

# WSDOT HOV Feasibility Study I-5: JBLM to S 38th Street

Summary Report | January 2017



Prepared for:



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# Executive Summary

The Washington State Department of Transportation (WSDOT) is planning to widen the I-5 corridor and add lanes (one in each direction) between Mounts Road and Thorne Lane in the JBLM area as part of the *I-5–JBLM Vicinity Congestion Relief Project*. Additionally, WSDOT is extending an HOV lane in each direction on I-5 from 54th Avenue (Fife) to S 38th Street (Tacoma) as part of the *I-5–SR 16 Tacoma/Pierce County HOV Program*. The added lanes through JBLM will be opened as general purpose (GP) lanes, with the ability to convert to HOV lanes in the future. The HOV lane to S 38th Street and the added lanes through JBLM are expected to be opened by 2021. As part of the Connecting Washington legislation, the State Legislature provided funding for WSDOT to conduct this study of the I-5 segment between the JBLM and Tacoma HOV lane expansion projects to assess the feasibility of providing an HOV lane on I-5 between Thorne Lane (M.P. 123.6) and S 38th Street (M.P. 131.9) (see Figure 1). The outcomes of this work can be used by elected officials to determine if further development of any of the identified alternatives should be funded.

## ALTERNATIVES

Three basic alternatives were developed and examined for this study with the common goal of providing an HOV lane on I-5 between Thorne Lane and S 38th Street. This study considered only 24-hour continuous operation concepts. Other studies, by WSDOT and PSRC, are considering time-of-day (e.g. peak period) operation concepts.

### Lane Conversion

This alternative assumed a direct conversion of the inside (left-most) general purpose travel lane to HOV-only use. This would reduce the overall corridor capacity for general purpose traffic,

likely causing increased congestion during the peak travel periods, but would provide for HOV mobility, including transit, at a relatively low cost.

### Practical Design

A variety of practical design strategies to best utilize the existing roadway and right-of-way space were evaluated for the study corridor. The practical design concepts consisted of narrowing widths on the mainline to four-foot inside shoulders, 11-foot travel lanes and 10-foot outside shoulders to accommodate the new HOV lane in each direction. This would require widening of I-5. In some locations where constrained by existing bridges, I-5 shoulder widths of 2 feet are proposed. The following locations would require additional reconstruction since existing widths would be inadequate for additional I-5 lanes:

- » **S Tacoma Way/ Union Street Bridge:** replace with new bridge to accommodate the added mainline width
- » **SR 512:** replace the existing bridge and potentially reconfigure the interchange as a diverging diamond interchange (DDI)
- » **S 56th Street:** replace the existing bridge and potentially reconfigure the interchange as a DDI

### Full Standards

A full standard design includes the addition of an HOV lane with a design to full standards, including 12-foot travel lanes, 10-foot outside shoulders and 10-foot inside shoulders. It includes the recommendations from the Tacoma HOV Program for the corridor section between SR 512 and S 38th Street with every interchange and bridge being reconstructed, some with new interchange configurations.

## RESULTS

Representative alternatives were compared with each other and with a No Build alternative using the following criteria: mobility, safety, perceived stakeholder support and forward compatibility. In addition, “opinion of cost” estimates were developed for each alternative.

The results of the comparison of alternatives are shown in Table S-1. Each alternative was given one of five different qualitative rankings for each criterion as indicated in the following rating scale.



### No Build Alternative

This segment of I-5 currently experiences regular and recurring congestion and unreliable travel times. The currently programmed improvements both north and south of this segment may relieve some congestion resulting from the reduction from four to three lanes at Thorne Lane, and northbound congestion stemming from the heavy SR 16 and I-705 merges. However, these same improvements will add capacity resulting in more northbound traffic into the corridor from the south, and more southbound traffic into the corridor from the north. With the overall growth in traffic expected in Pierce County, including that associated with JBLM, traffic and related safety conditions through this section of I-5 will continue to worsen. The No Build Alternative provides no relief to address these conditions, and no improvement to HOV mobility, including transit.

### Lane Conversion Alternative

While this alternative provides improved HOV mobility, it does so at an impact to general purpose mobility and safety. When compared to all alternatives, including No Build, lane conversion scores the lowest with an estimated 33 percent of the benefits considered possible with the Full Design Standards Alternative, including scoring the lowest on mobility, perceived stakeholder support, and forward compatibility.

### Practical Design Alternative

This alternative scored high or moderately high for all of the criteria. It is expected to provide improved mobility for both HOV and general purpose traffic and improved safety as compared to the No Build. It is expected to be well supported by stakeholders; and is relatively forward compatible with what might be the ultimate configuration for the corridor. In all, it is anticipated to provide up to 85–90 percent of the benefits considered possible with the Full Design Standards Alternative at 16–25 percent of the cost.

### Full Design Standards Alternative

This alternative scores the highest of all the alternatives. It provides improved HOV and general purpose mobility and improved safety. It scores high on forward compatibility because it is likely the ultimate build-out configuration for the corridor. However, it is also the most expensive alternative at four to six times the cost of the practical design alternative.

**Table S-1: Summary Comparison of HOV Lane Alternatives**

Alternative	Evaluation Criteria				Combined Rating	Opinion of Cost (\$M)	Performance Rating Comparison (Relative to Full Standards)	Summary
	Mobility	Safety	Perceived Stakeholder Support	Forward Compatibility				
<b>No Build</b>						0	44%	Traffic conditions through this segment of I-5 will continue to worsen, particularly with the improvements to I-5 on segments both north and south of this segment. Provides no improvement to HOV mobility.
<b>Lane Conversion<sup>1</sup></b>						\$4–\$5	33%	Provides HOV mobility, but scores lower than No Build due to low scores on all criteria, including the lowest on mobility, stakeholder support, and forward compatibility.
<b>Practical Design<sup>2</sup></b>						\$250–\$310	89%	Provides HOV mobility. High ratings across all criteria. Ratings of 89% of full design standards benefits at 16–20% of the cost.
<b>Full Design Standards<sup>3</sup></b>						\$1,250–\$1,560	100%	Provides HOV mobility. Scores the highest of all alternatives, but very high cost.

**NOTES:**

1. Assumes basic lane conversion, without additional mitigating treatments.
2. The representative practical design alternative assumes a four-foot inside shoulder, eleven-foot lanes and a ten-foot outside shoulder through the majority of the corridor. At constrained locations, i.e., overcrossings or undercrossings, the inside and outside shoulder widths may be further reduced, but to never less than two-feet. The following 3 bridges over I-5 would need to be rebuilt: S Tacoma Way/Union Avenue Bridge; SR 512 Bridge (including an interchange reconfiguration, represented in this study as a Diverging Diamond Interchange {DDI}); and the 56th Street Bridge (including reconfiguration of the interchange, represented in this study as a DDI).
3. Assumes full compliance with the WSDOT Design Manual standards, including the improvements identified by Tacoma HOV program from SR 512 interchange to the 38th Street interchange. It also includes bridge replacement at the South Tacoma Way, BNRR, 47th Ave SW, Bridgeport Way, McChord Drive, and Gravelly Lake undercrossings, widening of the Clover Creek overcrossing bridge, modifications to the Bridgeport Way and Gravelly Lake interchanges, and main line I-5 widening—all to full standards.



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# Introduction

The Washington State Department of Transportation (WSDOT) is implementing the addition of a lane to each direction of I-5 between Mounts Road and Thorne Lane (JBLM area) as part of the *I-5–JBLM Vicinity Congestion Relief Project*. Additionally, WSDOT is extending HOV lanes on I-5 from 54th Avenue (Fife) to S 38th Street (Tacoma) as part of the *I-5–SR 16 Tacoma/Pierce County HOV Program*. WSDOT’s core HOV system plan extends south to SR 512, but the portion between S 38th Street and SR 512 is unfunded. The added lanes through the JBLM area are intended to be opened as General Purpose (GP) lanes but would transition to HOV use in the future, once the HOV system is extended to provide continuous HOV service between Tacoma and DuPont. As part of the Connecting Washington legislation, the State Legislature provided funding for WSDOT to conduct this study of the feasibility of providing an HOV lane on I-5 between Thorne Lane (M.P. 123.6) and S 38th Street (M.P. 131.9).



Figure 1: Study Corridor

# Study Process

## ANALYSIS APPROACH

Because lane conversion and full design standards alternatives were largely defined and understood by the study team, the majority of the study effort focused on the practical design alternative for the corridor. A two-tiered evaluation process was used to derive the practical design alternative: an initial screening of possible options, and then a second evaluation of the options surviving the initial screening to select the options that would represent the Practical Design Alternative.

## Baseline Conditions

The study began by defining current and future baseline (no build) conditions in the corridor in terms of current lane configuration and widths, traffic operations and safety. The existing lane configuration of I-5 through the corridor is schematically shown in Figure 2. I-5 consists of four general purpose travel lanes in both directions between Thorne Lane and S 38th Street. At the south end of the study corridor near Thorne Lane, I-5 drops a lane southbound, becoming a three-lane section, and adds a lane northbound, expanding from a three-lane to four-lane section. The reduction in southbound capacity resulting from this lane drop frequently leads to southbound congestion and backups into the study corridor. At the north end of the study corridor, northbound I-5 drops a lane to the S 38th Street/SR 16 collector-distributor (CD) roadway, reducing the mainline section from four lanes to three lanes. In the southbound direction, the S 38th Street/SR 16 CD roadway adds a lane to become a four-lane section until the lane drop near Thorne Lane. Northbound traffic at S 38th Street can be volatile in the peak periods, frequently backing up from congestion caused by the merging of heavy traffic volumes from SR 16 and SR 705 north of the study corridor. Traffic in the southbound direction is also typically congested through the

segment north of the study area (i.e., Fife to SR 16), and begins to operate better south of 38th Street until it slows down again due to the back up from Thorne Lane.

Two projects are currently underway which will affect I-5 both south and north of the study corridor. The “I-5–JBLM Vicinity Congestion Relief Project” south of the corridor will add an additional through lane on I-5 between Mounts Road and Thorne Lane, increasing the cross-section from three to four lanes in both the northbound and southbound directions. North of the study corridor, the “I-5–SR 16 Tacoma/Pierce County HOV Program” is adding an HOV lane in both directions to I-5 between the Fife area and S 38th Street. Figure 3 schematically shows the currently programmed future configuration of the corridor and its end points. Both of these projects will have an effect on travel conditions within the study corridor. The HOV lane alternatives for this study corridor were assessed for compatibility with this future baseline condition.

## Evaluation Criteria

The following evaluation criteria were used to assess the representative HOV corridor alternatives. Results of the initial screening are found in the companion Technical Report for this study.

## Mobility

The overall mobility criterion considers the alternative’s effect on the level of congestion in the corridor, and the associated speed and reliability for both general purpose and HOV traffic. The measure was assessed by identifying existing (year 2016) speeds, congestion and volumes in the corridor, and assessing how these parameters would likely change with a given alternative.

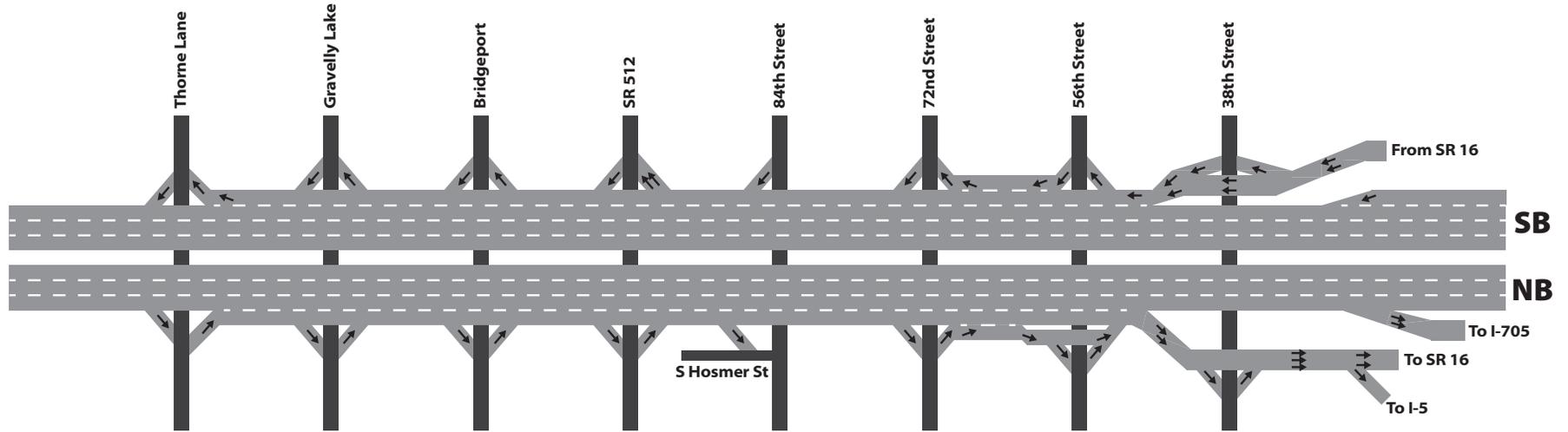


Figure 2: Existing I-5 Lane Configuration

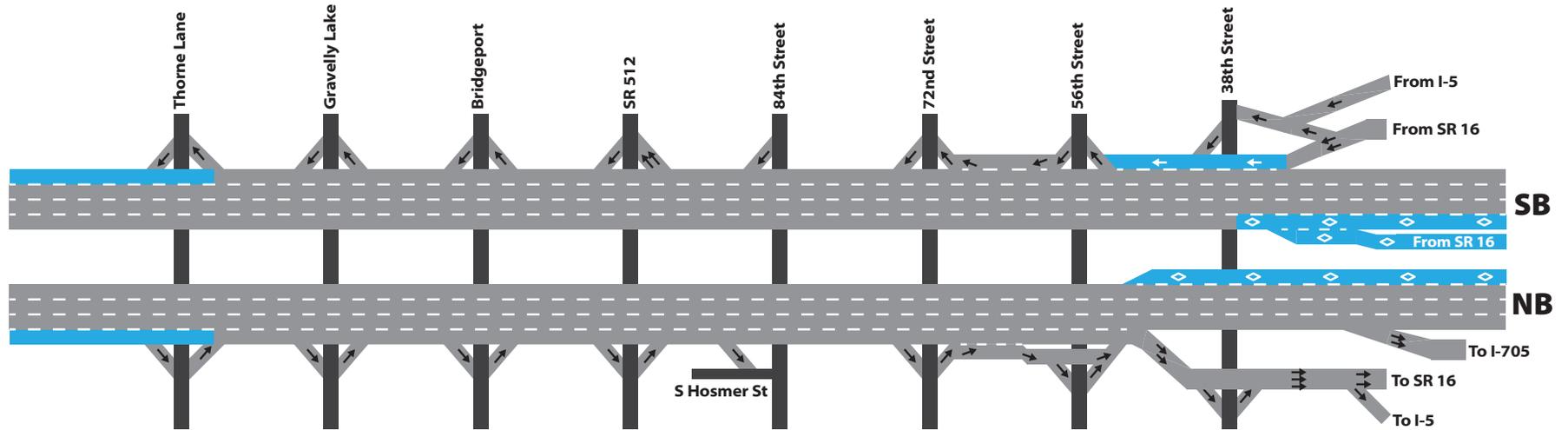


Figure 3: Future Baseline I-5 Lane Configuration

## Safety

An assessment of safety for the HOV implementation was conducted at two levels—an initial qualitative review of potential risks associated with the proposed elements of a practical design option for HOV implementation, and a more detailed, quantitative crash prediction modeling of the freeway corridor for evaluating the practical design alternatives. A simplistic model of the freeway, varying lane widths, shoulder widths, daily traffic volumes and freeway configurations was developed applying the AASHTO Highway Safety Manual Interactive Highway Safety Design Model (IHSDM). This model was used to evaluate the range of options for HOV lane implementation.

## Perceived Stakeholder Support

Support for an alternative by relevant stakeholders is critical to its success. This measure included an assessment of the perceived level of support from the traveling public as well as from the jurisdictions and agencies most immediately affected by a given alternative. Due to the high-level nature of this study and its limited scope, direct engagement of the general public was not undertaken; hence, any assessment of general public support is “perceived” support based on experience with similar improvement concepts elsewhere. However, an indication of support from relevant jurisdictions and agencies was gathered through participation by representatives in a Study Stakeholder Team (see Stakeholder Agency Participation section).

## Forward Compatibility

This measure assesses the level to which an alternative is consistent with, or lays the groundwork for, a potential future improvement. In most cases the assumed future improvement was the full design standards alternative. Any improvement that was less compatible with that ranked lower. Additionally, any alternative that had a high amount of “throw-away” portions in order to achieve the desired future improvement also rated lower. Another consideration was the level of difficulty involved in adding an additional lane on the mainline of I-5 in the future. An example would be construction of a new bridge over I-5 that provided enough horizontal clearance to add future lanes without having to rebuild the bridge. This would have a high rating. Additionally, if an alternative already assumes design deviations regarding lane width and shoulder width, then it

would be unlikely that further narrowing of lanes or shoulders in the future could yield an additional lane if needed. It would also not be likely that a high priority would be given to upgrading that alternative to full standards once it is built and in operation. In other words, if it is built and operating and functioning relatively well, it is unlikely that additional funds would be spent to upgrade it to standards when there are likely other more pressing needs. Hence, the rating for these options would be somewhat lower for forward compatibility.

## Costs

Capital cost is a fundamental evaluation measure and is a primary consideration in the assessment of alternatives. For the initial screening of practical design options, a qualitative assessment of capital cost was used to screen practical design options at select interchange locations (see the Technical Report). An opinion of capital cost was subsequently developed for evaluation of the Lane Conversion, Practical Design and Full Design Standards alternatives in consideration of their associated construction costs.

## STAKEHOLDER AGENCY PARTICIPATION

In addition to WSDOT participation, the following agencies were invited to participate in work sessions during the study: Federal Highway Administration (FHWA), City of Lakewood, City of Tacoma, Pierce Transit, Sound Transit, Intercity Transit, and the Puget Sound Regional Council (PSRC). A list of individual participants is included in the appendix of the Technical Report. Three work sessions were conducted throughout the process of the study to review materials and provide input at key junctures. The information gathered and outcomes from these meetings were critical to developing reasonable alternatives.

## Project Team Meetings

Study work sessions were held to gather input at key points of the study. These included the following three meetings in the fall of 2016:

- » October 13—Defining Baseline Conditions and Evaluation Measures
- » October 28—Alternatives Definition Workshop
- » December 12—Evaluation Workshop

# Developing the Practical Design Alternative

The study developed and analyzed three basic alternatives for providing an HOV lane on I-5 between Thorne Lane and S 38th Street, and only addressed configurations that would be in place 24 hours per day. There are strategies being evaluated by others for “time of day” operation (Hard Shoulder Running, peak period HOV restrictions, etc.); however, this study did not include such “time of day” options. The majority of the analysis focused on developing a feasible full-time practical design alternative for the corridor. This section discusses the development of the practical design alternative. A summary description of the alternatives is contained in the next report section.

## PRACTICAL DESIGN OPTIONS

The development of practical design options for this segment of I-5 began with the concept of adding an HOV lane by widening the existing mainline pavement by the minimum amount necessary. Mainline pavement widening, however, would be accomplished with the premise that design deviations or compromises are applied to reduce the cost in a “practical design” manner for adding an HOV lane. The basic corridor section for this practical design assumes a four-foot inside shoulder, 11-foot lanes and a 10-foot outside shoulder as illustrated in Figure 4. A cursory examination of the terrain within the project area and the width of existing right-of-way revealed that mainline pavement widening could be feasibly accomplished within the existing right of way along the majority of the project corridor.

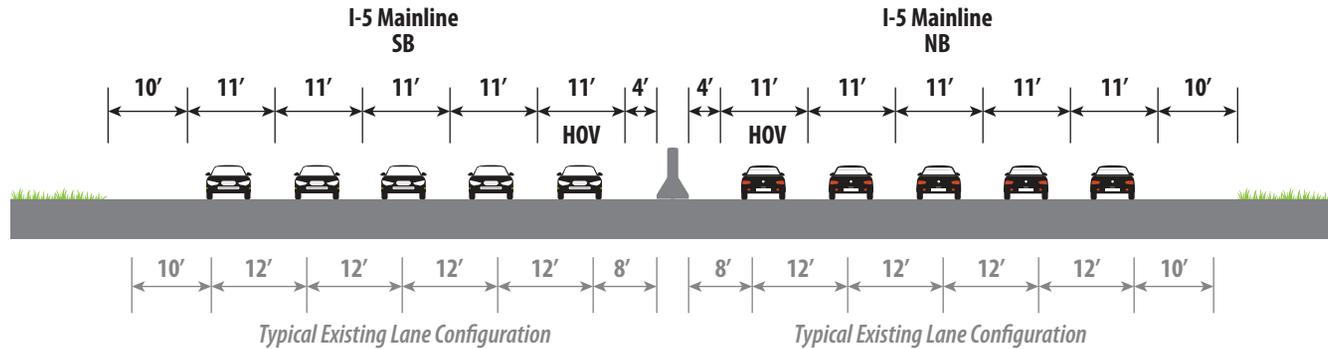
A number of physical constraints to adding HOV lanes were identified, namely bridges. Each of these undercrossing or overcrossing bridges was examined using available plans for the existing structures to determine the available pavement width between columns, barriers and/or abutments. If one of these

## PRACTICAL DESIGN

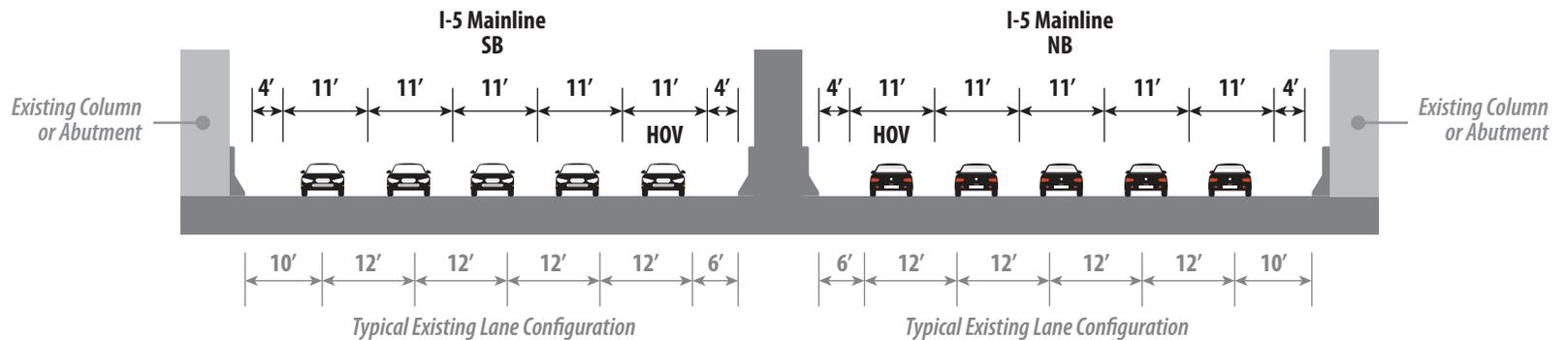
Practical design is an approach to making project decisions that focuses on the specific problem the project intends to address. This performance-based approach looks for lower-cost solutions that meet outcomes that WSDOT, partnering agencies, communities, and stakeholders have identified. Practical design is a fundamental component to the Vision, Mission, Values, Goals, and Reforms identified in Results WSDOT, the department’s Strategic Plan. The primary objectives of the practical design approach are: (1) focusing on project need, and (2) seeking the most reasonable low-cost solution to meet that need.

*Section 1100.01(1)(b),  
WSDOT Design Manual*

## PRACTICAL DESIGN LANE CONFIGURATION — UNCONSTRAINED



## PRACTICAL DESIGN LANE CONFIGURATION — AT BRIDGE (TYPICAL)



**Figure 4: Practical Design Alternative – Typical Cross-Sections\***

\* Note: At some existing bridges that will remain, shoulder widths may be reduced to two feet.

alternatives is selected for further development, a field survey at each bridge location is needed to confirm available widths which could ultimately produce different results, including the possible need to replace more structures than indicated by this study. The review of plans for the existing structures found that if a further width reduction to two-foot inside and outside shoulders were acceptable for short distances<sup>1</sup> (e.g., through an undercrossing), then the majority of the corridor can accommodate an additional lane. The investigation also yielded the following three undercrossing locations that, even with further lane and shoulder width reductions, cannot accommodate the additional HOV lane within the mainline cross section: S Tacoma Way (Union Avenue), SR 512, and S 56th Street. Table 1 highlights those bridges that can accommodate the additional HOV lane by shoulder and lane width reductions and those that cannot and would require a different approach for HOV lane implementation.

Due to I-5 width constraints at S Tacoma Way, the practical design solution proposed is to reconstruct the bridge over I-5. Possible solutions were brainstormed for the SR 512 and S 56th Street interchange constraints. The list of initial options included:

1. replacing the existing bridge along with possible modifications to the existing interchange, and
2. retaining the existing bridge but modifying the interchange to allow the addition of a mainline lane on the collector-distributor (CD) ramp or by creating a multi-lane CD ramp from the 72nd Street interchange to SR 705.

## EVALUATION OF PRACTICAL DESIGN OPTIONS

An initial screening of all of the practical design options was conducted to identify and retain only those options with the highest level of feasibility. A second evaluation of the remaining practical design options was then conducted to further investigate the merits of each and identify those that would compose the final representative alternative. The details of the screening and evaluation are contained in the Technical Report. The results of the second-level assessment process is the representative practical design alternative described below.

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<sup>1</sup> This was deemed acceptable based on input received from both FHWA and WSDOT representatives in the study stakeholder meetings.

**Table 1: Practical Design Options at Constrained Locations**

Location	Reduce lane & shoulder widths <sup>2</sup>	Replace bridge	Retain Bridge/ 4th GP lane on CD	Retain loop ramps	Modify loop ramps*	Convert to other interchange configuration
<b>SOUTH SEGMENT</b>						
Gravelly Lake Drive Bridge	X					
McChord Drive SW Bridge	X					
Clover Creek Bridge	X					
Bridgeport Way	X					
47th Ave SW Bridge	X					
BNSF Bridge	X					
S Tacoma Way Bridge		X				
SR 512 Bridge						
Option 1		X		X		
Option 2		X				X
Option 3 (*remove NE loop) – GP lane on CD			X		X	
Option 4 (*remove SE loop) – GP lane on CD			X		X	
Option 5			X			X
<b>NORTH SEGMENT</b>						
96th Street S Bridge	X					
84th Street S Bridge	X					
S 72nd Street Bridge	X					
S 56th Street Bridge						
Option 1		X		X		
Option 2		X				X
Option 3 (*remove NE & SW loops)			X		X	
Option 4			X			X
S 48th Street Bridge	X					

**The following CD alternative is a part of the above "56th Street Option 3" or "56th Street Option 4"**

**Collector-Distributor NB: 72nd–SR 705**

SR 16/56th/38th/SR 705 traffic exits to 2-3 lane CD north of 72nd. 72nd on-ramp braids with CD off-ramp. Convert inside mainline lane to HOV for 3+1 configuration.

**Collector-Distributor SB: SR 16–72nd**

CD begins as 1-lane with 38th St off traffic, collecting SR 16 on- and 56th on- traffic before joining ML north of 72nd St off-ramp. 56th off- traffic weaves across the CD to exit. Inside mainline lane converted to HOV for 3+1 configuration through 56th Street Bridge. ML is 4+1 configuration south of where CD joins.

<sup>2</sup> All of the bridges marked in this column except S 48th Street currently do not meet the 16 foot minimum vertical clearance for existing bridges. This would remain so with any associated practical design solution, which would require a design deviation to implement.

# Representative Alternatives

The study developed and analyzed three basic alternatives for providing an HOV lane on I-5 between Thorne Lane and S 38th Street, addressing configurations that would be in place 24 hours per day. As noted earlier, this study did not include “time of day” options. A summary description of each alternative follows.

## LANE CONVERSION

This alternative assumed a straight conversion of the inside general purpose travel lane to HOV-only use by applying pavement markings and signing. This would reduce the overall corridor capacity for general purpose traffic, likely causing increased congestion during the peak travel periods. It was acknowledged during the course of the study that other strategies could be combined with this option to mitigate its impacts to general purpose traffic and enhance its performance. Allowing shoulder use as a travel lane during the peak traffic periods to replace the general purpose capacity could mitigate the primary impacts. Additionally, active traffic management (ATM) strategies including variable speed limits and queue warning capabilities to address increased congested conditions could be considered. These mitigation strategies require construction of improvements and thus come at a cost. Because these additional treatments are also typically used as part of practical design solutions a decision was made to keep the Lane Conversion alternative as a straightforward conversion without added treatments, to illustrate one extreme of the possible HOV implementation techniques.

## PRACTICAL DESIGN

After a two-tiered screening and evaluation process, select modifications were chosen as the most feasible “representative” practical design elements that, when combined, comprised

the Practical Design Alternative for the corridor as shown in Figure 5. The basic corridor section of practical design assumes a four-foot inside shoulder, 11-foot lanes and a 10-foot outside shoulder as previously illustrated in Figure 4. At a number of physical constraints, namely bridges, further width reduction to two-foot inside and outside shoulders for short distances would be implemented. Even with these more reduced shoulder widths, three locations cannot accommodate the additional lanes within the mainline cross section: the S Tacoma Way (Union Avenue) Bridge, the SR 512 Bridge and the S 56th Street Bridge. At these three locations, the Practical Design Alternative assumes the following:

- » **S Tacoma Way Bridge:** replace with new bridge to accommodate the added mainline width
- » **SR 512:** replace the existing bridge and potentially reconfigure the interchange. While this study was not tasked to define interchange configurations, if the SR 512 Bridge were replaced, it would be an appropriate time to consider reconfiguring the interchange. This study assumed interchange reconfiguration as a Diverging Diamond Interchange (DDI) (see Figure 6). If work is advanced on the corridor, an Interchange Justification Report would be needed to evaluate and determine an appropriate interchange configuration.
- » **S 56th Street:** replace the existing bridge and potentially reconfigure the interchange. Potential interchange configurations could include either a DDI or a single point urban interchange (part of the original HOV system plan recommendation). If work is advanced on the corridor, an Interchange Justification Report would be needed to evaluate and determine an appropriate interchange configuration. A DDI has been illustrated in Figure 7.



Figure 5: Practical Design Alternative Components

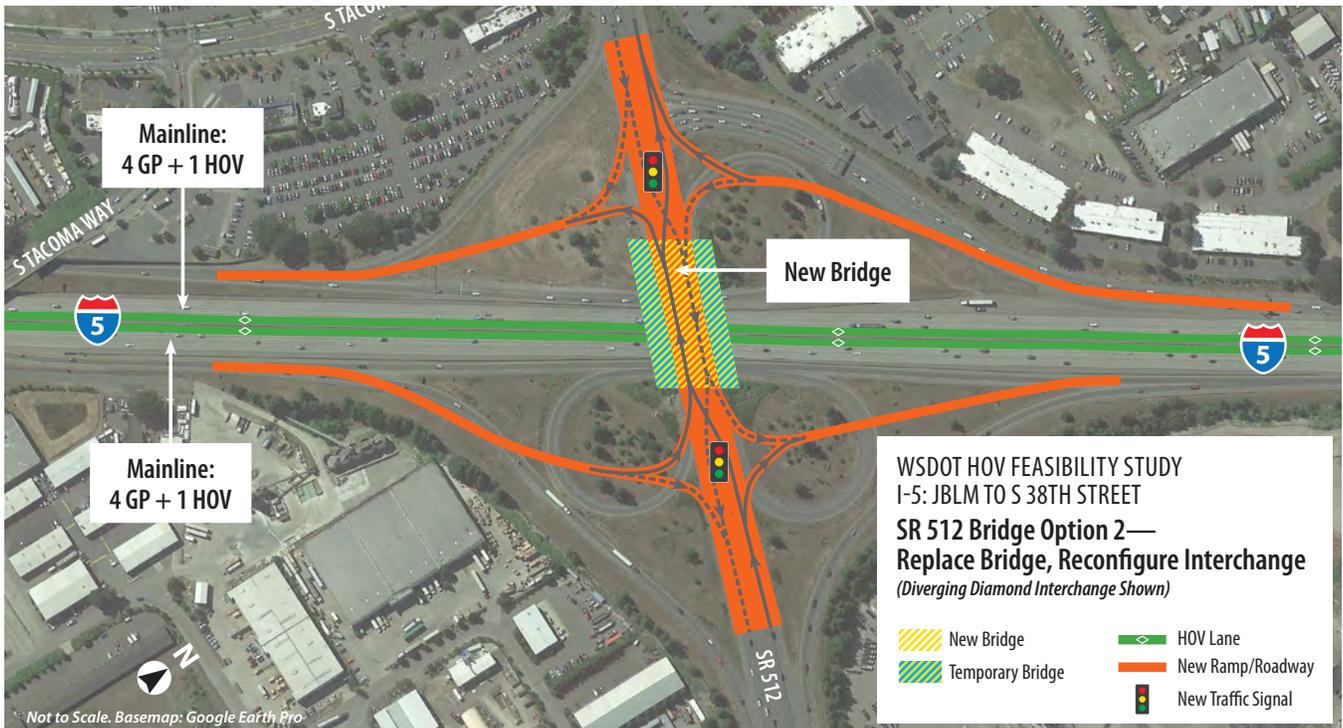


Figure 6: Practical Design Alternative – SR 512 Interchange

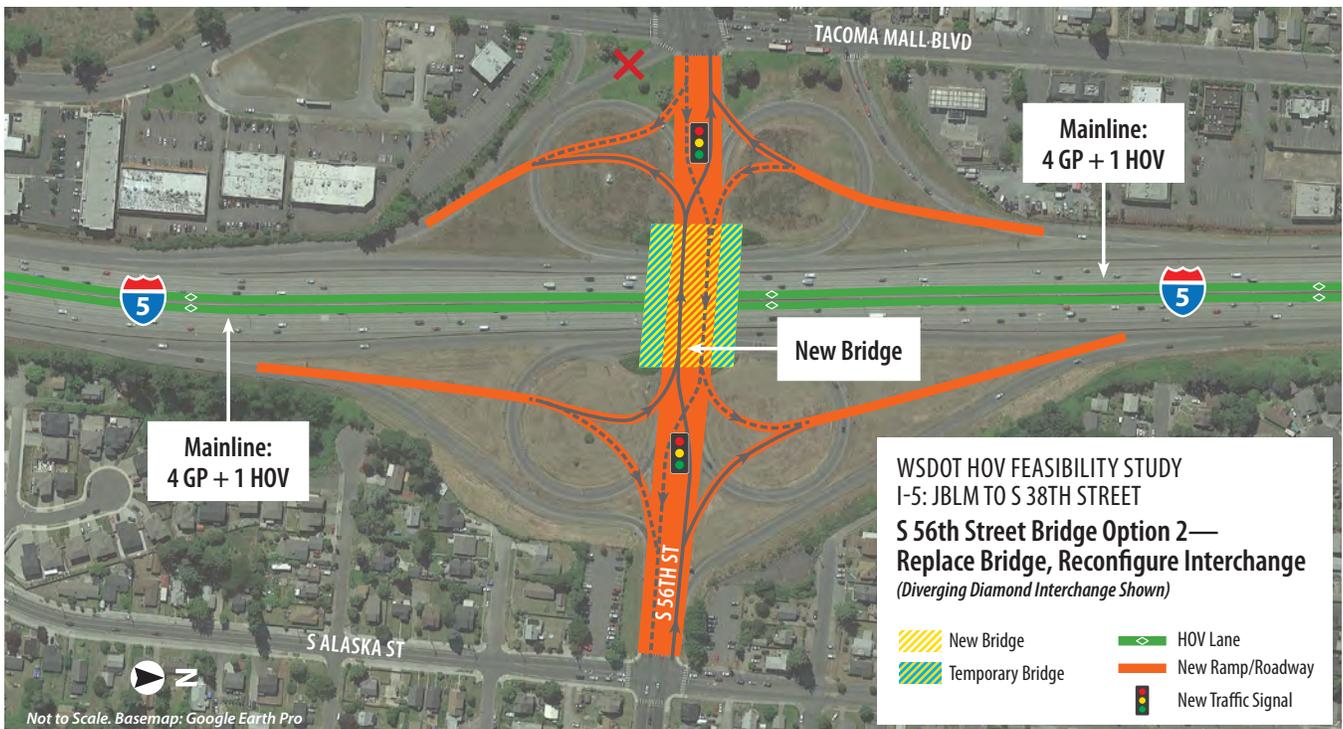


Figure 7: Practical Design Alternative – S 56th Street Interchange

## FULL DESIGN STANDARDS

As its name implies, this alternative assumes the addition of an HOV lane through the study corridor with a design to full standards, including 12-foot travel lanes, 10-foot outside shoulders and ten-foot inside shoulders. It includes the recommendations from the Tacoma HOV Program for the corridor section between SR 512 and S 38th Street with every interchange and bridge being reconstructed, some with new interchange configurations. Between Thorne Lane and SR 512, all undercrossing structures were assumed to be replaced and the Clover Creek overcrossing widened to accommodate the wider main line. For the purposes of this study, the Bridgeport Way interchange was assumed to be modified to a diverging diamond interchange while the Gravelly Lake interchange was assumed to be modified but remain a tight diamond.

# Study Results

Once the representative alternatives were defined, they were compared with each other and with the No Build alternative across multiple criteria in order to provide each alternative's merits and trade-offs. Note that it is not the intent of this study to make a recommendation as to which alternative would be most feasible for implementing HOV lanes in this corridor, but rather to show how the alternatives compare and what the primary trade-offs associated with each would likely be. The comparison criteria consisted of the following: mobility, safety, perceived stakeholder support and forward compatibility. In addition, "opinion of cost" estimates were developed for each alternative.

The results of the comparison of alternatives are shown in Table 2. Each alternative was given one of five different rankings for each criterion as indicated in the following rating scale.



A brief discussion of how the different alternatives were rated by each criterion follows.

## MOBILITY

The overall mobility criterion considers the alternative's effect on the level of congestion in the corridor, and the associated speed and reliability for both general purpose and HOV traffic.

The corridor currently experiences peak period congestion on a regular basis, and travel can frequently be unreliable through this segment. The No Build Alternative would not address these issues, and travel conditions would be expected to worsen as traffic through the corridor grows. Additionally, without the addition of an HOV lane, HOV traffic would experience the same levels of congestion as general purpose traffic. Based on this, the No Build Alternative was given a relatively low ranking of "○" for mobility.

The Lane Conversion Alternative would reduce the general purpose capacity of the corridor from four to three lanes, which would result in better conditions for HOV traffic, but would likely create more congestion for general traffic. For this reason, and despite the benefits for HOV traffic, the Lane Conversion Alternative is considered to be worse than the No Build Alternative for mobility and was given a ranking of "○".

The Practical Design Alternative would add an HOV lane through the study corridor and hence increase the overall capacity of the corridor. This would provide benefits for both general purpose as well as HOV traffic. This is estimated to be a significant benefit over No Build conditions, and hence this alternative is given a ranking of "●" for mobility.

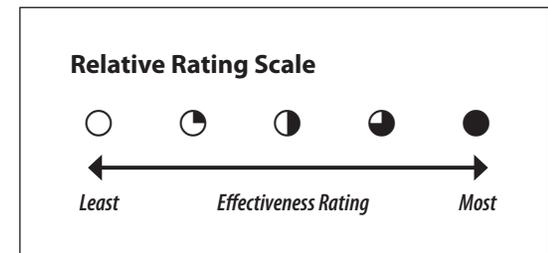
The Full Design Standards Alternative would provide the same added capacity for both general purpose and HOV traffic as the Practical Design Alternative, but with full design standards. Because of this, it would likely result in a slightly higher quality of travel and level of comfort for the traveling public. Additionally, this alternative assumes significant reconfiguration of multiple interchanges through the corridor which would improve traffic flow to and from I-5. Because of this, the Full Design Standards Alternative is given a ranking of "●" for mobility.

**Table 2: Summary Comparison of HOV Lane Alternatives**

Alternative	Evaluation Criteria				Combined Rating	Opinion of Cost (\$M)	Performance Rating Comparison (Relative to Full Standards)	Summary
	Mobility	Safety	Perceived Stakeholder Support	Forward Compatibility				
<b>No Build</b>						0	44%	Traffic conditions through this segment of I-5 will continue to worsen, particularly with the improvements to I-5 on segments both north and south of this segment. Provides no improvement to HOV mobility.
<b>Lane Conversion<sup>1</sup></b>						\$4–\$5	33%	Provides HOV mobility, but scores lower than No Build due to low scores on all criteria, including the lowest on mobility, stakeholder support, and forward compatibility.
<b>Practical Design<sup>2</sup></b>						\$250–\$310	89%	Provides HOV mobility. High ratings across all criteria. Ratings of 89% of full design standards benefits at 16–20% of the cost.
<b>Full Design Standards<sup>3</sup></b>						\$1,250–\$1,560	100%	Provides HOV mobility. Scores the highest of all alternatives, but very high cost.

**NOTES:**

1. Assumes basic lane conversion, without additional mitigating treatments.
2. The representative practical design alternative assumes a four-foot inside shoulder, eleven-foot lanes and a ten-foot outside shoulder through the majority of the corridor. At constrained locations, i.e., overcrossings or undercrossings, the inside and outside shoulder widths may be further reduced, but to never less than two-feet. The following 3 bridges over I-5 would need to be rebuilt: S Tacoma Way/Union Avenue Bridge; SR 512 Bridge (including an interchange reconfiguration, represented in this study as a Diverging Diamond Interchange {DDI}); and the 56th Street Bridge (including reconfiguration of the interchange, represented in this study as a DDI).
3. Assumes full compliance with the WSDOT Design Manual standards, including the improvements identified by Tacoma HOV program from SR 512 interchange to the 38th Street interchange. It also includes bridge replacement at the South Tacoma Way, BNRR, 47th Ave SW, Bridgeport Way, McChord Drive, and Gravelly Lake undercrossings, widening of the Clover Creek overcrossing bridge, modifications to the Bridgeport Way and Gravelly Lake interchanges, and main line I-5 widening—all to full standards.



## SAFETY

Safety is a measure of the potential increase or decrease in collisions on the main line in the corridor based on technical forecasting and professional judgment. Safety for each alternative was assessed using the AASHTO Highway Safety Manual crash prediction model for the I-5 corridor (IHSDM), with comparison to the No Build alternative. This modeling tool is sensitive to traffic volumes and the geometrics of the roadway segment, (specifically lateral offset).

The No Build alternative was given a ranking of “●” for safety, and the other alternatives are subsequently compared to No Build.

The Lane Conversion Alternative is given a ranking of “●” because with increased congestion and more traffic per general purpose lane than the No Build, safety is expected to worsen in the corridor.

The Practical Design Alternative is expected to improve safety in the corridor by adding one travel lane thereby reducing congestion and reducing the predicted crashes per general purpose lane. The interchange improvements at SR 512 and S 56th Street also are expected to improve safety, resulting in an overall ranking of “●” for safety.

The Full Design Standards Alternative is expected to improve safety in the corridor by adding one travel lane and full shoulder widths thereby reducing congestion and reducing the predicted crashes per general purpose lane in comparison with the No Build alternative. Additionally, the associated interchange improvements included in this alternative are also expected to improve safety. This alternative is given a safety ranking of “●”.

## PERCEIVED STAKEHOLDER SUPPORT

The level of perceived stakeholder support was assessed based on feedback from local agency staff during study team workshops, as well as experience with the public from implementation of HOV lane projects elsewhere in the state and country.

The No Build Alternative would not address the current and anticipated future traffic issues in the corridor and because of this was given a moderately low ranking of “●”.

Lane conversion experience from other areas around the country shows the potential for a major public backlash resulting from converting a general purpose traffic lane to HOV only use. This is particularly true when it occurs within an already congested corridor, such as I-5 in South Tacoma, resulting in a noticeable increase in congestion in the general purpose lanes. Because of this, the Lane Conversion Alternative is considered to be worse than the No Build Alternative for this criterion and was given a ranking of “○”.

The Practical Design Alternative adds an HOV lane through the study corridor and increases the overall capacity of the corridor. Because this provides benefits for both general purpose and HOV traffic, it is considered a significant improvement and is given a ranking of “●”.

The Full Design Standards Alternative provides the same added capacity for both general purpose and HOV traffic as the Practical Design Alternative does at higher design standards. It also provides significant improvements to multiple interchanges through the corridor which would improve traffic flow to and from I-5. The cumulative benefits are likely higher than any other alternative; however, because of its extremely high cost, this alternative is less likely to be funded and built. Because of this, the Full Design Standards Alternative is given a ranking of “●” for perceived stakeholder support.

## FORWARD COMPATIBILITY

This criterion assesses the level to which an alternative is consistent with, or lays the groundwork for, an assumed desired future improvement—which in most cases is assumed to be the full design standards alternative. The No-Build Alternative was given a low ranking of “○” for forward compatibility because it does nothing to lay the groundwork for this future improvement.

The Lane Conversion Alternative was given a similarly low ranking of “○” because it also does not provide any foundation for the ultimate future improvement.

The Practical Design Alternative adds many elements of the full design standards alternative, most notably an HOV lane through the corridor. However, it does not reconfigure some corridor interchanges, and in the case of the SR 512 interchange could include a configuration that may need replacing if the ultimate plan from the Tacoma HOV Program were to be implemented. However, if the proposed practical design improvement at SR 512 proves to be functional, then the ultimate improvement may not be desirable due to its extremely high cost. For this reason, the Practical Design Alternative is given a relatively high ranking of “●” for forward compatibility.

The Full Design Standards Alternative is given a ranking of “●” for forward compatibility because it reflects an ultimate build-out alternative for the corridor.

## OPINION OF COST

The Opinion of Cost category is not a criterion used to assess performance of the alternatives, but is provided as a major piece of information associated with each alternative. In addition to expected performance, potential cost of implementation would be a major criterion for selecting an alternative to advance through further development. Opinions of Cost for the concept alternatives are given as a range to avoid implying a certain level of precision in developing these costs and are also meant to reflect, in the case of practical design, that a range of options may be considered if this alternative is selected for implementation.

The opinion of cost for the lane conversion alternative, \$4–\$5 million (M), reflects the simple concept of restriping an existing GP lane for HOV traffic and providing additional fixed signing associated with HOV restrictions. Additional congestion and traffic safety mitigation elements such as Active Traffic Management Systems (ATMS) were not included here but may be worth considering if this alternative is selected to advance for further study.

The opinion of cost for the practical design alternative of \$250M to \$310M reflects the practical design options that include reconstruction of the I-5 bridges at SR 512 and S 56th Street as well as at South Tacoma Way (Union Avenue). The cost also includes reconfiguration of the SR 512 and S 56th Street interchanges, reconstruction of the inside main line shoulders, pavement widening to provide an HOV lane and 10-foot outside shoulders, restriping, and HOV restriction signing.

The full standard alternative opinion of cost includes the Tacoma HOV unfunded programmatic cost and the proportional capital cost of rebuilding the undercrossing structures between Thorne Lane and SR 512. The \$1.25 billion (B) to \$1.56B range of costs also includes interchange revisions at Gravelly Lake Drive and Bridgeport Way and reconstruction of the main line pavement to account for an additional lane and full-design shoulder and lane widths.

## COMBINED RATING

A simple “combined rating” was calculated by taking the average of the rankings across all four criteria, as a way to assess the overall performance of each alternative. The Full Design Standards Alternative received the highest combined rating of “●” and the Practical Design Alternative received a moderately high rating of “●”. The No Build received a moderately low rating of “●”, and the Lane Conversion Alternative received the lowest rating at “○”.

## PERFORMANCE RATING PERCENTAGE COMPARISON

Another way to assess the overall performance of the alternatives is to compare the cumulative combined rating score for each to the rating of the Full Design Standards Alternative in terms of “percentage of benefits”. The Full Design Standards Alternative, by definition, receives a 100%. The Practical Design Alternative is estimated at 89% of the Full Design Standards Alternative benefits, while the No Build is estimated at 44% and the Lane Conversion Alternative at 33%.

## SUMMARY CONCLUSIONS

This high level assessment of three representative build alternatives for implementing a 24-hour HOV lane through the I-5 corridor between Thorne Lane and S 38th Street has revealed the following findings:

### No Build Alternative

Both general purpose and HOV traffic in this segment of I-5 currently experience congestion and unreliable travel times. The currently programmed improvements to segments both north and south of this segment may relieve some current issues such as southbound back-ups resulting from the reduction from four to three lanes at Thorne Lane, and northbound congestion stemming from the heavy SR 16 and I-705 merges. However, these same improvements will also accommodate more northbound traffic into the corridor from the south, and more southbound traffic into the corridor from the north due to the resulting increase in capacity from those improvements. With the overall growth in traffic expected in Pierce County, including that associated with JBLM, traffic and related safety conditions through this section of I-5 are expected to worsen. The No Build Alternative provides no relief to address these conditions, nor improvement to HOV mobility.

### Lane Conversion Alternative

While this alternative provides improved HOV mobility, it would impact general purpose mobility and safety. When compared to all alternatives, including No Build, lane conversion scores the lowest with an estimated 33 percent of the benefits associated with the Full Design Standards Alternative, including scoring the lowest on mobility, perceived stakeholder support, and forward compatibility. Some strategies to alleviate the impacts of this alternative were identified and discussed during this study, but were beyond the scope of this study to pursue further. If a lane conversion option were to warrant further consideration, then complementary active traffic management treatments (such as variable speed limits, queue warning, and hard shoulder running during the peak periods) and enhanced incident management programs should also be considered.

### Practical Design Alternative

This alternative scored high or moderately high for all of the criteria. It is expected to provide improved mobility for both HOV and general purpose traffic and improved safety as compared to the No Build. It is also expected to be well supported by stakeholders and is relatively forward compatible with what might be the ultimate configuration for the corridor. In all, it is anticipated to provide up to 89 percent of the benefits associated with the Full Design Standards Alternative at 16 to 25 percent of the cost. If this alternative is selected for further development however, a field survey at each bridge location is needed to confirm available widths which could ultimately produce different results, including the possible need to replace more bridges than indicated here.

### Full Design Standards Alternative

This alternative scores the highest of all the alternatives. It provides improved HOV and general purpose mobility and improved safety. It scores high on forward compatibility because it is likely to be the ultimate build-out configuration for the corridor. However, it is estimated to be four to six times more costly than the next most expensive option (Practical Design Alternative), which may make it cost-prohibitive.

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