**Parametrix** ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

411 108th AVENUE NE, SUITE 1800
BELLEVUE, WA 98004-5571
T. 425.458.6200 F. 425.458.6363
www.parametrix.com

# TECHNICAL MEMORANDUM 4

| | |
|---|---|
| Date: | July 12, 2010 |
| To: | George Kovich, WSDOT<br>Randy Wessleman, City of Olympia |
| From: | Peter Chen |
| Subject: | West Olympia Access Study - Alternative Screening Evaluation and Concept Design<br>Technical Memorandum 4 |
| cc: | John Perlic, PE, Parametrix |
| Project Number: | 554-1631-062 |
| Project Name: | West Olympia Access Study |

## INTRODUCTION

### Project Background and Work to Date

#### *Need for Improvements*

During the last 5 to 10 years, observed congestion along United States route 101 (US 101) and at local intersections in the West Olympia vicinity has resulted in the need to study the area and identify potential operating deficiencies and transportation facility improvements to improve access and mobility. With the aid of the Thurston Regional Planning Council (TRPC) and the cities of Olympia and Tumwater, existing and future traffic conditions were modeled to confirm operational challenges along the US 101 corridor and the local transportation system in West Olympia.

Short weave sections, frequent lane change maneuvers, and steep grades in some areas currently cause congestion along US 101 in the West Olympia vicinity during peak periods. Additionally, substantial traffic volume increases on US 101 and Interstate 5 (I-5) are expected to worsen congestion in the year 2030 and many sections of US 101 and I-5 are expected to experience unacceptable operating conditions if no improvements are implemented.

In addition to US 101 and I-5 mainline challenges, the local transportation systems in West Olympia and Tumwater are also forecasted to substantially degrade and experience long delays and queues in the year 2030. Of particular concern are the Black Lake Boulevard Single Point Urban Interchange (SPUI), Black Lake Boulevard SW/Cooper Point Road SW intersection, and the Cooper Point Road SW/Top Foods Driveway intersection. The traffic demand at these locations is estimated to substantially exceed capacity and the resulting queues are expected to create bottleneck traffic congestion along eastbound US 101 from the Black Lake off-ramp to west of the Evergreen Parkway interchange.

The high level of interdependency between the freeway and local transportation systems pointed to a need to study improvements to US 101 and local intersections in the cities of Olympia and Tumwater. Without

improvements, connectivity between regional activity centers would substantially degrade, congestion could become a detriment to local economic activities, and collision rates and severity would likely increase.

***Screening Process***

The initial screening process is documented in Technical Memorandum 1, Evaluation and Screening Methods (WSDOT 2007). The first step of the initial screening process included reviewing suggestions during Phase I of the public involvement effort and conducting a fatal flaw analysis. The purpose of the fatal flaw analysis was to eliminate the options that did not meet the objectives of the study.

Based on the initial screening process, options that were selected for further consideration were packaged into scenarios to assess their effectiveness as a system. A more detailed traffic evaluation of the scenarios was conducted in the second screening process, which was documented in Technical Memorandum 2, Existing 2007 and Year 2030 No Build (Parametrix 2008a) and Technical Memorandum 3, Traffic Operations Analysis (Parametrix 2008b). The second screening process focused on reviewing traffic changes and identifying whether the scenarios would relieve traffic congestion at failing intersections and congested freeway locations.

***Improvement Scenarios***

The result of the initial screening process eliminated potential improvement options with fatal flaws and identified a set of reasonable scenarios (Scenarios 1 through 7) to be carried forward for further consideration. Since that time, the WSDOT and the City of Olympia expressed a desire to conduct an evaluation of an additional interchange improvement (Scenarios 8 and 9). All of these improvement scenarios consisted of:

- **No-Build (Scenario 1)** – The No-Build Scenario 1 accounted for various local and State projects indentified for construction and completion prior to 2030, but did not include any improvements to US 101 or the local transportation system directly related to the build scenarios.
- **Local System Only (Scenarios 2 and 3)** – These scenarios focus on changes to the local transportation system only and do not modify US 101 access. The difference between these scenarios is the inclusion of three street connections between existing roadway facilities in the southwest residential area of West Olympia, collectively referred to as the "Southwest Connections." Scenario 2 does not include the Southwest Connections and Scenario 3 does include the Southwest Connections.
- **Black Lake Interchange (Scenarios 4 and 5)** – In addition to the improvements included in the Local System Only Scenarios 2 and 3, these scenarios also included modified access to US 101. The existing Black Lake interchange would be modified with an additional lane diverging from the westbound off-ramp that connects to Yauger Way SW, and another lane from Yauger Way SW would connect to the existing eastbound on-ramp prior to merging with the US 101 mainline. Scenario 4 does not include the Southwest Connections and Scenario 5 does include the Southwest Connections.
- **Evergreen Interchange (Scenarios 6 and 7)** – These scenarios also included the arterial network improvements included in the Local System Only Scenarios 2 and 3, but also modified access to US 101. These scenarios included straightening the existing eastbound on-ramp and westbound off-ramp such that both gore points with US 101 would be located further east. Bifurcated ramps to and from Kaiser Road SW would also be added that would connect to the re-aligned on- and off-ramps. Both relocated eastbound and westbound ramps would parallel US 101 under the Kaiser Road SW bridge. Scenario 6 does not include the Southwest Connections and Scenario 7 does include the Southwest Connections.
- **Hybrid Interchange (Scenarios 8 and 9)** – These scenarios are a hybrid of the Black Lake and Evergreen Interchange improvements. Similar to the Black Lake interchange scenarios, a second ramp would be constructed that diverges from the existing Black Lake westbound off-ramp and would connect to Yauger Way SW. Unlike the Black Lake interchange scenarios, this new ramp would continue

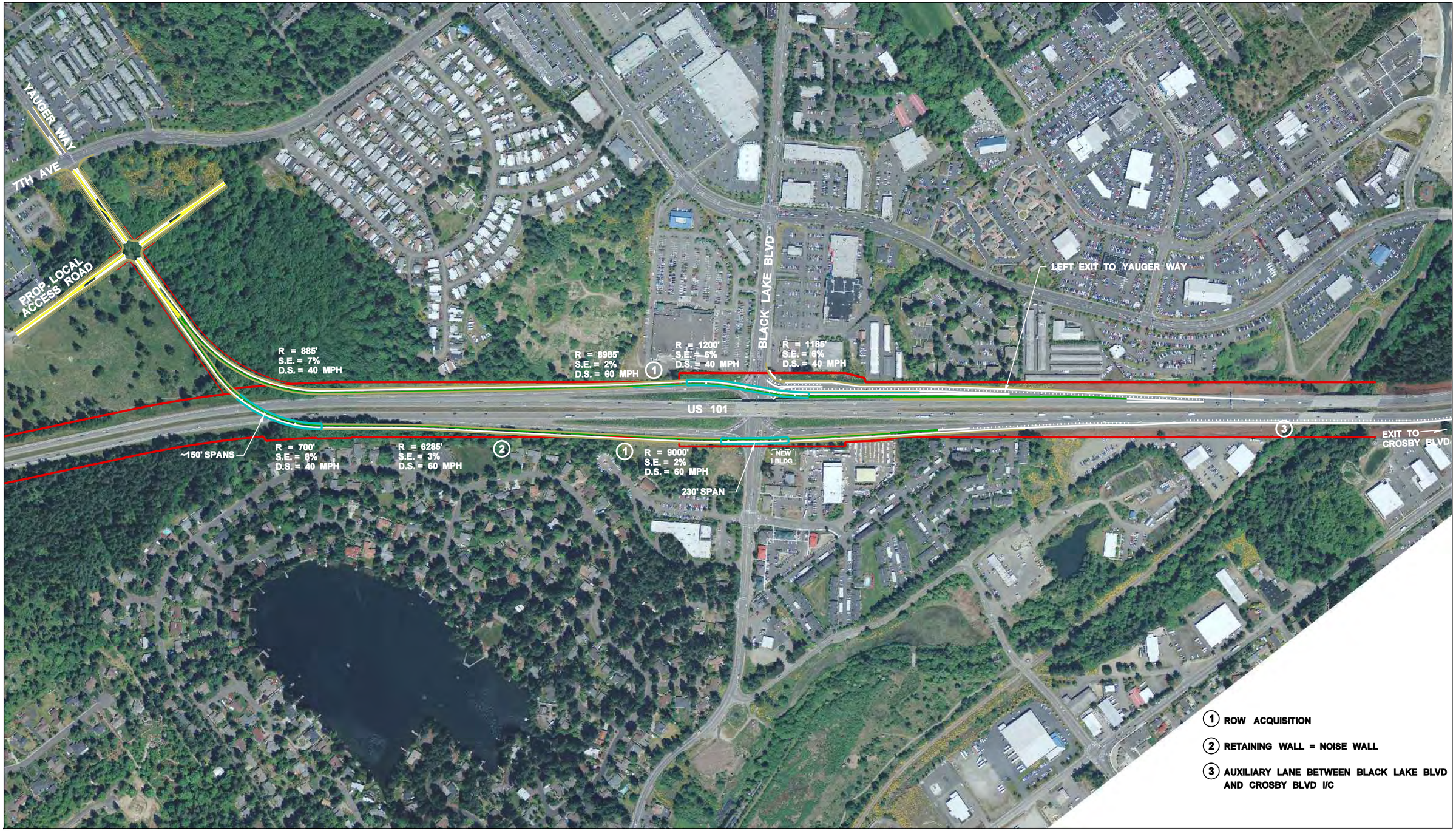
westbound and terminate at Kaiser Road. For the eastbound direction of US 101, an additional eastbound on-ramp from Kaiser Road would be constructed downstream of the existing on-ramp from Evergreen, which would also be straightened and connect to US 101 further east of its current location. The arterial network improvements included in the Local System Only Scenarios 2 and 3 would also be included in the Hybrid Interchange scenarios. Scenario 8 does not include the Southwest Connections and Scenario 9 does include the Southwest Connections.

The Black Lake, Evergreen, and Hybrid interchange configurations are shown on Figures 1, 2, 3a, and 3b.

The traffic analyses for Scenarios 1 through 7 are detailed in Technical Memorandum 2 (Parametrix 2008a) and Technical Memorandum 3 (Parametrix 2008b) and the operational analyses for Scenarios 8 and 9 are provided as an appendix to this technical memorandum. Recommendations from these Technical Memorandums were based on the freeway and local system operations.

Since freeway operations are comparable for all build scenarios, the recommendations place more emphasis on the local system operations. The local system operations (1-hour analysis) for the build scenarios are summarized in Table 1.

Text descriptions and conclusions in this technical memorandum are based on the 1-hour analysis described in Table 1. The City of Olympia uses a slightly different methodology for calculating LOS for concurrency purposes that uses 2 hour peak period volumes. Using the City of Olympia's methodology, the local system operations (2-hour analysis) for the build scenarios are summarized in Table 2.




**Parametrix** 554-1631-062/03(05) 7/10

N

0 500'
SCALE IN FEET

West Olympia Access Study
EB: C/D Outside Black Lake Blvd Interchange Ramps
WB: C/D Braid Over Black Lake Blvd

**Figure 1**
**Black Lake Interchange**

FILE: P8028-RP-Evergreen CD 11x17.dgn

**Parametrix** 554-1631-062/03(05) 7/10

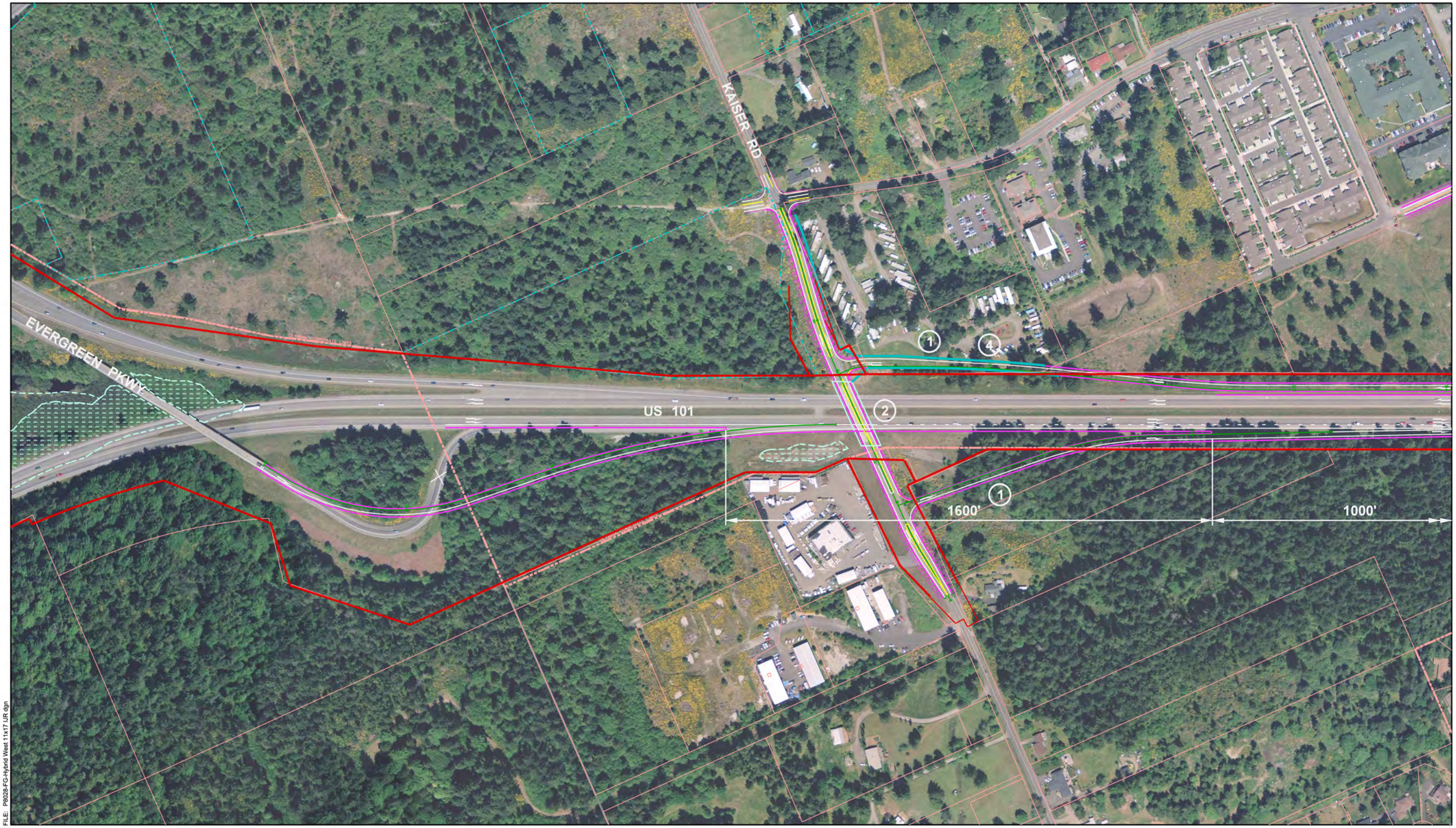
N

0 500'

SCALE IN FEET

West Olympia Access Study
EB: C/D for On-Ramps from Evergreen Pkwy and Kaiser Rd
WB: C/D for Off-Ramps to Kaiser Rd and Evergreen Pkwy

**Figure 2**
**Evergreen Interchange**




FILE: P8028-FG-Hybrid West 11x17 UR.dgn

**Parametrix** 554-1631-062/03(05) 7/10

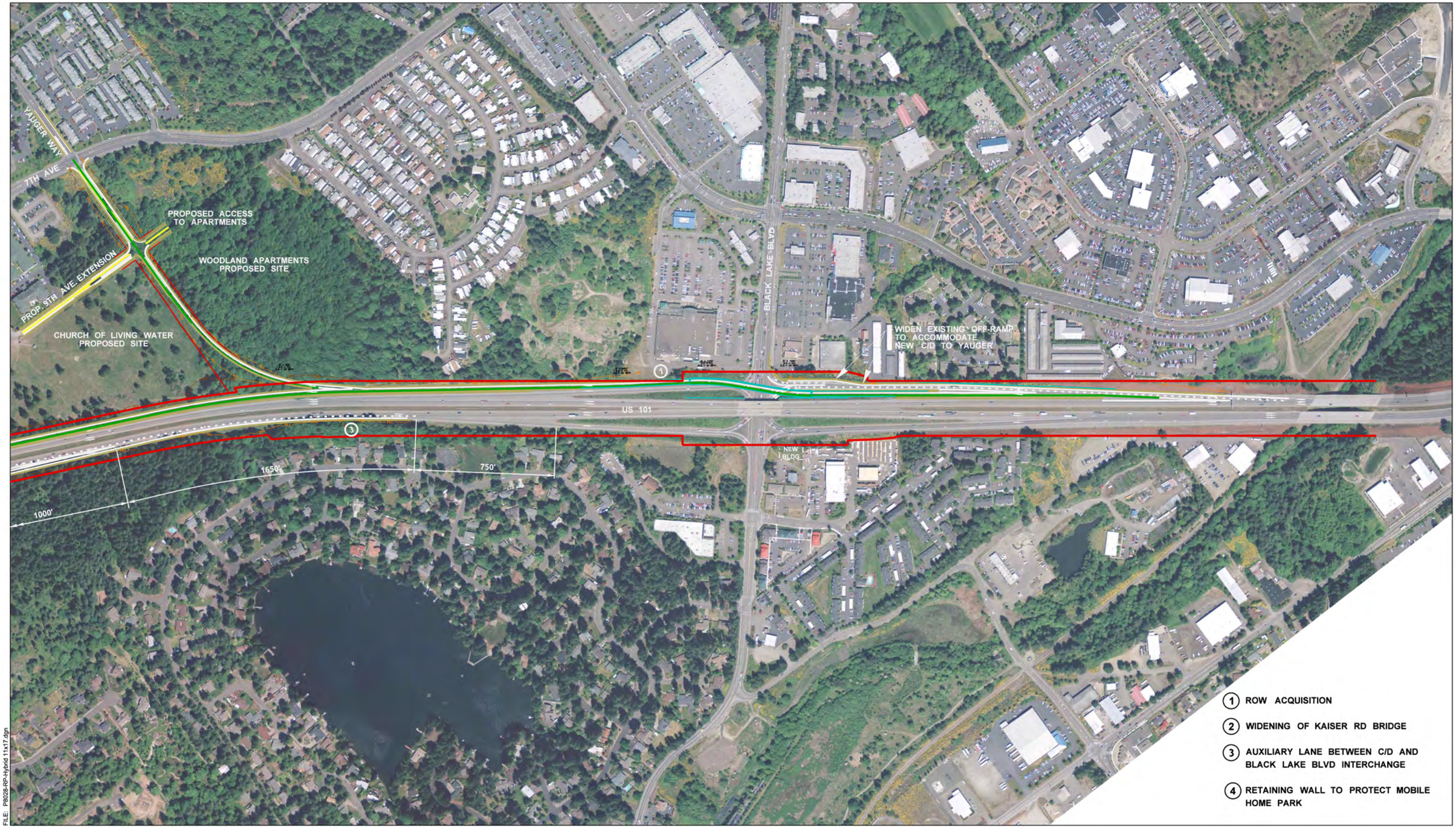
N

0 300'

SCALE IN FEET

West Olympia Access Study
EB: On-ramps from Evergreen Pkwy and Kaiser Rd
WB: C/D Braid Over Black Lake Blvd Interchange Ramps
C/D Off-ramps to Kaiser Rd and Yauger Way

**Figure 3a**
**Hybrid Interchange (West)**




FILE: P8028-RP-Hybrid 11x17.dgn

**Parametrix** 554-1631-062/03(05) 7/10

0 500'
SCALE IN FEET

West Olympia Access Study
EB: On-ramps from Evergreen Pkwy and Kaiser Rd
WB: C/D Braid Over Black Lake Blvd Interchange Ramps
C/D Off-ramps to Kaiser Rd and Yauger Way

**Figure 3b**
**Hybrid Interchange (East)**

**Table 1. Summary of 2030 PM Peak Hour Local System Operations (1-Hour Analysis)**

| LOS Range | No-Build Scenario 1 | Local System Only Scenario 2 | Local System Only Scenario 3 | Black Lake Interchange Scenario 4 | Black Lake Interchange Scenario 5 | Evergreen Interchange Scenario 6 | Evergreen Interchange Scenario 7 | Hybrid Interchange Scenario 8 | Hybrid Interchange Scenario 9 |
|---|---|---|---|---|---|---|---|---|---|
| ***Full Scope*** [1] | | | | | | | | | |
| LOS A, B, C | 8 | 11 | 9 | 12 | 13 | 11 | 12 | NA | NA |
| LOS D or E | 3 | 9 | 11 | 8 | 11 | 9 | 10 | NA | NA |
| LOS F | 13 | 4 | 4 | 4 | 0 | 4 | 2 | NA | NA |
| ***Reduced Scope*** [2] | | | | | | | | | |
| LOS A, B, C | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| LOS D or E | 0 | 4 | 5 | 4 | 7 | 5 | 7 | 5 | 7 |
| LOS F | 8 | 4 | 3 | 3 | 0 | 3 | 1 | 2 | 0 |

[1] The original scope analyzed a total of 24 local intersections.

2 The scope of the Hybrid interchange scenarios was reduced to analyze 9 key intersections that were consistent with the original scope. The Kaiser Rd SW/7th Ave SW intersection was also added and would operate at LOS D for both Scenarios 8 and 9.

**Table 2. Summary of 2030 PM Peak Local System Operations (2-Hour Analysis)**

| LOS Range | No-Build Scenario 1 | Local System Only Scenario 2 | Local System Only Scenario 3 | Black Lake Interchange Scenario 4 | Black Lake Interchange Scenario 5 | Evergreen Interchange Scenario 6 | Evergreen Interchange Scenario 7 | Hybrid Interchange Scenario 8 | Hybrid Interchange Scenario 9 |
|---|---|---|---|---|---|---|---|---|---|
| ***Full Scope*** [1] | | | | | | | | | |
| LOS A, B, C | 8 | 12 | 12 | 12 | 14 | 13 | 16 | NA | NA |
| LOS D or E | 5 | 10 | 10 | 10 | 10 | 9 | 8 | NA | NA |
| LOS F | 11 | 2 | 2 | 2 | 0 | 2 | 0 | NA | NA |
| ***Reduced Scope*** [2] | | | | | | | | | |
| LOS A, B, C | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| LOS D or E | 2 | 5 | 5 | 5 | 7 | 5 | 7 | 7 | 8 |
| LOS F | 6 | 2 | 2 | 2 | 0 | 2 | 0 | 1 | 0 |

[1] The original scope analyzed a total of 24 local intersections.

[2] The scope of the Hybrid interchange scenarios was reduced to analyze 9 key intersections that were consistent with the original scope. The Kaiser Rd SW/7th Ave SW intersection was also added and would operate at LOS C and LOS D for Scenarios 8 and 9, respectively.

**NOTE:** As described above, the 2-hour analysis presented here is for the City of Olympia, which uses a different methodology to calculate LOS for concurrency purposes. The text and conclusions in this report are based on 1-hour analyses.

The local system analysis for the Hybrid Interchange scenarios was based on a scope that reduced the number of arterial intersections analyzed. As a result, including the local operations for the Hybrid Interchange scenarios in the above list or when discussing the total number of local intersection improvements is an inappropriate comparison. However, comparisons among all scenarios are made when appropriate.

The number of local intersection improvements is important to consider when identifying recommendations because land uses at the intersections needing improvements are generally built out and construction of the improvements would require property acquisition for right-of-way. Full or partial displacement of existing uses substantially increase project costs, lengthens project schedules, and can be more difficult to implement. Additionally, increasing the number of turn lanes at intersections also increases pedestrian crossing times, which is less conducive to a pedestrian-friendly environment and inconsistent with the City of Olympia's Comprehensive Plan. Compared to the Local System Only scenarios, Black Lake Scenario 5 and Evergreen Scenario 7 require the least amount of local intersection improvements. For the limited scope of the Hybrid interchange analysis, all interchange improvement scenarios require the same number of turn lanes, but the Hybrid interchange requires one additional signal at the Capital Mall Drive/Yauger Way intersection.

Local intersections that form the "Triangle" and Black Lake SPUI coordinated system are of paramount importance. When these key intersections are mitigated to their LOS standards, the Black Lake and Hybrid interchange scenarios operate approximately the same and provide the most congestion relief. However, the Black Lake scenario requires one less turn lane improvement compared to the Evergreen and Hybrid interchange scenarios. If this turn lane is added, then the Black Lake interchange provides the best congestion relief.

Black Lake Scenarios 4 and 5, and to a lesser degree the Hybrid Scenarios 8 and 9, also provide important travel time and accessibility benefits to the Capital Medical Center by providing a direct route to and from US 101 for emergency vehicles, avoiding the highly congested Black Lake Boulevard and Cooper Point Road corridors. In a similar fashion, the Black Lake and Hybrid Scenarios also provide an important secondary route to and from Capital Mall and surrounding retail businesses during peak holiday shopping weekends and seasons. A holiday season peak period traffic analysis was not specifically conducted; however, the new ramp connection to and from Yauger Way would likely improve safety and reduce vehicle queues and congestion that oftentimes extends into the US 101 mainline during these peak shopping days.

Based on this information, the two initial study recommendations and reasons for the recommendations were:

1. Eliminate Local System Only Scenarios 2 and 3 from further consideration
    - Local system impacts are substantially higher than other build scenarios
    - There is no traffic volume reduction at the highly congested US 101/Black Lake Boulevard SPUI and Black Lake Boulevard/Cooper Point Road intersections
    - With feasible improvements only, several intersections operate at unacceptable LOS E or F conditions with high delay at US 101/Black Lake Boulevard SPUI, Black Lake Boulevard/Cooper Point Road and three to four other intersections
    - There is no accessibility or travel time benefit to Capital Medical Center and other key locations compared to other build scenarios
    - There is no benefit during holiday shopping time periods compared to other build scenarios

2. Conduct further evaluation of the interchange scenarios
    - Concept design, accident/safety analysis, and an environmental screening evaluation to provide more detailed information to select a preferred interchange alternative
    - Prepare an Interchange Justification Report (IJR) and NEPA/SEPA environmental document

From these recommendations, the interchange improvement scenarios have been evaluated with respect to five evaluation criteria and are described below.

**Purpose**

Previous efforts have eliminated potential improvement options based on fatal flaws and analyzed several improvement scenarios from the traffic operations perspective. The purpose of this Technical Memorandum 4 is to build on the conclusions and recommendations of the previous traffic operations analyses and evaluate the Black Lake, Evergreen, and Hybrid interchange improvement scenarios with respect to other factors that should be taken into consideration during the decision-making process. This “second-level” screening analysis will become part of subsequent environmental review and documentation to comply with NEPA and SEPA for a preferred alternative.

## SCREENING CRITERIA DESCRIPTIONS

The WSDOT has identified five screening criteria, each with two or more elements, to assess the relative advantages and disadvantages of the interchange improvements. Table 3 summarizes the five screening criteria, and their elements and measurements for evaluation.

The scoring system for these five screening criteria is shown in Table 4.

**Table 3. Screening Criteria**

| Element | Evaluation Measurement |
|---|---|
| **Criterion 1: Built Environmental Impacts** | |
| Disruptions and Displacements<br>How many commercial and residential properties will be displaced? | Quantitative estimate of the net number of properties adversely affected and an initial assessment of full or partial acquisitions. |
| Right-of-Way<br>How much additional ROW is required? | Quantitative estimate of the additional right-of-way required. |
| **Criterion 2: Natural Environmental Impacts** | |
| Wetlands/Shorelines<br>How will implementation of an option impact known wetland resources? | Planning-level estimate of impact and quality of impacted wetlands and/or buffers. |
| Water Resources (Stormwater)<br>What are the impacts on surface and groundwater? | Quantitative estimate of additional impervious surface. Planning-level estimate of impact and quality of impacted water basins. |
| **Criterion 3: Constructibility** | |
| Constructibility<br>How easy and lengthy would it be to implement the option during construction? | Qualitative judgments based on the potential overall construction schedule, impacts to traffic operations, ability to sequence and phase project delivery, etc. |
| Probable Construction Cost<br>How much to build the full project? | Probable construction cost estimate based on INROADS footprint cut/fill volumes and typical markups for similar projects. |
| **Criterion 4: Safety** | |
| Compatibility with Freeway Safety<br>How does the option impact safety on the freeway? | The projected number of congested conflict zones (ramp merge and diverge segments) as a function of Level of Service (LOS). |
| Compatibility with Local Street Safety<br>How does the option impact safety on the local streets? | Impact on key intersections based on number of collisions per year as a function of traffic volumes. |
| Ability to Meet Design Standards<br>How well does the option adhere to WSDOT design standards? | Nominal safety is examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures. |
| **Criterion 5: Transportation Benefits** | |
| Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT)<br>How does the option affect distribution of vehicle trips within the local transportation system? | This will show the daily amount of vehicle travel and the total daily hours of travel for vehicles on the study area road system. VMT and VHT are an output of the travel forecasting model. |
| Compatibility with Freeway Operations<br>How does the option impact the freeway mainline? | The projected number of poorly operating mainline segments. For this evaluation, "poorly operating" is defined by the number of mainline and ramp segments operating at Level of Service "LOS = D, E, or F" and mainline travel speeds. |
| Compatibility with Local System Operations<br>How does the option impact key local intersections? | Based on the potential for increases or decreases in LOS at key intersection ("Triangle" + Black Lake SPUI intersections) |

**Table 4. Scoring System Descriptions**

| Qualitative Description | Score | Description |
|---|---|---|
| Worst | 1 | Most impact or no benefit |
| | 2 | High impact or low benefit |
| | 3 | Moderate impact or benefit |
| | 4 | Low impact or high benefit |
| Best | 5 | No impact or highest benefit |

## SCREENING CRITERIA EVALUATIONS

This section describes the potential impacts and benefits of the interchange scenarios and then provides a quantitative scoring of each interchange.

### Criterion 1: Built Environmental Impacts

The Built Environmental Impacts are composed of two elements: Disruptions and Displacements and Right-of-Way.

#### *Disruptions and Displacements*

The Black Lake interchange improvements would add new ramps to Yauger Way from the existing ramps connecting to Black Lake Boulevard. A portion of these new ramps would be located in existing WSDOT right-of-way, while the other portion would extend over undeveloped areas. No business or residential displacements are expected.

Most of the Evergreen interchange improvements would occur within existing WSDOT right-of-way or in undeveloped areas. However, Kaiser Road would need to be widened at its intersection with the US 101 westbound ramps and three mobile homes may need to be relocated in the northeast quadrant of the interchange. No commercial displacements are expected.

Similar to the Black Lake interchange, the Hybrid interchange improvements would add a new westbound ramp to Yauger Way that would primarily be located within existing WSDOT right-of-way and undeveloped areas and would not require any displacements. However, the Hybrid interchange improvements also include a westbound ramp to Kaiser Road, which could displace three mobile homes, similar to the Evergreen interchange scenarios.

None of the interchange improvements are expected to result in commercial displacements. The Evergreen and Hybrid interchange improvements could require three residential displacements, but these residences could be relocated within the same mobile home park. Nonetheless, the Evergreen and Hybrid interchange improvements receive a lower (worse) score with respect to disruptions and displacements.

#### *Right-Of-Way*

The right-of-way estimates described below for the interchange improvements do not include stormwater needs.

Although the Black Lake interchange improvements would not require displacements, approximately 147,000 square feet (3.4 acres) of right-of-way would be required and some property acquisition (partial takes) would be needed. Of the 147,000 square feet of right-of-way needed:

- 129,000 square feet is from vacant land (undeveloped),
- 15,700 square feet is from commercial land (15,000 square feet from Top Foods and 700 square feet from a lumber distribution facility), and
- 2,300 square feet is from an apartment complex.

The Evergreen interchange improvements would require roughly 240,000 square feet of right-of-way and potential displacement of three mobile homes (see Disruptions and Displacements section above). Of the 240,000 square feet (5.5 acres) of right-of-way needed:

- 199,000 square feet is from vacant land (undeveloped), and
- 41,000 square feet is from residential properties along Kaiser Road and would result in the displacement of three mobile homes.

The Hybrid interchange improvements would require roughly 310,000 square feet of right-of-way and potentially displace three mobile homes. Of the 310,000 square feet (7.1 acres) of right-of-way needed:

- 269,000 square feet is from vacant land (undeveloped), and
- 41,000 square feet is from residential properties along Kaiser Road and would result in the displacement of three mobile homes.

The Black Lake interchange improvements require less acquisition area compared to the Evergreen and Hybrid improvements, but the areas needed from platted developments and existing commercial properties is higher. Although the Hybrid interchange requires the most right-of-way, the additional area is in vacant (undeveloped) land. As a result, all interchange scenarios were equally rated as having moderate impacts for the right-of-way criterion.

**Criterion 2: Natural Environmental Impacts**

The Natural Environmental Impacts are composed of two elements: Wetlands/Shorelines and Water Resources (Stormwater).

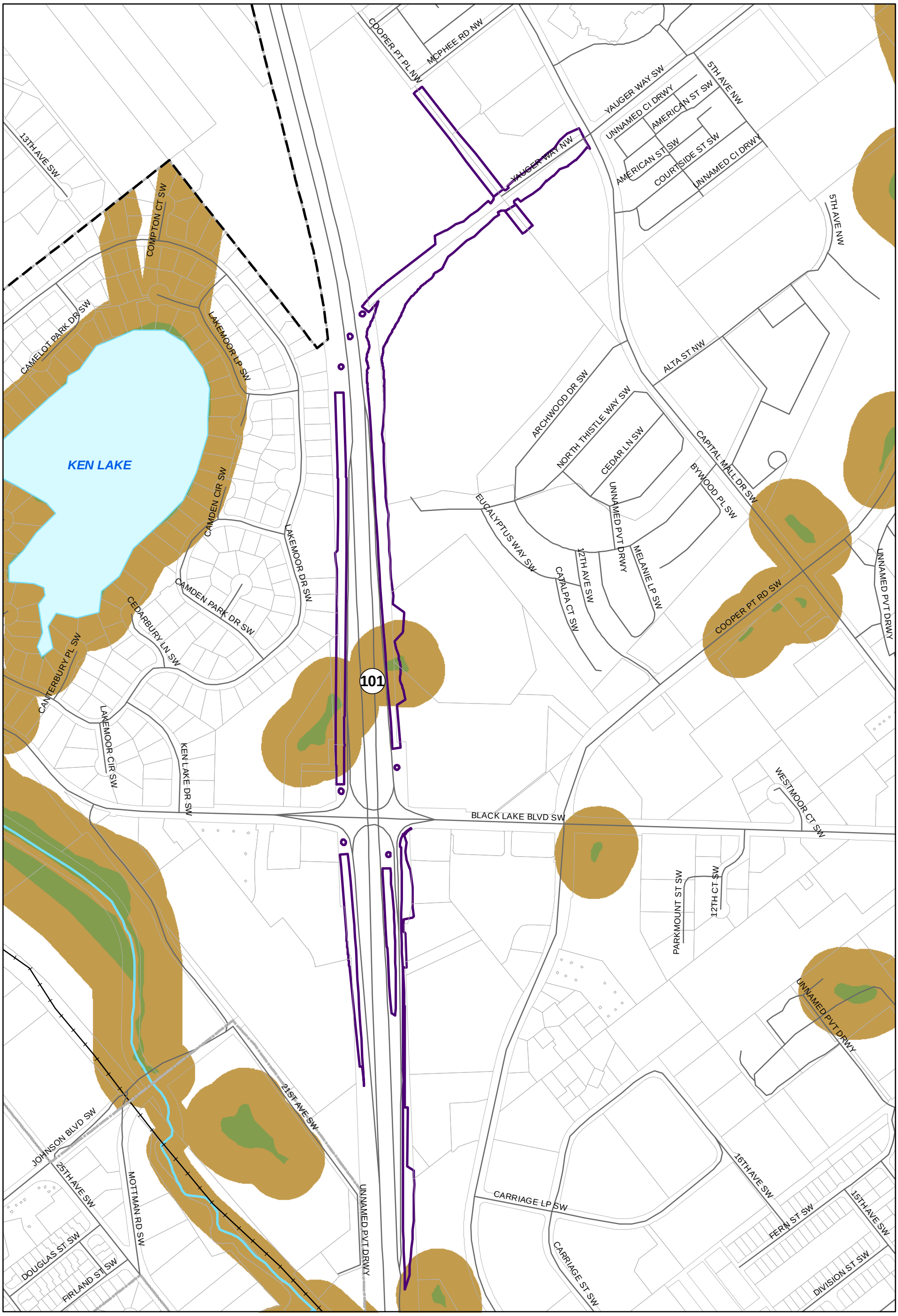
***Wetlands/Shorelines***

Three relatively small palustrine forested (PFO) wetlands exist near the Black Lake interchange; one to the north side of the westbound on-ramp, one on the south side of the eastbound off-ramp, and one near the westbound off-ramp near the gore point. Construction of the Black Lake interchange improvements would impact a total of 0.2 acres of wetlands and a total of 1.5 acres of wetland buffers. These wetland and buffer impacts are shown on Figure 4.

One palustrine emergent (PEM) wetland occurs on the south side of US 101 in the vicinity of Kaiser Road and the associated buffer extends to the north and south sides of US 101. Construction of the Evergreen interchange improvements would impact a total of 0.1 acres of wetlands and a total of 2.4 acres of wetland buffers. These wetland and buffer impacts are shown on Figure 5.

Since the Hybrid interchange improvements are similar to the Black Lake and Evergreen interchanges, the impacts would be similar to those described above except that the Hybrid interchange would impact only 2.0 buffer acres compared to 2.4 buffer acres under the Evergreen interchange. The Hybrid interchange would impact a total of 0.1 acres of wetlands and a total of 2.0 acres of wetland buffers, which are shown on Figure 6.

Because the total acreage of wetlands and buffer areas are similar among all three interchange scenarios, each scenario received the same score of “moderate impact.”




K:\gis\1631_westolympia\mapdocs\8x11_Impacts080409.mxd

**Parametrix**

**Yauger Critical Area Buffer Impacts**

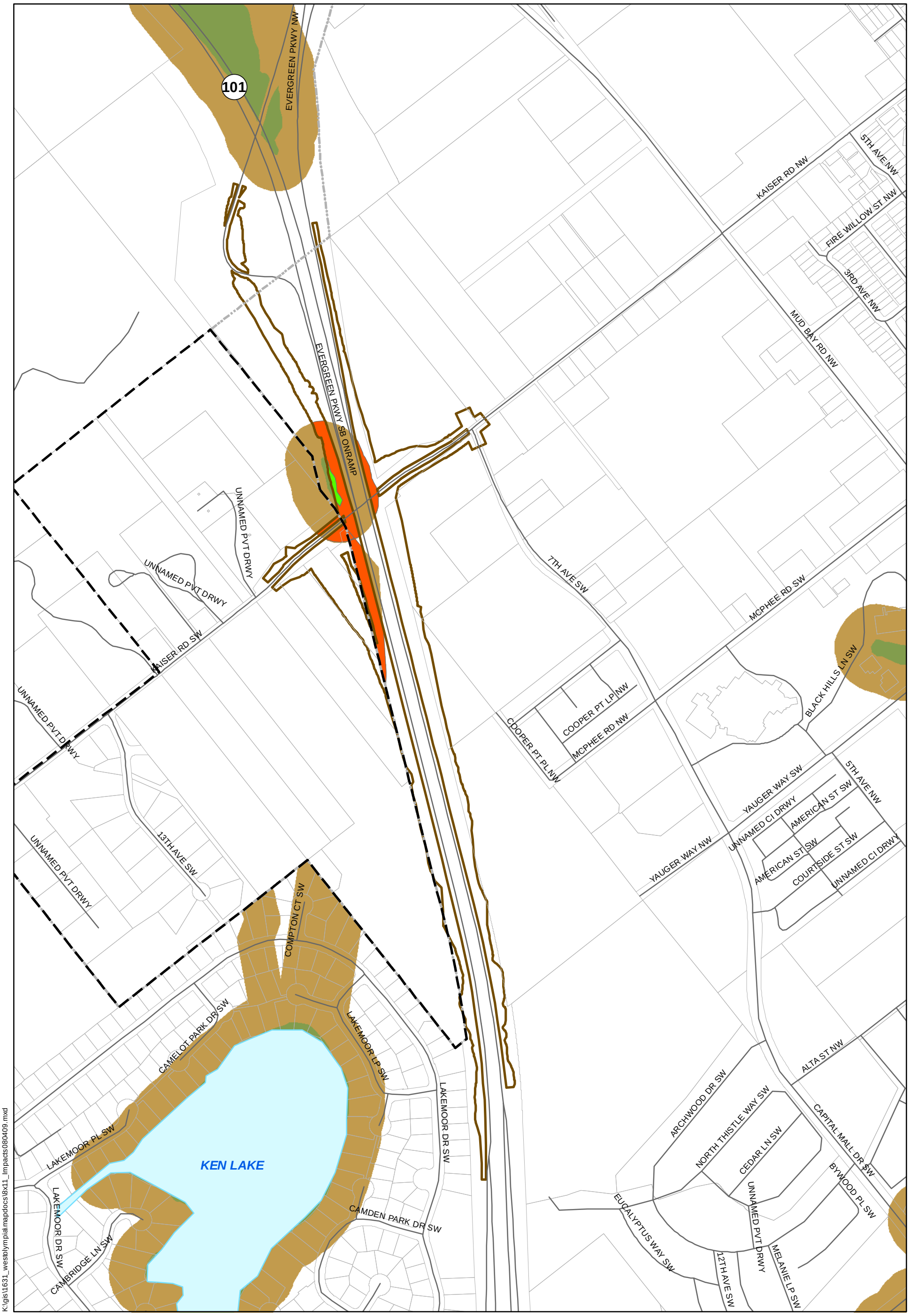
- Yauger Wetland Impacts
- Yauger Buffer Impacts
- Wetland
- Buffer
- Yauger Alignment
- Parcels
- Streams
- Waterbody
- Railroads
- Roads
- City Boundary
- UGA Boundary

N

0 500
Scale in Feet

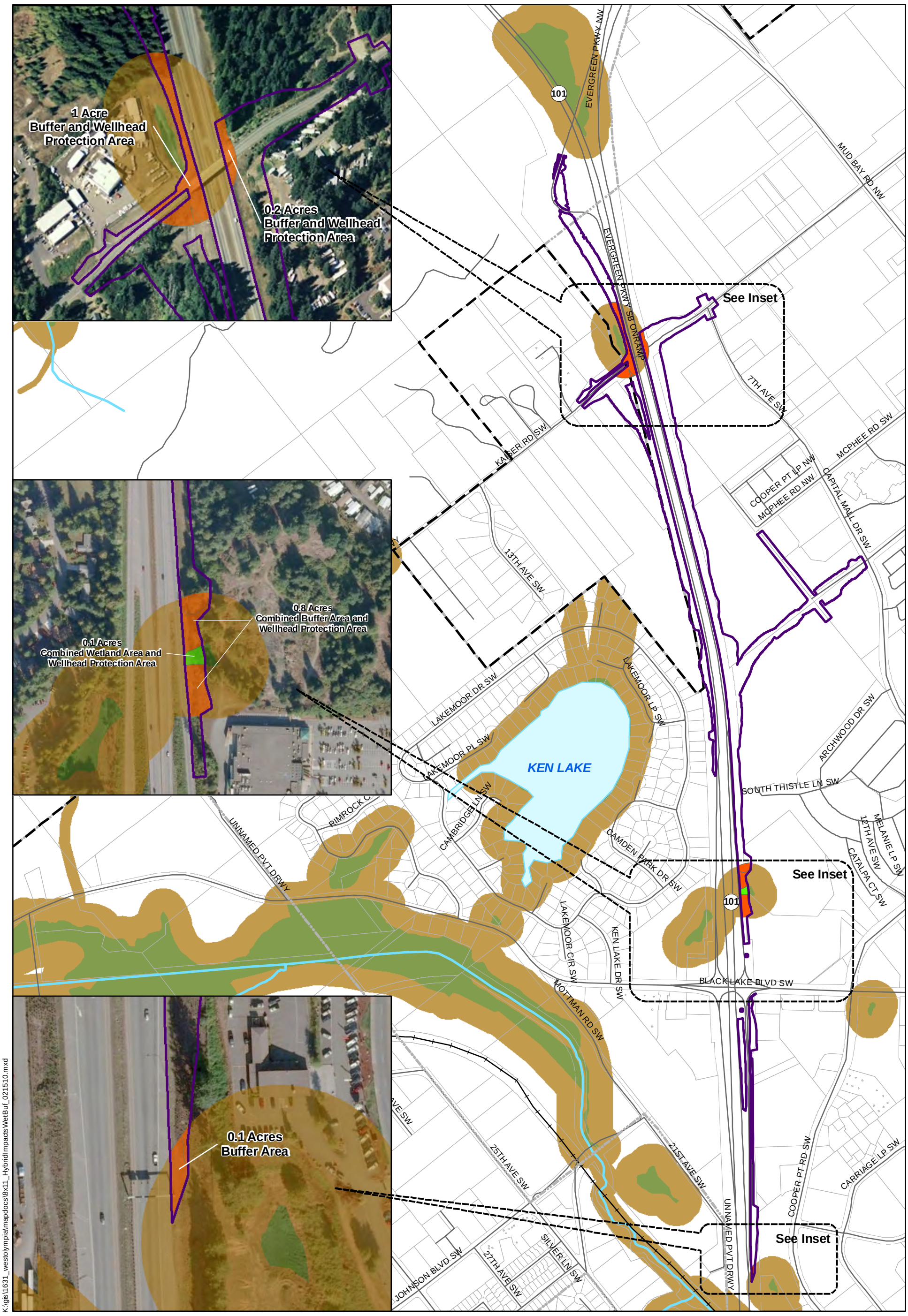
Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 4**
**Black Lake Interchange**
**Wetland and Buffer Impacts**




Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 5**
**Evergreen Interchange**
**Wetland and Buffer Impacts**




K:\gis\1631_westolympia\mapdocs\8x11_HybridImpactsWetBuf_021510.mxd

Parametrix

Buffer
Wetland
Hybrid Alternative Impacts
Wetland Impacts
Buffer Impacts
Hybrid Alternative
City Boundary
UGA Boundary
Parcels
Waterbody
Roads
Railroads
Streams

0 800
Scale in Feet

Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 6**
**Hybrid Interchange**
**Wetland and Buffer Impacts**

***Water Resources (Stormwater)***

The Allison Springs Wells 13 and 19 are located south of Mud Bay Road NW and west of Delphi Road SW. These wells would be affected by all three interchange improvements.

The Black Lake interchange improvements are located within the 10-year Allison Springs wellhead protection area. If the new Yauger Way ramps are constructed, approximately 11.7 acres would be impacted. Figure 7 shows the impacted areas associated with the Black Lake improvements.

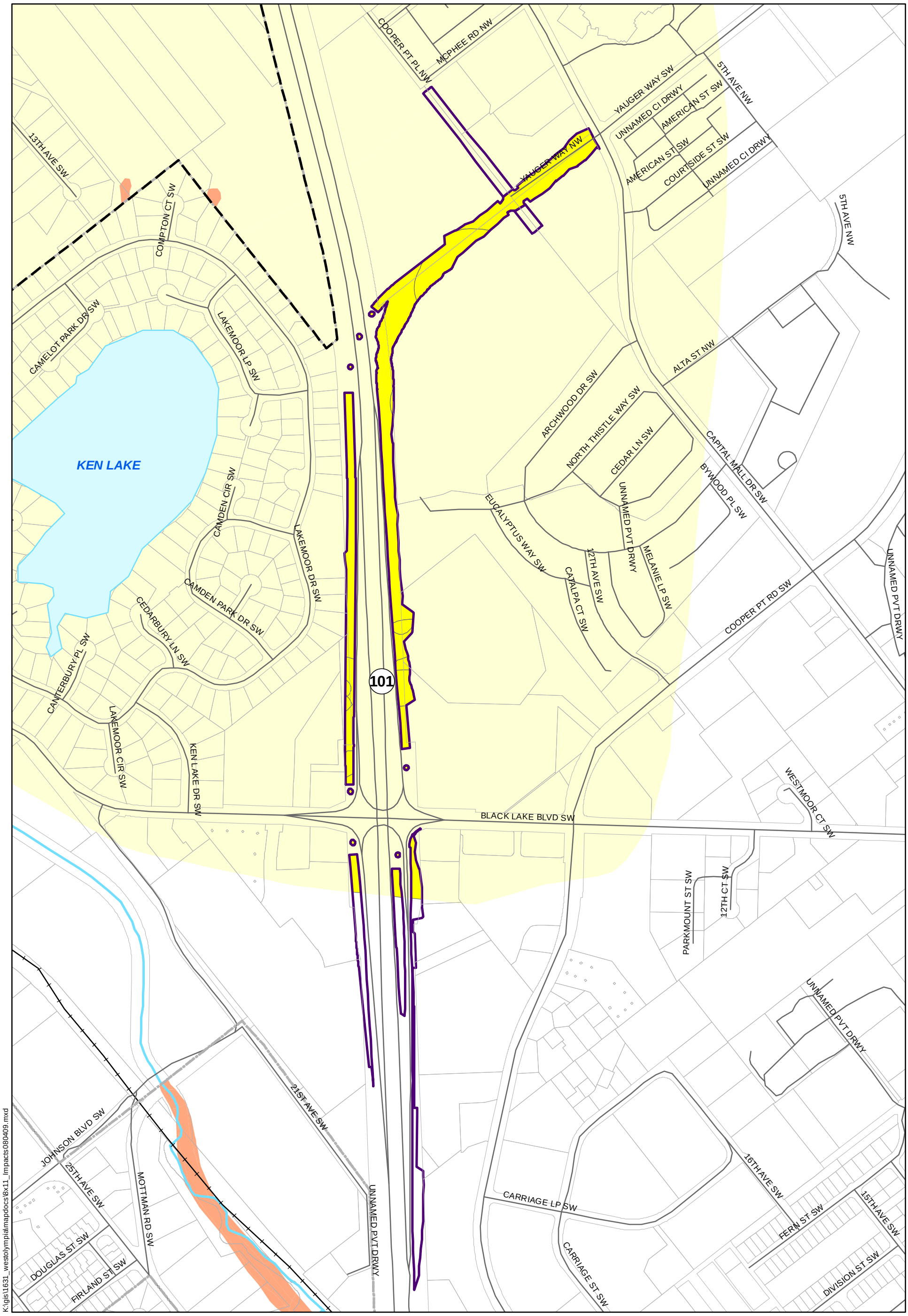
As shown in Figure 8, improvements at the Evergreen interchange would also impact the Allison Springs wellhead protection area for Wells 13 and 19. However, since the Evergreen improvements are much closer to these wells, a total of 21.4 acres would be impacted, consisting of:

- 0.1 acres in the 1-year wellhead protection area,
- 18.2 acres in the 5-year wellhead protection area, and
- 3.1 acres in the 10-year wellhead protection area.

The Hybrid interchange improvements, shown on Figure 9, would be similar to the combined impacts associated with the Black Lake and Evergreen interchange improvements. A total of 30.8 acres would be impacted, consisting of:

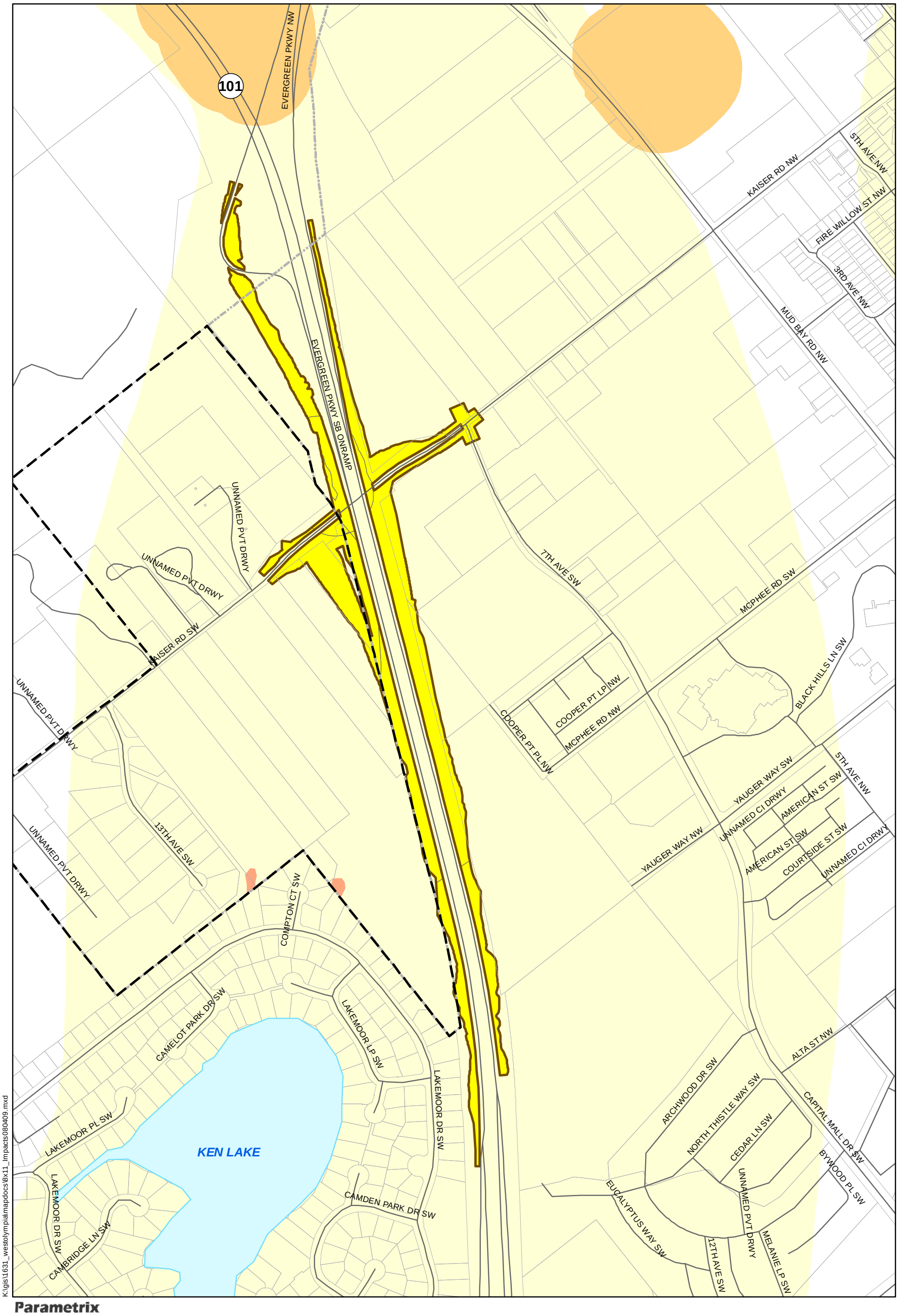
- 16.8 acres in the 5-year wellhead protection area, and
- 14.1 acres in the 10-year wellhead protection area.

The total wellhead protection area acreage impacted by the Black Lake improvements is less than the Evergreen and Hybrid interchange impacts (11.7 acres compared to 21.4 acres and 30.8 acres). Additionally, while the Black Lake interchange improvement impacts on the wellhead protection area are all within the 10-year travel time zone, the majority of impacts associated with the Evergreen (18.2 of 21.4 acres) and Hybrid (16.8 of 30.8 acres) interchange improvements are within the 5-year travel time zone. As a result, the Black Lake interchange received a “low impact” rating compared to a “high impact” rating for the Evergreen interchange and “most impact” rating for the Hybrid Interchange.




Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 7**
**Black Lake Interchange**
**Floodplain and Wellhead Impacts**




K:\gis\1631_westolympia\mapdocs\8x11_Impacts080409.mxd

**Parametrix**

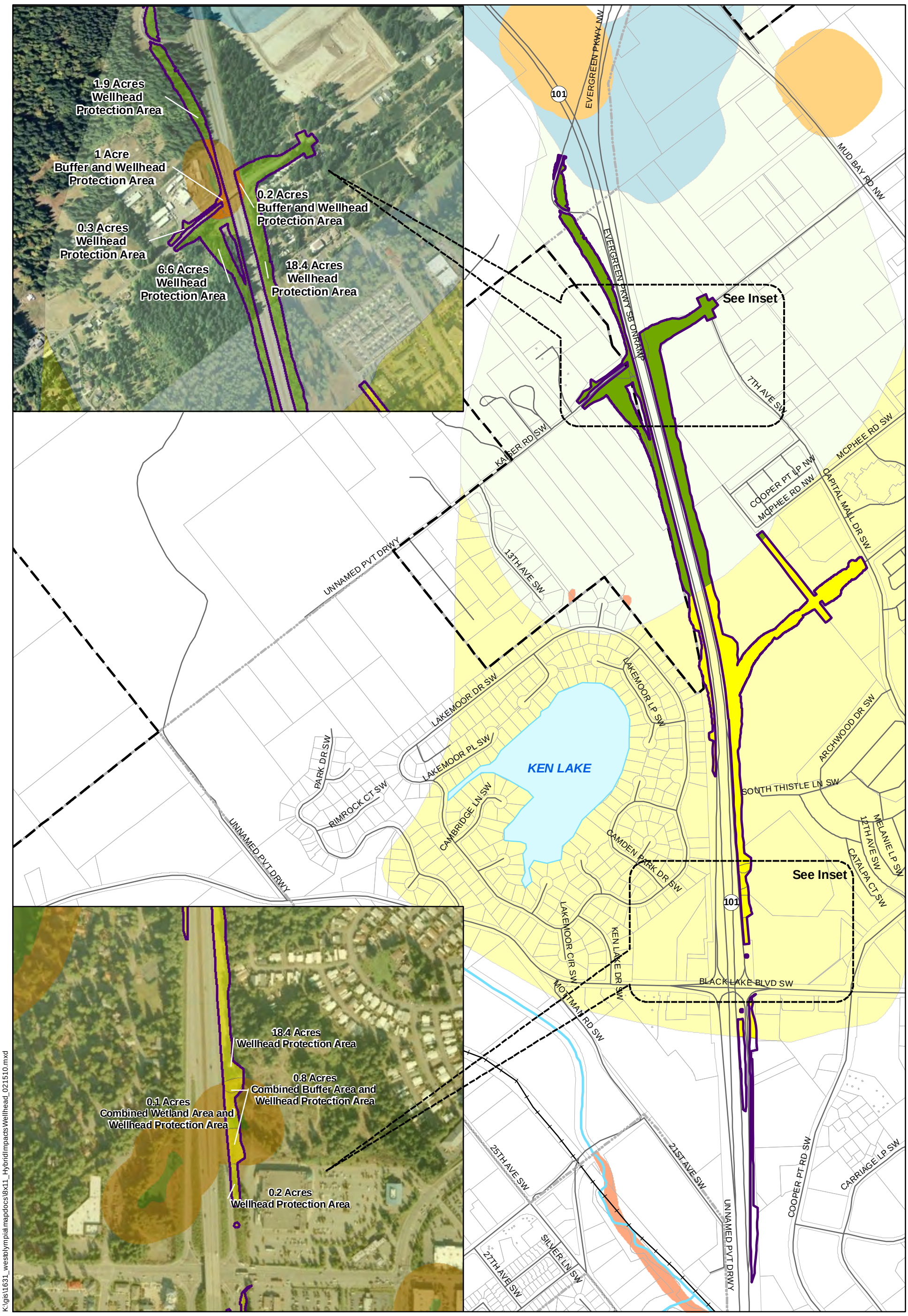
Evergreen Floodplain/ Wellhead Protection Area Impacts
Wellhead Protection Area
Floodplain
High Groundwater Flooding
Evergreen Alignment
Parcels
Streams
Waterbody
Railroads
Roads
City Boundary
UGA Boundary

N

0 500
Scale in Feet

Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 8**
**Evergreen Interchange**
**Floodplain and Wellhead Impacts**




Parametrix

Wellhead Protection Area Impacts
- 5-yr
- 10-yr

Hybrid Alternative
City Boundary
UGA Boundary
Parcels
Waterbody
Roads
Railroads
Streams
High Groundwater Flooding
Floodplain
Wellhead Protection Area
- 1-yr
- 5-yr
- 10-yr

0 800
Scale in Feet

Note: The data displayed on this map are critical area indicators only. Critical areas have not been field verified.
Data Sources: Thurston Regional Planning Council, Thurston County

**Figure 9**
**Hybrid Interchange**
**Floodplain and Wellhead Impacts**

**Criterion 3: Constructibility**

The Constructibility criterion is composed of two elements: Constructibility and Probable Construction Cost.

***Constructibility***

Constructibility challenges associated with the Black Lake interchange improvements are relatively high:

- Disruptions to traffic operations along Black Lake Boulevard, US 101 westbound off-ramp, and eastbound on-ramp during construction of bridge overcrossings, collector/distributor ramps, and revised ramp connections to mainline. However, most work can be staged to minimize roadway or lane closures.
- The Yauger Way extension and collector/distributor ramps west of Black Lake can be constructed with minimal disruption to existing roadways.

Constructibility challenges associated with the Evergreen interchange improvements are relatively low:

- Disruption to Kaiser Road traffic operations during bridge reconstruction.
- Occasional shoulder and outside lane closure on US 101 during construction of auxiliary lanes between Kaiser Road and Black Lake interchange.
- Collector/distributor ramps can be constructed without disruption to US 101.

Constructibility challenges associated with the Hybrid interchange improvements are relatively moderate:

- Disruptions to traffic operations along Black Lake Boulevard, US 101 westbound off-ramp, bifurcated ramps, and revised ramp connections to mainline.
- The Yauger Way extension and collector/distributor ramps west of Black Lake can be constructed with minimal disruption to existing roadways.
- Disruption to Kaiser Road traffic operations during bridge reconstruction.
- Occasional shoulder and outside lane closure on US 101 during construction of auxiliary lanes between Kaiser Road and Black Lake interchange.

The constructibility challenges with the Black Lake interchange improvements are considered higher (worse) than the Hybrid and Evergreen interchange improvements as a result of the magnitude of improvements and high traffic volumes that are expected to result in higher construction delays. Therefore, the Black Lake interchange received a “high impact” constructibility rating compared to a “moderate impact” rating for the Hybrid interchange and “low impact” rating for the Evergreen interchange.

***Probable Construction Cost***

Planning level conceptual cost estimates were prepared using information from the conceptual designs for each alternative. These planning level cost estimates only account for the construction costs and excludes the following items:

- Right-of-way
- Wetland mitigation and environmental permitting
- Preliminary engineering costs
- Risk and inflation factors

The cost estimates were based on conceptual design alignments, channelization, profiles, and rough earthwork generated in INROADS. Specific bid items were consolidated into generalized items due to the conceptual design level at this stage of the project. The unit prices for most of these generalized items are based on square footage costs calculated from the 30 percent PS&E construction cost estimate for the SR 522 Snohomish River Bridge to US 2 Project. The calculated square footage cost for each generalized item was multiplied by the new pavement area to yield the total item cost. Costs per cubic yard, ton, and linear foot are based on general knowledge of recent bid costs.

The planning level conceptual cost estimates totaled $86,268,000 for Black Lake interchange, $34,419,000 for Evergreen, and $84,762,000 for the Hybrid interchange. Tables 5, 6, and 7 summarize the cost estimates and Appendix A provides a more detailed breakdown.

**Table 5. Black Lake Interchange Cost Estimate ($2009)**

| | Westbound Collector / Distributor Ramp | Eastbound Collector / Distributor Ramp | Yauger Way | Total Base Cost |
|---|---|---|---|---|
| Area (SF) | 146,000 | 126,000 | 73,000 | |
| Preparation and Grading | $1,336,120 | $1,570,620 | $688,760 | $3,595,500 |
| Structures | $10,770,500 | $18,614,500 | $0 | $29,385,000 |
| Surfacing and Paving | $1,065,800 | $919,800 | $532,900 | $2,518,500 |
| Roadside Development and Drainage | $2,851,000 | $2,331,000 | $1,510,500 | $6,692,500 |
| Traffic Services and Safety | $2,073,000 | $2,090,500 | $1,978,500 | $6,142,000 |
| Subtotal | $18,096,420 | $25,526,420 | $4,710,660 | $48,333,500 |
| Other Items [1] | $14,202,926 | $20,034,926 | $3,698,198 | $37,934,050 |
| Total | $32,299,000 | $45,561,000 | $8,409,000 | **$86,268,000** |

[1] Includes allowance for Miscellaneous Bid Items, Mobilization, Sales Tax (8.5%), Contingencies during construction, and Construction Engineering.

**Table 6. Evergreen Interchange Cost Estimate ($2009)**

| | Evergreen EB ramp w/ US101 Widening | Kaiser Road Widening | WB Off-Ramp to Kaiser Road | EB On-Ramp from Kaiser Road | Total Base Cost |
|---|---|---|---|---|---|
| Area (SF) | 92,000 | 14,600 | 36,000 | 111,000 | |
| Preparation and Grading | $543,040 | $564,952 | $441,120 | $806,820 | $2,355,932 |
| Structures | $450,000 | $2,133,000 | $2,420,000 | $525,000 | $5,528,000 |
| Surfacing and Paving | $671,600 | $106,580 | $262,800 | $810,300 | $1,851,280 |
| Roadside Development and Drainage | $1,882,000 | $435,100 | $666,000 | $2,163,500 | $5,146,600 |
| Traffic Services and Safety | $1,181,000 | $1,347,300 | $456,500 | $1,328,500 | $4,313,300 |
| Subtotal | $4,727,640 | $4,586,932 | $4,246,420 | $5,634,120 | $19,195,112 |
| Other Items [1] | $3,749,360 | $3,639,068 | $3,366,580 | $4,467,880 | $15,223,888 |
| Total | $8,477,000 | $8,226,000 | $7,613,000 | $10,102,000 | **$34,419,000** |

[1] Includes allowance for Miscellaneous Bid Items, Mobilization, Sales Tax (8.5%), Contingencies during construction, and Construction Engineering.

**Table 7. Hybrid Interchange Cost Estimate ($2009)**

| | Evergreen EB On-Ramp | Kaiser EB On-Ramp | Kaiser Road Widening | WB Off-Ramp to Yauger Way Extension | WB Off-Ramp CD Extension to Kaiser | Black Lake WB Off-Ramp | Total Base Cost |
|---|---|---|---|---|---|---|---|
| Area (SF) | 92000 | 111000 | 14600 | 262000 | 117000 | 49000 | |
| Preparation and Grading | $543,040 | $806,820 | $564,952 | $1,823,840 | $991,140 | $81,380 | $4,811,172 |
| Structures | $450,000 | $525,000 | $2,133,000 | $7,969,800 | $3,220,000 | $0 | $14,297,800 |
| Surfacing and Paving | $671,600 | $810,300 | $106,580 | $1,912,600 | $854,100 | $357,700 | $4,712,880 |
| Roadside Development and Drainage | $1,882,000 | $2,163,500 | $435,100 | $5,142,000 | $2,314,500 | $931,500 | $12,868,600 |
| Traffic Services and Safety | $1,181,000 | $1,328,500 | $1,347,300 | $4,327,000 | $1,486,000 | $1,129,500 | $10,799,300 |
| Subtotal | $4,727,640 | $5,634,120 | $4,586,932 | $21,175,240 | $8,865,740 | $2,500,080 | $47,489,752 |
| Other Items [1] | $3,710,360 | $4,421,880 | $3,600,068 | $16,618,760 | $6,957,260 | $1,963,920 | $37,272,248 |
| Total | $8,438,000 | $10,056,000 | $8,187,000 | $37,794,000 | $15,823,000 | $4,464,000 | **$84,762,000** |

[1] Includes allowance for Miscellaneous Bid Items, Mobilization, Sales Tax (8.5%), Contingencies during construction, and Construction Engineering.

The primary contributors to the higher costs associated with the Black Lake and Hybrid interchanges are the additional structures and generalized items that include allowances for Miscellaneous Bid Items, Mobilization, Sales Tax (8.5%), Contingencies during construction, and Construction Engineering. The higher probable costs associated with the Black Lake and Hybrid interchange improvements resulted in lower ratings compared to the Evergreen interchange.

**Criterion 4: Safety**

**NOTE:** Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

The Safety criterion is composed of three elements: Compatibility with Freeway Safety, Compatibility with Local Street Safety, and Ability to Meet Design Standards. A general evaluation was conducted for a relative comparison of the alternatives. A more detailed analysis of the collision history for the Preferred Alternative is necessary for the IJR. The collision history of the area is described first since it is applicable to existing conditions and all interchanges.

***Collision History***

The following subsection is applicable when considering both interchange improvements. Additional detail on the collision history analysis is provided in Appendix B.

Collision data were obtained for the three most recent, complete, and consecutive years (January 1, 2005 through December 31, 2007) at the time when the analysis was conducted. Collision data were provided by the WSDOT Transportation Data Office and the City of Olympia.

Within the study area and timeframe described above, the following findings summarize the collision history analysis:

- **Freeway Collision History**
  - 471 collisions along 4.8 miles of US 101
  - 61 percent of US 101 collisions occurred on the mainline and the remaining 39 percent occurred at interchanges
  - 2 High Accident Corridors (HACs) are located within the study area and are shown on Figure 10

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 10**
**WSDOT 2007-2009 HAC and HAL Locations**

    - Westbound US 101 mainline (MP 366.59 to MP 367.41) from I-5 to Cooper Point Road/Crosby Boulevard interchange
    - Eastbound US 101 mainline (MP 366.90 to MP 367.41) from I-5 to Cooper Point Road/Crosby Boulevard interchange
  - 4 High Accident Locations (HALs) are located within the study area and are also shown on Figure 10
    - 1 HAL within the Cooper Point Road/Crosby Boulevard interchange
    - 3 HALs within the Black Lake interchange
  - The most common collision type was rear ends (41 percent), followed by fixed objects (25 percent) and sideswipes (14 percent)
  - The most frequent collision severity was property-damage only (67 percent), followed by possible injuries (25 percent) and evident injuries (7 percent)
  - Based on the most frequent collision type and severity, the majority of collisions are likely attributed to congested traffic conditions
- **Local Street Collision History**
  - 887 collisions at 35 intersections within the local street system of West Olympia
  - 54 percent of local system collisions occurred at intersections and the remaining 46 percent occurred along the roadways (between intersections)
  - The City of Olympia has identified 35 HALs city-wide; 8 of the 35 HALs are located along the three principal arterials (Black Lake Boulevard SW, Cooper Point Road SW, and Harrison Avenue NW) within the study area
  - The most common collision type was rear ends (46 percent), followed by right angle (22 percent) and sideswipes (15 percent)
  - The most frequent collision severity was property-damage only (72 percent), followed by possible or evident injuries (28 percent)
  - Based on the most frequent collision type and severity, the majority of collisions are likely attributed to congested traffic conditions

***Compatibility with Freeway System***

Analyzing nominal safety (design standards) and substantive safety (collision data) elements provides a basis for evaluating potential benefits of alternatives.

Although the Black Lake and Hybrid interchanges have potential design challenges, these challenges would not necessarily result in design deviations. Since the Black Lake and Hybrid interchange improvements are expected to have slightly better operations compared to the Evergreen interchange, these scenarios were rated better for the freeway safety element.

The Evergreen interchange improvements decrease interchange spacing in both directions. Shorter interchange spacing typically results in worse operating conditions, which may lead to more frequent collisions. For the Evergreen interchange scenarios, the spacing between the westbound Black Lake on ramp and Evergreen off ramp is reduced and creates a weaving segment on the US 101 mainline. This weaving segment is expected to operate with a density of 40.0 passenger cars per mile per lane (pcpmpl) for the Evergreen interchange scenario,

compared to 34.6 and 36.6 pcpmpl under the Black Lake and Hybrid interchange scenarios. As a result, the Evergreen interchange received the slightly worse rating of "moderate impact."

***Compatibility with Local Street System***

All interchange scenarios include a variety of local intersection improvements. At this time, all potential intersection improvements identified are expected to meet design standards and all of the interchange improvements are expected to decrease the collision potential relative to the No-Build.

The "Triangle" intersections are of particular interest since they experience the highest traffic volumes and delays. Table 8, summarizes potential collision occurrences at these locations based on the methods outlined in FHWA's *Statistical Models of At-Grade Intersection Accidents—Addendum* (FHWA 2000).

**Table 8. WSDOT Annual Collision Projections at Triangle Intersections**

| | Black Lake Interchange | | | Evergreen Interchange | | | Hybrid Interchange | | |
|---|---|---|---|---|---|---|---|---|---|
| **Intersection** | **Collisions** | **ADT** | **LOS (Delay)** | **Collisions** | **ADT** | **LOS (Delay)** | **Collisions** | **ADT** | **LOS (Delay)** |
| Black Lake Blvd/Cooper Point Rd | 10 | 79,613 | E (78.5) | 10 | 82,388 | E (65.1) | 8 | 55,750 | E (78.6) |
| Cooper Point Rd/Harrison Ave/Mud Bay Rd | 8 | 58,075 | E (74.9) | 8 | 57,513 | E (71.3) | 8.4 | 59,188 | E (73.3) |
| Harrison Ave/Division St | 8 | 55,675 | E (76.2) | 8 | 56,313 | E (79.4) | 10.3 | 79,438 | E (63.9) |
| **Total** | **26** | | | **26** | | | **27** | | |

NOTE**:** Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

Based on the FHWA methodology, the total number of collisions that could potentially occur for all interchange improvements are expected to be similar at the "Triangle" intersections and therefore, all interchanges were rated the same as "moderate impact" for local street safety.

***Ability to Meet Design Standards***

For the Black Lake interchange improvements, deviation for superelevation runoff distance may be needed on the new westbound bridge crossing over Black Lake Boulevard. Unique design considerations, but not necessarily deviations, include:

- Weaving distance westbound between Black Lake and Crosby interchanges,
- Advance signing of westbound off-ramp to Black Lake Boulevard and new collector/distributor to Yauger Way, and
- Westbound collector/distributor transition from ramp into local roadway (Yauger Way) and new intersection at 9th Avenue.

No deviations are identified for the Evergreen interchange improvements. Unique design considerations, but not necessarily deviations, include:

- Weaving distance for both directions of US 101 between Kaiser and the Black Lake interchange,

- If a tight diamond configuration is proposed for the westbound off-ramp to Kaiser Road, the off-ramp may be tying into a steep cross-grade on Kaiser Road, which is not ideal for large trucks turning against the steep cross-grade.

The Hybrid interchange would have the same one deviation and three potential design challenges as the Black Lake interchange described above. It would also share one of the potential design challenges with the Evergreen interchange; a short weaving distance on eastbound US 101 between the Kaiser on ramp and the Black Lake interchange.

As described above, all three interchange improvements are expected to meet design standards for local improvements. However, since the Black Lake and Hybrid interchange improvements have a larger number of design challenges, the Evergreen interchange scenario was rated slightly higher as “no impact” compared to a “low impact” for the Black Lake and Hybrid interchanges for this evaluation element.

**Criterion 5: Transportation Benefits**

The Transportation Benefit is composed of three elements: VMT and VHT, Compatibility with Freeway Operations, and Compatibility with Local System Operations.

***Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT)***

The VMT and VHT for all interchange improvements are summarized in Tables 9 and 10. This information was extracted from the TRPC regional travel demand model.

**Table 9. US 101 VMT and VHT (2030)**

| | Vehicle Miles Traveled | | | Vehicle Hours Traveled | | |
|---|---|---|---|---|---|---|
| Scenario | VMT | Change | % Change | VHT | Change | % Change |
| 2030 No-Build | 36,190 | | | 880 | | |
| 2030 Black Lake | 35,750 | -440 | -1.20% | 850 | -30 | -3.40% |
| 2030 Evergreen | 35,920 | -270 | -0.70% | 860 | -20 | -2.30% |
| 2030 Hybrid | 35,000 | -1,190 | -3.30% | 860 | -20 | -2.30% |

**Table 10. US 101/Black Lake/Cooper Point VMT and VHT (2030)**

| | Vehicle Miles Traveled | | | Vehicle Hours Traveled | | |
|---|---|---|---|---|---|---|
| Scenario | VMT | Change | % Change | VHT | Change | % Change |
| 2030 No-Build | 44,870 | | | 1,330 | | |
| 2030 Black Lake | 42,910 | -1,960 | -4.40% | 1,160 | -170 | -12.80% |
| 2030 Evergreen | 43,260 | -1,610 | -3.60% | 1,200 | -130 | -9.80% |
| 2030 Hybrid | 42,330 | -2,540 | -5.66% | 1,190 | -140 | -10.53% |

Although relatively similar, the Black Lake and Hybrid interchanges are expected to result in the most VMT and VHT reduction and have been rated as a “high benefit” compared to a “moderate benefit” for the Evergreen interchange.

### *Compatibility with Freeway Operations*

US 101 freeway operations were analyzed using VISSIM and were primarily assessed with respect to two measures of effectiveness: LOS (as defined by densities) and operating speed. Table 11 summarizes the LOS and densities along US 101 at key locations where the operations change between scenarios. Table 12 presents the LOS summary.

**Table 11. PM Peak Hour US 101 Densities and LOS (2030)**

| | No-Build | | Black Lake/Yauger** | | Evergreen*** | | Hybrid Interchange*** | |
|---|---|---|---|---|---|---|---|---|
| Segment | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS | Density (pc/mi/ln) | LOS |
| ***Westbound US 101*** | | | | | | | | |
| Crosby/Black Lake Weave | 24 | C | 28 | C | 24 | C | 24 | C |
| Mainline | 30 | D | 29 | D | 31 | D | 27 | D |
| Black Lake On-Ramp | 26 | C | 25 | C | 31 | D | 23 | C |
| ***Eastbound US 101*** | | | | | | | | |
| Evergreen On-Ramp | 133 | **F** | 31 | D | 49 | **F** | 20 | C |
| Mainline | 137 | **F** | 41 | **E** | NA | NA | 20 | C |
| Kaiser On-Ramp | NA | NA | NA | NA | NA | NA | 15 | B |
| Black Lake Off-Ramp/ Kaiser On-Black Lake Off Weave* | 131 | **F** | 43 | E | 37 | E | 26 | C |
| Mainline W/o Crosby Blvd On-Ramp | 19 | C | 26 | D | 29 | D | 32 | D |
| Crosby Blvd On-Ramp | 19 | B | 39 | E | 48 | **F** | 58 | **F** |
| Mainline | 32 | D | 56 | **F** | 62 | **F** | 65 | **F** |

* Diverge segment for the Black Lake interchange. Weave segment for the Evergreen and Hybrid interchanges.

** Eastbound Yauger on-ramp is metered.

*** Eastbound Black Lake and Crosby on-ramps are metered.

**Table 12. PM Peak Hour LOS Summary (2030)**

| All Scenarios | No Build | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange |
|---|---|---|---|---|
| Total # of Segments Operating at LOS D or better | 28 | 28 | 30 | 31 |
| Total # of Segments Operating at LOS E | 6 | 8 | 4 | 5 |
| Total # of Segments Operating at LOS F | 8 | 8 | 10 | 7 |
| Average of All Densities [1] | 42 | 36 | 36 | 35 |
| Sum of All Densities | 1710 | 1459 | 1458 | 1454 |

[1] Averages are for the corridor as a whole, including portions not shown in this table, but that are in the study area.

All interchange scenarios change travel patterns and redistribute traffic volumes. As a result, while the US 101 corridor as a whole is expected to operate relatively similar among all interchange scenarios, changes in densities are evident along specific segments of the corridors. These changes in densities at different locations affect the number of freeway segments that operate unacceptably:

- Black Lake Interchange – two segments at LOS E and two segments at LOS F
- Evergreen Interchange – one segment at LOS E and three segments at LOS F
- Hybrid Interchange – two segments at LOS F

VISSIM was also used to estimate average operating speeds along the US 101 corridor and the results are shown in Table 13.

**Table 13. US 101 Operating Speeds (mph) (2030)**

| | No Build | Black lake Interchange* | Evergreen Interchange** | Hybrid Interchange** |
|---|---|---|---|---|
| **Westbound US 101** | | | | |
| Mud Bay Interchange | 59 | 59 | 58 | 59 |
| Evergreen Pkwy On Ramp | NA | NA | 59 | NA |
| Evergreen Pkwy Off Ramp | 59 | 59 | 58 | 59 |
| Black Lake On Ramp | 55 | 56 | 55 | 57 |
| Black Lake Off Ramp | 57 | 57 | 57 | 58 |
| Crosby Blvd/Cooper Point Off Ramp | 43 | 42 | 43 | 43 |
| US 101/I-5 | 48 | 47 | 46 | 47 |
| ***Average Westbound US 101*** [1] | **56** | **56** | **56** | **56** |
| **Eastbound US 101** | | | | |
| Mud Bay Interchange | 57 | 59 | 59 | 59 |
| Evergreen Pkwy Off Ramp | NA | NA | 57 | NA |
| Evergreen Pkwy On Ramp | 47 | 56 | 50 | 59 |
| Kaiser On Ramp | NA | NA | NA | 59 |
| Black Lake Off Ramp | 59 | 59 | 59 | 59 |
| Black Lake On Ramp | 58 | 59 | 59 | 59 |
| Crosby Blvd/Cooper Point On Ramp | 50 | 51 | 51 | 49 |
| US 101/I-5 | 45 | 45 | 43 | 44 |
| ***Average Eastbound US 101*** [1] | **54** | **57** | **56** | **56** |

[1] Inclusive of all measurement points between areas listed

* EB Yauger on-ramp is metered

** EB Black Lake and Crosby on-ramps are metered

As shown in Table 13, the operating speeds at key locations for all interchanges are expected to be similar.

Although the US 101 corridor speeds as a whole are expected to be similar for all build scenarios, the Evergreen interchange would have the most segments operating unacceptably at LOS E and LOS F and, therefore, was assigned a lower (worse) rating compared to the Black Lake and Hybrid interchanges.

### *Compatibility with Local System Operations*

The local system analysis was conducted using Synchro 7 (build 761) and evaluated 24 intersections within the cities of Olympia and Tumwater. Table 14 summarizes the traffic analysis (1-hour) at key locations within the study area and an expanded LOS table with all of the study intersections is provided in Appendix C. Table 15 provides the LOS analysis using the City of Olympia's 2-hour methodology for calculating LOS.

**Table 14. Aggregated Local System Operations (2030) (1-Hour Analysis)**

| Intersection | No Build | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange |
|---|---|---|---|---|
| Harrison Avenue/Division Street | F (187.1) | E (76.2) | E (79.4) | E (78.6) |
| Harrison Avenue/Cooper Point Road | F (110.3) | E (74.9) | E (71.3) | E (73.3) |
| Black Lake Boulevard/Cooper Point Road | F (199.9) | E (67.7)* | E (65.1) | E (63.9) |
| Cooper Point Rd/Top Foods Entrance | F (85.7) | D (41.5) | E (67.4) | D (48.5) |
| Black Lake Boulevard SPUI | F (187.0) | E (72.5) | F (82.4) | E (79.0) |
| Total Delay (sec/veh) | 770.0 | 332.8 | 365.6 | 343.3 |
| LOS A, B, C | 0 | 0 | 0 | 0 |
| LOS D | 0 | 1 | 0 | 1 |
| LOS E | 0 | 4 | 4 | 4 |
| LOS F | 5 | 0 | 1 | 0 |

* Includes second southeast right turn lane

**Table 15. Aggregated Local System Operations (2030) (2-Hour Analysis)**

| Intersection | No Build | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange |
|---|---|---|---|---|
| Harrison Avenue/Division Street | F (163.6) | E (66.4) | E (68.2) | E (72.9) |
| Harrison Avenue/Cooper Point Road | F (95.7) | E (66.5) | E (63.9) | E (63.8) |
| Black Lake Boulevard/Cooper Point Road | F (173.5) | E (60.1)* | E (56.8) | E (58.0) |
| Cooper Point Rd/Top Foods Entrance | E (67.2) | D (38.2) | E (59.4) | D (40.0) |
| Black Lake Boulevard SPUI | F (178.6) | E (70.2) | E (77.9) | E (79.6) |
| Total Delay (sec/veh) | 678.6 | 309.3 | 326.2 | 314.3 |
| LOS A, B, C | 0 | 0 | 0 | 0 |
| LOS D | 0 | 1 | 0 | 1 |
| LOS E | 1 | 4 | 5 | 4 |
| LOS F | 4 | 0 | 0 | 0 |

* Includes second southeast right turn lane

**NOTE:** As described above, the 2-hour analysis presented here is for the City of Olympia, which uses a different methodology to calculate LOS for concurrency purposes. The text and conclusions in this report are based on 1-hour analyses.

As shown in Table 14, all three interchange improvements reduce the total delay at the key intersections by a similar magnitude compared to the No-Build. At these key intersections, the amount of mitigation is also the same. As a result, all three interchanges received the same rating for this evaluation criterion.

## EVALUATION SUMMARY

Table 16 provides a brief description and summary of the impacts for all interchange scenarios with respect to the five evaluation criteria.

The advantages and disadvantages of these interchanges identified in Table 16 were quantified according to the scoring system identified in Table 4, which included:

- Score of 1: Most impact or no benefit (Worst)
- Score of 2: High impact or low benefit
- Score of 3: Moderate impact or high benefit
- Score of 4: Slight impact or high benefit
- Score of 5: No impact or highest benefit (Best)

Based on this scoring system, Table 17 provides a quantitative comparison of impacts and benefits for all interchange improvements.

The scoring shown in Table 17 represents the consensus of the project stakeholders. The total combined ratings of the interchange scenarios exhibited small differences, but those differences became more pronounced with the weighting of the evaluation criteria and the Black Lake interchange had the highest (best) score.

**STUDY RECOMMENDATIONS**

It is important to note that the quantitative scoring matrix shown in Table 17 was used only as a guide during decision making. There are other factors that are less tangible and difficult to quantify and were therefore not included as evaluation criteria. Furthermore, scores and weighting are subjective and should not be interpreted as or used for final judgment.

Concurrent with this study, the WSDOT, City of Olympia, and TRPC have conducted extensive coordination efforts and the following recommendations have resulted:

- Eliminate the stand-alone Black Lake interchange alternative from further consideration; this recommendation is based on the high eastbound on-ramp traffic volume with a short weave section, high construction costs, and impacts to the Ken Lake neighborhood (e.g., aesthetic and noise)
- Advance the Hybrid interchange into the next phase of project development, which includes:
  - Completion of the Interchange Justification Report (IJR) process (Engineering and Operational Acceptability)
  - Complete environmental documentation to comply with the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA), and obtain final IJR approval, and
  - Preliminary engineering
- Phase the Hybrid interchange in the next phase of work

**Table 16. Summary of Impacts**

| Criteria | Element | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange |
|---|---|---|---|---|
| **1. Built Environmental Impacts** | *Disruptions and Displacements* | • No displacements<br>• No disruptions of access identified | • Potential relocation of 3 mobile homes<br>• Potential disruption of access to residential and commercial properties in the US 101/Kaiser interchange area | • Potential relocation of 3 mobile homes<br>• Potential disruption of access to residential and commercial properties in the US 101/Kaiser interchange area |
| | *Right-of-Way* | • Less right-of-way acquisition (147,000 SF)<br>• Impacts to platted developments and existing commercial developments (15,700 SF) | • More right-of-way acquisition (240,000 SF)<br>• No impacts to platted developments or existing commercial developments | • More right-of-way acquisition (310,000 SF)<br>• No impacts to platted developments or existing commercial developments |
| **2. Natural Environmental Impacts** | *Wetlands/Shorelines* | • Slightly less wetland and buffer impacts (1.7 acres) | • Slightly more wetland and buffer impacts (2.5 acres) | • Slightly more wetland and buffer impacts (2.1 acres) |
| | *Water Resources (Stormwater)* | • Less water resource impacts based on proximity to Allison Springs (11.7 acres)<br>• Slightly more impervious surface (8 acres) | • More water resource impacts based on proximity to Allison Springs (21.4 acres)<br>• Slightly less impervious surface (7 acres) | • More water resource impacts based on proximity to Allison Springs (30.8 acres)<br>• Slightly less impervious surface (14.2 acres) |
| **3. Constructibility** | *Constructibility* | • Most difficult to construct: periodic and major disruptions to traffic during construction<br>• Most bridge structures and retaining wall required | • Least difficult to construct: periodic disruptions to traffic during construction, can be built mostly outside of roadway<br>• Least bridge structures and less retaining wall required | • Moderately difficult to construct: periodic disruptions to traffic during construction, can be built mostly outside of roadway<br>• Fewer bridge structures and less retaining wall required |
| | *Probable Construction Cost* | • Higher estimated construction cost ($86M) | • Lower estimated construction cost ($34M) | • Lower estimated construction cost ($85M) |
| **4. Safety** | *Compatibility with Freeway Safety* | • Slightly better than Evergreen operations<br>• Does not affect interchange spacing | • Essentially worse operations than Black Lake and Hybrid<br>• Shortens interchange spacing in both directions | • Slightly better than Evergreen operations<br>• Shortens interchange spacing in one direction |
| | *Compatibility with Local Street Safety* | • Essentially equal with other scenarios | • Essentially equal with other scenarios | • Essentially equal with other scenarios |
| | *Ability to Meet Design Standards* | • Potential design deviation and more design issues | • No design deviations identified and fewer design issues | • Potential design deviation and more design issues |
| **5. Transportation Benefits** | *VMT and VHT* | • Slightly less VMT and VHT | • Slightly more VMT and VHT | • Slightly less VMT and VHT |
| | *Compatibility with Freeway Operations* | • Slightly better at key locations | • Slightly worse at key locations | • Slightly worse at key locations |
| | *Compatibility with Local System Operations* | • Essentially equal with other scenarios at key intersections<br>• 0 intersections operating at LOS F at key locations<br>• 4 new turn pockets at key locations (“Triangle” intersections and coordinated system) | • Essentially equal with other scenarios at key intersections<br>• 1 intersections operating at LOS F at key locations<br>• 4 new turn pockets at key locations (“Triangle” intersections and coordinated system) | • Essentially equal with other scenarios at key intersections<br>• 0 intersections operating at LOS F at key locations<br>• 4 new turn pockets at key locations (“Triangle” intersections and coordinated system) |

**Table 17. Quantitative Scoring**

| | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange | Weight | Black Lake Interchange | Evergreen Interchange | Hybrid Interchange |
|---|---|---|---|---|---|---|---|
| **1. Built Environment Impacts** | **8** | **7** | **7** | **16.7** | **13** | **12** | **12** |
| Displacement | 5 | 4 | 4 | | | | |
| Right of Way | 3 | 3 | 3 | | | | |
| **2. Natural Environment Impacts** | **7** | **5** | **4** | **20** | **14** | **10** | **8** |
| Wetland/Shorelines | 3 | 3 | 3 | | | | |
| Water Resources | 4 | 2 | 1 | | | | |
| **3. Constructibility** | **4** | **8** | **5** | **6.7** | **3** | **5** | **3** |
| Constructibility | 2 | 4 | 3 | | | | |
| Estimated Construction Cost (Planning Level) | 2 | 4 | 2 | | | | |
| **4. Safety** | **11** | **11** | **11** | **30** | **22** | **22** | **22** |
| Ability to meet Design Standards | 4 | 5 | 4 | | | | |
| Compatibility with Local System Safety | 3 | 3 | 3 | | | | |
| Compatibility with Freeway Safety | 4 | 3 | 4 | | | | |
| **5. Transportation Benefits** | **10** | **8** | **10** | **26.6** | **18** | **14** | **18** |
| Vehicle Miles Traveled (VMT)/Vehicle Hours Traveled (VHT) | 4 | 3 | 4 | | | | |
| Compatibility with Local System Operations | 2 | 2 | 2 | | | | |
| Compatibility with Freeway Operations | 4 | 3 | 4 | | | | |
| **TOTAL SCORE** | **40** | **39** | **37** | **100** | **70** | **63** | **63** |

### *Recommended Hybrid Interchange Phasing*

Phasing of the Hybrid interchange is recommended and could consist of:

- Phase 1 – Kaiser on- and off-ramps
- Phase 2 – Westbound Yauger Way off-ramp
- Phase 3 – Evergreen eastbound on-ramp re-alignment

Phase 3, which is an independent project that consists of improving the ramp design speed and geometry, could be constructed at any time depending on funding availability. The planning level cost estimate for the re-alignment is approximately $8,500,000.

By using a phased approach for the Hybrid interchange it does not cost any more to complete the IJR than just moving forward with the Evergreen Parkway-Kaiser.

Phase 1, which consists of the Kaiser Road on- and off-ramps, would:

- Provide a cost-effective and timely solution to current and future access and circulation needs, and
- Serve existing land use and planned future land uses.

These ramps are recommended to be the first phase of this long-term project because it provides both on- and off-ramps to US 101 as compared to Yauger Way, which would only provide an off-ramp.

Phase 2, which consists of the Yauger Way off-ramp, would:

- Allow even greater distribution of traffic serving both current commercial and future uses, as growth occurs as planned,
- Further alleviate growing traffic volumes at the intersection of Black Lake Boulevard and Cooper Point Road, and
- Potentially provide access and circulation to the proposed development land use changes for Friendly Village.

## REFERENCES

WSDOT 2007. Washington State Department of Transportation, West Olympia Access Study, *Technical Memorandum 1, Evaluation and Screening Methods*. 2007.

Parametrix 2008a. Parametrix, West Olympia Access Study, *Existing 2007 and Year 2030 No-Build Technical Memorandum 2*. July 2, 2008.

Parametrix 2008b. Parametrix, West Olympia Access Study, *Traffic Operations Analysis Technical Memorandum 3*. November 10, 2008.

FHWA 2000. Federal Highway Administration, *Statistical Models of At-Grade Intersection Accidents—Addendum*. March 2000.

## STAKEHOLDER ACCEPTANCE

The undersigned parties concur with the conclusions and recommendations for the West Olympia Access Study as presented in this document.

**WSDOT Assistant Design Engineer**

Signature

Asst. State Design Engr.
Title

6/28/10
Date

**FHWA**

Signature

Area Engineer
Title

6/30/2010
Date

**WSDOT Access and Hearings**

Signature

Development Svcs & Access Mgr.
Title

July 1, 2010
Date

**City of Olympia**

Signature

Transportation Engineering & Planning Manager
Title

7/6/10
Date

**WSDOT Olympic Region**

Signature

Region Traffic Engr
Title

July 6, 2010
Date

**Thurston Regional Planning Council**

Signature

Senior Planner
Title

7 July 2010
Date

# APPENDIX A

Planning Level Cost Estimates

**Parametrix** ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

1231 FRYAR AVENUE
SUMNER, WA 98390-1516
T. 253.863.5128 F. 253.863.2873
www.parametrix.com

# MEMORANDUM

| | |
|---|---|
| Date: | May 26, 2010 |
| To: | John Perlic |
| From: | Owen Kikuta, P.E. |
| Subject: | Planning Level Construction Cost Estimate for Alternative Screening Analysis |
| cc: | Project File |
| Project Number: | 554-1631-062 |
| Project Name: | West Olympia Access Study |

---

This memorandum summarizes the process used to create the attached construction cost estimates for the three conceptual alternatives of the West Olympia Access Study. Alternatives include the Black Lake, Evergreen (modified), and Hybrid interchange improvements. These are planning level cost estimates that compare the three conceptual alternatives to provide input for the alternatives screening analysis. The cost estimates only account for the construction costs and excludes the following items:

- Right-of-way
- Wetland mitigation and environmental permitting
- Preliminary engineering costs
- Risk and inflation factors

The cost estimates are based on conceptual design alignments, channelization, profiles, and rough earthwork generated in Inroads. Specific bid items are consolidated into generalized items for this cost estimate due to the conceptual design level of the project. The unit prices for most of these generalized items are based on square footage costs calculated from the 30% PS&E construction cost estimate for the SR 522 Snohomish River Bridge to US 2 project. The calculated square footage cost for each generalized item is multiplied by the new pavement area to yield the total item cost. Costs per cubic yard, ton, and linear foot are based on general knowledge of recent bid costs.

WSDOT completed a planning level cost estimate in July 2008. Due a to differing methodology, the WSDOT and Parametrix estimates cannot be compared directly on a dollar to dollar basis. However, a comparison of the cost ratio between the Black Lake and Evergreen alternatives can be made. In the WSDOT estimate, the Black Lake alternative is approximately 46 percent higher compared to the Evergreen alternative. In the attached Parametrix estimate, the Black Lake and Hybrid alternatives are around double the cost of the Evergreen alternative.

If you have any questions about the cost estimate, please contact Owen Kikuta at 253-501-1066.

1969-2009 40th Anniversary

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Black Lake Alternative** | | | | | | | | |
| Prepared by OSK 7-10-09, Checked by KW 7-13-09 | | | | | | | | |
| This estimate is for comparison purposes only between conceptual alternatives. Additional risk and inflation factors are needed for this estimate to be used for budgeting purposes. | | | | | | | | |
| R/W, Wetland Mitigation, Permitting, and Preliminary Engineering costs are not included | | | | | | | | |
| Costs are expressed in 2009 dollars. | | | | | | **Total Base Cost** | | |
| **I. CONSTRUCTION** | | | | | | | | |
| **1. PREPARATION AND GRADING** | | | **WB C/D Ramp** | **EB C/D Ramp** | **Yauger Way** | | Check | |
| Area (SF) | | | 146000 | 126000 | 73000 | | | |
| Mobilization (See below) | | | | | | | | |
| Clearing and Grubbing ($5,000/AC=$0.12/SF) | 0.12 | | $17,520 | $15,120 | $8,760 | $41,400 | | |
| General Removal Items ($2/SF) | 2 | | $292,000 | $252,000 | $146,000 | $690,000 | | |
| Embankment ($12/Ton) | 12 | | $780,000 | $1,200,000 | $432,000 | $2,412,000 | | |
| Roadway Ex.($12/CY) | 12 | | $21,600 | $36,000 | $12,000 | $69,600 | | |
| Special ground improvements ($45/SF) | 45 | | $225,000 | $67,500 | $90,000 | $382,500 | | Assume for roadway in wetland areas |
| **subtotal** | | | **$1,336,120** | **$1,570,620** | **$688,760** | **$3,595,500** | **$3,595,500** | |
| **2. STRUCTURES** | | | | | | | | |
| Concrete Precast Girder Bridge ($220/SF) | 220 | | $0 | $3,366,000 | $0 | $3,366,000 | | |
| Steel Plate Girder Bridge ($310/SF) | 310 | | $6,448,000 | $3,751,000 | $0 | $10,199,000 | | |
| Retaining Walls ($100/SF) | 100 | | $3,705,000 | $9,405,000 | $0 | $13,110,000 | | |
| SEW Moment slab traffic barrier ($250/LF) | 250 | | $617,500 | $1,567,500 | $0 | $2,185,000 | | |
| Noise Walls ($75/SF) | 75 | | $0 | $525,000 | $0 | $525,000 | | |
| **subtotal** | | | **$10,770,500** | **$18,614,500** | **$0** | **$29,385,000** | **$29,385,000** | |
| **3. SURFACING AND PAVING** | | | | | | | | |
| Surfacing incl. HMA and CSBC ($7.30/SF) | 7.3 | | $1,065,800 | $919,800 | $532,900 | $2,518,500 | | Assume 1' HMA@$80+$8/Ton, 0.5'CSBC@$16/Ton |
| **subtotal** | | | **$1,065,800** | **$919,800** | **$532,900** | **$2,518,500** | **$2,518,500** | |
| **4. ROADSIDE DEVELOPMENT AND DRAINAGE** | | | | | | | | |
| Landscaping- outside roadway ($50/LF/side) | 50 | | $150,000 | $0 | $80,000 | $230,000 | | |
| Planter Strips ($50/LF) | 50 | | $0 | $0 | $80,000 | $80,000 | | |
| Temp. Water Pol. Control ($6.50/SF) | 6.5 | | $949,000 | $819,000 | $474,500 | $2,242,500 | | |
| Drainage incl. Det./Treatment ($12.00/SF) | 12 | | $1,752,000 | $1,512,000 | $876,000 | $4,140,000 | | |
| **subtotal** | | | **$2,851,000** | **$2,331,000** | **$1,510,500** | **$6,692,500** | **$6,692,500** | |
| **5. TRAFFIC SERVICES AND SAFETY** | | | | | | | | |
| Intersection Control ($500K each) | | | $0 | $0 | $1,000,000 | $1,000,000 | | |
| Illumination ($65/LF/side, 1 side C/D ramps, 2 on | 65 | | $390,000 | $487,500 | $130,000 | $1,007,500 | | |
| Signing | | | $150,000 | $80,000 | $50,000 | $280,000 | | |
| Sidewalk ($20/LF) | 20 | | $0 | $0 | $32,000 | $32,000 | | |
| Traffic Safety items (striping, guardrail, etc: $7/SF) | 7 | | $1,022,000 | $882,000 | $511,000 | $2,415,000 | | |
| Traffic Control ($3.50/SF) | 3.5 | | $511,000 | $441,000 | $255,500 | $1,207,500 | | |
| ITS/Ramp metering | | | $0 | $200,000 | $0 | $200,000 | | Assuming one ramp meter signal, no other ITS equipment |
| **subtotal** | | | **$2,073,000** | **$2,090,500** | **$1,978,500** | **$6,142,000** | **$6,142,000** | |
| **SUB TOTAL** | | | **$18,096,420** | **$25,526,420** | **$4,710,660** | **$48,333,500** | **$48,333,500** | |
| 6. Allowance for misc. bid items ***(30%)*** | | | $5,428,926 | $7,657,926 | $1,413,198 | $14,500,050 | | For bid items not covered by general items above |
| 7. Construction Sub-total | | | $23,525,000 | $33,184,000 | $6,124,000 | $62,834,000 | | |
| 8. Mobilization ***(11% of line 7))*** | | | $2,588,000 | $3,650,000 | $674,000 | $6,912,000 | | |
| 9. Subtotal (lines 7 and 8) | | | $26,113,000 | $36,834,000 | $6,798,000 | $69,746,000 | | |
| 10. Sales Tax (8.5%) | | | $2,220,000 | $3,131,000 | $578,000 | $5,928,000 | | Olympia rate as of 7/10/09 |
| 11. Other Environmental Permits & Mit.(not incl.) | | | | | | | | |
| 12. Subtotals (lines 9 thru 11) | | | $28,333,000 | $39,965,000 | $7,376,000 | $75,674,000 | | |
| 13. Contingencies during Construction (4%) | | | $1,133,000 | $1,599,000 | $295,000 | $3,027,000 | | |
| 14. Construction Engineering ***(10%)*** | | | $2,833,000 | $3,997,000 | $738,000 | $7,567,000 | | |
| **CONSTRUCTION** | | | **$32,299,000** | **$45,561,000** | **$8,409,000** | **$86,268,000** | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Evergreen Alternative** | | | | | | | | | | | | | |
| Prepared by OSK 2-15-10 | | | | | | | | | | | | | |
| This estimate is for comparison purposes only between conceptual alternatives. Additional risk and inflation factors are needed for this estimate to be used for budgeting purposes. | | | | | | | | | | | | | |
| R/W, Wetland Mitigation, Permitting, and Preliminary Engineering costs are not included | | | | | | | | | | | | | |
| Costs are expressed in 2009 dollars. | | | | | | | | **Total Base cost** | | | | | |
| **I. CONSTRUCTION** | | | | | **Evergreen EB ramp w/ US101 Widening** | **Kaiser Road** | **WB Off-Ramp to Kaiser Road** | **EB On-Ramp from Kaiser Road** | | Check | | | |
| | **1. PREPARATION AND GRADING** | | | | | | | | | | | | |
| | | | Area (SF) | | 92000 | 14600 | 36000 | 111000 | | | | | |
| | | Mobilization (See below) | | | | | | | $0 | | | | |
| | | Clearing and Grubbing ($5,000/AC=$0.12/SF) | | 0.12 | $11,040 | $1,752 | $4,320 | $13,320 | $30,432 | | | | |
| | | General Removal Items ($2/SF) | | 2 | $184,000 | $29,200 | $72,000 | $222,000 | $507,200 | | | | |
| | | Embankment ($12/Ton) | | 12 | $22,200 | $432,000 | $360,000 | $480,000 | $1,294,200 | | | | |
| | | Roadway Ex.($12/CY) | | 12 | $100,800 | $12,000 | $4,800 | $24,000 | $141,600 | | | | |
| | | Special ground improvements ($45/SF) | | 45 | $225,000 | $90,000 | $0 | $67,500 | $382,500 | | Assume for roadway in wetland areas | | |
| | | | **subtotal** | | **$543,040** | **$564,952** | **$441,120** | **$806,820** | **$2,355,932** | **$2,355,932** | | | |
| | **2. STRUCTURES** | | | | | | | | | | | | |
| | | Concrete Precast Girder Bridge ($220/SF) | | 220 | $0 | $924,000 | $0 | $0 | $924,000 | | | | |
| | | Retaining Walls ($100/SF) | | 100 | $300,000 | $1,209,000 | $2,070,000 | $0 | $3,579,000 | | | | |
| | | SEW Moment slab traffic barrier ($250/LF) | | 250 | $150,000 | $0 | $350,000 | $0 | $500,000 | | | | |
| | | Noise Walls ($75/SF) | | 75 | $0 | $0 | $0 | $525,000 | $525,000 | | | | |
| | | | **subtotal** | | **$450,000** | **$2,133,000** | **$2,420,000** | **$525,000** | **$5,528,000** | **$5,528,000** | | | |
| | **3. SURFACING AND PAVING** | | | | | | | | | | | | |
| | | Surfacing incl. HMA and CSBC ($7.30/SF) | | 7.3 | $671,600 | $106,580 | $262,800 | $810,300 | $1,851,280 | | Assume 1' HMA@$80+$8/Ton, 0.5'CSBC@$16/Tor | | |
| | | | **subtotal** | | **$671,600** | **$106,580** | **$262,800** | **$810,300** | **$1,851,280** | **$1,851,280** | | | |
| | **4. ROADSIDE DEVELOPMENT AND DRAINAGE** | | | | | | | | | | | | |
| | | Landscaping- outside roadway ($50/LF/side) | | 50 | $180,000 | $90,000 | $0 | $110,000 | $380,000 | | | | |
| | | Planter Strips ($50/LF) | | 50 | $0 | $75,000 | $0 | $0 | $75,000 | | | | |
| | | Temp. Water Pol. Control ($6.50/SF) | | 6.5 | $598,000 | $94,900 | $234,000 | $721,500 | $1,648,400 | | | | |
| | | Drainage incl. Det./Treatment ($12.00/SF) | | 12 | $1,104,000 | $175,200 | $432,000 | $1,332,000 | $3,043,200 | | | | |
| | | | **subtotal** | | **$1,882,000** | **$435,100** | **$666,000** | **$2,163,500** | **$5,146,600** | **$5,146,600** | | | |
| | **5. TRAFFIC SERVICES AND SAFETY** | | | | | | | | | | | | |
| | | Intersection Control ($500K each) | | | $0 | $1,000,000 | $0 | $0 | $1,000,000 | | | | |
| | | Illumination ($65/LF/side, 1 side on ramps, 2 on | | 65 | $195,000 | $117,000 | $58,500 | $143,000 | $513,500 | | | | |
| | | Signing | | | $20,000 | $20,000 | $20,000 | $20,000 | $80,000 | | | | |
| | | Sidewalk ($20/LF) | | 20 | $0 | $57,000 | $0 | $0 | $57,000 | | | | |
| | | Traffic Safety items (striping, guardrail, etc: $7/SF) | | 7 | $644,000 | $102,200 | $252,000 | $777,000 | $1,775,200 | | | | |
| | | Traffic Control ($3.50/SF) | | 3.5 | $322,000 | $51,100 | $126,000 | $388,500 | $887,600 | | | | |
| | | | **subtotal** | | **$1,181,000** | **$1,347,300** | **$456,500** | **$1,328,500** | **$4,313,300** | **$4,313,300** | | | |
| | **SUB TOTAL** | | | | **$4,727,640** | **$4,586,932** | **$4,246,420** | **$5,634,120** | **$19,195,112** | **$19,195,112** | | | |
| | 6. Allowance for misc. bid items ***(30%)*** | | | | $1,418,292 | $1,376,080 | $1,273,926 | $1,690,236 | $5,758,534 | | For bid items not covered under general items abov | | |
| | 7. Construction Sub-total | | | | $6,146,000 | $5,963,000 | $5,520,000 | $7,324,000 | $24,954,000 | | | | |
| | 8. Mobilization ***(11% of Line 7)*** | | | | $676,000 | $656,000 | $607,000 | $806,000 | $2,745,000 | | | | |
| | 9. Subtotal (lines 7 and 8) | | | | $6,822,000 | $6,619,000 | $6,127,000 | $8,130,000 | $27,699,000 | | | | |
| | 10. Sales Tax (8.5%) | | | | $614,000 | $596,000 | $551,000 | $732,000 | $2,493,000 | | Olympia rate as of 7/10/09 | | |
| | 11. Other Environmental Permits & Mit.(not incl.) | | | | | | | | | | | | |
| | 12. Subtotals (lines 9 thru 11) | | | | $7,436,000 | $7,215,000 | $6,678,000 | $8,862,000 | $30,192,000 | | | | |
| | 13. Contingencies during Construction ***(4%)*** | | | | $297,000 | $289,000 | $267,000 | $354,000 | $1,208,000 | | | | |
| | 14. Construction Engineering ***(10%)*** | | | | $744,000 | $722,000 | $668,000 | $886,000 | $3,019,000 | | | | |
| | | **CONSTRUCTION** | | | **$8,477,000** | **$8,226,000** | **$7,613,000** | **$10,102,000** | **$34,419,000** | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hybrid Alternative** | | | | | | | | | | | | |
| Prepared by ES 2-12-10, Checked by OK 2-12-10 | | | | | | | | | | | | |
| This estimate is for comparison purposes only between conceptual alternatives. Additional risk and inflation factors are needed for this estimate to be used for budgeting purposes. | | | | | | | | | | | | |
| R/W, Wetland Mitigation, Permitting, and Preliminary Engineering costs are not included | | | | | | | | | | | | |
| Costs are expressed in 2009 dollars. | | | | | | | | | **Total Base Cost** | | | |
| **I. CONSTRUCTION** | | | | **Evergreen EB On-Ramp** | **Kaiser EB On-Ramp** | **Kaiser Road Widening** | **WB Off-Ramp to Yauger Way Extension** | **WB Off-Ramp CD Extension to Kaiser** | **Black Lake WB Off-Ramp** | | | |
| **1. PREPARATION AND GRADING** | | | | | | | | | | Check | | |
| | | Area (SF) | | 92000 | 111000 | 14600 | 262000 | 117000 | 49000 | | 645600 | 14.82 |
| | Mobilization (See below) | | | | | | | | | | | |
| | Clearing and Grubbing ($5,000/AC=$0.12/SF) | | 0.12 | $11,040 | $13,320 | $1,752 | $31,440 | $14,040 | $5,880 | $77,472 | | |
| | General Removal Items ($2/SF) | | 2 | $184,000 | $222,000 | $29,200 | $524,000 | $234,000 | $5,000 | $1,198,200 | | |
| | Embankment ($12/Ton) | | 12 | $22,200 | $480,000 | $432,000 | $984,000 | $516,000 | $12,000 | $2,446,200 | | |
| | Roadway Ex.($12/CY) | | 12 | $100,800 | $24,000 | $12,000 | $194,400 | $159,600 | $36,000 | $526,800 | | |
| | Special ground improvements ($45/SF) | | 45 | $225,000 | $67,500 | $90,000 | $90,000 | $67,500 | $22,500 | $562,500 | | Assume for roadway in wetla |
| | | **subtotal** | | **$543,040** | **$806,820** | **$564,952** | **$1,823,840** | **$991,140** | **$81,380** | **$4,811,172** | **$4,811,172** | |
| **2. STRUCTURES** | | | | | | | | | | | | |
| | Concrete Precast Girder Bridge ($220/SF) | | 220 | $0 | $0 | $924,000 | $4,557,300 | $0 | $0 | $5,481,300 | | |
| | Retaining Walls ($100/SF) | | 100 | $300,000 | $0 | $1,209,000 | $2,925,000 | $2,760,000 | $0 | $7,194,000 | | |
| | SEW Moment slab traffic barrier ($250/LF) | | 250 | $150,000 | $0 | $0 | $487,500 | $460,000 | $0 | $1,097,500 | | |
| | Noise Walls ($75/SF) | | 75 | $0 | $525,000 | $0 | $0 | $0 | $0 | $525,000 | | |
| | | **subtotal** | | **$450,000** | **$525,000** | **$2,133,000** | **$7,969,800** | **$3,220,000** | **$0** | **$14,297,800** | **$14,297,800** | |
| **3. SURFACING AND PAVING** | | | | | | | | | | | | |
| | Surfacing incl. HMA and CSBC ($7.30/SF) | | 7.3 | $671,600 | $810,300 | $106,580 | $1,912,600 | $854,100 | $357,700 | $4,712,880 | | Assume 1' HMA@$80+$8/T |
| | | **subtotal** | | **$671,600** | **$810,300** | **$106,580** | **$1,912,600** | **$854,100** | **$357,700** | **$4,712,880** | **$4,712,880** | |
| **4. ROADSIDE DEVELOPMENT AND DRAINAGE** | | | | | | | | | | | | |
| | Landscaping- outside roadway ($50/LF/side) | | 50 | $180,000 | $110,000 | $90,000 | $270,000 | $150,000 | $25,000 | $825,000 | | |
| | Planter Strips ($50/LF) | | 50 | $0 | $0 | $75,000 | $25,000 | $0 | $0 | $100,000 | | |
| | Temp. Water Pol. Control ($6.50/SF) | | 6.5 | $598,000 | $721,500 | $94,900 | $1,703,000 | $760,500 | $318,500 | $4,196,400 | | |
| | Drainage incl. Det./Treatment ($12.00/SF) | | 12 | $1,104,000 | $1,332,000 | $175,200 | $3,144,000 | $1,404,000 | $588,000 | $7,747,200 | | |
| | | **subtotal** | | **$1,882,000** | **$2,163,500** | **$435,100** | **$5,142,000** | **$2,314,500** | **$931,500** | **$12,868,600** | **$12,868,600** | |
| **5. TRAFFIC SERVICES AND SAFETY** | | | | | | | | | | | | |
| | Intersection Control ($500K each) | | | $0 | $0 | $1,000,000 | $1,000,000 | $0 | $500,000 | $2,500,000 | | |
| | Illumination ($65/LF/side, 1 side C/D ramps, 2 on | | 65 | $195,000 | $143,000 | $117,000 | $455,000 | $227,500 | $65,000 | $1,202,500 | | |
| | Signing | | | $20,000 | $20,000 | $20,000 | $100,000 | $30,000 | $50,000 | $240,000 | | |
| | Sidewalk ($20/LF) | | 20 | $0 | $0 | $57,000 | $21,000 | $0 | $0 | $78,000 | | |
| | Traffic Safety items (striping, guardrail, etc: $7/SF) | | 7 | $644,000 | $777,000 | $102,200 | $1,834,000 | $819,000 | $343,000 | $4,519,200 | | |
| | Traffic Control ($3.50/SF) | | 3.5 | $322,000 | $388,500 | $51,100 | $917,000 | $409,500 | $171,500 | $2,259,600 | | |
| | | **subtotal** | | **$1,181,000** | **$1,328,500** | **$1,347,300** | **$4,327,000** | **$1,486,000** | **$1,129,500** | **$10,799,300** | **$10,799,300** | |
| **SUB TOTAL** | | | | **$4,727,640** | **$5,634,120** | **$4,586,932** | **$21,175,240** | **$8,865,740** | **$2,500,080** | **$47,489,752** | **$47,489,752** | |
| 6. Allowance for misc. bid items ***(30%)*** | | | | $1,418,292 | $1,690,236 | $1,376,080 | $6,352,572 | $2,659,722 | $750,024 | $14,246,926 | | For bid items not covered by |
| 7. Construction Sub-total | | | | $6,146,000 | $7,324,000 | $5,963,000 | $27,528,000 | $11,525,000 | $3,250,000 | $61,737,000 | | |
| 8. Mobilization ***(11% of line 7))*** | | | | $676,000 | $806,000 | $656,000 | $3,028,000 | $1,268,000 | $358,000 | $6,791,000 | | |
| 9. Subtotal (lines 7 and 8) | | | | $6,822,000 | $8,130,000 | $6,619,000 | $30,556,000 | $12,793,000 | $3,608,000 | $68,528,000 | | |
| 10. Sales Tax (8.5%) | | | | $580,000 | $691,000 | $563,000 | $2,597,000 | $1,087,000 | $307,000 | $5,825,000 | | Olympia rate as of 7/10/09 |
| 11. Other Environmental Permits & Mit.(not incl.) | | | | | | | | | | | | |
| 12. Subtotals (lines 9 thru 11) | | | | $7,402,000 | $8,821,000 | $7,182,000 | $33,153,000 | $13,880,000 | $3,915,000 | $74,353,000 | | |
| 13. Contingencies during Construction (4%) | | | | $296,000 | $353,000 | $287,000 | $1,326,000 | $555,000 | $157,000 | $2,974,000 | | |
| 14. Construction Engineering ***(10%)*** | | | | $740,000 | $882,000 | $718,000 | $3,315,000 | $1,388,000 | $392,000 | $7,435,000 | | |
| | **CONSTRUCTION** | | | **$8,438,000** | **$10,056,000** | **$8,187,000** | **$37,794,000** | **$15,823,000** | **$4,464,000** | **$84,762,000** | | |
| **ROW ACQUISITION (Not including stormwater needs)** | | | | 0 SF | 70000 SF | 40000 SF | 90000 SF | 110000 SF | 0 SF | | | |
| | | Phase 1--WB off-ramp to Yauger Way | | $42,258,000 | | | | | | | | |
| | | Phase 2--Kaiser EB On-ramp | | $26,681,000 | | | | | | | | |
| | | Phase 3--Kaiser WB Off-ramp | | $15,823,000 | | | | | | | | |

# APPENDIX B

Collision Analysis Technical Memorandum

# West Olympia Access Study Collision History Summary and Analysis

Prepared by: WSDOT Olympic Region

Date: August 28, 2009

## Introduction

The purpose of this technical memorandum is to provide a summary and analysis of collision data for the West Olympia Access Study. This documentation summarizes collisions that occurred on those portions of US 101, I-5 and city and county streets within the West Olympia Access Study (WOAS) limits. It also includes a planning level collision analysis of the two alternatives that are in consideration.

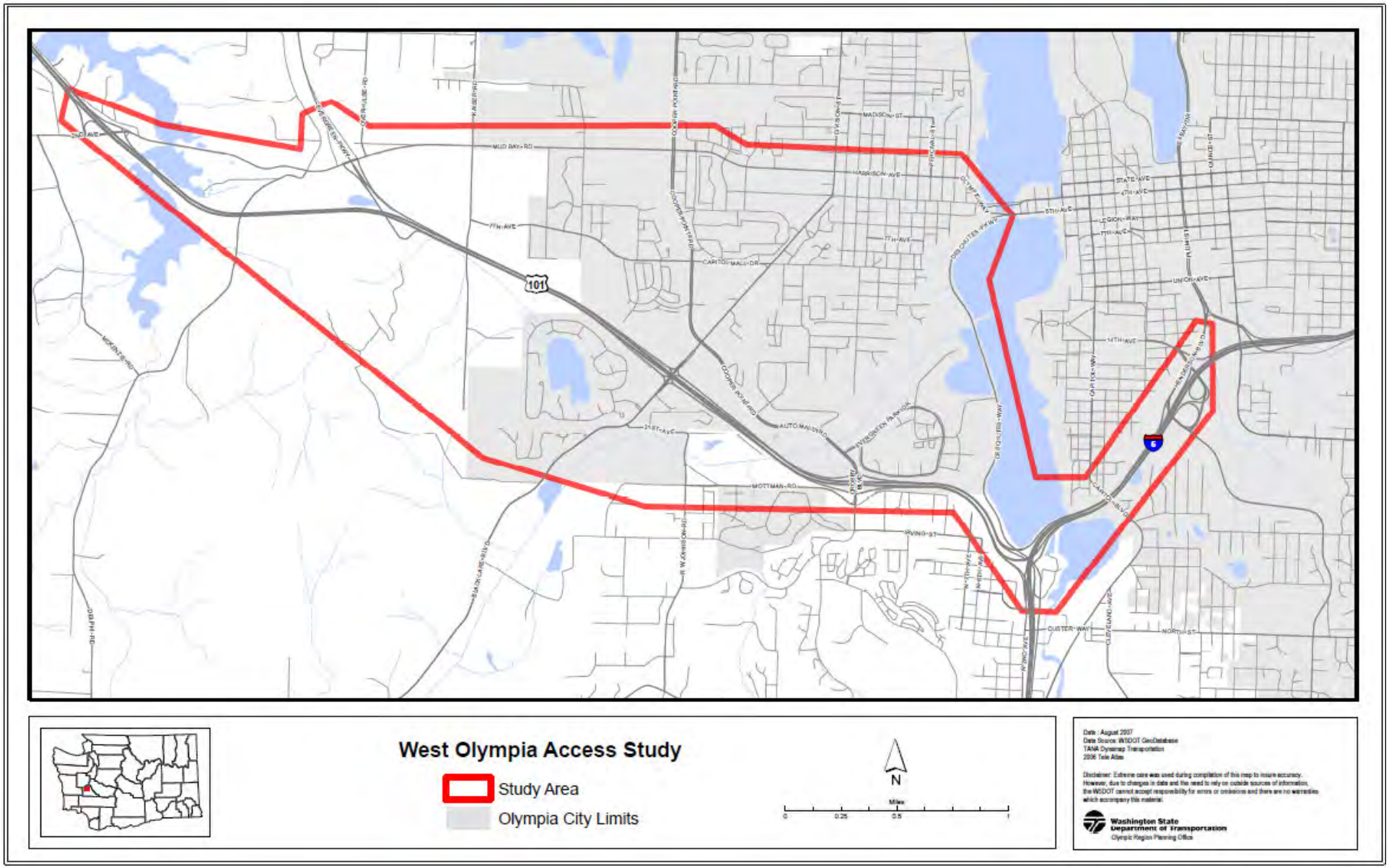
The study area for the WOAS, shown in Figure 1, can be broadly categorized from a traffic operations perspective as two systems: freeway corridors (I-5 and US 101) and the local transportation system in the cities of Olympia and Tumwater. The study area along the I-5 corridor is approximately 2.81 miles long and includes interchanges with US 101 and the southern half of the City Center interchange. The portion of the US 101 corridor within the study area is approximately 4.82 miles long and contains four interchanges, including Mud Bay Road, Evergreen Parkway, Black Lake Boulevard, and Crosby Boulevard/Cooper Point. The study area for the local transportation system is in the cities of Olympia and Tumwater and is located to the north and south of US 101. The local network segments which were considered are:

- Mud Bay Road beginning at 2nd Avenue to Harrison Avenue ending at West Bay Drive
- Evergreen Parkway beginning at Mud Bay Road ending at 17th Avenue
- Overhulse Road beginning at Mud Bay Road ending at 17th Avenue
- Kaiser Road SW beginning at Mud Bay Road to the end of the road
- McPhee Street beginning at Mud Bay Road ending at 7th Ave./Capital Mall Dr.
- Yauger Way beginning at Mud Bay Road ending at Capital Mall Drive
- Cooper Point Road beginning at Harrison Avenue, turns into Automall Drive and ending at Crosby Boulevard
- Black Lake Boulevard beginning at Harrison Avenue ending at 21st Avenue
- 7th Avenue/Capital Mall Drive beginning at Kaiser Road ending at Blake Lake Boulevard
- Mottman Road beginning at RW Johnson Road ending at Crosby Boulevard
- Crosby Boulevard beginning at Irving Street ending at Automall Road
- Evergreen Park Drive beginning at Automall Road ending at Lakeridge Way
- Lakeridge Drive beginning at Evergreen Park Drive ending at Deschutes Parkway



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 1**
**Study Area**




Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Note:** For the purpose of the report, northbound US 101 will be referred to as eastbound US 101 (increasing milepost) and southbound US 101 will be referred to as westbound US 101 (decreasing milepost) since the directional orientation within the study area is closer to east-west than north-south.

## Collision Information Collection

Collision Data was obtained and compiled for a three year period. The most current information available at the beginning of this study was obtained from the Washington State Department of Transportation's Transportation Data Office (TDO) and the City of Olympia. Collision data used in this memorandum was for the period January 1, 2005, to December 31, 2007.

## Summary of Collision History

### State Highway Collisions History

The history of collisions helps to determine areas within the project limits which could be a potential hazard. Within the study area during the three-year timeframe, there were a total of 1035 collisions on the state highway system (471 collisions on US 101 and 564 collisions on I-5).

Forty-four percent of all state highway collisions were rear end type crashes. The most common contributing factor in half of the collisions was drivers exceeding a reasonable safe speed for driving conditions. This is a very common contributing factor for highways that are congested.

*US 101 Collision History Summary*

Statistical Analysis

Statistical analysis of the collision history for the period of January 1, 2005, to December 31, 2007 in the study area along US 101 concludes the following:

- 471 collisions were recorded within the 4.8 mile stretch of US 101.
- This segment averaged 33 collisions per mile per year
- Collisions most frequently occurred between the hours of 5pm and 6pm.
- Non-injury collisions accounted for 70% of all collisions.
- Fatal collisions accounted for 0.2% of all collisions.
- Rear end collisions accounted for 41% of all collisions.
- Fixed object collisions accounted for 25% of all collisions.
- Sideswipe collisions accounted for 14% of all collisions.

Collisions by Type and Severity

The following table summarizes the type of collisions that occurred in the study area along US 101. The collision information includes collisions that occurred on mainline US 101 and at the associated interchanges. Interchange collisions include those that occurred at on ramps, off ramps and over/undercrossing.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

| Table 1<br>US 101 Collisions by Type | | | | | |
|---|---|---|---|---|---|
| | | | | 3-Year Total | |
| **Collision Type** | **2005 Collisions** | **2006 Collisions** | **2007 Collisions** | **Collisions** | **Percent** |
| Animal | 3 | 4 | 6 | 13 | 2.8% |
| Head on | 0 | 0 | 1 | 1 | 0.2% |
| Front end (NOT HEAD ON) | 2 | 2 | 3 | 7 | 1.5% |
| Angle collision | 12 | 17 | 18 | 47 | 10.0% |
| **Sideswipe** | **14** | **25** | **25** | **64** | **13.6%** |
| Bicycle | 0 | 0 | 2 | 2 | 0.4% |
| Vehicle overturned | 1 | 6 | 8 | 15 | 3.2% |
| **Fixed object** | **27** | **42** | **48** | **117** | **24.8%** |
| **Rear end** | **45** | **66** | **81** | **192** | **40.8%** |
| Other | 2 | 2 | 9 | 6 | 2.8% |
| **Total** | **106** | **164** | **201** | **471** | |

The collision rate within the project limits on US 101 is 1.47 collisions per million vehicle miles. This is less than the 2007 statewide collision rate of 2.55 for urban principal arterials.

The number of collisions per year by severity is summarized in the following table:

| Table 2<br>US 101 Collisions by Severity | | | | | |
|---|---|---|---|---|---|
| | | | | 3-Year Total | |
| **Collision Type** | **2005 Collisions** | **2006 Collisions** | **2007 Collisions** | **Collisions** | **Percent** |
| Fatal Collisions | 1 | 0 | 0 | 1 | 0.2% |
| Serious Injury Collisions | 0 | 0 | 2 | 2 | 0.4% |
| Evident Injury Collisions | 4 | 16 | 13 | 33 | 7.0% |
| Possible Injury Collisions | 30 | 38 | 36 | 104 | 22.1% |
| Non-injury Collisions | 71 | 110 | 150 | 331 | 70.3% |
| **Total** | **106** | **164** | **201** | **471** | |

The type of collision typically corresponds with the severity of the collision. For example, opposite direction head-on crashes tend to be much more severe than rear end type crashes. This area does not have a significant number of serious or fatal injury type crashes, as nearly-three quarters (70%) of the collisions that occurred on US 101 within the West Olympia study area were non-injury collisions. General observation of traffic operations and the collision data indicate that the majority of crashes are due in part to congested conditions and are typically occurring at lower speeds. The collisions are primarily a mix of rear end (vehicles following too closely), sideswipe (typically due to merging vehicles colliding with vehicles on the mainline freeway or vehicles changing lanes), and fixed objects (hitting median barrier, guard rail, sign posts, etc.).

The fatality rate on US 101 is below the 2007 statewide average. During the three year analysis period, there was one fatal collision on US 101 (0.2% of all collisions). This was a single vehicle crash and involved a vehicle striking a fixed object. The operation of

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

a vehicle while under the influence of alcohol was the major contributing factor in this crash.

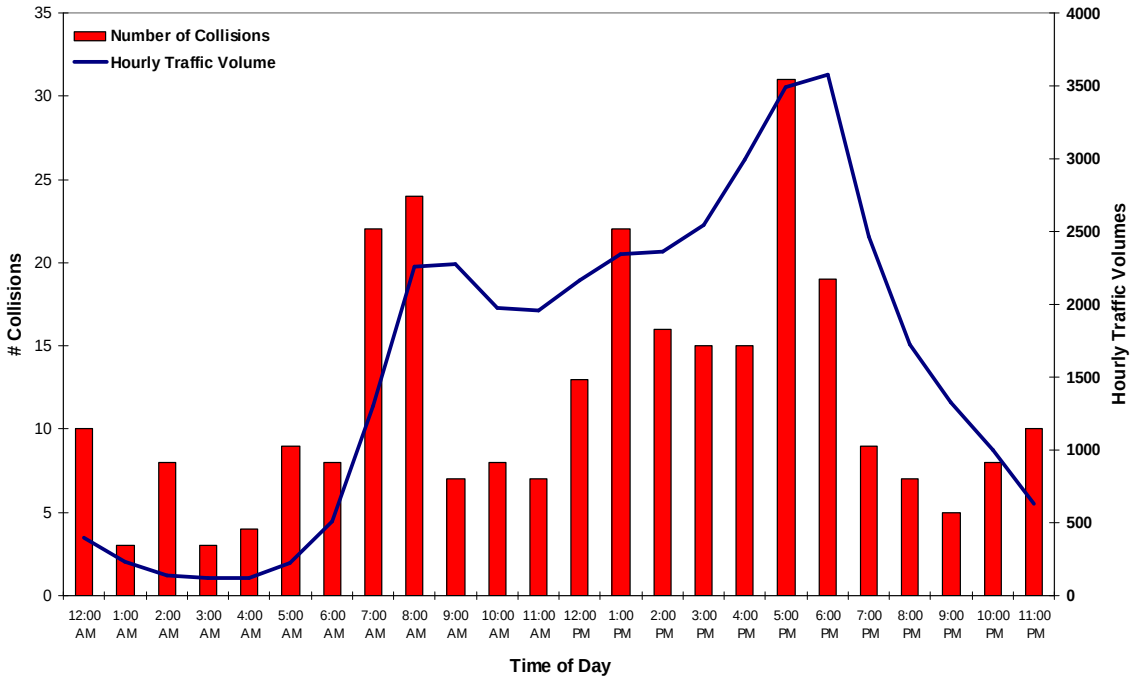
There were two serious injury collisions (0.4% of all collisions), one of which involved a bicyclist.

Collision Relationship to Traffic Volume

It is fairly common that collisions have a direct correlation to volume and congestion. Figure 2 below provides a graphical representation for the study area along US 101. As shown in the Figure 2, US 101 experienced the highest number of collisions during the evening, morning, and afternoon with the most collisions occurring between the hours of 5pm and 6pm, which happens to be during the evening peak period. The next highest number of crashes occurred between the hours of 7am and 8am. The fact that the majority of crashes were rear end type collisions most of which occurred during the times of the heaviest traffic volumes, suggests that the collisions are primarily congestion related.

The figure below shows the number of collisions as related to the time of day and traffic volumes.

**Figure 2**
**US 101 Collisions by Time of Day**

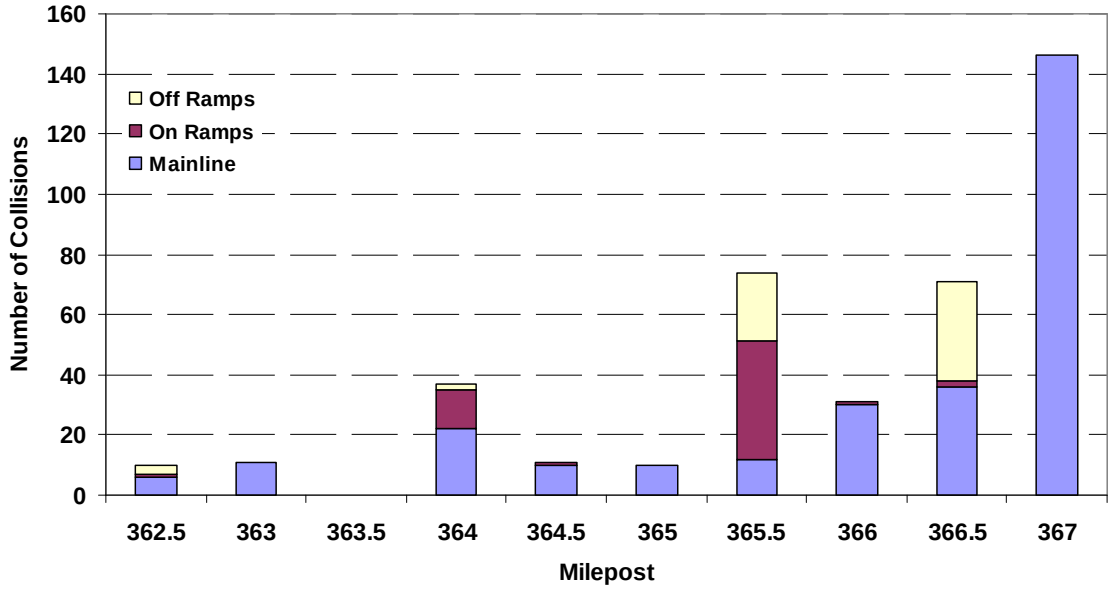



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

Collisions per Mile

To determine the locations within the study area that had the highest collision rate the collision data was evaluated at half mile intervals. Figure 3 provides a graphical representation of collisions occurrence on the mainline and at the on and off ramps along US 101. By far, the most crashes occurred at the Milepost 367 segment. Most of these collision occurred on the mainline near the terminus of US 101 in the vicinity of the US 101/I-5 interchange

**Figure 3**
**US 101 Collisions by Milepost**




Collisions at Interchanges

Higher collisions rates at ramp locations are usually expected because drivers experience significantly more decisions points than what they experience on the mainline freeway. Figure 4 below depicts the collision occurrences at the US 101 interchange on and off ramps as well as the interchange over and under crossings within the study area. The four US 101 interchanges accounted for 188 collisions. Seventy percent of the collisions were non-injury collisions.

The Black Lake and Crosby/Cooper Point interchanges accounted for 85% of the collisions that occurred at the four US 101 interchanges. The westbound off and eastbound on ramps accounted for most of the Black Lake ramp collisions, while the westbound off ramp accounted for most collisions at the Cooper Point/Crosby interchange.

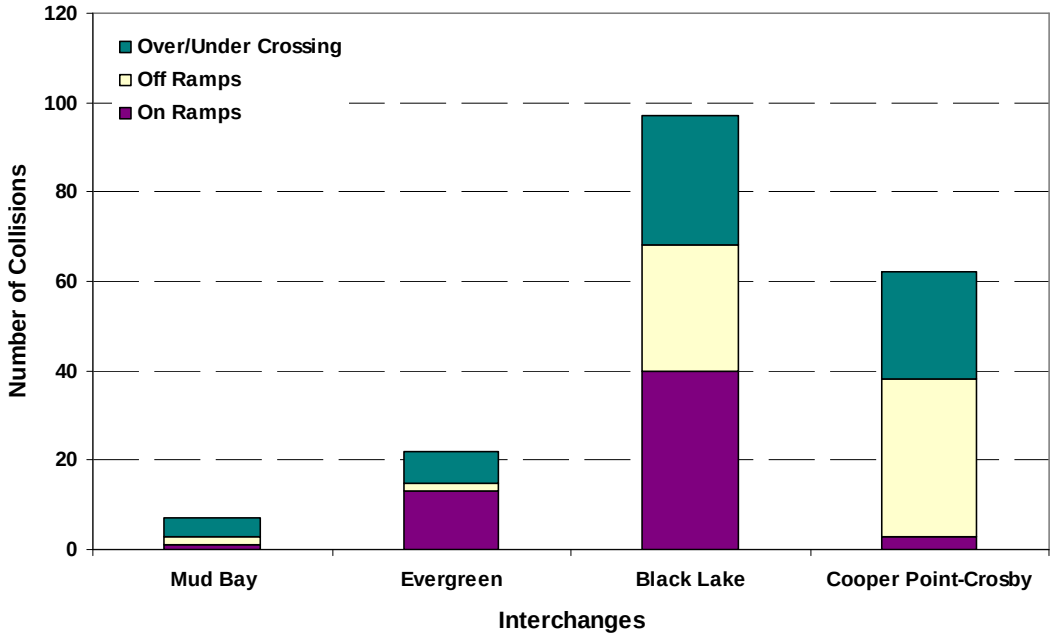
For the Black Lake Interchange, at the off ramps, 93% of the crashes were rear end type collisions. For the on ramps, the collisions were fairly evenly spread amongst 3 types of crashes, 35% rear end crashes, 35% sideswipe crashes, and 28% run off the road striking a fixed object.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

At the Cooper Point/Crosby Interchange, 86% of the crashes were rear end type collisions, with most occurring at the westbound off ramp. Only three collisions occurred on the Cooper Point/Crosby on ramps, two rear end and one angle collisions. The collisions that occurred on the over/under crossings at both interchanges are primarily located in the vicinity of the intersections at the end of the ramp terminals.

**Figure 4**
**Collisions at US 101 Interchanges**




*Interstate 5 Collision History Summary*

Statistical Analysis

Statistical analysis of the collision history between January 1, 2005, to December 31, 2007 in the study area along Interstate (I-5) concludes the following:

- Over 560 collisions were recorded within the 2.8 mile stretch of I-5.
- This segment averaged 67 collisions per mile per year
- Collisions most frequently occurred between the hours of 5pm and 6pm.
- Non-injury collisions accounted for 65% of all collisions.
- Fatal collisions accounted for 0.4% of all collisions.
- Rear end collisions accounted for 47% of all collisions.
- Fixed object collisions accounted for 21% of all collisions.
- Sideswipe collisions accounted for 15% of all collisions.

Collisions by Type and Severity

The following table summarizes the type of collisions that occurred in the study area along Interstate (I-5). The collision information includes collisions that occurred on mainline I-5 and at interchanges. Interchange collisions include those at on ramps, off ramps and over/undercrossing.

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

| Table 3<br>I-5 Collisions by Type | | | | | |
|---|---|---|---|---|---|
| | | | | 3-Year Total | |
| **Collision Type** | **2005 Collisions** | **2006 Collisions** | **2007 Collisions** | **Collisions** | **Percent** |
| Animal | 2 | 1 | 1 | 4 | 0.7% |
| Bicycle | 0 | 0 | 1 | 1 | 0.2% |
| Pedestrian | 0 | 0 | 1 | 1 | 0.2% |
| Hitting construction | 1 | 1 | 0 | 2 | 0.4% |
| Roadway ditch | 1 | 0 | 1 | 2 | 0.4% |
| Head on | 1 | 0 | 0 | 1 | 0.2% |
| Front end (not head on) | 2 | 3 | 5 | 10 | 1.8% |
| Angle collision | 15 | 12 | 11 | 39 | 6.7% |
| **Sideswipe** | **24** | **29** | **32** | **83** | **15.1.9%** |
| Vehicle overturned | 3 | 4 | 5 | 12 | 2.1% |
| **Fixed object** | **30** | **45** | **45** | **120** | **21.3%** |
| **Rear end** | **81** | **81** | **102** | **264** | **46.8%** |
| Other | 12 | 8 | 4 | 23 | 4.3% |
| **Total** | **172** | **184** | **208** | **564** | |

Much like the study segment on US 101, rear end type collisions were the predominant collision type on I-5, followed by striking a fixed object and then sideswiping another vehicle. As noted in Table 3 above, 564 collisions were recorded along stretch of I-5 during the three-year period, of which 368 (65%) occurred on the mainline. The collision rate within the project limits on I-5 is 1.71 collisions per million vehicle miles. This is slightly higher than the 2007 statewide collision rate of 1.46 for urban interstates.

Nearly two-thirds (65%) of the interstate collisions were non-injury collisions. Again as on US 101 the remaining collisions are a primarily mix of sideswipe, angle and hitting fixed objects. The number of collisions per year by severity is summarized in the following table:

| Table 4<br>I-5 Collisions by Severity | | | | | |
|---|---|---|---|---|---|
| | | | | 3-Year Total | |
| **Collision Type** | **2005 Collisions** | **2006 Collisions** | **2007 Collisions** | **Collisions** | **Percent** |
| Fatal Collisions | 1 | 0 | 1 | 2 | 0.4% |
| Serious Injury Collisions | 0 | 2 | 0 | 2 | 0.4% |
| Evident Injury Collisions | 13 | 17 | 9 | 39 | 7% |
| Possible Injury Collisions | 38 | 52 | 65 | 155 | 27% |
| Non-injury Collisions | 120 | 113 | 133 | 366 | 65% |
| **Total** | **172** | **184** | **208** | **564** | |



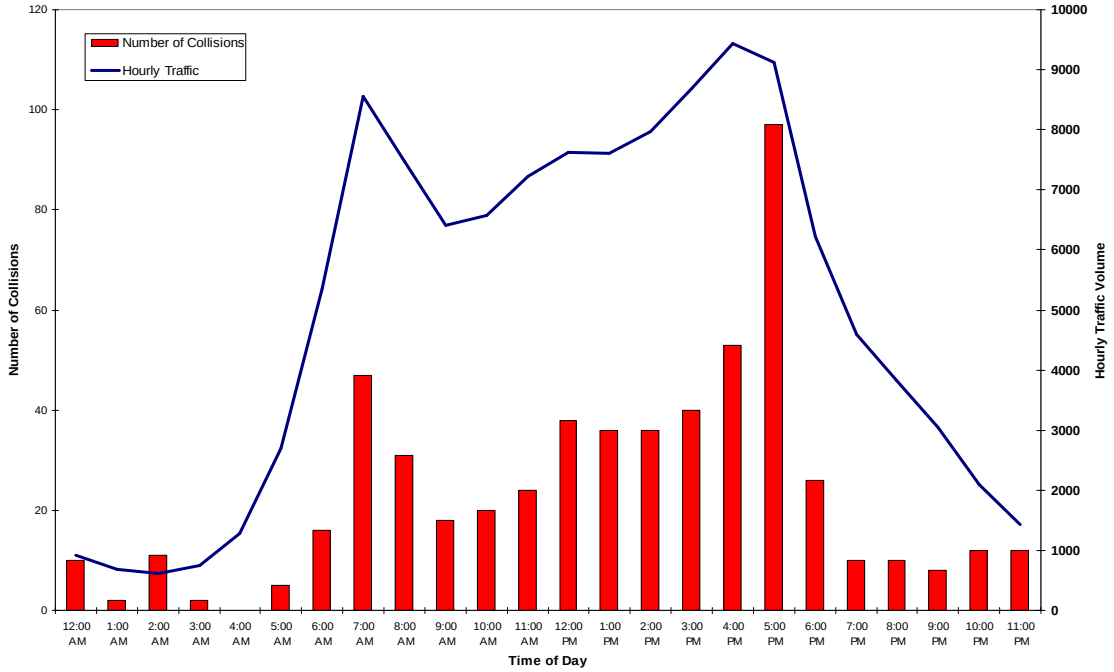
Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

During the 3 year analysis period, there were two collisions that involved fatal injuries. Both of these crashes involved motorcycles. One crash involved a motorcycle striking guardrail, while the other was a sideswipe crash with another vehicle. Also, there were two crashes that resulted in serious injuries. One crash involved an overturned vehicle and the other was a sideswipe involving a motorcycle. Both were in the vicinity of the Capitol/Port of Olympia interchange.

Collision Relationship to Traffic Volume

As seen in the analysis of US 101 mainline, there is correlation between the collisions that occur on I-5 mainline and traffic volumes and congestion. Figure 5 below provides a graphical representation of the study area along I-5.

**Figure 5**
**I-5 Collisions by Time of Day**




As shown in the Figure 5 the highest number of collisions on I-5 mainline occurred during the evening peak period, between 5pm and 6pm. Again as with US 101 the highest type of collisions along I-5 in the study area being rear end collisions and the highest number of collisions occur during peak traffic periods.

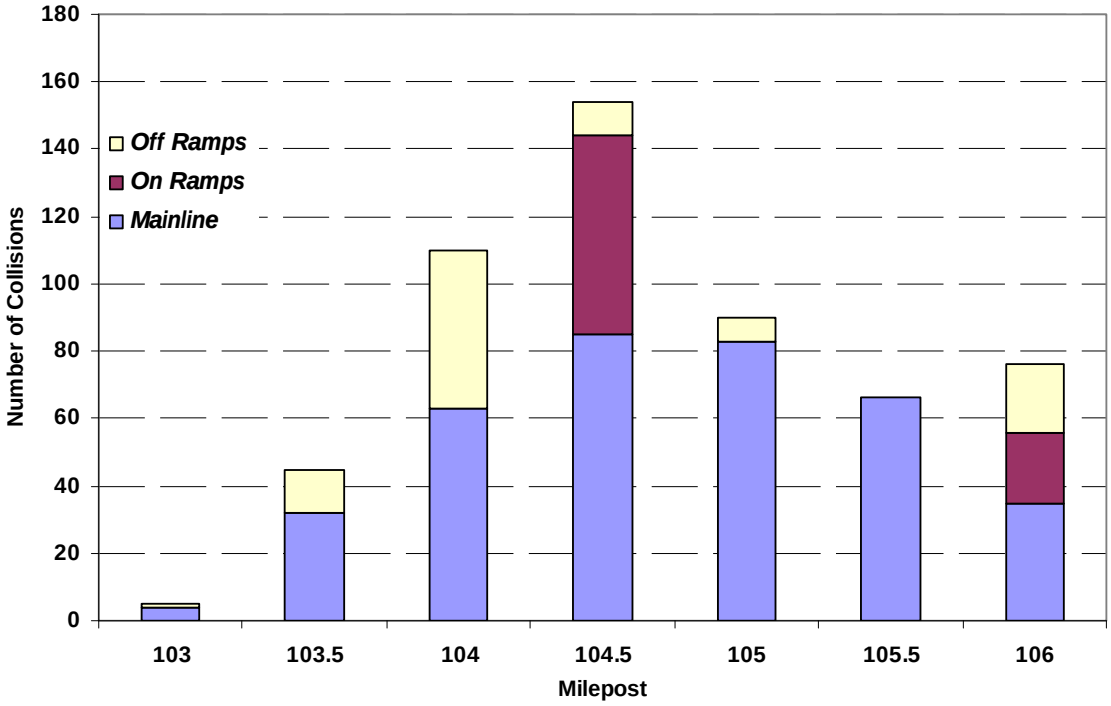
Collisions per Mile

To determine which segments within the study area had the highest number of collisions collision data was evaluated at half mile intervals. Figures 6 provide a graphical representation. On average I-5 within the study area had 67 collisions per mile per year. As represented in Figure 6 the highest number of collisions was in the vicinity of the US 101/I-5 interchange (milepost 104.5).



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 6**
**I-5 Collisions by Milepost**



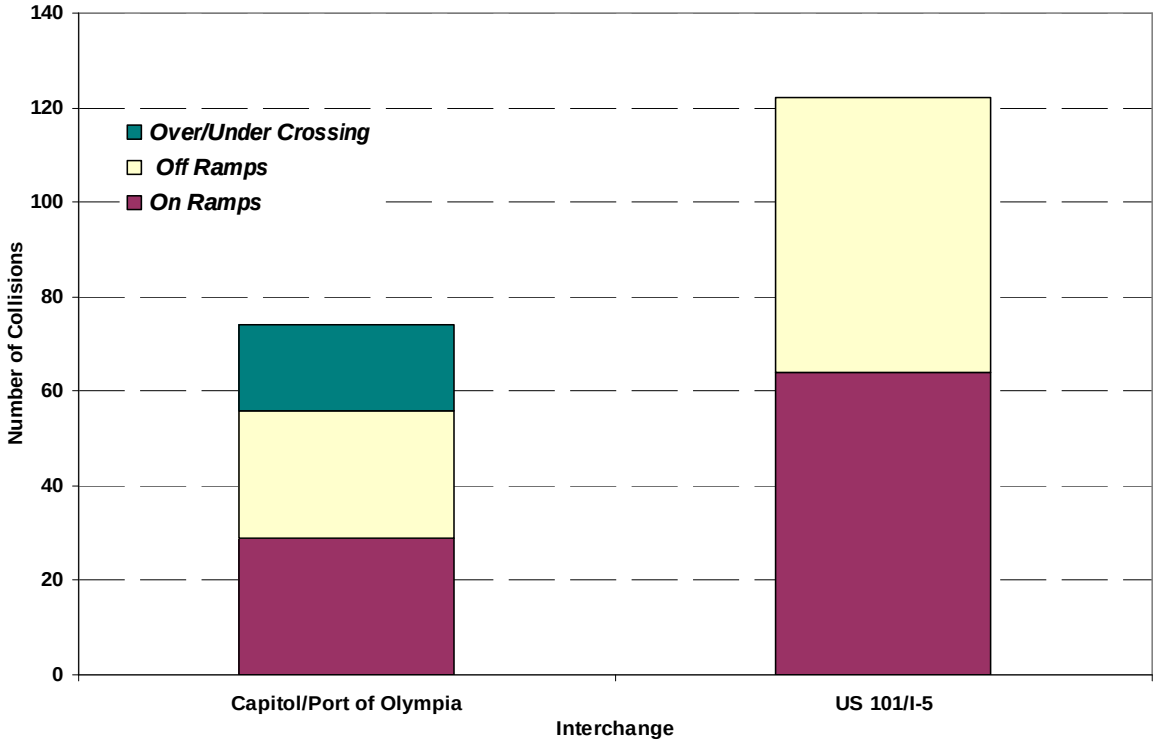

Collisions at Interchanges

Figure 7 below depicts the collision occurrences at the I-5 interchange on and off ramps as well as the interchange over and under crossings within the study area. The two I-5 interchanges within the study area accounted for 196 of all I-5 collisions. As with US 101, non-injury collisions accounted for 67% of the I-5 interchanges collisions. Though rear ends collisions was still the predominate type of collision at the I-5 interchanges, striking fixed objects, sideswipe and angle collisions were also prevalent at these locations. In general, the northbound ramps had more collisions ~~occur~~ than the southbound ramps.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 7**
**Collisions at I-5 Interchanges**




**WSDOT Accident history - High Accident Locations (HAL) and Corridors (HAC)**

Washington State Department of Transportation (WSDOT) regularly reviews the accident history of all state highways to look for problem locations. The two main approaches used in these reviews are identifying High Accident Locations (HALs) and High Accident Corridors (HACs).

*High Collision Locations (HAL)* - spot locations less than a mile long which have experienced a higher than average rate of severe accidents during the previous two years

*High Collision Corridors (HAC)* – are sections of state highway one or more miles long, which have a higher than average number of severe accidents over a continuous period of time.

Table 5 below lists the designated locations of the HACs and HALs on I-5 and US 101 within the West Olympia study area.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

| Table 5<br>HAC and HAL within Study Area | | | | | |
|---|---|---|---|---|---|
| **State Route** | **HAC/HAL** | **Begin MP** | **End MP** | **Travel Direction** | **Description** |
| I-5 | HAC | 105.62 | 107.61 | I-5 | Mainline from State Capitol/Port of Olympia Interchange to Pacific Avenue ramps. Two HALs are located within this HAC. |
| I-5 | HAL | 106.10 | | I-5 Southbound | HAL located on Plum Street off ramp |
| I-5 | HAL | 106.23 | | I-5 Northbound | HAL located on Plum Street on ramp |
| I-5 | HAL | 104.02 | | I-5 Northbound | HAL located on the off ramp to US 101 |
| I-5 | HAL | 104.35 | | I-5 Southbound | HAL located on the end of 2nd Avenue off ramp with intersection of DeSoto Street |
| I-5 | HAL | 104.81 | | I-5 Northbound | HAL located on the on ramp from US 101 |
| US 101 | HAC | 366.59 | 367.41 | US 101 | Mainline US 101 from I-5 to Cooper Point Road/Crosby Road Interchange. |
| US 101 | HAC | 366.90 | 367.41 | US 101 | Mainline US 101 from Cooper Point Road/Crosby Road HAL is within this HAC. |
| US 101 | HAL | 366.68 | | US 101 Westbound | HAL located on the Cooper Point Off Ramp |
| US 101 | HAL | 365.03 | | US 101 Eastbound | HAL located on the Black Lake Off Ramp |
| US 101 | HAL | 365.91 | | US 101 Eastbound | HAL located on the Black Lake On Ramp |
| US 101 | HAL | 365.98 | | US 101 Westbound | HAL located on the Black Lake Off Ramp |

***Source: WSDOT 2007-2009 HAC & HAL List***

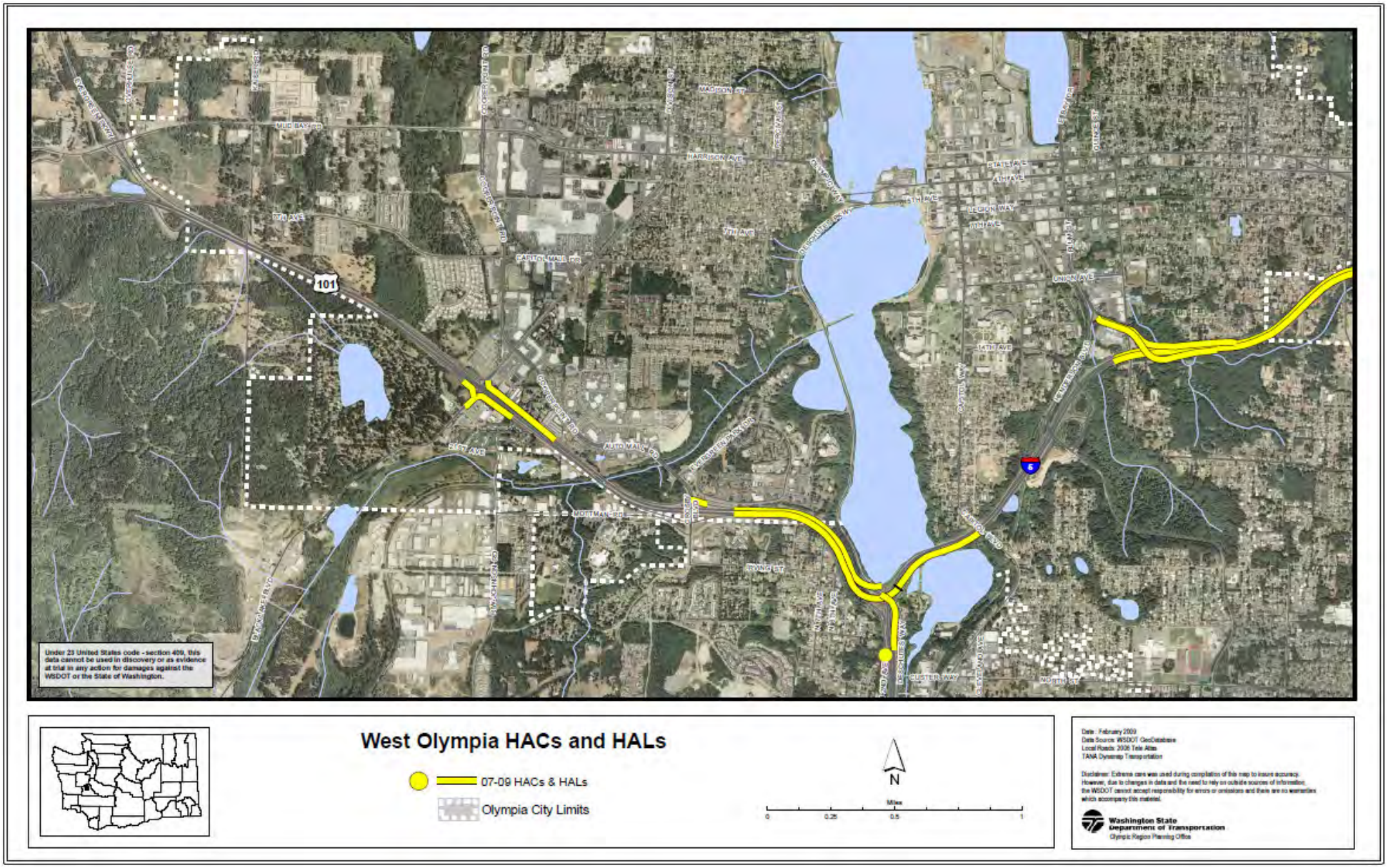
On the US 101 corridor there are two HACs, both of which are located within the last mile of US 101. While on I-5 there is one HAC which is located at the north end of the study area and extends beyond the study boundary.

There are four HALs located on US 101 within the study limits. Each of these HALs was situated on highway on and off ramps. One HAL was within the Crosby Road/Cooper Point Road Interchange, while the other three HALs were within the Black Lake Interchange. On I-5 all of the HALs identified in the study area were located on highway on and off ramps. Two HALs were located at the State Capitol/Port of Olympia Interchange while the other three HALs were within the US 101/I-5 Interchange.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 8**
**WSDOT 2007-2009 HAC & HAL Locations**




Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Local Road Collisions History**
An analysis was performed of collisions that occurred on city and county streets within the West Olympia Access Study limits. Only the collision data for the segment of streets that are within the study limits was considered. Within study area during the three-year timeframe, there were a total of 887 collisions on roads that made up the local system in the study area.

*Local Road Collision History Summary*

Statistical Analysis
Statistical analysis of the collision history for the period January 1, 2005, to December 31, 2007 on the local system in the study area concludes the following:

- Intersection related collisions accounted for 54% of all collisions.
- The highest number of collisions occurs between 3pm and 6pm.
- Non-injury collisions accounted for 72% of all collisions.
- Fatal collisions accounted for 0.1% of all collisions.
- Rear end collisions accounted for 46% of all collisions.
- Right Angle collisions accounted for 22% of all collisions.
- Sideswipe collisions accounted for 15% of all collisions.
- Eight of the 35 City of Olympia High Collision Locations are in West Olympia

Collisions by Type and Severity
The following table summarizes the type of collisions that occurred on the local network in the study area US 101. The collision information includes collisions that occurred on the roadway mainline and at the associated intersections.

**Table 6**
**Local Roads Collisions by Type**

| Collision Type | 2005 Collisions | 2006 Collisions | 2007 Collisions | 3-Year Total Collisions | 3-Year Total Percent |
|---|---|---|---|---|---|
| Animal | 0 | 1 | 0 | 1 | 0.1% |
| Approach Turns | 23 | 15 | 25 | 63 | 7.6% |
| Backing | 3 | 4 | 2 | 9 | 1.1% |
| Fixed object | 19 | 13 | 18 | 50 | 6.0% |
| Head On | 3 | 1 | 1 | 5 | 0.6% |
| Pedestrian/Cyclist | 12 | 8 | 24 | 44 | 5.3% |
| Rear end | 122 | 126 | 137 | 385 | 46.4% |
| Right Angle | 52 | 69 | 60 | 181 | 21.8% |
| Sideswipe | 30 | 42 | 51 | 123 | 14.8% |
| Front end | 0 | 0 | 0 | 0 | 0.0% |
| Roadway Ditch/Over Embankment | 4 | 0 | 1 | 5 | 0.6% |
| Vehicle overturned | 3 | 1 | 1 | 5 | 0.6% |
| Other | 5 | 7 | 4 | 16 | 1.9% |
| **Total** | **276** | **287** | **324** | **887** | |



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

As with the collisions that occurred on the state system rear end collisions were the primary collision type accounting for 46% of all collisions that occurred on the local system; followed by right angle collisions and sideswiping another vehicle. Right angle collisions as defined by the City of Olympia are collisions in which one vehicle is turning right and is struck by another vehicle, this type of collision is predominately intersection or driveway related collisions.

The number of collisions a year by severity is summarized in the following table. Non-injury collisions accounted for approximately 72% of the local network collisions. Only one fatal collision occurred within the study area on the local network during the three-year period. The fatal collision involved a bicyclist not granting right of way to a vehicle on the Mud Bay Road mainline.

**Table 7**
**Local Roads Collisions by Severity**

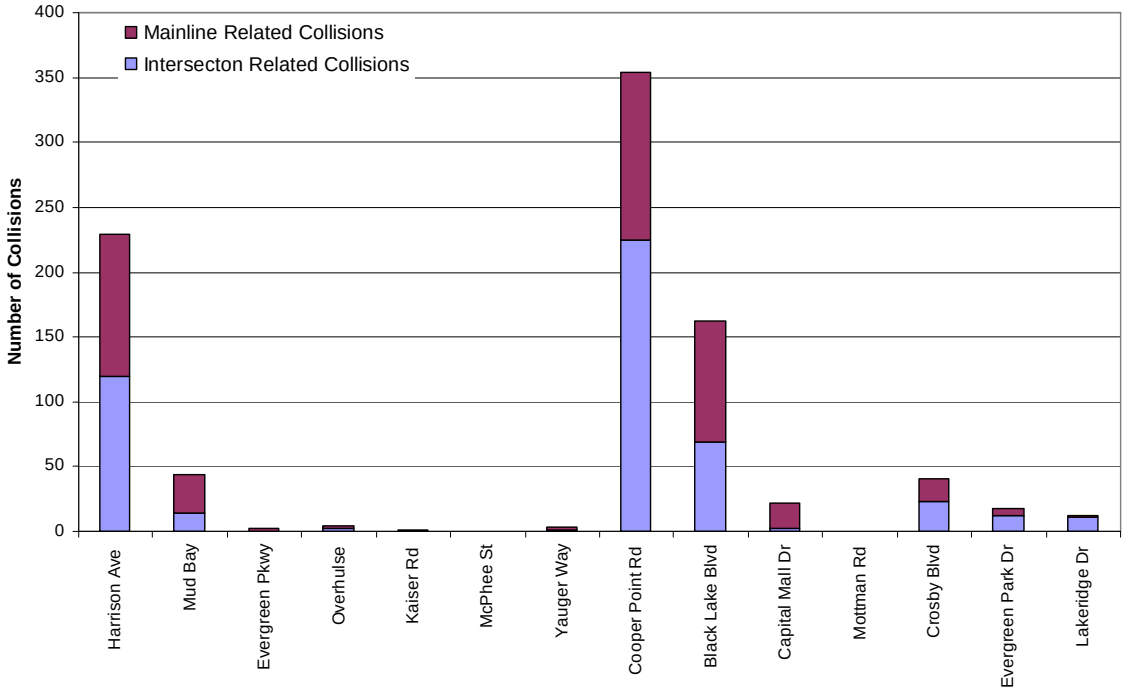
| | | | | 3-Year Total | |
|---|---|---|---|---|---|
| **Collision Type** | **2005** | **2006** | **2007** | **Collisions** | **Percent** |
| Fatal Collisions | 0 | 0 | 1 | 1 | 0.1% |
| Injury Collisions | 87 | 73 | 90 | 250 | 28.2% |
| Non-injury Collisions | 189 | 214 | 233 | 636 | 71.7% |
| **Total** | **276** | **287** | **324** | **887** | |

The following figure depicts the number of collisions that occurred on the individual local network roads. Intersection related collisions accounted for 54% of the collisions on the local network in the study area. Facilities with the highest number of collisions coincide with the three principal arterials in the study area; Cooper Point Road with 354 collisions, Harrison Avenue with 229 collisions and Black Lake Boulevard with 162 collisions. Adding the county segment of Mud Bay Road to Harrison Avenue collision totals, the Harrison/Mud Bay corridor accounts for 273 collisions for the three-year period. These three arterials account for approximately 90% of all the local network collisions within the study area.



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

**Figure 9**
**Local Network Collisions**




On each of the three arterials, almost 46% of the collisions were the result of rear end type collisions. Following rear collisions the most common collisions that occurred on these three arterials include, right angle (19%), and sideswipe (15%). Table 8 summarizes the most common types of collisions that occurred on these three arterials. Combining this with the fact that property damage only collisions are the primary severity type collision highly suggest that congestion is a contributing factor to collisions. The time of the day that had the most traffic collisions was between 3 pm and 6 pm.

**Table 8**
**Common Collision Types on Arterials**

| | Rear End | Right Angle | Sideswipe | Approach Turns |
|---|---|---|---|---|
| **Black Lake Blvd** | 71 | 20 | 39 | 10 |
| **Harrison Ave/Mud Bay** | 88 | 76 | 29 | 28 |
| **Cooper Point Rd** | 203 | 53 | 50 | 16 |
| **Total** | 362 | 149 | 186 | 54 |

Source: City of Olympia

Intersections are frequent location of collisions, 54% of the collisions on the local network in the study area were at intersections. As anticipated the common type of collisions that occurred at intersections were rear end, sideswipe and right angle collisions. The City of Olympia identifies their High Collision Locations where a significant number of intersection-related collisions occurred and ranked by the collision rate of each intersection. All of the High Collision Locations identified by the city are intersection related. Of the 35 intersections identified as High Collision Locations in the City of Olympia for the period 2005-2007 eight were located in West Olympia. Table 9



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

shows these eight high collision location intersections; all of which are related to one of the three key arterials, Cooper Point Road, Harrison Avenue, and Black Lake.

**Table 9**
**West Olympia High Collision Locations**

| Ranking | Location | Number of Collisions | Collision Rate |
|---|---|---|---|
| 14 | Black Lake Blvd at Cooper Point Rd | 58 | 0.9 |
| 17 | Black Lake Blvd at Capital Mall/9th Ave | 25 | 0.77 |
| 19 | Capital Mall at Cooper Point Rd | 27 | 0.75 |
| 21 | 12th Ave at Cooper Point Rd | 22 | 0.71 |
| 22 | Harrison at West Bay Dr | 21 | 0.65 |
| 24 | Division at Harrison Ave | 21 | 0.58 |
| 26 | Harrison Ave at Perry St | 15 | 0.58 |
| 34 | Cooper Point Rd at Harrison Ave | 14 | 0.37 |

Source: City of Olympia

## Alternative Safety Comparison

A comparative statistical safety analysis of the two alternatives carried forward for additional analysis was performed. This analysis considered potential for collisions at intersections and along the US 101 segments as associated with each improvement alternative in 2030. The two alternatives considered are:

***Black Lake Interchange:*** The existing Black Lake interchange would be modified with an additional lane diverging from the westbound off-ramp that connects to Yauger Way SW, and another lane from Yauger Way SW would connect to the existing eastbound on-ramp prior to merging with the US 101 mainline. The option includes local system improvements to local intersections.

***Evergreen Interchange:*** The Evergreen interchange primarily consist of adding an eastbound off-ramp and a westbound on-ramp, which would provide full access to and from all directions of travel at the Evergreen interchange. The existing eastbound on-ramp and westbound off-ramp would also be re-aligned to provide an at-grade connection with Kaiser Road SW prior to merging/after diverging from the US 101 mainline. The option also includes local system improvements to local intersections.

## Intersection Collisions

An analysis of intersections was based on statistical models as identified in FHWA PUBLICATION NO. FHWA-RD-99-094, *Statistical Models of At-Grade Intersection Accidents—Addendum*, (MARCH 2000). This is an addendum to the work published in FHWA publication FHWA-RD-96-125 titled *Statistical Models of At-Grade Intersections*. The objective of both research studies was to develop statistical models of the relationship between traffic accidents and highway geometric elements for at-grade intersections. The addendum presents predictive models based on all collision types including both multiple-vehicle and single-vehicle accidents.

Specifically the analysis used the research report charts which depict number of collisions per year as a function of traffic volumes. The charts provide the variation of the annual number of intersection accidents with major road and crossroad average daily traffic

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

(ADT) to predict the number of collisions per year. Intersection types considered were urban, four-leg, stop-controlled intersections; urban, three-leg, stop-controlled intersections; and urban, four-leg, signalized intersections (Attachment A).

The analysis used the 2030 intersection traffic volumes for each option as identified in the study's *Traffic Operations Analysis Technical Memorandum 3* (Attachment B). After determining the ADT for each intersection these values were applied to the appropriate chart to arrive at an "order of magnitude" estimate of collisions at each intersection for each interchange option. Based on the predictive models the following is the resulting estimated total number of intersection related collisions that could be expected to occur in a year at study area intersections.

| Black Lake Interchange | Evergreen Interchange |
|---|---|
| 129 | 130 |

The total average number of intersection related collisions that occurred during the three-period (2005-2007) was approximately 159.7.

For screening purposes the analysis focused on key intersections that were identified on the arterials making up the 'triangle', these included the Cooper Point Road Harrison Avenue, Division at Harrison Avenue, and Black Lake Blvd at Cooper Point Road intersections. The analysis, summarized in Table 10, indicates that for each option the total number of intersection related collisions that could be expected to occur is similar.

**Table 10**
**Annual Collision Projections**

| | Black Lake Interchange | | | Evergreen Interchange | | |
|---|---|---|---|---|---|---|
| **Intersection Description** | **Accidents** | **ADT** | **LOS (Delay)** | **Accidents** | **ADT** | **LOS (Delay)** |
| Black Lake Blvd/Cooper Point Rd | 10.2 | 79613 | E (78.5) | 10.3 | 82388 | E (65.1) |
| Cooper Point Rd/Harrison Ave/Mud Bay Rd | 8 | 58075 | E (74.9) | 7.9 | 57513 | E (71.3) |
| Harrison Ave/Division St | 7.9 | 55675 | E (76.2) | 7.9 | 56313 | E (79.4) |
| | **26.1** | | | **26.1** | | |

**Freeway Segments**

The collision history for US 101 within the study area indicates that most of the collisions have been congestion related. As noted in Section 1.5.3 Safety of FHWA, *Freeway Management and Operations Handbook*, though the details of the relationship between congestion and safety are not well defined, it is generally accepted congestion and collisions are directly related. Collisions increase as congestion increases, but the severity of the crashes is generally lower. Also, crashes in congestion tend to lead to secondary crashes.

The statistical analysis of the two interchange alternatives considered the freeway PM Period traffic volumes as identified in the study's *Traffic Operations Analysis Technical Memorandum 3* as well as the collision rate based on the three-year collision data (2005-2007) for the same freeway segments of US 101. The 2005-2007 collision rate was applied to the 2030 volumes in order to project future collision numbers.

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

Based on the premise that additional congestion leads to additional crashes, the collision projections were modified for the segments of freeway that are expected to experience a decrease in level of service (LOS). The analysis assumed that each step of degradation in LOS leads to a 5% increase in crashes during the peak period (i.e. A to B = 5% B to C =5%, A to C = 10%, B to D = 10%, etc.) This factor was only applied to crashes that occurred during the peak period, since the worse LOS will predominately occur during the peak period.

Adding access to a freeway introduces additional conflict points which also tend to lead to more crashes. Taking this into account the freeway segment analysis considered the number of mainline conflict points as an indicator of mainline safety. In essence these are defined as the number of access points, which could impact the overall safety record of the freeway system within the study area. These include ramp merge and diverges and assume that design criteria has been met by the design. In addition the analysis considered the LOS that is expected at these congested conflict zones. The basic relationship between LOS and accidents is increases in vehicle delay result in a decrease in LOS performance and decrease in LOS performances could typically result in an increase in collisions.

The analysis also considered safety by evaluating each option in reference to ability to meet design standards, guidelines and sanctioned design procedures. Whenever a deviation or the differences from the design level specified in the *Design Manual* is needed to implement a design increases the possibility for a potential collision to occur. The analysis compared each option as to their ability to meet design standards according the *WSDOT Design Manual* by considering the number of potential deviations that could be required to gain endorsement of each design. A summary of the analysis is shown in Table 11.

Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

| Table 11<br>Conflict Points and Design Standard Considerations | | | | | |
|---|---|---|---|---|---|
| **Black Lake Interchange** | | | **Evergreen Interchange** | | |
| **Conflict Points** | | **Ability to meet standards** | **Conflict Points** | | **Ability to meet standards** |
| • two weaves (eastbound Black Lake -Crosby, westbound Crosby-Black Lake)<br>• two merges (eastbound Evergreen on-ramp, westbound Black Lake on-ramp)<br>• two diverges (eastbound Black Lake off-ramp, westbound Evergreen off-ramp) | • three are LOS D or better<br>• two are LOS E<br>• one is LOS F | • one deviation for superelevation runoff distance, which may be needed on new westbound bridge crossing over Black Lake Blvd.<br>• three potential design issues, but not necessarily deviations which include:<br>o weaving distance westbound between Black Lake interchange and Crosby interchange<br>o advance signing of westbound off-ramp to Black Lake Blvd and new collector-distributor to Yauger<br>o westbound collector-distributor transition from ramp into local roadway (Yauger Way) and new intersection at 9th | • four weaves (eastbound Black Lake–Crosby & Evergreen-Black Lake, westbound Crosby-Black Lake & Black Lake-Evergreen)<br>• two merges (eastbound Evergreen on-ramp, westbound Black Lake on-ramp)<br>• two diverges (eastbound Black Lake off-ramp, westbound Evergreen off-ramp) | • four conflict points are LOS D or better<br>• two are LOS E<br>• two are LOS F | • no deviations currently identified.<br>• two potential design issues, but not necessarily deviations include;<br>o weaving distance both directions of SR 101 between Kaiser interchange and Black Lake interchange<br>o westbound off-ramp to Kaiser. If tight diamond configuration, the off-ramp may be tying into a steep cross-grade on Kaiser Road. This is not ideal for large trucks turning against the steep cross-grade. |



Under 23 United States Code-Section 409, this data cannot be used in discovery or as evidence at trial in any action for damages against the WSDOT, or any jurisdictions involved in the data.

# APPENDIX C

Operational Analysis Comparison

**Travel Time (4:30-5:30)**

| Segment | 2007 Existing Conditions | 2030 No-Build Scenario 1 | 2030 Black Lake Interchange Scenario 5 | 2030 Evergreen Interchange Scenario 7 | 2030 Hybrid Interchange Scenario 9 |
|---|---|---|---|---|---|
| **Eastbound 101** | | | | | |
| Start of model to Mud Bay On Ramp | 42 | 44 | 43 | 43 | 43 |
| Mud Bay On Ramp to Black Lake On Ramp | 196 | 470 | 211 | 211 | 201 |
| Black Lake On Ramp to Crosby On Ramp | 50 | 71 | 61 | 58 | 61 |
| Crosby On Ramp to I-5 Off Ramp | 36.02 | 67 | 57 | 65 | 71 |
| ***Eastbound 101 Total Travel Time*** | **324** | **652** | **372** | **378** | **376** |
| ***Eastbound 101 Speed (mph)*** | **59** | **29** | **51** | **51** | **51** |
| **Westbound 101** | | | | | |
| I-5 On Ramp to Crosby On Ramp | 72 | 76 | 81 | 76 | 76 |
| Crosby On Ramp to Black Lake On Ramp | 71 | 76 | 77 | 74 | 73 |
| Black Lake On Ramp to Mud Bay Off Ramp | 134 | 138 | 138 | 138 | 137 |
| Mud Bay Off Ramp to Model End | 58 | 61 | 61 | 61 | 61 |
| ***Westbound 101 Total Travel Time*** | **336** | **350** | **357** | **350** | **347** |
| ***Westbound 101 Speed (mph)*** | **57** | **55** | **54** | **55** | **55** |
| **Northbound I-5** | | | | | |
| Start of model to US 101 Off Ramp | 32 | 34 | 34 | 35 | 34 |
| US 101 Off Ramp to US 101 On Ramp | 31 | 33 | 33 | 34 | 33 |
| US 101 On Ramp to 14th St Off Ramp | 41 | 66 | 73 | 71 | 73 |
| 14th St Off Ramp to Model End | 22 | 23 | 23 | 23 | 23 |
| ***Northbound I-5 Total Travel Time*** | **127** | **155** | **163** | **163** | **164** |
| ***Northbound I-5 Speed (mph)*** | **58** | **48** | **45** | **45** | **45** |
| **Southbound I-5** | | | | | |
| Start of model to 14th St On Ramp | 185 | 205 | 201 | 200 | 201 |
| 14th St On Ramp to US 101 Off Ramp | 34 | 35 | 34 | 34 | 34 |
| US 101 Off Ramp to US 101 On Ramp | 43 | 43 | 43 | 43 | 43 |
| ***Southbound I-5 Total Travel Time*** | **261** | **282** | **278** | **278** | **278** |
| ***Southbound I-5 Speed (mph)*** | **29** | **27** | **28** | **28** | **28** |

**Speeds**

| | 2007 Existing Conditions | 2030 No-Build Scenario 1 | 2030 Black Lake Interchange Scenario 5 | 2030 Evergreen Interchange Scenario 7 | 2030 Hybrid Interchange Scenario 9 |
|---|---|---|---|---|---|
| **Southbound I-5** | (4:30-5:30) | (4:30-5:30) | (4:30-5:30) | (4:30-5:30) | (4:30-5:30) |
| City Center Off Ramp | 35 | 29 | 29 | 29 | 29 |
| City Center On Ramp | 33 | 32 | 33 | 33 | 33 |
| I-5/US 101 Weave | 46 | 46 | 47 | 46 | 46 |
| US 101 Off Ramp | 59 | 58 | 59 | 59 | 58 |
| US 101 On Ramp | 53 | 49 | 48 | 48 | 48 |
| ***Average Southbound I-5*** [1] | **46** | **43** | **43** | **42** | **42** |
| **Northbound I-5** | | | | | |
| City Center Off Ramp | 60 | 58 | 58 | 58 | 58 |
| US 101 On Ramp | 57 | 51 | 50 | 50 | 50 |
| US 101 Off Ramp | 60 | 57 | 57 | 56 | 57 |
| ***Average Northbound I-5*** [1] | **59** | **56** | **55** | **56** | **56** |
| **Westbound US 101** | | | | | |
| Mud Bay Interchange | 60 | 59 | 59 | 58 | 59 |
| Evergreen Pkwy On Ramp | NA | NA | NA | 59 | NA |
| Evergreen Pkwy Off Ramp | 60 | 59 | 59 | 58 | 59 |
| Black Lake On Ramp | 59 | 55 | 56 | 55 | 57 |
| Black Lake Off Ramp | 59 | 57 | 57 | 57 | 58 |
| Crosby Blvd/Cooper Point Off Ramp | 45 | 43 | 42 | 43 | 43 |
| US 101/I-5 | 51 | 48 | 47 | 46 | 47 |
| ***Average Westbound US 101*** [1] | **58** | **56** | **56** | **56** | **56** |
| **Eastbound US 101** | | | | | |
| Mud Bay Interchange | 60 | 57 | 59 | 59 | 59 |
| Evergreen Pkwy Off Ramp | NA | NA | NA | 57 | NA |
| Evergreen Pkwy On Ramp | 59 | 47 | 57 | 50 | 59 |
| Kaiser On Ramp | NA | NA | NA | NA | 59 |
| Black Lake Off Ramp | 60 | 59 | 59 | 59 | 59 |
| Black Lake On Ramp | 60 | 58 | 58 | 59 | 59 |
| Crosby Blvd/Cooper Point On Ramp | 56 | 50 | 50 | 51 | 49 |
| US 101/I-5 | 55 | 45 | 45 | 43 | 44 |
| ***Average Eastbound US 101*** [1] | **59** | **54** | **57** | **56** | **56** |

[1] Inclusive of all measurement points between areas listed

**Freeway LOS and Densities**

| Segment | Type | 2030 No-Build Scenario 1 | | 2030 Black Lake Interchange Scenario 5 | | 2030 Evergreen Interchange Scenario 7 | | 2030 Hybrid Interchange Scenario 9 | |
|---|---|---|---|---|---|---|---|---|---|
| | | Density (pc/mi/ln) | LOS (HCM Equivalent) | Density (pc/mi/ln) | LOS (HCM Equivalent) | Density (pc/mi/ln) | LOS (HCM Equivalent) | Density (pc/mi/ln) | LOS (HCM Equivalent) |
| ***Westbound US 101*** | | | | | | | | | |
| WB US 101 e/o Crosby Blvd | Basic | 38 | E | 43 | E | 43 | E | 42 | E |
| WB US 101 Crosby Blvd Off-Ramp | Diverge | 50 | F | 57 | F | 54 | F | 56 | F |
| WB US 101 Mainline | Basic | 26 | C | 28 | D | 26 | D | 27 | D |
| WB US 101 Crosby Blvd/Black Lake Weave | Weave | 24 | C | 30 | C | 24 | C | 24 | C |
| WB US 101 Mainline | Basic | 30 | D | 29 | D | 31 | D | 27 | D |
| WB US 101 Black Lake On-Ramp | Merge | 26 | C | 26 | C | 31 | D | 23 | C |
| WB US 101 Mainline | Basic | 36 | E | 35 | E | NA | NA | 34 | D |
| WB US 101 Evergreen Off-Ramp/ Black lake Off-Evergreen On Weave** | Diverge/ Weave | 33 | D | 32 | D | 40 | F | 32 | D |
| WB US 101 Mainline | Basic | NA | NA | NA | NA | 26 | C | NA | NA |
| WB US 101 Evergreen On-Ramp | Merge | NA | NA | NA | NA | 21 | C | NA | NA |
| WB US 101 Mainline | Basic | 26 | C | 27 | D | 27 | D | 28 | D |
| WB US 101 Mud Bay Off-Ramp | Diverge | 26 | C | 28 | C | 27 | C | 29 | D |
| WB US 101 Mainline | Basic | 26 | C | 27 | D | 26 | D | 28 | D |
| WB US 101 Mud Bay On-Ramp | Merge | 26 | C | 24 | C | 28 | C | 26 | C |
| WB US 101 Mainline | Basic | 35 | E | 34 | D | 36 | E | 35 | E |
| *Westbound US 101 Average* | | **31** | | **32** | | **31** | | **32** | |
| ***Eastbound US 101*** | | | | | | | | | |
| EB US 101 Mainline | Basic | 26 | D | 27 | D | 27 | D | 26 | D |
| EB US 101 Mud Bay Off-Ramp | Diverge | 30 | D | 29 | D | 28 | D | 29 | D |
| EB US 101 Mainline | Basic | 27 | D | 24 | C | 23 | C | 23 | C |
| EB US 101 Mud Bay On-Ramp | Merge | 29 | D | 15 | B | 15 | B | 15 | B |
| EB US 101 Mainline | Basic | 124 | F | 26 | D | 25 | C | 25 | C |
| EB US 101 Evergreen Off-Ramp | Diverge | NA | NA | NA | NA | 27 | C | NA | NA |
| EB US 101 Mainline | Basic | NA | NA | NA | NA | 24 | C | NA | NA |
| EB US 101 Evergreen On-Ramp | Merge | 133 | F | 26 | C | 49 | F | 20 | C |
| EB US 101 Mainline | Basic | 137 | F | 38 | E | NA | NA | 20 | C |
| EB US 101 Kaiser On-Ramp | Merge | NA | NA | NA | NA | NA | NA | 15 | B |
| EB US 101 Black Lake Off-Ramp/ Kaiser On-Black Lake Off Weave* | Diverge/ Weave | 131 | F | 37 | E | 37 | E | 26 | C |
| EB US 101 Mainline | Basic | 17 | B | 24 | C | 28 | D | 28 | D |
| EB US 101 Black Lake On-Ramp | Merge | 15 | B | 24 | C | 21 | C | 21 | C |
| EB US 101 Mainline | Basic | 20 | C | 35 | D | 30 | D | 29 | D |
| EB US 101 Crosby Blvd Off-Ramp | Diverge | 19 | B | 31 | D | 29 | D | 29 | D |
| EB US 101 Mainline | Basic | 19 | C | 27 | D | 29 | D | 32 | D |
| EB US 101 Crosby Blvd On-Ramp | Merge | 19 | B | 39 | E | 48 | F | 58 | F |
| EB US 101 Mainline | Basic | 32 | D | 58 | F | 62 | F | 65 | F |
| *Eastbound US 101 Average* | | **52** | | **31** | | **31** | | **29** | |
| ***Northbound I-5*** | | | | | | | | | |
| NB I-5 Mainline | Basic | 33 | D | 33 | D | 34 | D | 33 | D |
| NB I-5 US 101 Off-Ramp | Diverge | 41 | E | 44 | E | 46 | F | 43 | E |
| NB I-5 Mainline | Basic | 29 | D | 29 | D | 29 | D | 29 | D |
| NB I-5 US 101 On-Ramp | Merge | 81 | F | 117 | F | 115 | F | 117 | F |
| NB I-5 Mainline | Basic | 38 | E | 40 | E | 40 | E | 40 | E |
| NB I-5 Plum/14th Off-Ramp | Diverge | 32 | D | 33 | D | 33 | D | 34 | D |
| NB I-5 Mainline | Basic | 30 | D | 31 | D | 31 | D | 32 | D |
| *Northbound I-5 Average* | | **40** | | **47** | | **47** | | **47** | |
| ***Southbound I-5*** | | | | | | | | | |
| SB I-5 Mainline | Basic | 81 | F | 78 | F | 79 | F | 78 | F |
| SB I-5 US 101 Weave | Weave | 57 | F | 56 | F | 57 | F | 56 | F |
| SB I-5 Mainline | Basic | 24 | C | 24 | C | 24 | C | 24 | C |
| SB I-5 Deschutes Pkwy Off-Ramp | Diverge | 21 | C | 21 | C | 21 | C | 21 | C |
| SB I-5 Mainline | Basic | 24 | C | 23 | C | 23 | C | 23 | C |
| SB I-5 US 101 On-Ramp | Merge | 43 | E | 48 | F | 46 | F | 49 | F |
| SB I-5 Mainline | Basic | 34 | D | 35 | E | 35 | D | 35 | E |
| *Southbound I-5 Average* | | **40** | | **41** | | **41** | | **41** | |
| LOS A | | | 0 | | 0 | | 0 | | 0 |
| LOS B | | | 4 | | 1 | | 1 | | 2 |
| LOS C | | | 12 | | 11 | | 13 | | 12 |
| LOS D | | | 12 | | 16 | | 16 | | 17 |
| **Total # of Segments Operating at LOS E** | | | **6** | | **8** | | **4** | | **5** |
| **Total # of Segments Operating at LOS F** | | | **8** | | **6** | | **10** | | **7** |
| **Average of All Densities** | | **42** | | **36** | | **36** | | **35** | |
| **Sum of All Densities** | | **1710** | | **1459** | | **1458** | | **1454** | |

*Diverge segment for Scenario 5. Weave Segment for scenarios 7 and 9

** Diverge segment for Scenarios 5 and 9. Weave segment for Scenario 7

# West Olympia Access Study
# Intersection Level of Service

## 1-Hour Analysis

| | | 2007 Existing Conditions | 2030 No-Build Scenario 1 | 2030 Local System Only w/o SW Connections Scenario 2 | 2030 Local System Only w/ SW Connections Scenario 3 | 2030 Black Lake Interchange w/o SW Connections Scenario 4 | 2030 Black Lake Interchange w/ SW Connections Scenario 5 | 2030 Evergreen Interchange w/o SW Connections Scenario 6 | 2030 Evergreen Interchange w/ SW Connections Scenario 7 | 2030 Hybrid Interchange w/o SW Connections Scenario 8 | 2030 Hybrid Interchange w/ SW Connections Scenario 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection Description** | **Intersection Control[a]** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** |
| Harrison Ave/Division St | Signalized | F (84.7) | F (187.1) | F (84.7) | E (77.9) | F (81.3) | E (76.2) | F (89.4) | E (79.4) | F (82.3) | E (78.6) |
| Black Lake Blvd/Cooper Point Rd | Signalized | F (85.2) | F (199.9) | F (126.9) | F (86.6) | F (114.4) | E (67.7)* | F (120.4) | E (65.1) | F (108.3) | E (63.9) |
| US 101 SPUI (Through/Lefts)/Black Lake Blvd | Signalized | E (63.2) | F (187) | F (140.7) | F (130.8) | E (70.3) | E (72.5) | E (77.9) | F (82.4) | E (75.1) | E (79) |
| Cooper Point Rd/Harrison Ave/Mud Bay Rd | Signalized | D (49.6) | F (110.3) | E (74.2) | E (70) | E (79.6) | E (74.9) | E (75.7) | E (71.3) | E (74.3) | E (73.3) |
| Cooper Point Rd/Capitol Mall Blvd | Signalized | D (38.2) | F (112.8) | E (75) | E (75) | E (77.2) | E (70.8) | E (57.8) | E (69.2) | E (75.4) | E (74.3) |
| Black Lake Blvd/9th Ave/Capital Mall Dr | Signalized | C (32.6) | F (101.2) | F (88.5) | F (100.1) | F (102.8) | E (77.5) | F (101.4) | E (78.1) | E (74.8) | E (75) |
| Cooper Point Rd/Automall Dr/Evergreen Park Dr | Signalized | C (27.6) | F (162.4) | E (71.4) | E (77.4) | E (57.3) | E (71.1) | F (82.5) | F (84.9) | | |
| Cooper Point Rd/Top Foods Entrance | Signalized | C (24.5) | F (85.7) | E (77.9) | E (77.8) | D (42.3) | D (41.5) | D (49.8) | E (67.4) | D (52.9) | D (48.5) |
| US 101 Westbound Ramps (dec. MP)/Crosby Blvd | Signalized | C (21) | E (65.9) | E (64.5) | E (64.8) | F (87) | E (57.5) | E (76.6) | E (58.2) | | |
| US 101 Eastbound Ramps (inc. MP)/Crosby Blvd | Signalized | B (19.3) | F (114.5) | C (33.5) | D (36.9) | E (68.5) | C (33.4) | E (69.4) | C (26.2) | | |
| Crosby Blvd/Mottman Rd | Signalized | B (18.8) | E (64.4) | D (38.8) | D (38.6) | D (38.7) | C (29.1) | D (42.6) | C (24.9) | | |
| Crosby Blvd/Irving St | Signalized | B (13.9) | C (24.7) | D (39.3) | D (39.2) | C (21.7) | C (26.8) | C (25.7) | C (20.5) | | |
| Harrison Ave/Kenyon St | Signalized | B (12.4) | C (20.7) | C (20.5) | C (20.4) | C (20.8) | C (20.4) | C (20.9) | C (20.5) | | |
| Black Lake Blvd/Capital Mall Entrance | Signalized | B (10.4) | B (12.3) | B (12.3) | B (10.6) | B (12.3) | B (11.1) | B (12.2) | B (10.7) | | |
| Harrison Ave/Yauger Wy | Signalized | A (8.6) | C (20.7) | C (25.9) | C (24.7) | C (32.4) | C (28.7) | C (26.8) | C (28.3) | | |
| US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd | Signalized | A (8) | A (6.4) | B (10) | A (9.1) | A (7.9) | A (6.2) | A (8.2) | A (6.7) | | |
| US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd | Signalized | A (2.7) | A (7.3) | A (3.2) | A (3.4) | A (3.2) | A (3.5) | A (4.2) | A (2.8) | | |
| Harrison Ave/McPhee Rd | Unsignalized | F (>200) | C (21.7) | C (21.7) | C (20.9) | D (29.6) | D (28.9) | C (21.3) | C (19) | | |
| Harrison Ave/Kaiser Rd | Unsignalized | F (158.5) | A (8.2) | B (13.2) | B (12.2) | B (10.5) | B (11) | B (11.2) | B (11.4) | B (10.7) | B (13.2) |
| Mud Bay Rd/Evergreen Prkwy Westbound Ramp | Unsignalized | F (>200) | F (>200) | C (30.4) | C (32.5) | C (32.3) | C (34.3) | B (16.6) | C (30.7) | | |
| Mud Bay Rd/Evergreen Prkwy Eastbound Ramp | Unsignalized | F (>200) | F (>200) | B (19.6) | C (20.8) | B (16.7) | B (15.5) | C (22.7) | B (19.2) | | |
| Black Lake Blvd/Top Foods Entrance | Unsignalized | C (22.7) | E (45.8) | E (41.1) | F (55.8) | C (21) | C (23.1) | D (30.1) | D (31.3) | | |
| Lakeridge Dr/Deschutes Prkwy | Unsignalized | C (16.9) | F (>200) | B (14.3) | D (50.3) | B (13.9) | D (43.3) | B (15) | D (41.6) | | |
| Kaiser Rd/7th Ave | Unsignalized | | NA | | | | NA | | NA | D (29.4) | D (29.1) |
| Capital Mall Dr/Yauger Wy | Unsignalized/Signalized | B (13.6) | F (138.4) | D (34) | D (29.6) | B (15.1) | B (15) | D (31.3) | D (29.1) | A (7.6) | B (14) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOS A, B, C** | | **15** | **8** | **11** | **9** | **12** | **13** | **11** | **12** | **2** | **2** |
| **LOS D or E** | | **3** | **3** | **9** | **11** | **8** | **11** | **9** | **10** | **6** | **8** |
| **LOS F** | | **6** | **13** | **4** | **4** | **4** | **0** | **4** | **2** | **2** | **0** |
| **Sum Check** | | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Turn Pockets Added** | | **NA** | **NA** | **9** | **8** | **7** | **5** | **10** | **6** | **5** | **5** |
| **Total Through Lanes Added** | | **NA** | **NA** | **1** | **1** | **0** | **1** | **0** | **1** | **0** | **0** |
| **Total Signals Added** | | **NA** | **NA** | **3** | **3** | **3** | **3** | **3** | **3** | **1** | **1** |
| **Number Failing** | | **7** | **15** | **6** | **6** | **7** | **3** | **7** | **3** | **3** | **1** |

[a] Unsignalized LOS and delay were calculated by HCS+. The LOS and delay for all-way stop-controlled intersections are reported for the intersection as a whole, whereas the LOS and delay for two-way stop-controlled intersections are reported for the worst

[b] The one-hour analysis is based on HCM methodologies and provided the basis for intersection improvements. The two-hour analysis results account for the 2-Hour Adjustment Factor that the City of Olympia uses to define their LOS standards. A "NA" indicate

* Without additional SER turn pocket the LOS (Delay) is - E (78.5)

**NOTE: All scenarios mitigated to acceptable LOS conditions based on the standard one-hour LOS methodology except where improvements are inconsistent with the Olympia Comprehensive Plan**

# West Olympia Access Study
# Intersection Level of Service

## 2-Hour Analysis

| | | 2007 Existing Conditions | 2030 No-Build Scenario 1 | 2030 Local System Only w/o SW Connections Scenario 2 | 2030 Local System Only w/ SW Connections Scenario 3 | 2030 Black Lake Interchange w/o SW Connections Scenario 4 | 2030 Black Lake Interchange w/ SW Connections Scenario 5 | 2030 Evergreen Interchange w/o SW Connections Scenario 6 | 2030 Evergreen Interchange w/ SW Connections Scenario 7 | 2030 Hybrid Interchange w/o SW Connections Scenario 8 | 2030 Hybrid Interchange w/ SW Connections Scenario 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection Description** | **Intersection Control[a]** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** | **LOS (Delay)** |
| Harrison Ave/Division St | Signalized | E (73.4) | F (163.6) | E (76.6) | E (70.1) | E (69.5) | E (66.4) | E (77.4) | E (68.2) | E (80) | E (72.9) |
| Black Lake Blvd/Cooper Point Rd | Signalized | E (74.2) | F (173.5) | F (111) | E (75) | F (100.7) | E (68) | F (104.7) | E (56.8) | F (92.5) | E (58) |
| US 101 SPUI (Through/Lefts)/Black Lake Blvd | Signalized | E (60.1) | F (178.6) | F (134.8) | F (124.3) | E (67.6) | E (70.2) | E (74) | E (77.9) | E (69) | E (79.6) |
| Cooper Point Rd/Harrison Ave/Mud Bay Rd | Signalized | D (45) | F (95.7) | E (65.9) | E (62.9) | E (70.2) | E (66.5) | E (66.8) | E (63.9) | E (65.4) | E (63.8) |
| Cooper Point Rd/Capitol Mall Blvd | Signalized | C (34.9) | F (94.3) | E (62.6) | E (61.6) | E (63.4) | E (59) | D (50.6) | E (59.1) | E (62.4) | E (61.7) |
| Black Lake Blvd/9th Ave/Capital Mall Dr | Signalized | C (31.5) | F (89.3) | E (78.4) | F (87.5) | F (91.9) | E (69.1) | F (90.5) | E (69.4) | E (74.7) | E (67.4) |
| Cooper Point Rd/Automall Dr/Evergreen Park Dr | Signalized | C (25.7) | F (121.4) | E (57.4) | E (60.7) | D (49.3) | E (59.7) | E (67.5) | E (60.5) | | |
| Cooper Point Rd/Top Foods Entrance | Signalized | C (23.1) | E (67.2) | E (67.7) | E (68.6) | D (39.8) | D (38.2) | D (43.5) | E (59.4) | D (41) | D (40) |
| US 101 Westbound Ramps (dec. MP)/Crosby Blvd | Signalized | B (19.9) | D (35.2) | D (38.5) | D (42.3) | D (54.8) | D (38.9) | D (47.6) | C (34.9) | | |
| US 101 Eastbound Ramps (inc. MP)/Crosby Blvd | Signalized | B (18.6) | F (86.3) | C (32.4) | C (33.8) | D (50.6) | C (28.3) | D (48.6) | C (22.6) | | |
| Crosby Blvd/Mottman Rd | Signalized | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | | |
| Crosby Blvd/Irving St | Signalized | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | | |
| Harrison Ave/Kenyon St | Signalized | B (12.2) | B (19.7) | B (19.7) | B (19.5) | B (19.7) | B (19.5) | B (19.9) | B (19.6) | | |
| Black Lake Blvd/Capital Mall Entrance | Signalized | B (10) | B (11.6) | B (11.6) | B (10.2) | B (11.6) | B (10.6) | B (11.7) | B (10.2) | | |
| Harrison Ave/Yauger Wy | Signalized | A (8.4) | B (19.1) | C (22.9) | C (22.1) | C (28.9) | C (24) | C (24.1) | C (24) | | |
| US 101 SPUI Westbound US 101 (dec. MP) Off-Ramp Right Turns/Black Lake Blvd | Signalized | A (7.8) | A (6.2) | A (9.6) | A (8.8) | A (7.8) | A (6.2) | A (8.1) | A (6.5) | | |
| US 101 SPUI Eastbound US 101 (inc. MP) Off-Ramp Right Turns/Black Lake Blvd | Signalized | A (2.7) | A (7.1) | A (3.2) | A (3.4) | A (3.2) | A (3.4) | A (3.9) | A (2.7) | | |
| Harrison Ave/McPhee Rd | Unsignalized | F (165.7) | C (20.3) | C (20.3) | C (19.6) | D (26.6) | D (25.9) | C (20) | C (18) | | |
| Harrison Ave/Kaiser Rd | Unsignalized | F (104.6) | A (7.7) | B (11.5) | B (10.5) | A (9.6) | A (9.3) | B (11.5) | B (10.4) | B (11.4) | B (11.5) |
| Mud Bay Rd/Evergreen Prkwy Westbound Ramp | Unsignalized | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | | |
| Mud Bay Rd/Evergreen Prkwy Eastbound Ramp | Unsignalized | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | NA (NA) | | |
| Black Lake Blvd/Top Foods Entrance | Unsignalized | C (20.1) | D (32.8) | D (31.1) | E (38.3) | C (18) | C (19.5) | C (23.8) | C (24.9) | | |
| Lakeridge Dr/Deschutes Prkwy | Unsignalized | B (14.2) | F (>200) | B (11.4) | C (25.5) | B (11.5) | C (23.5) | B (11.5) | C (22.9) | | |
| Kaiser Rd/7th Ave | Unsignalized | | | | | | | | | C (25) | C (24.7) |
| Capital Mall Dr/Yauger Wy | Unsignalized/Signalized | B (11.8) | D (32.7) | C (18.1) | C (17.3) | B (11.2) | A (9) | C (18.8) | C (18.1) | D (33) | D (30.5) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOS A, B, C** | | **16** | **8** | **12** | **12** | **12** | **14** | **13** | **12** | **2** | **2** |
| **LOS D or E** | | **4** | **5** | **10** | **10** | **10** | **10** | **9** | **11** | **7** | **8** |
| **LOS F** | | **4** | **11** | **2** | **2** | **2** | **0** | **2** | **1** | **1** | **0** |
| **Sum Check** | | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** | **ok** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Turn Pockets Added** | | **NA** | **NA** | **9** | **8** | **7** | **5** | **10** | **6** | **5** | **5** |
| **Total Through Lanes Added** | | **NA** | **NA** | **1** | **1** | **0** | **1** | **0** | **1** | **0** | **0** |
| **Total Signals Added** | | **NA** | **NA** | **3** | **3** | **3** | **3** | **3** | **3** | **1** | **1** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Number Failing** | **5** | **12** | **3** | **3** | **3** | **2** | **4** | **3** | **0** | **0** |

[a] Unsignalized LOS and delay were calculated by HCS+. The LOS and delay for all-way stop-controlled intersections are reported for the intersection as a whole, whereas the LOS and delay for two-way stop-controlled intersections are reported for the worst

[b] The one-hour analysis is based on HCM methodologies and provided the basis for intersection improvements. The two-hour analysis results account for the 2-Hour Adjustment Factor that the City of Olympia uses to define their LOS standards. A "NA" indicate

* Without additional SER turn pocket the LOS (Delay) is - E (78.5)

**NOTE: All scenarios mitigated to acceptable LOS conditions based on the standard one-hour LOS methodology except where improvements are inconsistent with the Olympia Comprehensive Plan**