R060 (permanent traffic recorder located between Marvin Road and Martin Way.) Counts collected in 2006 were increased by 4% to represent 2007 base year conditions. These traffic volume counts were used for the existing year analysis and as the basis for preparing the 2030 traffic volume projections.

The traffic volume projections used in this analysis were prepared using the regional Emme/2 transportation demand model. The model, prepared by Thurston Regional Planning Council (TRPC), has been most recently calibrated to represent 2005 traffic conditions. The base year model has subsequently been updated by TRPC to represent a 2007 (end of 2006) horizon by adding new households and employment in the area to the 2005 land-use.

Model Enhancements

TRPC has prepared a 2030 model scenario that includes the regionally adopted household and employment projections for the region. The 2030 scenario also includes all roadway improvements identified in the current Thurston County Regional Transportation Plan (RTP). For this analysis, the 2030 model has been enhanced to include additional detail specific to the Lacey area. The enhancements primarily involve the addition of traffic analysis zones in the Hawks Prairie Business District (located generally between I-5 and Britton Parkway, and Marvin Road and Carpenter Road – also known as the "Lacey Gateway Towncenter"). Also, additional household and employment have been added in areas where specific development proposals exceed the 2030 land-use projections built into the current TRPC model.

Model Network Modifications

As noted, the 2030 TRPC model includes all regional roadway and intersection improvements in the current adopted RTP. This applies to the areas outside of the LTSAAE study. Within the study area only the following improvements have been included in the 2030 "baseline" roadway network:

- Widening Carpenter Road from 2 to 4 lanes – Britton Parkway to Pacific Avenue
- Constructing College Street Extension (1 lane each direction) from 6th Ave NE to 15th Ave NE
- Constructing Interim Martin Way Interchange improvements. This project involves widening Martin Way at the I-5 ramp terminals to increase left-turn storage for the high left-turn operation onto the on-ramps.
- Widening Britton Parkway from 2 to 4 lanes – Marvin Road to Carpenter Road
- Constructing roadway grid in Hawks Prairie Business District. Basic network will include:
    - A new east-west roadway (Main Street) connecting Marvin Road and Carpenter Road between I-5 and Britton Parkway
    - Three new north-south roadways connecting Main Street and Britton Parkway
- Construction of Phase 2 of the Marvin Road Interchange, a Single Point Urban Interchange

In addition to the localized surface street improvements, the travel forecasts will be developed assuming an additional capacity lane on I-5 is in place between Nisqually and Sleater-Kinney. Because the local and highway system will be constrained by the 2030 forecast, travel demand flow and trip assignments will be significantly altered from normal driver tendencies. The additional capacity lanes on I-5 through

the study area will allow the traffic model to distribute regional and local traffic in a more predictable manner. Therefore, the additional capacity lanes provide a means to assess the sensitivity of this improvement and to define a more realistic travel forecast and future-year model volumes. This process and baseline assumption was presented at previous stakeholder meetings and endorsed by the committee for analysis purposes.

Model Post-Processing

While the model is calibrated to replicate existing travel patterns, traffic volumes on individual roadways may vary somewhat from existing traffic counts. To account for this variance, the transportation model traffic volume assignments were "post-processed" to align them with existing "ground counts." Specifically, the traffic volume growth predicted by the transportation model was added to the actual 2007 traffic volumes to prepare the 2030 AM and PM peak hour traffic volumes used in the analysis. The Traffic Volume Projection worksheets are provided as an attachment.

III. Operational Analysis Methodology

The acknowledged source for determining overall capacity for roadways and intersections is the current edition of the Highway Capacity Manual (HCM). Signalized and stop-sign controlled intersection analysis was performed using the Synchro software package. The software provides an analysis based on the methods of the 2000 Highway Capacity Manual. The Sidra software methodology was used to analyze the operation of the modern roundabouts.

Queuing was evaluated using the Simtraffic microsimulation program. A total of three simulations were run for each scenario. The 95th percentile queue results were averaged for each group of simulations.

Intersections were analyzed for existing and 2030 baseline conditions. As defined in this study, the 2030 baseline roadway and intersection conditions reflect the intersection and roadway improvements described in the previous section, including the Interstate 5 mainline widening.

Level of Service calculations for intersections determine the amount of "control delay" (in seconds) that drivers will experience while proceeding through an intersection. Control delay includes all deceleration delay, stopped delay and acceleration delay caused by the traffic control device. The Level of Service is directly related to the amount of delay experienced.

For intersections under minor street stop sign control, the LOS of the most difficult movement (typically the minor street left-turn) represents the intersection Level of Service. **Table 1** below shows the Level of Service criteria for unsignalized intersections.

Table 1. Level of Service Criteria for Stop Sign-Controlled Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	≤ 10
B	> 10 – 15
C	> 15 – 25
D	> 25 – 35
E	> 35 – 50
F	> 50

The *Highway Capacity Manual* (*HCM*) also presents capacity analysis results in terms of LOS for signalized intersections. The *HCM* bases the LOS criteria in terms of overall average delay a vehicle may experience at the intersection during the analysis period. Intersections under modern roundabout control are also assessed based on overall intersection delay. LOS delay criteria for signalized and modern roundabout-controlled intersections are shown in **Table 2** below.

Table 2. Level of Service Criteria for Signalized and Modern Roundabout Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	≤ 10
B	> 10 – 20
C	> 20 – 35
D	> 35 – 55
E	> 55 – 80
F	> 80

IV. Intersection Analysis Results

The existing 2007 and projected 2030 intersection analysis results are presented in the following sections. The operational analysis includes interaction between all major roadways and intersections within the study area. However, for presentation purposes the study area has been broken into five groups representing the influence areas of Interstate 5 interchanges and main north-south corridors.

Following is a brief description of the existing and predicted operation of the intersections within each of the five intersection groupings. The intersection control type for each location is noted on the Level of Service summary tables. Intersection analysis worksheets and Simtraffic queue evaluation summaries will be provided at the TSAAE stakeholder meeting on March 4.

Sleater-Kinney Road – College Street Corridors

This area includes the Sleater-Kinney Road interchange (Exit 108) and Martin Way interchange (Exit 109). It also includes the Martin Way/College Street intersection which is one of the busiest intersections in Thurston County. Currently the following are notable congestion points within the area:

- The Sleater-Kinney Road/Martin Way intersection operates near capacity during the evening peak hour
- The southbound I-5 on-ramp from Sleater Kinney Road occasionally backs up to 6th Avenue SE during the evening peak hour
- The Martin Way/College Street intersection and Martin Way interchange ramp junctions generate queues that impact upstream intersections. Eastbound and westbound left-turn queues on Martin Way between the ramp terminals frequently exceed the available storage capacity
- Eastbound queuing on Martin Way at College Street occasionally extends to the upstream traffic signal at Kasey Keller Drive
- Queuing on the SB off-ramp occasionally backs to the Interstate 5 mainline

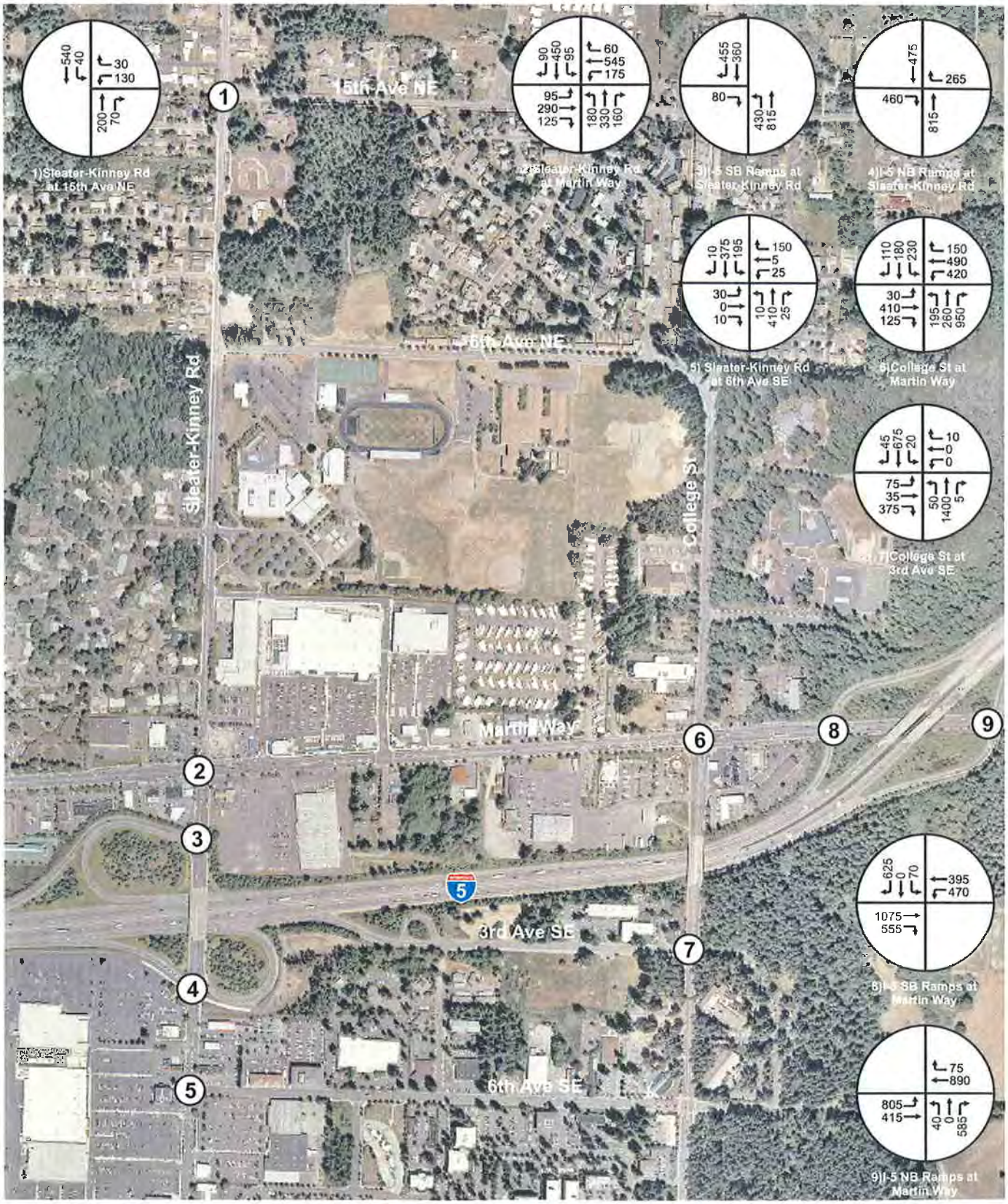
The 2030 analysis includes the extension of College Street to 15th Avenue NE creating a new 'tee' intersection. The analysis also includes additional left-turn lane capacity on Martin Way at the NB and SB ramp terminals.

With the increase in traffic expected by the 2030 horizon, the operation of the Martin Way interchange and Martin Way/Sleater Kinney Road intersection degrade to the point that it affects the flow of most of the other intersections within the area.

Table 3 Level of Service Summary - Sleater Kinney Road/College Street Corridors

Intersection	Control Type	Existing AM Peak Hour		2030 Baseline AM Peak Hour		Existing PM Peak Hour		2030 Baseline PM Peak Hour	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Sleater-Kinney Rd at 15th Ave	Stop	E	46.2	B	12.9	F	85.6	F	660.5
Sleater-Kinney Rd at Martin Way	Signal	D	49.1	F	83.4	E	59.9	F	124.1
I-5 SB Ramps at Sleater-Kinney Rd	Stop	A	9.7	B	11.7	C	16.2	D	28.2
I-5 NB Ramps at Sleater-Kinney Rd	Stop	D	31.4	D	31.3	F	138.4	D	32.5
Sleater-Kinney Rd at 6th Ave SE	Signal	C	27.5	F	191.6	D	50.1	E	60.9
College St at Martin Way	Signal	D	37.3	F	86.4	C	27.6	F	83.8
College St at 3rd Ave SE	Signal	B	16.5	C	20.4	D	42.3	C	34.7
I-5 SB Ramps at Martin Way	Signal	C	30.3	F	89.0*	D	41.6	F	112.3*
I-5 NB Ramps at Martin Way	Signal	D	47.9	B	16.4*	C	27.0	C	30.7*
15th Ave/College St (new intersection)	Stop	N/A		F	>999	N/A		F	>999

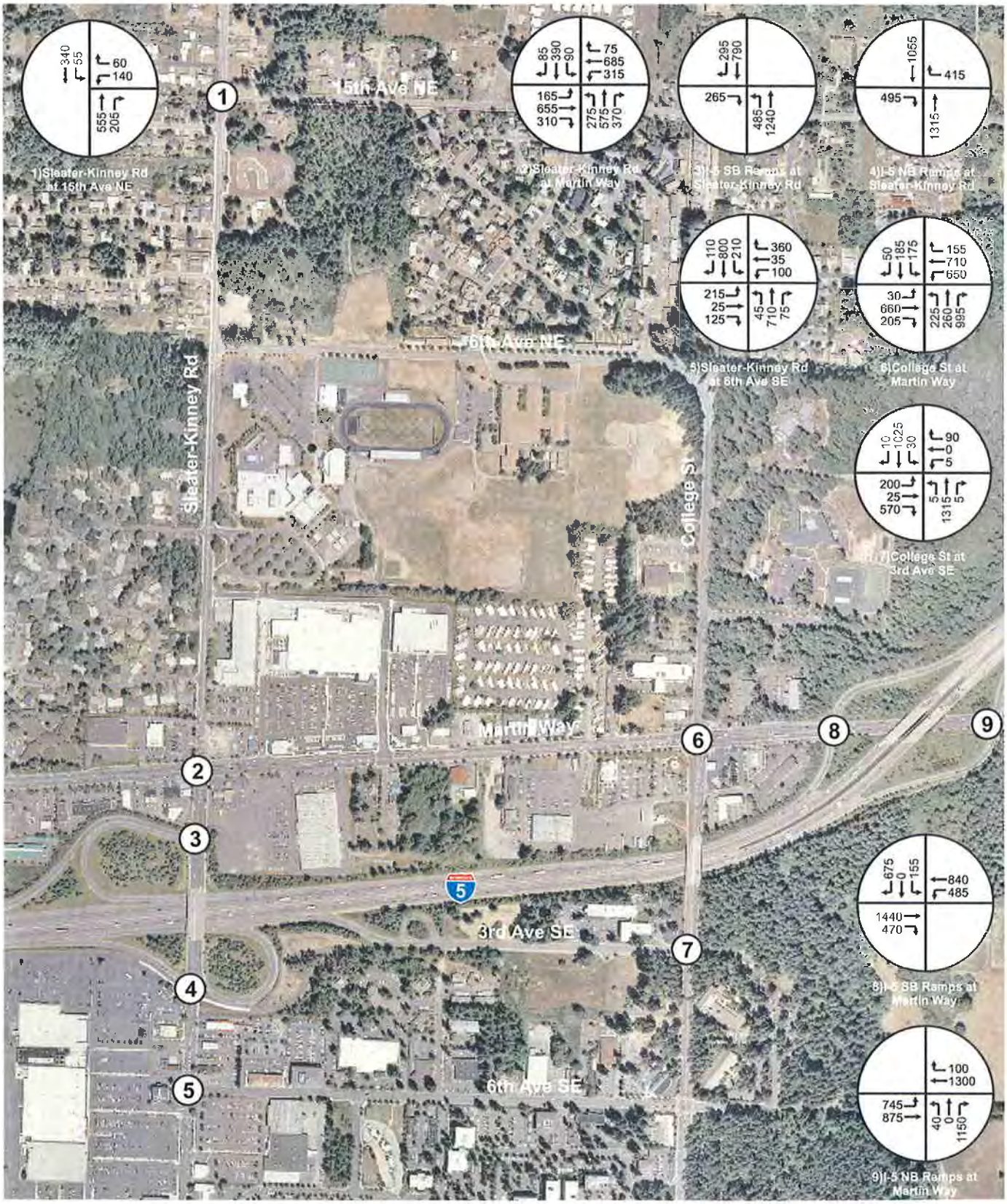
* Includes adding EB and WB left-turn lane storage on Martin Way for traffic entering the freeway



SHEA CARR JEWELL

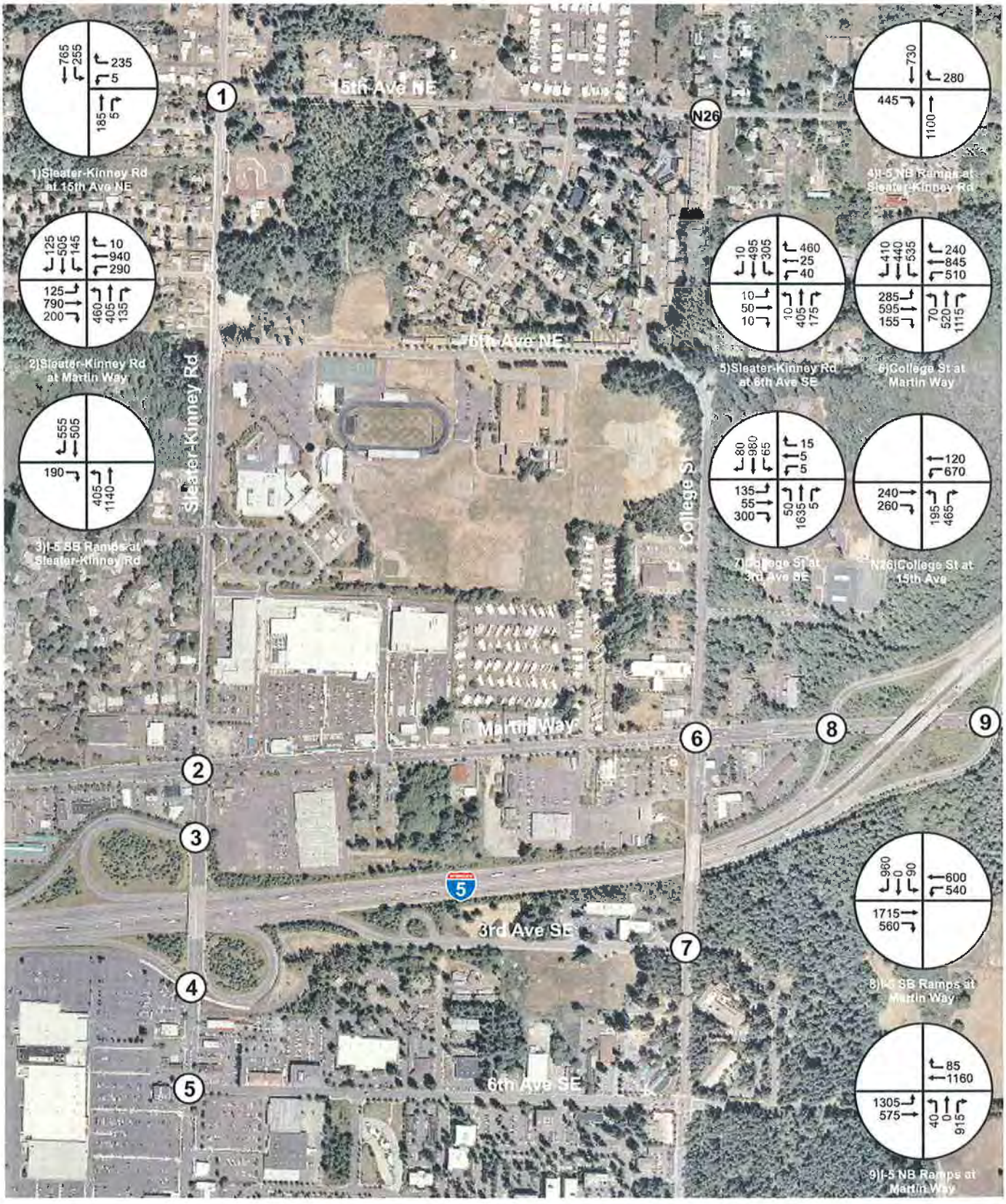
Sleater-Kinney Road and College Street Corridors
Intersection AM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation



Sleater-Kinney Road and College Street Corridors
Intersection PM Peak Hour - 2007 Volumes

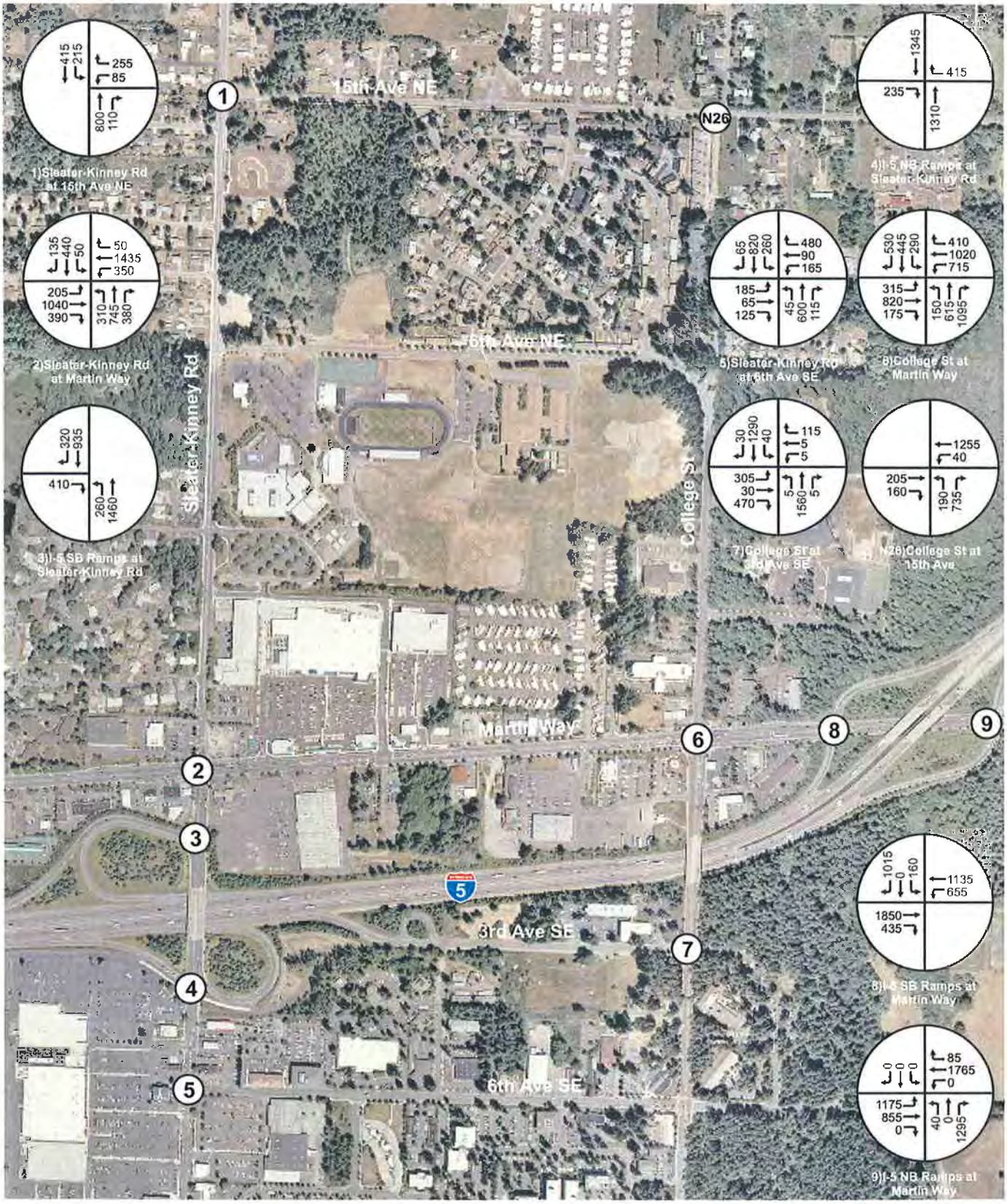
Transportation Systems Analysis and Alternatives Evaluation



SHEA CARR JEWELL

Sleater-Kinney Road and College Street Corridors
Intersection AM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation



SHEA CARR JEWELL

Sleater-Kinney Road and College Street Corridors
Intersection PM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Sleater-Kinney Road and College Street Corridors
Road Segments Significantly Impacted
By PM Peak Hour Queuing

Transportation Systems Analysis and Alternatives Evaluation

Carpenter Road Corridor

This area includes the study intersections along Carpenter Road between Martin Way and Britton Parkway. Under current conditions, each intersection operates acceptably during the morning and evening peak hours.

In the 2030 scenario Carpenter Road has been assumed to be widened to a 5-lane roadway between Pacific Avenue (south of the study area) to Britton Parkway. Also Britton Parkway has been widened to 2 lanes in each direction.

The Martin Way/Carpenter Road intersection reflects planned improvements that involve implementing dual left-turn lane operation for eastbound and westbound movements on Martin Way. The project also includes widening the northbound and southbound approaches of Carpenter Road to include two through lanes and exclusive left-turn lanes.

In the 2030 horizon significant traffic growth is anticipated for Carpenter Road between Martin Way and Britton Parkway. Evening PM peak hour flows are projected to increase from 430 vph (total both directions) to 3,640 vph. Much of the new traffic will use the new Main Street/Carpenter Road intersection to access the Lacey Gateway Towncenter area.

The increased traffic loadings will result in a poor LOS and operation at the Martin Way/Carpenter Road intersection in both the AM and PM peak hours. Eastbound queuing at this intersection would occasionally extend several thousand feet toward the Martin Way interchange. In addition the increase in traffic will result in the need for intersection upgrades at Britton Parkway/Carpenter Road and Draham Rd/Carpenter Road intersections.

Table 4. Level of Service Summary – Carpenter Road Corridor

Intersection	Control Type	Existing AM Peak Hour		2030 Baseline AM Peak Hour		Existing PM Peak Hour		2030 Baseline PM Peak Hour	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Carpenter Rd at Draham Rd	Stop	B	11.0	F	724.8	B	13.0	F	>999
Carpenter Rd at Britton Pkwy	Stop	B	10.9	F	>999	B	13.0	F	>999
Carpenter Rd at Martin Way	Signal	C	33.0	F	144.0	D	38.2	F	111.0

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Carpenter Road Corridor
Intersection AM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Carpenter Road Corridor
Intersection PM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Carpenter Road Corridor
Intersection AM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Carpenter Road Corridor
Intersection PM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Carpenter Road Corridor
Road Segments Significantly Impacted
By PM Peak Hour Queuing

Transportation Systems Analysis and Alternatives Evaluation

Marvin Road Corridor

This area includes the Marvin Road interchange (Exit 111) which serves as the main gateway into the Hawks Prairie area of North Lacey. Under current conditions, the intersections and roadways function acceptably during the morning and evening peak periods.

The 2030 analysis includes conversion of the Marvin Road interchange to a Single Point Urban Interchange. The 2030 scenario also includes the addition of the Main Street/Marvin Road intersection functioning as a three-leg Modern RAB with two circulating lanes.

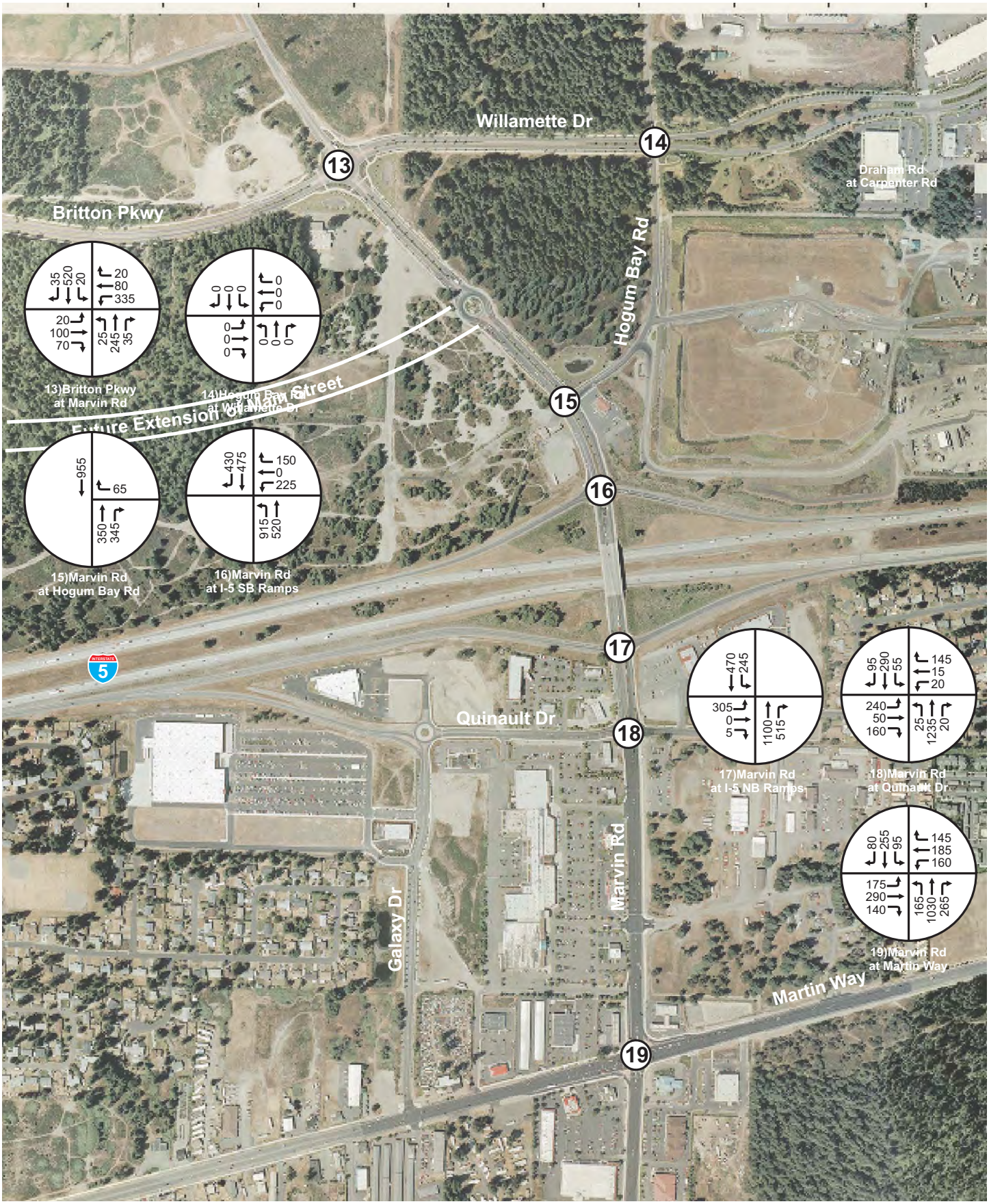
Traffic flows are predicted to increase significantly on the roadways north of Interstate 5 and at the Marvin Road interchange. Currently, between Interstate 5 and Hogum Bay Road, Marvin Road serves approximately 2,000 vehicles during the evening peak hour (total of NB and SB movements). For the 2030 scenario, that volume is projected to increase to 6,500 PM peak hour vehicles.

Based on the projected traffic flows, the Single Point Urban Interchange would not function acceptably during the morning or evening peak periods. Also, each of the signalized and modern RAB intersections would be over capacity along the Marvin Road corridor.

Table 5. Level of Service Summary – Marvin Road Corridor

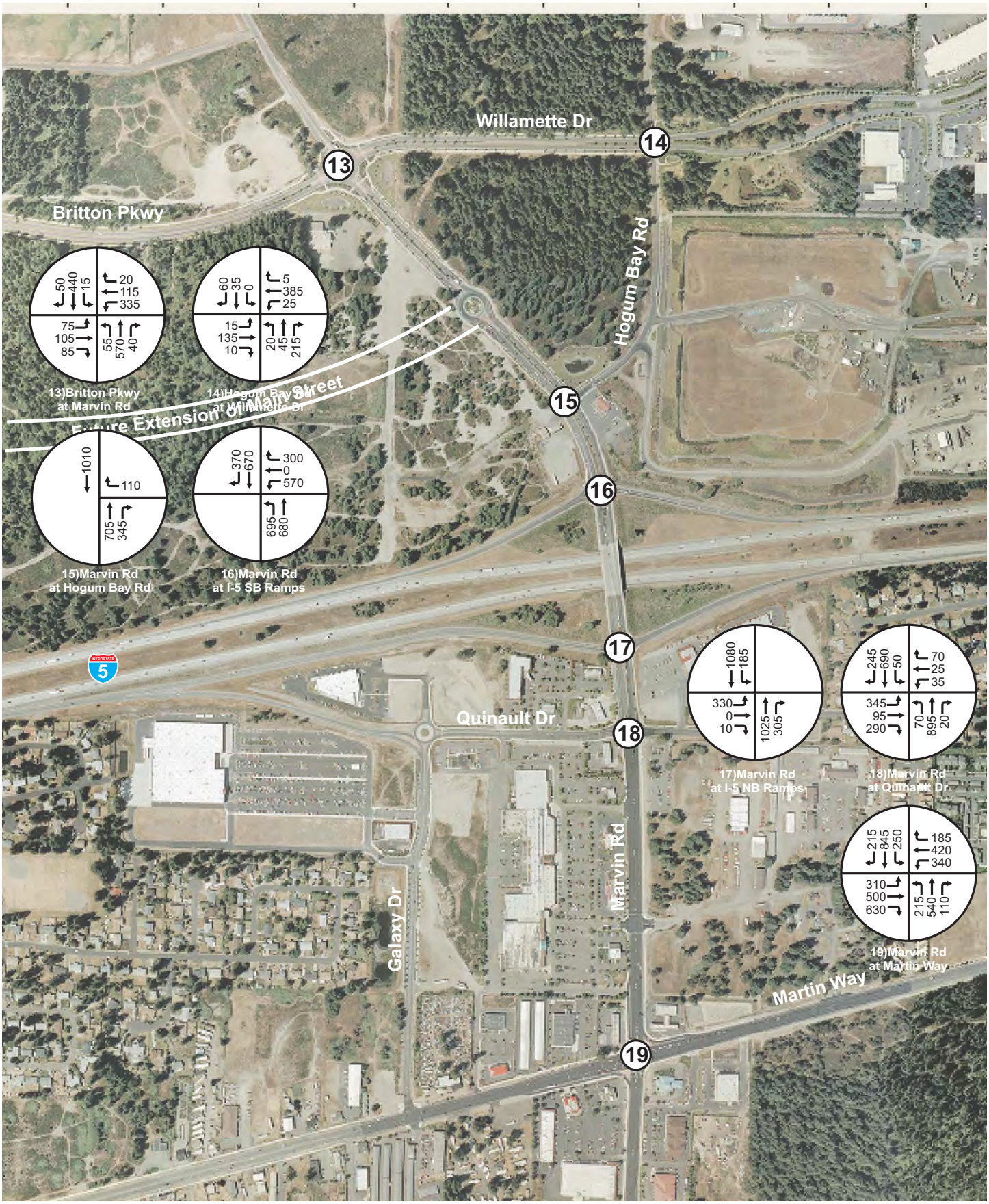
Intersection	Control Type	Existing AM Peak Hour		2030 Baseline AM Peak Hour		Existing PM Peak Hour		2030 Baseline PM Peak Hour	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Marvin Rd at Britton Pkwy	Modern RAB	A	8.6	F	167.6	A	9.1	F	192.8
Willamette Dr at Hogum Bay Rd	Stop	Turning movement counts pending				C	16.1	F	>999
Marvin Rd at Hogum Bay Rd	Stop	B	11.4	D	34.0	B	11.7	F	53.5
I-5 SB Ramps at Marvin Rd	Signal	C	20.9	F*	80.5*	C	27.0	F*	103.4*
I-5 NB Ramps at Marvin Rd	Signal	B	14.5			B	15.7		
Marvin Rd at Quinault Dr	Signal	C	20.8	F	129.9	C	23.2	E	66.2
Marvin Rd at Martin Way	Signal	D	36.4	E	75.5	E	56.0	F	112.9
Marvin Rd at Main Street (new intersection)	Modern RAB	N/A				N/A			

* With conversion to Single Point Urban Interchange



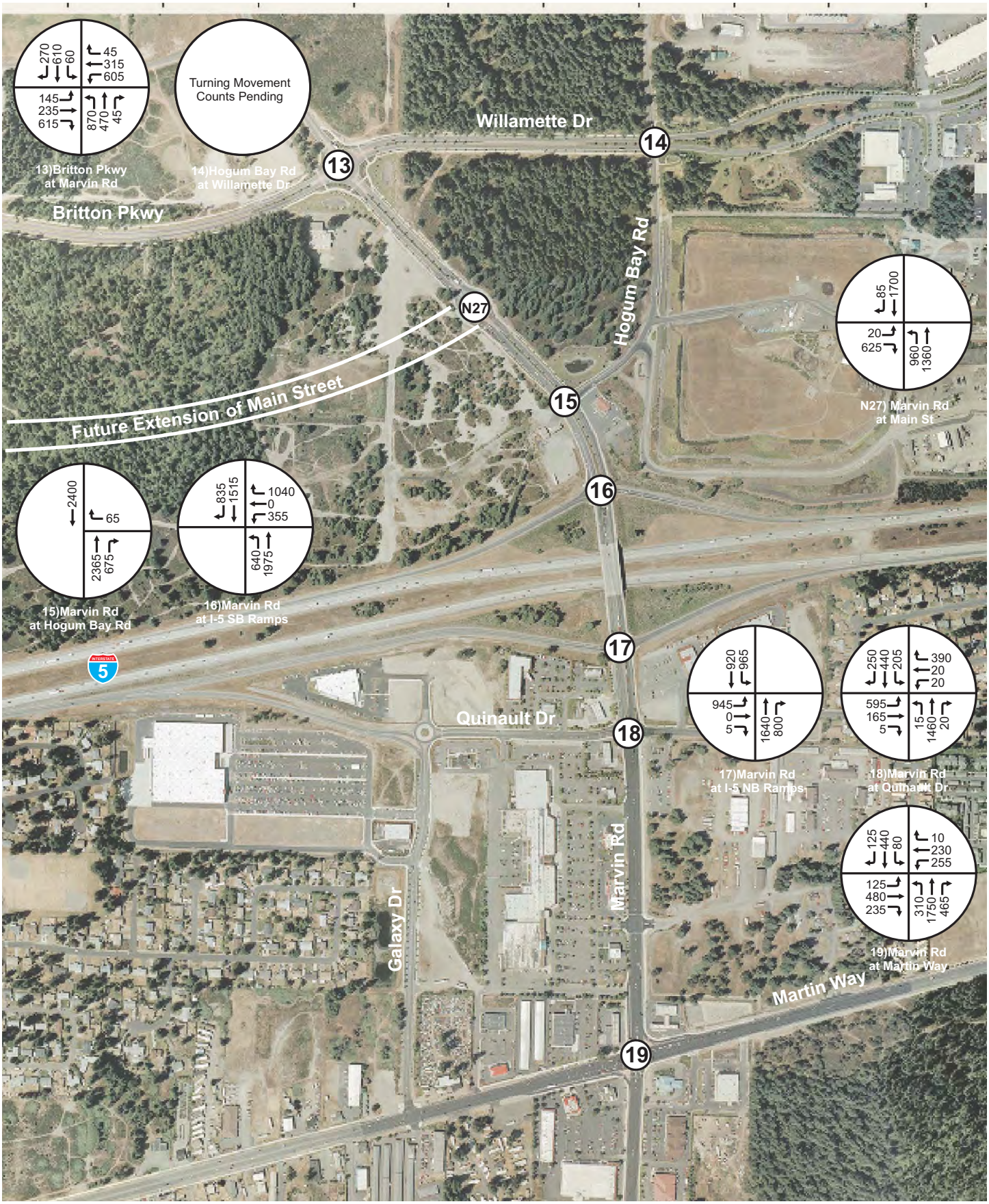
Marvin Road Corridor
Intersection AM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation



Marvin Road Corridor
Intersection PM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation



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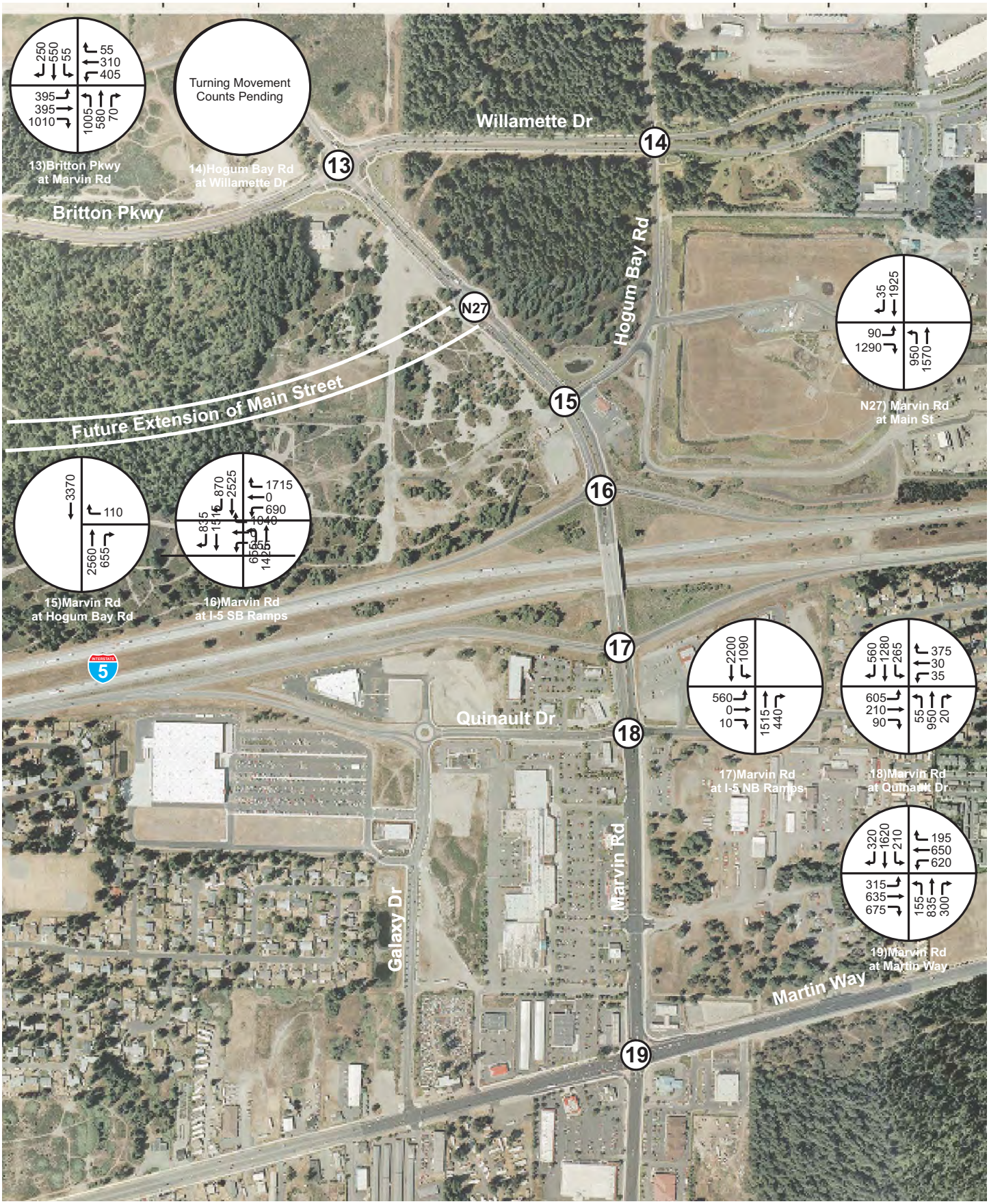
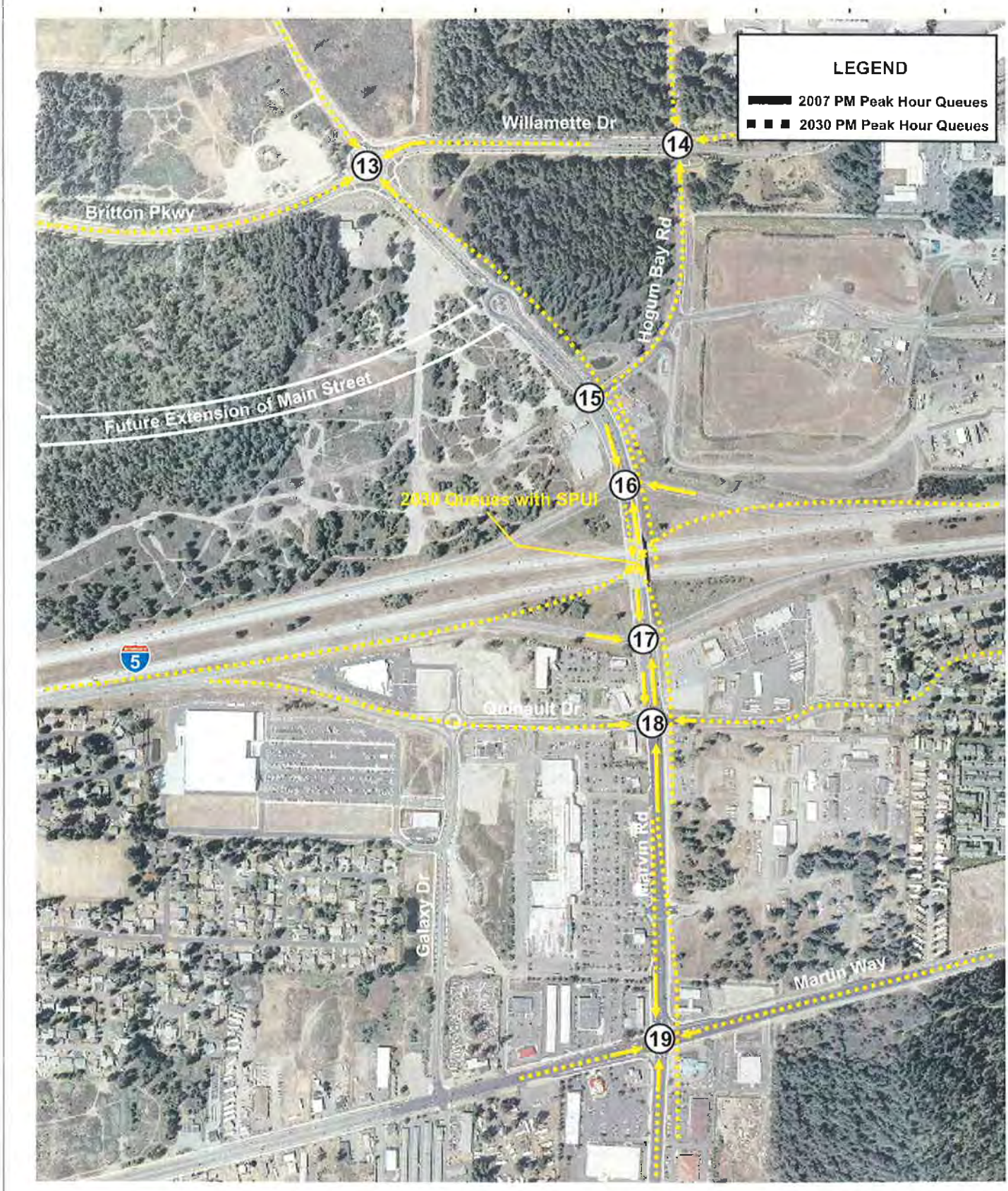
Marvin Road Corridor
Intersection AM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation



Marvin Road Corridor
Intersection PM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation



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Marvin Road Corridor
Road Segments Significantly Impacted
By PM Peak Hour Queuing

Transportation Systems Analysis and Alternatives Evaluation

Meridian Road Corridor

This area is based around the Orion Drive – Meridian Road route between Martin Way and Willamette Drive. This serves as a secondary outlet for traffic north of Interstate 5 within the Hawks Prairie area. Intersections along this corridor were recently included in the study and traffic data is incomplete at this time.

Table 6. Level of Service Summary – Meridian Road Corridor

Intersection	Control Type	Existing AM Peak Hour LOS	Existing AM Peak Hour Delay	2030 Baseline AM Peak Hour LOS	2030 Baseline AM Peak Hour Delay	Existing PM Peak Hour LOS	Existing PM Peak Hour Delay	2030 Baseline PM Peak Hour LOS	2030 Baseline PM Peak Hour Delay
Willamette Dr at Orion Dr	Stop	Turning movement counts pending				B	13.1	F	244.1
Meridian Rd at Orion Dr	Modern RAB	Turning movement counts pending							
Meridian Rd at Martin Way	Signal	Turning movement counts pending				C	29.5	E	79.4

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Meridian Road Corridor
Intersection AM Peak Hour Volumes - 2007

Transportation Systems Analysis and Alternatives Evaluation

Meridian Road Corridor
Intersection PM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation

Meridian Road Corridor
Intersection AM Peak Hour Volumes - 2030

Transportation Systems Analysis and Alternatives Evaluation

Meridian Road Corridor
Intersection PM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Meridian Road Corridor
Road Segments Significantly Impacted
By PM Peak Hour Queuing

Transportation Systems Analysis and Alternatives Evaluation

Nisqually Interchange

This area includes the Nisqually Interchange (Exit 114) at the eastern terminus of Martin Way. The intersections currently operate at acceptable levels during the AM and PM peak hours. Under the 2030 scenarios, the signalized intersection at the I-5 NB On Ramp/SB Off Ramp at Martin Way will degrade to a LOS F condition during both the AM and PM periods. This would be caused by the significant increase in traffic using the Interstate 5 ramps to/from the north.

Table 7. Level of Service Summary – Nisqually Interchange

Intersection	Control Type	Existing AM Peak Hour		2030 Baseline AM Peak Hour		Existing PM Peak Hour		2030 Baseline PM Peak Hour	
		LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Nisqually Cut-Off Rd/I-5 SB On Ramp	Stop	A	n/a	A	n/a	A	n/a	A	n/a
Nisqually Cut-Off Rd/I-5 NB Off Ramp	Stop	A	8.8	A	8.9	A	9.4	A	9.1
I-5 NB On Ramp/SB Off Ramp at Nisqually Cut-Off Rd/Martin Way	Signal	C	23.8	F	216.9	D	39.1	F	199.2

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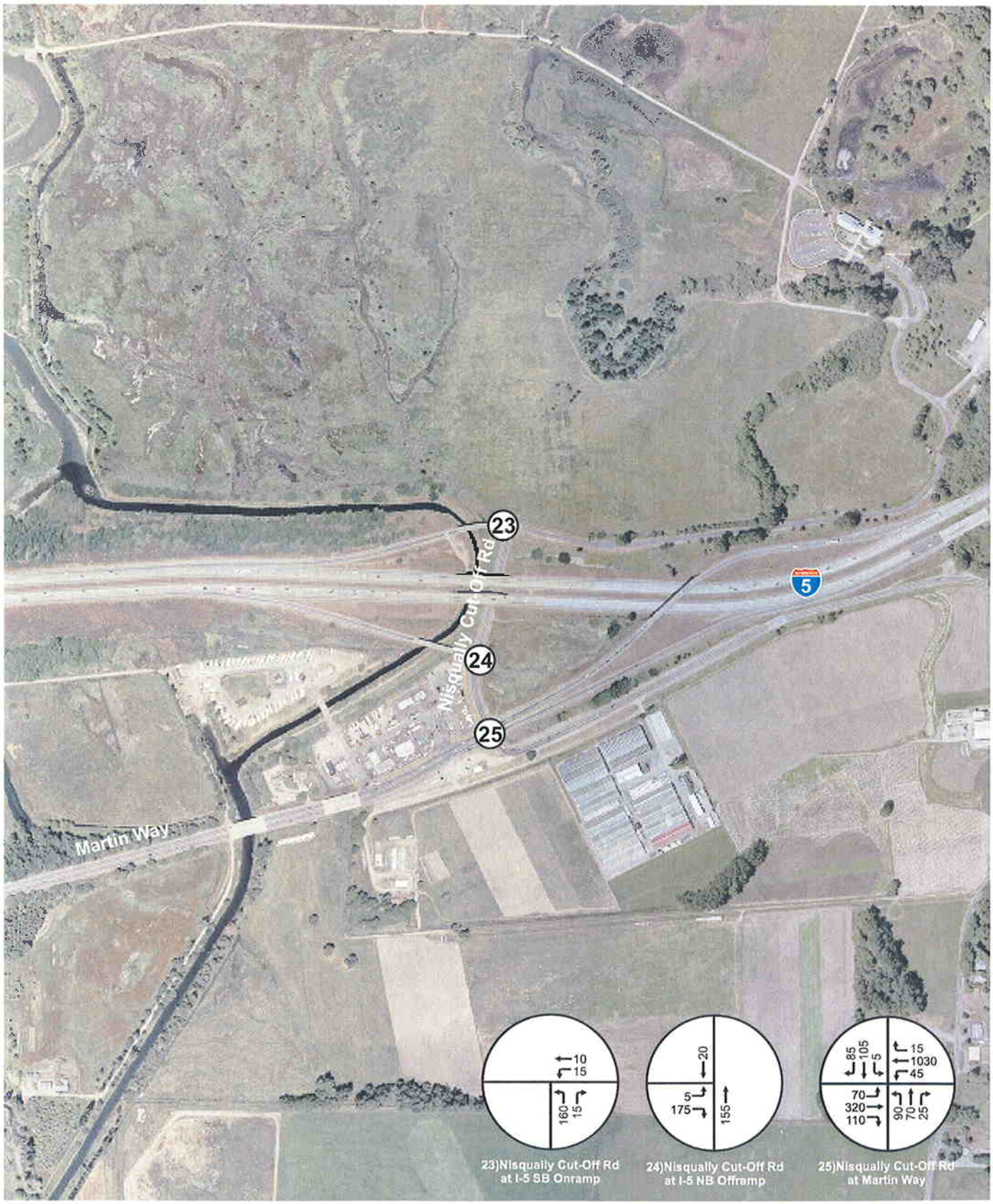
Nisqually Cut-Off Corridor
Intersection AM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation



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Nisqually Cut-Off Corridor
Intersection PM Peak Hour - 2007 Volumes

Transportation Systems Analysis and Alternatives Evaluation

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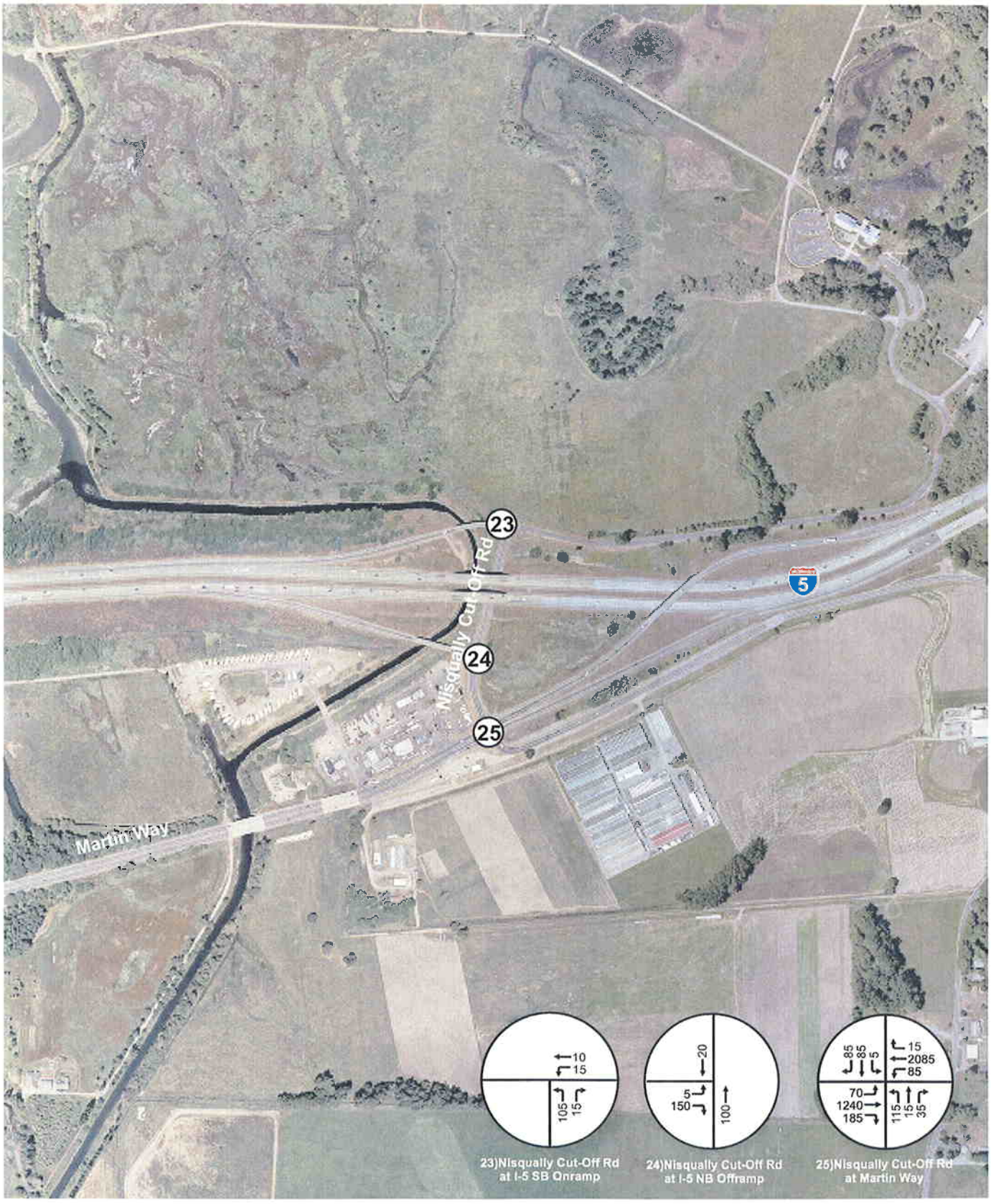
Nisqually Cut-Off Corridor
Intersection AM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation



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Nisqually Cut-Off Corridor
Intersection PM Peak Hour - 2030 Volumes

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL INC.

Nisqually Cut-Off Corridor
Road Segments Significantly Impacted
By PM Peak Hour Queuing

Transportation Systems Analysis and Alternatives Evaluation

V. Freeway mainline and ramp analysis results

The mainline Interstate 5 segments and interchange ramps merge and diverge areas were analyzed using the methodologies outlined in sections 24 and 25 of the Highway Capacity Manual. The results are presented in terms of Level of Service and are based on the density of vehicles using the facilities. The analysis is provided for AM and PM peak hour conditions for the existing 2007 and projected 2030 scenarios.

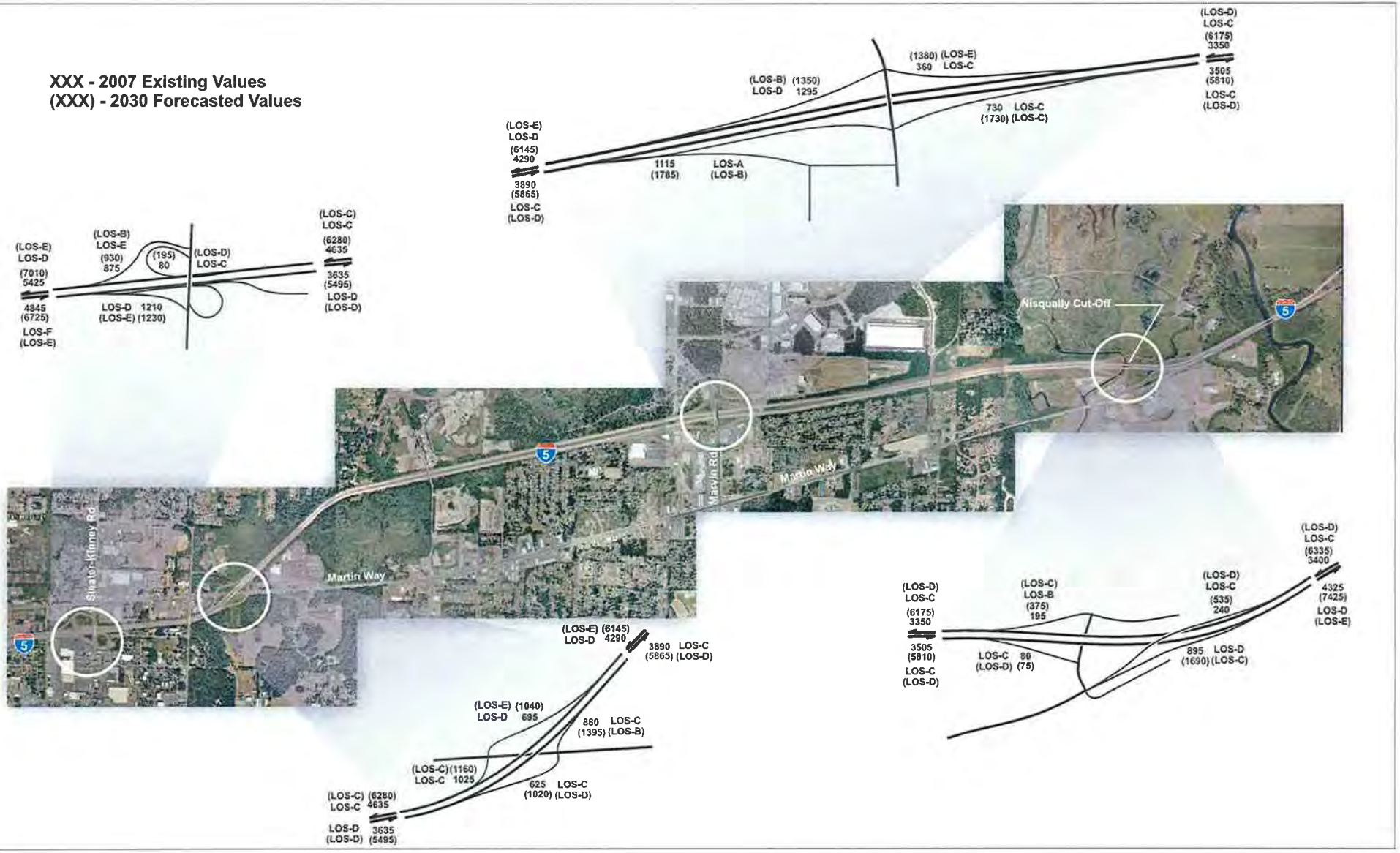
The 2030 freeway segment and ramp analysis includes an additional mainline capacity lane between Sleater Kinney Road and the Nisqually River Bridge. In some instances this has resulted in lower overall vehicle densities at the merge and diverge points and an improvement in the projected ramp operation. The existing 2007 and projected 2030 freeway mainline and ramp merge/diverge volumes and levels of service are shown on the following figures.

VI. Conclusion

The City of Lacey is in the process of preparing the *Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE)* that will involve a detailed evaluation of the arterial and highway network and future traffic demand in the north Lacey area. Subsequent analysis will include screening various improvement strategies to identify a preferred program of roadway and intersection improvements.

This information has been prepared for Stakeholder review in advance of the LTSAAE meeting on March 4, 2008. Technical appendices supporting the traffic volume projections and facilities analysis will be provided at that time.

XXX - 2007 Existing Values
(XXX) - 2030 Forecasted Values



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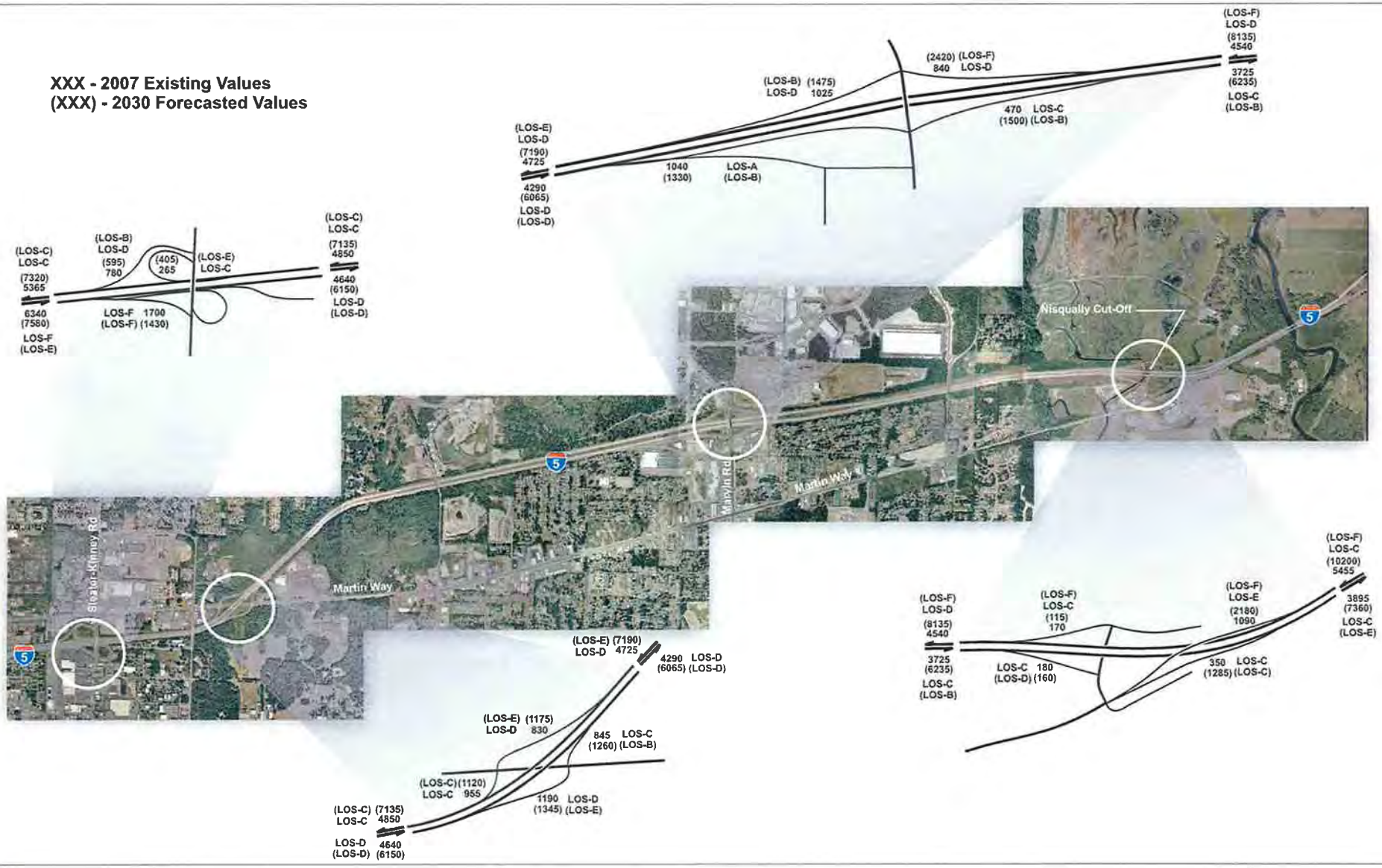
I-5 Mainline and Ramp AM Peak Hour Volumes
and Level of Service

Transportation Systems Analysis and Alternatives Evaluation

XXX - 2007 Existing Values
(XXX) - 2030 Forecasted Values



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I-5 Mainline and Ramp PM Peak Hour Volumes
and Level of Service

Transportation Systems Analysis and Alternatives Evaluation

Appendix D

TECHNICAL MEMORANDUM: 2030 SURFACE STREET IMPROVEMENT SCENARIO TESTING

The technical appendices are included as published at their time. In some instances subsequent analyses refined the results of the published material. Any such refinements are reflected in the subsequent materials, but the published material is unchanged.

TECHNICAL MEMORANDUM

TO:	LTSAAE Stakeholders
FROM:	Perry Shea, P.E., Principal
DATE:	March 26, 2008
REGARDING:	Lacey Transportation Systems Analysis and Alternatives Evaluation – 2030 Surface Street Improvement Scenario Testing SC&J #0805.04
ENCLOSURES:	2030 "Raw" Model Volume Plots; Traffic Volume Calculation Worksheets; Traffic Volume Comparison Plots

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I. Introduction

The City of Lacey is in the process of preparing the *Lacey Transportation Systems Analysis and Alternatives Evaluation (LTSAAE.)* Previous analysis described existing roadway and intersection operations at all key locations within the study area. Predicted conditions for the "baseline" 2030 horizon were also prepared, and many future deficiencies were identified on facilities in the study area. Notable deficiencies included the Martin Way corridor between Sleater-Kinney Road and the Martin Way/Interstate 5 interchange and Marvin Road from Martin Way to Britton Parkway.

The stakeholder team was tasked with identifying potential surface street improvements that could help alleviate the predicted congestion along those corridors and the rest of the study area. An extensive list of roadway and intersection improvements was proposed by the stakeholder group that has been taken forward for analysis.

Shea, Carr & Jewell has prepared traffic volume comparisons for the study area with and without the proposed surface street improvements. This memorandum describes the results of the surface street improvement scenario testing.

This information has been prepared for Stakeholder review in advance of the LTSAAE meeting on March 31, 2008.

II. Surface Street Improvement Alternatives

The stakeholder group identified approximately 15 improvements for potential analysis. The full list of proposed improvements is provided below. The proposed improvements were screened and grouped into three packages to be built into the transportation demand model.

Lacey TSAAE - Surface Street Improvement Scenario Testing

Potential Improvement Identified by Stakeholder Group	Add to next model scenarios?	Package
1. Mullen Road Extension – Ruddell Rd to College Street (at 37th Ave)	Already in 2030 model	N/A
2. 6th Avenue Extension – College Street to Desmond Drive	No (1)	N/A
3. Bowker Street Extension – 7th Avenue to Desmond Drive	Yes	A
4. Hoh Street Extension – Martin Way to Steilacoom Rd	Yes	A
5. Interstate 5 Over-Crossings		
a. Kinwood Rd Extension – Martin Way to Main Street	a. No (2)	N/A
b. Mid-point crossing in vicinity of Stillwell, Whisler and Horne Streets – Martin Way to Main Street	b. Yes	C
c. Mid-point non-motorized crossing in vicinity of Stillwell, Whisler and Horne Streets – Martin Way to Main Street	c. Yes	A
6. Meridian Road Upgrades (increase capacity and structure to accommodate increased truck traffic) – Martin Way to Willamette Drive	Yes	A
7. Draham Rd NE/15th Ave NE widen to four lanes – Carpenter Road to Sleater-Kinney Rd	Yes	A
8. 15th Avenue Extension – from Sleater-Kinney Rd to Lilly Road	Yes	B
9. College Street Extension Extension – from 15th Ave NE to future 26th Avenue Connector	Yes	B
10. 26th Avenue Connector – from Marvin Road to Sleater Kinney Road	Yes	B
11. 31st Avenue Extension – from Hogum Bay Road to Marvin Road in vicinity of future 26th Avenue Connector	Yes	B
12. Hogum Bay Road Upgrades (increase structural and geometric capability of roadway to accommodate truck traffic) – Marvin Road to Hawks Prairie Road	Yes	A
a. May include optional slip-ramp access from I-5 SB off-ramp directly to Hogum Bay Road	a. Yes	A
13. NE Lacey (Hawks Prairie) Interconnecting Roadways – commercial collector grid between Hogum Bay Road and Carpenter Road north of I-5	Yes	A

(1) Per negotiations between Saint Martins University and the City of Lacey this item will be removed from Lacey Transportation Plan

(2) This project functionally similar to 5c, which has been included in "A" package of improvements

The three alternative improvement packages are listed below:

Alternative A

- Bowker Street Extension – from 7th Avenue to Desmond Drive
- Hoh Street Extension – from Martin Way to Steilacoom Road
- Non-motorized Interstate 5 over-crossing in vicinity of Stillwell, Whisler and Horne Streets – from Martin Way to Main Street
- Meridian Road Upgrades (increase capacity and structure to accommodate increased truck traffic) – from Martin Way to Willamette Drive
- Draham Rd NE/15th Ave NE widen to four lanes – Carpenter Road to Sleater-Kinney Road
- Hogum Bay Road Upgrades (increase structural and geometric capability of roadway to accommodate truck traffic) – Marvin Road to Hawks Prairie Road
- Construct slip ramp access from I-5 SB off-ramp directly to Hogum Bay Road
- NE Lacey (Hawks Prairie) Interconnecting Roadways – commercial collector grid between Hogum Bay Road and Carpenter Road north of I-5

Alternative B

- 15th Avenue Extension – from Sleater-Kinney Road to Lilly Road
- College Street Extension Extension – from 15th Avenue NE to future 26th Avenue Connector
- 26th Avenue Connector – from Marvin Road to Sleater-Kinney Road
- 31st Avenue Extension – from Hogum Bay Road to Marvin Road in vicinity of future 26th Avenue Connector

Alternative C

This scenario has been added for comparative purposes; however, in the initial screening process it was determined that disruption to an existing neighborhood may prohibit implementation.

- Vehicular Interstate 5 over-crossing in vicinity of Stillwell, Whisler and Horne Streets – Martin Way to Main Street

III. Traffic Volume Projections

Traffic Modeling Methodology

The traffic volume projections for Alternatives A, B and C were prepared using the same methodology used for the "baseline" 2030 traffic assignments. The improvement packages were incrementally added to the 2030 baseline model scenario. Each alternative builds on the previous alternative. That is, the roadway and intersection improvements in Alternative A were added to the baseline and model assignments were prepared. Then Alternative B was added and additional assignments were prepared. Then Alternative C was added creating a third batch of model assignments.

Post-Processed Traffic Volume Assignments

The transportation model traffic volume output was post-processed to align the analysis volumes with existing "ground counts." Specifically, the traffic volume growth predicted by the transportation model was added to the actual 2007 traffic volumes to prepare the 2030 PM peak hour traffic volumes shown in this memorandum. The Traffic Volume Projection worksheets are provided as an attachment.

We have provided the post-processed traffic analysis volumes for Baseline, Alternative A, and Alternative B for selected locations on the Figures 1 through 5. The "raw" (not post-processed) PM peak traffic volume model plots for the baseline 2030 scenario and Alternatives A, B and C are also attached.

Figure 1
Sleater-Kinney Road Corridor
Projected 2030 PM Peak Hour
Directional Traffic Volumes

Figure 2
Carpenter Road Corridor
Projected 2030 PM Peak Hour
Directional Traffic Volumes

Transportation Systems Analysis and Alternatives Evaluation

Figure 3
Marvin Road Corridor
Projected 2030 PM Peak Hour
Directional Traffic Volumes

Transportation Systems Analysis and Alternatives Evaluation

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Figure 4
Meridian Road Corridor
Projected 2030 PM Peak Hour
Directional Traffic Volumes

Transportation Systems Analysis and Alternatives Evaluation

Figure 5
Nisqually Road Corridor
Projected 2030 PM Peak Hour
Directional Traffic Volumes

Transportation Systems Analysis and Alternatives Evaluation

III. Traffic Volume Comparison

As would be expected, adding the network improvement packages changes travel patterns within the study area causing significant shifts in traffic flows on some roadways. The attached graphics depict the change (increase or decrease) in projected 2030 PM peak hour traffic volumes within the study area between the Baseline and Alternative A, the Baseline and Alternative B and the Baseline and Alternative C.

The following is a discussion of some of the more notable changes for each of the Alternatives.

2030 Alternative A

Bowker Street Extension – from 7th Avenue to Desmond Drive

This new roadway would draw approximately 150 PM peak hour trips, improving local access but not providing a significant regional benefit.

Hoh Street Extension – from Martin Way to Steilacoom Road

This new roadway would draw approximately 400 vehicles during the 2030 PM peak hour. This would improve local access and provide some benefit to the congested Marvin Road corridor south of Martin Way.

Non-motorized Interstate 5 over-crossing in vicinity of Stillwell, Whisler and Horne Streets – from Martin Way to Main Street

This non-motorized connection would improve multi-modal access between the neighborhood south of I-5 and the Hawks Prairie area north of I-5. It would not be expected to have a significant effect on vehicular traffic.

Meridian Road Upgrades (increase capacity and structure to accommodate increased truck traffic) – from Martin Way to Willamette Drive

This could improve the safety and functionality of Meridian Road/Orion Drive but would not attract a significant amount of new traffic to Meridian Road.

Draham Rd NE/15th Avenue NE widen to four lanes – Carpenter Road to Sleater-Kinney Road

This improvement would be expected to create a significant increase in traffic (approximately 1200 vehicles in the 2030 PM peak hour) on 15th Avenue/Draham Road. This would reduce congestion on Carpenter Road and would increase traffic flows on Sleater-Kinney Road north of Martin Way.

Hogum Bay Road Upgrades (increase structural and geometric capability of roadway to accommodate truck traffic) – Marvin Road to Hawks Prairie Road
This could improve the safety and functionality of Hogum Bay Road; however, the capacity upgrade would not be expected to significantly affect traffic flows on Hogum Bay Road.

Construct slip ramp access from I-5 SB off-ramp directly to Hogum Bay Road
The slip ramp would attract approximately 600 vehicles in the PM peak hour. This would result in a corresponding reduction in traffic on Marvin Road between I-5 and Hogum Bay Road. Demand modeling indicates that some vehicles en route from southbound Interstate 5 to Britton Parkway would use the Hogum Bay slip ramp to avoid a congested Marvin Road.

NE Lacey (Hawks Prairie) Interconnecting Roadways – commercial collector grid between Hogum Bay Road and Carpenter Road north of I-5
These roadways would provide local access to properties in the area and improved access between Hogum Bay Road, Marvin Road and Carpenter Road. It is not expected that these new roadway connections would significantly affect traffic flows south of Interstate 5.

Network Traffic Volume Changes
The roadway and intersection improvements in Alternative A would result in significant shifts in localized traffic volumes with improvement in overall congestion levels. Traffic volumes at the "pinch-points" identified in the baseline analysis would experience marginal benefit. Traffic on Marvin Road in the vicinity of Interstate 5 would be reduced by only 1%. Traffic on Martin Way in the vicinity of the I-5 interchange would be reduced by only 6%. Carpenter Road in the vicinity of Martin Way would experience the most benefit with a 12% reduction in traffic volumes. Freeway traffic volumes in the study area would remain almost unchanged.

2030 Alternative B

The results summarized below describe some of the differences in projected 2030 PM peak hour traffic volumes between Alternative B and Alternative A. (Note that Alternative B includes the Alternative A improvements.)

15th Avenue Extension – from Sleater-Kinney Road to Lilly Road
This new roadway connection would attract approximately 1000 PM peak hour trips by the 2030 horizon. This would result in a decrease in traffic on Sleater-Kinney Road between Martin Way and 15th Avenue NE with traffic flows on this section of Sleater-Kinney Road adjusting back to 2030 baseline volumes.

College Street Extension Extension – from 15th Ave NE to future 26th Avenue Connector

This new roadway would be expected to attract approximately 350 PM peak hour trips in the 2030 horizon. It would not be expected to result in a significant change in traffic volumes on the other section of the College Street Extension (between 6th Avenue NE and 15th Avenue NE.)

26th Avenue Connector – from Marvin Road to Sleater-Kinney Road

This new roadway would draw approximately 1200 vehicles during the PM peak hour. It would also increase traffic flows on 26th Avenue west of Sleater-Kinney Road by approximately 400 vph.

31st Avenue Extension – from Hogum Bay Road to Marvin Road in vicinity of future 26th Avenue Connector

This new roadway would provide improved local access and would attract approximately 1000 vehicles during the PM peak hour.

Network Traffic Volume Changes

The roadway and intersection improvements in Alternative B would result in additional shifts in localized traffic volumes. Marginal reduction in traffic volumes would be experienced at the "pinch-points." Traffic on Marvin Road in the vicinity of Interstate 5 would be reduced by only 2%. Traffic on Martin Way in the vicinity of the I-5 interchange would be reduced by 8%. Carpenter Road in the vicinity of Martin Way would experience the most benefit with a 14% reduction in traffic volume. Freeway traffic volumes in the study area would remain almost unchanged.

2030 Alternative C

Vehicular Interstate 5 over-crossing in vicinity of Stillwell, Whisler and Horne Streets – Martin Way to Main Street

This new roadway would attract approximately 1300 vehicles during the PM peak hour. It would result in a reduction of approximately 400 vehicles on Carpenter Road north of Martin Way and a reduction of approximately 350 vehicles on Marvin Road north of Interstate 5.

Network Traffic Volume Changes

Alternative C would result in minimal changes (beyond Alternative B) network-wide. The traffic shift from this Alternative would occur mostly on Marvin Road and Carpenter Road, between Martin Way and Britton Parkway. Traffic volumes on Marvin Road in the vicinity of I-5 would be reduced by 9% compared to baseline. Traffic volumes on Carpenter Road would be reduced by 26%. Traffic volumes on Martin Way west of Carpenter Road would be increased by over 10%.

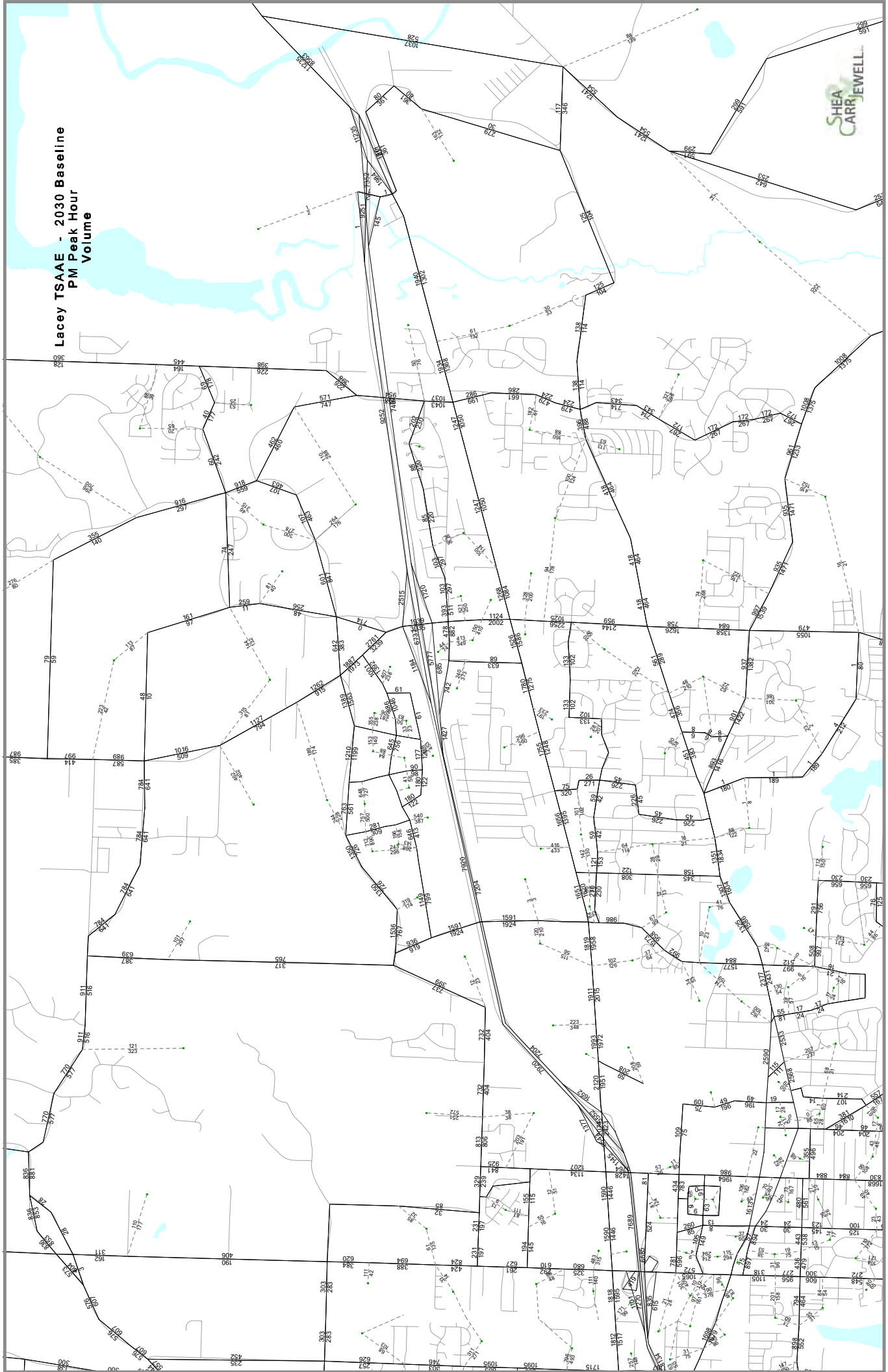
IV. Conclusions

We have analyzed the Lacey TSAAE study area for projected 2030 conditions with a series of potential surface street improvements. The proposed intersection and roadway projects each provide circulation benefits within their own localized area. Some of the improvements also provide significant regional benefit resulting in lower overall congestion levels.

Alternative A improves the regional circulation by providing additional local access connections, and enhancing east-west mobility north of Interstate 5. The critical Martin Way/Interstate 5 and Marvin Road/Interstate 5 interchanges receive only marginal benefit. Under Alternative A, additional improvements would be required to accommodate future traffic loadings in the area.

Alternative B significantly improves traffic circulation within the Hawks Prairie area and enhances the east-west connections presented in Alternative A. However, as with Alternative A, the critical Martin Way/Interstate 5 and Marvin Road/Interstate 5 interchanges receive only marginal benefit. Under Alternative B, additional improvements would be required to accommodate future traffic loadings in the area.

Alternative C provides an additional reduction in traffic flows on Carpenter Road and Marvin Road. The reduction in traffic on Marvin Road could provide improvement to the function of the Marvin Road/Interstate 5 interchange. However, the traffic flows at the Martin Way/Interstate 5 interchange would remain within 6% of baseline conditions. Under Alternative C additional improvements would be required to accommodate future traffic loadings in the area.


Lacey TSAAE - 2030 Baseline
PM Peak Hour
Volume
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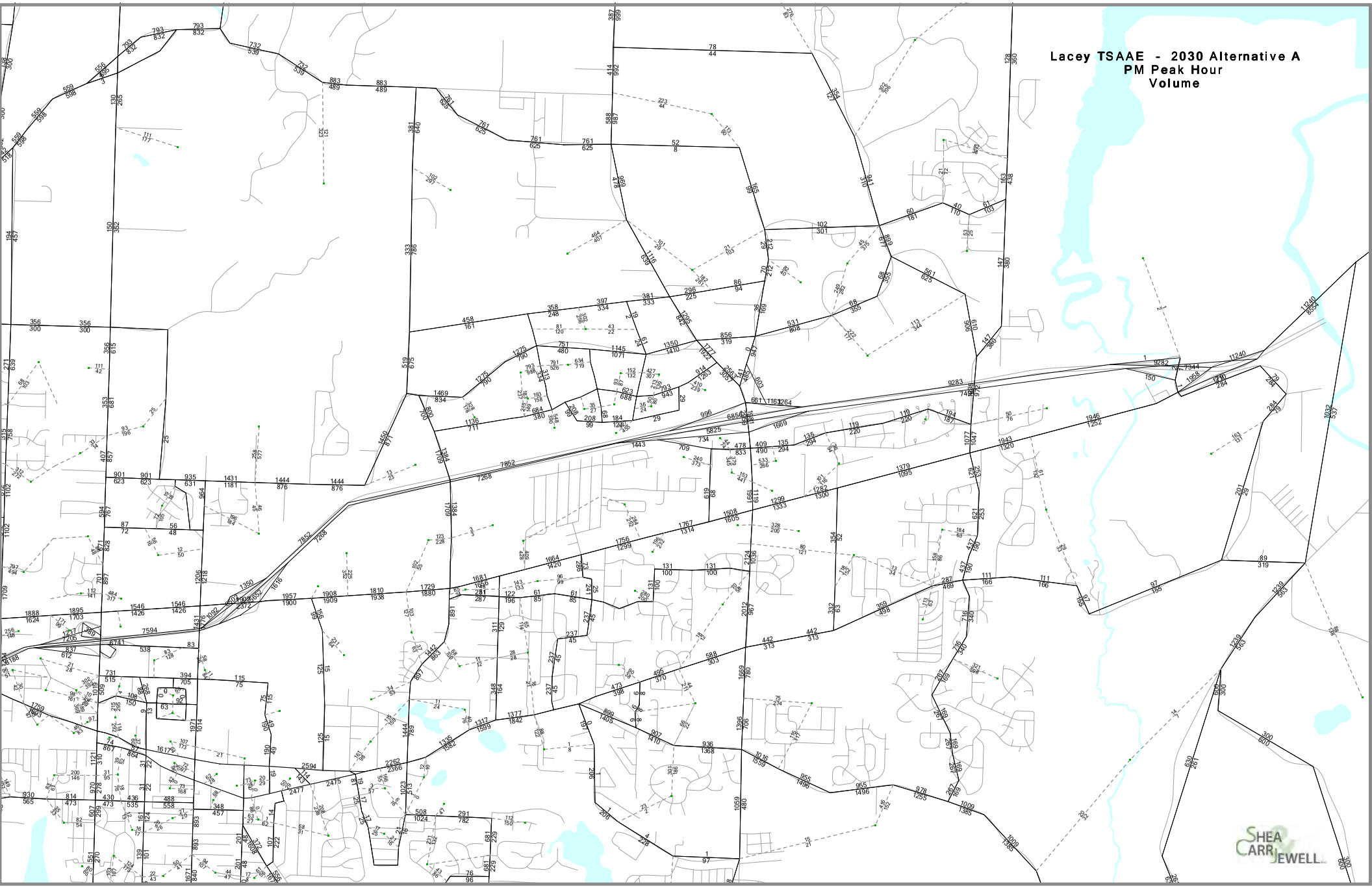
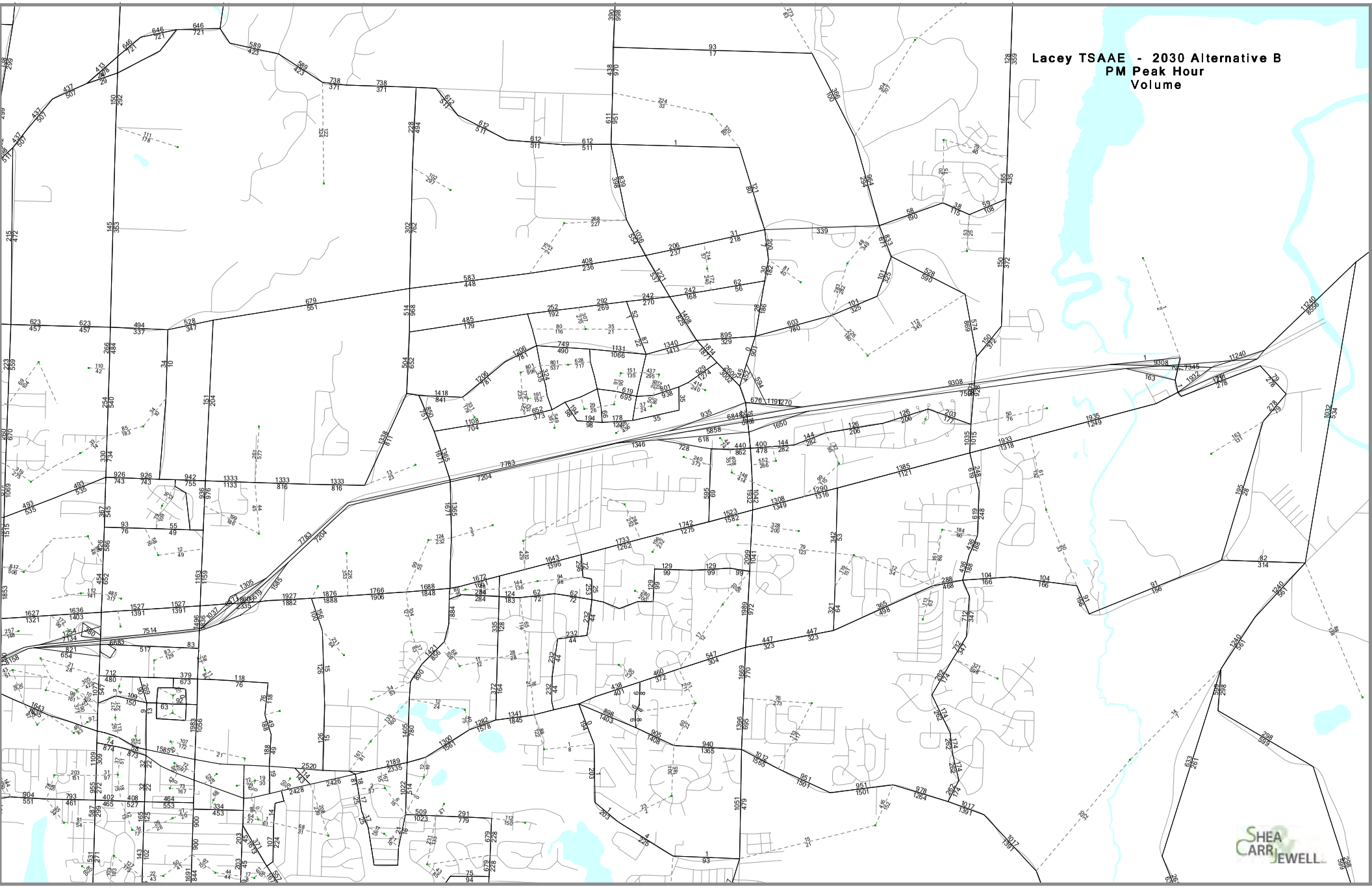
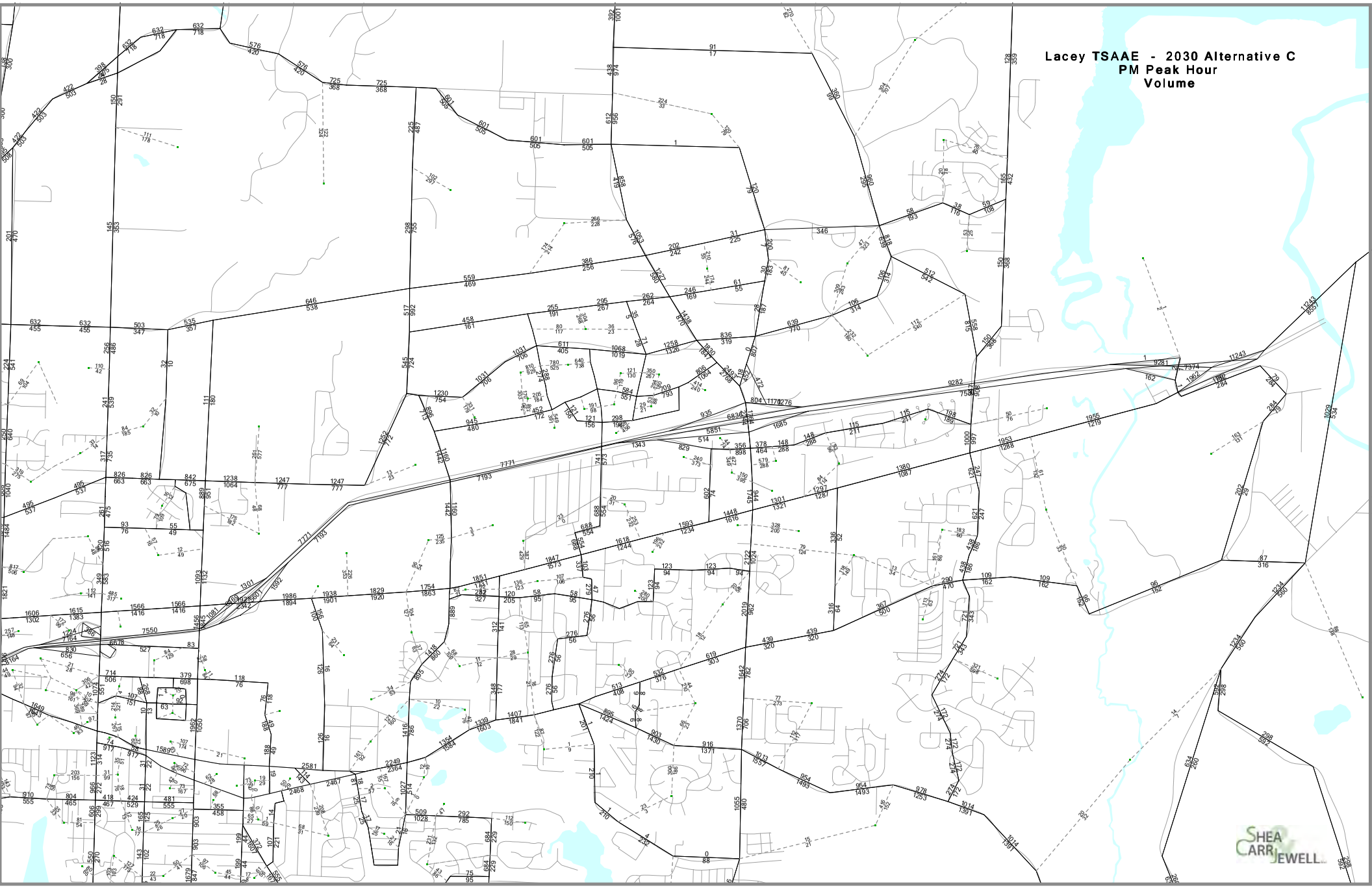
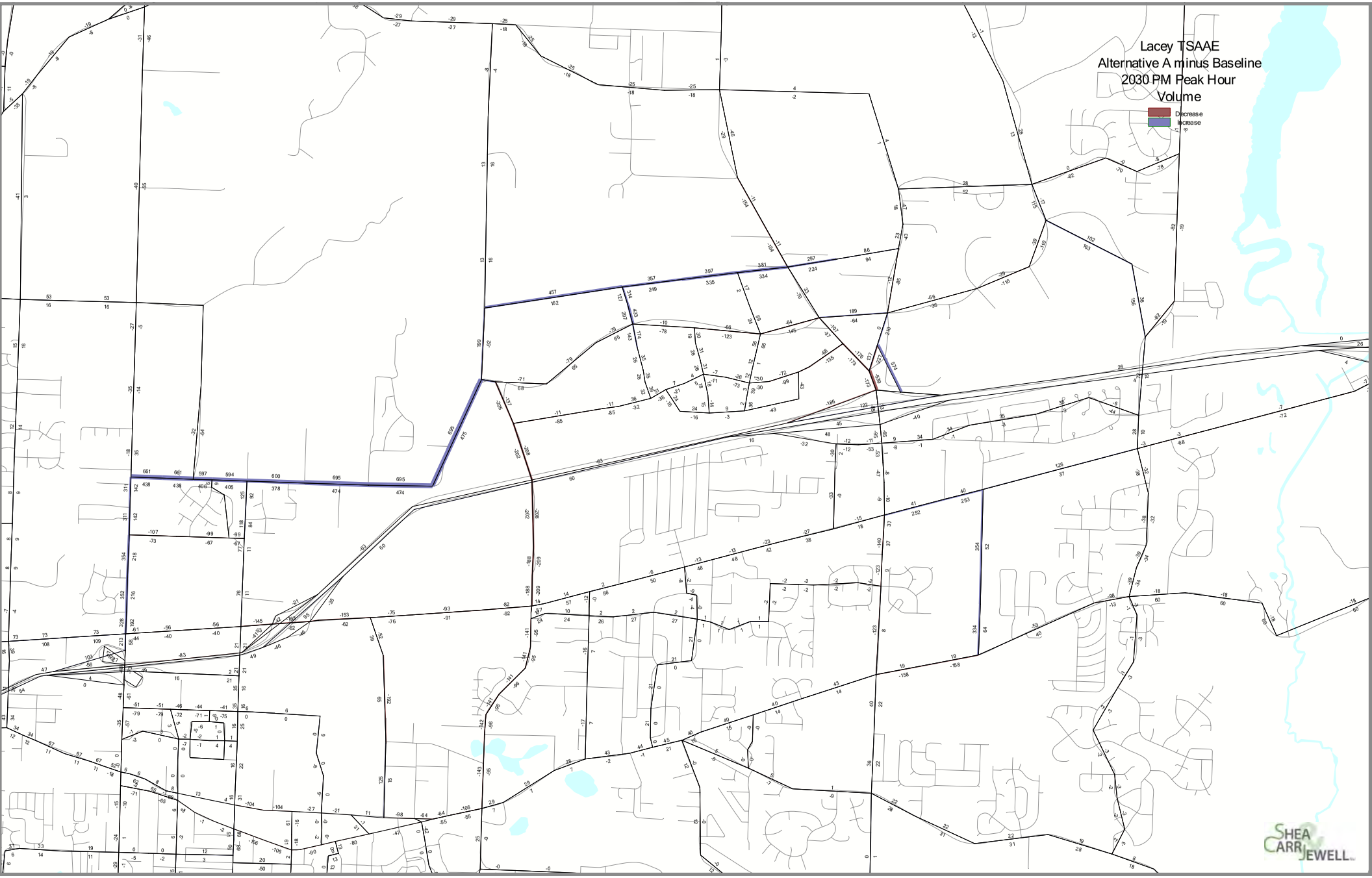

Lacey TSAAE - 2030 Alternative A
PM Peak Hour
Volume
SHEA CARR JEWELL


Lacey TSAAE - 2030 Alternative B
PM Peak Hour
Volume
SHEA CARR JEWELL


Lacey TSAAE - 2030 Alternative C
PM Peak Hour
Volume
SHEA CARR JEWELL


Lacey TSAAE
Alternative A minus Baseline
2030 PM Peak Hour
Volume
Decrease
Increase
SHEA CARR JEWELL

Lacey TSAAE
Alternative B minus Baseline
2030 PM Peak Hour
Volume
Decrease
Increase
SHEA CARR JEWELL

Appendix E

PRELIMINARY LAYOUT OF EXISTING INTERCHANGE SCENARIOS

The technical appendices are included as published at their time. In some instances subsequent analyses refined the results of the published material. Any such refinements are reflected in the subsequent materials, but the published material is unchanged.

Sleater Kinney Road Interchange

Option #1

- Remove Ramp
- Signalized Intersection
- Proposed Roadway
- Bridge

Critical Area Indicators *

- Ponds, Lakes and Streams
- Buffers of Critical Areas Including:

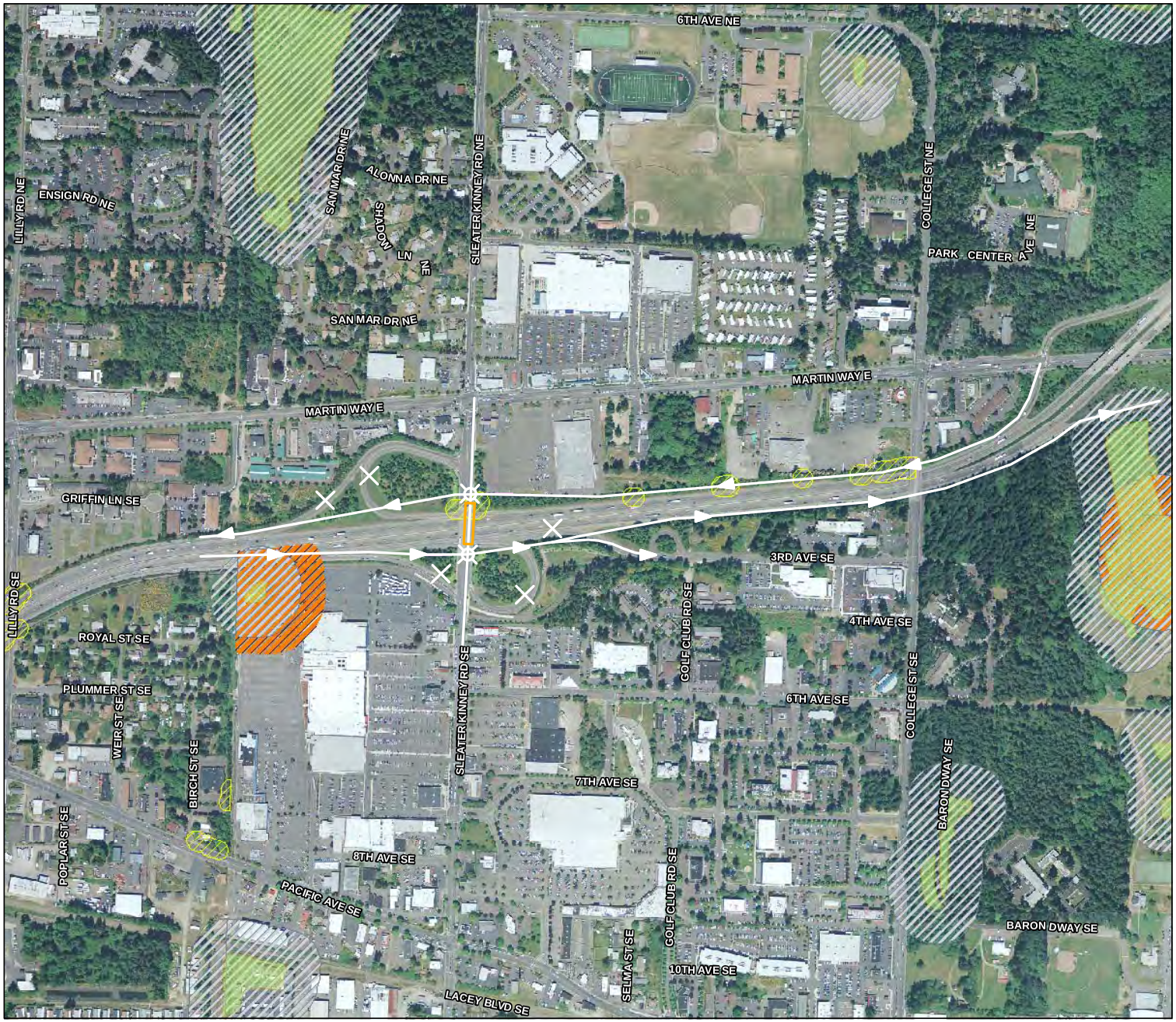
  Streams, Wetlands, Ponds, Lakes, Shorelines

- Steep Slopes
- High Ground Water
- Oak and Prairie Grass
- Wetlands
- Flood Plain

N W E S

0 250 500 1,000 Feet

* Areas identified are considered to be indicators that Critical Areas may be present based on each jurisdictions criteria. On-site verification is required to confirm presence or absence of Critical Areas.



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain

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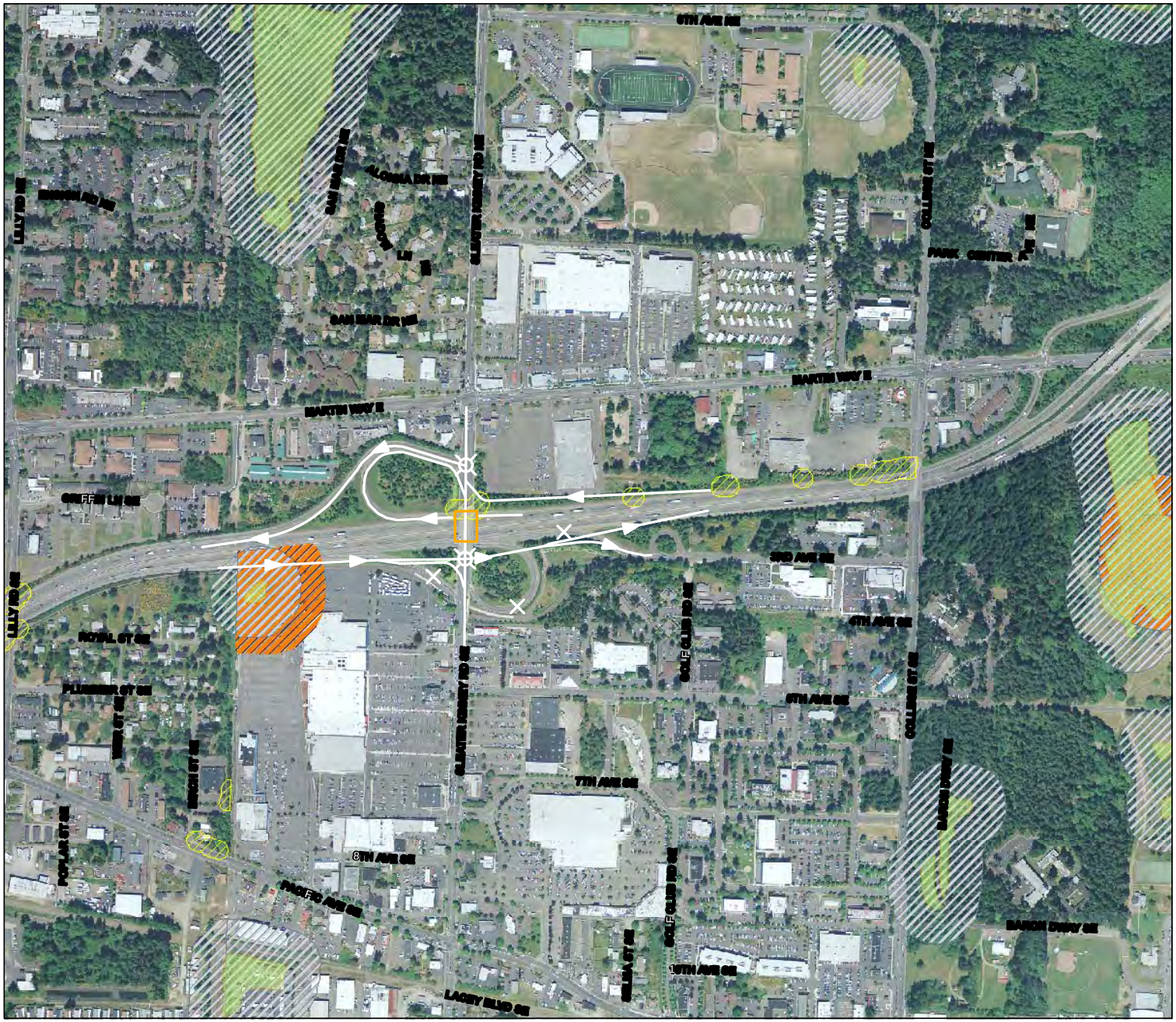

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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

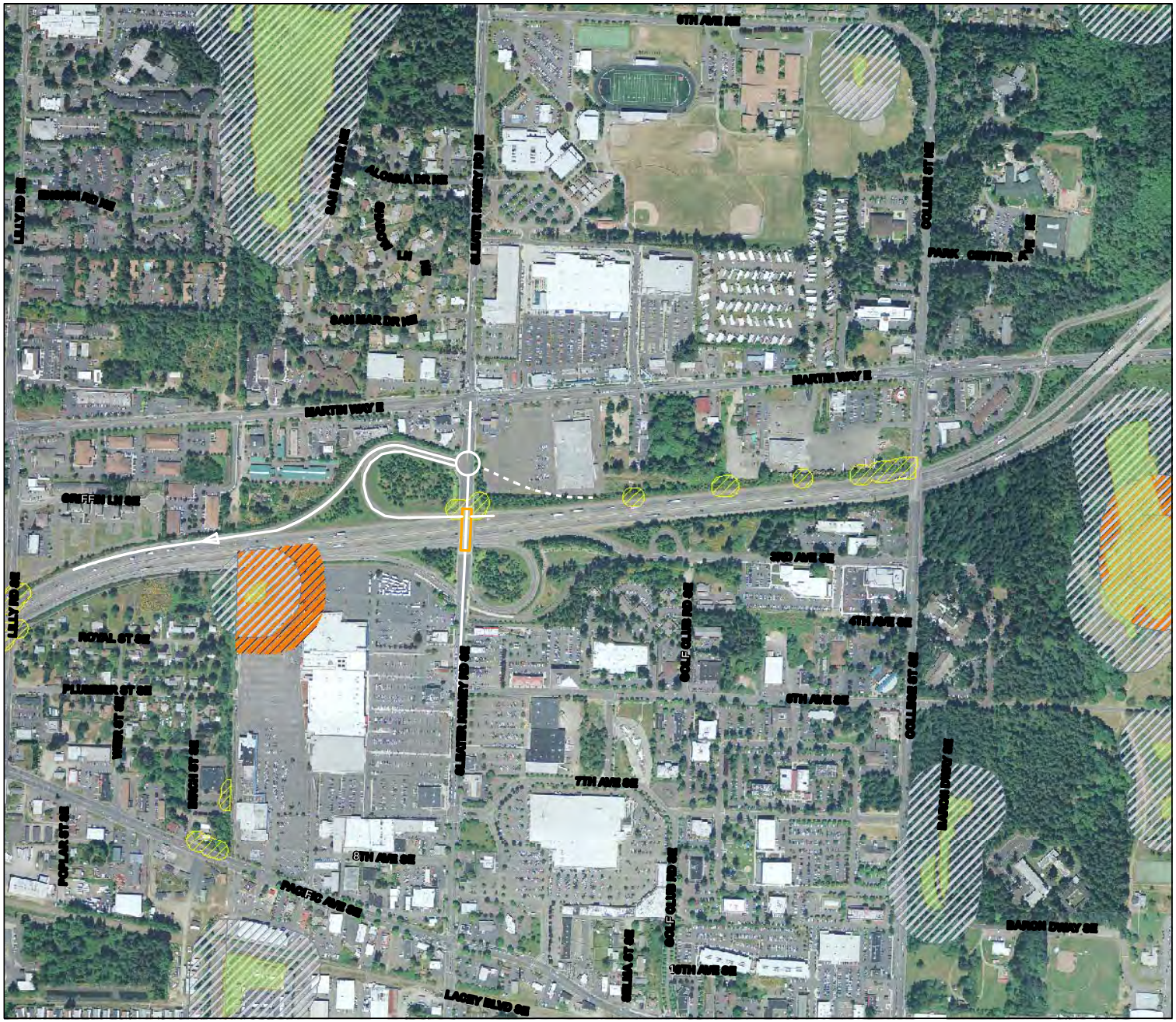
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain

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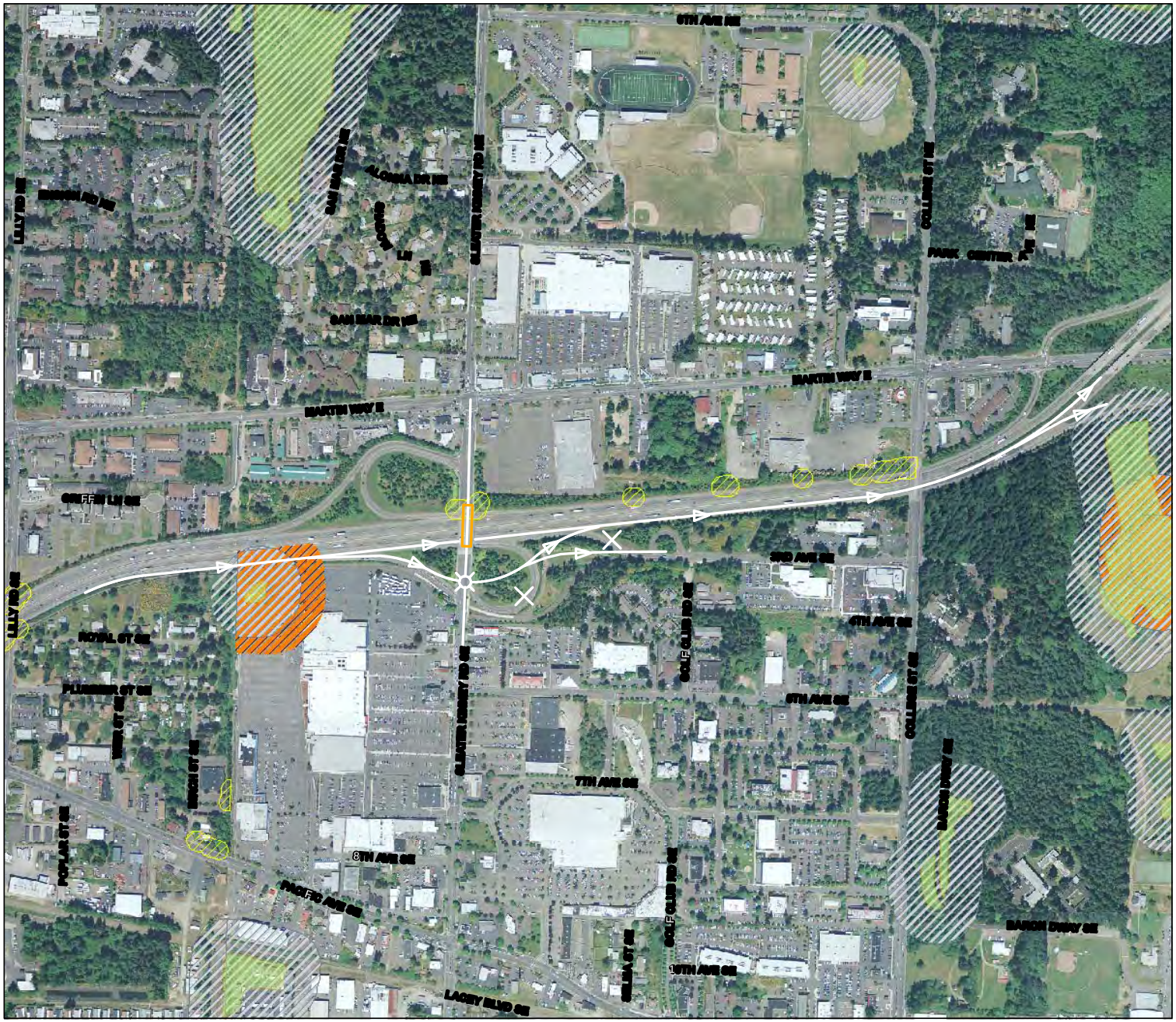

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- Remove Ramp
- Signalized Intersection
- Proposed Roadway
- Bridge

ri i re i r

- Ponds, Lakes and Streams
- Buffers of Critical Areas Including:

  Streams, Wetlands, Ponds, Lakes, Shorelines
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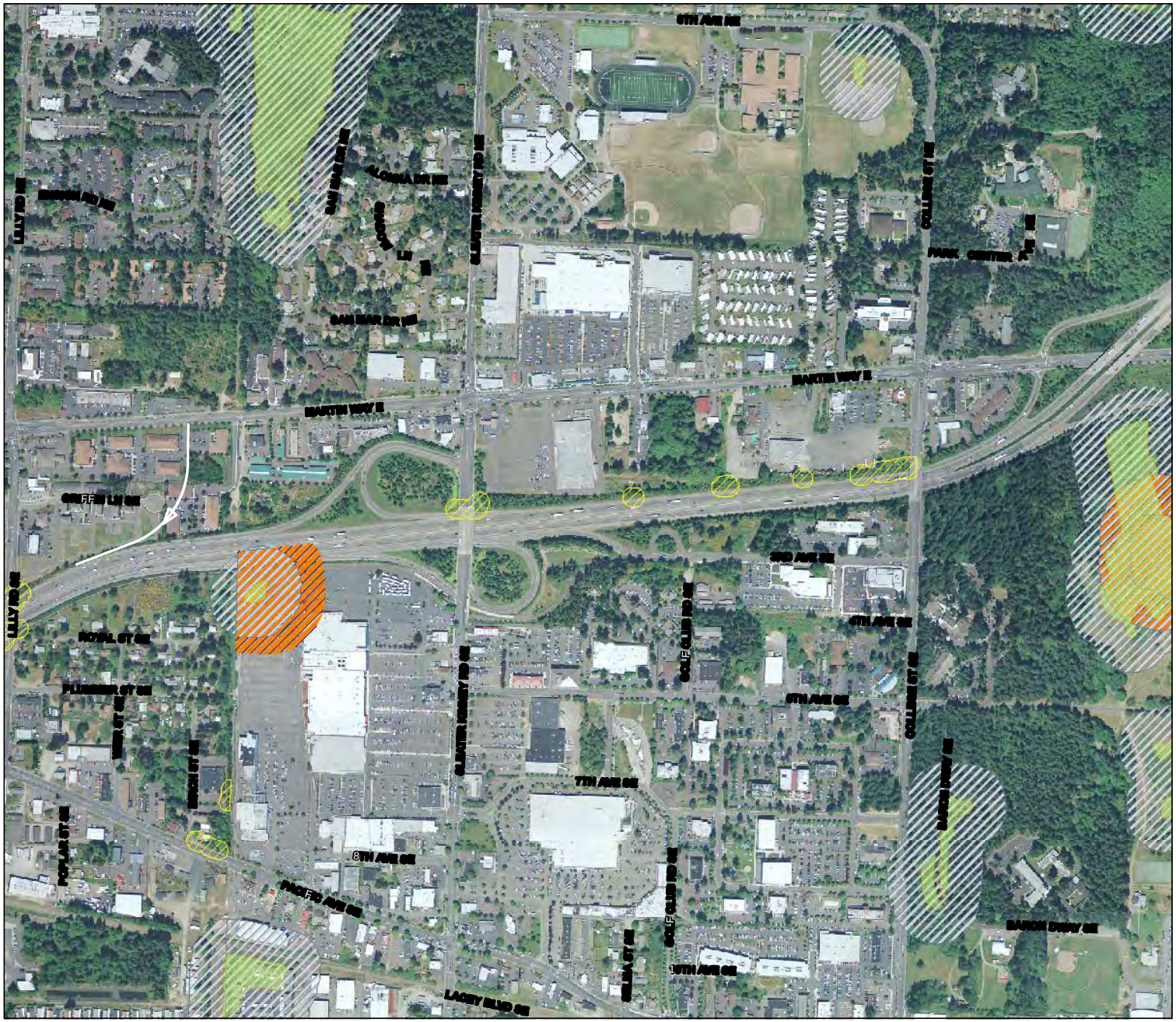

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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

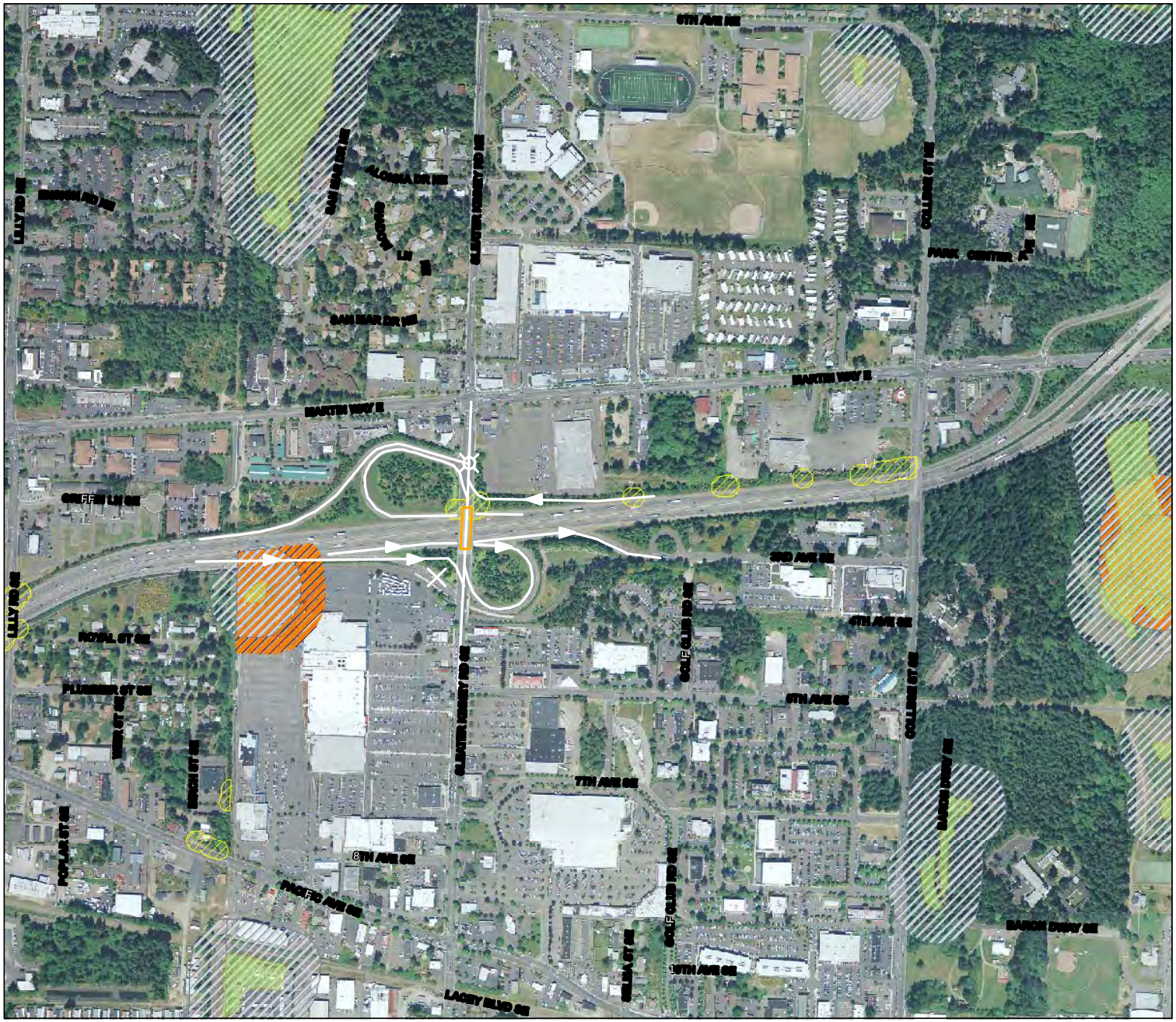
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

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Wetlands

Flood Plain

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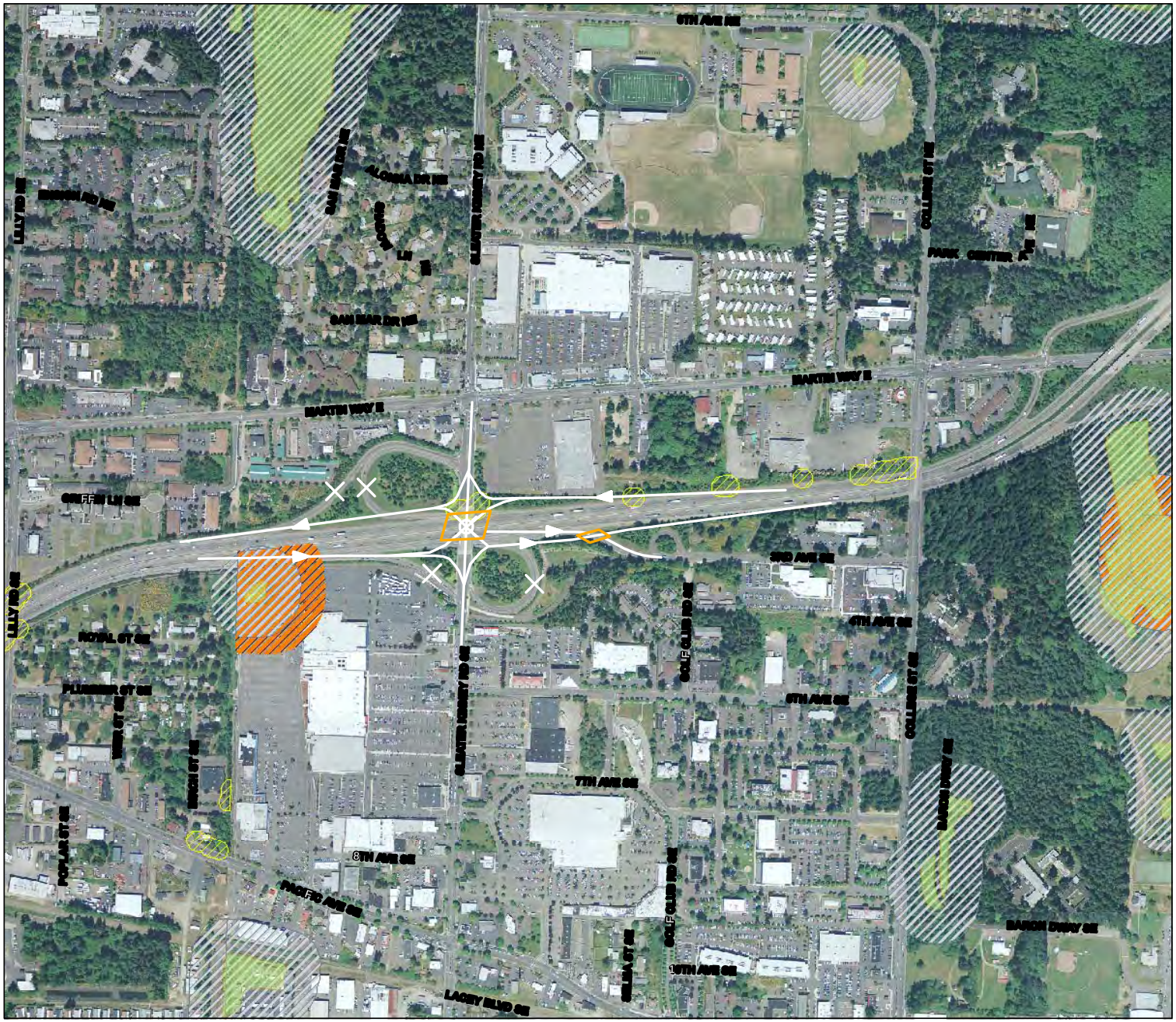

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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain

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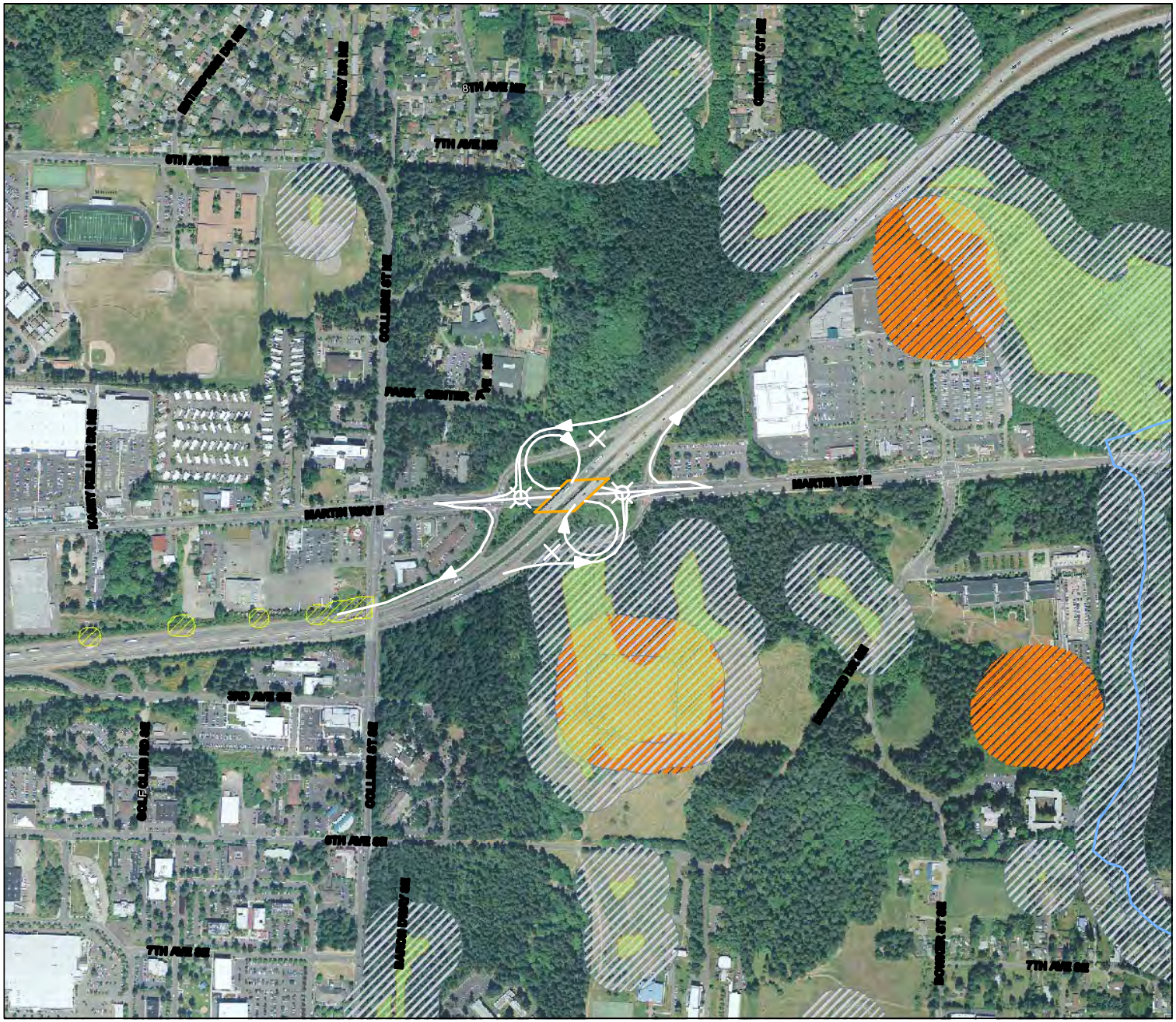

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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

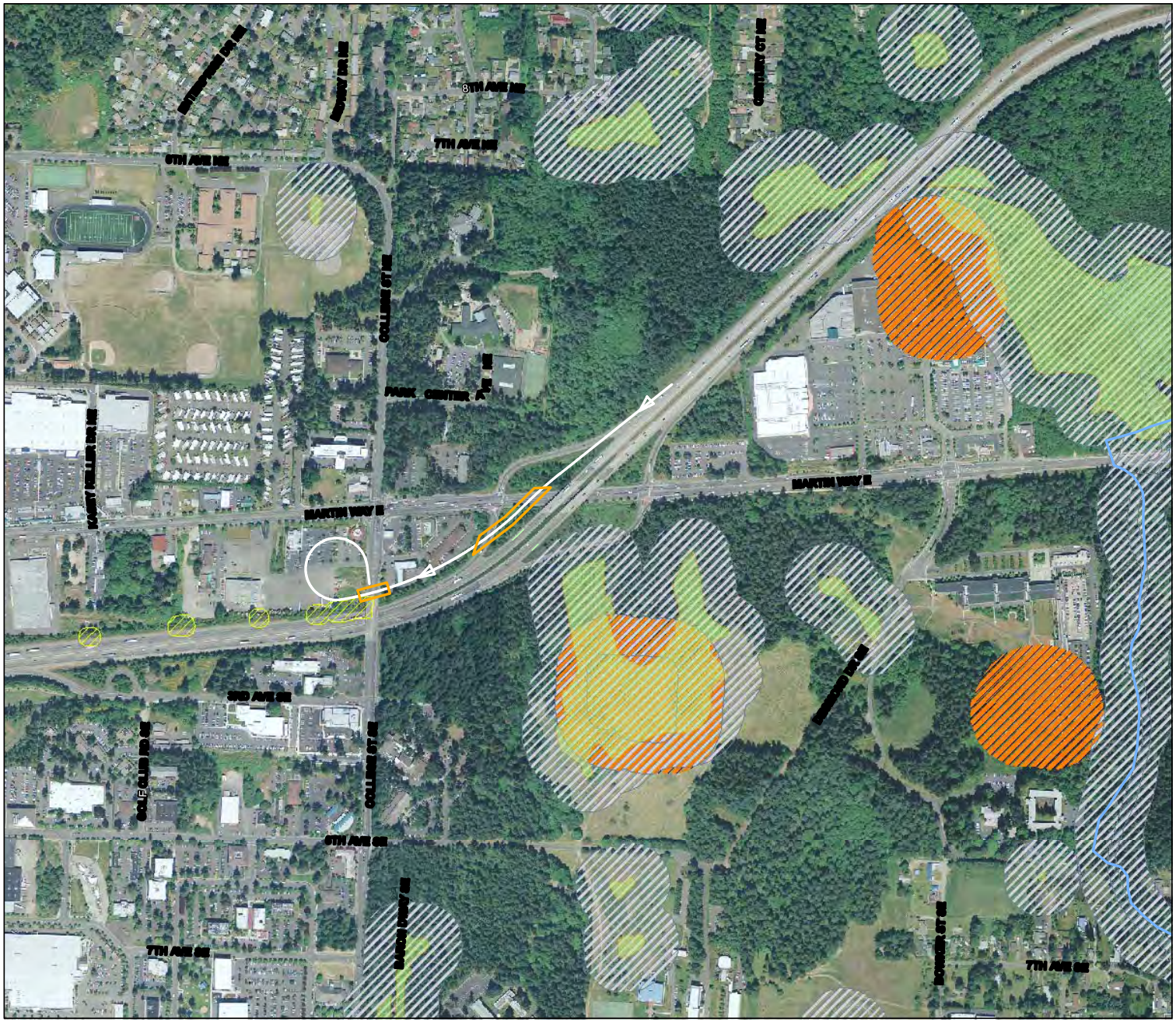
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

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Steep Slopes

High Ground Water

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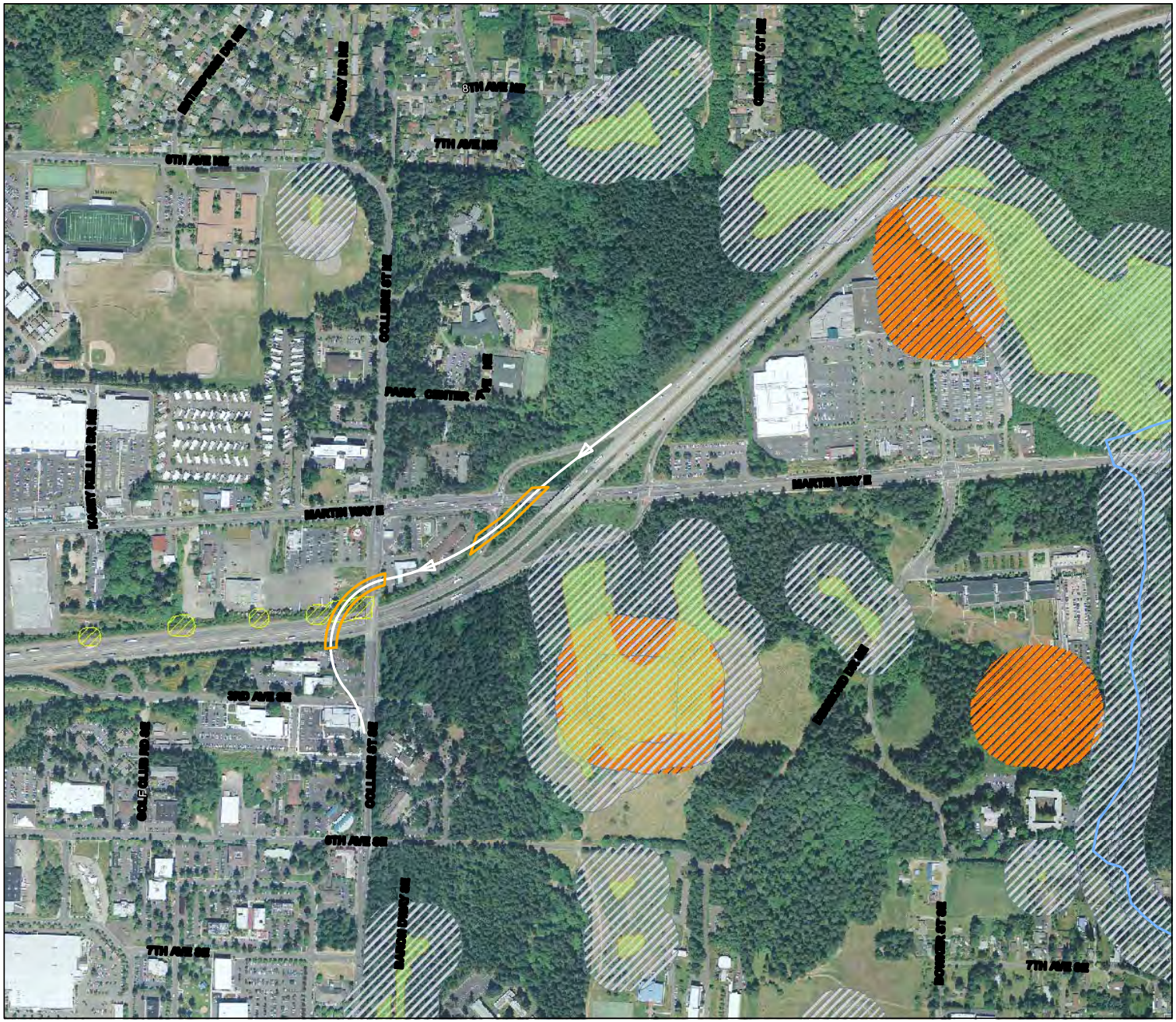
Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

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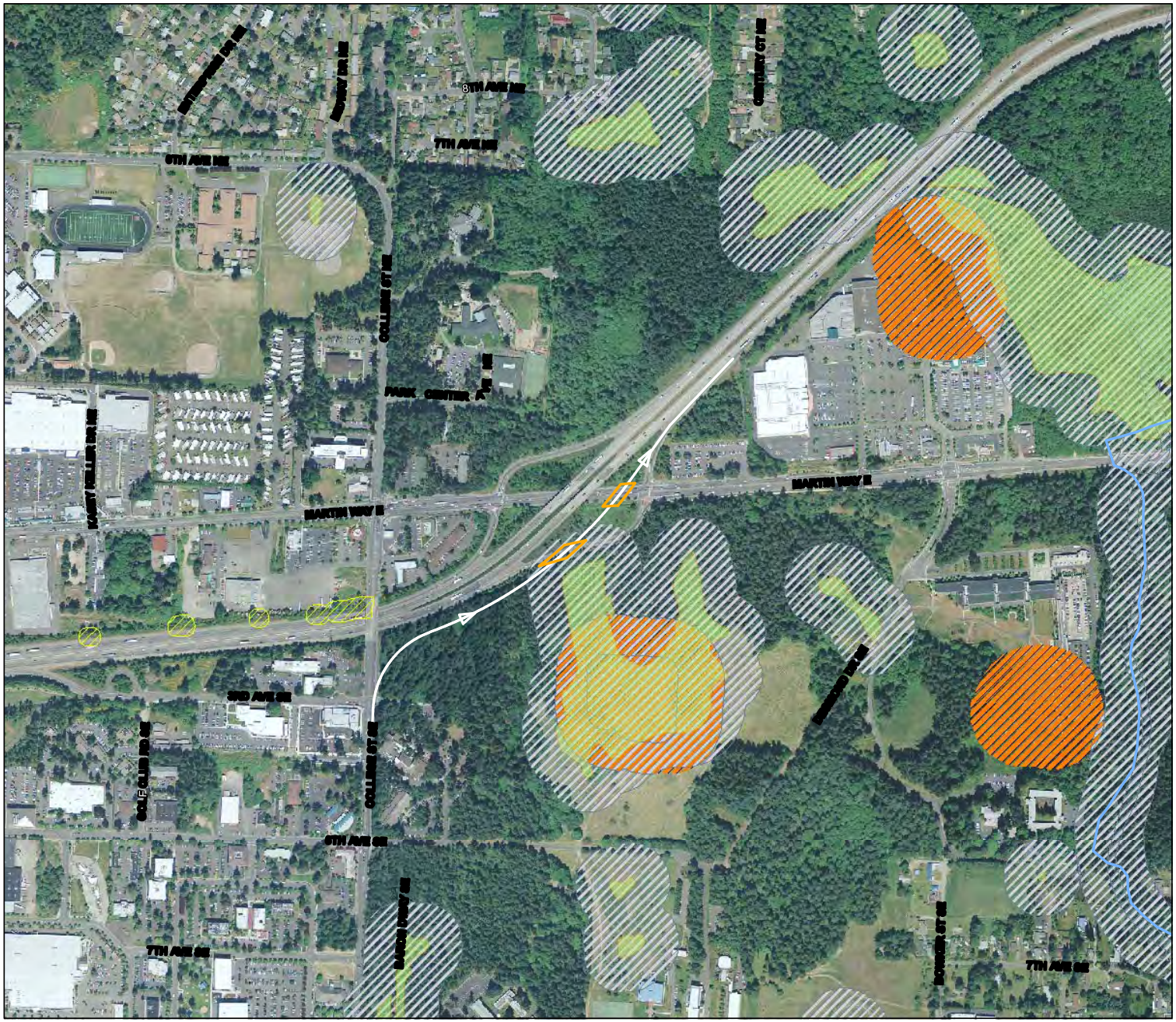
Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

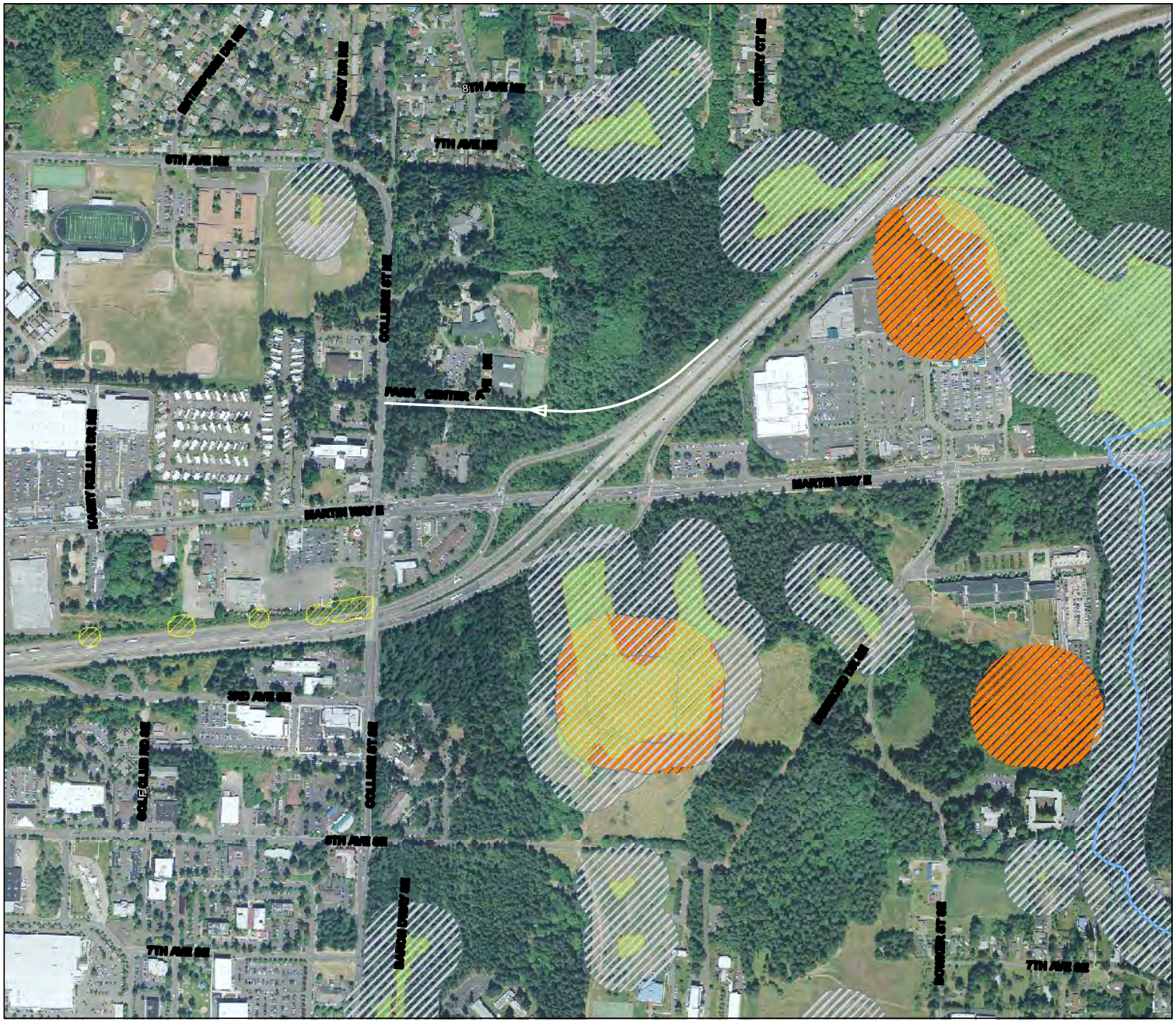
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

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Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

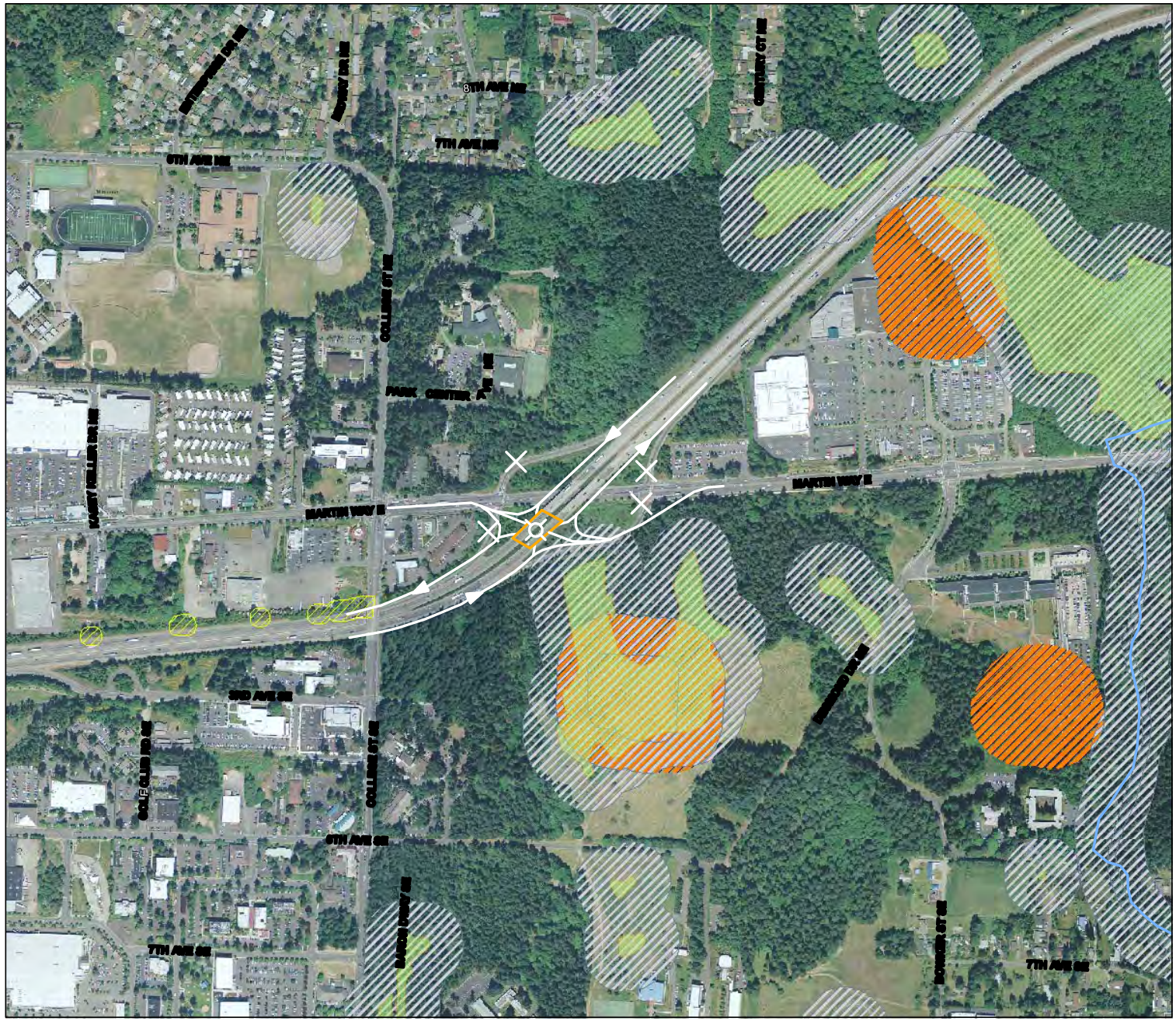
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

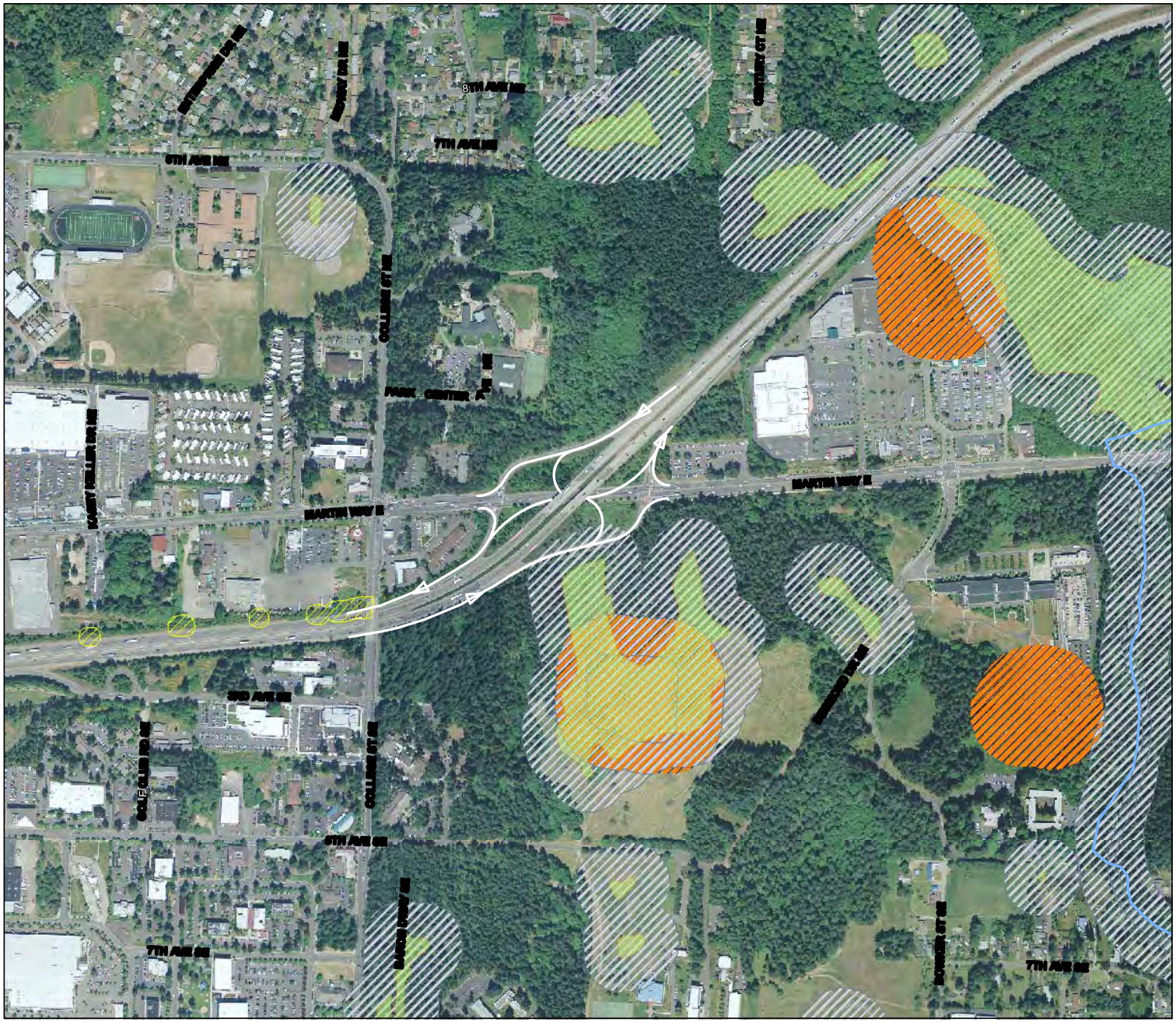
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

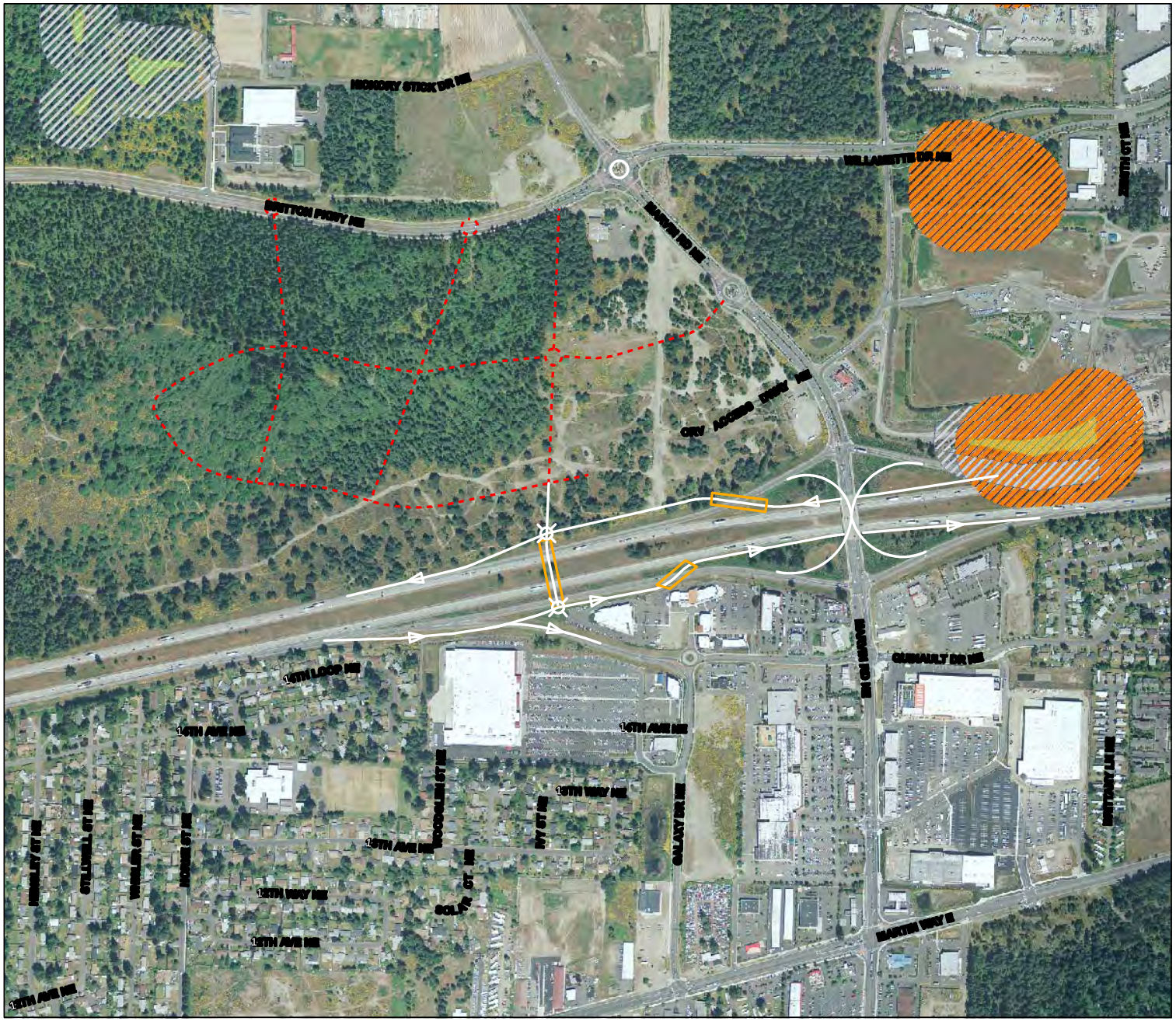
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain

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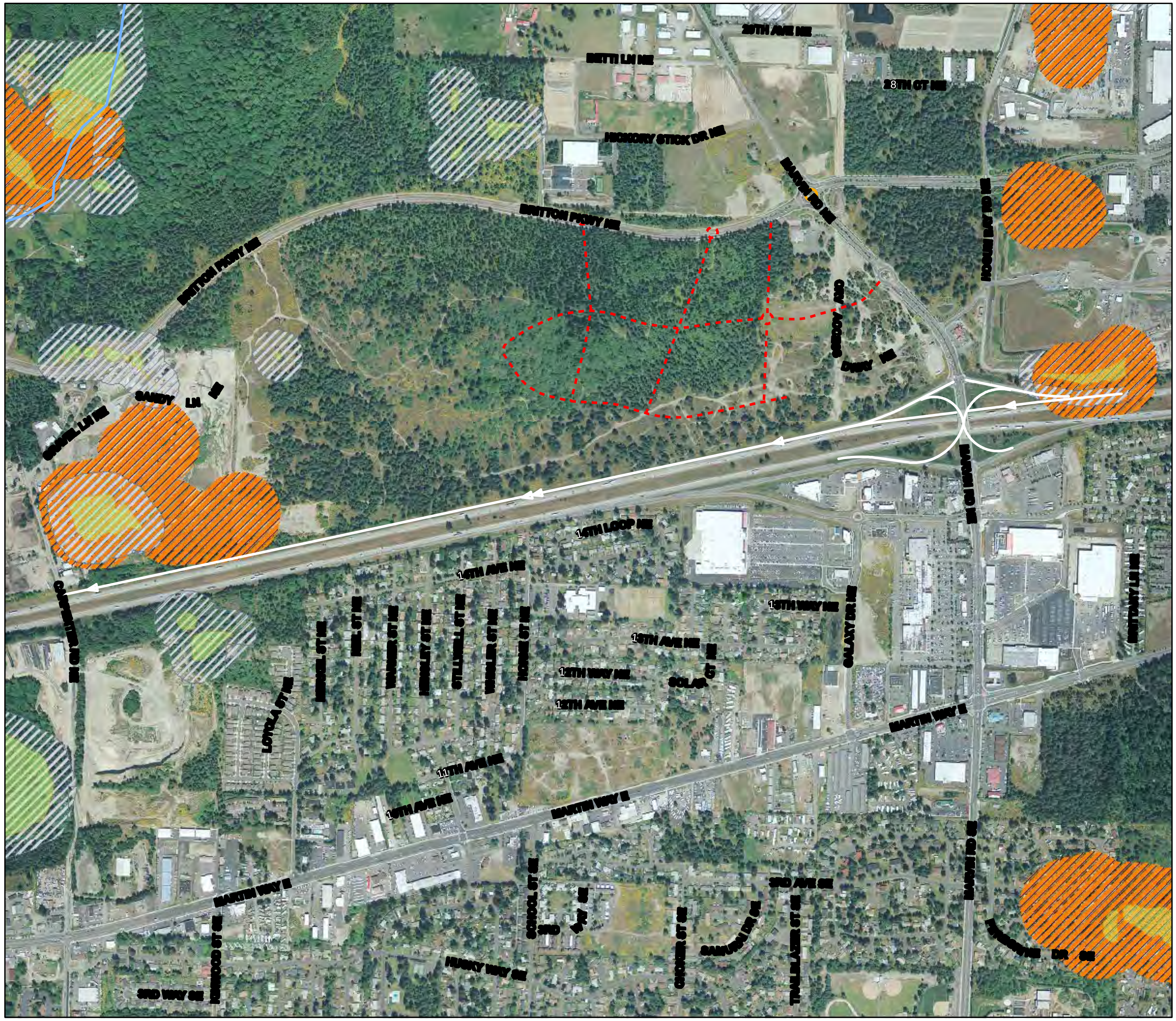

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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

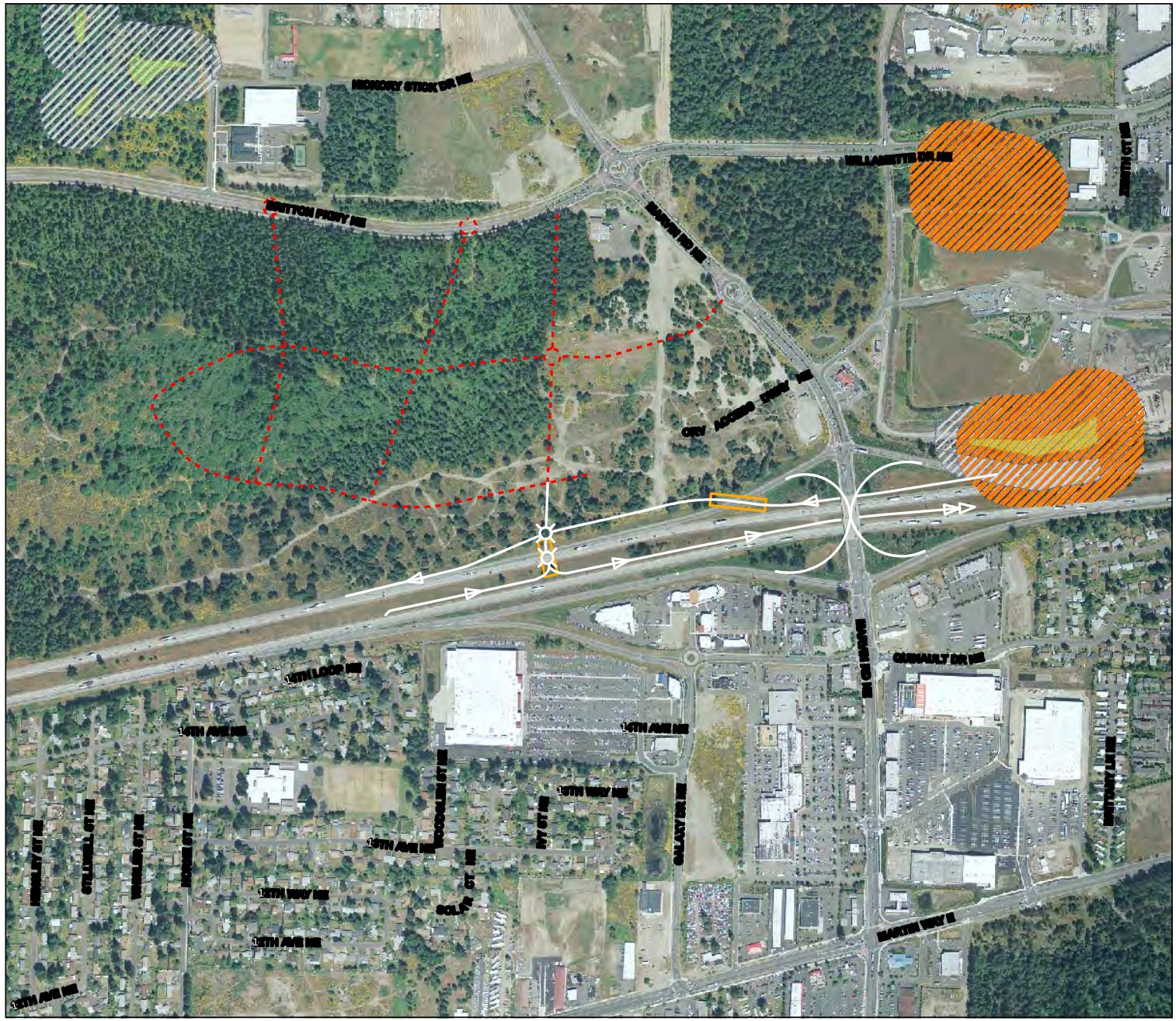
Steep Slopes

High Ground Water

Oak and Prairie Grass

Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

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Steep Slopes

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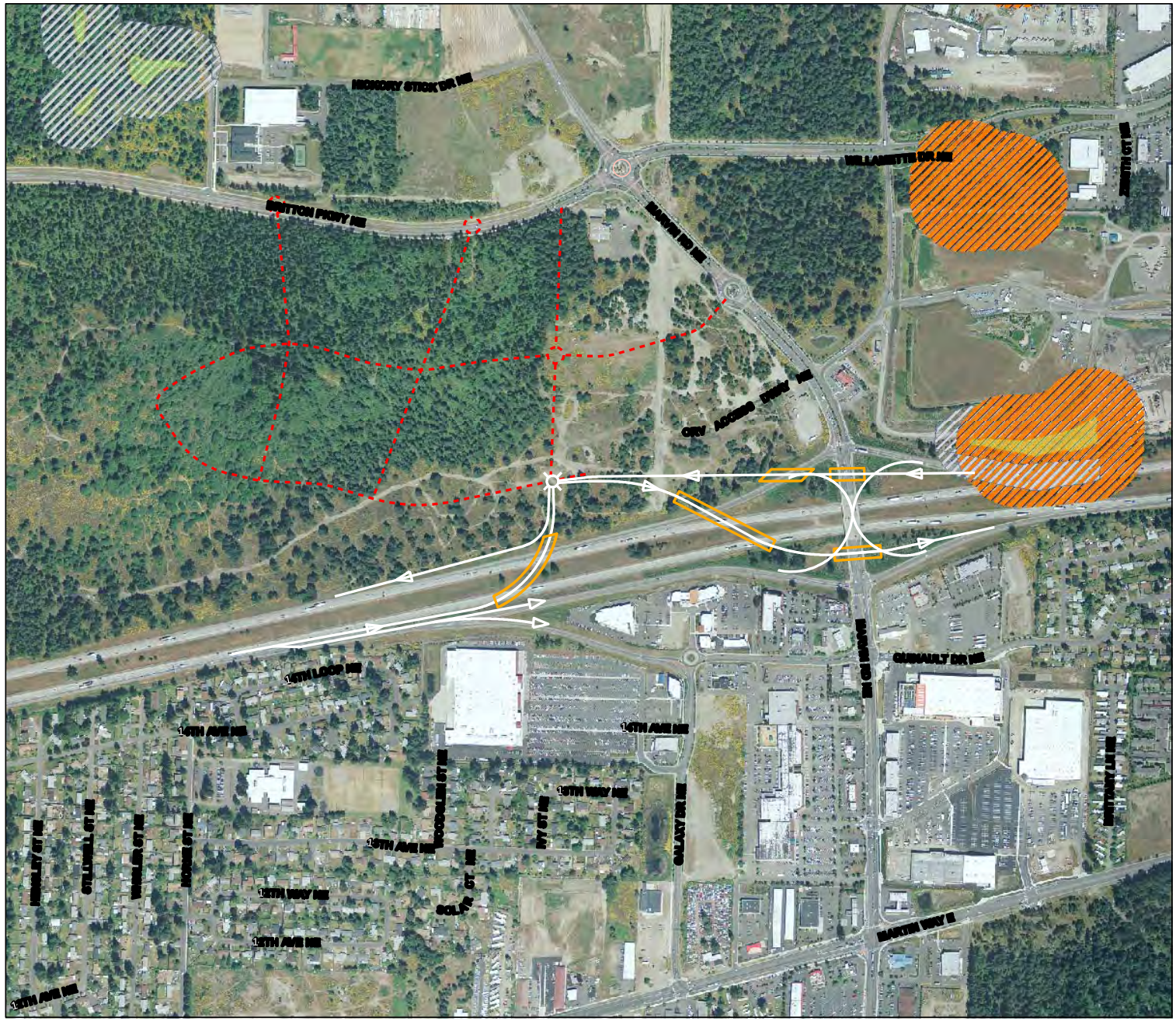
Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

Streams, Wetlands, Ponds, Lakes, Shorelines

Steep Slopes

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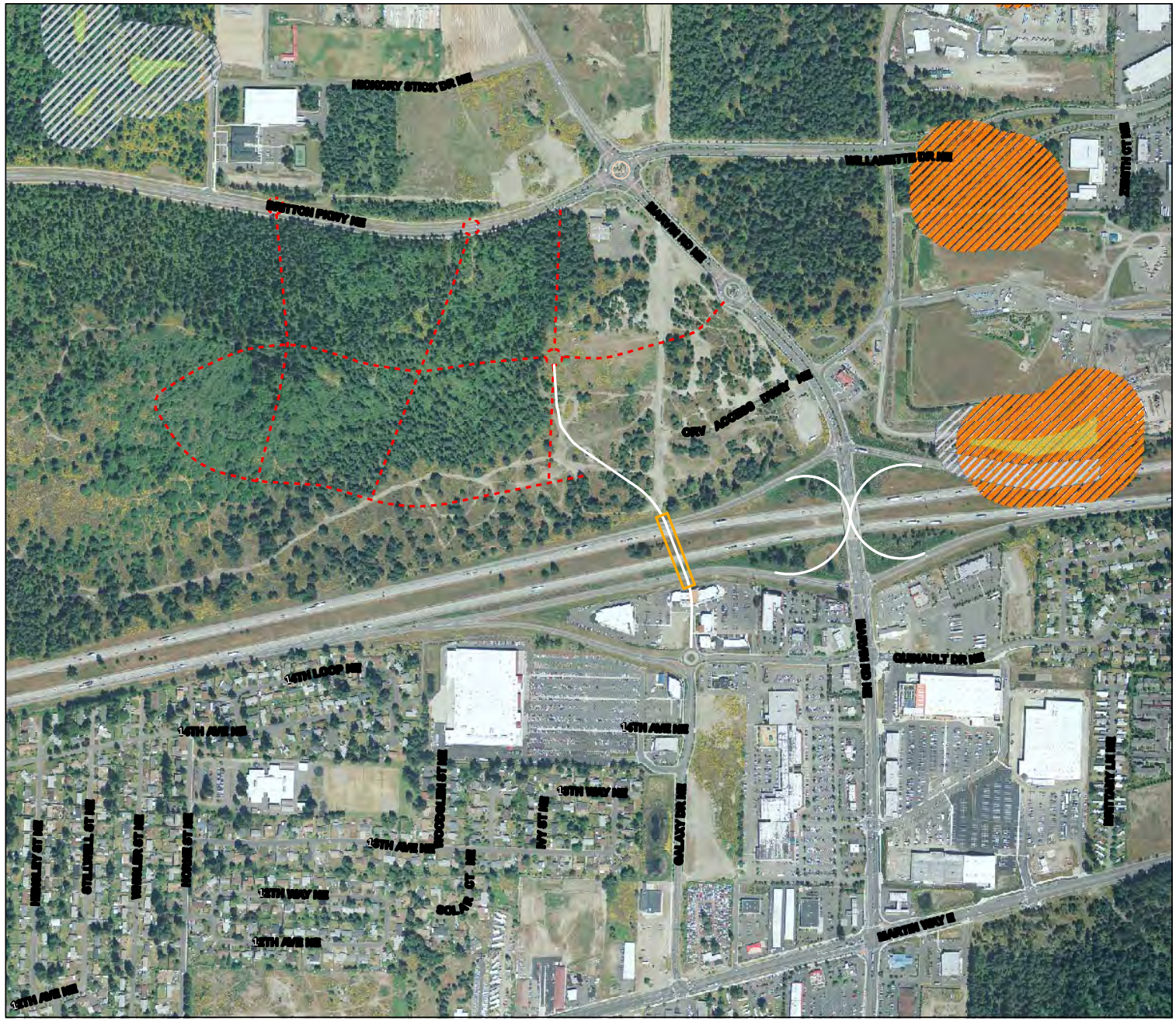
Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

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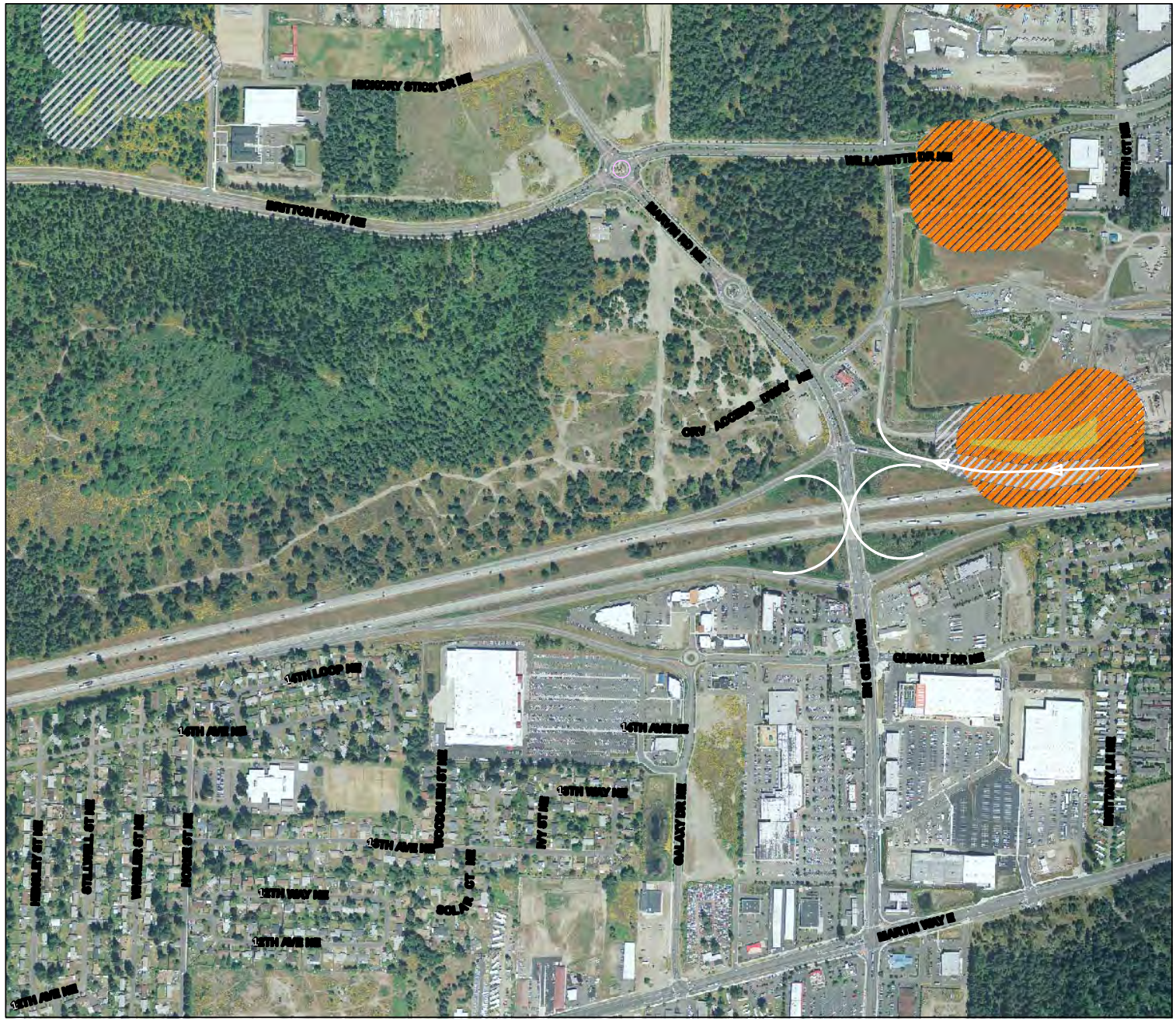
Wetlands

Flood Plain



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Remove Ramp

Signalized Intersection

Proposed Roadway

Bridge

Proposed Local Street Network

ri i re i r

Ponds, Lakes and Streams

Buffers of Critical Areas Including:

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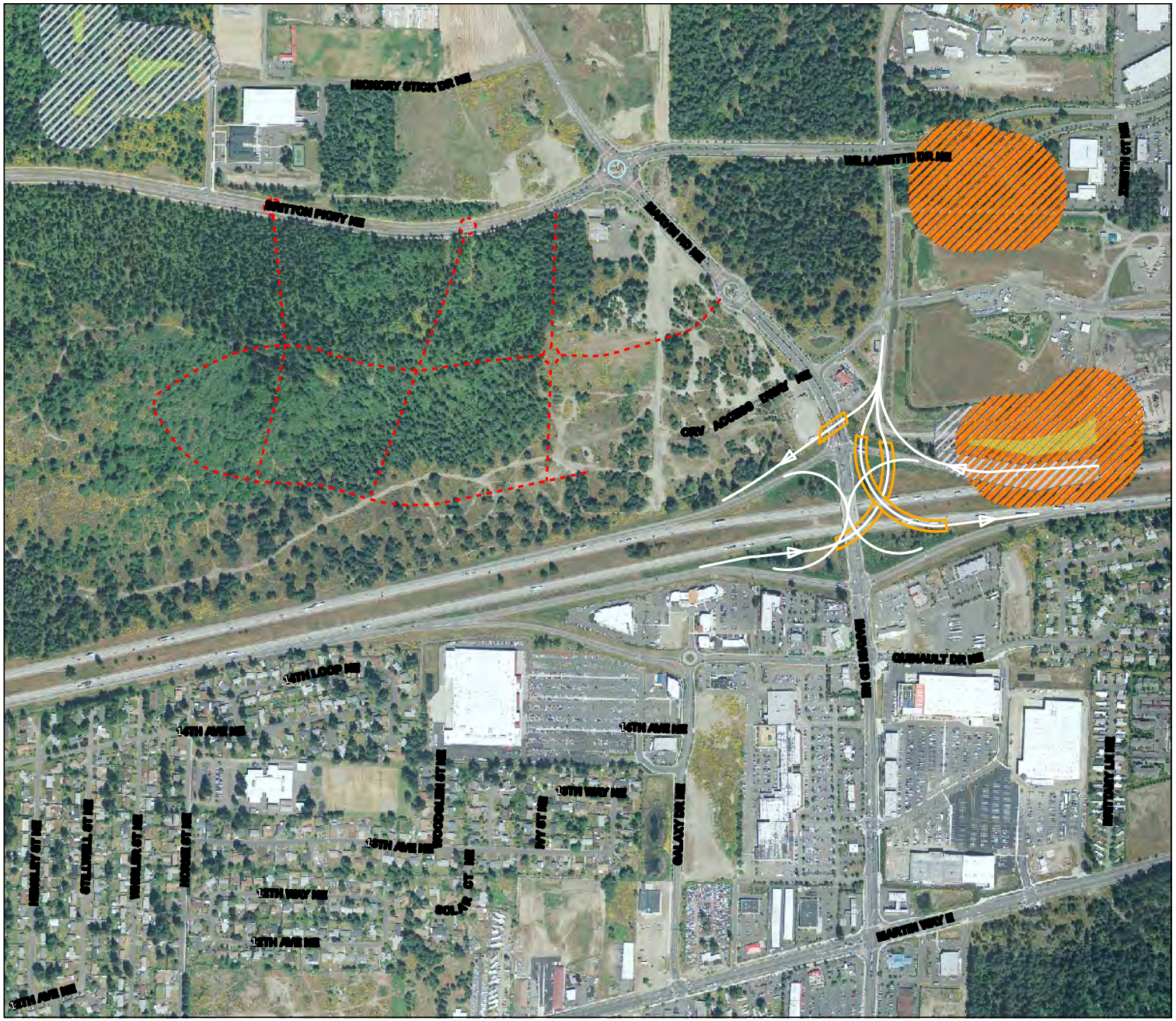

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Printing Date: September 18, 2008
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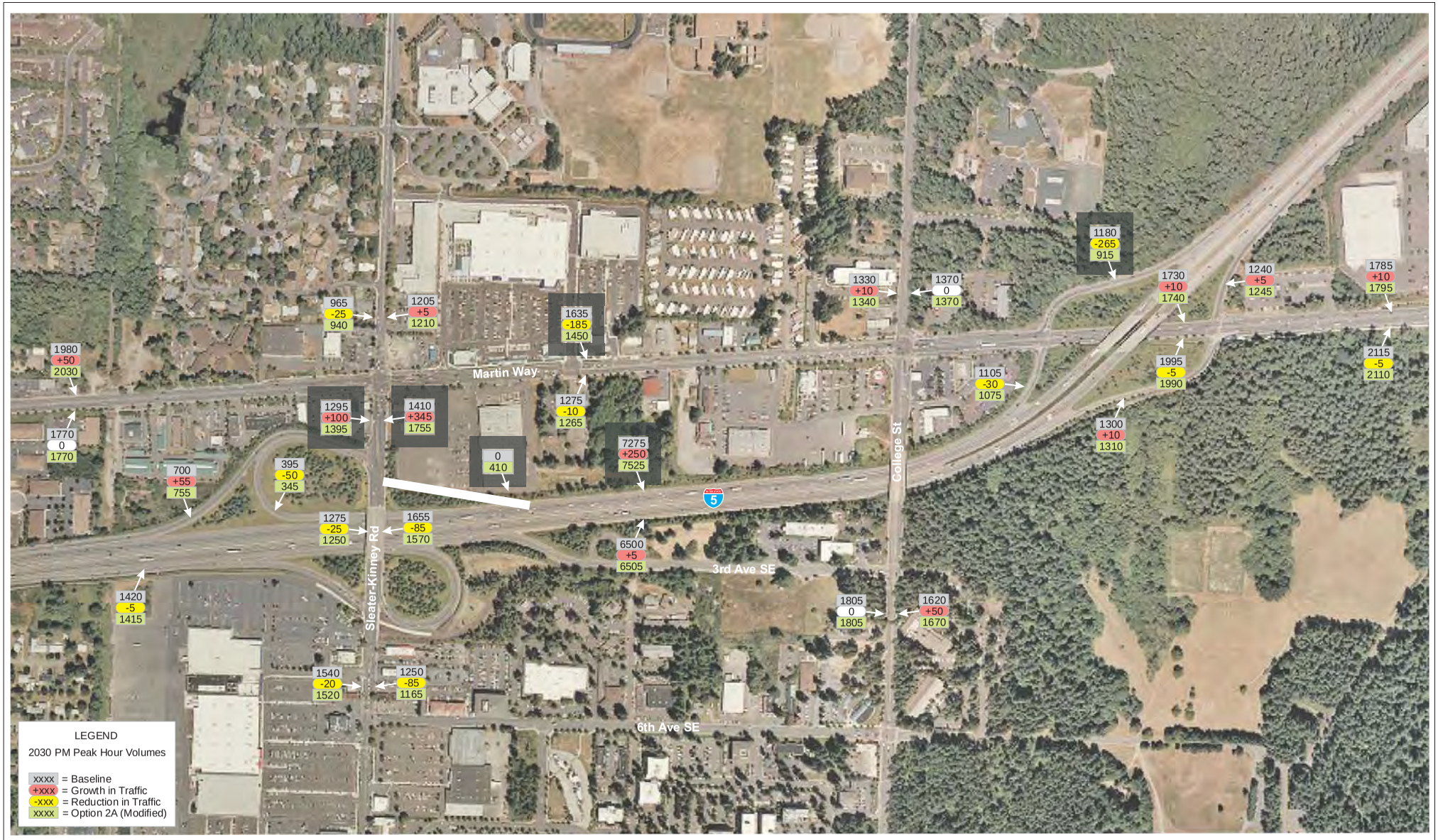
Appendix F

EXISTING INTERCHANGE LINK VOLUME COMPARISONS

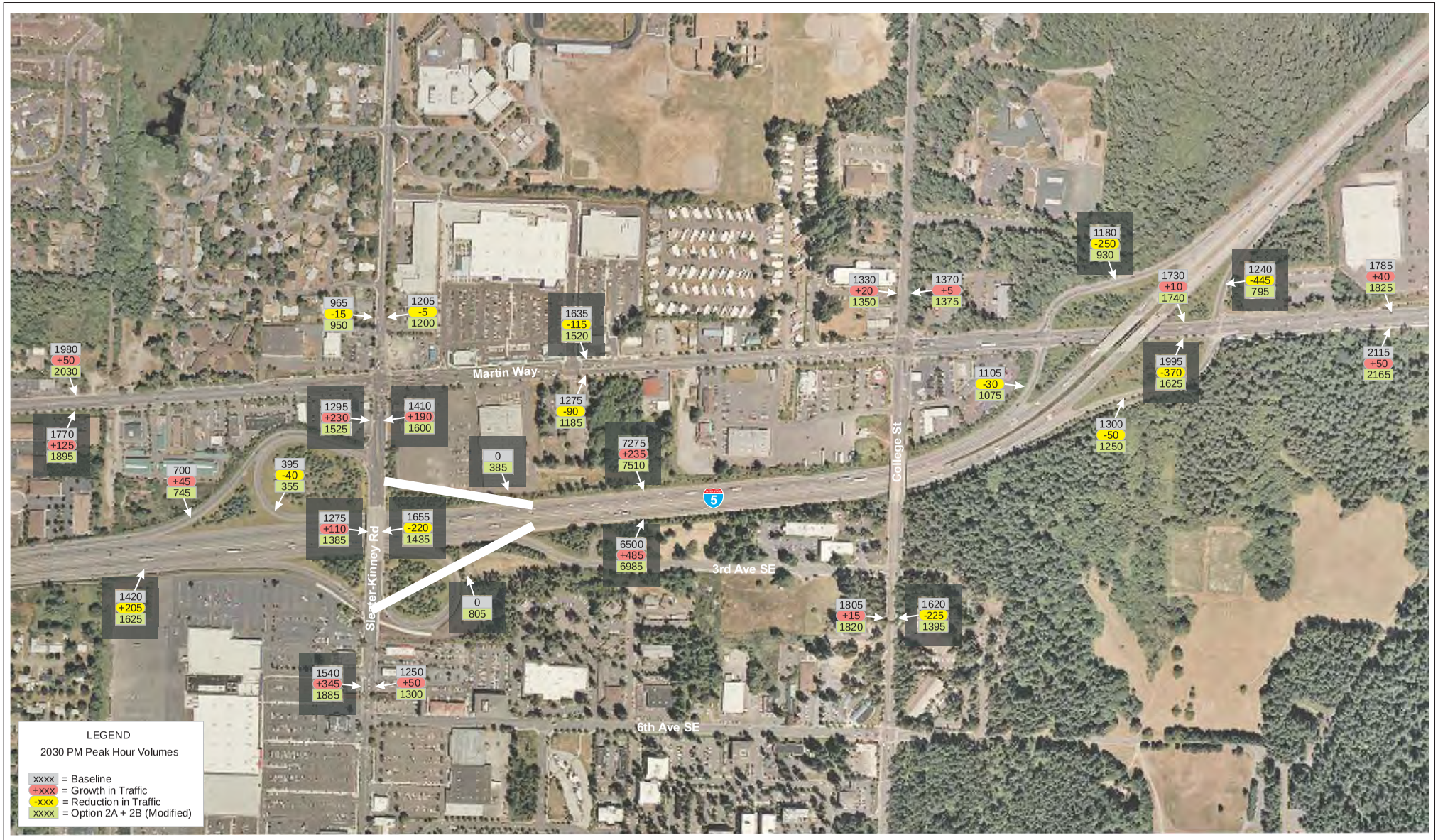
The technical appendices are included as published at their time. In some instances subsequent analyses refined the results of the published material. Any such refinements are reflected in the subsequent materials, but the published material is unchanged.



SHEA CARR JEWELL

Option 2A (Modified) - Add a SB I-5 to NB Sleater Kinney Rd off-ramp

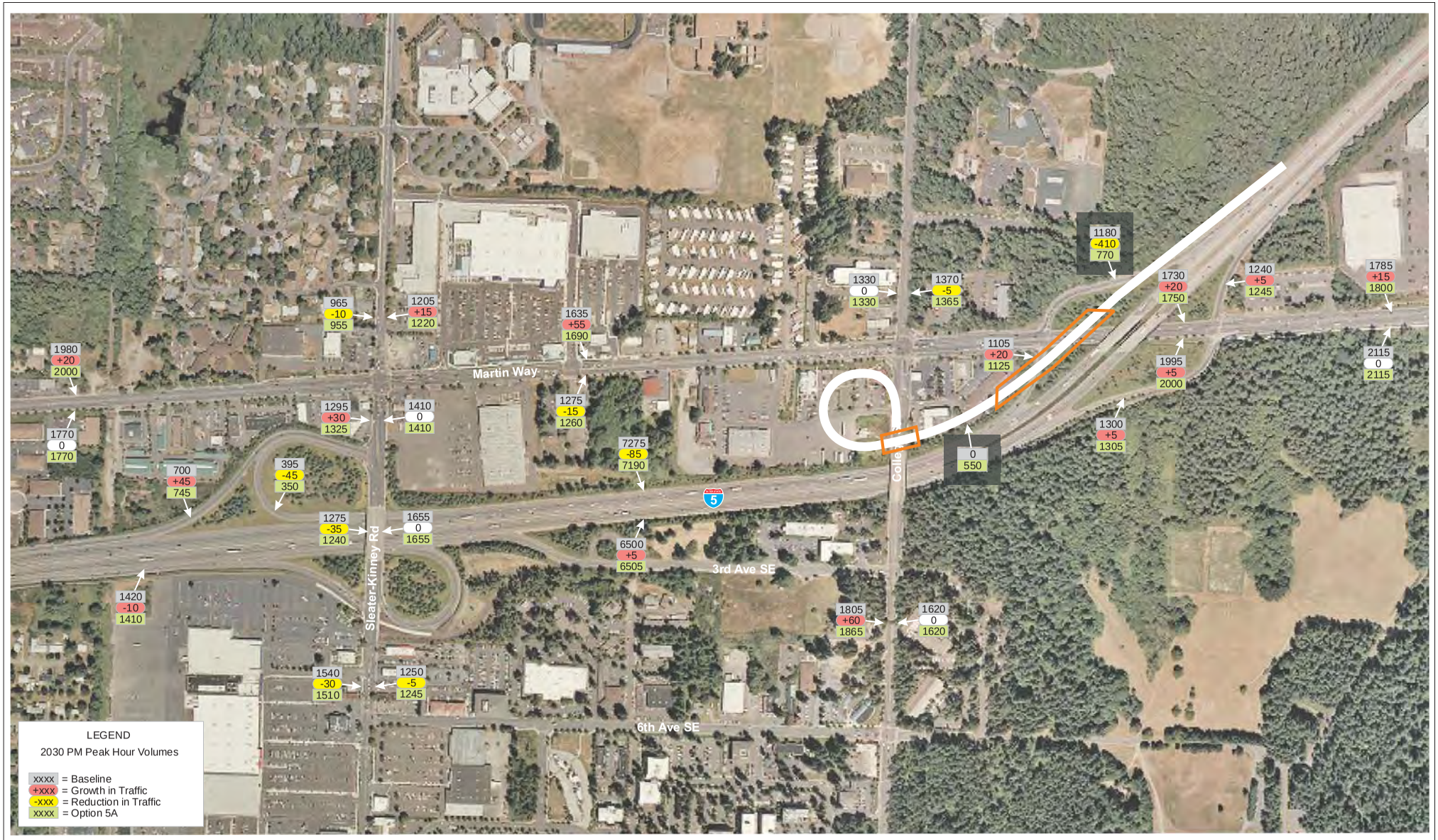
Transportation Systems Analysis and Alternatives Evaluation



SHEA CARR JEWELL

Option 2A & 2B (Modified) - Option 2A (Modified) plus a Sleater-Kinney Rd to NB I-5 on-ramp

Transportation Systems Analysis and Alternatives Evaluation



SHEA CARR JEWELL

Option 5A - Add a SB I-5 to SB College St flyover off-ramp

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 5C - Add a NB College St to NB I-5 flyover on-ramp

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 5A plus Option 5C

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 10A - SB CD to Carpenter Rd

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 10A (Modified) - Option 10A with access to Lacey Gateway Town Center

Transportation Systems Analysis and Alternatives Evaluation

Option 12 - NB off/on flyover ramps

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 13 - New over-crossing; Galaxy Drive Extension

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 14 - Direct SB off-ramp to Hogum Bay Rd

Transportation Systems Analysis and Alternatives Evaluation

SHEA CARR JEWELL

Option 14A - Flyover ramps to Hogum Bay Rd

Transportation Systems Analysis and Alternatives Evaluation