

I-5 JBLM Vicinity IJR and Environmental Documentation

Phase 1 – Corridor Plan Feasibility Study

January 2014

Washington State Department of Transportation

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I-5 JBLM AREA CORRIDOR PLAN FEASIBILITY STUDY

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ACKNOWLEDGEMENTS

Washington State Department of Transportation and the consultant team wish to thank the many individuals and agencies that participated and provided data and information used in the I-5 JBLM Area Corridor Plan Feasibility Study

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Acronyms

AC	Active Component (part of the Camp Murray training mission)
ACP	Access Control Point (military installation gate)
ADT	Average Daily Traffic (volumes)
Amtrak	American Passenger Rail Corporation
BNSF	Burlington Northern Santa Fe (railroad)
BRAC	Base Realignment and Closure Commission
CAC	Collision Analysis Corridor
CAL	Collision Analysis Location
C/D	Collector/Distributor (road)
DOD	Department of Defense
EIS	Environmental Impact Statement
FAZ	Forecast Analysis Zones
FHWA	Federal Highway Administration
GP	General Purpose (travel lane)
GPS	Global Positioning System
HOT	High Occupancy Toll (travel lane)
HOV	High Occupancy Vehicle (travel lane)
IAL	Intersection Analysis Location
I-E	Internal-External Trips
IJR	Interchange Justification Report
INRIX	Private corporation engaged in roadway operational data collection and reporting
IT	Intercity Transit
ITS	Intelligent Transportation Systems
JBLM	Joint Base Lewis McChord
LOS	Level of Service
LTB	Leadership Training Brigade (Western Army National Guard)
MP	Milepost
MVMT	Million Vehicle Miles of Travel
NCHRP	National Cooperative Highway Research Program
NCOE	Noncommissioned Officer Education System
NEPA	National Environmental Policy Act
OCS	Officer Candidate School
PSRC	Puget Sound Regional Council
ROW	Right of Way
SEPA	State Environmental Policy Act
SOV	Single Occupant Vehicle
SR	State Route
SSMCP	South Sound Military and Communities Partnership
TASS	Total Army School System
TAZ	Transportation Analysis Zone
TDM	Transportation Demand Management
TIGER III	Transportation Investment Generating Economic Recovery (federal grant-funding program, third series)
TRB	Transportation Research Board
TRPC	Thurston Regional Planning Council
USAR	United States Army Reserve
WSDOT	Washington State Department of Transportation

Glossary

Auxiliary Lane: Can improve safety and reduce congestion by accommodating cars and trucks entering or exiting the highway or traveling short distances between adjacent interchanges, and reduce conflicting weaving and merging movements.

Average Daily Traffic (ADT): The average number of vehicles passing a certain point on a highway, road, or street each day.

Cloverleaf Interchange: A two-level interchange where left turns are handled by physically-separated, free-flowing ramps. When viewed from the air this interchanges resemble a four-leaf clover.

Collector-distributor (CD): A roadway that typically parallels a higher capacity and/or limited access roadway. A CD road is designed to accommodate weaving and merging activity separately from the mainline of the higher capacity road and to reduce the number of mainline entrances and exits.

Diamond Interchange: The simplest and perhaps most common type of interchange. This type of interchange has two on-ramps and two off-ramps, and forms the shape of a diamond when viewed from the air.

Diverging Diamond: This recently introduced interchange design reconfigures the flow of traffic to eliminate left and right turn movements, reducing excessive signal phases and increasing the length of the green signal phase for through traffic.

Internal-External Trips: Refers to trips that have one end located in the study area and the other end outside (e.g., Olympia or Tumwater to JBML or DuPont to Tacoma)

Environmental Justice (EJ): Presidential Executive Order that ensures that highway projects do not disproportionately impact one segment of the population, e.g., low-income or minorities.

Environmental justice population: Refers collectively to the low-income and minority populations in a given area.

Latent Demand: Pent up travel desire or demand that goes unsatisfied because there is not sufficient capacity on a roadway to accommodate it.

Level of service (LOS): A qualitative measure of transportation system performance. LOS is most commonly used to describe roadway or intersection performance, but can also be applied to pedestrian, bicycle, transit, or other infrastructure elements. The American Association of State Highway and Transportation Officials defines the following levels of service for highway traffic flows: A= Free flow; B=Reasonably free flow; C=Stable flow; D=Approaching unstable flow; E=Unstable flow; and F=Forced or breakdown flow.

Maintenance area: An area that has a history of not meeting air quality standards for a particular air pollutant, but is now meeting the standards and has a maintenance plan for monitoring levels of that pollutant and ensuring continued conformity to the appropriate standards.

Mode split: The percentage of total travel in a given area by different forms of transportation, typically single-occupant vehicles, high-occupancy vehicles (two or more persons in a car), transit, walk, and bicycle.

Moving Washington: A policy-based framework used in Washington State for making transparent, cost-effective decisions about transportation infrastructure improvements.

National Environmental Policy Act (NEPA): Established in 1969, this act requires public disclosure of all environmental, social, and economic impacts for federally funded projects with significant impacts.

Non-attainment area: An area that fails to meet air quality standards for one or more pollutants.

Particulate matter (PM): A mixture of extremely small particles or liquid droplets suspended in the air.

Peak period: Informally known as "rush hour," this term refers to the time of the day when traffic volumes in an urban area are the highest and when travel patterns generate the most traffic, especially in a peak direction.

Section 4(f): Section 4(f) of the U.S. Department of Transportation Act (49 USC 303) concerns the use of or impacts on any significant public park, recreation area, wildlife or waterfowl refuge, or historic site by a transportation project. Section 4(f) applies to impacts caused by programs and policies undertaken by the USDOT.

Section 6(f): Section 6(f) of the Land and Water Conservation Fund Act is similar to Section 4(f) but concerns only those parks and recreational facilities that have received funding through this act. While Section 4(f) applies only to USDOT actions, Section 6(f) applies to impacts caused by programs and policies of any federal agency.

Single-point urban interchange (SPUI): This interchange configuration reduces the number of signals to one location in the center of an interchange rather than two signals as is common with the diamond configuration. Left turn movements are combined at a single point for more efficiency.

Transportation demand management (TDM): Measures that seek to reduce the number of vehicles using the road system, especially single-occupant vehicles, by providing alternative options to single-occupant auto travel.

Throughput: The number of users being served at any time by the transportation system.

Vehicles Miles of Travel (VMT): The number of miles traveled per vehicle multiplied by the total number of vehicles.

I. Introduction

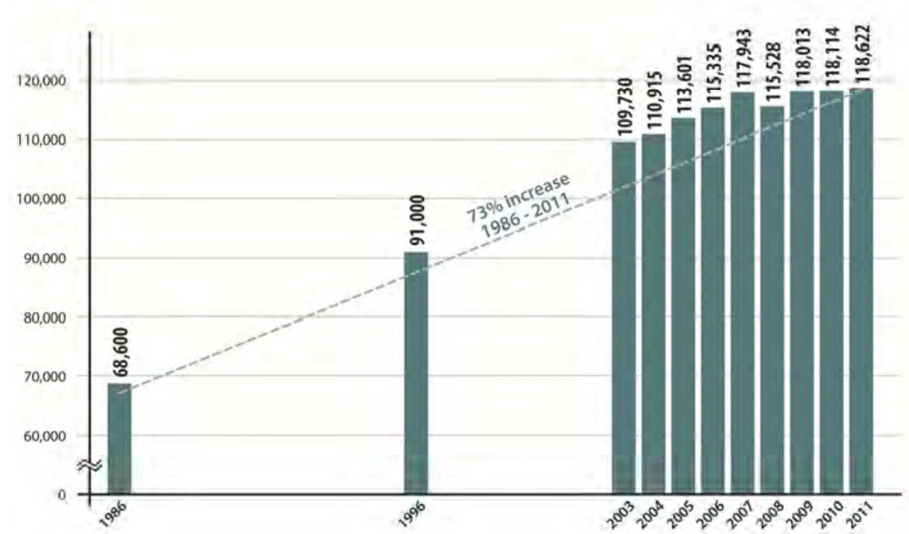
Background

Interstate 5 (I-5) is a national highway of strategic importance as it extends from the US/Mexico Border to the US/Canada border. It is the primary highway for the movement of goods and people traveling north and south on the west coast of the United States. In Washington State, I-5 links key population centers, such as Vancouver, Olympia, Tacoma, Seattle, Everett and Bellingham, as shown in Figure I-1. In the corridor study area, I-5 also serves a function in national defense by providing access to Joint Base Lewis McChord (JBLM).

Figure I-1: Interstate 5 through Washington

Over the past twenty years, traffic has increased along the entire I-5 corridor from Mexico to Canada. Within south Pierce County, traffic increased 73 percent between 1986 and 2011 to approximately 118,000 vehicles per day, as shown in Figure I-2.

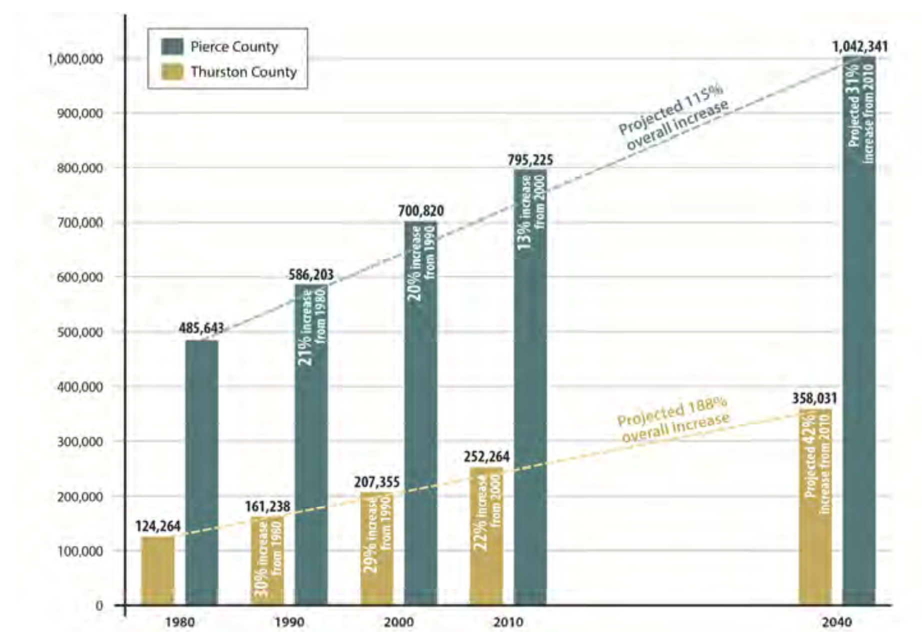
Figure I-2: Average Daily Traffic Volume for 1986-2011, I-5 at DuPont



The traffic increase in the corridor study area has been influenced both by population and employment growth, and by increased economic activity including a rapid rise in freight movement. Overall, this section of I-5 has not been widened since 1975, and is inadequate to meet today's demand.

Between 1970 and 2010, the population of Washington, Oregon and California grew by 88 percent (25.4 million to 47.8 million). During the same period, the population of Washington State grew by 97 percent, Pierce County grew by 93 percent, and Thurston County grew by 228 percent[1]. Population growth in Pierce and Thurston Counties is projected to continue at a similar pace through 2040, as shown in Figure I-3. The communities of Lakewood, DuPont and Steilacoom have also grown. These changes have resulted in increased through traffic along the I-5 corridor between Olympia and Seattle.

Figure I-3: Population Growth Trends, Pierce and Thurston

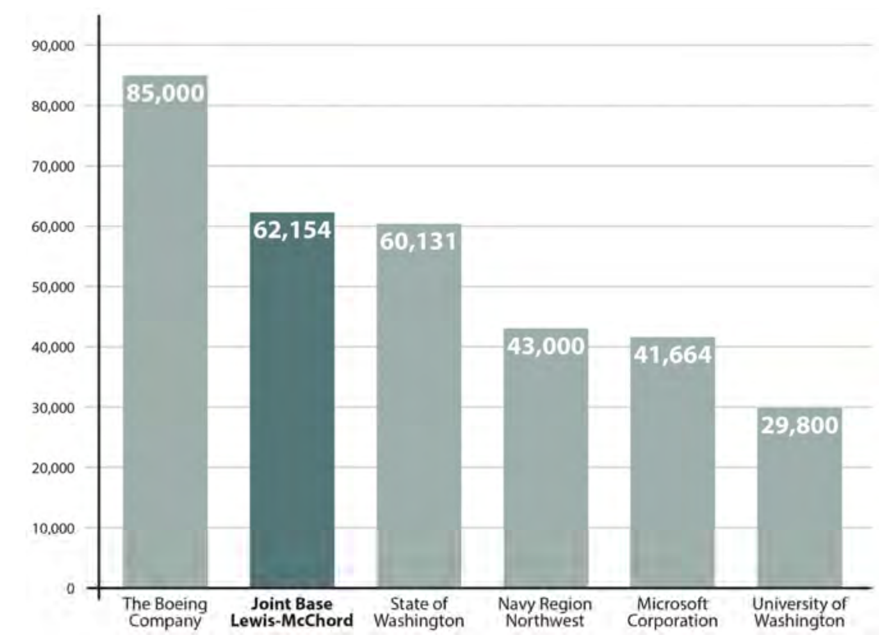


While there has been substantial population growth affecting the corridor, there has also been significant employment growth. Joint Base Lewis-McChord (JBLM) has evolved into a strategic military base with 62,154 employees, making it the second largest employer in Washington State, shown in Figure I-4. It should be noted, however, that JBLM is the largest employer in the state with employees situated on a single site. Employment on the base has increased almost 64 percent since 2006, and JBLM is now the fifth fastest growing military installation in the United States. Camp Murray which houses the headquarters of the Washington Military Department and the Washington Air National Guard has also expanded. Additionally, truck traffic along I-5 in the corridor study area has grown from approximately 8,900 vehicles on a typical weekday in 1986 to over 14,000 in 2011.

Because of the presence of secured military bases on both sides of I-5 (JBLM and Camp Murray), there are no existing alternative parallel routes for regional travel through the corridor study area. Using roads other than I-5 requires circuitous routes and extended detours. As a result, congestion along I-5 through the JBLM vicinity has become a daily occurrence with heavy through volumes and a large number of vehicles getting on and off the freeway in the study area. Heavy off-ramp traffic regularly backs up along the ramp and spills back onto the I-5 mainline. This causes drivers to change lanes to avoid other drivers entering or leaving the highway. The heavy amount of ramp traffic dramatically increases lane changes which cause traffic to slow, create extended delays, and reduce traffic safety along I-5. Additionally, the narrowing of I-5 from four lanes to three at the Thorne Lane interchange constrains traffic movement and results in low travel speeds and extended delays for peak period southbound traffic entering the study area.

Accommodating traffic growth through the corridor study area is challenging, largely due to the physical constraints along the highway including both the military bases and the presence of an existing rail line paralleling the west side of the freeway.

Figure I-4: Largest Employers in Washington State



[1] Washington State grew from 3.4 million to 6.7 million, Pierce County grew from 411,027 to 795,225, and Thurston County grew from 76,894 to 252,264.

Purpose of the Project

In 2012, the Washington State Department of Transportation (WSDOT) undertook an effort to prepare Interchange Justification Reports (IJR's) for four designated interchanges in the JBLM area. IJR's are required to be completed to justify new and/or revised ramps accessing limited access freeways such as I-5. The purpose of these access revisions would be to open up opportunities for potential solutions to chronic congestion on I-5 in the vicinity of JBLM. An IJR includes:

- The need for the proposed improvements to interchanges
- Evaluation of all other reasonable alternatives (including roadways other than I-5)
- Analyses and evaluation of the proposed improvements to meet the need
- Evidence that the proposed improvement follows design criteria
- Documentation of consistency with local, regional and state land use and transportation plans
- Status of environmental documentation for the proposed improvements.

Federal law requires the Federal Highway Administration (FHWA) to approve all access revisions to the interstate system, and the IJR is the document used for this process.

I-5 Corridor Study Area

The I-5 Corridor Study Area includes nine interchanges running from Mounts Road (Exit 116) on the south to SR 512 (Exit 127) on the north. The corridor study area is illustrated in Figure I-5. This corridor study area encompasses all of the interchanges that were identified by the Washington Legislature for focused analysis and improvement, as well as adjacent or nearby interchanges that could potentially be impacted by modifications at the focus interchanges. The focused interchanges will be more fully addressed in an Interchange Justification Report and are highlighted in green in Figure I-5. These interchanges include:

- I-5/Steilacoom-DuPont Road Interchange (Exit 119)
- I-5/41st Division /Main Gate Interchange (Exit 120, commonly known as the Main Gate interchange)
- I-5/Berkeley Street Interchange (Exit 122)
- I-5/Thorne Lane Interchange (Exit 123)

Based on IJR requirements, at a minimum the next interchanges north and south of these four interchanges must also be analyzed. These locations are shown in blue in the figure and include the interchanges at Center Drive (Exit 118) on the south and Gravelly Lake Drive (Exit 124) on the north, as well as the freeway mainline between Center Drive and Gravelly Lake Drive. Collectively, the minimum study area for an IJR is illustrated in both green and blue.

If impacts extend beyond the minimum study area then the boundaries could be extended to include the area shown in purple. This purple area includes the interchange with Mounts Road (Exit 116) on the south, the interchanges with Bridgeport Way (Exit 125) and SR 512 (Exit 127) on the north, and the freeway mainline segments connecting to these interchanges. The areas shown in purple represent the potential IJR influence area.

To avoid confusion, for the remainder of this report the combined minimum IJR study area and the potential IJR influence area will be referred to as the Corridor Study Area (or study area).

In the corridor study area, I-5 is a limited access highway with four northbound and four southbound lanes north of the Thorne Lane Interchange. South of the Thorne Lane Interchange, I-5 transitions to three northbound and three southbound lanes.

Figure I-5: Corridor Study Area

Design Year and Phased Implementation

This study uses a potential "build year" of 2020. A "design year" of 2040 is used, 20 years after the build year, as defined in WSDOT design policy. Forecasts for traffic demand in the design year will be used to define a facility expected to be necessary for acceptable performance in that year.

Construction of the ultimate (design year) improvements is expected to be implemented in several stages based on both funding availability, growth of traffic demand. A staging plan will be developed in Phase 2 that provides transitional flexibility between the build year and design year.

Project Phases

The planning, preliminary design, and environmental work for this project is being completed in two phases. The intent of Phase 1 is to prepare a vision and improvement strategy (framework plan) for the I-5 corridor to meet future (2040) travel demand. The framework plan defines scenarios for reducing congestion and managing demand for travel on I-5. It provides a context for identifying concepts for revisions to the focus interchanges. Phase 2 will continue analysis of mainline and local street improvements and other travel modes to recommend the improvements needed to improve mobility along I-5, produce the IJR for revised interchange concepts, and environmental documentation needed to identify and seek funding for a prioritized and phased program of improvements.

Phase 1

Phase 1 creates a framework plan for the future I-5 mainline improvements through the JBLM area. This framework plan is essential because currently there is no corridor plan addressing future capacity/demand strategies for I-5 in this area to help guide the decision-making process for interchange improvements. Accurately identifying the number and type of lanes needed on I-5 in the corridor study area is necessary to design interchange ramps and bridges. The final report for Phase 1 is this document: *I-5 JBLM Area Corridor Plan Feasibility Study* (*Corridor Plan Feasibility Study*).

The *Corridor Plan Feasibility Study* addresses existing and expected future deficiencies along the corridor and establishes a vision for I-5 through the JBLM area to achieve a specific series of objectives:

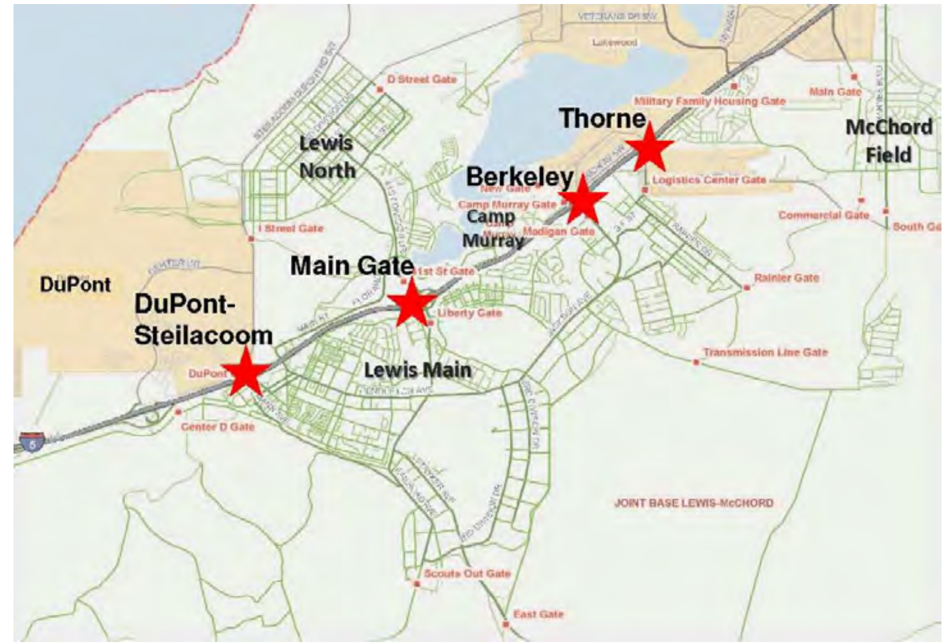
- Determine the potential freeway width that future interchanges or other bridges will need to span
- Relieve congestion on I-5 within the study area
- Improve local and mainline system efficiency
- Enhance mobility
- Improve safety and operations
- Increase transit and Transportation Demand Management (TDM) opportunities

Phase 1 included evaluation of scenarios to improve I-5 throughput, to support the use of transit and TDM strategies, such as vanpooling, and to identify strategic capacity improvements. Six mainline scenarios were identified and evaluated, and two of the most promising scenarios are recommended to be carried forward into Phase 2 for additional analysis prior to selecting a preferred scenario for the I-5 mainline.

Phase 1 identified interchange improvement concepts for the four focus interchanges and the most promising concepts will also be carried forward into Phase 2. The four focus interchanges, as shown on Figure I-6, are:

- Steilacoom-DuPont Road Interchange
- Main Gate Interchange
- Berkeley Street Interchange
- Thorne Lane Interchange

Figure I-6: Focus Interchanges



An environmental scan was also conducted in Phase 1 to identify the presence of sensitive natural and built environment features within or near the corridor that must be taken into consideration as the project moves forward.

Phase 2

Phase 2 of the project will continue to analyze and evaluate mobility improvements for I-5 through the JBLM area in a comprehensive multi-modal Alternatives Analysis with appropriate environmental assessment and documentation. This analysis will further investigate the selected I-5 corridor improvement scenarios with other non-interstate, local improvements and alternative travel modes to estimate their benefits to reduce travel demand on I-5 and increase overall corridor mobility.

The appropriate environmental documentation will be determined early in Phase 2 through discussion with affected agencies. An environmental assessment of the benefits and impacts of each of the alternative improvement strategies will be prepared with technical discipline reports. Findings from these discipline reports will be combined with the Alternatives Analysis to select a preferred alternative.

If the resulting preferred alternative includes modifications to I-5 interchanges, an Interchange Justification Report will be prepared. A proposed sequence of projects (highlighting those with most benefit and reasonable implementation timelines) will also be prepared.

An extensive public involvement will also be developed in Phase 2 to support the Alternative Analysis and environmental documentation processes.

Purpose of the Corridor Plan Feasibility Study

The *Corridor Plan Feasibility Study* will be the guiding document to achieve the following outcomes:

- Create a plan to provide transitional flexibility and identification of needed right-of-way (ROW).
- Identify program needs for an efficient, multi-use/multi-modal corridor, such as managed lanes, improved transit and TDM.
- Identify and evaluate interchange concepts that support and enhance cross-circulation for JBLM operations and internal base connectivity to improve interchange operations on I-5.
- Evaluate the need for and strategic sequencing of additional general purpose lanes.
- Incorporate functional design elements to improve efficiency with the potential to reduce serious and fatal collisions.
- Assess local street and on-base roadway options to improve connectivity within local communities as a means to ease demand on I-5.
- Explore transit priority options and enhanced service opportunities along I-5 and to/from JBLM.
- Identify a short-list of I-5 mainline scenarios and interchange improvement concepts to be advanced to Phase 2.

The *Corridor Plan Feasibility Study* provides guidance in developing the forthcoming *I-5 JBLM Interchange Justification Report* (IJR) and the environmental documentation for recommended and prioritized construction projects. While the *Corridor Plan Feasibility Study* addresses needs for the I-5 corridor between Mounts Road and SR 512, the IJR will focus on four key interchanges.

How were Decisions made in the Study?

Decisions about specific freeway, interchange and street improvements are being made within the context of the *Moving Washington* initiative. This initiative provides a framework for making transparent, cost-effective decisions that keep people and goods moving in support of a healthy economy and environment with stable, vibrant communities.

This initiative establishes transportation priorities through a three-pronged approach that includes:

- Operate efficiently using a variety of management tools that get the most out of existing highways.
- Manage demand on overburdened routes to encourage the use of other routes or other modes, or traveling during less congested times of day.
- Add capacity strategically by targeting hot spots or filling critical system gaps that fix bottlenecks or add facilities to encourage the use of carpools, vanpools and transit.

Consistent with the *Moving Washington* initiative, the completed Alternatives Analysis and subsequent IJR will identify interstate, transit and TDM improvements, including the necessary environmental documentation.

How Was the Study Prepared?

As a starting point, the *Corridor Plan Feasibility Study* considered the findings and recommendations of several prior studies in the area. Key prior studies included:

- I-5 Transportation Alternatives Report (Lakewood)
- JBLM Growth Coordination Plan
- Point Defiance Bypass Project (WSDOT Rail Division)
- I-5 Lacey Area IJR
- Cross-Base Highway EIS
- I-5/Fort Lewis Congestion Study (WSDOT Planning Office)

Additionally consideration was given to the effects of recent improvements like the Center Drive Interchange lane channelization modifications and the Camp Murray gate relocation, as well as pending changes to Madigan Gate access from I-5 and a variety of projects funded by a TIGER III grant to improve traffic operations reliability and efficiency.

The study focused on responding to three fundamental questions:

1. What is the nature of the problem to be solved, both existing and in the future?
2. How can we most effectively manage expected demand?
3. Where and when should we add capacity, and what types of lane should be used?

This report presents the results of analysis conducted in response to these questions.

Report Organization

This report is organized into nine chapters, the first of which is this Introduction. The remaining chapters include the following:

- *Chapter II - Project Setting*: Describes the corridor study area including existing military installations (JBLM and Camp Murray) and affected communities (Pierce County, Cities of Lakewood and DuPont, and Town of Steilacoom). It provides a description of the project study area with a focus on the I-5 mainline and its interchanges. A summary of key previous studies is also included.
- *Chapter III – Existing Study Area Conditions*: Characterizes existing transportation facilities, services and performance within the corridor study area. It includes a physical description of roadways, railroads, bicycle and pedestrian facilities, and JBLM access gates, land use and traffic patterns. A summary of existing traffic volumes, performance and safety is provided, as well as a description of current transit/vanpool service and ridership.
- *Chapter IV – Travel Forecasting*: Documents the methods used and assumptions made in developing future 2040 peak period traffic forecasts for baseline conditions, and for I-5 improvement alternatives.
- *Chapter V – Future I-5 Baseline Conditions*: Presents 2040 baseline conditions without I-5 improvements including peak hour traffic vehicle and person trip forecasts, and provides a summary of future peak hour traffic performance. The 2040 conditions provide a baseline against which mainline improvement scenarios are evaluated and compared.
- *Chapter VI – I-5 Mainline Build Scenarios*: Describes the range of improvements considered to address existing and future congestion and safety deficiencies, including actions to improve operational efficiency, to better manage traffic, and selectively add freeway system capacity. Performance measures are documented that allow comparison of the mainline scenarios with the 2040 base conditions and with each other. A summary of the scenario evaluation findings is also provided.
- *Chapter VII – Interchange Concepts Considered*: Describes the range of improvement concepts considered at the four focus interchanges along I-5. For each focus interchange two to four concepts are recommended for further analysis in Phase 2.
- *Chapter VIII – Environmental Scan Summary*: Documents the results of an environmental scan conducted for the mainline improvement scenarios and interchange concepts. This scan will form the basis for identifying the environmental issues to be addressed in greater detail during Phase 2.
- *Chapter IX – Findings and Recommendations*: Summarizes the key findings and conclusions of the Corridor Plan Feasibility Study and makes recommendations for further analysis during Phase 2.

Agency and Public Involvement

The project team assembled two stakeholders groups to help guide the overall study and provide technical feedback – an Executive Committee and a Technical Support Team. Regular meetings were held with these groups between March and September of 2013. Additional focus group meetings were held as needed during this period with key project stakeholders. Agency and public outreach activities are described below.

Executive Committee

The Executive Committee was comprised of elected officials and senior staff from the adjacent cities, towns, Pierce County, JBLM, Camp Murray, WSDOT, FHWA, Puget Sound Regional Council (PSRC), Thurston Regional Planning Council (TRPC), Nisqually Tribe, and the South Sound Military Communities Partnership (SSMCP). This committee was convened four times over the course of Phase 1 to provide executive level support and feedback on the direction of the study, issues of concern, key findings and conclusions, and recommendations.

Technical Support Team

The Technical Support Team comprised of staff with expertise in transportation from all of the agencies with Executive Committee representation. This team provided review and input on technical analysis methods and results. The Technical Support Team met eight times throughout Phase 1. Each Technical Team meeting was a half-day in length and delved into the details of analysis including:

- Methods and assumptions
- Understanding of the nature and magnitude of existing and expected future (2040) deficiencies
- Development and evaluation of multimodal improvement scenarios, considering transit, TDM facilities and actions, and capacity
- Recommendations for Phase 1.

Focus Groups

Focus group meetings were held with a variety of organizations over the duration of the study. These groups included:

- JBLM – A total of six meetings were held with JBLM staff focusing on JBLM issues. Base housing, cultural resources and identification of potential issues associated with I-5 mainline improvements were discussed at three meetings. Two meetings were held to discuss JBLM's Access Control Points (or gates). A briefing on the study status and pending Phase 1 recommendations was given at the final meeting.
- Camp Murray – One meeting was held to discuss gate access and other relevant issues.
- Nisqually Tribe – One meeting was held to discuss issues and concerns in preparation for tribal participation on the Executive Committee and Technical Support Team.

- Transit Providers – Two meetings were convened bringing together all three transit operators in the corridor, representatives from the WSDOT Public Transportation and CTR offices, CTR coordinators from JBLM, and the two MPOs to discuss ways in which transit and trip reduction strategies should be considered in the analysis and to solicit advice and technical input on ways to increase the potential for added transit service.
- Cities – One meeting was held with the City of Lakewood, and one with joint participation by the City of DuPont and the Town of Steilacoom to discuss their issues and concerns.
- Pierce County – One meeting was held with staff to discuss their issues and concerns, and a briefing was given to the County Council on the study status.

Public Information

During Phase 1 public information and outreach largely consisted of the focus group meetings described above, and the dissemination of information on the WSDOT website. Additionally, information regarding on-going improvements to address congestion in the I-5 corridor through JBLM was made available including a public information brochure (see Figure I-7 which presents the first page of this four-page document).

WSDOT staff also met with individuals and provided information to explain the prior studies conducted in the corridor, the pending improvement projects funded by a federal TIGER III grant, and the findings, conclusions and initial recommendations of the *Corridor Plan Feasibility Study*. Lastly, public agency briefings were conducted in October and November 2013 that provided additional opportunities for public information and input as Phase 1 concluded.

At the outset of Phase 2, an in-depth public involvement plan will be developed. This plan will be implemented during the preparation of the alternatives analysis, environmental documentation, and the IJR.

Web site

Information available on the WSDOT website has largely focused on identifying the improvements funded by a recently awarded TIGER III grant, including both the overall improvement package and information on the status of construction. Additionally, the public information brochure shown in Figure I-7 is included on the website.

Figure I-7: I-5 JBLM Improvements Public Information

July 2013

Washington State Department of Transportation

I-5: SR 510 to SR 512–Joint Base Lewis-McChord Vicinity

Improving travel through a vital transportation corridor

MOVING WASHINGTON

Interstate 5 is the primary transportation route in the state of Washington, connecting Canada, Oregon, California and Mexico. It is also the only continuous north/south route in the state that connects Vancouver to Blaine.

Over the past decade, traffic volumes on I-5 in south Puget Sound have grown significantly, resulting in heavy peak congestion, particularly between SR 510 in Lacey and SR 512 in Tacoma.

This section of I-5 was built in the late 1950s and widened to six lanes in the 1970s. Forty years of population growth have led to traffic demands that have outgrown highway capacity. New large-scaled companies established in the area, increases in Joint Base Lewis-McChord (JBLM) operations and an older highway system have contributed to the daily congestion drivers now experience on I-5.

"**Moving Washington**" is WSDOT's vision of how it sets priorities and makes investments. It integrates new capacity, efficiencies and commute options to address congestion head-on and improve the performance of the state's transportation system.

The **Moving Washington** principles – operate efficiently, manage traffic demand, and strategically add capacity – provide the foundation for managing congestion in the JBLM vicinity. This folio describes past accomplishments, ongoing efforts and future plans to continue this effort.

I-5 BERKELEY AVE

© WSDOT Jun 28, 2010 4:45 PM PDT

Population growth has strained I-5's traffic capacity over the past several years, leading to unacceptable congestion and traffic delays.

"More than 152,000 vehicles travel through Joint Base Lewis-McChord (JBLM) gates each day, and 80% of those vehicles use I-5."

–Joint Base Lewis-McChord Growth Coordination Plan

More demand than capacity

The graph to the right illustrates the pattern of traffic growth since 2008. The freeway routinely operates at peak capacity and in 2011, volumes exceeded the threshold over several months. Without improvements, I-5 can no longer handle daily traffic demands.

In December 2010, the City of Lakewood published the Joint Base Lewis-McChord Growth Coordination Plan. Transportation was a key component analyzed in the plan with regard to JBLM's impact on the community and surrounding region.

The city's study recommended several improvements (listed at right) at a cost of nearly $1 billion. That would provide the overall framework to bring about the much needed, long-term relief.

I-5 Northbound DuPont traffic

Average daily traffic

From the Joint Base Lewis-McChord Growth Coordination Plan:

PROJECT COMPONENT	ESTIMATED COST*
DuPont Steilacoom Road Interchange	$22 million to $72 million**
41st Division Drive Interchange	$16 million
Berkeley Street Interchange	$22 million to $72 million
Thorne Lane Interchange	$300 million (included in cross-base highway project)
I-5 Mainline Improvements (ITS Auxiliary Lanes, General Purpose Lanes)	$600 million

* Planning level costs only (2010 dollars)

** Range of costs represent alternate interchange concepts as diverging diamond is less expensive due to reduced additional structure need.

II. Project Setting

I-5 is the main north-south route through western Washington. It is classified as part of the National Highway System (NHS) and a Highway Statewide Significance (HSS). It is a principal route for the movement of people, goods, services, and the military on a statewide basis and is a key link in the trade-dependent state economy. In the project vicinity, I-5 connects the Olympia/Lacey/Tumwater area to the south with the Tacoma/Seattle/Everett area to the north. In the project area, I-5 passes through Joint Base Lewis-McChord (JBLM) and serves as the principle access to the Base for the Cities of DuPont and Lakewood and the Town of Steilacoom, as shown in Figure II-1. Because of the secure nature of the military installation, I-5 is the only continuous corridor through the northwest side of JBLM. Other north-south routes around the southeast side of JBLM include SR 7/SR 507, SR 161, and SR 510. Through the project area, I-5 follows the historic alignment of SR 99, though not all of that is WSDOT right-of-way. It crosses JBLM partially on an easement granted by the Department of Defense.

Joint Base Lewis-McChord (JBLM)

JBLM is one of the largest US Army installation in the western United States and is the second largest employer in Washington State. JBLM was formally established as one of 12 U.S. joint bases worldwide on October 1, 2010. Pursuant to recommendations of the 2005 Base Realignment and Closure Commission, it was formed through the merger of the former US Army base, Fort Lewis (est. 1917), and the US Air Force base, McChord Air Force Base (est. 1947). The merger enhanced JBLM's position as a "Power Projection Platform" and as a result the base has experienced significant growth. JBLM supports 40,000 active military personnel 15,000 civilian workers and 60,000 family members who live on and off the base. Today, approximately 76 percent of military personnel live off base and commute to work. All civilian personnel live off-base.

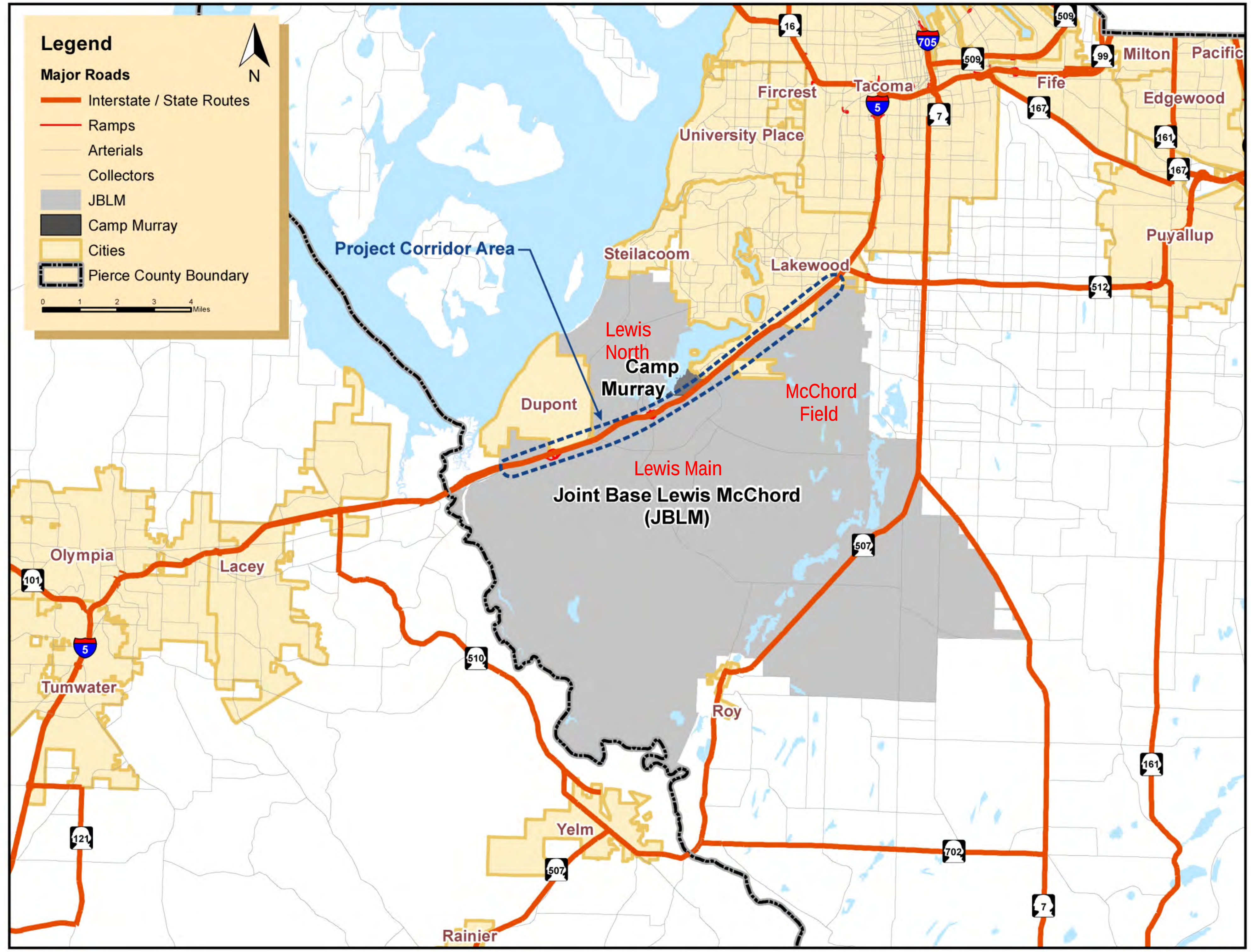
JBLM's mission is to "*Provide state-of-the-art training and infrastructure, responsive quality of life programs, and fully-capable mobilization and deployment operations for Army, Navy, Air Force, and Marines. Manage resources efficiently and equitably to support mission readiness and execution, and the well-being of service members, families, and civilians. Sustain and protect the environment as a fully-integrated community partner in the lower Puget Sound, with a highly-trained and motivated workforce.*"[1]

JBLM is generally comprised of three areas:

- JBLM Main or Lewis Main is part of the old Fort Lewis army base that is east and south of I-5. It includes the main administrative and training facilities.
- Lewis North or North Fort is part of the old Fort Lewis, lying north and west of I-5.
- McChord Field is comprised of the old McChord Air Force base.

[1] JBLM website www.lewis-mcchord.army.mil/about.htm#mission

Figure II-1: Vicinity Map



Northeast Thurston County and Southwest Pierce County Area
Source: Pierce County

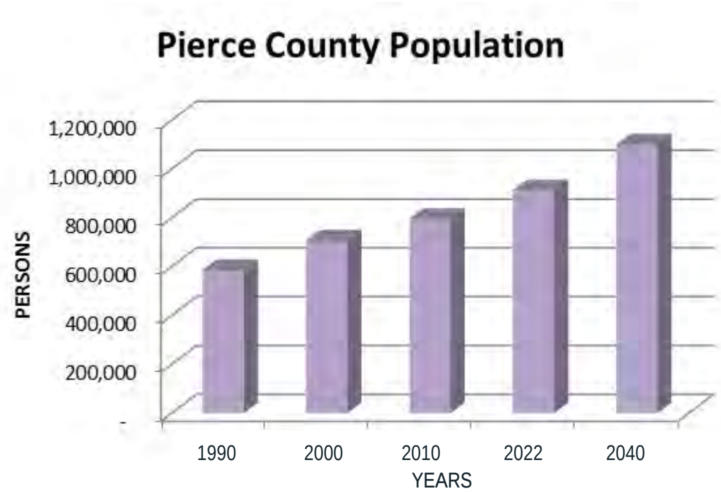
Camp Murray

Camp Murray is the headquarters for the Washington Military Department, the parent organization of the WA Army National Guard (WAARNG) and Air National Guard (WAANG), the WA State Emergency Management Department (EMD) and the WA Youth Academy. The Washington Army National Guard dates to 1854 with formation of the Washington Territorial Militia. Today, it consists of 6,300 soldiers in two brigades and has approximately 2,200 personnel in various units throughout the state.

Camp Murray is on a 235 acre site, located on the north side of I-5 near the Berkeley Street Interchange and borders JBLM on the south and east. Approximately 143 acres are developed with the remaining 97 acres set aside for wildlife habitat, recreation, and training purposes.

Pierce County

Pierce County encompasses the project area, including JBLM, Camp Murray, the Cities of DuPont and Lakewood, and the Town of Steilacoom, and the unincorporated areas. Over the past decade, Pierce County has experienced substantial population growth which is expected to continue over the next 20 years as forecasted by the Puget Sound Regional Council and Pierce County. This growth, especially near the I-5 corridor, is impacting traffic congestion on I-5 and surrounding roads.



City of DuPont

The City of DuPont is a growing community located primarily northwest of I-5 and bounded by JBLM to the north, south and east. It encompasses approximately 5.8 square miles. In 2013, the population of DuPont was about 8,855 persons with an employment base of 3,320 workers[2]. At build-out, the City is expected to grow to about 12,100 persons with a business base of about 21,400 workers.

Because of the natural barriers of Puget Sound on the west, the Nisqually Wildlife refuge on the south and the restricted military base, access to and from the City of DuPont is primarily via I-5 at the Center Drive and Steilacoom-DuPont Road Interchanges.

City of Lakewood

The City of Lakewood is located primarily northwest of I-5, bounded by JBLM on the east and south, Puget Sound on the west, the Cities of University Place and Tacoma on the north, and the Town of Steilacoom on the southwest.

The City of Lakewood covers approximately 24 square miles. In 2011, the population of Lakewood was about 58,190 persons with an employment base of about 23,390 workers. By 2030, the City's population is expected to grow to about 72,000 persons with a business base of about 38,340 workers.

Regional north/south access to the City of Lakewood is via I-5 at six interchanges, namely, Berkeley Street, Thorne Lane, Gravelly Lake, Bridgeport Way, SR 512 and South 84th Street. The Tillicum neighborhood was physically isolated from the rest of Lakewood with the construction of I-5 in the 1950s. Today, motorized access to Tillicum is only by way of I-5, and there are no non-motorized connections.

Town of Steilacoom

The Town of Steilacoom was the first community to be incorporated in the Washington Territory in 1854 and was established as a National Historic District 1974. It is bordered by Puget Sound on the west, the City of University Place on the north, the City of Lakewood on the east and JBLM on the south. Today, the Town's population is about 6,050 persons, with a business base of about 620 workers.

[2] Employment data from PSRC's *Point Level Employment Data Set*

Primary access to the Town of Steilacoom is via roadways connecting to the City of Lakewood or via Steilacoom-DuPont Road through JBLM connecting to I-5 at the Steilacoom-DuPont Road Interchange.

Prior/Pending Plans, Studies and Improvements

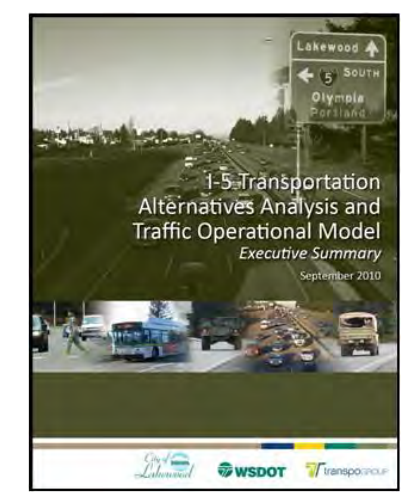
As a starting point, the *Corridor Plan Feasibility Study* considered the findings and recommendations of several prior studies in the area. Key prior studies included:

- I-5 Transportation Alternatives Report (Lakewood)
- JBLM Growth Coordination Plan
- WSDOT Rail Division Point Defiance Bypass Project
- I-5 Lacey Area IJR
- Cross-Base Highway EIS
- I-5/Fort Lewis Congestion Study

Additionally consideration was given to the effects of recent improvements like the Center Drive Interchange improvements and the Camp Murray gate relocation, as well as the pending changes to Madigan Gate access from the freeway and a variety of projects funded by a TIGER III grant to improve traffic operations reliability and efficiency.

A brief synopsis of the recent studies and their relevance to the *Corridor Plan Feasibility Study* is presented in the following section.

I-5 Transportation Alternatives Report



This report was prepared in 2010 to document the evaluation and recommendation of improvements for I-5 from Mounts Road (Exit 116) to State Route 512 (Exit 127), including the development of initial interchange concepts for the core of the corridor study area (e.g., Exits 119 through 123 inclusive). This study was the precursor to the current *I-5 JBLM Vicinity IJR and Environmental Documentation Study*.

This report focused on serving JBLM traffic as a priority. Safety and operational considerations were important but in many cases were directly related to the amounts and patterns of military traffic. Additionally, bridge sufficiency and geometric deficiencies were identified.

The study included the development and evaluation of improvement options for both the mainline and key interchanges. A variety of system-wide improvements were also considered in an effort to reduce demand along the I-5 corridor or to manage demand more effectively.

Five general system-wide concepts were developed and evaluated:

- Intelligent Transportation System (ITS) Improvements
- Demand Management
- Transit System Improvements
- I-5 Mainline Improvements
- Parallel Corridor Improvements (including SR 507)

Mainline improvements included collector/distributor roads, auxiliary lanes and added general purpose lanes. Improvement concepts were grouped to assess both their individual effectiveness and synergy among improvements. Three concept groupings were developed for the corridor which included varying levels of interchange and mainline improvements. Consideration was also given to system improvements including ITS infrastructure, demand management strategies, and transit improvements.

JBLM Growth Coordination Plan

JBLM's recent and growth affects a geographically diverse area, including two counties, multiple jurisdictions, school districts, and service providers. This study evaluated a wide range of potential impacts associated with this growth including: housing, education and child care, land use, economic, public safety, utilities and infrastructure, health, social services, quality of life, and transportation.

Key transportation impacts included:

- Both short- and long-term effects of growth in JBLM traffic demand on I-5 and the public street system in the corridor study area. There are few options for parallel travel routes due to the barriers created by the base and there is limited transit service due to funding and security constraints at gates. Providing transit service to/from inside JBLM is challenging due to gate security checkpoints. Also, currently only authorized personnel can use transit service once it passes through the gates.
- There is a high variability in day-to-day base operations that affect gate operations. Anticipated increases in future troop levels will further affect gate operations and impact the I-5 corridor.

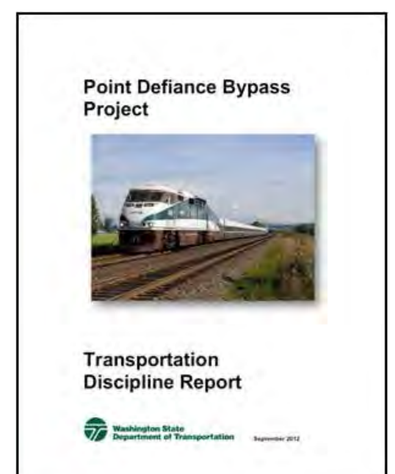
To ensure efficiency in the transportation system and provide continued opportunities for economic growth in the region, major investments are needed along the I-5 corridor. Other key transportation issues include the need for regional collaboration, need for a fixed route bus system on base, investment in coordinated marketing and transportation demand management strategies, and other surface street investments.

A key element of this study was the recommendation for a new internal roadway to connect the Lewis Main portions of the base with McChord. The general alignment of this roadway is shown in Figure II-2.

Figure II-2: Joint Base Internal Connector Road

Point Defiance Bypass Project

The Point Defiance Bypass Project, a joint effort by WSDOT and the Federal Rail Administration (FRA), will upgrade the rail line owned by Sound Transit adjacent to I-5 to allow Amtrak service to relocate to this more direct route between Nisqually and Tacoma. This project is slated for completion by the fall of 2017.



Along the current coastal route trains must slow due to tight curves and single-track tunnels. The project improves the bypass route along I-5 to provide faster and more reliable service for Amtrak and its passengers. Part of the bypass route is used by Sound Transit for Sounder commuter rail to the Lakewood Station.

The project allows Amtrak service to avoid delays due to schedule conflicts with freight trains and other delay factors (such as drawbridge openings and mudslides).The bypass will allow travel speeds to increase up to 79 mph, reducing travel times between Seattle and Portland by ten minutes. Amtrak passenger rail services will result in approximately one train passing through the corridor study area during each AM and PM peak period.

WSDOT and FRA addressed impacts from vehicle queues and vehicle delay at rail crossings and adjacent roadway intersections. The project includes safety and signal improvements to five at-grade rail crossings within the corridor. The improved at-grade crossings are: Clover Creek SW, Thorne Lane, Berkley Street, 41st Division Drive and DuPont-Steilacoom Road. The project will minimize queuing and Level of Service impacts with interconnection of all north-south corridor traffic signals.

Lacey Area I-5 IJR

The *Lacey Area I-5 IJR* focused on improvements to the Martin Way and Marvin Road Interchanges. It analyzed existing and 2040 base conditions along I-5 from the Nisqually River to the Pacific Avenue Interchange. A thorough review of possible local roadway improvements was completed to identify improvements that would benefit I-5 and interchange operations and safety. A series of interchange improvements were analyzed and evaluated. Findings from the *Lacey Area I-5 IJR* included:

- A partial cloverleaf interchange concept was recommended for the Martin Way Interchange with loop ramps added in the northwest and southeast quadrants.
- A Single Point Urban Interchange (SPUI) concept with a collector-distributor (CD) road on the west side of I-5 was recommended for the Marvin Road Interchange.
- A list of local improvements were identified and included in the City of Lacey's Transportation Improvement Project (TIP) list.
- Possible widening of the three lane section of I-5 north of Sleater-Kinney Interchange should be considered for future study.

The *Lacey Area I-5 IJR* is currently being reviewed by WSDOT and FHWA for engineering and operational acceptance.

Cross-Base Highway EIS

The Cross-Base Highway (SR 704) would provide regional travelers with a new six-mile long, multi-lane highway beginning at the I-5/Thorne Lane interchange (Exit 123) at the west end, and ending at 176th Street at SR 7 on the east end. The intent of the project is to ease congestion on I-5, SR 512, SR 7, Spanaway Loop Road, 152nd/Military Road, and 174th Street by providing a route through instead of around JBLM. The interchange at Thorne Lane would be reconstructed as a single-point urban interchange to accommodate the expected increase in traffic volumes resulting from this connection. A frontage road along the north side of I-5 between Thorne Lane and Gravelly Lake Drive would be constructed, as would a rail/roadway grade separation. Specific impacts to the I-5 study corridor, beyond the Thorne Lane interchange, were not developed in the EIS. However, it was recognized that improvements to the Thorne Lane interchange would impact freeway mainline and ramp operations within the vicinity. Regional improvement needs associated with the construction of the new highway were expected to be considered as a part of the development of I-5 improvement strategies.

I-5 / Fort Lewis Congestion Study

In 2005, the legislature directed WSDOT to study congestion on I-5 in the vicinity of Fort Lewis. Their study concluded that it would be impossible to do more than provide short-term solutions or shift congestion without widening the interstate, providing an alternative routes, or modes. The study recommended the following short-term solutions:

- Install ramp meters at all interchanges in the study area;
- Construction an auxiliary lane between the Berkeley Street and the Thorne Lane interchanges; and
- Expand the incident response system with early incident detection.

Recent or Pending Improvement Projects

Recent and/or pending improvement projects that affect traffic operations along I-5 in the corridor study area include:

- Camp Murray gate relocation
- TIGER III grant projects
- Madigan access improvements

Camp Murray Gate Relocation

The Camp Murray main gate was originally located immediately adjacent to and west of the Berkeley Street interchange, but was relocated in March of 2013 to reduce interchange-related traffic impacts. A secondary access is still provided at the original location adjacent to the interchange, mainly for commercial vehicles.

TIGER III Grant Projects

The Washington State Department of Transportation was recently awarded a $15 million federal grant to provide congestion management improvements along a 15-mile section of I-5 between SR 510 and SR 512. Improvements include signage, ramp metering, congestion monitoring and an auxiliary lane. Easing congestion in this area will allow more efficient movement through the I-5 corridor, including freight delivery.

Figure II-3 shows the location and type of improvements that would be funded by the TIGER III grant.

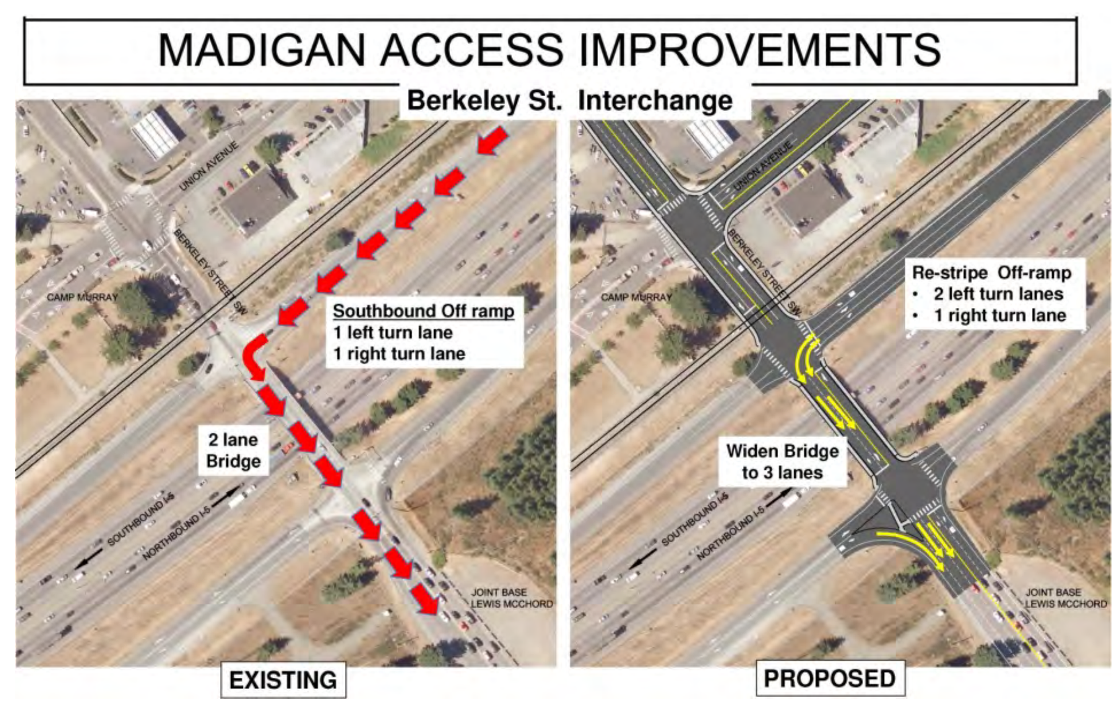
Madigan Gate Access Improvements

The City of Lakewood was recently awarded a $5.7 million grant to reconfigure the Freedom Bridge (Berkeley Street) that currently connects JBLM to Camp Murray and Tillicum. Plans for construction include bridge widening to add sidewalks and a third travel lane on the bridge, and a second left turn lane on the I-5 southbound off-ramp. Madigan Medical Center on the base sees more than 1.4 million visitors per year and is directly served by this interchange. Completion of this improvement is expected in 2015, and will result in significant travel time savings for medical access.

Figure II-4 illustrates the proposed improvements.

Figure II-3: TIGER III Improvements

Figure II-4: Access Improvements to Madigan Gate



III. Existing Study Area Conditions

This section of the report characterizes existing conditions for I-5 and the surrounding study area, including:

- Physical descriptions of I-5 and key local streets and intersections that are impacted by traffic congestion along I-5
- The JBLM system of gates (Access Control Points or ACPs) that connect on-base roads in this secure military installation to the public street system
- I-5 traffic volumes and performance
- Existing public transit services in the study area including buses, vanpools and park and ride lots
- Existing rail characteristics and operational considerations
- A summary of the collision history along I-5 through the JBLM area
- Existing traffic volumes, highway system performance, highway safety, and transit performance.

Figure III-1: Interstate 5 through Washington

Physical Characteristics

Interstate 5

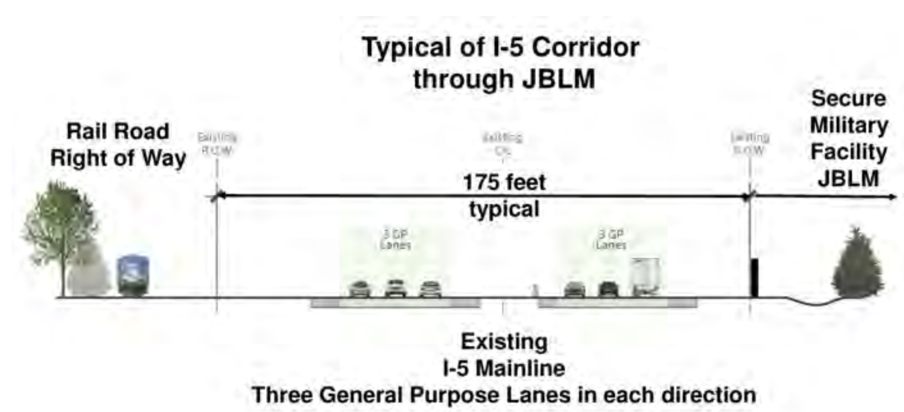
In Washington, I-5 links key population centers such as Vancouver, Olympia, Tacoma, Seattle, Everett and Bellingham (see Figure III-1.) In the study area, I-5 also serves national defense by providing access to JBLM.

Within the study area, I-5 is a divided interstate highway with three through lanes in each direction south of Thorne Lane and four through lanes in each direction north of Thorne Lane. All lanes are unmanaged general purpose lanes. Northbound and southbound auxiliary lanes are added between the Center Drive (Exit 118) and Steilacoom-DuPont Road (Exit 119) interchanges.

I-5 is physically constrained through the study area with JBLM on both sides and an active rail line paralleling immediately to the northwest. Alternative routes to move regional traffic are severely limited by the size and function of JBLM, and further limited by water bodies, sensitive environmental areas and locations of archeology or cultural significance.

Right-of-way for I-5 across JBLM is partially owned in fee by the U.S. Department of Defense with an easement granted to the State of Washington for roadway purposes. The rail corridor is owned by Sound Transit through the corridor study area and is currently used by Tacoma Rail. In 2017, the Point Defiance Bypass project will move Amtrak service to this line. Figure III-2 illustrates the JBLM and rail line constraints[1].

Figure III-2: I-5 Constraints through the Study Area, South of Thorne Lane



The corridor study area includes nine arterial interchanges with I-5 and four arterial crossings without connection to I-5. There is one under-crossing at Pendleton Avenue (between the Steilacoom-DuPont Road and Main Gate interchanges), and three overcrossings at McChord Drive (between Gravelly Lake Drive and Bridgeport Way interchanges), 47th Avenue (north of the Bridgeport Way interchange, and S Tacoma Way (immediately south of the SR 512 interchange). The nine interchanges are described below.

Interchanges

There are nine interchanges along I-5 in the corridor study area. Focus interchanges for the IJR are noted below in bold text below:

- Exit 116 - Mounts Road Interchange
- Exit 118 - Center Drive Interchange
- **Exit 119 - Steilacoom-DuPont Road Interchange**
- **Exit 120 - Main Gate Interchange**
- **Exit 122 - Berkeley Street Interchange**
- **Exit 123 - Thorne Lane Interchange**
- Exit 124 - Gravelly Lake Drive Interchange
- Exit 125 - Bridgeport Way Interchange
- Exit 127 - SR 512 Interchange

Each of these interchanges offers an opportunity to cross I-5, although at some interchanges accessibility for the general public is limited because of JBLM gates. Characteristics of these interchanges are presented below.

Mounts Road Interchange (Exit 116)

The Mounts Road interchange operates as a traditional diamond with stop-control for both northbound and southbound ramp junctions. This interchange serves the Eagles Pride Golf Course and a residential neighborhood in the city of DuPont along the north side of I-5. It also connects with Nisqually Road/Old Pacific Highway on the south, linking the freeway with the Nisqually community and SR 510 to connect with the cities of Lacey and Yelm. Mounts Road provides a single travel lane in each direction on a bridge over I-5, and is grade-separated from the Pt. Defiance Bypass route railroad immediately west of the freeway.

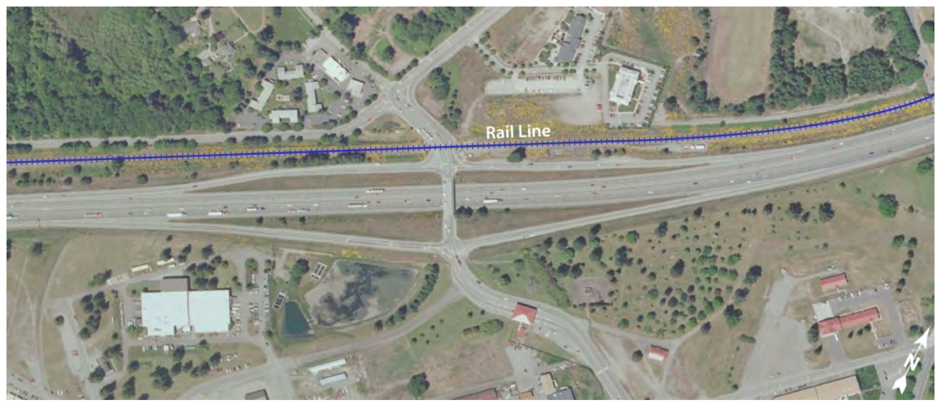
Center Drive Interchange (Exit 118)

The Center Drive interchange is a modified diamond with a loop ramp in the northeast quadrant. The southbound ramps are a traditional diamond with stop-control for the off-ramp. The northbound ramps include a northbound-to-westbound loop off-ramp and a direct northbound on-ramp. The interchange is integrated with a northbound weigh station located immediately to the south. The freeway on-ramp from the weigh station is grade-separated from Center Drive east of I-5 and merges with the Center Drive northbound on-ramp before merging with I-5.

[1] *Point Defiance Bypass Project, Transportation Discipline Report*, WSDOT, 2012.

On the east side of I-5, Center Drive has a single westbound lane between Railroad Avenue and I-5. This street is currently an exit only road from the secure JBLM installation, and is stop-controlled where it intersects the interchange. Center Drive provides two eastbound travel lanes and a single westbound travel lane on a bridge over I-5. This bridge also provides grade-separation from the rail which is located between the I-5 mainline and the southbound ramps.

Steilacoom-DuPont Road Interchange (Exit 119)
IJR Focus Area Interchange

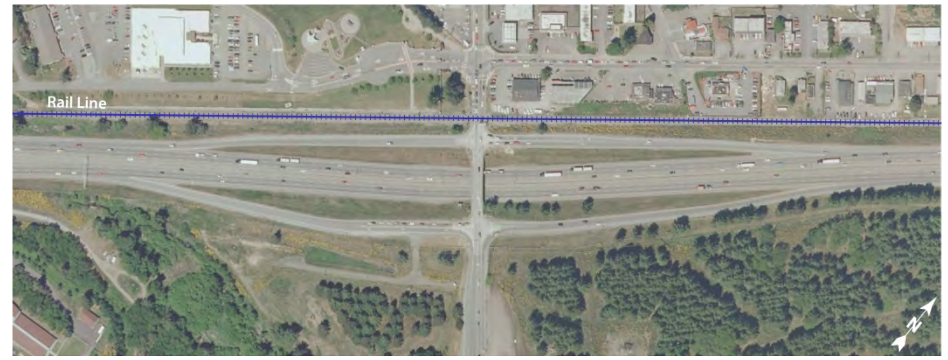


The Steilacoom-DuPont Road interchange is a traditional diamond with traffic signals for the northbound and southbound ramp terminals. Immediately west of the southbound ramp is the signalized intersection of Steilacoom-DuPont Road with Wilmington Drive and Barksdale Avenue. The rail line crosses Steilacoom-DuPont Road at-grade between this intersection and the southbound ramps. West of the freeway, Steilacoom-DuPont Road serves the eastern portion of DuPont and the future Wharf Gate to JBLM North. To the east of I-5, Steilacoom-DuPont Road becomes Clark Road and accesses JBLM through the DuPont Gate. Steilacoom-DuPont Road provides two eastbound lanes and a single westbound lane on a bridge over I-5.

Main Gate Interchange (Exit 120)
IJR Focus Area Interchange

The Main Gate interchange is a full cloverleaf with yield control where the ramps merge with the arterial road. I-5 crosses over 41st Division Drive via a bridge structure. The rail line crosses 41st Division Drive at-grade immediately west of the southbound ramps. West of the freeway, 41st Division Drive accesses the JBLM Lewis North. East of I-5, it accesses Lewis Main through the Main or Liberty Gate. 41st Division Drive provides two lanes in each direction under I-5.

Berkeley Street Interchange (Exit 122)
IJR Focus Area Interchange



The Berkeley Street Interchange is a diamond with traffic signals for the north and southbound ramp terminals. Immediately west of the southbound ramp terminal, Berkeley Street has an at-grade crossing of the rail line. Slightly further west is the signalized intersection of Berkeley Street with Union Avenue/Railroad Avenue/ Militia Drive. On the west of the freeway Berkeley Street accesses the southwestern portion of the City of Lakewood and the Tillicum neighborhood. East of the freeway, Berkeley Street becomes Jackson Avenue and accesses the Madigan Gate to JBLM. Berkeley Street provides a single lane in each direction on a bridge over I-5.

Thorne Lane Interchange (Exit 123)
IJR Focus Area Interchange

The Thorne Lane Interchange is a diamond with traffic signals for the north and southbound ramps. Immediately west of the southbound ramp terminal, Thorne Lane has an at-grade crossing of the rail line. Slightly further west is the stop-controlled intersection with Union Avenue. On the west of the freeway Thorne Lane accesses the Tillicum neighborhood of Lakewood. East of the freeway, Thorne Lane becomes Murray Road and accesses a small portion of Lakewood east of I-5 and the Logistics Gate to JBLM. Thorne Lane provides a single lane in each direction on a bridge over I-5.

Gravelly Lake Drive Interchange (Exit 124)

The Gravelly Lake Drive interchange is a diamond with traffic signals for the north and southbound ramp terminals. Gravelly Lake Drive provides two travel lanes in each direction on a bridge over I-5. Immediately west of the southbound ramps, this bridge also provides a grade-separation over the rail line. On the west of the freeway Gravelly Lake Drive accesses the western portion of Lakewood. East of the freeway, Gravelly Lake Drive becomes Woodbrook Road and accesses a small portion of Lakewood east of I-5 and the McChord Family Housing gate.

Bridgeport Way Interchange (Exit 125)

The Bridgeport Way interchange is a diamond with traffic signals for the north and southbound ramp terminals. Immediately west of the southbound ramp termini is the signalized intersection with Pacific Highway. The rail line crosses Bridgeport Way at-grade immediately west of this intersection. West of the freeway, Bridgeport Way accesses the heart of Lakewood. To the east of the freeway, Bridgeport Way accesses a small portion of Lakewood, as well as the main gate to McChord Field. Bridgeport Way provides two travel lanes in each direction on a bridge over I-5.

SR 512 Interchange (Exit 127)

The SR 512 interchange is a partial cloverleaf with loop ramps in the northwest, northeast and southeast quadrants. Southbound traffic exiting I-5 must pass through a signalized intersection immediately east of the SR 512 intersection with S. Tacoma Way which is the western terminus of the state highway. To the east, SR 512 connects Lakewood and south Tacoma to Puyallup and other communities in eastern Pierce County. This interchange is situated at the far north end of the study area and is not included in the technical analysis documented in this report.

I-5 Geometric Review

A geometric review of the I-5 corridor through the study area consisted of examining available as-built drawings to determine if I-5 is designed in accordance with current WSDOT design standards. This review included an assessment of the following design features:

- Interchange spacing
- Horizontal alignment
- Lane widths
- Shoulder widths

The results of this conceptual analysis are summarized below:

Interchange Spacing

The Interchange spacing review showed that the distance between the Berkeley Street and Thorne Lane interchanges is 0.9 miles – less than the minimum one mile spacing standard for urban areas. The distance between Thorne Lane and Gravelly Lake Drive interchanges is 1.02 miles and the distance between the Center Drive and Steilacoom-DuPont Road interchanges is 1.05 miles. These distances are at the minimum requirement for urban interchanges. Spacing for all other interchanges is greater than 1.2 miles apart.

Horizontal Alignment

The horizontal alignment review showed all mainline curves meet the minimum radius for a superelevation rate of eight percent. The tightest horizontal curve is just north of the Gravelly Lake Drive Interchange with a radius of 1,910 feet.

Lane Widths

From a review of the as-built plans for I-5, all lanes are designed at 12-feet wide and meet current design requirements for interstate highways.

Shoulder Widths

For a six-lane or eight-lane limited access interstate, both right shoulder and left shoulder widths should be a minimum of ten feet. Through the JBLM area, I-5 has a left shoulder width of six to eight feet which is a design exception.

At the Main Gate interchange, the right shoulder width for the southbound loop on-ramp and loop off-ramp is listed as six feet. The current design standard for right shoulder width on ramps is eight feet.

Bridge Inventory

There are 24 bridges in the 10.8-mile stretch of I-5 between the Mounts Road/Old Nisqually Road Bridge over I-5 at milepost 116.7 and the SR 512 Bridge over I-5 at milepost 127.48. Table III-1 presents a list of these structures and indicates the year in which they were built.

Table III-1: Summary of Structures along I-5

Interchange Structures	Bridge Number	Year Built	Other Structures	Bridge Number	Year Built
Mounts Road/Old Nisqually Road	005/406	1967	Mounts Rd/BN Railroad	005/406A	1960
Center Drive	005/407	1997	BNSF Railroad	005/407.5	1957[1]
SB Deceleration Ramp	005/407S-N	1997	Truck Ramp UC JBLM	005/407A	1997
SB Acceleration Ramp	005/407S-S	1997	Pendleton Avenue	005/409	1957
Steilacoom-DuPont Road	005/408	1957	Gravelly Lake over RR	005/415A	1959
Main Gate	005/411E	1969	New York Avenue	005/416	1957
NBCD over 41st Division Drive	005/411NCD	1969	Clover Creek	005/417	1957[2]
SBCD over 41st Division Drive	005/411SCD	1954	47th Avenue SE	005/419	1957
Main Gate	005/411W	1954[1]	BNSF Railroad	005/420	1958
Berkeley Street	005/413	1954	South Tacoma Way	005/421	1958
Thorne Lane	005/414	1954			
Gravelly Lake Drive	005/415	1954			
Bridgeport Way	005/418	1958			
SR 512	512/001	1958			

Source: WSDOT, 2009.
[1] Bridge rebuilt in 1969.
[2] Bridge rebuilt in 1974.

Of these 24 bridges, 16 were built in or before 1960. Ten are currently considered functionally obsolete including: Center Drive, Steilacoom-DuPont Road, Pendleton Avenue, Berkeley Street, Thorne Lane, New York Avenue, Bridgeport Way, 47th Avenue SE, South Tacoma Way, and SR 512 .

Bicycle and Pedestrian Facilities

Bicycle and pedestrian facilities in the study area are limited, with significant gaps in system continuity. Bicycles are allowed on the section of I-5 south of the Gravelly Lake interchange and north of Martin Way in Lacey. A few of the local arterials and collectors crossing or paralleling I-5 include sidewalks and/or bicycle lanes, but there are no routes that provide a reasonable or continuous alternative to I-5. At the south end of the study area in DuPont, Wilmington Drive includes sidewalks on one or both sides between Center Drive and Steilacoom-DuPont Road, and bicycle lanes between Palisade Boulevard and Steilacoom-DuPont Road. Additionally, there is a multi-use path along Center Drive. Pacific Highway in Lakewood generally includes both bicycle lanes and sidewalks between Gravelly Lake Drive and north of Bridgeport Way to SR 512.

None of the I-5 interchanges through the study area includes bicycle lanes, but sidewalks and/or crosswalks with pedestrian signals are provided in five locations.

Railroads

There are three rail operators who use the Sound Transit rail line located adjacent to and west of I-5 within the study area, BNSF, Tacoma Rail, and Sound Transit. Tacoma Rail operates two to three trains per week on this line. In 2012, Sound Transit increased rail operations north of the corridor study area by extending commuter rail service to the Lakewood Station.

Currently, Amtrak regularly uses the BNSF mainline tracks along the Puget Sound coast operating 10 trains per day. With completion of the Point Defiance Bypass Project (currently in design) Amtrak rail service will be moved from the BNSF mainline tracks to the higher speed rail line along I-5. Construction is anticipated to begin in early 2015, and open to revenue service in 2017. The Point Defiance Bypass project will result in increased rail crossings occurring near each of the I-5 interchanges from Steilacoom-DuPont Road to D Street in Tacoma. Based on the *Point Defiance Bypass Project Environmental Assessment*, the additional train service will cause added delay at some at-grade crossings, but reduced delay at others with improved signal timings.

JBLM Access, Land Use, and Traffic

JBLM presents a complex traffic situation as a large employment center in a secure installation. JBLM is comprised of the former Fort Lewis Army Base and McChord Air Force Base, which recently merged together as a joint military installation. There are approximately 62,000 employees on the site with significant local housing demand. About 24 percent of housing demand by active duty military personnel is met with on-base housing. The rest of the military and civilian personnel and their families live off-base in local communities, such as Lacey, DuPont, Steilacoom, Lakewood, and other adjacent locations. The following sections discuss JBLM's key access and land use issues, and JBLM's effect on I-5 traffic flow.

JBLM Access

Travel to and from JBLM is a significant contributor to traffic volumes along the I-5 corridor. All vehicles must be processed through one of 17 active security gates located on the controlled perimeter of the base. These gates are illustrated in Figure III-3, excerpted from the *Joint Base Lewis-McChord Growth Coordination Plan, Transportation Technical Appendix*. Four of the highest volume JBLM Lewis gates are located within close proximity to the I-5 corridor (DuPont, Liberty / Lewis Main, 41st Street, and Madigan) and so is the high volume JBLM McChord Main Gate (Bridgeport Way). Other gate locations are served by Steilacoom-DuPont Road, 150th Street SW/ Perimeter Road, SR 507 and other roads. Some of these roadways are not designed to accommodate high volumes of traffic.

The physical limitations of the freeway interchanges and local streets in the vicinity of JBLM gates occasionally contributed to traffic queues extending back onto the surrounding roadway system. Long queuing has occurred primarily along I-5 off-ramps. Recent changes to gate operations have improved traffic queuing at ramps. However, day-to-day variability in gate traffic levels can occasionally result in queues that negatively impact ramp and/or freeway traffic.

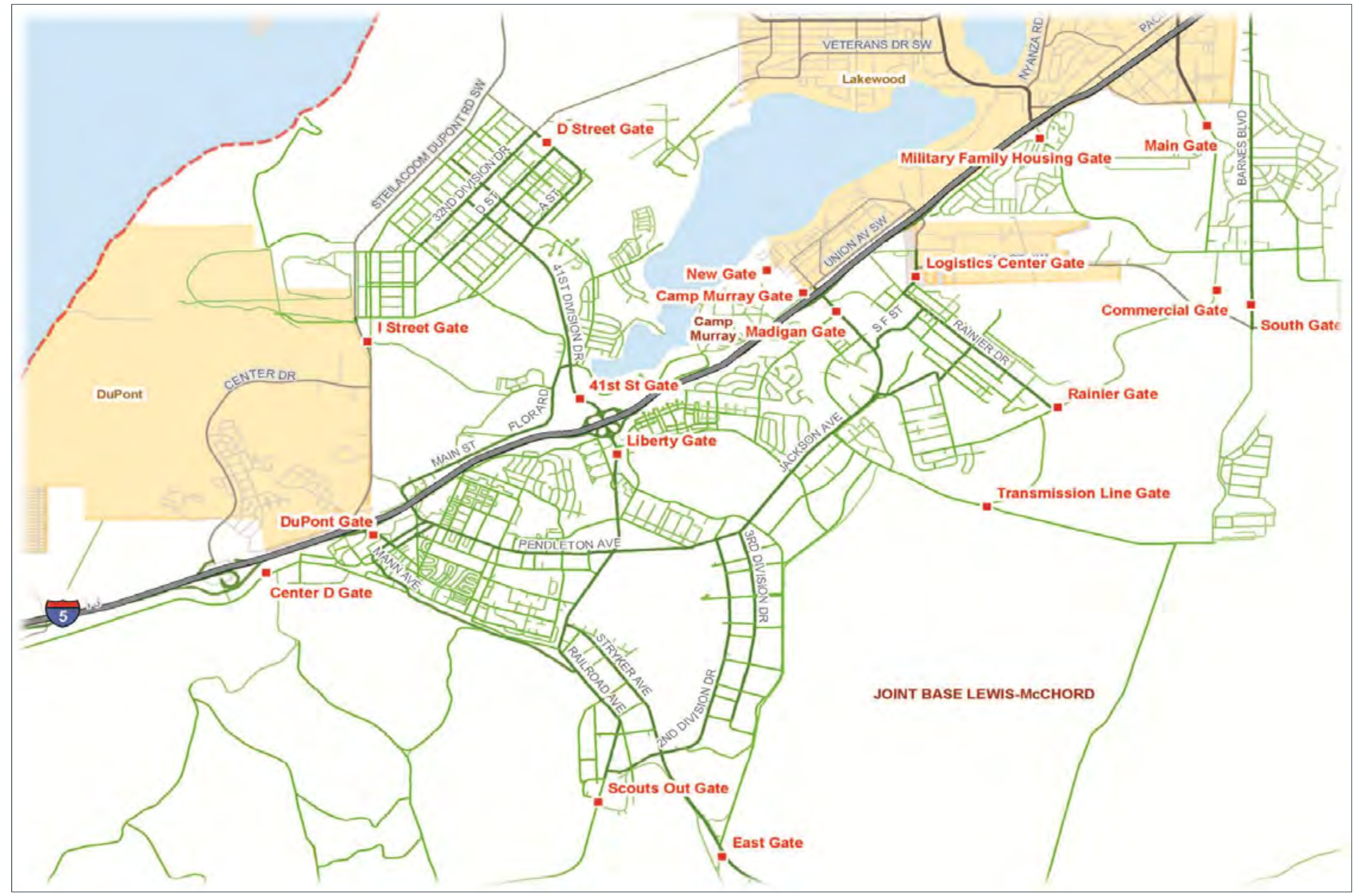
Existing JBLM gates in the corridor study area are discussed below.

Gates Accessing I-5

Six of the nine interchanges included in the corridor study area provide access to and from JBLM on the east side of I-5. The Main Gate interchange (Exit 120) also provides access on the west side of I-5 (Lewis North). With construction of the Wharf Gate on Steilacoom-DuPont Road (near the existing Wharf Road intersection), additional access to Lewis North would be available via the Steilacoom-DuPont Road interchange. In addition to these six gates, the Center Drive interchange provides peak period egress from the base.

Approximately 80 percent of the traffic to/from JBLM uses the I-5 corridor[2]. This is significant for understanding the impact of JBLM traffic on I-5, both today and in the

Figure III-3: JBLM and Camp Murray Gate Locations



Source: Joint Base Lewis McChord Growth Coordination Plan, Transportation Technical Appendix, The Transpo Group, December 2010.

future. A short discussion of each existing JBLM gate adjacent to the I-5 corridor and its function within the larger JBLM street system is presented below. A map of these gates is shown in Figure III-3.

- Center Drive Gate (Lewis) at the Center Drive Interchange (Exit 118) – This gate is located adjacent to the east side of I-5 and has only recently been opened to accommodate PM peak traffic exiting from JBLM. Its purpose is to help mitigate existing traffic congestion at the DuPont Gate (I-5 exit 119) by providing an alternative I-5 access for traffic traveling to the south. Center Drive is a one-way westbound road with an intersection at Railroad Avenue, an internal JBLM circulation road that connects to other parts of the base. The Center Drive access point to the interchange is non-traditional with a stop-controlled intersection on the northbound ramp.
- DuPont Gate (Lewis) at the Steilacoom-DuPont Road interchange (Exit 119) – This gate is situated on the east side of I-5 and connects to Clark Road which accesses the southern and western portions of the base, and connects to the full internal on-base street system. This gate serves as the primary access location for JBLM I-5 traffic to and from Thurston County. With the construction of the Wharf Gate (near the existing I Street Gate on Figure III-3), additional access to Lewis North would be available via the Steilacoom-DuPont Road interchange.
- Main/Liberty Gate (Lewis) and 41st Street Gate (Lewis North) at the Main Gate interchange (Exit 120) – Two gates are located at this interchange, one on each side of I-5. The Main/Liberty Gate is located on the east side of I-5 and serves as the major access point to the heart of Lewis Main. The gate connects directly with 41st Division Drive from which all destinations within JBLM can be reached and serves approximately one-third of all traffic destined to and from JBLM. The 41st Street Gate is located on the west side of I-5. It connects with 41st Division Drive and serves as the major access point to the Lewis Fort area.

[2] *Joint Base Lewis McChord Growth Coordination Plan, Transportation Technical Appendix*, The Transpo Group, December 2010.

- Madigan (Lewis) and Camp Murray Gates at the Berkeley Street interchange (Exit 122) – Two gates are located at this interchange, one on the east side to JBLM (Madigan) and one on the west side to Camp Murray. The Madigan Gate connects to I-5 via Berkeley Street which becomes Jackson Avenue east of I-5. The Madigan Gate is the primary access from I-5 for JBLM traffic to and from Pierce County and other destinations to the north. It also directly serves the Madigan Army Medical Center, a major on-base destination, and connects to the heart of Lewis Main.

  The Camp Murray Main Gate has recently been relocated to Portland Avenue further away from I-5. The gate provides access to all portions of Camp Murray which is owned by the State of Washington and operated by the Washington Military Department. The Camp Murray main gate was originally located immediately adjacent to and west of the I-5 interchange. This older gate now provides secondary access, principally for freight deliveries.

- Logistics Gate (Lewis) at the Thorne Lane interchange (Exit 123) – This gate is located some distance from I-5. East of the interchange Thorne Lane becomes Murray Road SW which connects both to the Logistics Gate and to a portion of the Lakewood that is located east of the freeway. Murray Road SW also connects to the 150th Street SW/Perimeter Road corridor that provides a connection to McChord Field.

- Family Housing Gate (McChord) at the Gravelly Lake Drive interchange (Exit 124) – This gate is located adjacent to the east side of I-5 at the Gravelly Lake Drive interchange. This gate primarily serves the residential portion of McChord Field and connects to Lincoln Boulevard SW which provides access throughout McChord Field.

- Main Gate (McChord) at the Bridgeport Way interchange (Exit 125) – This gate is located slightly east of I-5. It is accessed via Bridgeport Way which also serves another small portion of Lakewood located east of the freeway. At the McChord Main Gate, Bridgeport Way becomes Main Street and serves the heart of McChord Field.

JBLM Land Use Considerations

Currently 24% of active military personnel assigned to JBLM live in housing on base. Existing military housing on JBLM is currently leased to a private firm for operation and management. Figure III-4 shows in yellow the location of existing leased housing. The housing lease was signed for a 50-year period expiring in 2052. Acquiring use of this land for freeway widening or other improvements will require one-to-one replacement. Replacement must occur elsewhere on the base where existing land is suitable for residential dwellings. If existing housing units are displaced and not replaced, the lease holder is entitled to full payout of the lease terms through 2052. In addition to housing replacement or lease payout, the Department of the Army must agree to expansion of the existing highway easement for highway purposes.

Figure III-4: Location of Existing Leased Housing on JBLM

JBLM Traffic Levels and Patterns

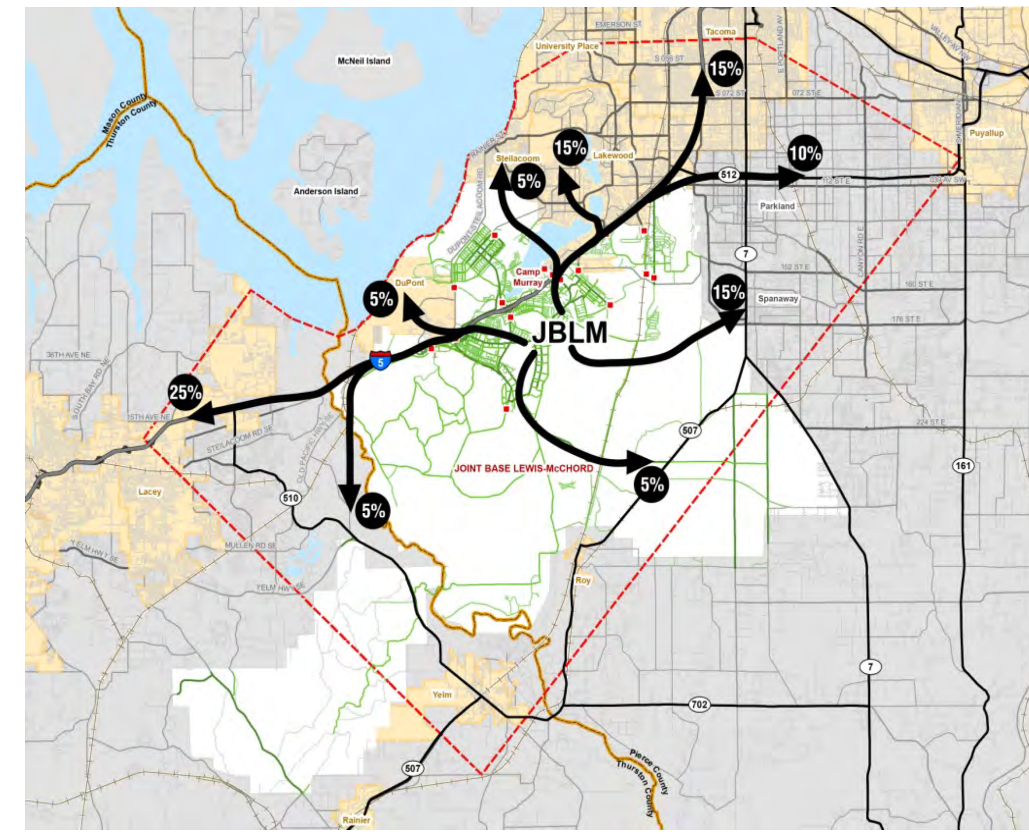
As indicated in the application for TIGER III grant funding of I-5 JBLM area improvements dated October 31, 2011, traffic volumes along I-5 have increased at approximately two percent per year prior to 2010. This traffic increase was, by itself, a significant source of growing congestion in the corridor. In 2003, the Base Realignment and Closure Commission (BRAC) made decisions that ultimately added more than 36,000 soldiers, family members and civilian employees to the JBLM population. This represents a net increase of 35 percent for JBLM. As of 2011, more than 152,000 vehicles traveled through JBLM gates each day with 80 percent using the I-5 corridor (see Figure III-5 for a map of the current distribution pattern of JBLM trips). It should be noted that, while there is extensive on-base housing for use by military personnel, 76 percent of active duty military and civilian personnel live off-base and must regularly commute to and from work.

According to the TIGER III grant application, the combination of regional and JBLM traffic growth both contribute to the current level of congestion. Continued fluctuation in JBLM population along with regional traffic growth will exacerbate existing problems in the future.

Some of the key challenges that must be addressed in developing improvement recommendations include:

- Severe congestion has become a phenomenon that can occur any time of day which significantly affects travel reliability.
- The unique geography of the area and military land use activities limit development of alternate routes to I-5.
- Three of the four primary interchange structures providing access to JBLM are functionally obsolete.
- Approximately 80 percent of JBLM traffic currently uses I-5 for trips to/from the Base with the remainder leaving to the south and east, primarily via the SR 7 and SR 507 corridor.
- The corridor study area is outside the existing limits of the WSDOT Core HOV system for the Puget Sound region.

Figure III-5: Distribution of JBLM Traffic



Source: Joint Base Lewis McChord Growth Coordination Plan, Transportation Technical Appendix, The Transpo Group, December 2010.

I-5 Traffic Volumes and Performance

Existing I-5 traffic mobility conditions were analyzed based on traffic data collected from permanent counters along I-5 at two locations and from intersection turning movement volumes at the nine interchanges and other key intersections near I-5 through the corridor study area. This data was collected in early 2013.

Existing traffic mobility performance along I-5 through the study area focused mainly on evaluation of the freeway mainline and weaving merge/diverge areas. Additional analysis was conducted for ramps and ramp termini intersections to provide a more complete picture of existing traffic congestion and system deficiencies. Traffic performance was measured primarily in terms of traffic volumes, travel speeds, travel time, hours of congestion, ramp volumes, merging and weaving, and person trips.

I-5 Mainline Travel Volumes

Northbound and southbound vehicle trips along I-5 during the AM, midday and PM peak hours are illustrated in Figure III-6. The average traffic volume per highway lane during these peak hours are shown in Figure III-7. The practical capacity of a general purpose lane along this section of I-5 was estimated at about 1,800 vehicles per hour (vph) given the higher amounts of merging and weaving in the corridor. Level of service (LOS) E is reached at about 90 percent of this capacity, or about 1,620 vehicles per hour. This is equivalent to 4,860 vph in the three lane areas and 6,480 vph in the four lane area. This capacity value is relatively low for a typical freeway section, but is appropriate for use here as it is consistent with field collected traffic volume data on maximum hourly vehicle throughput in congested locations.

From a review of the charts in Figures III-6 and III-7, the northbound traffic during the AM peak is at or above the threshold in the three lane section from Mounts Road to Thorne Lane. In the southbound direction, traffic is generally below these limits except for the area between Thorne Lane and Berkeley Street. During the midday peak, the traffic volumes on I-5 are generally below these thresholds in both the northbound and southbound directions.

During the PM peak, the southbound traffic is higher than these thresholds in the three lane section from the Main Gate interchange to Mounts Road, and from Berkeley Street to Thorne Lane in the northbound direction.

Daily traffic volumes along I-5 through the study area also show significant increases resulting from JBLM-related traffic in this area. In 2012 average daily traffic volumes (ADT) at the south end of the corridor study area were 111,000 at the Mounts Road interchange. Volumes in the core area increased to 134,000 ADT north of Berkeley Street and 143,000 ADT north of Thorne Lane[3].

Truck traffic is also a significant component of the vehicle mix on I-5 through the study area. Trucks accounted for 12 percent of total daily traffic on I-5 north of the Steilacoom-DuPont Interchange (Exit 119) of which 7 percent were doubles or triples.

Trucks accounted for 10 percent of total daily traffic north of the Bridgeport Interchange (Exit 125) of which 5 percent were doubles or triples.

Figure III-6: Existing I-5 Traffic Volumes by Direction through Corridor Study Area

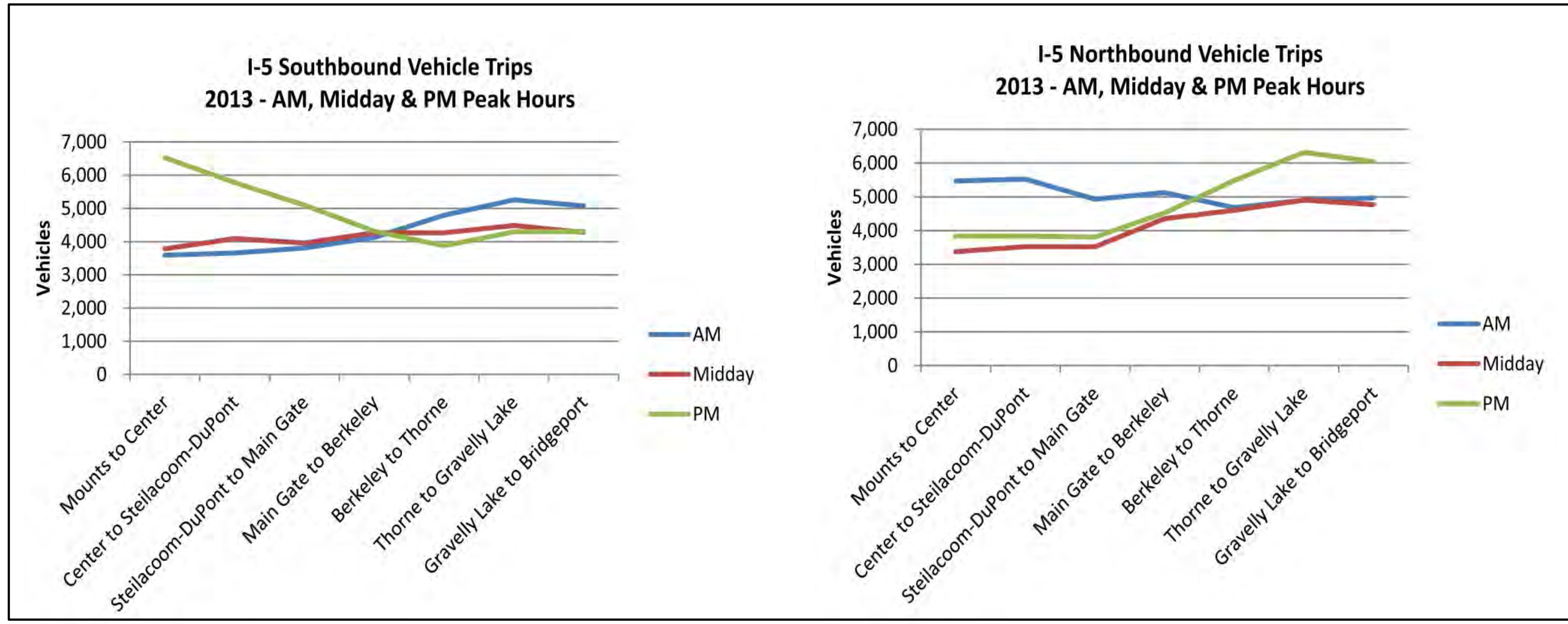
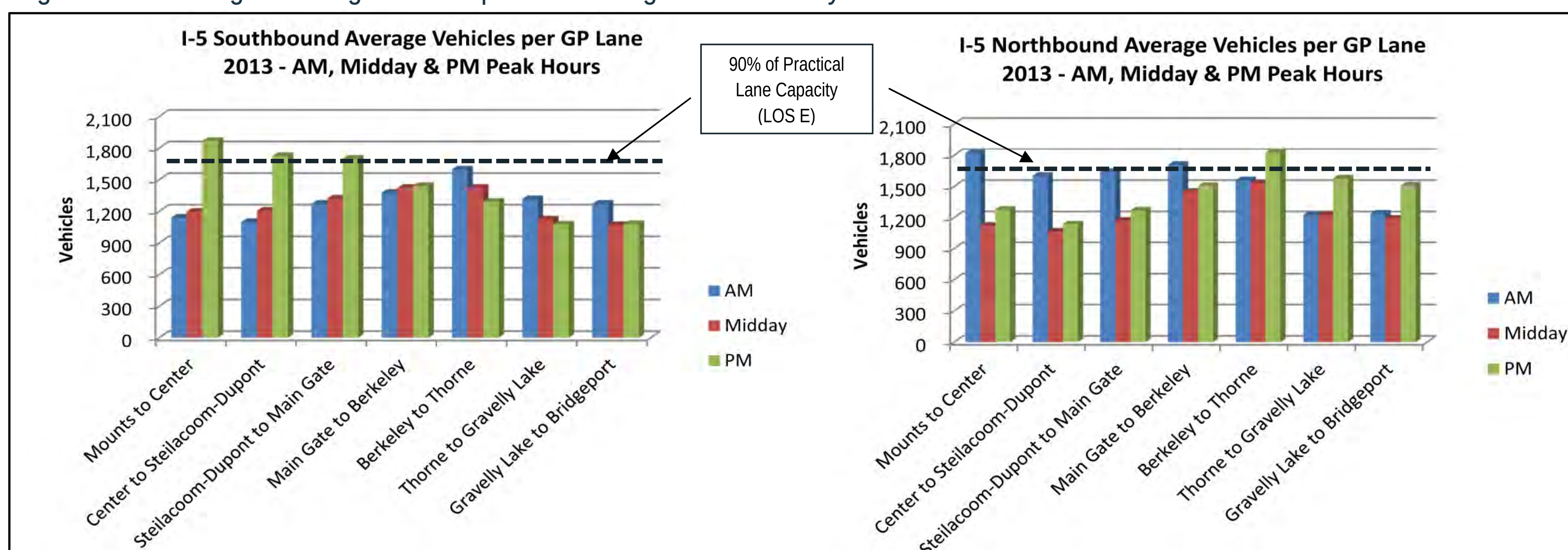


Figure III-7: Existing I-5 Average Vehicles per Lane through Corridor Study Area



[3] *Annual Traffic Report 2012*, WSDOT, 2013.

Mainline and Ramp Traffic Patterns

Figure III-8 shows 2013 AM and PM peak hourly traffic volumes along the I-5 mainline and ramps.

As indicated in this figure, there is a notable directionality in peak period traffic through this area, focused largely on the segment that includes the Main Gate and Berkeley Street interchanges (Exits 120 and 122, respectively). In the AM peak hour, northbound traffic volumes on the mainline tend to grow through the study area until experiencing a large drop with traffic exiting at Steilacoom-DuPont Road (Exit 119). After this point there is a slight increase in traffic from the Steilacoom-DuPont Road and Main Gate interchanges with another big drop at Berkeley Street (exit 122). In the southbound direction large drops in mainline traffic are experienced at Thorne Lane (Exit 123) and Berkeley Street (Exit 122). This traffic pattern is indicative of the significant impact caused by morning peak hour traffic entering JBLM.

During the PM peak hour, traffic directionality is reversed with the highest volumes in the corridor occurring in the northbound direction from Berkeley Street north. A large number of vehicles enter the I-5 mainline heading north at Berkeley Street (Exit 122), Main Gate (Exit 120) and Thorne Lane (Exit 123). In the southbound direction, a significant volume of traffic is added at Main Gate (Exit 120), Steilacoom-DuPont Road (Exit 119) and Center Drive (Exit 118). This pattern is indicative of the high traffic volumes leaving JBLM at the end of the workday.

Traffic volumes in the study area include a combination of three types of trips that are grouped depending on where they begin and/or end. These groups include: local trips, regional trips and IE (or internal/external) trips which are defined below.

- Local Trips — Refers to trips that begin and end within the study area (e.g., DuPont to McChord Field or Steilacoom to Madigan Hospital)
- Regional Trips — Refers to trips that pass through the study area without stopping (e.g., Olympia to Seattle or Renton to Lacey)
- IE (Internal/External) Trips — Refers to trips that have one end located in the study area and the other end outside (e.g., Olympia or Tumwater to JBML or DuPont to Tacoma)

Using select link output from the 2010 base year travel demand model developed for forecasting future traffic volumes, an analysis was made of the typical peak hour movement of vehicles along the corridor. (Refer to Chapter IV, Travel Forecasting.)

This analysis yielded the following information:

- On I-5 south of Mounts Road approximately 50 percent of the total AM and PM peak period northbound or southbound volumes represent regional traffic – that is, that it passes through the study area without a stop.
- At the same location in both directions, the other 50 percent of AM or PM peak period traffic on I-5 represents I-E traffic, that is, vehicles that have one end of their trip within the study area. This traffic travels to or from one of the interchanges along I-5 between Mounts Road and Bridgeport Way, inclusive.
- North of Bridgeport Way, peak period traffic is more directional. During the AM peak period approximately one third of total volumes on I-5 heading southbound is regional traffic. Fully two-thirds are I/E trips, destined for study area interchanges. In the PM peak period, the opposite occurs with northbound I-5 regional traffic representing about one third of total volume and I/E traffic representing two-thirds.
- In several locations, there is a significant volume of local trips – that is trips made entirely within the study area. For example:
  - o Approximately two-thirds of northbound traffic exiting Bridgeport Way in the PM peak comes from the seven interchanges along I-5 to the south

Figure III-8: 2013 Peak Hour Traffic Volumes on I-5 and Ramps

(e.g., Mounts Road through Gravelly Lake Drive). Nearly 50 percent of the traffic exiting at Bridgeport Way comes from either the Main Gate Interchange or the Thorne Lane Interchange. A similar pattern of traffic occurs in the PM peak southbound at the Mounts Road exit, with approximately 50 percent of the total exiting volume at Mounts Road coming from the three interchanges immediately north (Center Drive, Steilacoom-DuPont Road or Main Gate).

- Approximately 80 percent of the traffic exiting northbound at Gravelly Lake Drive in the PM peak comes from study area interchanges immediately to the south. A similar, but reversed pattern occurs for southbound AM peak traffic entering the freeway at Gravelly Lake Drive and traveling to one of the six study area interchanges to the south.
- Approximately one-third of both northbound and southbound AM and PM peak period traffic using the Main Gate interchange is destined to other study area interchanges, while two-thirds leaves the study area.

Travel Speeds along I-5 through JBLM Area

Existing speed data was obtained from INRIX which measures and records minute-by-minute real time travel data using a large number of in-vehicle GPS probes. INRIX data can also be used to identify incident locations and assess the severity of abnormal traffic behavior. An example of the speed data for a single time period from INRIX (Thursday, Marcy 19, 2013) is illustrated in Figure III-9 for I-5 from the SR 512 Interchange (Exit 127) to the Nisqually Interchange (Exit 114) in Thurston County. In this example, the southbound speeds from Gravelly Lake Drive to south of the Main Gate interchange range from 10 mph to 30 mph for the period from 3:30 PM to 6:30 PM.

In the northbound direction these slow speeds extend from Steilacoom-DuPont Road to Thorne Lane with some additional delays south of SR 512. These slow speeds last from 4:15 PM to 6:45 PM.

Using INRIX data accumulated over thirty weekdays in January and February of 2013, average speed data for AM, midday and PM peak periods along I-5 through the study area was estimated and is shown in Figure III-10.

In WSDOT's Highway System Plan 2007 – 2026, WSDOT uses 70 percent of posted speed (42 mph) to signify when significant congestion occurs or what is defined as LOS F (see Glossary on page vi to a definition of LOS categories). During the AM peak hour, travel speeds in both directions are above this threshold; although the southbound speed between Gravelly Lake Drive and Thorne Lane drops under 50 mph. This is probably because the number of lanes on I-5 transitions from four lanes to three lanes at this location and drivers are shifting lanes to continue south on I-5 creating friction that reduces overall travel speeds.

During the midday peak hour, the data shows that average speeds are around 60 mph in both directions.

Figure III-10: Average Speeds along I-5 during the AM and PM Peak Hours

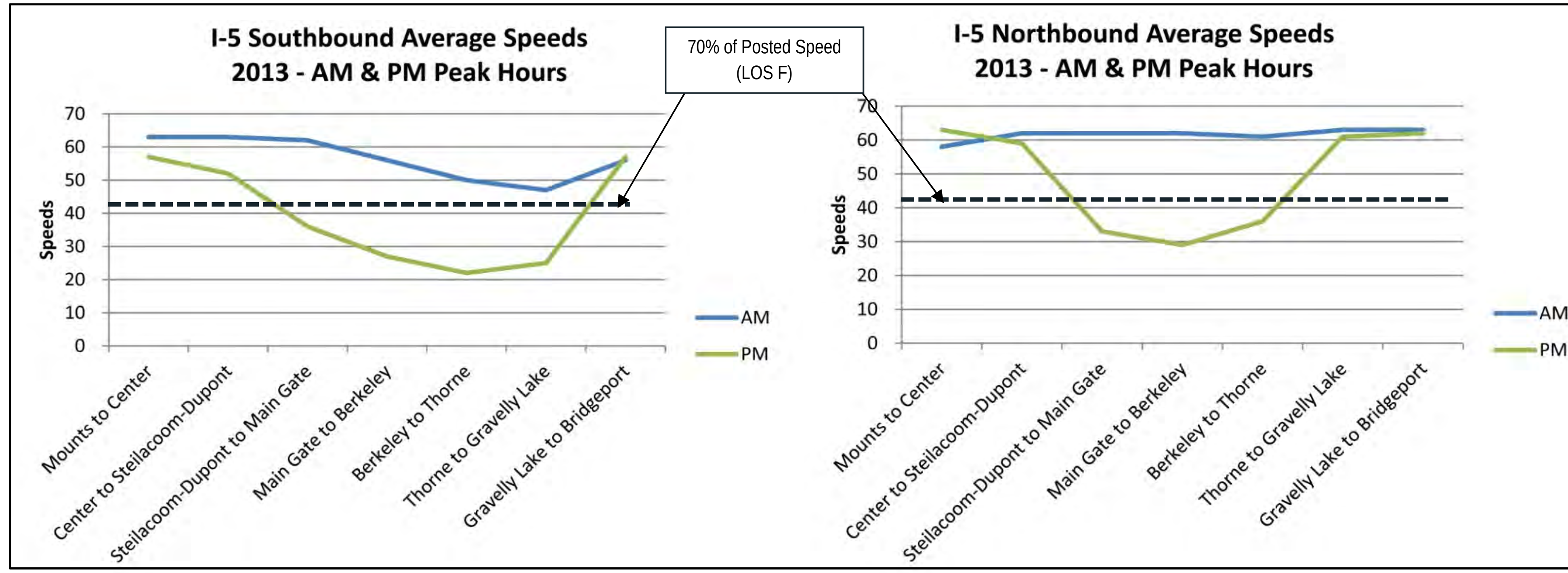
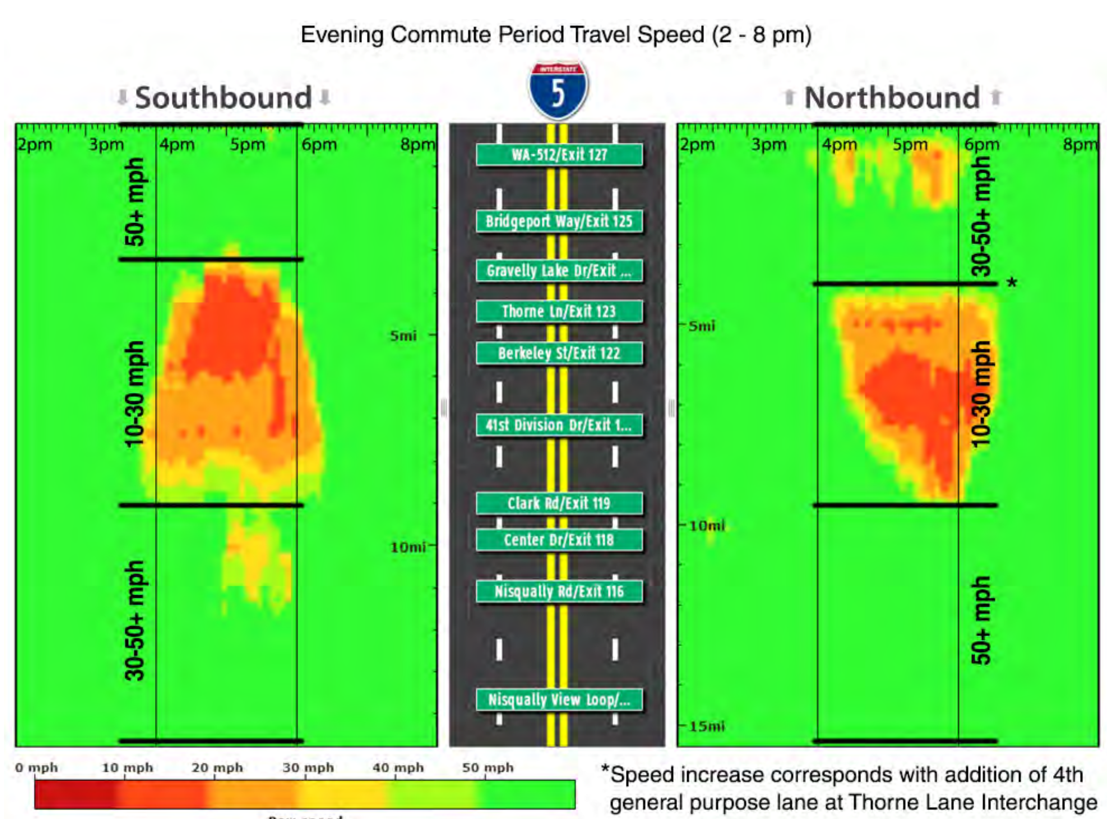


Figure III-9: PM Peak Period Sampling of Speeds: MP 114 to MP 127 (Thursday March 19, 2013)



During the PM peak hour, a significant drop in travel speeds is currently observed in the northbound direction along the I-5 mainline from north of Steilacoom-DuPont Road to Thorne Lane. This is attributable to both the three lane configuration and heavy entering traffic volumes between Steilacoom-DuPont Road and Berkeley Street. North of Thorne Lane, I-5 widens to include four through lanes, which accounts for the measurable increase in average speeds. In the southbound direction speeds drop considerably approaching Thorne Lane because of the reduction from four through lanes to three lanes and heavy entering traffic volume, and the speed drop continues to Steilacoom-DuPont Road.

Hours of Congestion

Because of the high traffic demand, congested speeds occurring along I-5 extend well beyond the AM and PM peak hours. To estimate how many hours are congested, an operational analysis was conducted using the existing hourly traffic distribution from two permanent counters located in the study area. For this analysis, the hours of congestion along I-5 are based on the number of hours that the average per lane volume exceeds 90 percent of the practical general purpose lane capacity.

From a review of the traffic data along the corridor, traffic congestion in the morning at the most heavily impacted location lasts at least two hours. During the afternoon/evening hours, traffic congestion lasts at least three hours. This is a recurring pattern of traffic which is exacerbated by traffic incidents.

I-5 Travel Time

INRIX data was also used to determine existing northbound and southbound travel time through the study area with a particular focus on the AM, midday and PM peak hours. Table III-2 summarizes this data and compares peak hour travel times with off-peak times.

Table III-2: 2013 Average Corridor Travel Times*

	Northbound		Southbound	
Time Period	Travel Time (In minutes)	Increase Over Off-Peak	Travel Time (In minutes)	Increase Over Off-Peak
AM Peak Hour	10.53	4%	9.64	6%
Midday Peak Hour	10.47	3%	9.31	2%
PM Peak Hour	17.69	75%	16.04	76%
Off-Peak (8pm-5am)	10.13		9.10	

* Travel time is measured from the Mounts Road Bridge over I-5 to south of the SR 512 interchange

During both the AM and midday peak periods, drivers experience only slightly longer travel times through the corridor. However, the effects of the congestion during the PM peak hour increase travel times approximately 75 percent.

Person Trips

Person trips along I-5 for the existing 2013 analysis period are based on an auto occupancy rate of 1.25 persons per vehicle. This rate was then applied to the vehicle trips along I-5 and the resultant person trips are illustrated in Figure III-11. Southbound person trips during the AM peak hour range from about 6,600 persons near Gravelly Lake Drive to about 4,300 persons at Mounts Road. Northbound person trips along I-5 remain fairly constant at about 6,000 to 7,000 persons. Person trips for both directions during the midday peak hour range from 4,000 persons to 6,000 persons. The total number of person trips in the corridor does not include transit, but does include vanpools.

During the PM peak hour southbound person trips range from about 5,400 persons at Bridgeport Way to 8,200 persons at Mounts Road. Persons travelling northbound on I-5 increases from about 4,800 persons at Mounts Road to about 7,900 persons at north of Thorne Lane.

Factors Affecting Traffic Operations

An evaluation of previous traffic data within the study area leads to a variety of conclusions concerning the transportation system needs and deficiencies and their impact on traffic flows through the JBLM area. Some of the key conditions along the I-5 corridor within the study area include:

- Growth in traffic volumes
- Change in the number of I-5 through lanes at Thorne Lane
- Limited alternative routes because of JBLM and geography in the area
- Heavy on and off-ramp volumes comprised of regional, IE, and local trips resulting in high level of merge and weave activity
- High freight volumes

Growth in Traffic Volumes

There has been a significant increase in traffic volumes over the past 25 years, and accompanying congestion impacts within the corridor study area (see Figure I-2). This growth is associated with increased through traffic, local community development, and JBLM commute patterns.

These higher traffic volumes:

- Reduce the gap distance between vehicles
- Make it more difficult for drivers to change lanes safely and to recover from traffic collisions
- Cause drivers to slow down or stop as other drivers try to change lanes with smaller gaps

These congested conditions have resulted in a large number of rear-end and sideswipe collisions through the study area, as discussed later in the report.

Change in the Number of Through Lanes

Another contributing factor attributed to existing congestion levels in the study area is the effect of the transition from three through lanes in each direction to four through lanes at the Thorne Lane Interchange. In the southbound direction, the effects of this lane drop can be seen in peak period travel speed reduction between Steilacoom-DuPont Road and Gravelly Lake Drive. These slowing speeds can be partially attributed to the merging of traffic from four lanes to three lanes.

In the northbound direction, the three lane section results in slow travel speeds from Thorne Lane south to Steilacoom-DuPont Road. North of Thorne Lane, where I-5 widens to four lanes, speeds increase.

Limited Alternative Routes through Secure Military Installation

Figure III-12 shows the key transportation routes in the vicinity of JBLM. As is apparent from this graphic, there are few existing alternatives to using I-5 when traveling north/south between Olympia and the Tacoma/Lakewood area. This lack of alternatives concentrates travel through the I-5 corridor and affects both regional through traffic, as well as traffic heading to or between various destinations within the study area.

Figure III-11: Estimated Person Trips along I-5 during Peak Hours

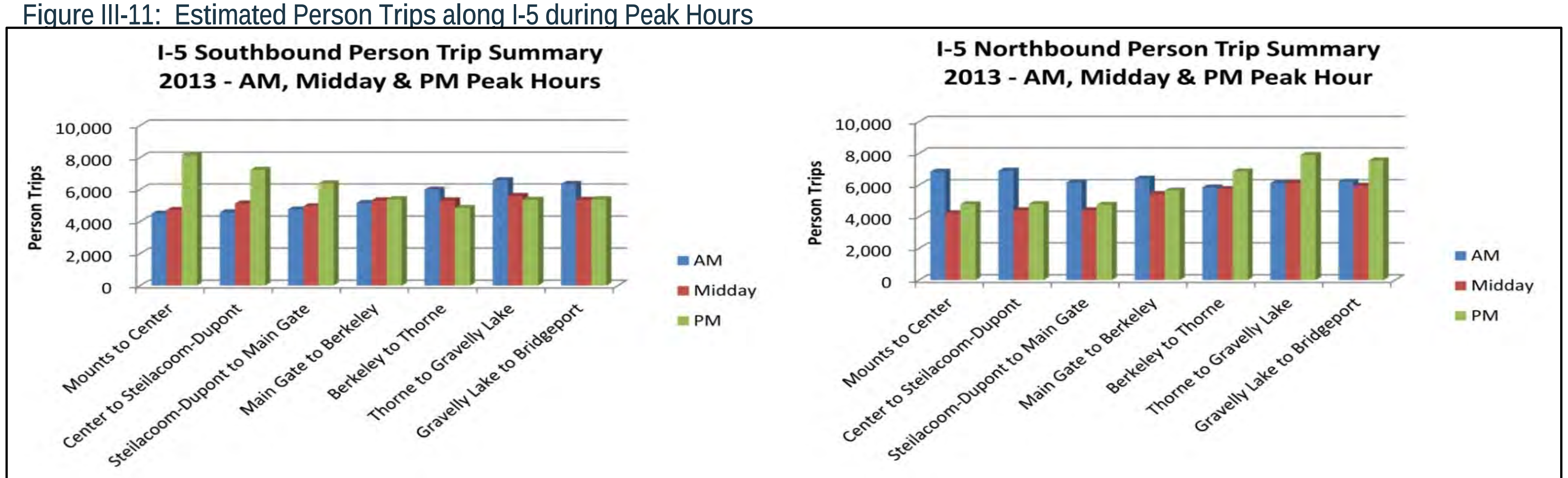
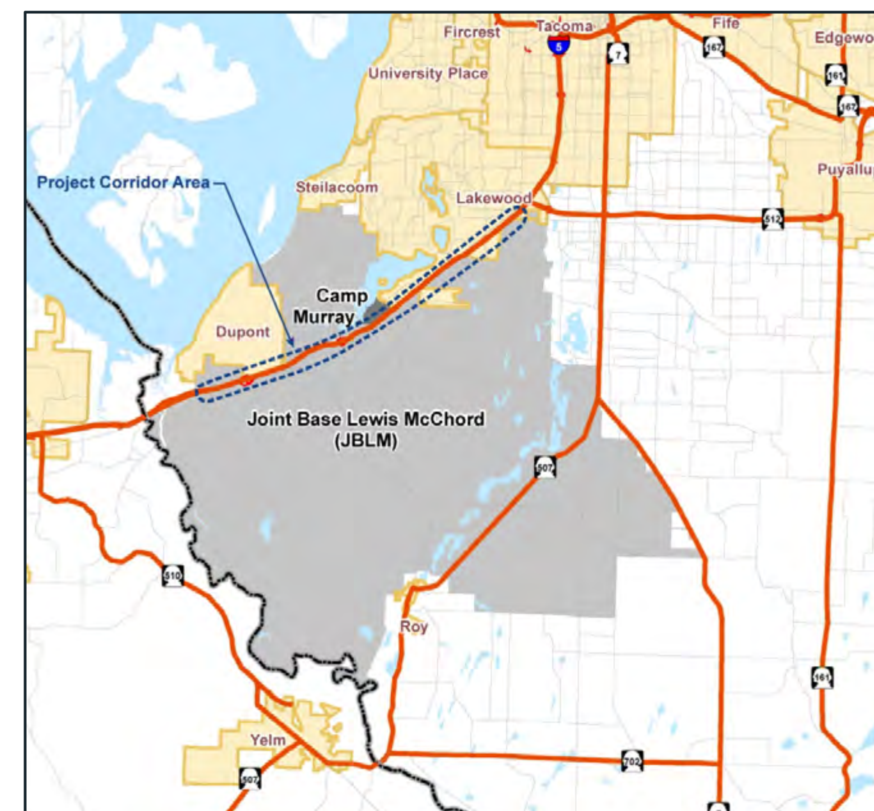


Figure III-12 Limited Highway Alternatives to Using I-5



Heavy On- and Off-Ramp Volumes

Another cause for congestion along I-5 through the study area is the high volume of traffic entering or leaving the freeway during peak hours. These volumes are illustrated in Figure III-13. In the southbound direction during the AM peak hour there are five locations where over 500 vehicles currently exit I-5. At two locations, when this exiting volume is combined with a high level of entering traffic at the upstream interchange, significant congestion occurs. In particular, on I-5 between the Gravelly Lake Drive on-ramp and the Thorne Lane off-ramp there is a combined total of 1,325 entering and exiting vehicles which constitutes approximately ¾ of the capacity of a single travel lane. In the northbound direction during the AM Peak hour, there is a high combined volume of on- and off-ramp traffic of over 1,400 vehicles on I-5 between the Main Gate and Berkeley Street interchanges, and of over 1,200 vehicles between Gravelly Lake Drive and Bridgeport Way. At the first location this combined volume equates to over 80 percent of single lane capacity, and nearly 70 percent at the second location. When the outside lane cannot handle these volumes, some drivers must change lanes when entering or exiting I-5. This causes side friction along the highway, slows traffic, and creates congestion.

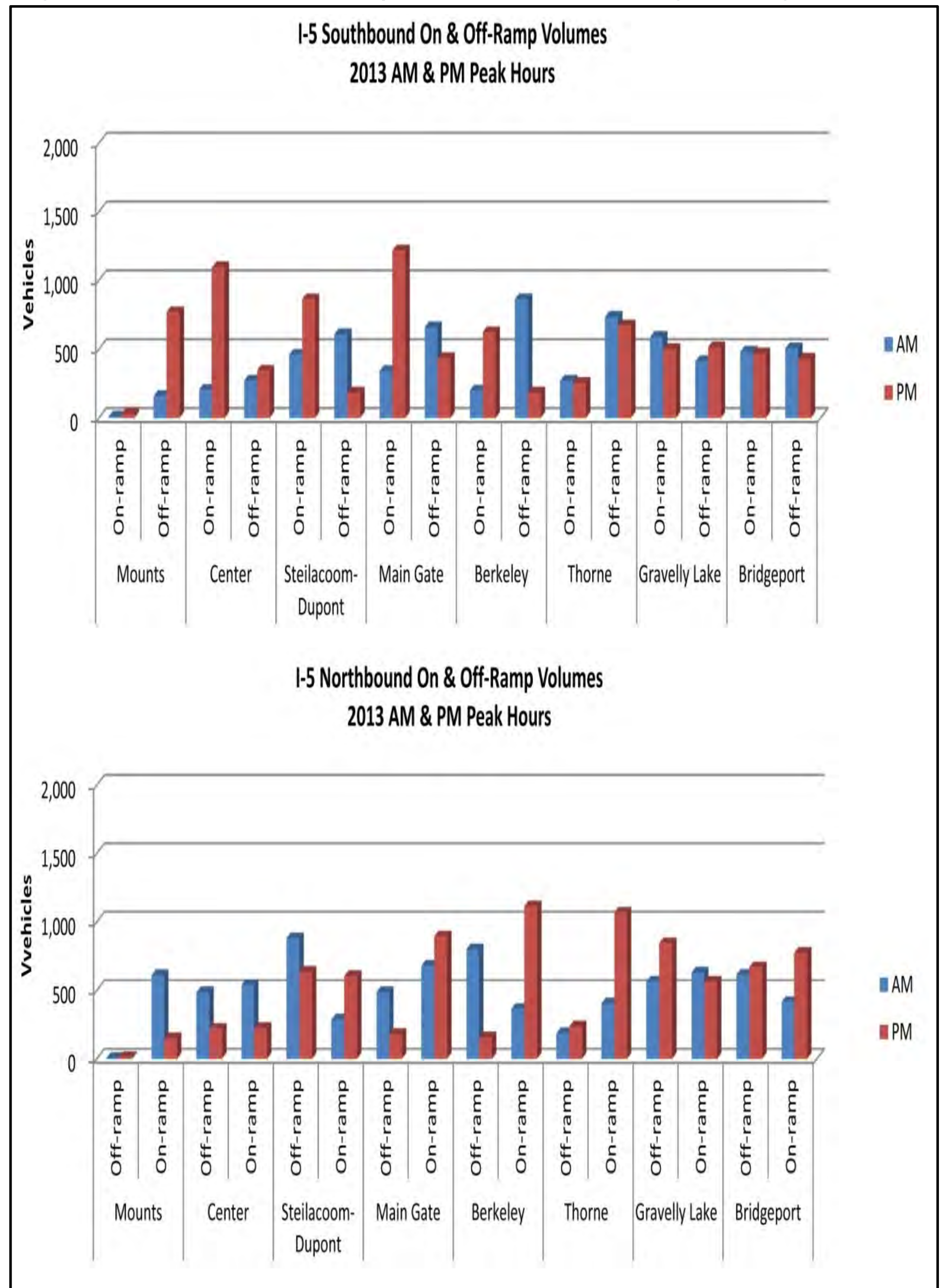
Similarly during the PM peak hour in the northbound direction, there are six locations where entering or exiting volumes exceed 500 vehicles per hour; in fact, in some locations entering volumes exceed 1,000 vehicles. At the same time, there are over 500 peak hour vehicles exiting I-5 at three locations. For three segments of I-5, there is a combined total of entering and exiting traffic that exceeds 1,100 vehicles. These locations are between Berkeley Street and Thorne Lane, between Thorne Lane and Gravelly Lake Drive, and between Gravelly Lake Drive and Bridgeport Way. At the first and third of these segments, combined volumes represent approximately 70 percent of single lane capacity. At the second location, the combined volumes are sufficiently high to result in complete saturation of the outside travel lane forcing lane changing maneuvers.

Travelling southbound on I-5 during the PM peak hour, drivers must contend with over 500 vehicles merging onto I-5 at five locations. Traffic volumes entering I-5 from Main Gate exceed 1,200 vehicles in the PM peak hour. Additionally, at three locations there is a high volume of peak hour exiting traffic ranging from 500 to 800 vehicles. In the segments between Gravelly Lake Drive and Thorne Lane, between 41st Division Drive and Steilacoom-DuPont Road, and between Steilacoom-DuPont Road and Center Drive the combined total of entering and exiting traffic represents between 65 and 80 percent of the capacity of a single travel lane. For the freeway segment between Center Drive and Mounts Road, the combination of entering and exiting traffic exceeds the functional capacity of a single travel lane forcing lane maneuvering. The combination of heavy on- and off-ramp traffic volumes results in lane changes that cause traffic to slow, increase congestion, increase the likelihood for collisions, and reduce per lane capacity for I-5 through the study area.

Based on an assessment of this data, key findings about existing traffic levels and trip patterns along I-5 through the corridor study area include:

- There is a high number of local or I-E trips along the corridor in comparison with the number of regional through trips.
- There is a heavy volume of local trips entering or exiting I-5 within the study area.
- There is a high level of weaving and merging traffic entering and leaving I-5 that affects through traffic mobility.

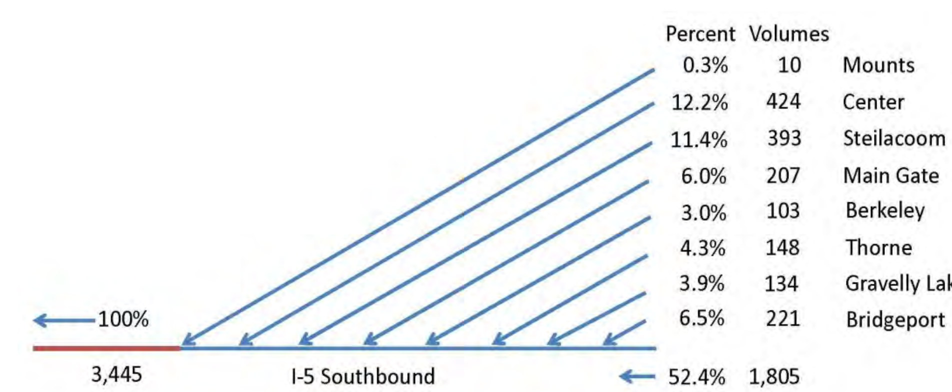
Figure III-13: On and Off-Ramp Volumes at Interchanges along I-5



High Number of Local or IE Trips Relative to Regional Through Trips - Approximately 50 percent of northbound and southbound peak period traffic on I-5 south of Mounts Road comes from or is going to destinations within the study area (e.g., local or I-E trips). The other 50 percent are regional trips traveling regionally through the study area. This is illustrated in Figure III-14 which shows the origin for 2013 AM peak hour traffic on southbound I-5 south of Mounts Road. Approximately 50 percent is already on I-5 north of Bridgeport Way and the other 50 percent enters I-5 using the on-ramps at the eight study area interchanges. A similar pattern of traffic is observed in the opposite direction on I-5 north of Bridgeport Way. This high level of I-5 on and off ramp activity along the freeway, contributes to congestion by requiring a large number of vehicles to merge or exit I-5, resulting in frequent lane changes to accommodate entering or exiting traffic. All travel lanes are affected by these lane changes.

This mix of local, I-E and regional traffic contributes to the number of collisions along I-5, especially rear end crashes and sideswipes. Both collision types are indicative of high level of congestion with frequent lane changes.

Figure III-14: Origin of AM Peak Hour Volumes on SB I-5 South of Mounts Road



Heavy Volume of Local Trips Using I-5 – As noted previously, a significant share of the total trips on I-5 are local trips, many of which are relatively short in terms of the distance traveled. These trips result from the limited number of local roads passing in and through the secure JBLM installation that often makes I-5 the most attractive or only reasonable travel route for local trips. Some of these trips are military personnel travelling between home and JBLM, or between areas within the expansive JBLM facility for a variety of purposes including meetings, meals, or physical training. Examples of these types of trips include:

- About two-thirds of northbound traffic exiting at Bridgeport Way in the PM peak comes from the seven interchanges along I-5 to the south (e.g., Mounts Road through Gravelly Lake Drive). Nearly 50 percent of the traffic exiting at Bridgeport Way comes from either the Main Gate Interchange or the Thorne Lane Interchange and is headed to housing and shopping destinations within the civilian community.
- Nearly 70 percent of the PM peak southbound traffic on the Mounts Road exit comes from within the study area, with approximately 50 percent of the total off volume at Mounts Road coming from three interchanges immediately north (Center Drive, Steilacoom-DuPont Road or Main Gate) and is headed to civilian destinations in Thurston County.
- Over 80 percent of the traffic exiting northbound at Gravelly Lake Drive in the PM peak comes from study area interchanges immediately to the south and is headed to civilian destinations. A similar, but reversed, interaction occurs for southbound AM peak traffic entering the freeway at Gravelly Lake Drive from civilian destinations and traveling to one of the six study area interchanges to the south.

Some of these local trips likely use I-5 as there are no or only limited alternatives for traveling between destinations within the study area. These trips contribute to the overall congestion and safety problems experienced in the corridor.

High Level of Weaving and Merging Activity - Certain portions of the I-5 mainline in the study area currently experience high level of weaving and merging activity which contributes to high congestion, low speeds, and high collision numbers in the corridor. Two of these locations are illustrated in the figures below.

Figure III-15 shows the number of northbound drivers weaving between Berkeley Street and Gravelly Lake Drive during a typical 2013 PM peak hour. Within a 1.5-mile distance over 3,200 drivers are weaving on or off I-5 and merging with through traffic. This "side friction" creates a similar pattern of weaving and merging during the PM peak hour in the southbound direction between Steilacoom-DuPont Road and Mounts Road, as illustrated on Figure III-16. Within a 1.5-mile segment of the freeway, over 3,000 drivers are weaving on or off I-5 and merging with through traffic. The outside auxiliary lane cannot handle these volumes; so some drivers must change lanes, causing side friction and slowing traffic in all lanes. While, the existing auxiliary lane helps to mitigate impacts to through traffic, it is not sufficient to eliminate weaving and merging impacts in this area.

Figure III-15: 2013 Northbound Merging/Diverging Between Berkeley Street and Gravelly Lake Drive, PM Peak Hour

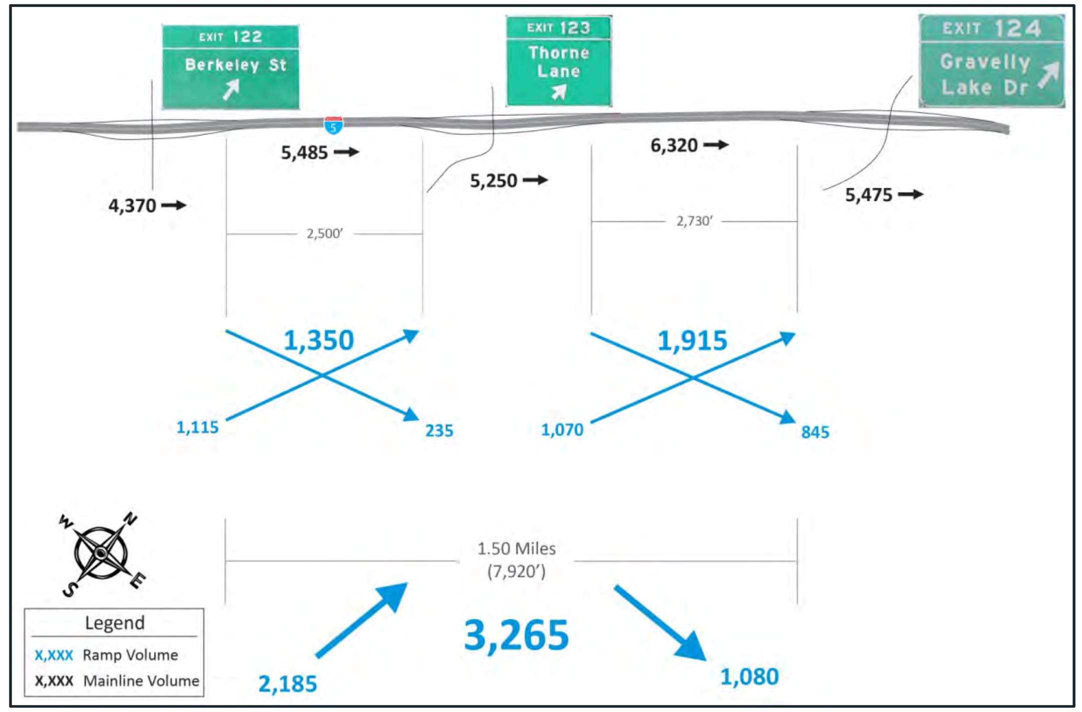
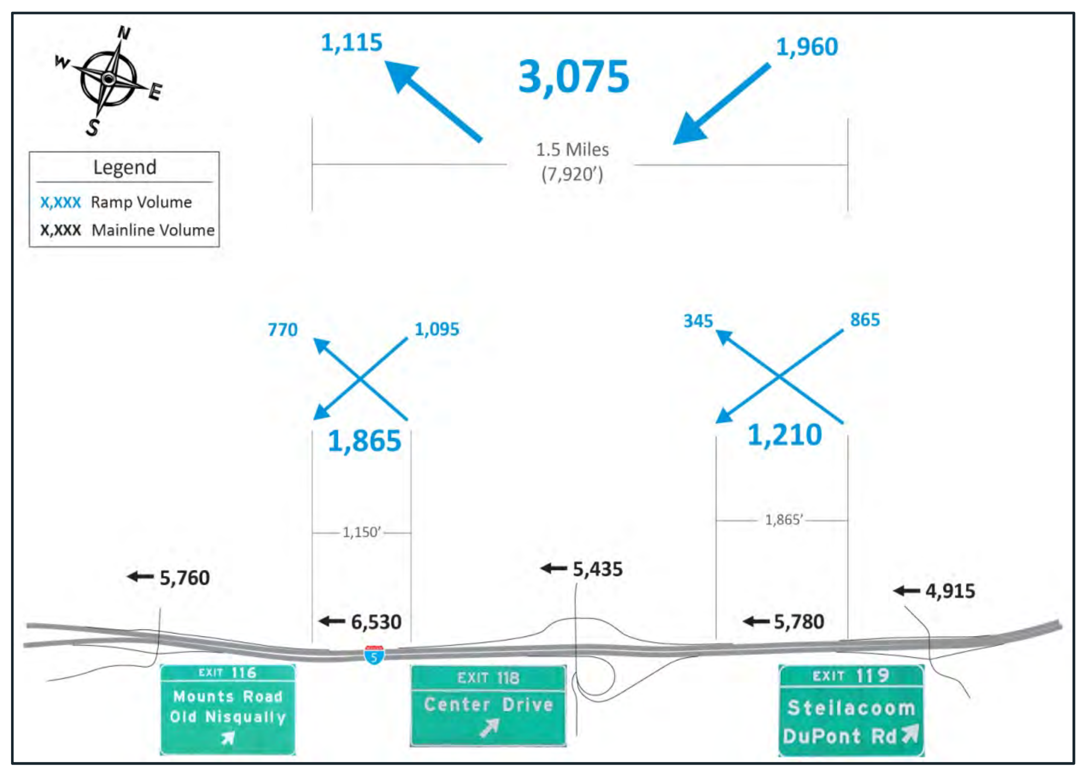


Figure III-16: 2013 Southbound Weaving/Merging Between Steilacoom-DuPont Road and Mounts Road, PM Peak Hour



High Freight Volumes

I-5 is the most significant freight corridor in Washington State and is essential to the economic vitality of the Puget Sound region and the State's trade-dependent economy. I-5 has been designated as a Class T1 freight highway indicating that it carries over 10,000,000 annual tons of freight, the highest category in the state. Within the study area trucks currently comprise 12 percent of total daily traffic on I-5 north of Steilacoom-DuPont Road of which 7 percent were doubles or triples. Trucks accounted for 10 percent of total traffic north of Bridgeport Way of which 5 percent were doubles. These high truck volumes both contribute to congestion and are impacted by congestion. Particularly significant is the impact on northbound traffic in the vicinity of Mounts Road where I-5 is on an uphill grade and slow-moving trucks in the right lanes affect the overall movement of traffic through this area. The impact of the existing weigh station north of the Mounts Road interchange will be analyzed in Phase 2.

As indicated in research done for the Washington Freight Plan, the impact of traffic congestion on truck speeds and travel times translates into a direct increase in the cost of doing business for freight-dependent businesses. This cost increase is often passed along to consumers in the form of higher prices.

Summary of Existing I-5 Traffic Operations

The I-5 corridor through the study area is bounded on both sides by JBLM. The base and other geographic features limit the availability of alternative routes for drivers travelling to and through the study area.

A summary of the I-5 PM peak hour traffic flow through the study area is displayed in Figure III-17 with volumes ranging from 3,685 vph to 6,320 vph northbound and 3,620 vph to 6,530 vph southbound. With the large mainline and ramp volumes, travel speeds along I-5 can slow to less than 36 mph with some areas of stop and go traffic, as illustrated on Figure III-18. These slow travel speeds equate to in a low level of service along I-5 corridor through the study area.

The slow speeds typically experienced along I-5 for about two hours in the morning and three hours in the afternoon. This congestion is caused by several factors:

- Heavy through volumes
- The reduction in through lanes at Thorne Lane
- A high volume of locally-generated trips to and from Thurston County and areas north of SR 512
- Close spacing of interchanges with high on and off-ramp volumes creating heavy amounts of weaving and merging
- A high volume of short trips along I-5

Figure III-17: 2013 PM Peak Hour I-5 Traffic Flow

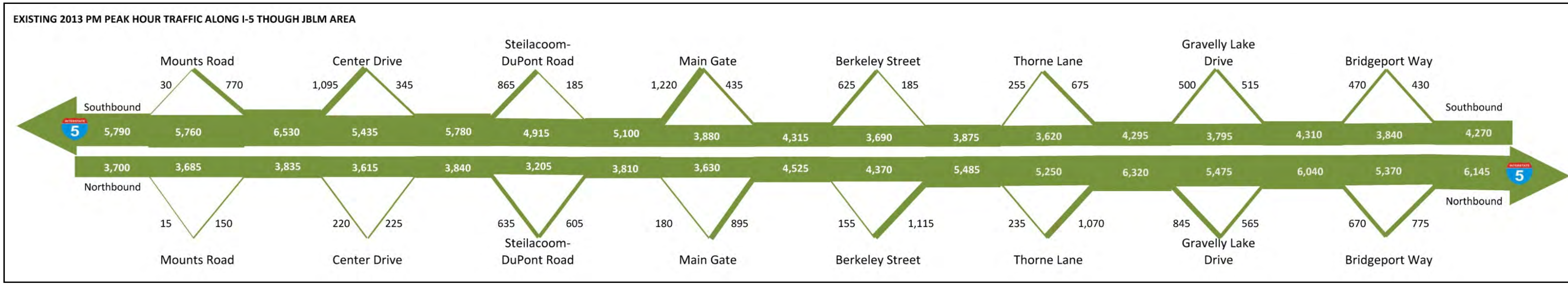
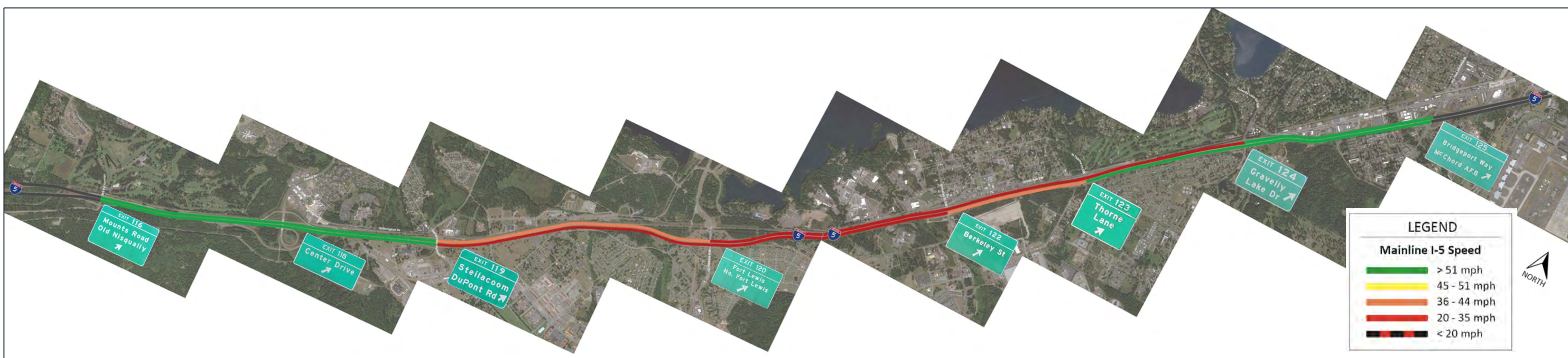


Figure III-18: 2013 PM Peak Hour I-5 Travel Speeds

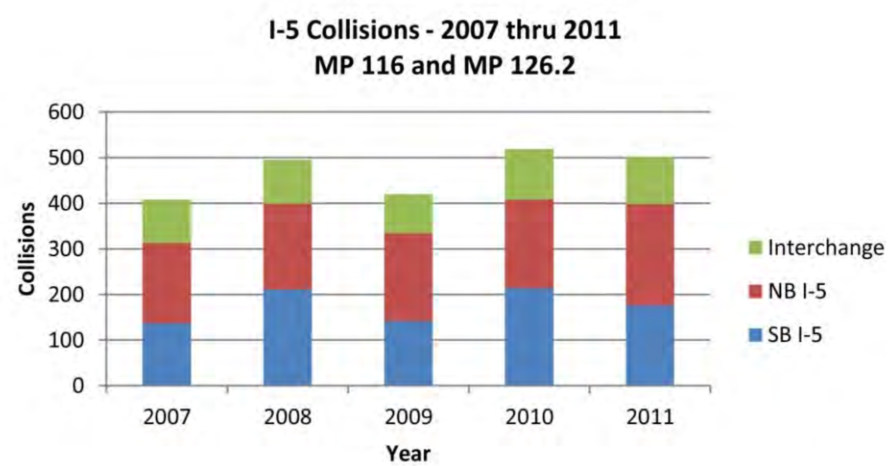


Collision Analysis

A five-year collision analysis[4] was conducted along the I-5 mainline from milepost (MP) 116.0 (south of the Mounts Road Interchange) to MP 126.2 (north of the Bridgeport Way Interchange) using data from 2007 to 2011(the most recent full years available). This analysis of mainline, ramp and cross street collisions within the limited access area included a review of the existing collision rate, location, severity, type and contributing factors.

During this five-year period there were 2,344 reported collisions along the I-5 corridor, as shown in Figure III-19. Of this total, approximately 79 percent occurred on the I-5 mainline with 21 percent occurring at the eight interchanges between Mounts Road and Bridgeport Way. Over the 5 year period this section of the highway averages over one collision per day.

Figure III-19: Collisions along I-5 through Corridor Study Area [4]



Collision Rates

A summary of the annual collision rates by severity of collisions along I-5, including mainline, ramps and all cross-streets within the limited access area, is indicated in Table III-3. This table shows that the estimated collision rates on I-5 through the JBLM area are below the statewide and Olympic Region averages for urban areas interstate highways for the period from 2007 through 2011.

Based on WSDOT's safety assessment, there is a Collision Analysis Segment (CAS) located on I-5 in the vicinity of the Center Drive Interchange. WSDOT is adding ramp meters and have other upcoming Tiger III grant project improvements around this location. There projects will help address collisions in the I-5 corridor, so WSDOT is not planning a specific countermeasure for Center Drive at this time. There is no other Collision Analysis Corridor (CAC), Collision Analysis Location (CAL) or Intersection Analysis Location (IAL) along this section of I-5 at this time.

Collisions by Time of Day

An evaluation conducted of collision data indicated that a significant proportion of collisions along the I-5 mainline and at interchanges and ramps occurred during the PM peak period. Approximately 45 percent of all collisions occurred between 3 and 7 PM, with nearly 30 percent during the period of highest congestion from 4 to 6 PM. Slightly less than 20 percent of all collisions occurred during the AM peak period from 5 to 9 AM.

I-5 Mainline Collision Analysis

Since 79 percent of the collisions in the corridor occurred along the I-5 mainline (1,852 collisions), an analysis was conducted to identify the severity, type, contributing factors and location of these collisions.

Severity of I-5 Mainline Collisions

The severity of the I-5 mainline collisions is summarized in Figure III-20. Property damage only collisions make up the majority (nearly 69 percent) of the collisions. Six fatalities occurred along I-5 during the five-year study period and 29 collisions involved serious injuries.

Type of I-5 Mainline Collisions

As shown in Figure III-21, approximately 64 percent of collisions along the I-5 mainline are rear end collisions with sideswipe collisions at about 15 percent. About 14 percent of the collisions involve hitting fixed objects, such as median barriers, guardrails, retaining walls, fences, bridges, and ditches. The rear end and sideswipe collisions are common occurrence in congested stop and go conditions as experienced on I-5 through the study area.

Figure III-20: Severity of I-5 Mainline Collisions [4]

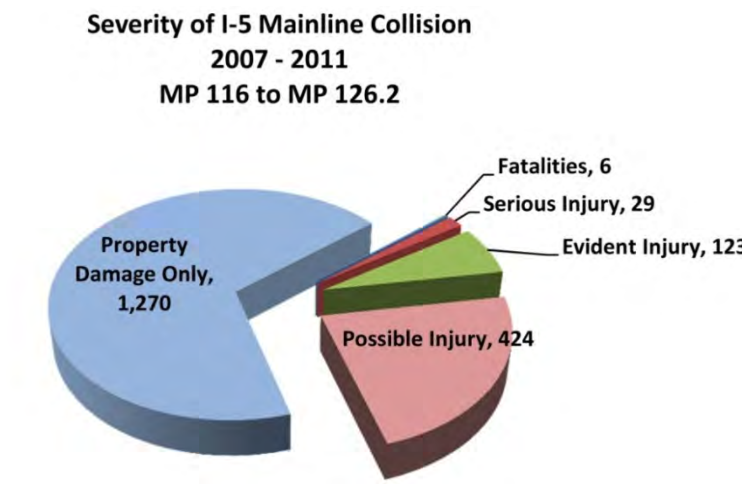


Figure III-21: I-5 Mainline Collisions by Type

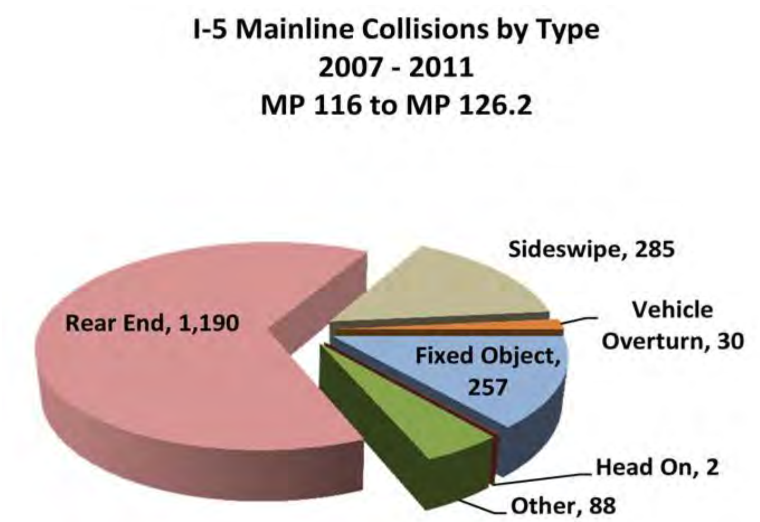


Table III-3: Collision Rate Summary (Mainline, Ramps and Cross Streets) MP 116.0 to MP 126.2 [4]

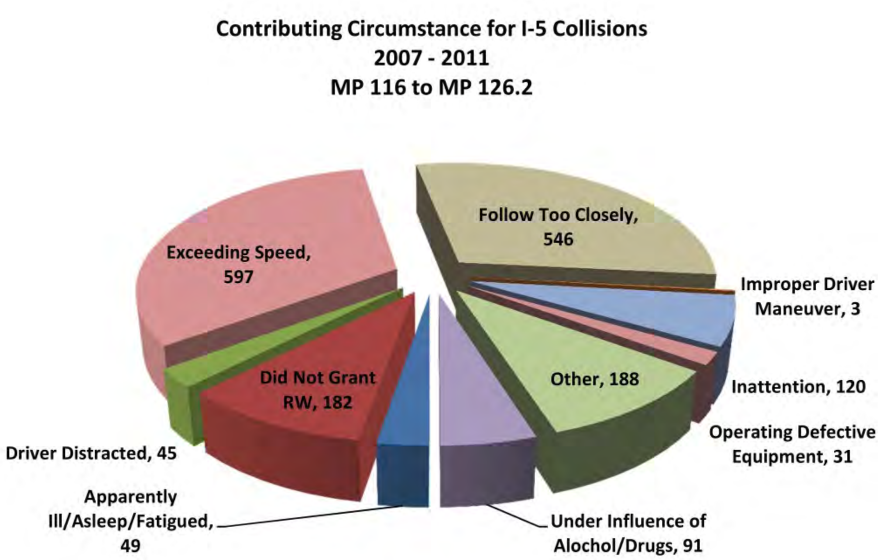
Severity of Collisions	2007 to 2011 Collisions	Annual Collision Average	Collision Rate per MVMT *		2011 Statewide Average Collision Rates on Urban Interstates	2011 Olympic Region Average Collision Rates on Urban Interstates
Fatalities	6	1.2	0.0025	0.0025	0.0032	0.004
Serious Injury	32	6.4	0.0133			
Evident Injury	160	32	0.0666	0.307	0.39	0.45
Possible Injury	545	109	0.2268			
Property Damage Only	1,601	320.2	0.6662	0.666	0.85	1.02
Annual Average	469	468.8	0.9753	0.975	1.24	1.47

[4] Under Section 409 of Title 23 of the United States Code, any collision data furnished is prohibited from use in any litigation against state, tribal or local government that involves the location(s) mentioned in the collision data.

Contributing Circumstances for I-5 Mainline Collisions

There are several circumstances that can contribute to collisions, as shown on Figure III-22. Along I-5 through the JBLM area, exceeding reasonable speeds for current conditions and following too closely are two factors that contribute to approximately 62 percent of the I-5 mainline collisions. Drivers who do not grant others the right of way or are inattentive contribute to another 16 percent of the collisions on the I-5 mainline.

Figure III-22: Contributing Factors Affecting I-5 Mainline Collisions [5]



Location of I-5 Mainline Collisions

Figure III-23 shows the location and number of collision along the I-5 corridor by milepost in both directions over the five year period from January 2007 through December 2011. With the close proximity of interchanges and heavy merging and existing volumes, the graphic shows a pattern of collisions occurring largely near interchanges on and off-ramps, with some exceptions. These collisions often occur as drivers change lanes. Collision experience is particularly significant in the vicinity of the Main Gate, Berkeley Street, and Thorne Lane interchanges. Along with Steilacoom-DuPont Road, these interchanges represent the focus of the study area.

Effect of Collisions on I-5 Traffic Flow and Speeds

Figure III-24 illustrates the effect of a collision on traffic congestion along I-5 through the study area. Data was obtained for a specific incident that occurred at approximately 2 PM on February 28, 2013 in the southbound directions. Traffic did not clear and begin to move until 4 PM. Northbound traffic remained slow until 7 PM and southbound traffic did not resume normal speeds until after 8 PM.

Figure III-23: Locations of I-5 Mainline Collisions – MP 116.0 to 126.2 [5]

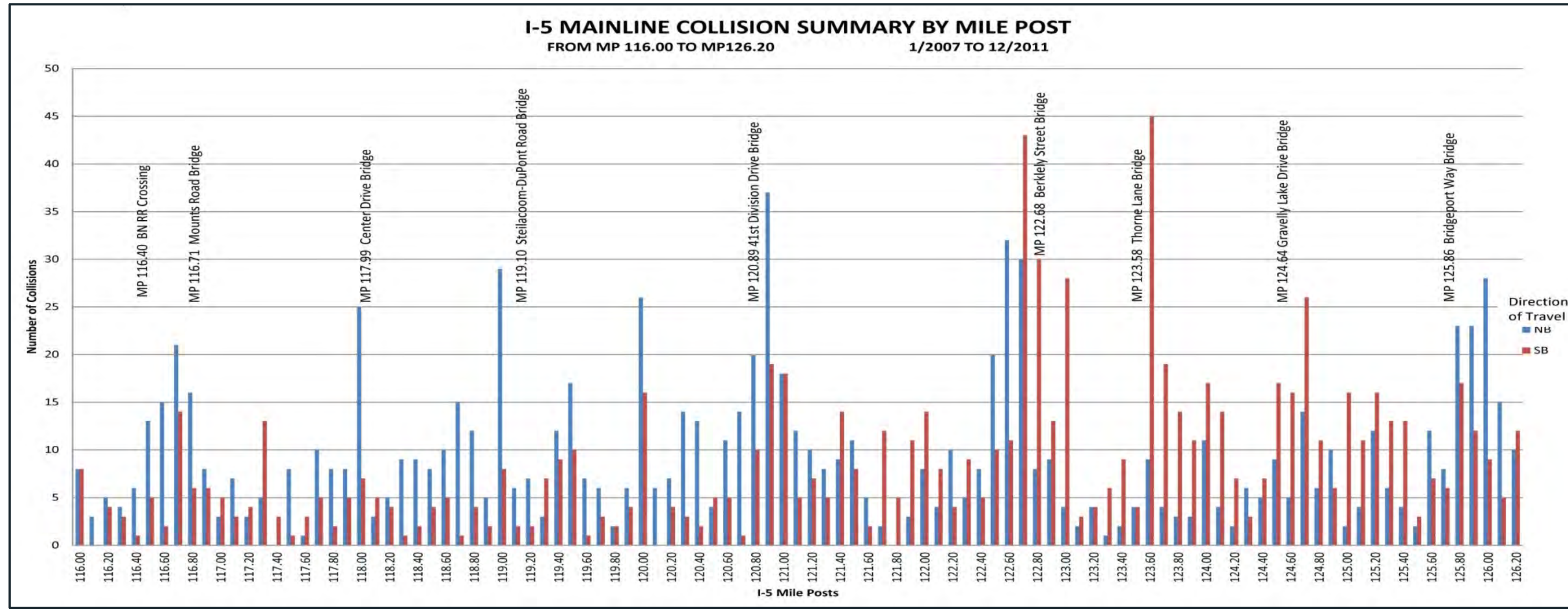
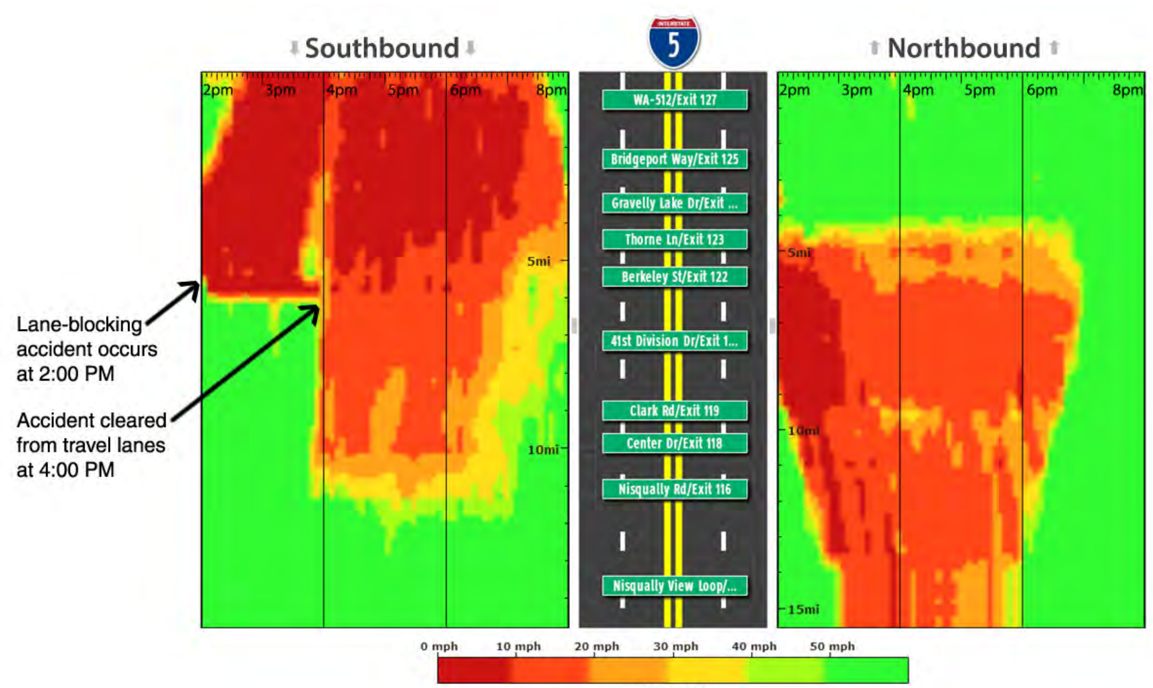


Figure III-24: Speeds on I-5 between Exits 114 and 127 with 2 PM Crash



[5] Ibid.

Summary of Interchange Collisions in Study Area

An analysis of interchange collisions was conducted to identify the severity and type of the collisions at each interchange in the study area over the five year period from January 2007 through December 2011.

Severity of Interchange Collisions

The severity of the I-5 interchange collisions is summarized in Table III-4. Overall, property damage only collisions make up the majority of the collisions at the eight interchanges in the study area. There were no fatalities and only three serious injuries over the five year period at these interchanges.

Table III-4: Severity of Collisions at I-5 Interchanges [6]

	Severity of Collisions					
Interchanges	Fatalities	Serious Injury	Evident Injury	Possible Injury	Property Damage Only	Total
Mounts Road	0	1	1	0	10	12
Center Drive	0	0	3	6	17	26
Steilacoom-DuPont Road	0	0	4	10	27	41
Main Gate	0	0	5	14	55	74
Berkeley Street	0	0	0	15	58	73
Thorne Lane	0	2	6	11	40	59
Gravelly Lake Drive	0	0	3	19	18	40
Bridgeport Way	0	0	15	46	106	167
Total	0	3	37	121	331	492

Types of Interchange Collisions

The types of the I-5 interchange collisions are summarized in Table III-5. Similar to the I-5 mainline, rear end collisions are the predominate type of collision at intersections.

Driver hitting fixed objects, such as guardrails, trees, poles, bridge features, and ditches, is the second most common type of collision.

Table III-5: Types of Collisions at I-5 Interchanges [6]

	Types of Collisions					
Interchanges	Fixed Objects	Rear End	Sideswipe	Overturned	Other	Total
Mounts Road	1	4	1	2	4	12
Center Drive	13	5	0	2	6	26
Steilacoom-DuPont Road	7	20	2	0	12	41
Main Gate	29	40	1	4	0	74
Berkeley Street	6	60	3	0	4	73
Thorne Lane	9	32	4	3	11	59
Gravelly Lake Drive	5	21	6	1	7	40
Bridgeport Way	8	74	15	2	68	167
Total	78	256	32	14	112	492

Collisions in the Minimum IJR Study Area

The previous data summarizes collision experience for the entire I-5 JBLM area from south of the Mounts Road Interchange to the SR 512 Interchange. However, a similar pattern has been observed within the minimum IJR study area between the Center Drive and the Gravelly Lake Road Interchange (MP 117.4 and 125.1) for the same time period. Overall, 1,708 collisions were reported during the five year period for this section of I-5. Within this area 1,396 or 82 percent of collisions occur on the mainline, while 312 or 18 percent occur at the interchanges. A summary of this collision data is presented below.

The severity of collisions on the I-5 mainline, interchange areas and ramps for the focused study area is presented in Table III-6. Property damage collisions (including unspecified "other" incidents) made up 70 percent of all collisions, while those with possible injuries made up 22 percent. There were three fatalities in this area over the five-year analysis period, and 23 collisions involving serious injury. This pattern is very similar to the I-5 corridor through JBLM as a whole.

Table III-6: Severity of Collisions in Minimum IJR Study Area [6]

	Severity of Collisions					
Interchanges	Fatalities	Serious Injury	Evident Injury	Possible Injury	Property Damage Only/Other	Total
Total	3	23	103	384	1,195	1,708

Table III-7 illustrates the various types of collisions by type. As with the entire study area corridor, rear end collisions are the primary type of crash comprising 64 percent of all incidents. Fourteen percent (240) involved sideswipes. Both are indicative of heavy congestion and the extensive weaving/merging activity that occurs in the corridor.

Table III-7: Types of Collisions at I-5 Interchanges in Minimum IJR Study Area [6]

	Types of Collisions					
Interchanges	Fixed Objects	Rear End	Sideswipe	Overturned	Other	Total
Total	246	1,086	240	30	106	1,708

[6] Ibid.

Transit Service

There are currently three public transit providers operating within the study area: Intercity Transit, Pierce Transit, and Sound Transit. An illustration of existing transit routes, transit centers and park-and-ride lots within the study area is presented in Figure III-25.

Intercity Transit

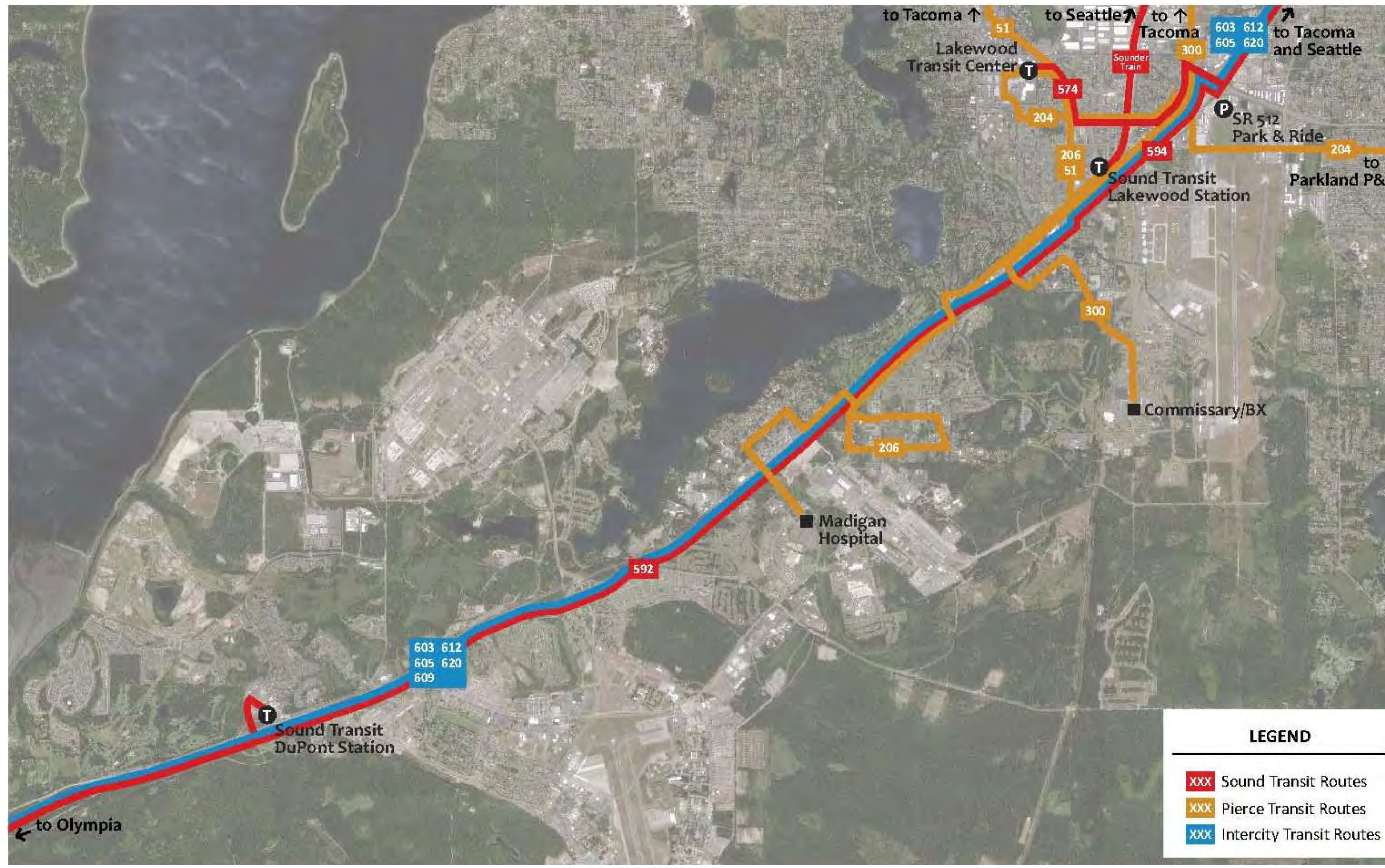
Based in Thurston County, Intercity Transit (IT) operates five routes in the study area, and sub-contracts service for a sixth route. All routes provide access close to a JBLM gate, but none operate directly on the base due to strict security regulations prohibiting general public riders from entering the facility. Direct service to certain JBLM destinations is provided by Pierce Transit and is described below. IT service includes:

- Route 603 is a weekday route providing bi-directional service between downtown Olympia/Capitol Campus, Lacey (Martin Way park and ride), Lakewood (Lakewood Station/SR 512 park and ride), and Tacoma (Tacoma Dome and downtown).
- Route 605 is a weekday route providing bi-directional service between downtown Olympia/Capitol Campus, Lacey (Martin Way park and ride), Lakewood (Lakewood Station/SR 512 park and ride), and Tacoma (Tacoma Dome and downtown).
- Route 609 is a weekday route providing bi-directional service between Tumwater (state agency campus), Olympia Capitol Campus, Lacey (Hawkes Prairie park and ride), and Lakewood (Lakewood Station/SR 512 park and ride). Service began in October 2013.
- Route 612 is a weekday route providing bi-directional service between Tacoma (Tacoma Dome and downtown), Lakewood (SR 512 park and ride and Lakewood Station), Lacey (Lacey Transit Center), and Olympia (Capitol Campus and downtown).
- Route 620 serves the study area on weekends providing bi-directional service between Olympia (downtown and Capitol Campus), Lacey (Lacey Transit Center and Martin park and ride), Lakewood (Lakewood Station and SR 512 park and ride lot), and Tacoma Mall.

IT contracts with Sound Transit for Route 592 weekday service between Olympia and Seattle which is described below under Sound Transit.

IT also offers a commuter vanpool program that serves a wide variety of destinations throughout Thurston, Pierce, Kitsap, Grays Harbor, King, and Lewis counties. Thirty-seven of the more than 230 vans currently on the road operate to and from JBLM (including Ft. Lewis, Madigan and McChord) and Camp Murray. Additional vanpool groups use I-5 with destinations in the Cities of Lakewood and DuPont. IT has been in regional discussions with JBLM to consider methods that would serve the general public's need for transit to the bases while satisfying the military's need for base security.

Figure III-25: Existing Transit Service and Park and Ride Lots



Pierce Transit

Pierce Transit is responsible for local bus service in Pierce County and operates four routes that provide access to or close to JBLM.

- Route 51 connects the Lakewood Station in the vicinity of the Bridgeport Way interchange with the Lakewood Transit Center and destinations in central and north Tacoma.
- Route 204 operates via South 112th Street and serves the SR 512 park and ride lot. Service is also available to McChord North Gate at the intersection of South 112th and Tacoma Way/Union Avenue.
- Route 206 operates between the Lakewood Transit Center and Madigan Hospital.
- Route 300 serves JBLM McChord Field operating between the Tacoma Mall Transit Center and McChord Commissary with stops at the SR 512 park and ride lot.

Similar to IT, Pierce Transit also offers regional vanpool services along the I-5 corridor. Currently 31 vans serve JBLM.

Sound Transit

The Central Puget Sound transit provider, Sound Transit (ST) operates three express bus routes along the I-5 corridor within the study area. All service is provided during peak periods in the morning and evening. Sound Transit does not provide local bus service to JBLM. The closest stop is located at the Lakewood Sounder Station and park and ride lot. The Sound Transit routes are:

- Route 574 operates between the Lakewood Transit Center and SeaTac Airport.
- Route 592 (Olympia Express) operates between the Olympia Transit Center and downtown Seattle including the Hawks Prairie park and ride lot, DuPont, Lakewood and the SR 512 park and ride. Since October 2013, service has been contracted by IT and operated by ST.
- Route 594 operates between the Lakewood Sounder Station and Seattle.

ST also operates Sounder Rail Service that connects Seattle and Tacoma with the Lakewood Sounder Station. Sounder service is operated in the former BNSF right-of-way adjacent to and west of I-5 which is now owed by ST. WSDOT will eventually improve the tracks along this corridor for Amtrak Cascades and Coast Starlight services which will relocate from the current Point Defiance route. Sound Transit's Long-Range Plan includes the potential for commuter rail service to operate to DuPont (and possibly beyond), as well to JBLM. Such service would likely require adding a second track within the right-of-way, grade-separating certain crossings, and locating new station(s) by the gate(s) to/from JBLM. Options for expanding I-5 and reconfiguring the interchanges should anticipate these rail operations and facilities, and not preclude or adversely impact them.

Park and Ride Lots

There are seven primary park and ride lots within or serving the corridor study area. A summary of the park and ride inventory data, including number of parking stalls and utilization is shown in Table III-8.

Table III-8: Park and Ride Lot Inventory

Facility/Lot	City	Location	Number of Parking Spaces	Average Daily Utilization
SR 512	Lakewood	I-5 & SR 512	493	93%
Lakewood Sounder Station	Lakewood	Pacific Highway & 47th Avenue SW	600	50%
DuPont	DuPont	Wilmington Drive & Palisade Blvd	126	63%
Martin Way	Lacey	I-5 & Martin Way	318	65%
Hawks Prairie	Lacey	I-5 & Hogum Bay Road	332	27%
Centennial Station	Thurston Co.	6600 Yelm Hwy SE	110	2%
Tumwater	Tumwater	Israel/Bonniewood Rds SE	30	15%

Source: Intercity Transit, Pierce Transit and Sound Transit, 2013.

Commute Trip Reduction

In 1991, the Washington State Legislature adopted the Commute Trip Reduction Law (CTR) as a tool to help address the growing traffic congestion problem in the state. The CTR encourages the use of non-single occupant vehicle travel modes for the work trip using employer-based programs. In 2006, legislators passed the CTR Efficiency Act, that required local governments in urban areas with traffic congestion to develop programs to reduce drive-alone trips and vehicle miles traveled per capita.

By 2009, the CTR Program had removed 30,000 vehicles from the states roadways each morning, reducing congestion, air pollution and energy consumption. Traffic delays have been cut by eight percent in the Central Puget Sound region, and rush hour commuters saved about $59 each during that year in fuel and time. CTR participants also conserved about 3 million gallons of gasoline in the 2009-2010 biennium and drove 154 million fewer miles in comparison with 2007. [7]

CTR targets workplaces with 100 or more full-time employees in the most congested areas of the state. Employers develop and manage their own programs based on locally-adopted goals for reducing vehicle trips and miles traveled. Statewide there are more than 1,050 worksites and 530,000 commuters participating in the CTR program. Employers regularly report on their programs and jurisdictions report on progress toward meeting drive-alone and Vehicle Miles Traveled (VMT) reduction targets.

As noted previously, within the I-5 JBLM study area, there are several active CTR programs that affect travel along I-5. These programs are provided by Intercity Transit and Pierce Transit who offer carpool, vanpool and other TDM services. In addition to the vanpool service provided by IT and PT, Seattle Metro and JBLM also provide vanpool services that affect the corridor.

JBLM Shuttles and Vanpools

As the largest employer in Pierce County, JBLM has developed an active Commute Trip Reduction program: [8]

- Approximately 125 employees use bus subsidies
- Approximately 375 employees use vanpools from either Pierce Transit or Intercity Transit

The Department of the Army has a program called the "Mass Transportation Benefit Program" (MTBP) that provides reimbursement for using mass transit (either vanpool or carpool). The MTBP is available to all personnel on base (civilian and military) and is a non-taxable program that subsidizes the use of transit up to $245 per month.

Transit Performance

As shown in Figure III-25, there are twelve existing transit routes that serve the study, area, either directly or by accommodating through trips that may otherwise have been made in a single occupant vehicle. Even more significant in terms of reducing demand on I-5 is the level of vanpool activity presently occurring within the study area. The following is an analysis of transit ridership and vanpool activity as it affects I-5 in the study area. The focus of this analysis is the PM peak period which typically has the highest level of congestion of any time period within the corridor.

Transit Ridership on I-5 in the Study Area

Table III-9 presents a summary of existing PM peak period (3-6 PM) transit ridership on I-5 in the study area as of November 2013. Currently bus transit service in the area is provided primarily by three agencies: Intercity Transit (serving Olympia and Thurston County), Pierce Transit (serving Tacoma and Pierce County), and Sound Transit (serving the Central Puget Sound region). An additional three trips during this time period are provided by the Bremerton-Kitsap Airporter which directly services JBLM, connecting it with the Sea-Tac Airport.

Table III-9: Weekday PM Peak Period (3-6 PM) Transit Ridership in Study Area

		Number of Buses		Ridership	
Agency	Route	NB	SB	NB	SB
Intercity Transit	Route 603	5		159	
	Route 605		3		79
	Route 609	4	4	27	22
	Route 612	1		28	
Pierce Transit	Route 206	5	5	100	160
	Route 300	6	6	126	139
Sound Transit	Route 592		8		232
Totals		21	26	440	632

Source: Intercity and Pierce Transit, 2013.

[7] WSDOT CTR website, December 23, 2013.
[8] *Joint Base Lewis McChord Growth Coordination Plan*, The Transpo Group, 2010.

As indicated in the table, Intercity Transit is currently providing seventeen express bus trips through the study area during the 3 to 6 PM peak period, ten in the northbound direction and seven in the southbound direction. The ten northbound routes carry a total average weekday ridership of 214 persons during the PM peak period. The seven southbound routes carry a total average weekday ridership during the PM peak period of 101 persons. This equates to a total weekday PM peak period average of 315 persons.

Pierce Transit has twenty-two buses serving the study area during the PM peak period, eleven in the northbound direction and eleven southbound. Average total weekday ridership during this time period is 226 persons northbound and 299 southbound for a total of 525 persons.

Sound Transit has eight trips serving the study area during this same time period, all of which head southbound. Average weekday PM peak period ridership is 232 persons.

The total number of buses providing service on I-5 in the study areas during a typical weekday PM peak period is twenty-one northbound and twenty-six southbound. Total persons using transit in the I-5 corridor during this same time period is 440 northbound and 632 southbound for a total weekday PM peak period ridership of 1,072 persons.

Vanpool Ridership on I-5 in Study Area

Table III-10 shows weekday PM peak hour ridership in existing vanpools during the summer of 2013. Only official vanpools sponsored by one of the transit operators providing service in the study area are included in this table. Additional vanpool service is provided by other transit agencies and private employers. Currently, IT sponsors 71 vanpools that serve the study area during the PM peak hour. Twenty-two of these vanpools are traveling in the northbound direction from Thurston County to destinations in Pierce and King Counties. These vanpools carry an average of 205 persons on I-5 during the PM peak hour. Forty-nine of these vanpools are traveling southbound from a variety of destinations to Thurston County. These vanpools carry an average of 367 persons on I-5 during the PM peak hour.

Table III-10: Weekday PM Peak Hour (4-5 PM) Vanpool Ridership in Study Area

			Number of Vanpools		Ridership	
Agency	Begin Trip	End Trip	NB	SB	NB	SB
Intercity Transit	King County	Thurston County		6		41
	Thurston County	King County	8		88	
	Kitsap County	Thurston County		2		19
	Camp Murray	Thurston County		3		19
	DuPont	Thurston County		12		76
	Gig Harbor	Thurston County		1		18
	JBLM/Ft. Lewis	Thurston County		10		70
	JBLM/Madigan	Thurston County		9		79
	Tacoma	Thurston County		6		45
	Thurston County	Pierce County	14		117	
Pierce Transit (1)	Pierce County	JBLM	16	3	129	24
Totals			38	52	334	391

(1) Only partial ridership data is available, ridership total based on estimated average vanpool ridership.

Pierce County Transit sponsors 16 northbound and 3 southbound vanpools that use I-5 through the study area during the weekday PM peak hour. Vanpool ridership on I-5 during this time period is 128 northbound and 24 southbound for a total of 153 persons.

Impacts of I-5 Congestion on Transit

Existing transit service along I-5 in the corridor study area primarily serves either regional through trips, trips to/from Sound Transit's Lakewood Station, or trips to/from the Lakewood Transit Center. With over 62,000 employees, JBLM is the second largest employer in Washington State and is the largest potential transit destination in the study area. However, the secure nature of JBLM limits the effectiveness of regular fixed route transit because buses carrying civilians cannot enter the secure facility or require non-military riders to deboard at the security gate. Currently only two routes serve the base, one to Madigan Hospital and the other to the McChord Commissary.

Unlike fixed route bus service, vanpools and carpools that carry only base personnel do have access to and from JBLM. There are vanpools sponsored by the major transit providers in the area that are currently connecting JBLM with destinations throughout the region. In 2013, vanpools and bus service carried approximately 1,200 people along I-5 during the PM peak hour. Both transit service and vanpools are impacted by freeway congestion, with existing PM peak travel times exceeding off-peak travel time by 75 percent. With no HOV facilities within the corridor study area to facilitate the advantages of alternative mode choices, buses and vanpools are caught in the same traffic as single occupant vehicles.

Transit and Vanpooling Benefits to I-5

Existing transit and vanpool ridership on I-5 in the study area has a substantial impact on reducing vehicular congestion in the corridor during peak weekday travel periods. As illustrated in Table III-11, if existing riders where to switch to individual vehicles a total of approximately 1,000 vehicles would be added to existing I-5 PM peak hour traffic (approximately 440 northbound and 560 southbound). By way of comparison, 560 vehicles represent about 31 percent of the existing maximum per lane capacity in the congested heart of the corridor. Thus, it is reasonable to conclude that the availability of transit and vanpooling options significantly benefits existing highway traffic operations.

Table III-11: Benefits of Transit and Vanpooling, Weekday 4-5 PM Peak Hour

		Ridership		Number of Cars Taken off I-5 (1)	
Agency	Mode	NB	SB	NB	SB
Intercity Transit	Bus	89	83	73	68
	Vanpool	205	367	168	301
Pierce Transit	Bus	100	96	82	79
	Vanpool	129	24	106	20
Sound Transit	Bus	11	107	9	88
Totals		534	677	438	555

(1) Assumes average vehicle occupancy of 1.22 in general purpose lanes without HOV lanes.

IV. Travel Forecasting

The travel forecasts for the *Corridor Plan Feasibility Study* were developed using a travel demand model specifically created for evaluating the needs of I-5. The I-5/JBLM/Lakewood Travel Demand Model was originally developed for Lakewood's I-5 Alternatives Analysis Study to provide a solid technical basis for evaluating transportation system needs in southwest Pierce County. The model was then updated and refined as part of the *I-5 JBLM Vicinity Interchange Justification Report (IJR) and Environmental Documentation*. The updated model (JBLM Travel Demand Model, or JBLM Model) is consistent with local and regional growth plans, including the Puget Sound Regional Council (PSRC) regional model. This model was used to develop traffic forecasts in the study area, and to understand traffic pattern changes that would result from various project improvement scenarios. This section provides an overview of the model, the choice of model platform, land use assumptions, roadway assumptions, travel modes forecasted, time periods modeled, and post-processing methods.

Model Overview

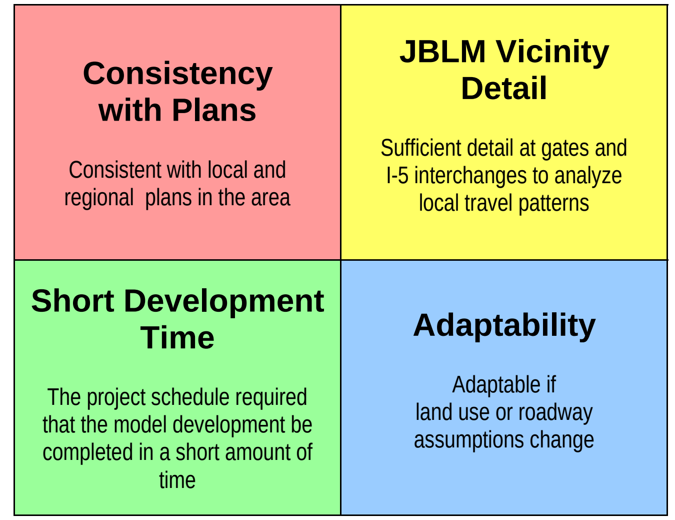
The section provides general facts about the model for context. The JBLM Model has a base year of 2010, and two forecast horizon years of 2020 and 2040. The general scope of the model is the area of Pierce County south of the Puyallup River, and also includes roadways in eastern Thurston County (see Figure IV-4). The model includes trip assignments for both high-occupancy vehicle (HOV) and single occupancy vehicle (SOV) mode splits for three time periods: AM peak period (6am to 9am), midday peak period (11am to 2pm), and PM peak period (3pm to 6pm).

The model has a total of 632 Transportation Analysis Zones (TAZs), including 21 external TAZs and 9 TAZs representing areas within JBLM. The 2010 network has 2,308 lane miles coded to represent freeways, expressways, arterials, collectors, and a few local streets. For JBLM specific TAZs, all trips start and stop at base gates or Access Control Points (ACPs). This means that internal base travel patterns are not explicitly modeled. In addition, the distribution of trips to each gate is not fixed. This allows trips to switch between gates in response to timed gate closures, newly constructed gates, or highway and roadway network traffic congestion.

Choice of Model

Selection of a model to use for this project was a key component of the work program. There were four candidate models to use or adapt including two regional models (PSRC and TRPC), a County model (Pierce County), and a local City model (JBLM/Lakewood) that had also been adapted for past I-5 analysis. The type and scope of the modeling effort was also driven by several important considerations as highlighted in Figure IV-1 including consistency with plans; JBLM vicinity detail; short development time; and adaptability.

Figure IV-1: JBLM Model Development Considerations



In general, the PSRC Model lacked the sufficient detail in the primary study area to be of use on the project. The study area was at the extreme perimeter of the PSRC Model and its sensitivity to land use, network, and external changes was not at a level sufficient to evaluate mainline and interchange alternatives through JBLM.

The TRPC Model was going through a major update during the JBLM Model development time period (spring of 2013). The earlier TRPC model was dated, and did not include any portions of Pierce County. The newer TRPC model was still unfinished and would not be useable in time for this project.

The more focused Pierce County Model was also in the midst of a major update. Like the TRPC model, the older version was getting outdated and the newer version was still unfinished. Any details on updated inputs were also unavailable.

The I-5/JBLM/Lakewood Model was selected as the preferred model to use because it was specifically developed to support evaluation of I-5 mainline and interchange concepts in the JBLM vicinity. The I-5/JBLM/Lakewood Model was a refined version of Pierce County's older regional EMME model, but was converted to the Visum software platform. TAZs had also been subdivided to better reflect travel patterns in the Cities of Lakewood and DuPont, and for JBLM Access Control Points.

The JBLM Model was built to be generally consistent with PSRC model inputs and outputs, such as regional land use forecasts, mode share estimates, and trip distribution in the model area, along with future forecasts at some external zones. The model also included the roadway network in eastern Thurston County. At the request of WSDOT and for added simplicity, land use inputs were not used for TAZs in Thurston County, and instead trip table outputs from the TRPC model were utilized. The JBLM Model is generally consistent with TRPC future volume forecasts for Thurston County external zones.

Land Use Assumptions

Land use inputs drive the travel demand developed for the study area. In other words, the number of person trips generated in the model is directly tied to the land use inputs. These land use inputs can be in units of people, homes, or employment, or for more unique land types, specific traffic counts.

Outside the JBLM-specific TAZs, land use inputs were compiled in the form of households and employment. Inside the JBLM specific TAZs, trip generation was based on existing daily vehicle volumes at the ACPs as they relate to the number of military personnel, civilian employees, contractors, and dependents who are stationed at the base. Future land use estimates were developed for 2020 and 2040 horizon years.

Households and Employment

The 2010 JBLM Model land use was developed in a series of steps for the areas outside the JBLM-specific TAZs. First, the starting data set of 2010 land use was established by interpolating between the 2007 and 2030 Lakewood Model land uses. PSRC employment data for 2010 Forecast Analysis Zones (FAZs) were then used as control totals, and TAZs outside the City of Lakewood and JBLM were scaled to match PSRC data. Census Block data sets containing households for 2010 were also obtained from PSRC, and were aggregated by TAZ for zones outside the City of Lakewood. Within the City of Lakewood TAZs, existing employment and household land uses were used as these reflected the recent buildable lands analysis conducted by the City.

The forecasting process for the 2040 JBLM Model land use was also developed in a series of steps. First the growth anticipated by local agencies was calculated by subtracting the 2030 Lakewood model land use from the 2010 JBLM model land use. This growth by TAZ was aggregated to PSRC FAZs, and added to the growth anticipated between 2030 and 2040 as provided in PSRC FAZ forecasts to create 2040 growth targets. Then, the original TAZ growth anticipated in the 2030 Lakewood model was scaled to match FAZ growth targets. Checks for reasonableness were made, and adjustments made where necessary. The 2040 land use methodology represents a reasonable estimate of growth in the study area, especially given that no City or County land use forecasts were available for 2040.

The forecasts for 2020 were interpolated from the 2010 and 2040 land use assumptions. As shown in Figure IV-2, the number of households grew at an annual rate of 1.40 percent between 2010 and 2040. For employment, the annual rate was 1.52 percent during that period of time.

Figure IV-2: Study Area Household and Employment Growth

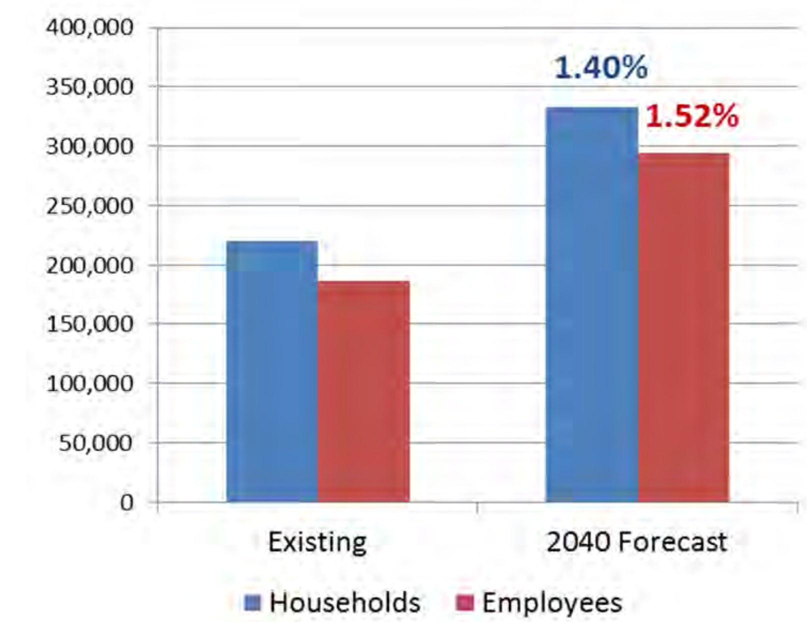
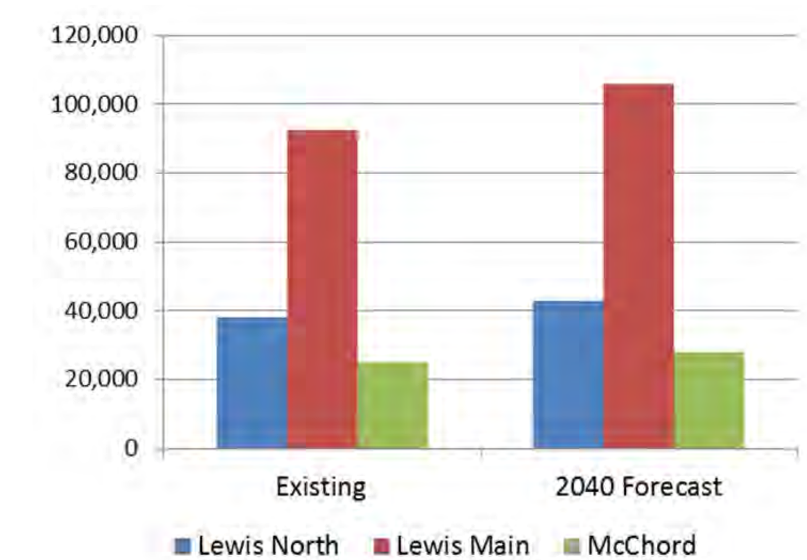


Figure IV-3: Growth at JBLM Access Control Points



JBLM Access Control Points

Existing 2010 JBLM model trips at the ACPs were based on counts of existing daily traffic volumes at each ACP. These traffic counts accounted for all vehicle trips entering or exiting controlled areas of JBLM, and were compiled for each hour of the day. Figure IV-3 shows the relative daily trips by different areas of JBLM. As shown in Figure IV-3, the majority of JBLM trips area associated with the Lewis Main area, or the area south of the I-5 corridor and Perimeter Road.

JBLM forecasts were consistent with assumptions in the *JBLM Growth Coordination Plan* prepared in 2010. As noted in that document, traffic volumes attributable to JBLM can vary on a day-to-day basis and are dependent on military operations. These operations can change depending on troop deployments, varying security levels, or holiday leave. In addition to short-term changes, long-term impacts also occur. Over the past ten years, the overall number of troops and their dependents stationed at JBLM have almost doubled; however future growth is expected to be minimal. Because of variable short-term military operations, a look at broad and long-term military travel patterns and trends is necessary to better understand how to address the impacts of JBLM-related traffic.

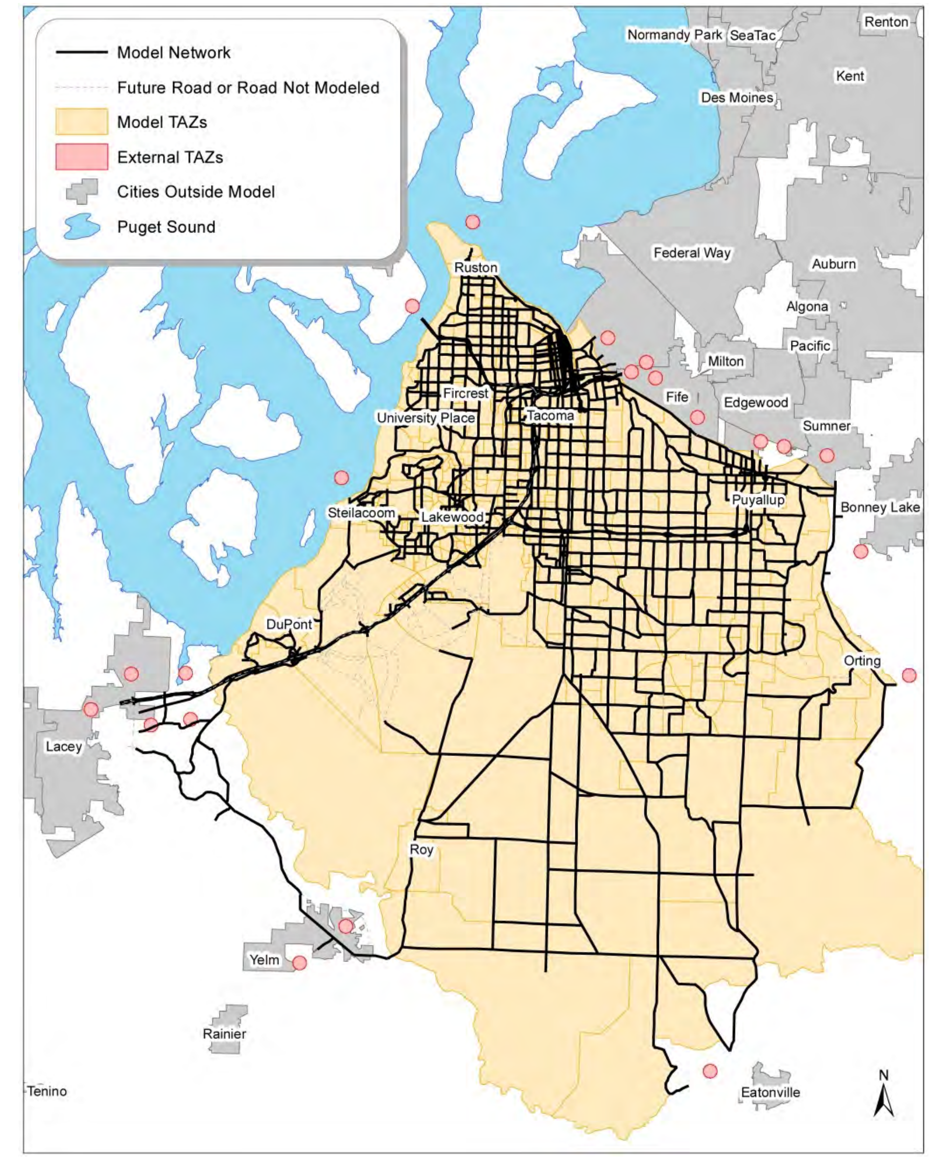
Based on traffic counts taken in early 2013 at all of the Access Control Points, JBLM currently generates approximately 158,000 off-site vehicle trips per day (including Camp Murray). Most of these trips are made in single occupant vehicles. This level of activity is comparable to the level identified for the 2010 *Coordination Plan*.

No specific plans have been prepared that highlight long-term growth plans at JBLM, as is typically done for cities and counties through their comprehensive planning process. JBLM growth decisions are made by the Department of Defense and Congress, and reflect national defense priorities that are outside any typical planning or forecasting process conducted at the local, regional, or even state levels. In general, without expansion of its boundaries, JBLM has developed most portions of its buildable land, and therefore has refocused efforts on building more compact, mixed-use developments as identified in its Master Plan. However, it is expected that future growth activity at the base will be limited.

In addition, a large portion of future JBLM-related (internal, "base to base") trips are expected to remain on base and not use the surrounding roadway system. Internalization of trips is likely to result from increased housing, retail and multi-use development on-base, as well as additional road improvements to better connect the Lewis North, Lewis Main, and McChord areas. As more local services are provided and connectivity improvements are made, more trips are expected to remain on-base, particularly during the mid-day hours. That said, it is expected that 70 – 75% of JBLM military members will continue to reside in the civilian community and will commute to and from JBLM on a daily basis.

To be consistent with past planning efforts (for example *JBLM Growth Coordination Plan*, 2010), a relatively low annual growth rate of 0.5 percent was assumed, and applied to 2013 volumes to develop 2040 forecasts for JBLM trips outside the ACPs. This rate is substantially lower than the 2 to 3 percent annual growth rate experienced at the base over the past ten years during the significant build-up of troop levels, due to Grow the Army Initiative and Base Realignment and Closures (BRAC), but this level of growth is not expected to be sustained due to reduced national defense funding and local environmental constraints. The 0.5 percent rate is still high enough to capture unforeseen military activity, such as additional base consolidations nationwide or future military personnel shifts over the next 30 years. This growth rate results in approximately 23,000 new daily vehicle trips to and from the base (a 15-percent increase from existing conditions), for a 2040 total of 181,000 daily vehicles. The increase in trips would be comparable to one additional brigade being located at the installation.

Figure IV-4: JBLM Travel Demand Model Network



Thurston County Trips

Existing 2010 JBLM model trips coming to or from Thurston County are based on existing daily counts on area roadways within Thurston County, rather than from land use estimates. This assumption was made to shorten the model development process. The expansion of the model into Thurston County and the addition of several new external zones within and around Lacey and Yelm helped in modeling traffic patterns at the county line and in reconciling the differences in regional modeling assumptions between the TRPC model and the PSRC model. Future 2040 JBLM model trip growth coming to and from Thurston County was primarily based on TRPC model outputs, but reconciled with PSRC model forecasts.

Roadway Network Assumptions

The roadway network provides a critical element of the travel demand model. The model roadway network reflects the supply for transportation movements, and in congested areas this supply is very limited. The future scenarios model how traffic demand responds to changes in the network supply (i.e. roadway improvements). Key features of the existing model network are discussed below, along with future baseline road networks and general roadway assumptions inherent in the various improvement scenarios tested by the model.

Existing Network

In the JBLM model, the scope of the street network includes most roads in Pierce County south of the Puyallup River. In addition, major roadways in eastern Thurston County were also included. The alignment and attributes of the existing street network (such as posted speeds, lanes, and traffic controls) were obtained from GIS data sources. A map of the existing modeled roadway network is shown in Figure IV-4.

Future Baseline Networks

The future street networks were adapted from the existing street network, but include various planned network improvements. As part of the model development and the JBLM planning process, several future baseline network design scenarios were developed. The 2040 and 2020 Baseline Funded scenarios include the planned improvements shown in Figure IV-5. The 2040 Baseline Unfunded scenarios include all the projects included in the funded scenario plus new ones as noted in Figure IV-5. The travel demand model is meant to forecast regional travel demands based on major characteristics of the roadway system. Any smaller scale planned improvements that relate to traffic operational impacts such as ramp metering or intersection turn pockets are not explicitly addressed in the travel demand model, but are addressed with more detailed traffic operations analyses.

Figure IV-5: Planned Roadway Improvements for Baseline Scenarios

2040 and 2020 Baseline – Funded Improvements
HOV lanes on I-5 and SR 16 north of S 38th Street in Tacoma
Madigan Access improvements
I-5 SB auxiliary lane between Thorne Lane and Berkeley Street interchanges and other Tiger III improvements*
Point Defiance Bypass
Wharf Street Gate
SR 510 Yelm Loop
Joint-Base Connector Phase 1 (Fig. II-2)
2040 Baseline – Unfunded Improvements
SR 704, Cross-Base Highway
Gravelly Lake to Thorne Connector
I-5 HOV lanes from S 38th Street to SR 512 interchange
Another 34 planned improvements from local and county plans (see Model Documentation for list)

* Analysis of Tiger III ramp meters will be conducted as part of Phase 2

Future Scenario Networks

There were several corridor elements tested in a wide variety of combinations to understand impacts to the I-5 corridor. Based on existing and future baseline conditions, the I-5 corridor was tested with capacity improvements that could include managed/HOV lanes, Collector/Distributor Roads, auxiliary lanes, additional general purpose lanes, as well as interchange improvements. Ramp meters included as part of Tiger III were not directed included in the Phase 1 forecasts but will be analyzed as part of Phase 2. The fundamental corridor elements tested are discussed below. The scenarios evaluated are discussed in more detail in Section VI.

Managed/HOV Lanes

Scenarios with managed/HOV lanes included one lane in each direction along the I-5 corridor that was restricted to vehicles with 2 or more persons. The managed/HOV lanes were assumed to operate for the full length of the I-5 corridor in the model. In other words, new managed/HOV lanes were assumed to exist between the current southerly terminus of HOV lanes in Tacoma and the Marvin Road Interchange in Lacey. The Thurston County portion was included to ensure that future HOV traffic forecasts reflected the full benefits of managed/HOV lanes in this portion of the larger South Sound region. They are coded as separate lanes so HOV traffic must enter and exit the HOV lanes at certain points in the model. In general, these access points are midway between interchanges. The model reflects only HOV traffic using these lanes, but these lanes could also be managed to reflect a congestion pricing mechanism to improve system efficiency (HOT lanes).

Collector/Distributor Roads or Auxiliary Lanes

The Collector/Distributor (CD) roads or auxiliary lanes, which mitigate the capacity bottlenecks associated with normal interchange ramps, were also included in the model network for some scenarios. Auxiliary lanes extend the functional capacity of the interchange ramps such that vehicles have greater distance to transition between mainline traffic speeds and ramp speeds. CD roads expand on the benefits of auxiliary lanes by insulating mainline traffic speeds from the slower speed transitions required at ramps between closely spaced interchanges.

The CD roads were defined to include two clusters of closely-spaced interchanges. The southern cluster included the Mounts Road, Center Drive, and Steilacoom- DuPont interchanges. The northern cluster included the Berkeley Street and Thorne Lane interchanges. The CD roads were defined as two lanes in each direction with lower speeds than mainline operations. Phase 2 modeling will determine the number of lanes necessary on CDs if they are implemented. One additional general purpose auxiliary lane was defined on the I-5 mainline between the two clusters of CD roads for some scenarios. In addition, an auxiliary lane was also located north of the northern cluster to tie with Gravelly Lake Drive ramps. This auxiliary lane would act as a transition area for vehicles entering or exiting the CD roads from the I-5 mainline.

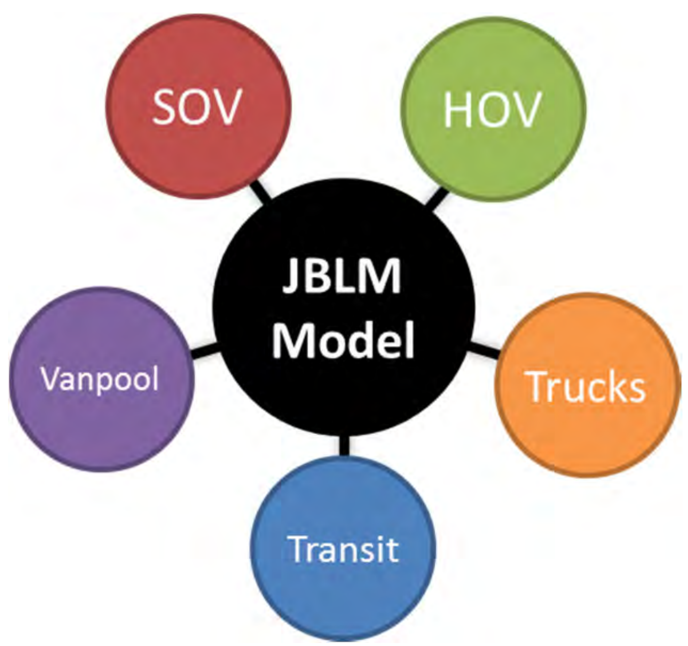
Additional General Purpose Lanes

Scenarios with additional general purpose lanes included one lane in each direction along the I-5 corridor. These general purpose lanes were defined to be in place for the full length of the I-5 corridor in the model. In other words, additional general purpose lanes were defined to exist between the Thorne Lane interchange and the Marvin Road Interchange in Lacey. The Thurston County portion was included so that travel forecasts reflected the full benefit of adding general purpose lanes in this South Sound region.

Transportation Modes Modeled

The JBLM Model allows for person trips using a variety of transportation modes to be forecasted. In general, the model reflects existing conditions which includes a level of commute trip reduction already occurring in the study area. The choice of mode (car, truck, vanpool, or transit) also reflects how the PSRC model estimates this traveler decision for both existing and future conditions. A basic explanation of the model mode choice process is provided, followed by a discussion of the relevant features of analysis for each mode. Each of these modes has a different degree of sensitivity in the model, but all are addressed. Figure IV-6 illustrates the travel modes forecast by the JBLM model.

Figure IV-6: Modes Modeled by the JBLM Model



Mode Choice Basics

Land use units were converted to daily person trips that must, in turn, be converted to vehicle trips. The model uses mode split matrices that provide the number of vehicle trips as a percent of total person trips. By using mode split matrices, the percentages can be unique for each zone pairing, and are based on the mode choice modeling in the PSRC model. These percentages do not automatically change with land use or network changes.

Single-Occupancy Vehicles

Additional mode split matrices further sub-divide the total auto trips into single-occupancy vehicles (SOVs). These percentages are based on mode choice modeling in the PSRC model and vary depending on TAZ.

High-Occupancy Vehicles

Similar to SOV calculations, additional mode split matrices further sub-divide the total auto trips into vehicles with 2 or more persons. The model has two HOV classifications that are modeled: "LOV" (2 persons) and "HOV" (3 or more persons). These percentages are based on mode choice modeling in the PSRC model and vary depending on TAZ. It should be noted that the HOV travel demand estimates prepared using this model are conservatively low and reflect the best forecasting methodology in the region currently available for use in the study area. In this model, HOV forecasts are largely not dependent on the presence or nature of the HOV facilities included in several of the I-5 mainline improvement scenarios discussed in Chapter VI.

Truck Trips

Truck trips are developed from the PSRC model and are independent of the JBLM trip generation results. The JBLM model has three categories of trucks with corresponding trips matrices: light, medium, and heavy duty trucks.

Vanpools

Vanpool trips are directly modeled in the JBLM Model. Vanpool matrices were developed based on PSRC estimates of vanpools for each horizon year. Vanpool person trips were also added to certain zone pairings based on existing vanpool information from JBLM and local transit organizations. The resulting model output was post-processed using the same methodology as was used for vehicle trips to adjust model output to more accurately reflect existing vanpool and ridership volumes

Transit (Bus Vehicles)

The model does not directly assign transit vehicles or transit person trips to the transportation network. When the model processes the mode choice step, vehicle trips are extracted from the total person trips. Person trips associated with walk, bike, and transit modes are not processed any further in the model nor assigned to any transportation network. The percent of trips associated with transit by TAZ are based on the mode choice model in the PSRC model.

Forecasted transit trips (primarily bus trips) within the study corridor are based on simple growth assumptions as applied to existing transit trips, and layered onto the non-transit traffic volumes developed by the model. Transit speeds are the same as non-transit traffic (in either HOV lanes and general purpose lanes, dependent on the improvement scenario under consideration) as they are not expected to have dedicated transit-only lanes. Without a fully functional cross-county transit model, growth in transit ridership is difficult to estimate given the sensitivity to policy decisions, frequency of service, funding availability, and future route locations. Based on the available PSRC mode split data and the nature of existing transit along I-5 within the study corridor, growth rate assumptions for transit were based on the growth in HOV (non-transit) vehicle trips on I-5 in the study area.

Time Periods Modeled

Daily trips must be assigned to time periods, to better understand traffic impacts during peak travel periods. The JBLM model forecasts traffic over multiple three-hour periods, because study area congestion is typically not limited to a single hour or a single time period. Time-of-day parameters identify when daily vehicle trips are expected to occur throughout the day. The JBLM model has three study periods: AM peak period (6am to 9am), midday peak period (11am to 2pm), and PM peak period (3pm to 6pm). The factors used to convert daily trips into peak period trips vary by trip type and are based on factors used in the PSRC model. Additionally, these factors are generally consistent with parameters shown in *NCHRP 716 Travel Demand Forecasting: Parameters and Techniques* (TRB, 2012).

The JBLM model also accounts for ACPs that open or close depending on the time of day. Based on the ACP that is closed, traffic generated at that TAZ will shift to other ACPs. Traffic may also shift to different ACPs based on external traffic conditions, such as heavy congestion in the I-5 corridor.

Post-Processing Methodology

Post-processing refers to the process of adjusting raw future model volumes to account for the model calibration or validation differences inherent in all travel demand models. The post-processed travel forecasts are necessary to evaluate possible improvements with the most relevant and reasonable travel data available.

The difference method for post-processing was used in developing the vehicular forecasts prepared for the *Corridor Plan Feasibility Study*, and works by subtracting the existing model volume from the future model volume, and adding the difference to existing traffic counts. The difference method may not produce reasonable results 100 percent of the time, so the results are checked for reasonableness, similar to all model post-processing analysis procedures.

The post-processing method in the JBLM Model also converts peak period model volumes, which represent three hours, into a single peak hour volume for operations analysis. The peak hour conversion factors are based on existing three-hour counts, and adjusted for reasonableness or to reflect the effects of significant congestion that could cause changes in how traffic spreads over the peak period in the future.

The main purpose of the travel demand model is to forecast the traffic "demand" for a particular roadway or corridor. Anytime traffic queues persist on roadways, the actual traffic "demand" is higher than the available "capacity". In other words, the travel demand model answers the "what is the forecasted traffic demand on the corridor" question, whereas the traffic operations model answers "what is the impact of that demand on corridor operations (delays and queuing)" question. While both models use similar concepts, they perform their functions under very different methodologies. The post-processed volumes represent the forecasted traffic demands on the corridor, a key input to traffic operations analysis.

These post-processed volumes were used as the basis for analyzing traffic operational conditions for the 2040 Base Condition as described in Chapter V and the various I-5 mainline improvement scenarios discussed in Chapter VI.

V. Future I-5 Baseline Conditions

Operational and mobility conditions for I-5 in year 2040 were analyzed to determine traffic volumes for the Future Baseline Condition. The Future Baseline Condition JBLM model uses the Future Baseline Network described in Section IV, Traffic Forecasts. The Future Baseline Network is the existing street network plus the planned future improvements with allocated funding sources. These improvements are shown in Figure IV-5 and described further below. Phase 1 analysis and data includes such items as average travel speeds, vehicle trips, person trips, and hours of congestion.

To determine how I-5 will function in 2040 if no improvements are made to the system (Baseline Condition) the mobility conditions were analyzed, using traffic forecasts developed from the JBLM Travel Demand Model. This section contains a summary of the 2040 operational analysis and findings.

Future Baseline System

The 2040 baseline highway system used in the model included the existing highway infrastructure and funded projects. The key funded projects related to this study are:

- I-5 Congestion Management Improvements Funded with a TIGER III Grant
- Madigan Access Improvements
- HOV Lanes on I-5 and SR 16 North of S 38th Street in Tacoma
- Point Defiance Bypass Rail Project
- Wharf Street Gate (JBLM Lewis North access central point)
- Joint-Base Connector Phase 1

These improvements are expected to help reduce congestion in targeted areas, but they will not relieve congestion throughout the corridor study area in the 2040 design year. These improvements will be accounted for as this study develops a long-term strategy for the I-5 corridor. Each project is described further below:

I-5 Congestion Management Improvements (TIGER III Grant)

As part of WSDOT's strategic plan to improve traffic operations through the corridor study area, the State is currently installing traffic management measures as part of a TIGER III grant-funded project. These improvements include:

- Variable Message Signs
- Congestion monitoring with CCTV cameras connected with fiber optic cables
- Ramp metering
- A southbound auxiliary lane from the Thorne Lane on-ramp to the Berkeley Street off-ramp
- HOV bypass lanes at selected ramp meters

Figure V-1 illustrates the TIGER III improvements. WSDOT began implementation of these improvements in 2013, and construction is expected to be completed in 2014. The ramp meters were not part of the modeled network in Phase 1 but will be analyzed in Phase 2.

Madigan Access Improvements

The City of Lakewood is actively involved in improving operations at the I-5/Berkeley Street Interchange by adding a third travel lane and sidewalks across the bridge over I-5, and adding a second left-turn lane from the I-5 SB off-ramp to Berkeley Street. The City will begin these improvements in 2014 and they are expected to be completed by 2015.

HOV Lanes on I-5 and SR 16 North of S 38th Street in Tacoma

HOV lanes on I-5 and SR 16 north of South 38th Street are included as part of the funded Baseline network. As part of WSDOT's 2007 – 2026 Highway System Plan, the rest of the core HOV system extending to SR 512 is unfunded. Additional HOV lanes from SR 512 to the Thorne Lane Interchange are in the Highway System Plan as part of the unfunded Tier III Solutions. The analysis presented in this study only includes the funded improvements. Analysis with unfunded improvements including HOV lanes between SR 512 and Thorne Lane will be conducted in Phase 2 of this study.

Point Defiance Bypass (Rail)

Funded recommendations from the Point Defiance Bypass Project including additional train service and at grade crossing improvements (including Thorne, Berkeley, 41st Division, and Steilacoom-DuPont) are included in the Baseline system.

Wharf Street Gate

The Wharf Street Gate is currently under construction and is expected to open in 2014. This new gate will replace the I Street gate and provides additional access to Lewis North via Steilacoom-DuPont Road.

Joint Base Connector Phase 1

Joint-Base Connector Phase 1 includes the first stage of a new high speed arterial between Lewis Main and McChord Field. The Phase 1 improvements include a secured overcrossing of Perimeter Road, enabling vehicles to stay within the secured perimeter when traveling between the two parts of the installation. The rest of the Joint-Base Connector is not funded but will be included as part of the unfunded analysis in Phase 2.

Figure V-1: I-5 SR 510 to SR 512 – Congestion Management Improvements

2040 Phase 1 Analysis Summary

The Phase 1 analysis utilized available data and model forecasts to develop operational data, such as average travel speeds, vehicle trips, person trips, and hours of congestion. The peak period traffic volume used in this analysis is constrained by the existing capacity of I-5 and limited to the peak hour. It is important to note that as the system reaches its capacity, the forecasted volume slows or stops growing, however travel demand through the area does not. In Phase 2 of the study a detailed simulation model (VISSIM) will be developed that will analyze longer peak periods to confirm and refine these preliminary analyses. These analyses assume no other improvements to the I-5 mainline except those discussed on page V-1.

Overall, the 2040 analysis shows that traffic congestion along I-5 through the corridor study area is expected to continue to increase over the next 27 years. Speeds will slow with periods of stop and go traffic and the hours of congestion will increase.

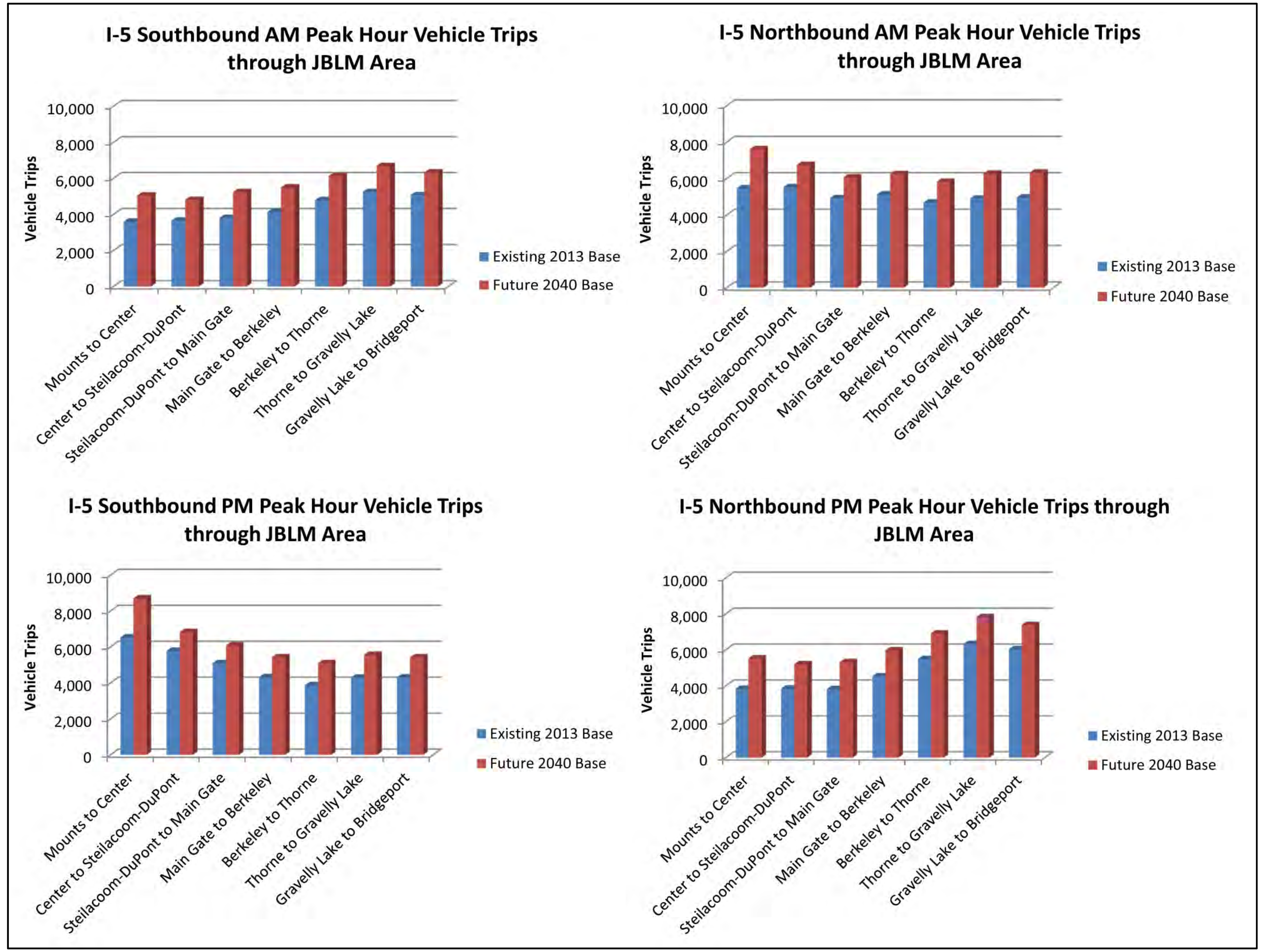
I-5 2040 Travel Forecast

In the corridor study area along I-5, the PM peak hour vehicular travel between Mounts Road and Bridgeport Way is expected to grow by an average of 29 percent by year 2040. Figure V-2 shows a comparison of the estimated AM peak hour and PM peak hour traffic volume by freeway segments and direction. These charts show that the AM peak hour traffic increase is expected to range from 25 percent to 41 percent with an average of approximately 32 percent in the southbound direction. In the northbound direction, the AM peak hour traffic volume increase is expected to range from 22 percent to 39 percent with an average of approximately 26 percent.

During the PM peak hour, the travel increase is expected to range from 18 percent to 33 percent with an average of approximately 26 percent in the southbound direction. In the northbound direction, the PM peak hour traffic volume increase is expected to range from 22 percent to 44 percent with an average of approximately 31 percent.

There are areas of lower traffic growth, especially in the southbound direction during the PM peak hour, because the existing 2013 travel along the corridor is already high, and is near or exceeding the practical capacity of the roadway. This limits the amount of traffic growth that can be reasonably added within the corridor study area during the peak hour and results in more hours of heavy vehicular travel.

Figure V-2: Comparison of 2013 and 2040 Baseline Traffic Volumes Along I-5



I-5 2040 Per Lane Travel Forecast

Another way of analyzing I-5 traffic is analyzing the average volume per lane. The average vehicle trip per general purpose (GP) lane is illustrated in Figure V-3. The practical capacity of a GP lane along this section of I-5 was estimated at about 1,800 vehicles per hour. The level of service (LOS) E volume is estimated at about 90 percent of this capacity, or about 1,620 vehicles per hour (vph), which is the practical threshold for determining congested conditions. Another way of representing this is a volume to capacity ratio (v/c) which equates to a 0.90 factor. The v/c relationship is further discussed in subsequent chapters.

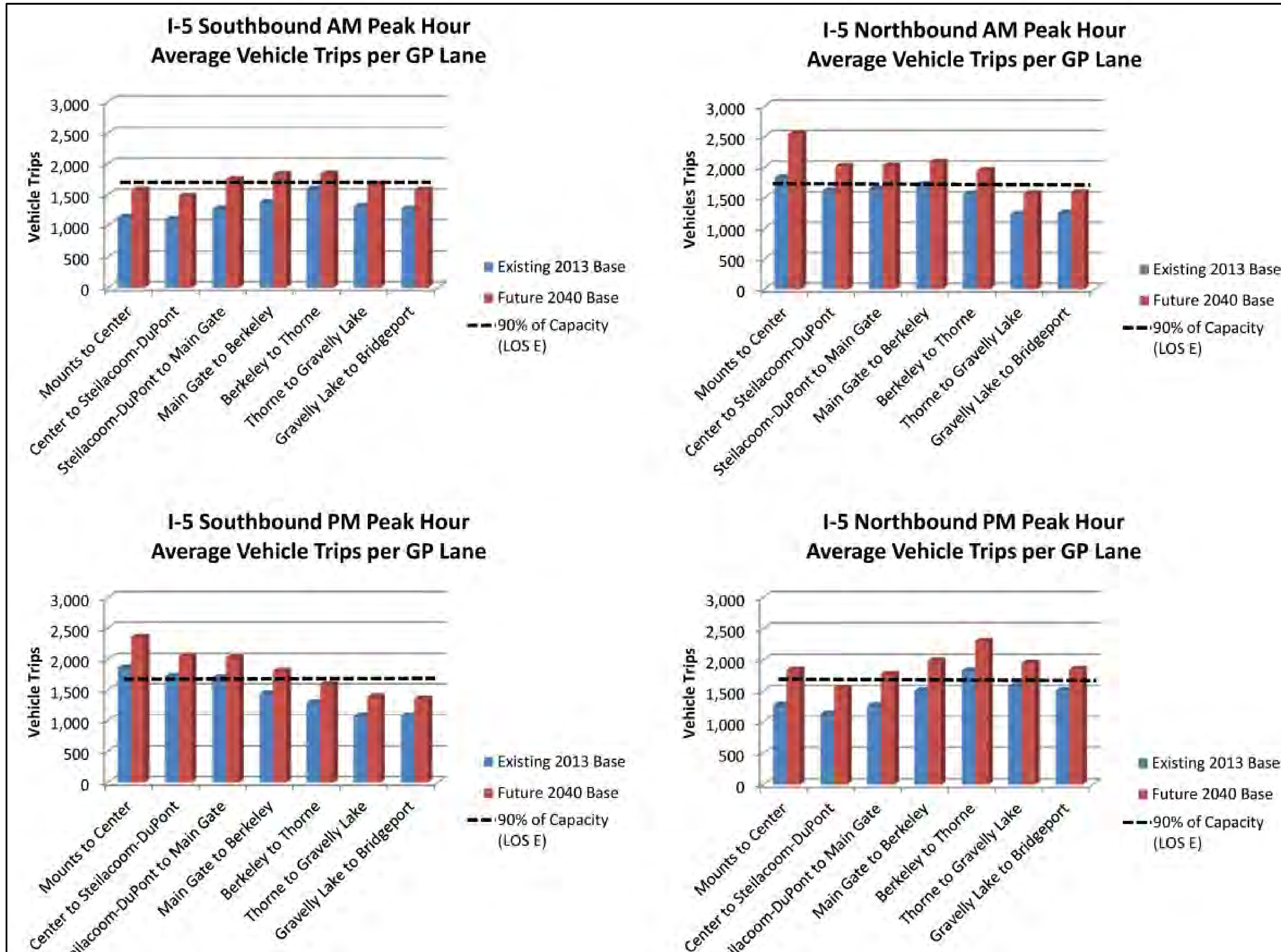
As can be observed from the charts, many of the northbound segments of I-5 are near or at the LOS E lane capacity in 2013. By 2040 during the AM peak hour, most of the segments along I-5 in this corridor area will be exceeding the LOS E capacity in both the northbound and southbound directions. Many northbound segments during the AM peak hour will exceed the practical lane capacity, especially south of Thorne Lane.

Similarly, during the PM peak hour, many of the I-5 segments exceed the LOS E lane capacity in 2013. By 2040, virtually all of the segments along I-5 will exceed the LOS E capacity with most northbound and southbound segments exceeding the practical lane capacity of 1,800 vph or LOS F.

This level of traffic congestion will:

- Reduce the gap distance between vehicles
- Make it more difficult for drivers to change lanes safely
- Causes drivers to slow down or stop as other drivers change lanes with smaller gaps
- Result in more rear-end and sideswipe collisions
- Increase unreliable trips

Figure V-3: Comparison of 2013 and 2040 Baseline I-5 Average Vehicles per GP Lane through JBLM Area



Note: Practical lane capacity is estimated to be 1,800 vph.

I-5 2040 Lane Capacity

The maximum practical I-5 lane capacity used in this study is 1800 vph. This is consistent with existing performance in the corridor. Technological improvements between now and 2040 may provide a higher lane capacity. There are no established standards currently available for future higher capacity. The transitional flexibility resulting from a staged implementation of improvements recommended by this study (Phase 2) will allow for adjustments (reductions) in the ultimate facility if higher lane capacities are realized.

I-5 2040 Travel Speed

Another factor used to illustrate congestion is average travel speed along the I-5 corridor. In WSDOT's Highway System Plan 2007 – 2026, 70 percent of posted speed (42 mph) is used to signify when heavy congestion, described as LOS F, occurs. LOS F is defined as unacceptable levels of peak period congestion.

As can be observed from the charts in Figure V-4, with no added capacity, travel speeds will continue to slow down along I-5 by 2040 during the AM peak hour and fall below an average of 42 mph for many segments. Northbound AM traffic average speed through the corridor study area average approximately 27 mph.

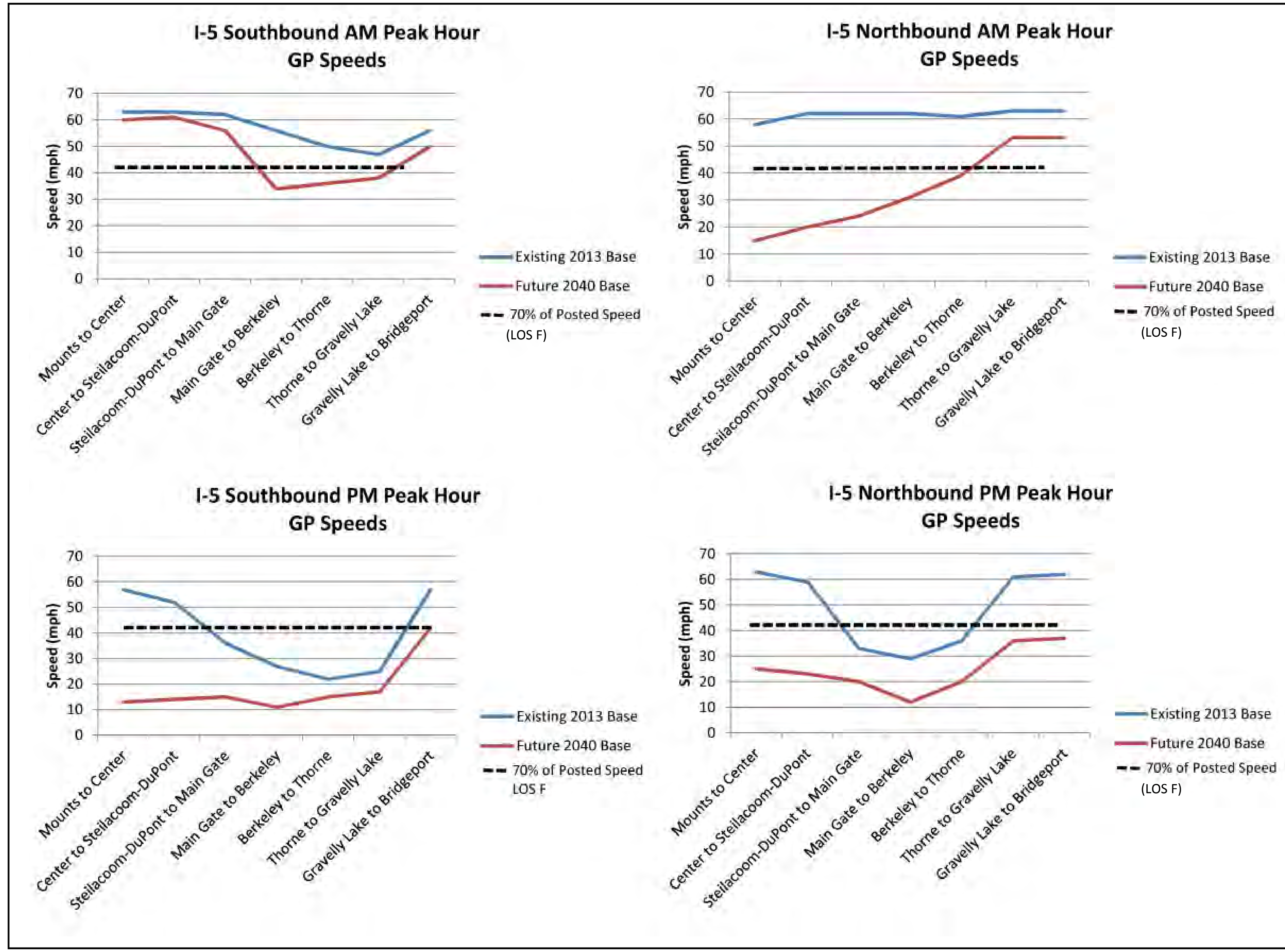
Similarly, with no added capacity to I-5, during the PM peak hour in 2040, the entire length of I-5 through the corridor study area is expected to be congested. Drivers travelling northbound and southbound on I-5 can expect average speeds less than 30 mph, and in many areas less than 20 mph.

With no added capacity, the average southbound PM peak hour travel speed through the corridor study area in 2040 is expected to drop to about 15 mph, as compared to the average of 34 mph in 2013. Similarly, the average northbound PM peak hour travel speed through the corridor study area in 2040 is expected to drop to about 21 mph, as compared to the average of 42 mph in 2013.

These slow average speeds signify that several areas along I-5 will have slow moving vehicles with periods of stop and go traffic.

It should be noted that during Phase 2 of the project, detailed traffic operational analysis (simulation) of freeway mainline segments, weave/merge areas, ramps and ramp terminal intersections will be conducted. This more detailed analysis will address all of the individual variations in operations that cannot be reflected in the more generalized demand analysis conducted for Phase 1.

Figure V-4: Comparison of 2013 and 2040 Baseline Average Speed along I-5 through the JBLM Area with Existing Lanes



Hours of Congestion – 2040

Due to the high traffic demand and the slow speeds, the hours of congestion along I-5 are expected to extend well beyond the AM and PM peak hours. To estimate how many hours will be congested, a Phase 1 analysis was conducted using the existing and forecasted traffic and the current hourly distribution of traffic from two permanent counters located in the corridor study area. For this analysis, the hours of congestion along I-5 is based on the number of hours that the average per lane volumes exceeds 90 percent of the practical GP lane capacity. This analysis estimated the number of congested hours on an average weekday without accidents or bad weather. With the higher levels of traffic forecasted in the baseline scenario, the likelihood of incidents and the congestion associated with these events is much higher than it is today.

By 2040 during the AM hours, the hours of congestion in the northbound direction are estimated to increase to six to seven hours out of a total of twelve hours for the first half of the day. This area has three GP lanes, whereas north of Thorne Lane, I-5 widens to four GP lanes.

In the southbound direction, during the 2040 AM hours, congestion is expected to increase to at least two hours north of the Steilacoom-DuPont Interchange. South of this interchange, projected traffic volumes are lower and less hours of congestion are anticipated.

During the PM hours, the number of hours of congestion is expected to increase from three hours in 2013 to at least seven hours by 2040, in both directions out of the second twelve hours of the day. In the northbound direction during the 2040 PM peak period, congestion will extend throughout the corridor study area and likely will spill back to the Nisqually River and into Thurston County. Likewise in the southbound direction, congestion likely will spill back into the four-lane area north of Thorne Lane.

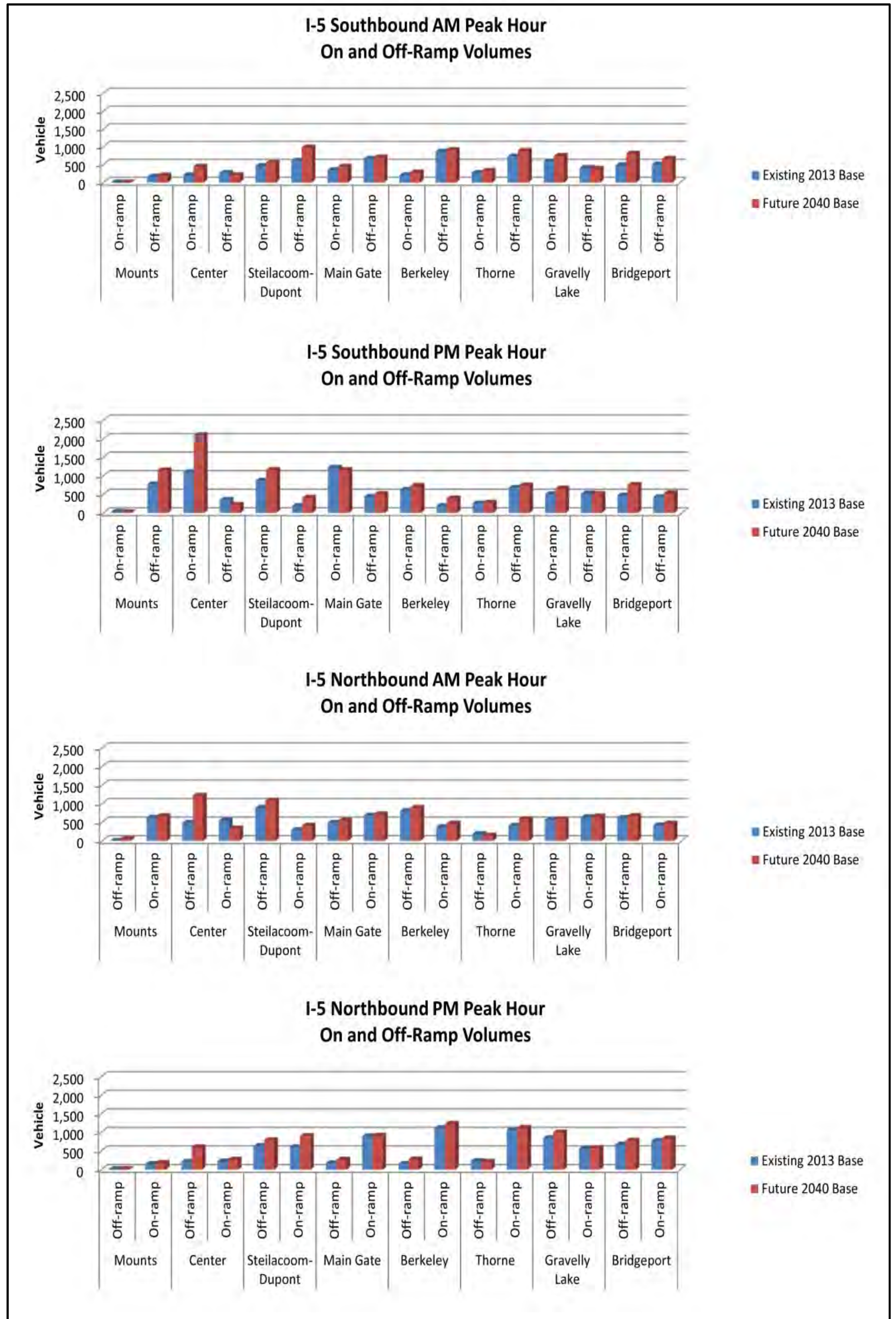
Heavy I-5 On / Off-Ramp Volumes – 2040

One of the causes for congestion along I-5 through the JBLM area is the high volume of traffic entering and exiting I-5, as shown in Figure V-5. During peak commute periods the entering and exiting traffic is predominately I/E (Internal/External – see pg. III-7). Volumes of "base to base" traffic during peak commute periods are understood to be low.

In the southbound direction during the AM 2040 peak hour, between Thorne Lane and Mounts Road, there are 3,885 vehicles exiting I-5 and 2,060 entering I-5. These 5,945 vehicles represent over 110 percent of the three-lane practical capacity of I-5 south of Thorne Lane. The outside lane cannot handle all off this traffic; so drivers must merge from other lanes before exiting or after merging onto I-5.

In the northbound direction during the AM 2040 peak hour, there are approximately 3,165 vehicles entering I-5 and 3,905 vehicles exiting I-5 between Mounts Road and Thorne Lane. These 7,070 vehicles are nearly 131 percent of the practical capacity of the whole three-lane section of I-5 south of Thorne Lane.

Figure V-5: Comparison of 2013 and 2040 Baseline On & Off-Ramp Volumes



Similarly during the 2040 PM peak hour in the southbound direction, between Thorne Lane and Mounts Road, it is estimated that there are 3,405 vehicles exiting I-5 and 5,430 entering I-5. These 8,835 vehicles represent nearly 165 percent of the three-lane practical capacity of I-5 south of Thorne Lane. In the northbound direction during the 2040 PM peak hour, there are approximately 4,630 vehicles entering I-5 and 2,175 vehicles exiting I-5 between Mounts Road and Thorne Lane. These 6,805 vehicles represent 126 percent of the practical capacity of the whole three-lane section of I-5 south of Thorne Lane.

At Center Drive alone, there are nearly, 2,100 vehicles expected to enter I-5 during the PM peak hour in the southbound direction to travel to Thurston County which is more than the 1,800 vph per lane practical capacity of a single travel lane on I-5. This high amount of traffic growth expected at the Center Drive Interchange is caused by the build-out of the City of DuPont, the expanded hours of operations at JBLM's Center Gate, and increased travel to Thurston County.

Overall, this heavy amount of lane changing along this section of I-5 causes traffic to slow, increases congestion, creates an increased likelihood for collisions, and reduces the per lane capacity for I-5 through the corridor study area.

High Level of Weaving and Merging Activity – 2040

Because of the heavy on and off-ramp volumes expected in the 2040 Baseline conditions, the level of merging and weaving is expected to increase along I-5, especially between Mounts Road and Steilacoom-DuPont Road and between Berkeley Street and Gravelly Lake Drive. I-5 on-ramp and off-ramp volumes in these locations will increase significantly compared to 2013 conditions. These areas will continue to experience high levels of weaving and merging activity which will aggravate the congestion, low speeds and collisions along the corridor.

Figure V-6 shows the expected number of northbound drivers weaving between Berkeley Street and Gravelly Lake Drive during a typical 2040 PM peak hour. Within a 1.5-mile distance, over 3,575 drivers are weaving on or off I-5 and merging with through traffic. This “side friction” creates congestion and increases collisions. Side friction affects not only entering and exiting traffic but also traffic simply moving through the corridor study area

A similar pattern of significant weaving and merging, occurs now and is expected to increase significantly in the southbound direction during the PM peak hour between Steilacoom-DuPont Road and Mounts Road, as illustrated in Figure V-7. Within a 1.5-mile distance, over 4,600 drivers are weaving on or off I-5 and merging with through traffic. A large contributor to the southbound PM peak merging traffic volumes is the growth within the City of DuPont and the expanded hours of operations at the JBLM’s Center Gate anticipated by the model. The outside lane cannot handle these volumes, so many drivers must change lanes, causing side friction, and slowing traffic in all lanes.

Figure V-6: 2040 Baseline – Northbound Merge/Diverge Between Berkeley Street and Gravelly Lake Drive, PM Peak Hour

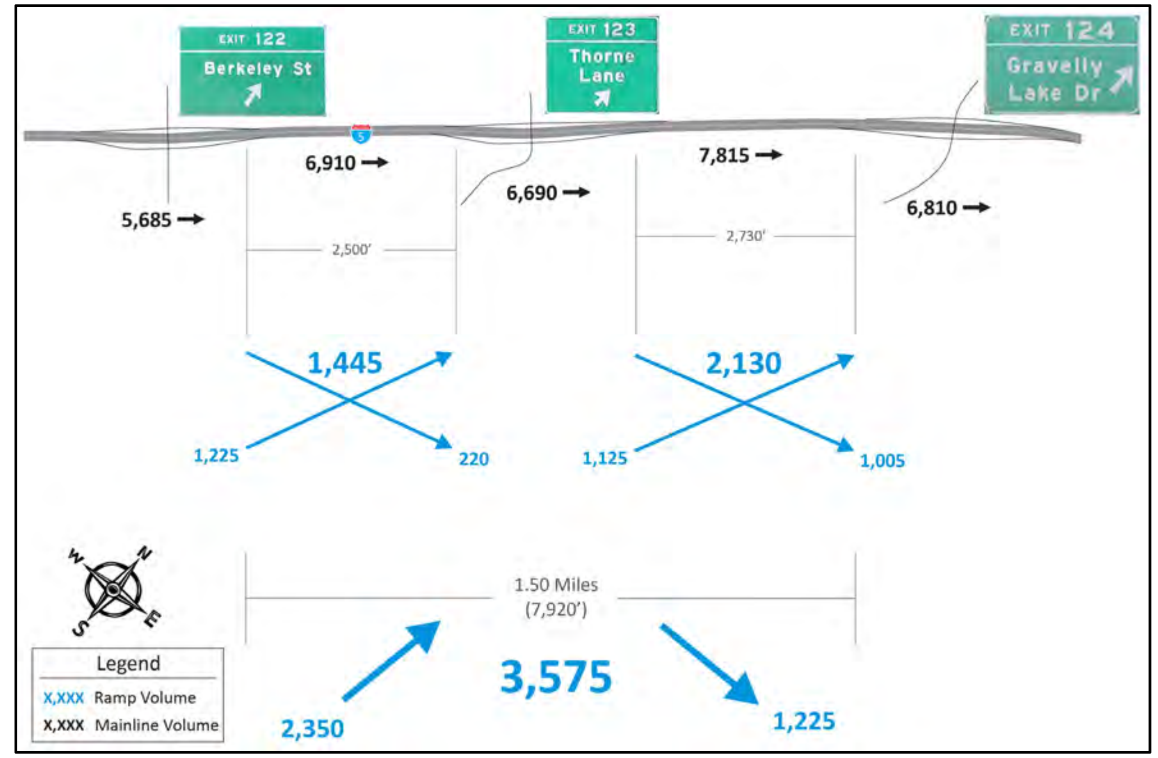
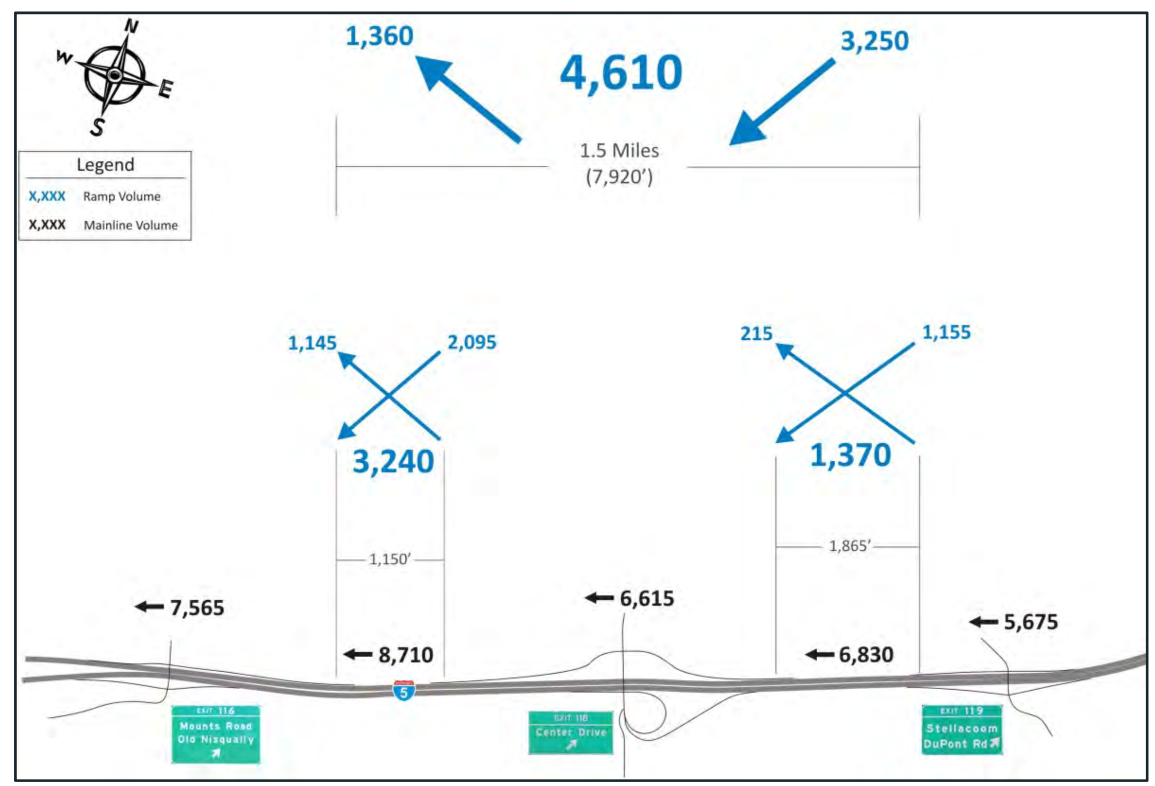


Figure V-7: 2040 Baseline – Southbound Weaving/Merging Between Steilacoom-DuPont Road and Mounts Road, PM Peak Hour



Summary of 2040 Baseline PM Peak Hour Travel and Speeds

Without added capacity by 2040, I-5 through the corridor study area will maintain its three lanes per direction south of Thorne Lane and four lanes per direction north of Thorne Lane. Travel demand along I-5 will continue to grow and congestion will increase with more hours of congested traffic. A summary of the expected I-5 PM peak hour 2040 traffic flow through the corridor study area is displayed in Figure V-8 with demand ranging from 4,405 vph to 7,815 vph northbound and 4,670 vph to 8,710 vph southbound.

With the large mainline and ramp volumes, travel speeds along I-5 slow to less than 20 mph with areas of stop and go traffic, as illustrated on Figure V-9. These slow travel speeds equate to a low level of service along I-5 through the corridor study area. **It is expected that these slow travel speeds along I-5 will last for approximately seven hours in both the AM and PM peak periods.**

These issues require drivers to change lanes frequently, merging in to small gaps between vehicles and often cut off other drivers. This weaving and merging side friction causes traffic to slow and sometimes causes collisions.

Overall, the increased congestion and slow travel speeds are expected to worsen significantly along I-5 by 2040 as compared to the existing 2013 conditions, if improvements are not implemented along the I-5 corridor. Since the model does not account for the effect of ramp metering through the corridor, the mainline conditions should be somewhat better than shown in these results.

With no new through roads planned for the area and I-5 being constrained on both sides by JBLM and also with the rail line of the west side, I-5 will continue to be the only practical and convenient route for drivers travelling to and through the corridor.

Figure V-8: 2040 Baseline PM Peak Hour I-5 Traffic Flow

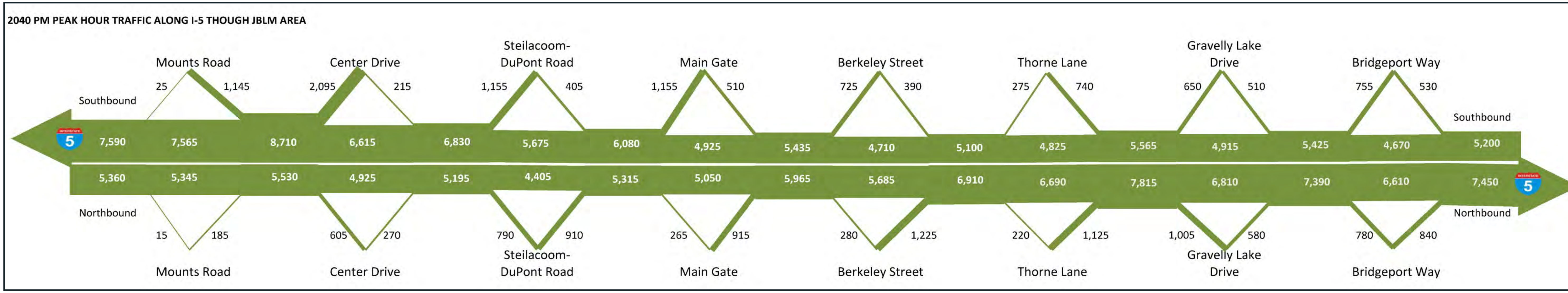


Figure V-9: 2040 Baseline PM Peak Hour I-5 Travel Speeds

Summary of 2040 Baseline PM Peak Hour Operations

A summary of the PM peak hour Phase 1 analysis for the 2040 Base (No-Build) Conditions are displayed in Figure V-10 for key southbound and northbound locations along I-5. In the southbound direction, the congestion and slow speeds north of Center Drive and Steilacoom-DuPont Road are critical locations that affect traffic flow through the corridor study area. Average travel demand volumes are expected to exceed the practical capacity of the travel lanes (1,800 vph). The slow speeds in these locations create a ripple effect that slows travel throughout the corridor study area. Contributing factors that slow travel speed include heavy through traffic, high weaving and merging traffic, and frequent lane changes.

These conditions are also evident in the northbound direction where congestion and slow speeds are expected north of the 41st Division/Main Gate and Berkeley Street interchanges. Again heavy through traffic and high amounts of weaving and merging traffic cause frequent lane changes and slows traffic.

Summary of Physical Constraints and Operations for the 2040 Base Conditions

A summary of the future 2040 Base (No-Build) Conditions along I-5 is illustrated on Figure V-11. This segment of I-5 is expected to have heavy congestions over an extended period of time with numerous periods of stop and go traffic.

Figure V-10: Summary of 2040 Baseline Conditions PM Peak Hour

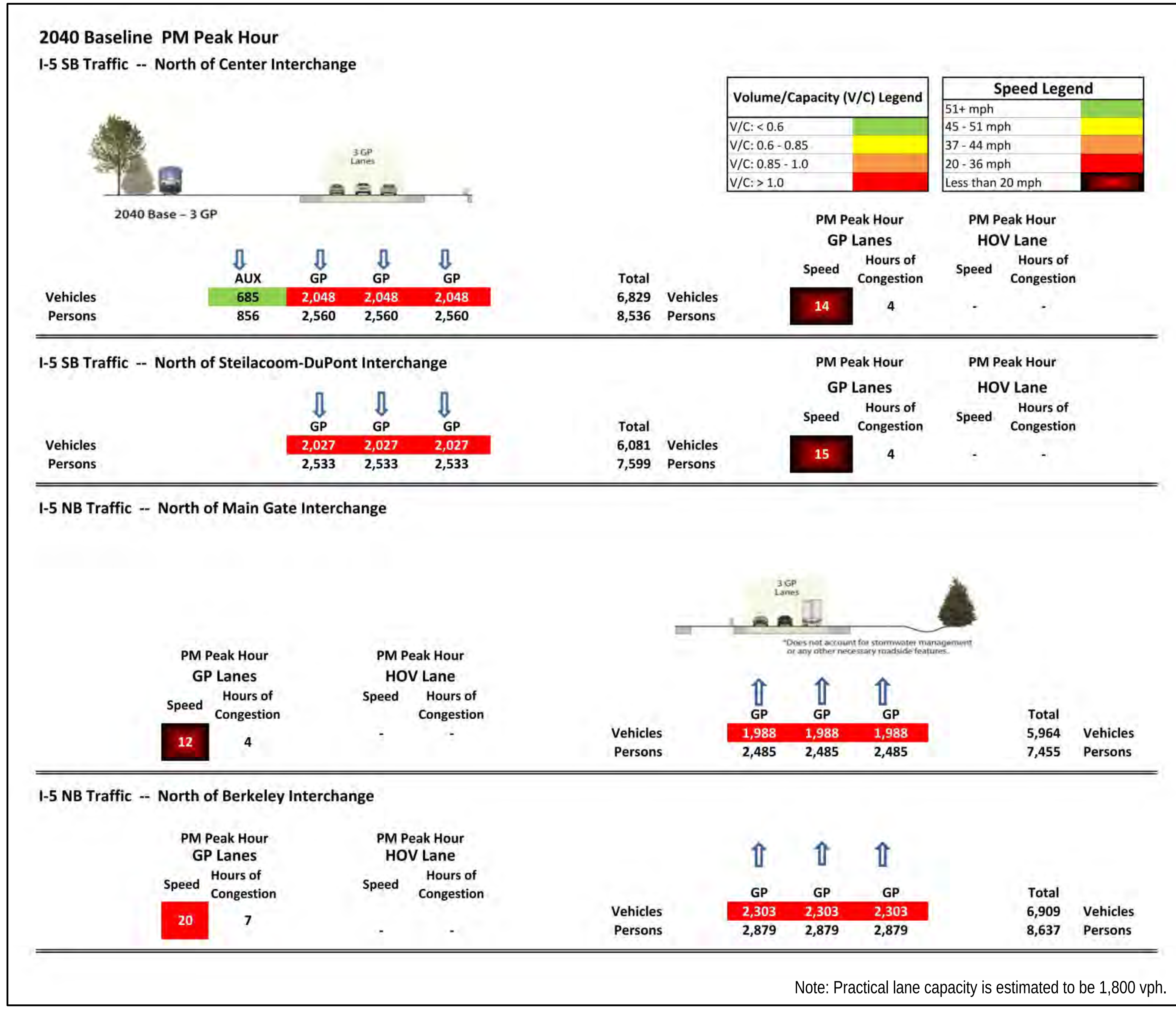


Figure V-11: 2040 Baseline Conditions Summary (No Build)

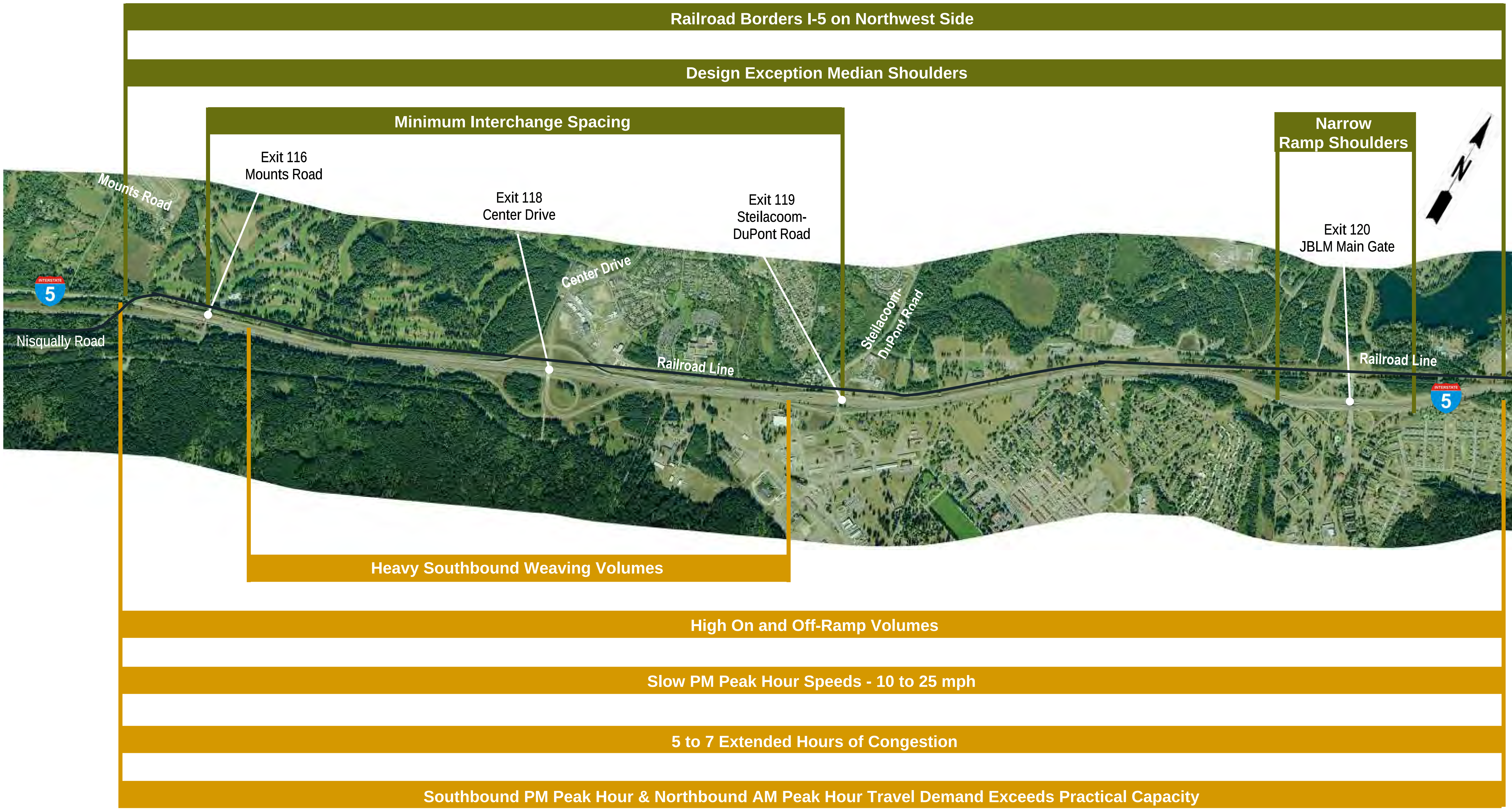


Figure V-11: 2040 Baseline Conditions Summary (No Build) continued

VI. I-5 Mainline Build Scenarios

The development of alternative scenarios for improving the I-5 mainline to address existing and expected future safety and mobility needs is presented in this chapter. The mainline build scenarios include HOV lanes (managed lanes), auxiliary lanes, Collector-Distributor (CD) roads and General Purpose (GP) lanes. The recommended mainline build scenarios will be combined with the interchange concepts, presented in the next chapter, to develop I-5 Build Alternatives. The determination of the mainline scenario is needed to:

- Refine the interchange concepts;
- Define the length of structures needed to accommodate the ultimate mainline design without rebuilding them; and
- Design ramp connections.

The development of mainline improvement scenarios was based on the strategies and guidelines from the “Moving Washington” Initiative. These strategies include:

- Operate Efficiently: Use a variety of traffic management tools to get the most out of existing highways. This includes the TIGER III Transportation System Management (TSM) projects currently under construction.
- Manage Demand: To relieve overburdened facilities, encourage the use of other routes or modes, or encourage travel during less congested times of day. This includes the Madigan Access improvements and the HOV lanes to encourage rideshare and transit usage.
- Add Capacity Strategically: Target hot spots and fill critical system gaps that fix bottlenecks or add facilities to encourage the use of carpools, vanpools and transit. This includes the addition of HOV lanes, CD lanes, auxiliary lanes and GP lanes where appropriate.

This chapter summarizes the process of developing and analyzing I-5 mainline improvement scenarios and includes:

- A discussion of constraints along I-5 corridor that impact the development of multimodal improvements. These constraints are more fully documented in the beginning of Chapter 3.
- Presentation and discussion of alternative scenarios to selectively and strategically enhance I-5 mainline capacity.

I-5 Corridor Constraints

There are several physical constraints along I-5 through the corridor study area. These constraints include:

- Two secure military installations are located along I-5, JBLM and Camp Murray. Much of the I-5 right-of-way is on an easement from the Department of Defense (DOD). Changes to the easement will require approval from DOD.
- A rail line parallels I-5 to the northwest. Preservation of the existing right-of-way for future double tracking of the corridor precludes widening of I-5 on this side.
- Alternative routes to move regional civilian traffic are severely limited by the size of JBLM and the secure nature of this installation and Camp Murray. The availability of alternative routes is further limited by water bodies, sensitive environmental areas, and historic structures.
- If any improvement impacts the military residential areas, the process to adjust the easement will involve a private enterprise which has a 50 year lease for the on-base military housing areas.

I-5 Mainline Build Scenarios

Together with the project stakeholders, the study team developed a series of scenarios to address congestion and improve safety along the I-5 mainline through the corridor study area. Overall the study team developed six potential cross sections for the I-5 mainline to evaluate their ability to address congestion in the corridor. The three tenets of the *Moving Washington* initiative were used to identify and assess the mainline scenarios. This was accomplished by virtue of the types of improvements selected for analysis and the criteria used to evaluate them.

In developing these improvement scenarios, the study team considered a variety of lane types and configurations to address the unique array of existing and expected operation problems along the corridor, as summarized below:

- Managed Lanes/HOV Lanes: A managed lane is a lane that increases efficiency by encouraging carpooling and transit use, such as high occupancy vehicle (HOV) lanes or high occupancy toll (HOT) lanes or other forms of congestion pricing. These travel lanes are restricted to use only by transit or ride-share vehicles (2+ passengers). Single occupant vehicles can use HOT lanes by paying a toll, with tolls set to achieve lane usages that maximize efficiency and person throughput. For study purposes, managed lanes are modeled as 2+ HOV lanes. Consideration of managed lanes is directly consistent with “Moving Washington” in that the addition of these lanes would offer a travel time advantage to transit and car/vanpools supporting the goal of more effectively managing demand and moving people rather than cars.
- Collector/Distributor (CD) Roads: CD roads are directional travel lanes within the limited access corridor that run parallel to the freeway, separated by a barrier or raised median. These lanes are designed to serve traffic entering or exiting the interstate at one or more adjacent interchanges. They reduce side friction on the freeway by reducing the number of conflict points between this traffic and vehicles on the mainline. A CD road system is intended to address existing and expected future problems with high on/off volumes and extensive weaving and merging activity by concentrating this activity in limited locations where it can be more effectively managed.
- Auxiliary Lanes: Auxiliary lanes are used to reduce congestion at high volume on-ramps and/or off-ramps by providing additional space for weaving and merging. They can be used in advance of off-ramps, or to extend the length of on-ramps. Commonly, they are used to add a lane for the full length between successive interchanges for on-ramp to off-ramp traffic. For this study, auxiliary lanes are used largely for this purpose.
- General Purpose (GP) Lanes: GP lanes are travel lanes on the freeway that are open to all types of licensed, motorized vehicles without restriction, including single occupancy vehicles, HOVs, vans, trucks, buses, taxis, semi-tractor-trailers, motorcycles and recreational vehicles.

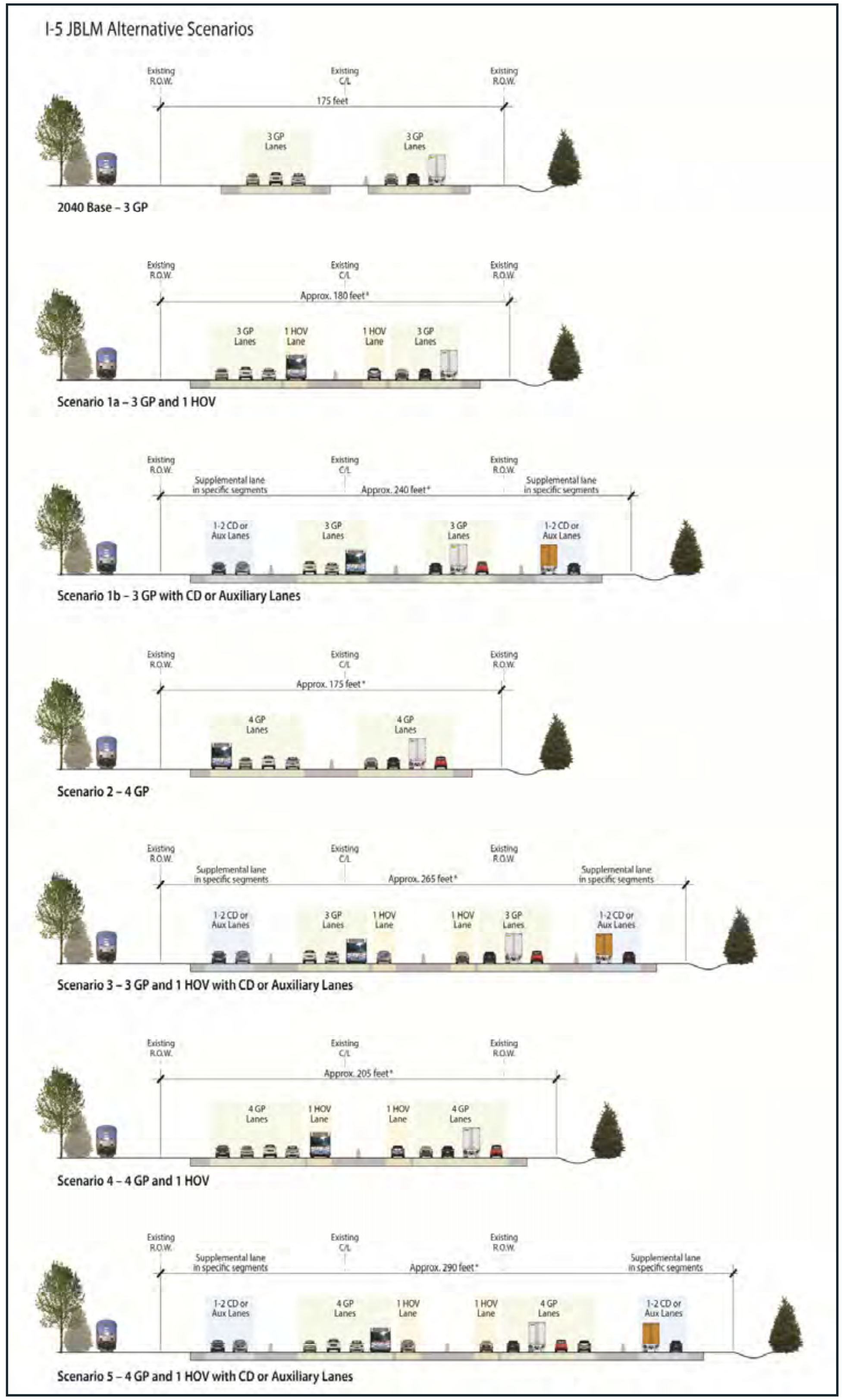
As a primary objective and guiding principle of this corridor study, the development of I-5 scenarios considered the need for flexibility in the design and ultimate configuration of the freeway to accommodate area growth. This requires a practical balance between the cost of improvements to address congestion for the next 27 years, and the need to secure sufficient right-of-way (ROW). Providing a width for I-5 that would not require reconstruction of relatively new bridges is likely a prudent fiscal decision. This flexibility is also important from the standpoint of acquiring future right-of-way which will involve a lengthy negotiation process with DOD and its housing leaseholder – a unique situation in Washington State and a rare occurrence anywhere within the United States.

To address the nature of existing/future deficiencies along the corridor and to remain consistent with the *Moving Washington* initiative, the study team used a “layering” concept (from minimum to maximum) to develop I-5 mainline scenarios. Each mainline scenario was developed by adding lanes of various types (managed/HOV, CD, auxiliary, and/or general purpose lanes) and testing these combinations to determine effectiveness in addressing congestion, having the potential to reduce fatal and serious collisions, increasing transit and ride-share opportunities, decreasing side friction, and balancing traffic volumes across through travel lanes to maximize system efficiency.

The six scenarios considered in the *Corridor Plan Feasibility Study* are listed below and shown in Figure VI-1:

1. Scenario 1a: Adds one managed lane/HOV lane in each direction combined with the existing three GP lanes south of Thorne Lane and four GP lanes to the north to increase transit and ride-share opportunities, reduce congestion and improve safety.
2. Scenario 1b: Adds a combination of CD roads or auxiliary lanes at strategic locations along I-5 to the existing three GP lanes south of Thorne Lane and four GP lanes to the north to reduce side friction by limiting the number of access and egress points, reduce congestion and improve safety.
3. Scenario 2: Adds one GP lane in each direction along I-5 south of Thorne Lane to create continuity of travel lanes along I-5 through the corridor study area, reduce congestion and improve safety.
4. Scenario 3: Adds one managed lane/HOV lane and a combination of CD roads or auxiliary lanes at strategic locations along I-5. This combines the features of Scenarios 1a and 1b.
5. Scenario 4: Adds one managed lane/HOV lane throughout the corridor study area and one GP lane in each direction south of Thorne Lane. This combines the features of Scenarios 1a and 2.
6. Scenario 5: Adds one managed lane/HOV lane throughout the corridor study area, one GP lane in each direction south of Thorne Lane, and a combination of CD roads or auxiliary lanes at strategic locations along I-5. This combines the features of Scenarios 1a, 1b, and 2.

Figure VI-1: I-5 Mainline Improvement Scenarios



* These distances indicate approximate roadway prisms and do not include areas for stormwater management, clear zone, and other roadside features.

Several of the scenarios include CD roads or auxiliary lanes. These combinations of lanes are under consideration because of the constraints along the corridor associated with the secure military installations, and parallel railroad line. These unique physical constraints make the use of frontage roads or local connections extremely difficult.

The CD roads or auxiliary lanes would be used where they would provide the most operational benefit. Because the two types of lanes function differently, they are not both needed in the same segments of the corridor. Figure VI-2 shows the general location of the CD roads or auxiliary lanes for the scenarios that include them.

I-5 Analysis and Evaluation Criteria/Metrics

To analyze and evaluate the mainline improvement scenarios, a set of Phase 1 evaluation criteria or metrics was identified, based on available data. During Phase 2, a more detailed operational analysis, using VISSIM and other operational analysis tools, will be conducted to verify the evaluation findings for the recommended scenarios.

For the *Corridor Plan Feasibility Study*, the specific metrics chosen were selected for their representation of freeway performance in accordance with the *Moving Washington* initiative. These following metrics were used in this evaluation:

- Speed
- Hours of Congestion
- Person Trips
- Friction/Conflict Reduction
- Environmental Impacts
- Cost

These metrics are discussed below.

Speed

Speed data was developed based INRIX data and extrapolated to future conditions using the forecast model speeds during the AM and PM peak hour for both the general purpose (GP) lanes and/or managed (HOV) lanes included in the various I-5 mainline scenarios. The purpose of this metric was to provide a measure of operational performance for the single highest travel hours during both morning and afternoon/evening commute periods. This data can then be compared among alternative scenarios to determine which would potentially provide reasonable travel speed in the future.

The data used in developing this performance measure was obtained from the JBLM Travel Demand Model for all mainline segments (e.g., between interchanges) for each scenario in both travel directions and both time periods (AM and PM peak hour). These modeled speeds were then post-processed to calibrate them with existing speed data to provide reasonable estimates. Modeled speed for each segment of I-5 was compared to projected speeds on adjacent segments with the object of insuring a broad, corridor-wide consistency of data. Where modeled speeds for a specific scenario, direction and segment were significantly different (higher or lower) than speeds in adjacent segments, the modeled speed in the differing segment was adjusted closer to the average of the adjacent segments. This adjustment helps to smooth out the modeled speeds and accounts for known traffic queuing and weave/merge issues that will affect actual speeds.

Figure VI-2: Potential Location of C/D Roads and Auxiliary Lanes

GP travel speeds and HOV lane travel speeds were evaluation separately. This provided additional points for those scenarios with HOV lane improvements because those scenarios provided additional benefits of encouraging alternative modes of travel, such as carpools and vanpools, reducing SOV trips, and following the principles of Moving Washington.

Hour of Congestion

Hours of congestion represent the total number of hours over the course of the day that would experience congestion in both the HOV and GP travel lanes, equating to LOS F or lower, that is, when the volume exceeds 90 percent of the practical roadway capacity. The hours of congestion metric provides a second traffic operational performance measure that focuses on identifying the duration of congestion over the course of a typical weekday. Hours of congestion were calculated by obtaining average traffic volume data on typical weekdays from the two Automated Data Collection (ADC) sites in the corridor study area – one located just south of Exit 120 (41st Division/Main Gate) and the other just south of Exit 127 (SR 512). This data is collected 24-hours per day, 365 days per year. By averaging the available 2013 hourly distribution data (January and February of 2013) from the permanent count stations on I-5 within the corridor area, a relationship was established between the AM and PM peak hours and all other hours during the first and second halves of the day. For example, if the PM peak hour is the highest hour in the afternoon and evening, then all eleven other hours during this half of the day can be expressed as a percent of the PM peak (e.g., 95% of the peak, 80% of the peak, etc.). Once an array of each hour in relation to the two daily peak hours is determined and future year AM and PM peak hour projections are identified, these percentages can be used to determine future year projections for each hour of a typical weekday.

The second step in evaluating hours of congestion was to compare the projected future hourly traffic volumes with a reasonable estimate of hourly highway capacity for each segment of I-5 through the corridor study area. These estimates were developed based on observations of existing maximum vehicle throughput under saturated flow conditions as currently experienced on I-5 in the corridor study area. A capacity value of 1,800 vehicles per hour (vph) was identified for each through or long auxiliary lane, with a value of 900 vph for short auxiliary lanes. These capacities were compared to each hourly traffic projection along the freeway under each scenario. Every hour where future volumes were projected to exceed this capacity, one hour of congestion was tabulated. Hours of congestion in each direction for each segment of the highway and scenario were then totaled and presented in the detailed evaluation matrices for the AM and PM halves of the day.

This approach is based on existing available hourly distribution data because future changes in hourly distribution of trips are not available at this time. During Phase 2, a VISSIM simulation model will provide a better estimate of both travel speed and hours of congestion.

Hours of congestion in the GP lanes and HOV lanes were evaluated separately. This provided additional data and criteria for those scenarios with HOV lane improvements to help distinguish the added benefits of encouraging alternative modes of travel, such as carpools and vanpools, reducing SOV trips, and following the principles of Moving Washington.

Person Trips

Person trip data represents the number of individuals expected to travel through the corridor study area in both directions during the AM and PM peak hours. Person trips were used to measure the ability of each scenario to accommodate the movement of people (as compared to the movement of vehicles) consistent with the objectives of the "Moving Washington" initiative. Person trips were calculated using a series of factors from the AM and PM peak hour vehicle trip forecasts, obtained from the JBLM Travel Demand Model. The process to estimate the total number of person trips segregated the vehicle forecasts by mode (e.g., single occupant vehicle, low occupant vehicle or LOV, high occupant vehicle or HOV and vanpool) and applying an average vehicle occupancy factor to the vehicle forecasts. The following occupancy factors were used for this analysis:

- Vehicle in a general purpose lane where no managed/HOV lanes are provided = 1.25 persons/vehicle
- Vehicle in a general purpose lane where managed/HOV lanes are provided = 1.04 persons/vehicle
- Vehicle in an HOV lane (including an aggregated total of LOVs, HOVs and vanpools) = 2.35 persons/vehicle

As discussed in Chapter IV, the travel demand model does not assign transit trips to the network, so they were removed from the model trip table prior to the traffic assignment process. As a result, transit trips were not included in the above averages and were not included for any of the scenarios.

Person trips were totaled for each segment of the I-5 mainline by travel direction for each scenario and time period. Data for each freeway segment was aggregated into four principal corridor segments in each direction using a weighted average of person trips. This data was then averaged and reported over the entire length of the corridor in each travel direction for AM and PM peak hours.

Friction / Conflict Reduction

Side friction through the corridor has been identified as a significant cause of the congestion experienced today in the corridor study area. The large amount of through traffic, combined with the high volume of entering and exiting vehicles, causes volume imbalances among the I-5 through lanes with the outside GP lane carrying a higher percentage of the total volume than is efficient for highway operations. There are also several closely spaced interchanges within the corridor study area that add to the significant side friction with a high volume of entering and exiting vehicles that must weave and merge with through traffic. The construction of a CD road in targeted locations has been identified as an improvement that can reduce side friction and thereby reduce conflicts that degrade highway operations.

The CD roads together with capacity improvements (such as additional GP lanes) would also provide some reduction in side friction by increasing mainline capacity.

Environmental

Environmental data represents a planning level assessment of the anticipated impacts to the natural and built environment associated with each scenario and pertinent discipline. These disciplines included: wetlands and streams, federally listed species, water quality and flooding, hazardous materials, cultural/historic resources (Sections 4(f) and 6(f)), air and noise quality, socio-economics and environmental justice, and geology and soils. See Chapter VIII for a full description of the environmental scan process and findings.

Cost

Cost of each scenario was not quantitatively calculated. Instead, the general magnitude of construction cost was compared among the scenarios assuming that the No Build condition would have the lowest cost and Scenario 5 would have the highest cost. All other scenarios were assessed relative to these high and low conditions.

Other criteria considered but not used

Other criteria considered but not used in the evaluation of corridor scenarios included safety, volume to capacity (v/c) ratio and a separate *Moving Washington* criterion. Based on discussions with the study team, it was determined that issues which affect safety and v/c ratio are covered by the speed, hours of congestion and friction/conflict reduction criteria. A separate criterion for *Moving Washington* was not used because person trips, HOV speeds and HOV hours of congestion represent the *Moving Washington* initiative.

Phase 1 Analysis of the Mainline Scenarios

Each of the mainline improvement scenarios is described below along with key findings from the Phase 1 analysis.

Scenario 1a: Adds a Managed/HOV Lane in Each Direction

To improve transit service and increase person throughput in the corridor, Scenario 1a would add one managed/HOV lane in each direction. For traffic forecasting purposes, the HOV lanes are modeled as continuous between Tacoma and Lacey. A typical section for Scenario 1a is illustrated in Figure VI-3.

The existing right-of-way along I-5 through the corridor study area averages 175 feet in width. With some design deviations, this scenario could be reduced to fit within the existing right-of way, although additional right-of way will be needed for storm water quality and flow control facilities.

The following sections discuss the operational impacts and benefits associated with Scenario 1a, including vehicle trips, person trips, average GP lane speeds, hours of congestion, and changes to ramp volumes.

Vehicle Trips

By 2040, the overall number of vehicles in the corridor study area would increase by approximately eight percent, as shown in Figure VI-4. This increase is caused by latent travel demand in the corridor using the capacity added by the HOV lanes. Latent demand is demand that would use the freeway if it could get on it.

While total vehicle trips increase, vehicle trips in the GP lanes would be slightly reduced. Even with this slight reduction, most of the three GP lane segments south of Thorne Lane are expected to remain congested with volumes exceeding the Level of Service (LOS) E capacity of 4,860 vph in both the northbound and southbound directions along I-5.

The usage of the HOV lane would range from over 1,000 vehicles to over 1,400 vehicles in the PM peak hour in the southbound direction, and from over 600 vehicles to over 1,500 vehicles in the northbound direction with many HOV trips expected to come from the area north of the Steilacoom-DuPont Road Interchange. These volumes, especially north of Thorne Lane, would near the LOS E limit of 1,620 vph in a single travel lane.

Figure VI-3: Scenario 1a - Typical Section

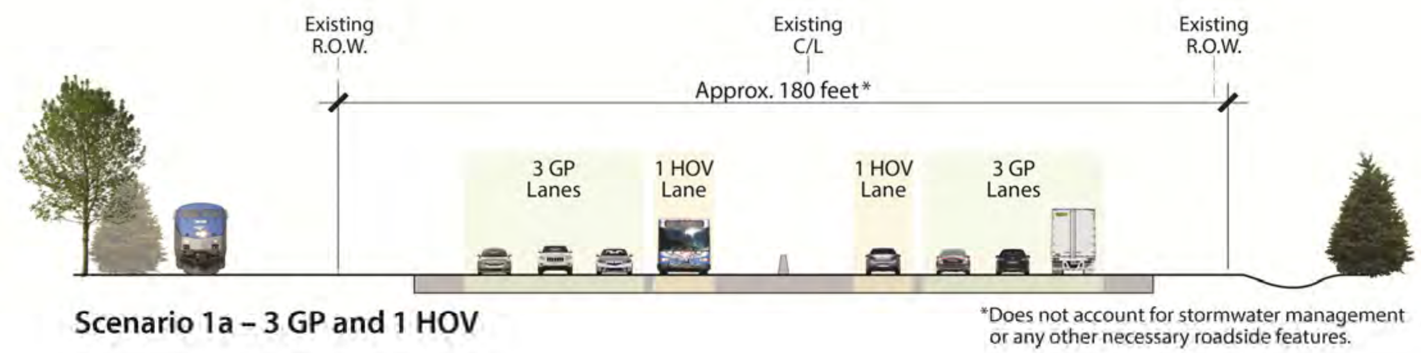


Figure VI-4: Scenario 1a - 2040 PM Peak Hour Vehicle Trip Summary

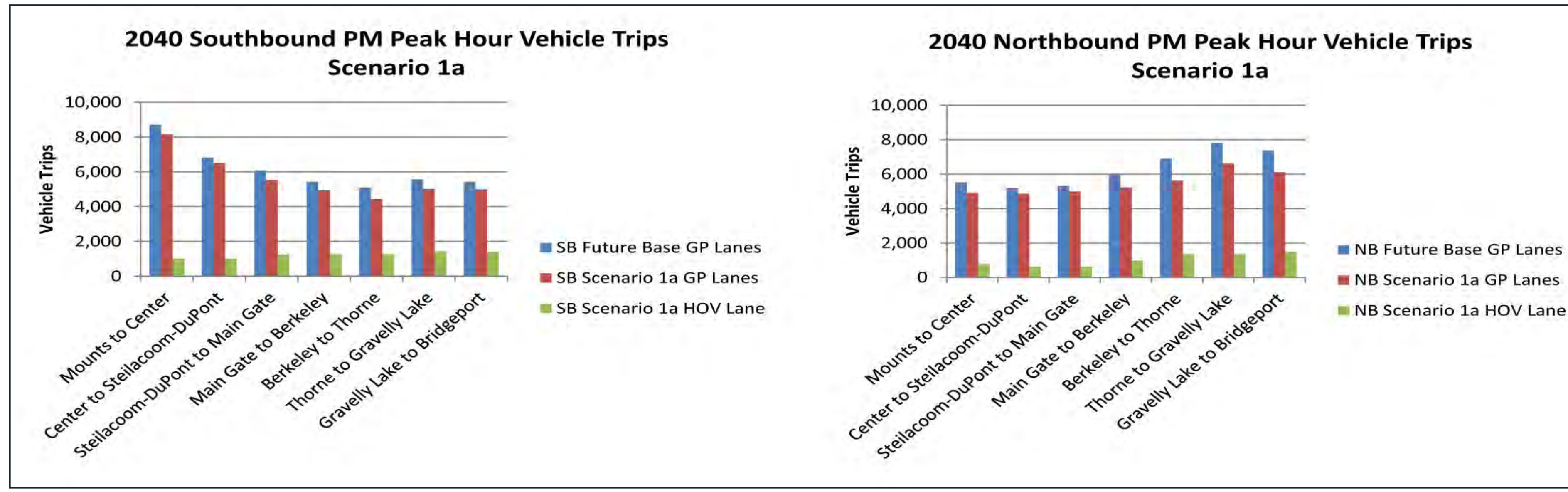
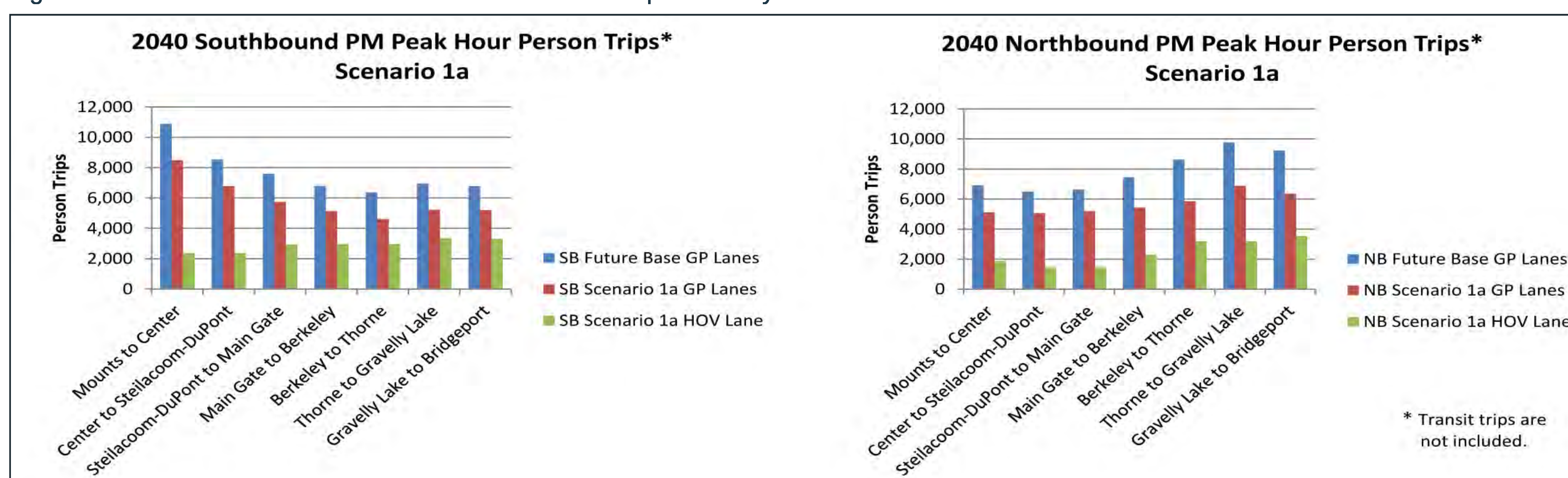


Figure VI-5: Scenario 1a - 2040 PM Peak Hour Person Trip Summary



Person Trips

With the addition of the HOV lane in Scenario 1a, the overall number of person trips on I-5 through the corridor study area in the PM peak hour would increase, as compared to the 2040 Baseline. This increase would average about nine percent when both travel directions are combined, with a 14 percent increase southbound and about three percent northbound. During the AM Peak Hour the number of person trips would have an overall increase of approximately one percent, mainly in the northbound direction.

Through the corridor study area, the number of person trips in a single HOV lane would generally be higher than the corresponding person trips in one GP lane, as illustrated in Figure VI-5. Only between Mounts Road and Center Drive in the southbound direction and between Center Drive and Main Gate in the northbound direction would the GP lane carry more per lane person trips than the HOV lane.

Average Travel Speeds

Figure VI-6 shows that the addition of the HOV lane in each direction along I-5 slightly improves average GP lane speed during the PM peak hour in comparison to 2040 Base Conditions. However, average speed would remain well below the 70 percent of posted speed threshold (42 mph) for acceptable operations through the corridor study area.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph in the 2040 Base Condition to 20 mph with Scenario 1a. Similarly, in the northbound direction the average GP lane speed would increase from 21 mph for the Base Condition to 29 mph with Scenario 1a. With these relative slow speeds in the GP lanes, drivers would continue to experience periods of stop-and-go traffic during the PM peak hour.

Drivers in the HOV lane would experience speeds between 50 to 60 mph with an average speed of approximately 53 mph through the corridor study area in the PM peak hour.

AM peak hour speeds for the GP lanes would be better than the PM peak with a southbound average speed at 52 mph. However, northbound speed would be below the congestion threshold at 34 mph.

Drivers in the GP lanes during the PM peak hour would have a travel time between Mounts Road and Bridgeport Way will be approximately 27 minutes in the southbound direction, and 19 minutes in the northbound direction. Drivers in the HOV lane could expect a travel time of approximately 10 minutes in either direction. This also improves travel time for transit buses and vanpools passing through the corridor study area.

Hours of Congestion

With the slow PM peak hour speeds in both directions, and slow AM peak hour speeds in the northbound direction, congestion is estimated to extend for several hours during the AM and PM hours. Congested conditions are expected to last for at least five hours during the AM half of a typical weekday in the northbound direction and about one to two hours in the southbound direction. During the PM half of the day, congestion is estimated to extend for at least seven hours in the southbound direction and four hours in the northbound direction.

On and Off-Ramp Volumes

As shown in Figure VI-7, the heavy traffic volumes at on and off-ramps and merge/diverge locations would generally be the same with Scenario 1a as 2040 Base Conditions. Drivers would still need to change lanes often to enter and exit I-5 as side friction impacts would continue to occur. This scenario would require that HOV users in the corridor study area to weave to and from the HOV lane across the three GP lanes to enter and exit I-5, however this scenario would improve travel time for HOV drivers and transit buses passing through the study area.

Figure VI-6: Scenario 1a - Average 2040 PM Peak Hour GP Lane Speed Summary

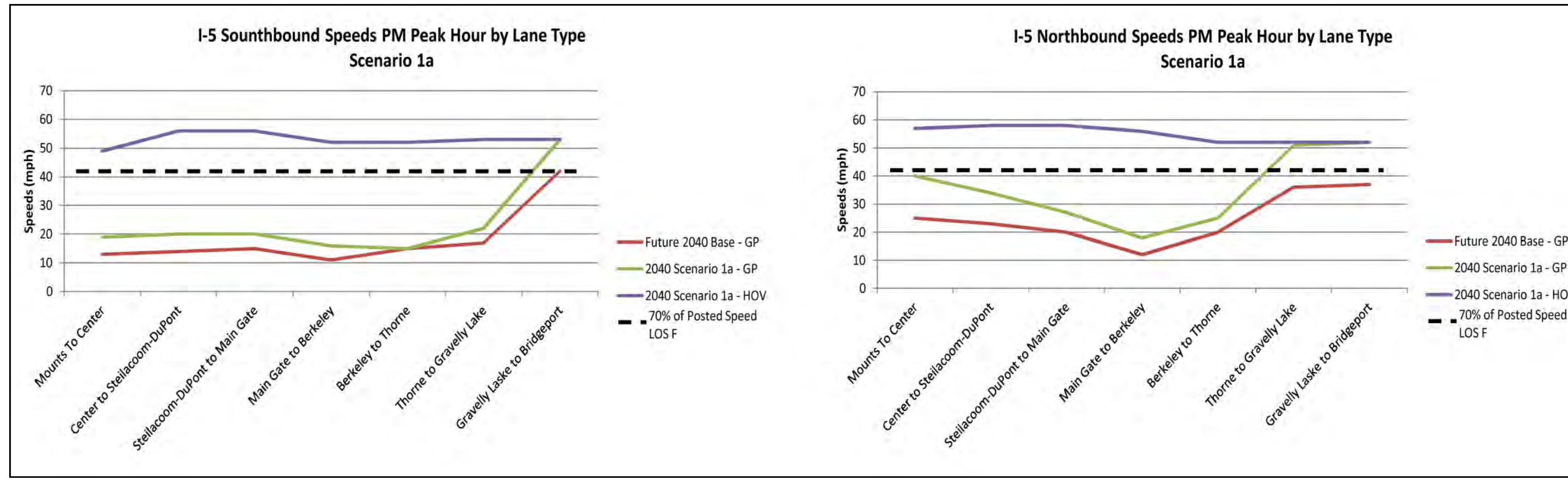
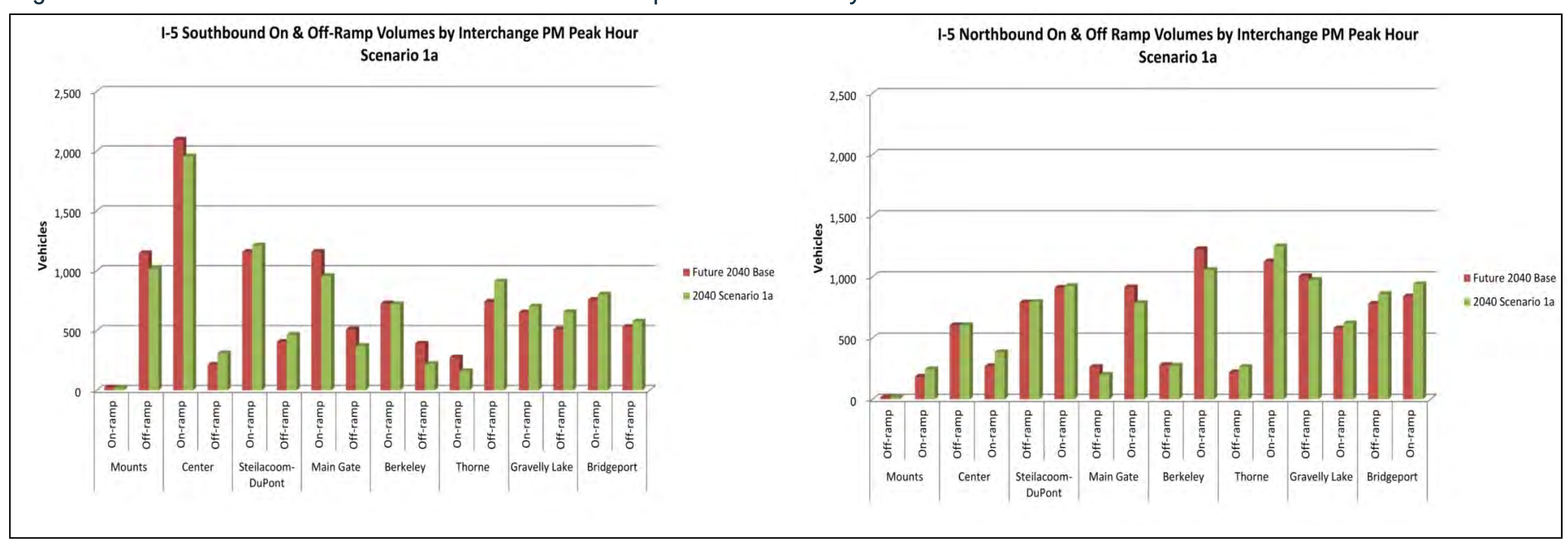


Figure VI-7: Scenario 1a - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 1a 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 1a is displayed in Figure VI-8 for selected southbound and northbound segments along I-5. In the southbound direction, the congestion and slow speeds expected north of Center Drive and Steilacoom-DuPont Road are critical locations causing a ripple effect that slows traffic through the entire corridor. Average traffic volumes are expected to exceed the practical capacity (1,800 vph) of the travel lanes. In comparison to the 2040 Base Conditions, average GP lane volumes for Scenario 1a would decrease with the addition of the HOV lane, while vehicle and person trips would increase. However average GP speed in the segment would remain about the same with a two hour reduction in hours of congestion.

These conditions are also evident in the northbound direction where congestion and slow speeds are expected north of the 41st Division/Main Gate and Berkeley Street interchanges. Again heavy through traffic and high ramp volumes would cause drivers to frequently change lanes and slow traffic. The average GP lane volumes would decrease with the addition of the HOV lane, as compared to the 2040 Base Condition, while vehicle and person trips are expected to increase. Average GP speeds slightly would improve with a three hour reduction in hours of congestion.

Scenario 1a - Summary of Findings

Based on the overall comparison of Scenario 1a with the 2040 Base Conditions, the following key findings for Scenario 1a were identified:

- HOV/managed lanes encourage ride-share and transit.
- Person trips would increase over the 2040 base condition.
- Would have the lowest total vehicle trips of any alternative in PM peak.
- HOV/managed lanes are expected to run at approximately 90 percent capacity in PM peak and 70 percent capacity in AM peak, with an average speed of 55 mph.
- Side friction from heavy on and off traffic would still exist and may worsen with added traffic moving in or out of managed/HOV lane.
- The GP lanes would generally operate better than the 2040 Base Condition, but would still be highly congested.
- Northbound GP speeds in the AM peak are expected to be about 34 mph, and southbound GP speeds in the PM peak are expected to be about 20 mph with periods of stop-and-go traffic.
- HOV lane speeds are expected to range between 50 to 60mph.
- Long durations of PM congestion are expected, especially northbound between the Steilacoom-DuPont and Berkeley interchanges and southbound south of the Steilacoom-DuPont interchange.
- Moderate durations of AM congestion are expected, especially northbound between the Mounts and Berkeley interchanges.
- Travel times in the GP lanes through the corridor study area would range from 19 to 27 minutes while travel time in the HOV lane would be about 10 minutes.

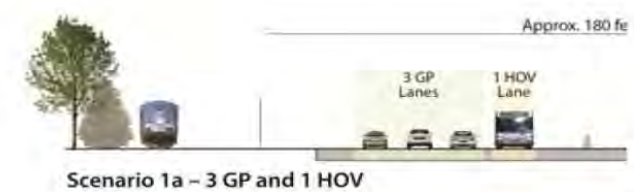
Figure VI-8: Scenario 1a - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 1a - 3 GP and 1 HOV

Volume/Capacity (V/C) Legend	
V/C: < 0.6	green
V/C: 0.6 - 0.85	yellow
V/C: 0.85 - 1.0	orange
V/C: > 1.0	red

Speed Legend	
51+ mph	green
45 - 51 mph	yellow
37 - 44 mph	orange
20 - 36 mph	red
Less than 20 mph	dark red

I-5 SB Traffic -- North of Center Interchange



	AUX	GP	GP	GP	HOV (2+)	Total	
Vehicles	760	1,920	1,920	1,920	1,010	7,530	Vehicles
Persons	790	1,997	1,997	1,997	2,374	9,155	Persons

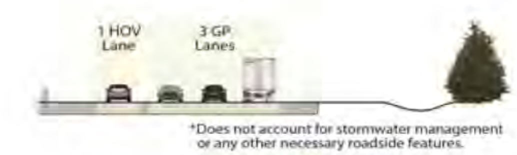
PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
20	3	56	0

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,843	1,843	1,843	1,255	6,784	Vehicles
Persons	1,917	1,917	1,917	2,949	8,700	Persons

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
20	4	56	0

I-5 NB Traffic -- North of Main Gate Interchange



PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
18	4	56	0

	HOV (2+)	GP	GP	GP	Total	
Vehicles	980	1,743	1,743	1,743	6,209	Vehicles
Persons	2,303	1,813	1,813	1,813	7,742	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
25	4	50	0

	HOV (2+)	GP	GP	GP	Total	
Vehicles	1,360	1,877	1,877	1,877	6,991	Vehicles
Persons	3,196	1,952	1,952	1,952	9,052	Persons

* The practical lane capacity is estimated to be 1,800 vph

Scenario 1b: Adds Collector/Distributor Road or Auxiliary Lane along I-5 in Each Direction

Scenario 1b would add collector/distributor (CD) roads at strategic places along I-5 connected by auxiliary lanes to reduce side friction. The number of through lanes would remain unchanged. A typical cross section of I-5 in an area where CD roads are provided is illustrated in Figure VI-9. One set of CD roads would connect the Mounts Road, Center Drive and Steilacoom-DuPont Road interchanges. The second set of CD roads would connect the Berkeley Drive and Thorne Lane interchanges. An auxiliary lane was added on both sides of I-5 between the CD road segments between the Steilacoom-DuPont and Berkeley Street interchanges.

The existing right-of-way along I-5 through the corridor study area is approximately 175 feet in width. The right-of-way needed to add the CD roads would increase the minimum width to 240 feet. Because the rail line on the northwest side of I-5 restricts expansion to the west, the additional width would encroach upon JBLM areas. Additional right-of-way would also be needed adjacent to the roadway for drainage and storm water facilities.

Vehicle Trips

The total number of vehicles in the corridor study area would increase by approximately nine percent as shown in Figure VI-10. This increase is caused by the shifting of some traffic to the CD roads which frees up mainline capacity and attracts new traffic resulting from latent demand. Vehicle trips in the GP lanes would decrease by an amount ranging from about 1,000 to 2,000 vehicles for segments between Mounts Road and Steilacoom-DuPont Road. Vehicle trips in the GP lanes would slightly increase between Thorne Lane and Berkeley Street southbound, but slightly decrease in the northbound direction. Even with these reductions in vehicle trips, most of the three GP lane segments south of Thorne Lane are expected to remain congested with volumes exceeding the LOS E capacity of 4,860 vph (three GP lanes) in the southbound direction, and in the northbound direction between Main Gate and Thorne Lane.

There are no managed/HOV lanes assumed in this scenario. The usage of the CD road would vary from approximately 700 to nearly 3,000 vehicle trips during the peak hours. Some short trips would only use the CD roads and never get on the I-5 mainline, especially between Steilacoom-DuPont Road, Center Drive and Mounts Road. This would reduce congestion along the mainline and the magnitude of side friction conflicts.

Person Trips

The overall number of person trips through the corridor study area would increase by about nine percent with the addition of CD roads. During the PM peak hour, a twelve percent increase in southbound person trips is expected, and about five percent increase northbound, as shown in Figure VI-11, as compared to the 2040 Baseline. During the AM peak hour, in the southbound direction a seven percent increase in person trips is expected with an eight percent increase in the northbound direction.

Figure VI-9: Scenario 1b - Typical Section

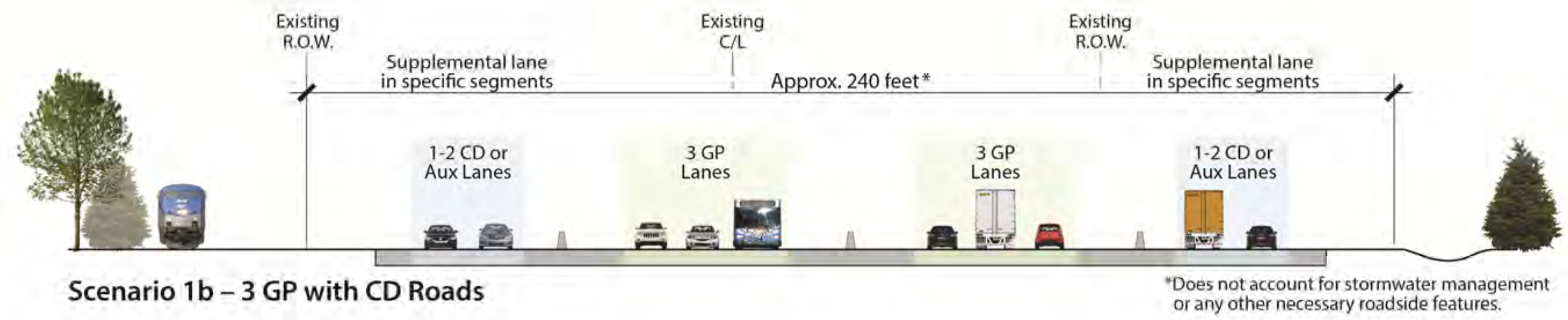


Figure VI-10: Scenario 1b - 2040 PM Peak Hour Vehicle Trip Summary

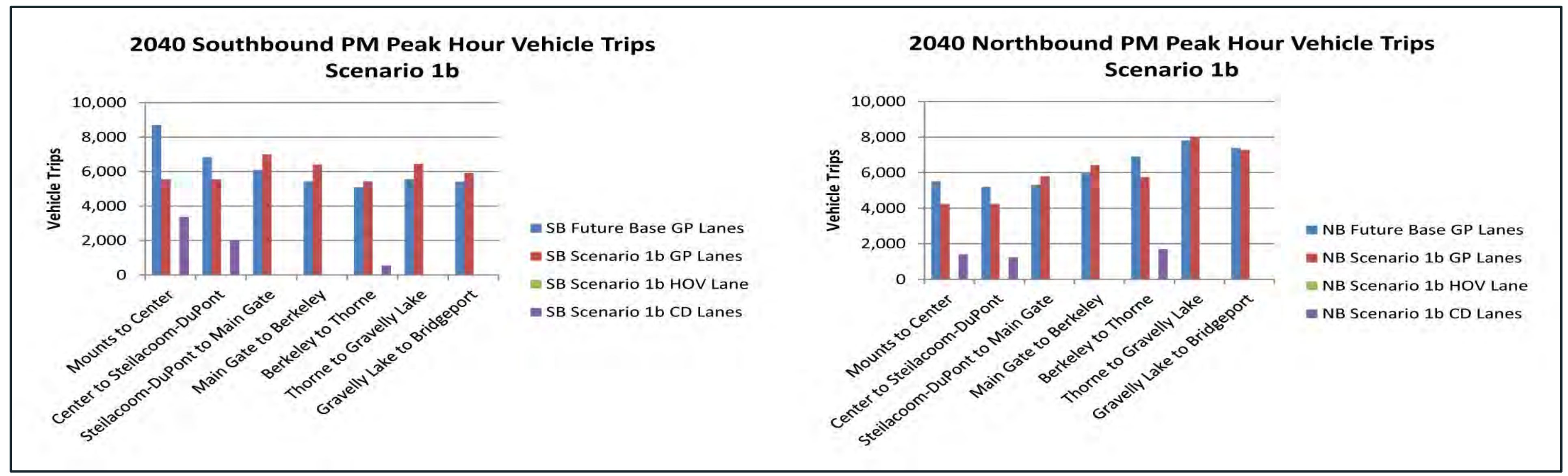
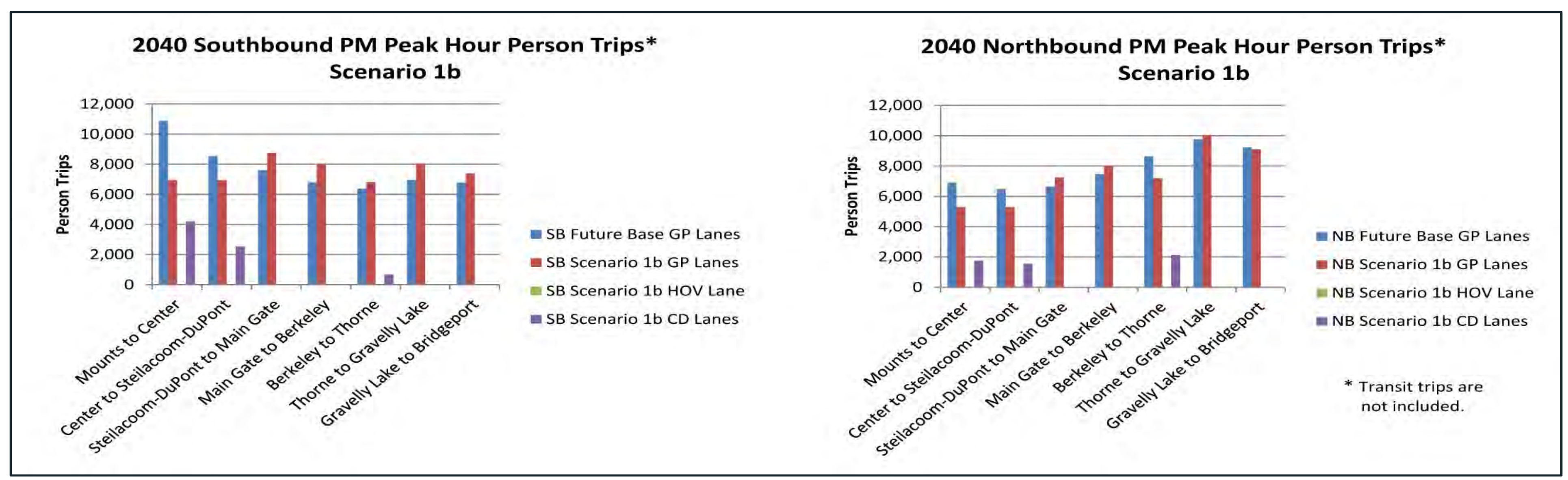


Figure VI-11: Scenario 1b - 2040 PM Peak Hour Person Trip Summary



Average Travel Speeds

The addition of CD roads or auxiliary lanes in each direction would improve average GP lane speed on I-5 during the PM peak hour; but speeds would remain well below the 70 percent of posted speed threshold (42 mph) for acceptable operations through the corridor study area, as shown in Figure VI-12.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph for the Base Condition to 22 mph. Similarly, in the northbound direction the average GP lane speed would increase from 21 mph for the Base Condition to 31 mph. With these relative slow speeds in the GP lanes, drivers would continue to experience periods of stop-and-go traffic during the PM peak hour.

The average AM peak hour speed for the GP lanes is expected above the 42 mph threshold in both directions. Some northbound segments south of Steilacoom-DuPont Road would be below this level.

Drivers in the GP lanes during the PM peak hour could expect a travel time between the Mounts Road Interchange and the Bridgeport Way Interchange of approximately 25 minutes in the southbound direction and 18 minutes in the northbound direction.

Hours of Congestion

With the high traffic volume in the GP lanes and the slow speeds, congestion is estimated to extend for several hours during the AM and PM hours. Congested conditions are expected to last for at least six hours during AM hours in the northbound direction and about one to two hours in the southbound direction. During the PM hours, congestion is estimated to remain for at least five hours in the southbound direction and four hours in the northbound direction.

On and Off-Ramp Volumes

With CD roads, the number of entry and exit points along the I-5 mainline between the Mounts Road and Thorne Lane interchanges would be reduced from twelve in each direction in the 2040 Base Condition to six in each direction as shown in Figure VI-13. This reduction in access points provides drivers more distance for weaving and merging lane changes on I-5, reducing the impact of side friction conflicts.

The CD roads would combine the entering or exiting traffic to fewer locations, thus increasing traffic volumes at the remaining locations. The CD roads would shift the traffic to locations where auxiliary lanes are added to reduce the side friction that would be associated with these larger traffic volumes. The auxiliary lanes allow drivers to change lanes over a longer distance than with a typical on or off-ramp configuration.

These CD roads would also accommodate some short trips, thereby reducing the number of these trips on the I-5 mainline.

Figure VI-12: Scenario 1b - Average 2040 PM Peak Hour GP Lane Speed Summary

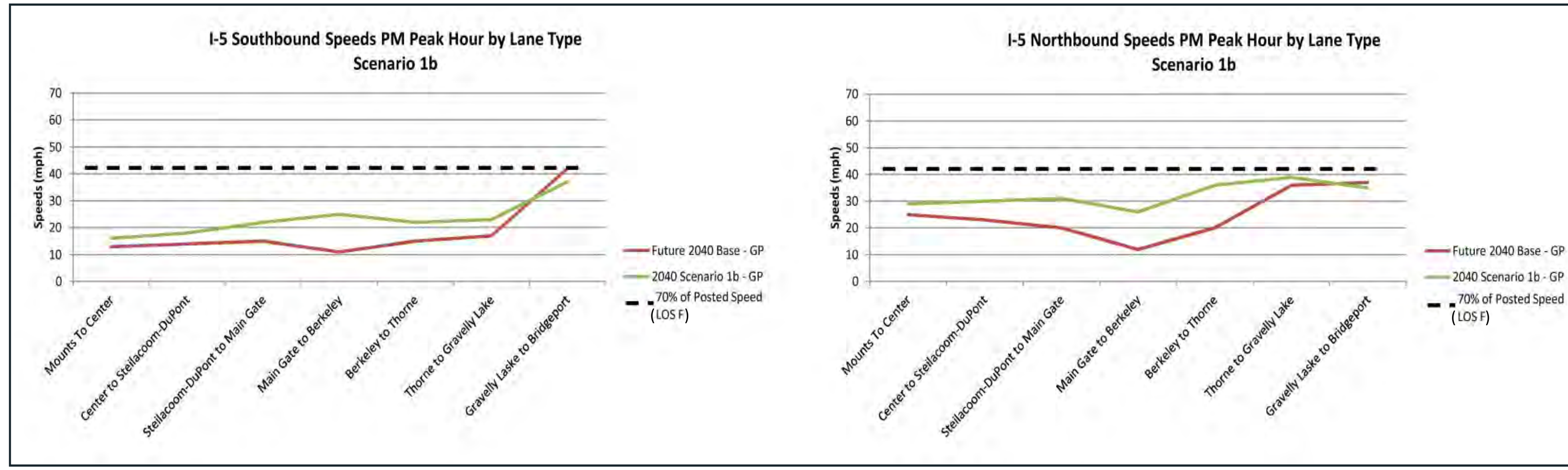
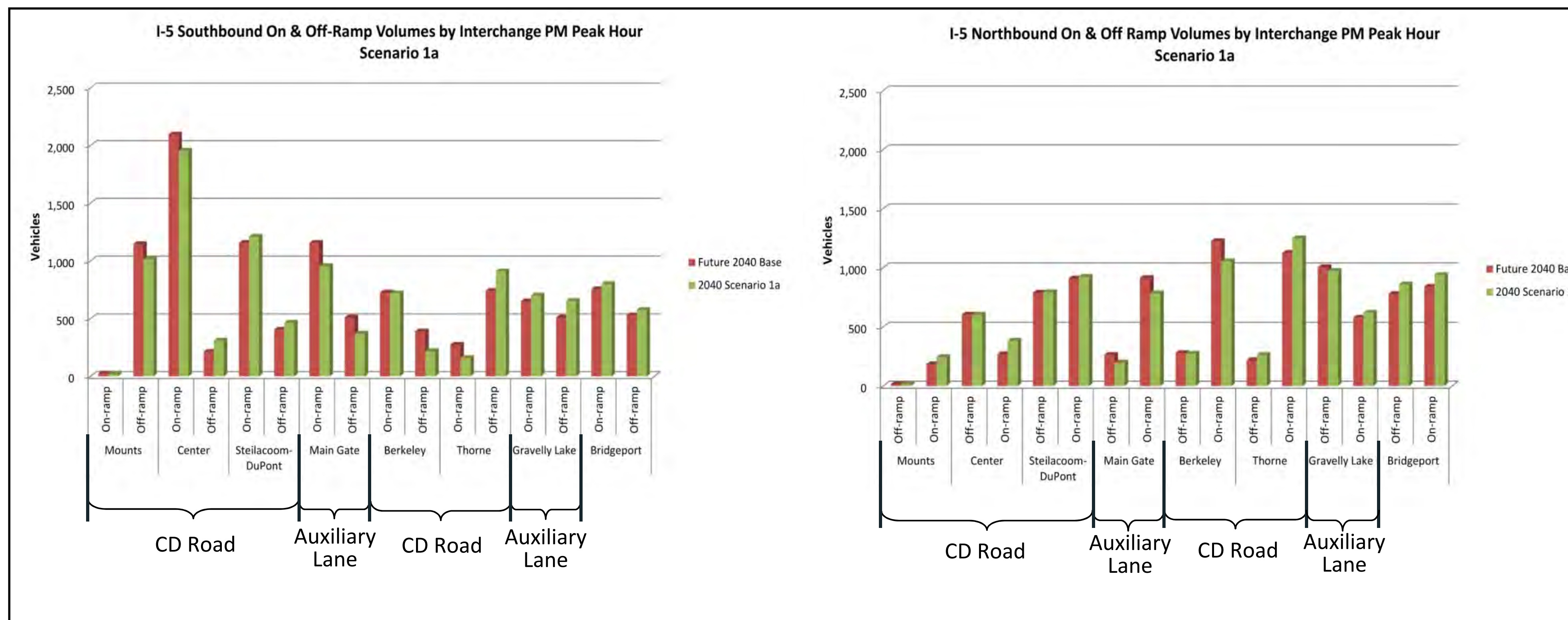


Figure VI-13: Scenario 1b - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 1b 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 1b is displayed in Figure VI-14 for selected southbound and northbound segments along I-5. In the southbound direction, congestion and slow speeds north of Center Drive and Steilacoom-DuPont Road would be critical locations that create ripple effects impacting traffic flow and speeds through the entire corridor. Average traffic volumes are expected to exceed the practical capacity (1,800 vph) of a single travel lane. In comparison to the 2040 Base Condition, average GP lane volumes for Scenario 1b would decrease with the addition of the CD roads, and both vehicle and person trips would increase. The average GP speed in the segment would slightly improve, but would remain slow with a one hour reduction in hours of congestion.

These conditions are also evident in the northbound direction where congestion and slow speeds are expected north of the Main Gate and Berkeley Street Interchanges. Volumes in the average GP lane would decrease with the addition of the CD roads or auxiliary lanes, as compared to the 2040 Base Condition. The CD road would be well utilized as total vehicle and person trips in the relevant segments would increase. Average GP speeds would slightly improve with a three hour reduction in hours of congestion. However, even with the CD roads to reduce the number of merge/diverge locations, heavy through traffic with the remaining high ramp volumes locations would cause drivers to frequently change lanes and slow traffic.

Scenario 1b - Summary of Findings

- CD roads reduce the number of access points on I-5 and help to separate local and thru traffic, thus reducing the areas experiencing side friction.
- Lane capacity added by CD roads would typically be filled by latent or previously unserved demand.
- GP lanes during the PM peak hour would still be congested with average northbound speeds of about 31 mph and average southbound speeds of about 22 mph.
- In AM peak, CD road would operate above the capacity of a single lane northbound between Mounts and Steilacoom-DuPont interchanges and would likely need a two-lane configuration.
- Moderate durations of AM congestion would generally be expected along the corridor, except northbound between the Berkeley and Thorne interchanges where long durations of congestion would be expected.
- Moderate duration of congestion would be expected during PM hours, but significant congestion would occur northbound north of the Berkeley interchange, and southbound between Thorne and Berkeley interchanges and south of the Steilacoom-DuPont interchange.
- Through the corridor study area, travel times in the GP lanes would range from 18 to 25 minutes.
- This scenario would not provide any provision to encourage high occupancy vehicle use.

Figure VI-14: Scenario 1b - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 1b - 3 GP with CD Roads

Volume/Capacity (V/C) Legend	
V/C: < 0.6	green
V/C: 0.6 - 0.85	yellow
V/C: 0.85 - 1.0	orange
V/C: > 1.0	red

Speed Legend	
51+ mph	green
45 - 51 mph	yellow
37 - 44 mph	orange
20 - 36 mph	red
Less than 20 mph	dark red

I-5 SB Traffic -- North of Center Interchange

Scenario 1b – 3 GP with CD Roads

	CD	GP	GP	GP		
Vehicles	2,025	1,852	1,852	1,852	7,581	Vehicles
Persons	2,531	2,315	2,315	2,315	9,476	Persons

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
18	3	-	-

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	AUX	GP	GP	GP	Total	
Vehicles	1,751	1,751	1,751	1,751	7,004	Vehicles
Persons	2,188	2,188	2,188	2,188	8,752	Persons

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
22	3	-	-

I-5 NB Traffic -- North of Main Gate Interchange

*Does not account for stormwater management or any other necessary roadside features.

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
26	4	-	-

	GP	GP	GP	AUX	Total	
Vehicles	1,605	1,605	1,605	1,605	6,420	Vehicles
Persons	2,006	2,006	2,006	2,006	8,024	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	Hours of Congestion	PM Peak Hour HOV Lane Speed	Hours of Congestion
36	4	-	-

	GP	GP	GP	CD	Total	
Vehicles	1,917	1,917	1,917	1,700	7,451	Vehicles
Persons	2,396	2,396	2,396	2,125	9,313	Persons

* Practical lane capacity is estimated to be 1,800 vph.

Scenario 2: Adds One General Purpose Lane in Each Direction South of Thorne Lane

Scenario 2 would add a fourth GP lane in each direction south of Thorne Lane to address congestion at the choke point where I-5 narrows from four lanes to three lanes in the southbound direction. For traffic forecasting, the model assumed the extra GP lane is extended from Thorne Lane to Marvin Road in Thurston County. A typical cross section with a fourth GP lane in each direction is illustrated in Figure VI-15. There are no managed/HOV lanes assumed in this scenario.

Scenario 2 will generally fit within the existing 175-foot right-of-way. However, some additional right-of way may be needed for storm water quality and flow control.

Vehicle Trips

The total number of vehicles in the corridor study area increases by approximately eight percent as shown in Figure VI-16. This increase is caused by latent travel demand in the corridor that would use the capacity added by the fourth GP lane. Even with the added capacity of the fourth GP lane, the southbound traffic volume would exceed the LOS E capacity of 6,480 vph south of the 41st Division/Main Gate Interchange. In the northbound direction, the traffic volume would exceed this threshold north of the Berkeley Street Interchange.

Person Trips

The overall number of person trips passing through the corridor study area during the PM peak hour would increase by about eight percent with the addition of the GP lanes with a 13 percent increase expected for the southbound direction and about three percent in the northbound direction, as shown in Figure VI-17. During the AM peak hour, person trips would increase by about eight percent with the addition of the GP lanes with a six percent increase for the southbound direction and about ten percent in the northbound direction.

Figure VI-15: Scenario 2 - Typical Section

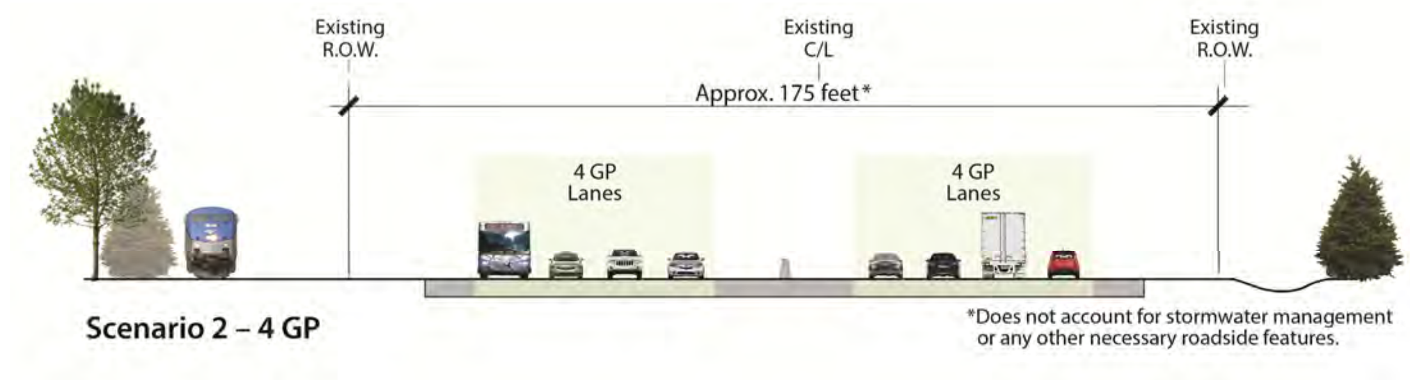


Figure VI-16: Scenario 2 - 2040 PM Peak Hour Vehicle Trip Summary

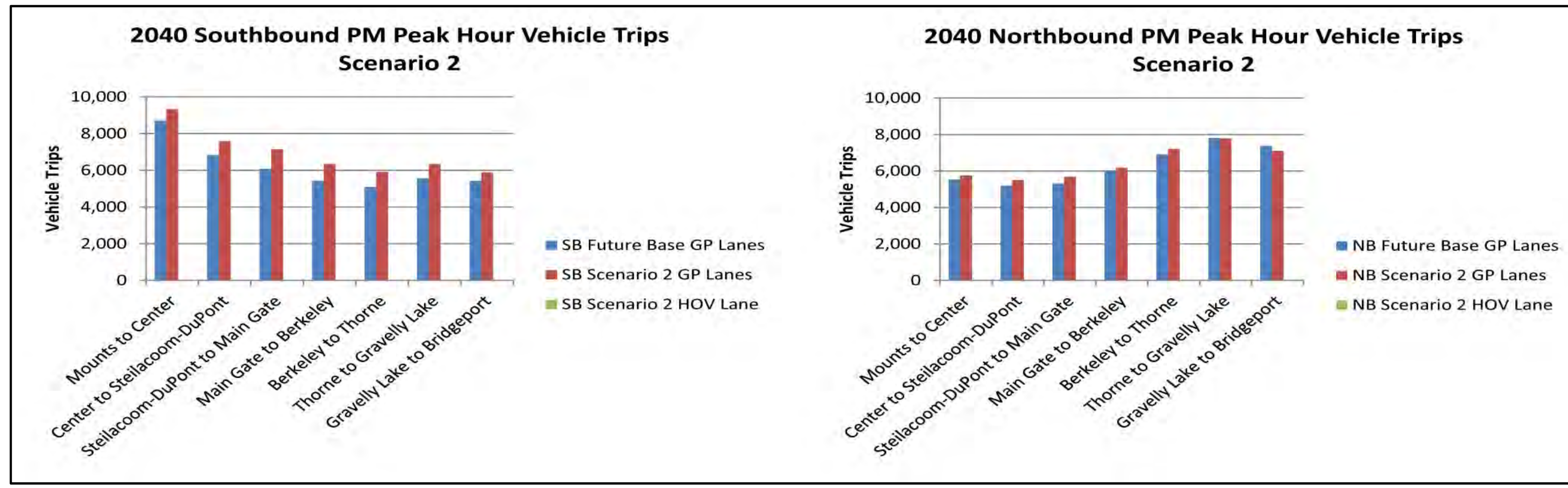
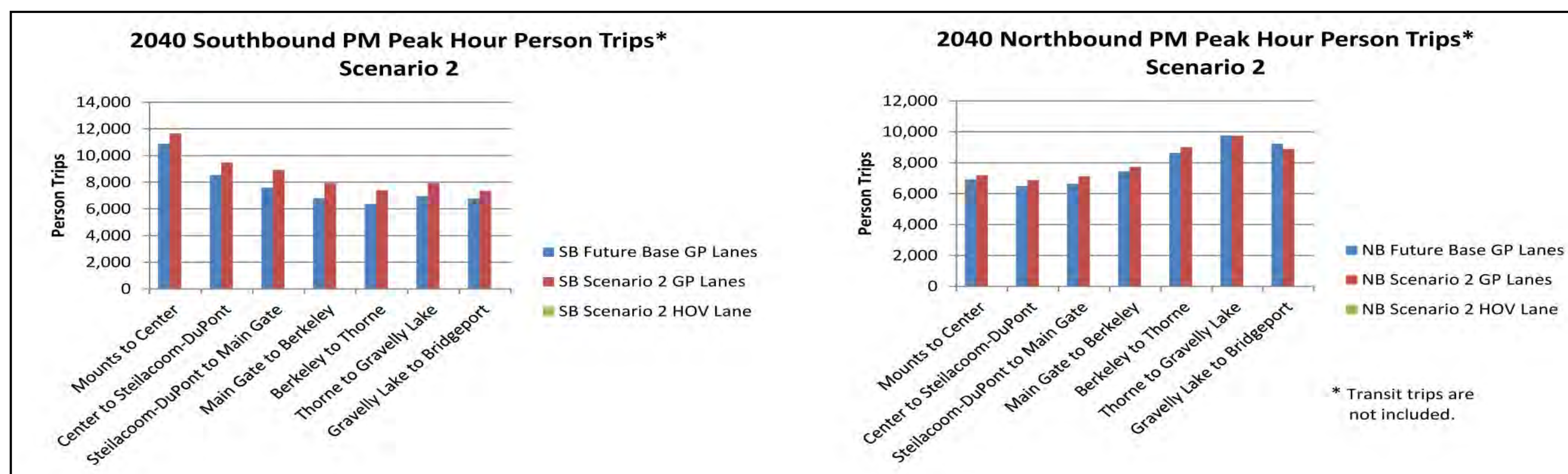


Figure VI-17: Scenario 2 - 2040 PM Peak Hour Person Trip Summary



Average Travel Speeds

Figure VI-18 shows that, with the addition of the fourth GP lane in each direction, the average GP lane speed on I-5 during the PM peak hour would be improved in the southbound direction, but the added traffic from latent demand would cause the northbound direction to be lower than speeds with the 2040 Base Condition north of Thorne Lane. Speeds in the southbound direction would remain well below the 70 percent of posted speed threshold (42 mph) for acceptable operations. In the northbound direction, speeds would fall below the threshold north of the Berkeley Street Interchange.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph for the Base Condition to 26 mph for Scenario 2. Similarly, in the northbound direction the average GP lane speed would increase from 21 mph for the Base Condition to 42 mph with Scenario 2, with the section south of Berkeley Street expected to operate above this speed and the section north of Berkeley below this speed. With these relatively slow speeds, drivers would continue to experience periods of stop-and-go traffic during the PM peak hour, especially in the southbound direction.

The average AM peak hour speed for the GP lanes is expected to be above the 42 mph threshold in the southbound direction, but below it in the northbound direction.

Drivers in the GP lanes during the PM peak hour could expect that travel time between the Mounts Road and Bridgeport Way interchanges would be approximately 22 minutes in the southbound direction and 13 minutes in the northbound direction.

Hours of Congestion

With high traffic volume in the GP lanes and slow speeds, congestion is estimated to extend for several hours during the AM and PM periods. Congested conditions are expected to last for at least three hours during the AM period in the northbound direction and about one to two hours in the southbound direction. During the PM hours, congestion is estimated to remain for at least four hours in both the southbound and northbound directions.

On and Off-Ramp Volumes

The heavy ramp traffic volumes would generally be the same with Scenario 2 as compared to the 2040 Base Condition as shown in Figure VI-19. There would be some fluctuation in the ramp volumes as drivers adjust their travel patterns consistent with the capacity added to I-5 with this scenario. Drivers would still need to change lanes often to enter and exit I-5.

Figure VI-18: Scenario 2 - Average 2040 PM Peak Hour GP Lane Speed Summary

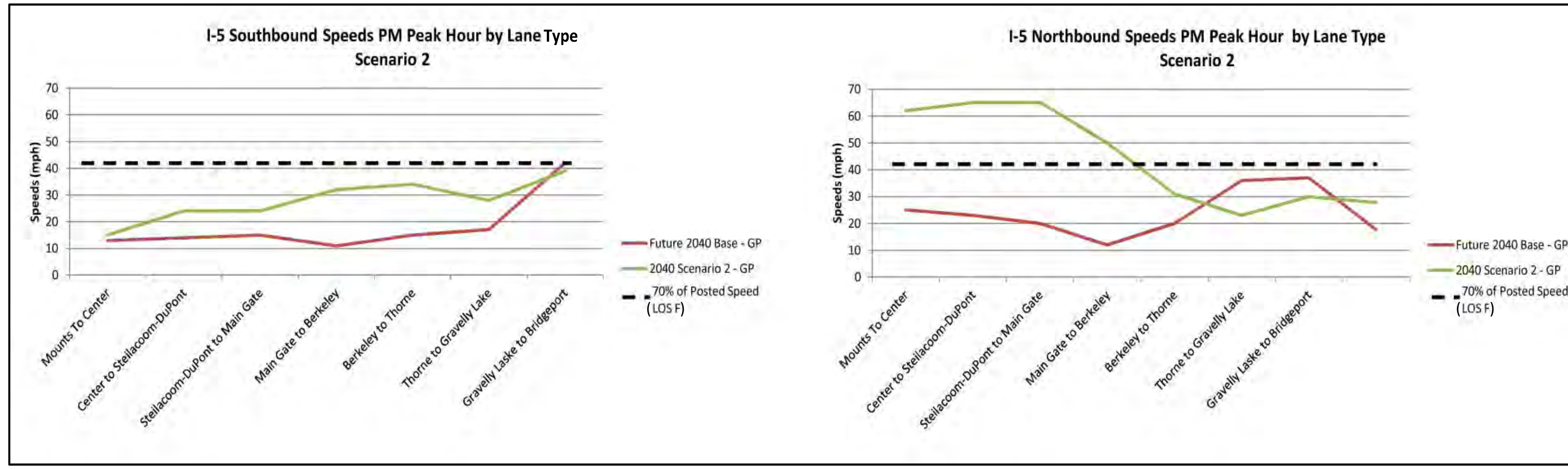
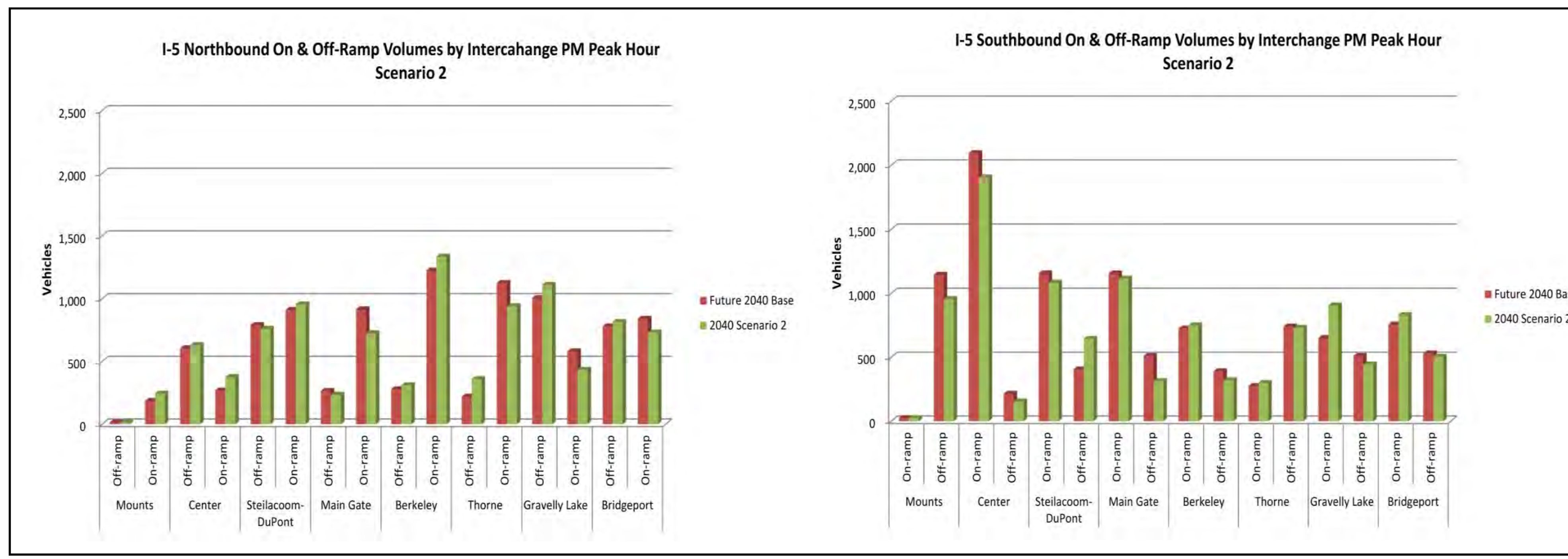


Figure VI-19: Scenario 2 - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 2 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 2 is displayed in Figure VI-20 for selected southbound and northbound segments along I-5. In the southbound direction, the congestion and slow speeds north of Center Drive and Steilacoom-DuPont Road would still occur. These are critical locations that create ripple effects that impact traffic flow through the entire corridor. Average traffic volumes are expected to exceed the LOS E capacity (1,620 vph) for a single travel lane. In comparison to the 2040 Base Condition, average volumes in a single GP lane would decrease with the addition of the extra GP lane. Total vehicle and person trips would increase. However, average GP speed would slightly increase by about 10 mph as compared to the 2040 Base Condition with an expected two hour reduction in hours of congestion.

These conditions are also evident in the northbound direction where congestion would be reduced and speeds increased as compared to the 2040 Base Condition. Speeds would remain slow north of the Berkeley Street interchange. Again heavy through traffic and high ramp volumes would cause drivers to frequently change lanes and slow traffic. The average GP lane volumes would decrease with the addition of the GP lane as compared to the 2040 Base Condition. Total vehicle and person trips would increase and average GP speeds would improve with a three hour reduction in hours of congestion.

Scenario 2 - Summary of Findings

- The fourth GP lane added in both directions would eliminate the southbound choke point at Thorne Lane.
- Both vehicle and person trips would increase over the 2040 base.
- Average GP southbound PM peak speeds are expected to be about 26 mph.
- Average GP northbound AM peak speeds are expected to be about 37 mph.
- Moderate duration of congestion would be expected northbound during the AM peak throughout corridor.
- Moderate duration of congestion would be expected southbound during the PM peak south of Steilacoom-DuPont interchange, and northbound north of the Berkeley interchange.
- Through the corridor study area, travel times in the GP lanes would range from 13 to 22 minutes.
- Side friction from heavy ramp volumes would still exist.
- This scenario would not provide provision to encourage high occupancy vehicle use.

Figure VI-20: Scenario 2 - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 2 - 4 GP

Volume/Capacity (V/C) Legend
V/C: < 0.6
V/C: 0.6 - 0.85
V/C: 0.85 - 1.0
V/C: > 1.0

Speed Legend
51+ mph
45 - 51 mph
37 - 44 mph
20 - 36 mph
Less than 20 mph

I-5 SB Traffic -- North of Center Interchange

Scenario 2 – 4 GP

	AUX	GP	GP	GP	GP	Total	
Vehicles	620	1,741	1,741	1,741	1,741	7,584	Vehicles
Persons	775	2,177	2,177	2,177	2,177	9,483	Persons

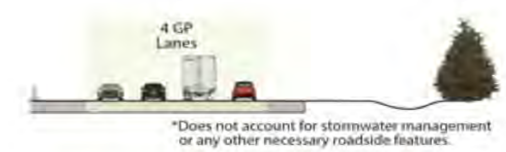
PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
24	2	-	-

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	GP	GP	GP	GP	Total	
Vehicles	1,786	1,786	1,786	1,786	7,144	Vehicles
Persons	2,233	2,233	2,233	2,233	8,932	Persons

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
24	3	-	-

I-5 NB Traffic -- North of Main Gate Interchange



PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
50	0	-	-

	GP	GP	GP	GP	Total	
Vehicles	1,546	1,546	1,546	1,546	6,184	Vehicles
Persons	1,933	1,933	1,933	1,933	7,732	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
31	3	-	-

	GP	GP	GP	GP	Total	
Vehicles	1,803	1,803	1,803	1,803	7,212	Vehicles
Persons	2,253	2,253	2,253	2,253	9,012	Persons

* Practical lane capacity is estimated to be 1,800 vph.

Scenario 3: Adds a Managed/HOV Lane and Collector/ Distributor Road or Auxiliary Lane in Each Direction

To promote multi-modal travel options and increase person throughput in the corridor, as well as reduce the side friction within the corridor study area, Scenario 3 would:

- Add one managed/HOV lane in each direction
- Maintain three GP lanes in each direction south of Thorne Lane and four GP lanes in each direction to the north
- Add collector/distributor (CD) roads or auxiliary lanes at strategic places along I-5

For travel forecasting purposes, the HOV lanes are modeled as continuous between Tacoma and Lacey. A typical cross section through the CD road area is illustrated in Figure VI-21. One set of CD roads would connect the Mounts Road, Center Drive and Steilacoom-DuPont Road interchanges. The second set of CD roads would connect the Berkeley Drive and Thorne Lane interchanges. An auxiliary lane would be added on both sides of I-5 between the CD roads between the Steilacoom-DuPont and Berkeley interchanges.

The existing right-of-way along the I-5 corridor through the corridor study area is 175 feet wide. The new right-of-way needed to add the HOV lanes and the CD roads would increase the minimum width to 270 feet. Because of the railroad line on the northwest side of I-5, the additional width would encroach into JBLM areas. Some additional right-of way would be needed for storm water quality and flow control facilities.

Vehicle Trips

The total number of vehicles in the corridor study area would increase by approximately 20 percent, as shown in Figure VI-22. This increase would be caused by latent travel demand in the corridor study area using the capacity added by the managed/HOV lanes, and the shifting of some traffic to the CD roads.

Vehicle trips in the GP lanes would decrease by a range of from 1,400 to 3,600 vehicles between Mounts Road and Steilacoom-DuPont Road, and by about 250 to 1,700 vehicles between Thorne Lane and Berkeley Street. A slight increase north of Thorne Lane is also expected. Even with the reductions in vehicle trips, most of the three GP lane segments south of Thorne Lane are expected to remain congested with volumes exceeding the LOS E capacity of 4,860 vph in the southbound direction, and between Steilacoom-DuPont Road and Thorne Lane in the northbound direction.

The usage of the HOV lane would range between 1,200 and 1,400 vehicles in the southbound direction and between 600 vehicles to over 1,500 vehicles in the northbound direction with many HOV trips expected to come from the area north of the Main Gate Interchange. The usage of the CD road would vary from approximately 650 to 2,850 vehicle trips, depending on location. Some short trips would only use the CD roads and never get on the I-5 mainline, especially between Steilacoom-DuPont Road, Center Drive and Mounts Road.

Figure VI-21: Scenario 3 - Typical Section

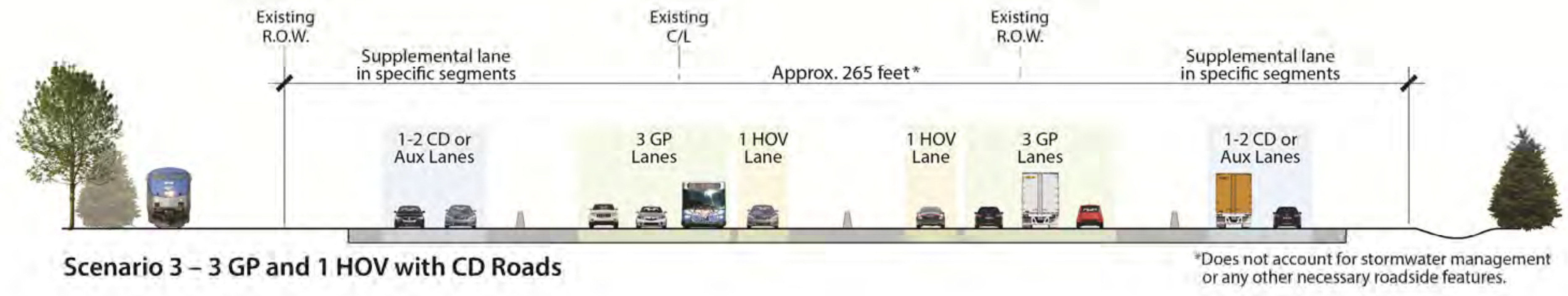


Figure VI-22: Scenario 3 - 2040 PM Peak Hour Vehicle Trip Summary

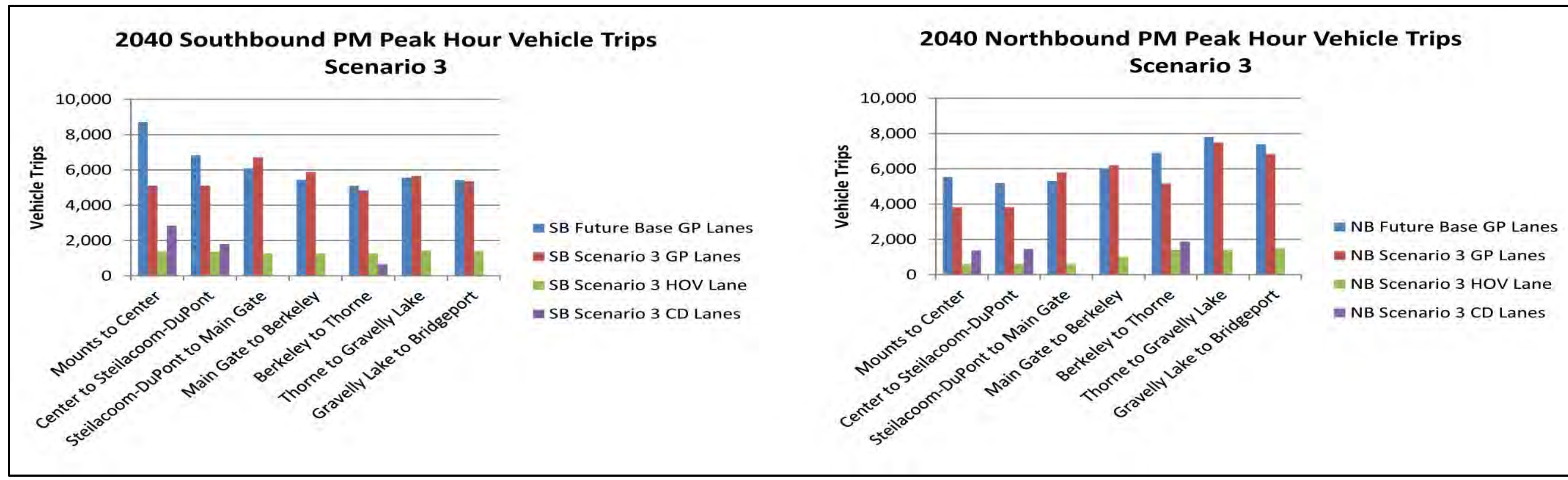
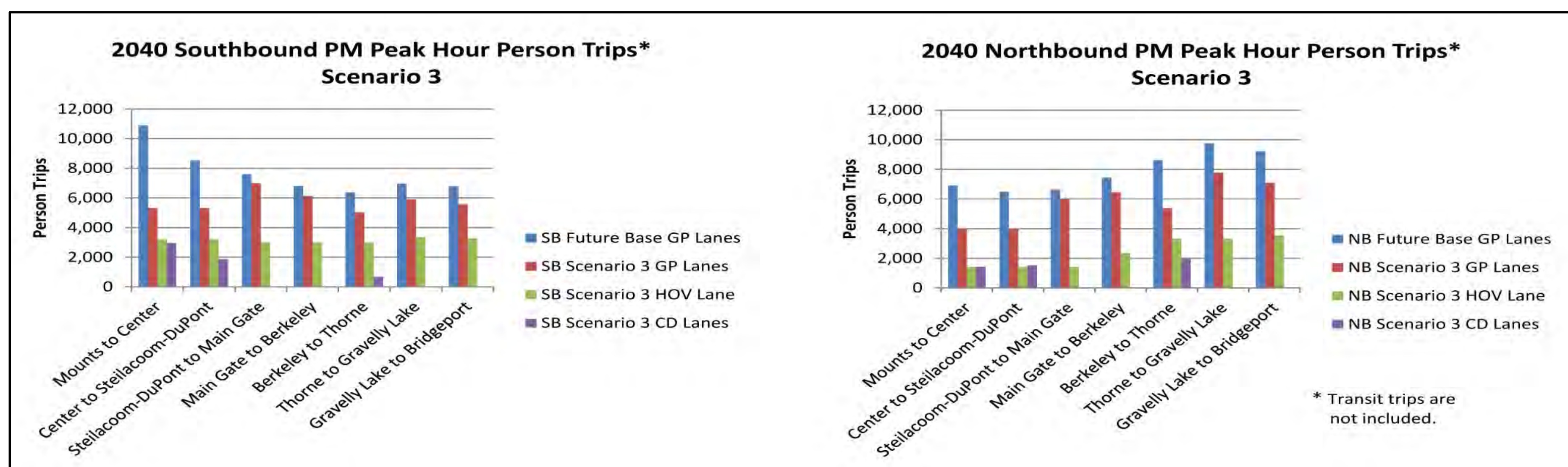


Figure VI-23: Scenario 3 - 2040 PM Peak Hour Person Trip Summary



Person Trips

The overall number of person trips through the corridor study area during the PM peak hour would increase by about 20 percent with the addition of the HOV lanes and CD roads. As shown in Figure VI-23, a person trip increase of 26 percent is expected in the southbound direction, and about 13 percent in the northbound direction. With the addition of the CD, some of the northbound HOV trips would not have access to the HOV lane until north of Steilacoom-DuPont Road. As a result the HOV volumes would be slightly lower in Scenario 3 south of Main Gate Interchange than they were for Scenario 1a. However, in the northbound direction the number of person trips in the HOV lane would be slightly higher. During the AM peak hour, person trips would increase by about ten percent with the addition of the HOV lanes and CD roads, primarily in the northbound direction.

Average Travel Speeds

Figure VI-24 shows with the addition of one HOV Lane and the CD roads or auxiliary lanes in each direction along I-5, average GP lane speeds during the PM peak hour would improve. However, the average speed would remain well below the 70 percent of posted speed threshold (42 mph) for acceptable operations.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph for the 2040 Base Condition to 31 mph. Similarly, in the northbound direction the average GP lane speed would increase from 21 mph for the 2040 Base Condition to 39 mph. With these relative slow speeds in the GP lanes, drivers will continue to experience periods of stop-and-go traffic during the PM peak hour. Drivers in the HOV lane would experience speeds between 50 and 60 mph.

The average AM peak hour speed for the GP lanes are expected to be above the 42 mph threshold in both directions. Some northbound segments south of Center Drive would be below this threshold.

Drivers in the GP lanes during the PM peak hour could expect that their travel time between the Mounts Road and Bridgeport Way interchanges would be approximately 18 minutes in the southbound direction, and 14 minutes in the northbound direction. Drivers in the HOV lanes could expect a travel time of approximately 10 to 11 minutes in either direction. This also improves travel times for transit buses and vanpools through the corridor study area.

Hours of Congestion

With the high traffic volume in the GP lanes and the slow speeds congestion is estimated to extend for several hours during the AM and PM hours. Congested conditions are expected to be reduced to three hours during the AM period in the northbound direction, and to about one to two hours in the southbound direction. During the PM hours, congestion would also be reduced to three hours in the southbound direction and two hours in the northbound direction.

On and Off-Ramp Volumes

With the HOV lanes and CD roads, the number of entry and exit points along the I-5 mainline between the Mounts Road and Thorne Lane interchanges would be reduced from twelve in each direction in the 2040 Base Condition to six in each direction, as shown in Figure VI-25. This reduction in access points would give drivers more distance for weaving and merging lane changes on I-5.

These CD roads would consolidate entering or exiting traffic to fewer locations, thus increasing the amount of traffic at the remaining locations. The C/D roads would also shift traffic to locations where auxiliary lanes are added to reduce the side friction that would be associated with these larger traffic volumes. The auxiliary lanes allow drivers to change lanes over a longer distance than with a typical on or off-ramp configuration. These CD roads also accommodate some short trips, thereby reducing the number of short trips on I-5 through lanes.

Figure VI-24: Scenario 3 - Average 2040 PM Peak Hour GP Lane Speed Summary

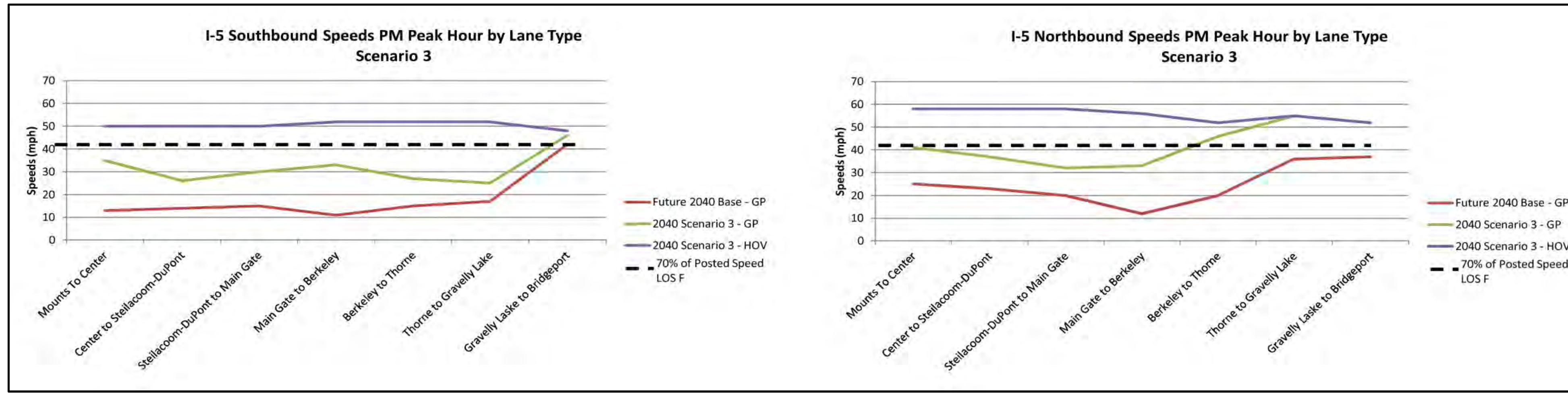
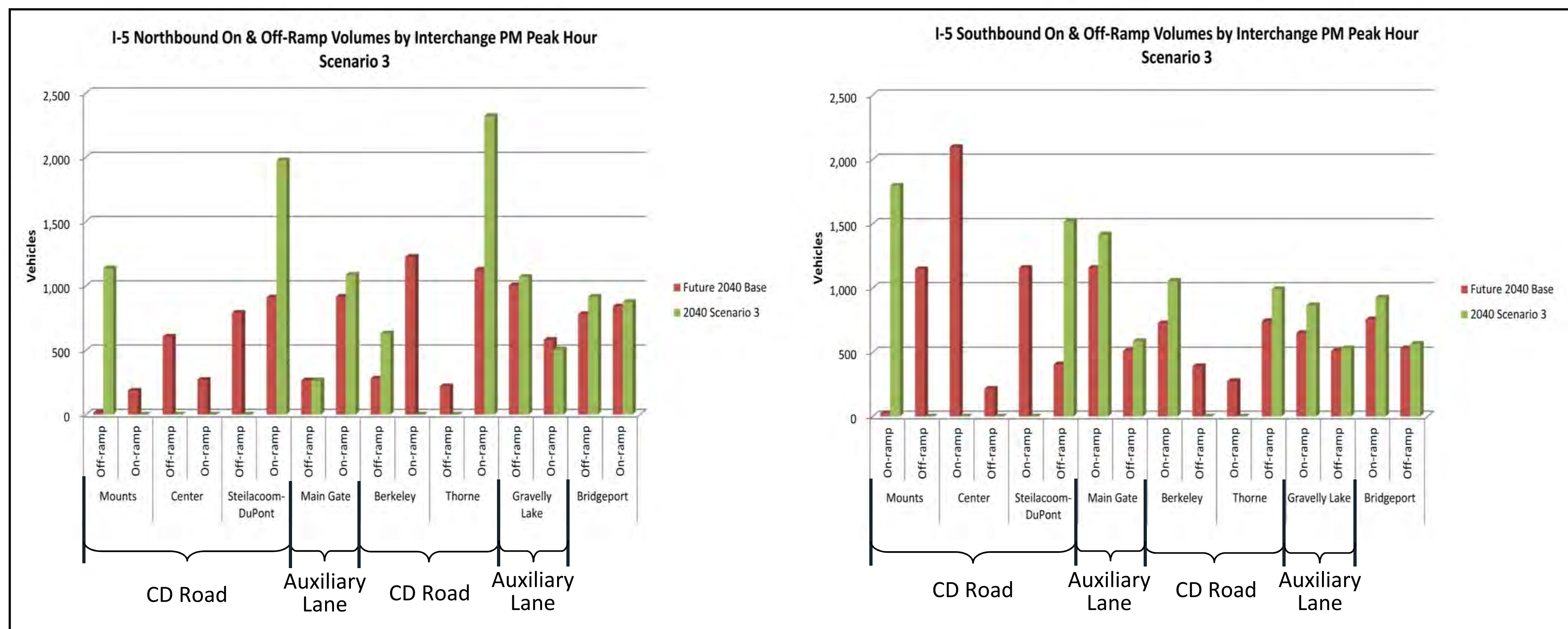


Figure VI-25: Scenario 3 - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 3 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 3 is displayed in Figure VI-26 for selected southbound and northbound segments of I-5. In the southbound direction, the congestion and slow speeds north of Center Drive and Steilacoom-DuPont Road would be critical locations that create ripple effects that impact traffic flow through the entire corridor. Average traffic volumes are expected to exceed the LOS E capacity (1,620 vph) of a single travel lane. In comparison to the 2040 Base Condition, average GP lane volumes for Scenario 3 would decrease with the addition of HOV lanes and CD roads. Total vehicle and person trips across all travel lanes would increase. Average GP speed in the segment would increase by 12 to 15 mph, but would remain slow with a two hour reduction in hours of congestion.

These conditions are also evident in the northbound direction where congestion and slow speeds are expected north of the Main Gate and Berkeley Street interchanges. The average GP lane volumes would decrease with the addition of HOV lanes as compared to the 2040 Base Condition. The HOV lane and CD roads would be well utilized as total vehicle s and person trips in the segments are expected to increase. Average GP speeds would slightly improve with a three to five hour reduction in hours of congestion. However, even with the CD roads to reduce the number of merge/diverge locations, heavy through traffic with the remaining high ramp volumes locations would cause drivers to frequently change lanes and slow traffic.

Scenario 3 - Summary of Findings

- Managed/HOV lanes and CD roads reduce the number of access points on I-5, help to separate local traffic from through traffic, and reduce side friction.
- Total person and vehicle trips would be the 2nd highest of any scenario.
- At the busiest segment, northbound and southbound managed/HOV lanes are expected to run just under 90 percent of lane capacity with average speeds of 55 mph.
- The northbound CD road would operate close to capacity north of the Berkeley Street Interchange during the PM peak and northbound north of Mounts in the AM peak. To serve AM peak traffic the CD road may require a 2-lane configuration.
- Average GP PM peak hour speeds are expected to be about 39 mph northbound and 31 mph southbound in the GP lanes.
- Average AM peak speeds are expected to be about 55 mph northbound and 56 mph southbound in the GP lane.
- HOV lane speeds are expected to range between 50 to 60 mph in both the AM and PM peaks.
- Several hours of PM congestion are expected southbound, south of the Steilacoom-DuPont Interchange but would be significantly improved in comparison to the 2040 Base Condition.
- Through the corridor study area, travel times in the GP lanes would range from 14 to 28 minutes, while travel time in the HOV lane would be about 10 minutes.

Figure VI-26: Scenario 3 - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 3 - 3 GP and 1 HOV with CD Roads

I-5 SB Traffic -- North of Center Interchange

Scenario 3 – 3 GP and 1 HOV with CD Roads

Volume/Capacity (V/C) Legend	
V/C: < 0.6	green
V/C: 0.6 - 0.85	yellow
V/C: 0.85 - 1.0	orange
V/C: > 1.0	red

Speed Legend	
51+ mph	green
45 - 51 mph	yellow
37 - 44 mph	orange
20 - 36 mph	red
Less than 20 mph	dark red

	CD	GP	GP	GP	HOV (2+)	Total
Vehicles	1,800	1,703	1,703	1,703	1,365	8,274
Persons	1,872	1,771	1,771	1,771	3,208	10,393

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
26	2	50	0

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	AUX	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,679	1,679	1,679	1,679	1,275	7,991	Vehicles
Persons	1,746	1,746	1,746	1,746	2,996	9,980	Persons

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
30	2	50	0

I-5 NB Traffic -- North of Main Gate Interchange

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
33	2	56	0

	HOV (2+)	GP	GP	GP	AUX	Total	
Vehicles	1,005	1,553	1,553	1,553	1,553	7,217	Vehicles
Persons	2,362	1,615	1,615	1,615	1,615	8,822	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
46	2	48	0

	HOV (2+)	GP	GP	GP	CD	Total	
Vehicles	1,415	1,723	1,723	1,723	1,885	8,469	Vehicles
Persons	3,325	1,792	1,792	1,792	1,960	10,661	Persons

* Practical lane capacity is estimated to be 1,800 vph.

Scenario 4: Adds a Managed/HOV Lane and a GP Lane in each Direction

Scenario 4 combines the proposed improvements from Scenario 1a and Scenario 2 into a new alternative. A typical cross section with the added HOV lanes and GP lanes is illustrated in Figure VI-27. Scenario 4 is designed to allow for improved transit service and increase person throughput. It would also reduce the congestion caused by the current narrowing I-5 from four lanes to three lanes in each direction at the Thorne Lane Interchange. For travel forecasting purposes the HOV lanes are modeled as continuous between Tacoma and Lacey and the extra GP lanes are modeled to extend from Thorne Lane to Marvin Road in Lacey.

The existing right-of-way along the I-5 corridor through the corridor study area is 175 feet. The right-of-way needed for HOV and GP lanes would increase the minimum width to approximately 200 feet. Because of the rail line on the northwest side of I-5, the additional width would encroach into JBLM. Some additional right-of way would be needed for storm water quality and flow control facilities.

Vehicle Trips

The total number of vehicles along the corridor study area would increase by approximately 18 percent as shown in Figure VI-28. This increase is caused by latent demand in the corridor study area using the capacity added by the HOV and GP lanes. The overall number of vehicle trips in the GP lanes through the corridor study area would change by less than 500 vehicles in comparison to the 2040 Base Condition. The southbound segment of I-5 south of the Main Gate Interchange and the northbound segment north of the Berkeley Street Interchange are expected to remain congested with volumes exceeding the LOS E capacity for four GP lanes of about 6,480 vph.

The usage of the HOV lane would range between 1,000 and 1,450 vehicles in the southbound direction and between 600 vehicles to over 1,600 vehicles in the northbound direction with many HOV trips coming from the area north of the Main Gate Interchange.

Person Trips

The overall number of person trips through the corridor study area during the PM peak hour would increase by about 18 percent with the addition of the HOV and the extra GP lanes. In the southbound direction, the average increase would be 25 percent and about 10 percent northbound, as shown in Figure VI-29. During the AM peak hour the person trips would increase by about ten percent with most of the increase in the northbound direction.

Figure VI-27: Scenario 4 - Typical Section

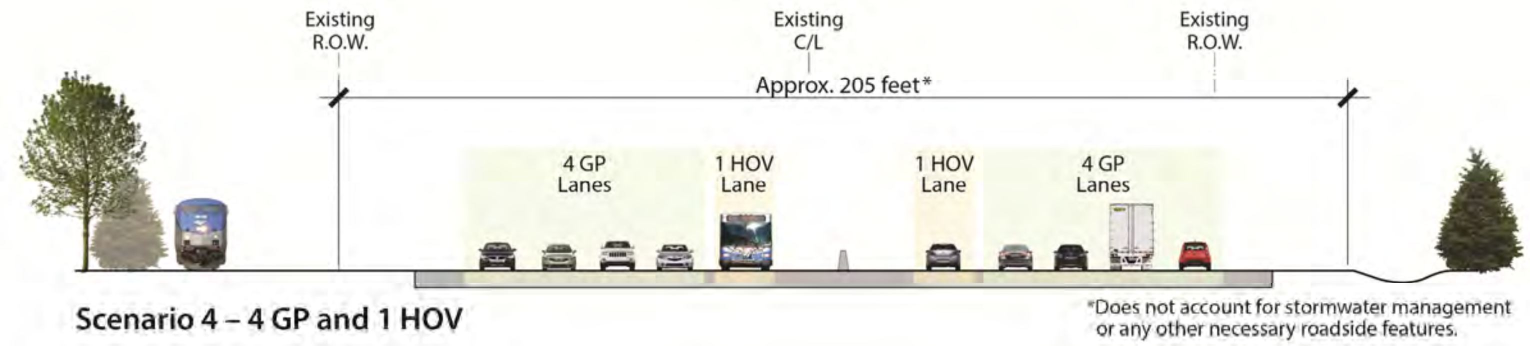


Figure VI-28: Scenario 4 - 2040 PM Peak Hour Vehicle Trip Summary

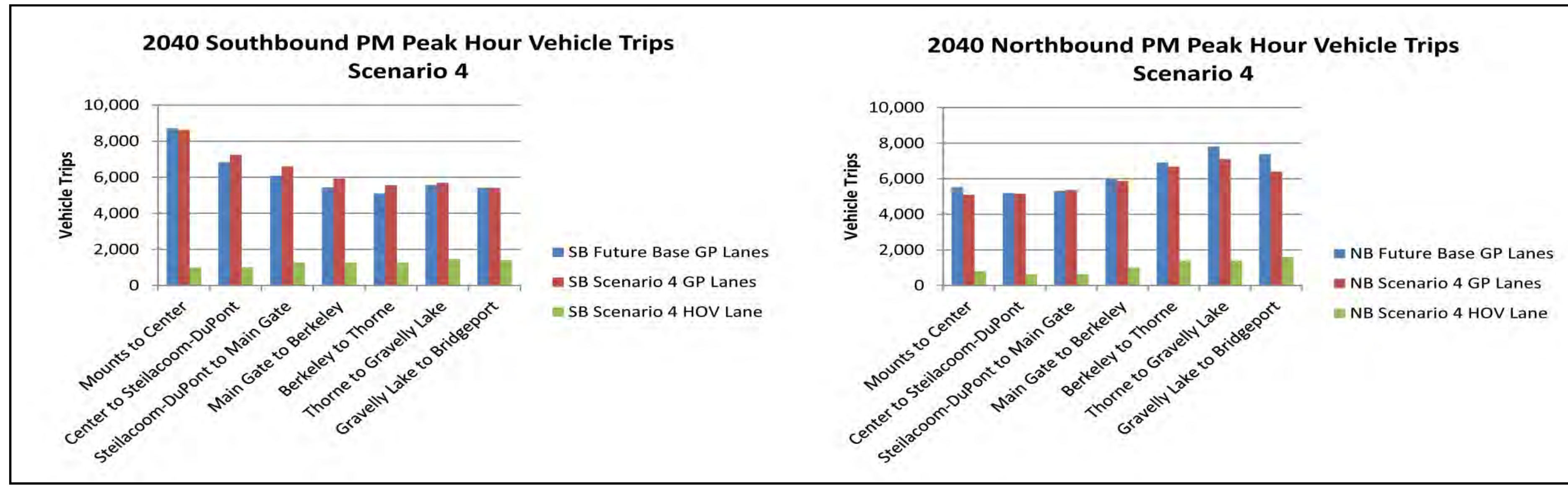
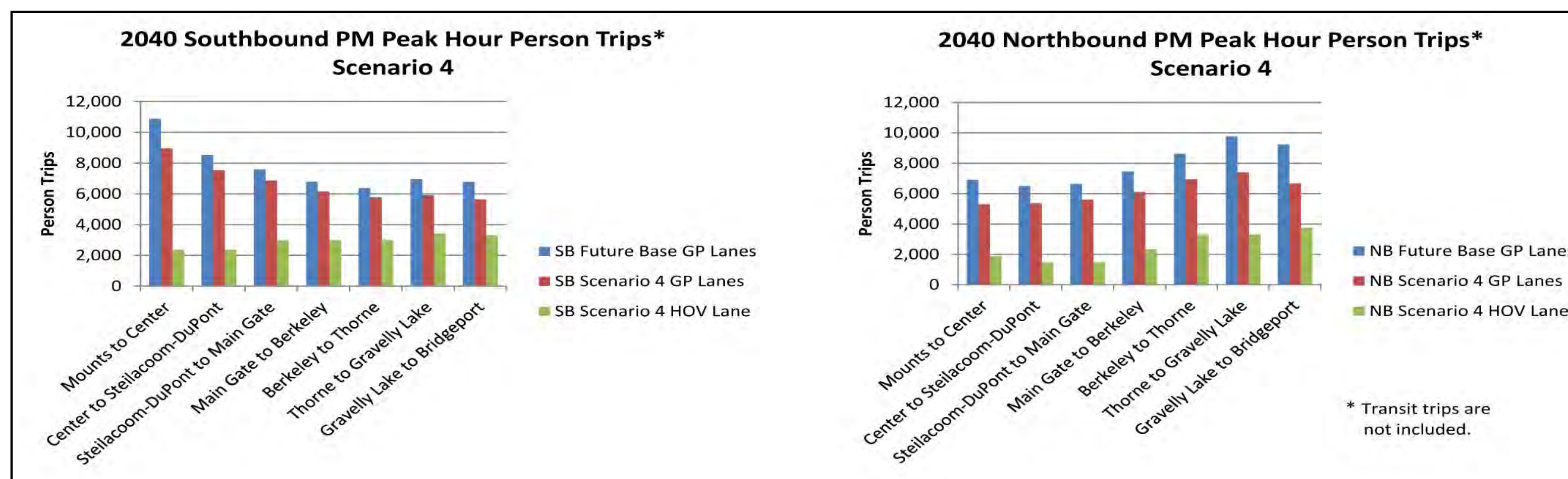


Figure VI-29: Scenario 4 - 2040 PM Peak Hour Person Trip Summary



Average Travel Speeds

Figure VI-30 shows that the addition of one HOV lane and one GP lane in each direction would improve average GP lane speeds during the PM peak hour. The southbound speeds generally would remain below the 70 percent of posted speed threshold (42 mph) for acceptable operations, while the northbound speeds would generally be above.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph for the 2040 Base Condition to 29 mph. However in the northbound direction, the average GP lane speed would increase from 21 mph for the 2040 Base Condition to 53 mph. With these southbound GP speeds, especially south of Berkeley Street, drivers would continue to experience periods of stop-and-go traffic during the PM peak hour. In the northbound direction, slowdowns may impact drivers as they approach the Berkeley Street Interchange. Drivers in the HOV lane would experience speeds between 50 to 60 mph in both the AM and PM peak hours.

The average AM peak hour speed for the GP lanes is expected above the 42 mph threshold in both directions. Some northbound segments south of Center Drive will be below this level.

Drivers in the GP lanes during the PM peak hour can expect that their travel time between the Mounts Road and Bridgeport Way interchanges would be approximately 19 minutes in the southbound direction and 10 minutes in the northbound direction. Drivers in the HOV lane can expect a travel time of approximately 10 to 11 minutes.

Hours of Congestion

With the high traffic volume in the GP lanes and the slow speeds, congestion is estimated to extend for several hours during the AM and PM hours. Congested conditions would be reduced to about two hours during AM hours in the northbound direction and about one hour in the southbound direction. During the PM hours, congestion is estimated to remain for at least five hours in the southbound direction and about two hours in the northbound direction.

On and Off-Ramp Volumes

The heavy ramp volumes would generally be the same with Scenario 4 as compared to the 2040 Base Condition as shown in Figure VI-31. There would be some fluctuation in ramp volumes, as drivers adjust their travel patterns to respond to the added mainline capacity on I-5. Drivers would still need to change lanes often to enter and exit I-5.

Figure VI-30: Scenario 4 - Average 2040 PM Peak Hour GP Lane Speed Summary

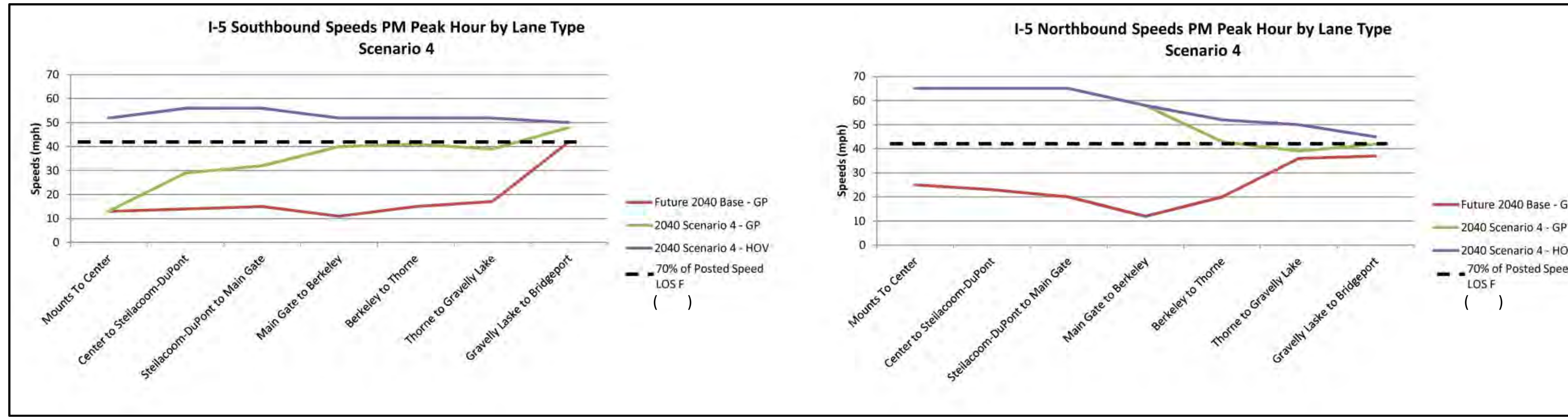
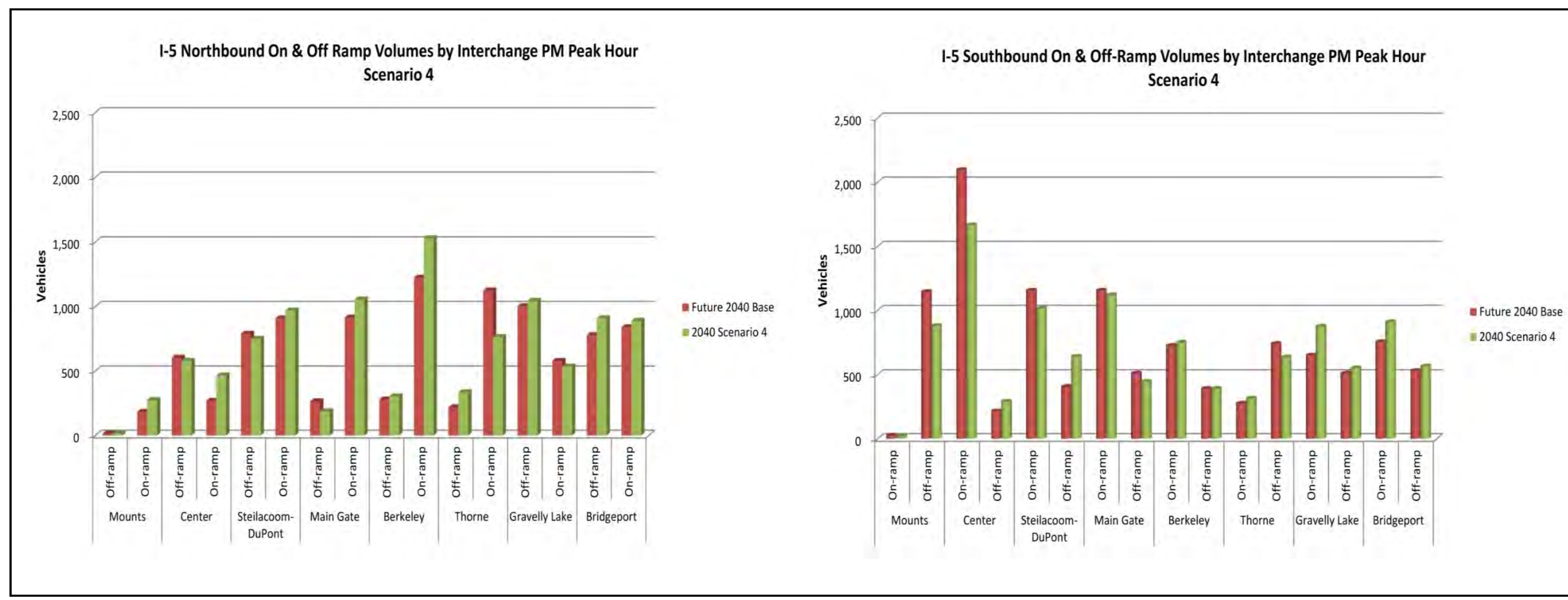


Figure VI-31: Scenario 4 - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 4 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 4 is displayed in Figure VI-32 for selected southbound and northbound locations along I-5. In the southbound direction, the congestion and slow speeds north of Center Drive and Steilacoom-DuPont Road would be critical locations that create ripple effects that impact traffic flow through the entire corridor. Average traffic volumes north of Center Drive are expected to exceed the practical capacity (1,800 vph) of a single travel lane. In comparison to the 2040 Base Condition, average GP lane volumes would decrease with the addition of the HOV lanes and extra GP lanes. Total vehicle and person trips would increase, however average GP speed in the segment would remain under 36 mph while the hours of congestion would be reduced.

In the northbound direction, congestion and travel speeds would be improved at the key locations north of the Main Gate and Berkeley Street interchanges. Heavy through traffic, and high ramp volumes would continue to cause drivers to frequently change lanes, but traffic would move better with the added HOV and GP lanes as compared to the 2040 Base Condition. The HOV lane would also be well utilized.

Scenario 4 - Summary of Findings

- Managed/HOV lanes encourage transit and the addition of a fourth GP lane would eliminate the lane reduction choke point at the Thorne Lane
- Total person and vehicle trips would increase, but to a level that is slightly less than Scenario 3.
- Managed/HOV lanes are expected to run at approximately 90 percent of lane capacity in the PM peak hour and 70 percent of capacity in AM peak hour, with average speeds of 55 mph.
- Side friction would still exist and may worsen with the added traffic moving in/out of the managed/HOV lanes.
- Moderate durations of AM and PM congestion are expected along the corridor, especially south of the Steilacoom-DuPont Interchange.
- Generally PM travel speeds in GP lanes would exceed the congestion threshold except northbound north of Thorne Lane and southbound south of 41st Division/Main Gate.
- Average GP AM speeds are expected to average about 40 mph or above through the corridor study area in the GP lanes.
- Average GP PM speeds are expected to be about 29 mph southbound and over 50 mph northbound in the GP lanes.
- Drivers in the HOV lane would experience speeds between 50 to 60 mph in the AM and PM peak hours.
- Through the corridor study area, travel times in the GP lanes would range from 10 to 19 minutes, while travel time in the HOV lane would be about 10 minutes.

Figure VI-32: Scenario 4 - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 4 - 4 GP and 1 HOV

I-5 SB Traffic -- North of Center Interchange

Scenario 4 – 4 GP and 1 HOV

Volume/Capacity (V/C) Legend	
V/C: < 0.6	green
V/C: 0.6 - 0.85	yellow
V/C: 0.85 - 1.0	orange
V/C: > 1.0	red

Speed Legend	
51+ mph	green
45 - 51 mph	yellow
37 - 44 mph	orange
20 - 36 mph	red
Less than 20 mph	dark red

	GP	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,810	1,810	1,810	1,810	1,005	8,245	Vehicles
Persons	1,882	1,882	1,882	1,882	2,362	9,890	Persons

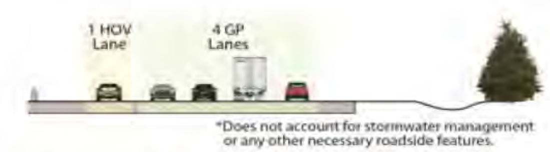
PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
29	3	56	0

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	GP	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,650	1,650	1,650	1,650	1,270	7,870	Vehicles
Persons	1,716	1,716	1,716	1,716	2,985	9,849	Persons

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
32	2	56	0

I-5 NB Traffic -- North of Main Gate Interchange



PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
58	0	56	0

	HOV (2+)	GP	GP	GP	GP	Total	
Vehicles	995	1,468	1,468	1,468	1,468	6,867	Vehicles
Persons	2,338	1,526	1,526	1,526	1,526	8,442	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	HOV Lane Hours of Congestion
43	2	48	0

	HOV (2+)	GP	GP	GP	GP	Total	
Vehicles	1,410	1,670	1,670	1,670	1,670	8,090	Vehicles
Persons	3,314	1,737	1,737	1,737	1,737	10,262	Persons

* Practical lane capacity is estimated to be 1,800 vph.

Scenario 5: Adds a Managed/HOV Lane, a GP Lane, and a Collector/Distributor Road or Auxiliary Lane in each Direction along I-5

Scenario 5 combines all the improvements from Scenarios 1a, 1b and 2 into a single scenario. This scenario would add:

- One managed/HOV lane in each direction
- One GP lane in each direction south of the I-5/Thorne Lane Interchange
- Collector/distributor (CD) roads or auxiliary lanes at strategic places along I-5

For this analysis, one set of CD roads would connect the Mounts Road, Center Drive and Steilacoom-DuPont Road interchanges. The second set of CD roads would connect the Berkeley Drive and Thorne Lane interchanges. An auxiliary lane would be added on both sides of I-5 between the CD roads between the Steilacoom-DuPont Road and Berkeley Street interchanges and between the Thorne Lane and Gravelly Lake Drive interchanges.

Scenario 5 improvements are intended to:

- Encourage transit usage and improve transit operations
- Eliminate the choke point at the Thorne Lane Interchange
- Reduce side friction along the I-5 mainline

For travel forecasting purposes the HOV lanes are modeled as continuous between Tacoma and Lacey and the extra GP lanes are modeled as continuous from Thorne Lane to Marvin Road. A typical cross section through the CD road area is illustrated in Figure VI-33.

The existing right-of-way along the I-5 corridor through the corridor study area is 175 feet. The right-of-way needed for Scenario 5 would increase the minimum width to about 290 feet. Because of the rail line on the northwest side of I-5, the additional width would encroach into JBLM. Some additional right-of way will be needed for storm water quality and flow control facilities.

Vehicle Trips

The total number of vehicles in the corridor study area would increase by approximately 24 percent as shown in Figure VI-34. This increase is caused by latent travel demand in the corridor study area using the capacity added by the HOV lanes, extra GP lanes, and traffic shifts to the CD roads. Vehicle trips in the GP lanes would decrease from about 1,000 to 3,000 vehicles for segments between Mounts Road and Steilacoom-DuPont Road. Vehicles trips in the GP lanes would slightly increase for segments between Thorne Lane and Berkeley Street in the southbound direction, but decrease by about 1,600 vehicles in the northbound direction. With these reductions in vehicle trips and the increased capacity in the corridor study area, the number of vehicles in the GP lanes would be below LOS E capacity of 1,620 vph.

The usage of HOV lanes would range between 1,150 and 1,450 vehicles in the southbound direction, and between 600 vehicles to over 1,550 vehicles in the northbound direction with many HOV trips coming from the area north of the Main Gate

Figure VI-33: Scenario 5 - Typical Section

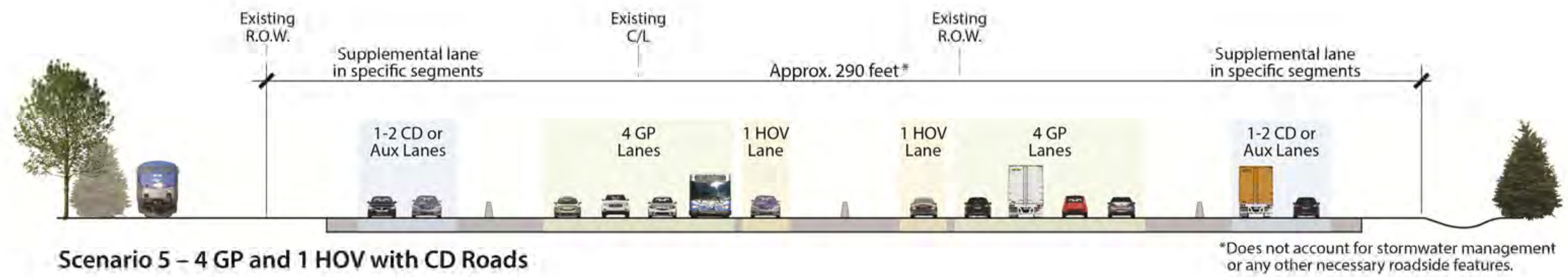


Figure VI-34: Scenario 5 - 2040 PM Peak Hour Vehicle Trip Summary

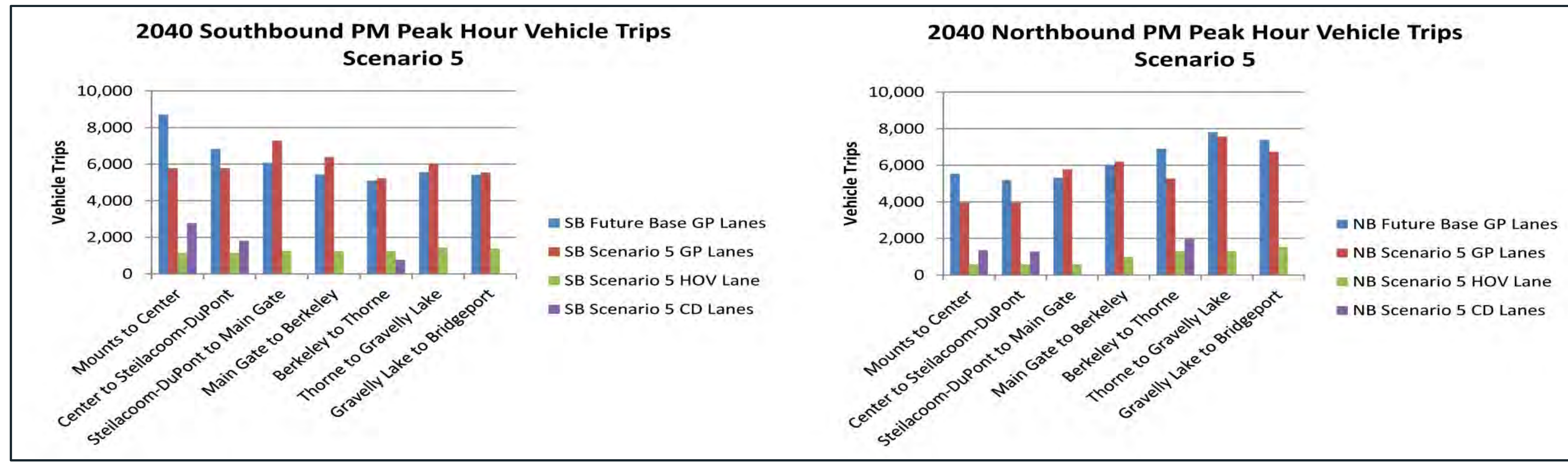
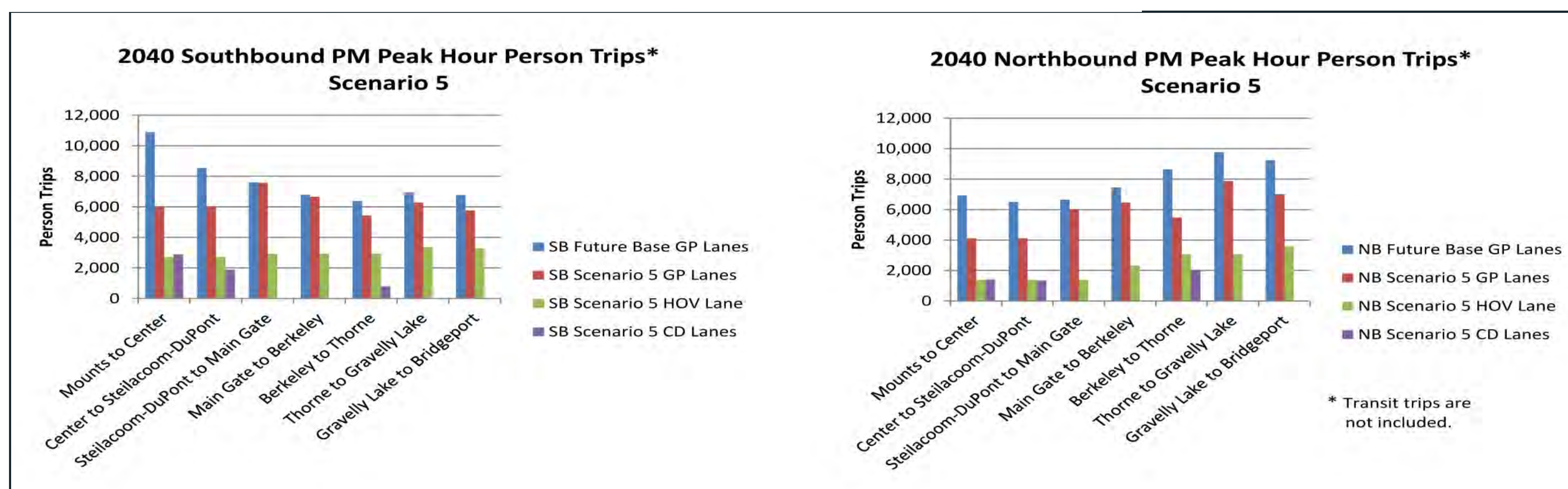


Figure VI-35: Scenario 5 - 2040 PM Peak Hour Person Trip Summary



Interchange. The usage of CD roads would vary from approximately 750 to nearly 2,800 vehicle trips, depending on location. Some short trips would only use the CD roads to meet their travel needs and never get on the I-5 mainline, especially between Steilacoom-DuPont Road, Center Drive and Mounts Road.

Person Trips

During the PM peak hour, the overall number of person trips through the corridor study area would increase by about 22 percent with the added improvements in Scenario 5 in comparison with the 2040 Base Condition. A 31 percent increase southbound person trips would be expected and about 12 percent northbound, as shown in Figure VI-35. During the AM peak hour, an overall increase in person trips of about 11 percent is expected, primarily in the northbound direction.

Average Travel Speeds

Figure VI-36 shows that the addition of the improvements with Scenario 5 would improve average GP lane speed during the PM peak hour. Speeds would be higher than the 70 percent of posted speed threshold (42 mph) for acceptable operations.

Between Mounts Road and Bridgeport Way, the average southbound GP lane speed during the PM peak hour would increase from 15 mph for the 2040 Base Condition to 52 mph for Scenario 5. Similarly, in the northbound direction the average GP lane speed would increase from 21 mph for the 2040 Base Condition to 60 mph. With these improved speeds, general traffic and freight would have improved travel times through this area. The average AM peak hour speed for the GP lanes would also be above the 42 mph threshold. Drivers in the HOV lane would also have similar speeds as the GP lanes.

Drivers in both the GP and HOV lanes during the PM peak hour could expect that their travel time between the Mounts Road and Bridgeport Way interchanges would be approximately 10 to 11 minutes in the southbound direction, and 9 to 10 minutes in the northbound direction.

Hours of Congestion

With the higher roadway capacity included in Scenario 5, congestion through the corridor study area would be reduced. Congestion in the southbound direction would spill back from congestion in the Nisqually delta area. In the northbound direction, some congestion may occur north of Gravelly Lake Drive. Drivers in the HOV lanes will be able to by-pass most of the congested areas.

On and Off-Ramp Volumes

With the CD roads in Scenario 5, the number of entry and exit points along the I-5 mainline between the Mounts Road and Thorne Lane interchanges would be reduced from twelve in each direction in the 2040 Base Condition to six in each direction, as shown in Figure VI-37. This reduction in access points provides more distance for weaving and merging lane changes on I-5. It would also increase the amount of traffic at the remaining locations.

The CD roads would also change the locations where drivers enter or exit I-5, shifting traffic to locations where auxiliary lanes have been added to reduce the side friction that would be associated with these larger traffic volumes. The auxiliary lanes would allow drivers to change lanes over a longer distance than with a typical on or off-ramp configuration.

These CD roads also accommodate some short trips, thereby reducing the number of short trips on the I-5 mainline. This scenario would require that HOV users weave to and from the HOV lane across the three GP lanes. However, this scenario would improve travel time for HOV drivers and transit buses passing through the corridor study area.

Figure VI-36: Scenario 5 - Average 2040 PM Peak Hour GP Lane Speed Summary

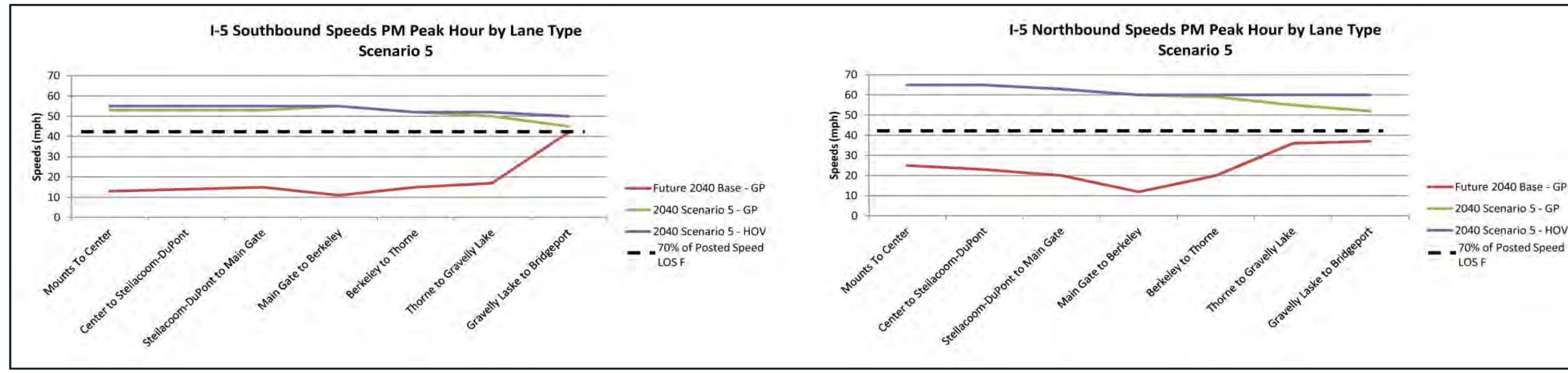
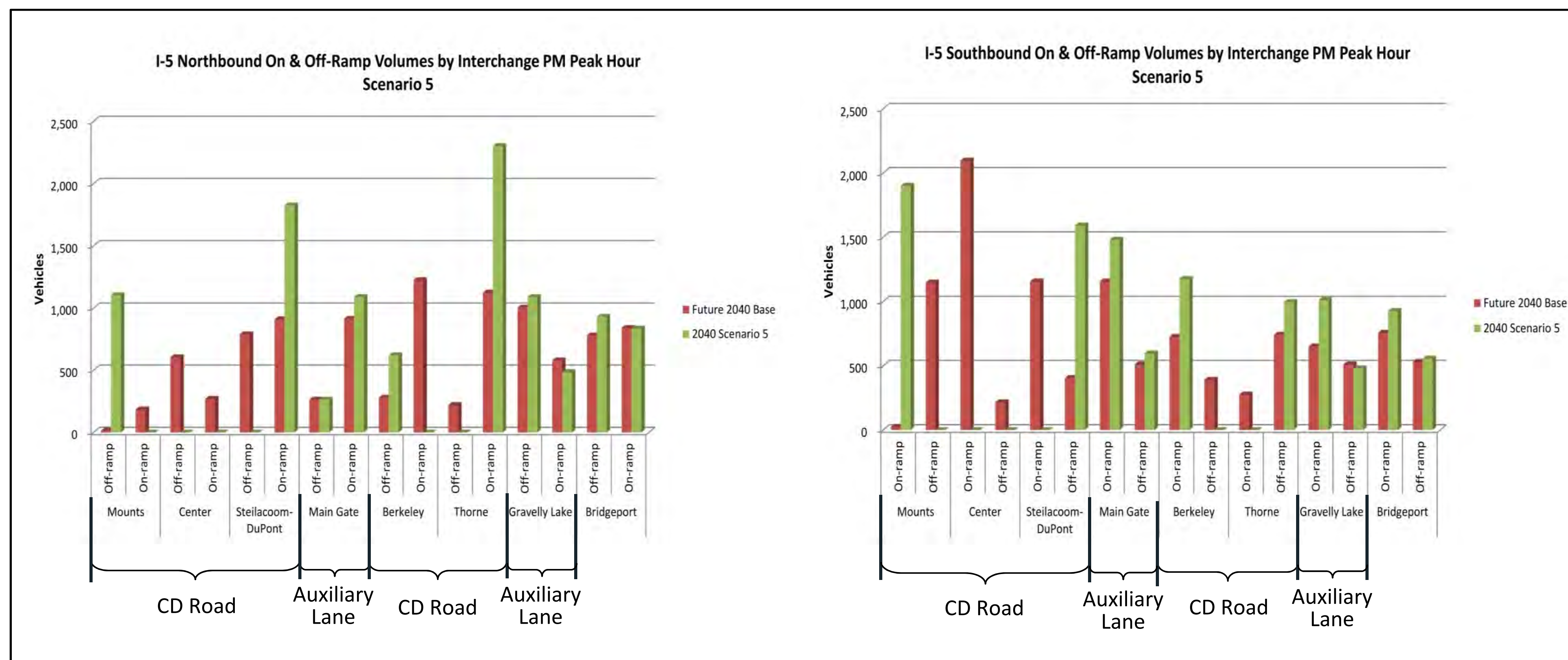


Figure VI-37: Scenario 5 - 2040 PM Peak Hour On & Off-Ramp Volume Summary



Summary of Scenario 5 2040 PM Peak Hour Analyses

A summary of the 2040 PM peak hour operation analysis for Scenario 5 is displayed in Figure VI-38 for selected southbound and northbound locations along I-5. In both directions, traffic flow would be expected to be near normal unconstrained operating speed of between 53 and 60 mph. During both AM and PM peak hours, average per lane volumes would be below the LOS E capacity of 1,620 vph. Drivers are expected to have adequate room to weave and merge without creating congestion or slowing traffic.

HOV lanes would not be as highly utilized as other scenarios because GP lane speeds and HOV speeds are similar, so there is less incentive to use the HOV lane. In comparison to the 2040 Base Condition, average GP lane volumes would be decreased with the addition of the HOV lanes, extra GP lanes and CD roads.

Scenario 5 - Summary of Findings

- Managed/HOV lanes, a fourth GP lane and CD roads in each direction would address the three major deficiencies in the corridor study area, namely encourage ride-share and transit, eliminate the choke point at Thorne Lane, and limit entry and exit points along I-5 to reduce side friction.
- Person trips and vehicle trip increases would be similar to Scenario 3.
- HOV lane are expected to run at over 85 percent capacity in the PM peak hour and over 70 percent capacity in the AM peak hour, with average speeds of about 55 mph
- AM peak hour northbound and southbound travel speeds are expected to average about 55 mph to 60 mph
- Northbound PM peak hour speeds would average about 55 mph to 60 mph, and southbound speeds would average about 50 mph to 55 mph.
- This scenario is estimated to flow freely even in the peak hours.
- CD roads would run at or slightly over capacity in several locations, requiring two travel lanes to accommodate AM and PM peak hourly traffic.
- Through the corridor study area, travel times in the GP lanes would range from 10 to 11 minutes, similar to travel time in the HOV lanes, which negates the incentive to use the HOV lane.
- This scenario would have the widest footprint and right of way impact of any scenario.

Figure VI-38: Scenario 5 - Summary of Operational Analysis at Key Locations – 2040 PM Peak Hour

Scenario 5 - 4 GP and 1 HOV with CD Roads

Volume/Capacity (V/C) Legend	
V/C: < 0.6	green
V/C: 0.6 - 0.85	yellow
V/C: 0.85 - 1.0	orange
V/C: > 1.0	red

Speed Legend	
51+ mph	green
45 - 51 mph	yellow
37 - 44 mph	orange
20 - 36 mph	red
Less than 20 mph	dark red

I-5 SB Traffic -- North of Center Interchange

Scenario 5 – 4 GP and 1 HOV with CD Roads

	CD	GP	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,810	1,446	1,446	1,446	1,446	1,155	8,749	Vehicles
Persons	1,882	1,504	1,504	1,504	1,504	2,714	10,612	Persons

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
53	0	54	0

I-5 SB Traffic -- North of Steilacoom-DuPont Interchange

	AUX	GP	GP	GP	GP	HOV (2+)	Total	
Vehicles	1,457	1,457	1,457	1,457	1,457	1,245	8,530	Vehicles
Persons	1,515	1,515	1,515	1,515	1,515	2,926	10,501	Persons

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
53	0	54	0

I-5 NB Traffic -- North of Main Gate Interchange

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
60	0	56	0

	HOV (2+)	GP	GP	GP	GP	AUX	Total	
Vehicles	990	1,241	1,241	1,241	1,241	1,241	7,195	Vehicles
Persons	2,327	1,291	1,291	1,291	1,291	1,291	8,782	Persons

I-5 NB Traffic -- North of Berkeley Interchange

PM Peak Hour GP Lanes Speed	PM Peak Hour GP Lanes Hours of Congestion	PM Peak Hour HOV Lane Speed	PM Peak Hour HOV Lane Hours of Congestion
59	0	51	0

	HOV (2+)	GP	GP	GP	GP	CD	Total	
Vehicles	1,305	1,318	1,318	1,318	1,318	1,960	8,537	Vehicles
Persons	3,067	1,370	1,370	1,370	1,370	2,038	10,585	Persons

* Practical lane capacity is estimated to be 1,800 vph.

Evaluation of I-5 Mainline Scenarios

The evaluation methodology for this study was designed to analyze each scenario using the criteria/metrics described previously. These metrics include speed, hours of congestion, total person trips, friction/conflict reduction, environmental impacts, and relative construction costs. The scoring of these metrics follows a Consumer Reports format where the lowest value is represented by a solid red circle and the best value highlighted by a solid green circle. For purposes of this evaluation process, it was decided that each criterion would use a scoring range of five (5) circles as shown below.

Speed

Data for each freeway location was aggregated into four principal corridor segments in each direction using weighted average speeds. These four segments are listed below under *Scoring Process and Range*. This data is reported in back-up matrices that present speed data for each scenario. Data was then averaged based on the length of each segment for the entire length of the corridor in each travel direction for AM and PM peak hours in the GP and HOV lanes. These corridor-wide averages are reported in the summary corridor-wide evaluation matrix.

Speed scoring range

- More than 50 mph
- 45 – 50 mph
- 36 – 44 mph
- 20 -36 mph
- Less than 20 mph

Points were then assigned for the defined ranges of speed data in each direction for both the AM and PM peak hours. The range of values was based on the methodology included in the WSDOT's Highway System Plan for 2007-2026 that used 85 percent of the posted speed to estimate maximum throughput and rounded to 50 mph as the best speed. These points were averaged to create a combined speed score for each scenario illustrating speed results from the lowest to the highest.

Hour of Congestion

Data for this metric was summarized for four principal highway segments by scenario, travel direction and time period. This data was rolled up into a summary for the AM and PM halves of the day to highlight the segment showing the highest total hours of congestion in that time period in each travel direction.

Hours of congestion range

- 0 Hours
- 1 Hour
- 2 Hours
- 3-4 Hours
- 5+ Hours

Points were assigned based on the defined ranges of AM and PM hours of congestion for each segment and time period. A single directional value was determined for the overall corridor, and this value represented the highest number of hours calculated for the AM and PM periods. These points summarize the results of the analysis process from the lowest to the highest. Use of this single value simplifies the comparison of hours of congestion among the various scenarios.

Person Trips

Data for this metric was summarized for four principal highway segments by scenario, travel direction and time period. Points were then assigned for the defined ranges of person trip data in each direction for both the AM and PM peak hours. For the range of person trips in this analysis, a value of 6,000 persons per hour was selected as the low score which is roughly equivalent to 1.1 persons per vehicle at the three lane capacity. The range was then generated by increasing the occupancy rate by about 0.22 persons per vehicle with the highest value being approximately 2.0 persons per vehicle. The points were averaged to create a combined person trip score for each scenario illustrating results from the lowest to the highest.

Person trip scoring range

- More than 9,600
- 8,400 to 9,599
- 7,200 to 8399
- 6,000 to 7,189
- Less than 6,000

Friction / Conflict Reduction

Collector-Distributor (CD) roads provide friction/conflict reduction by lowering the number of entry or exit points along the I-5 mainline. The CD roads/auxiliary lane concept proposed in some mainline scenarios would reduce the number of conflict points between the Mounts Road Interchange and the Thorne Lane Interchange from twenty to twelve locations. This reduction of eight conflict points is expected to provide significant friction relief to the side friction that affects the safety and operation of mainline traffic.

Friction/Conflict relief scoring range

- Excellent: removes friction/conflict relief points
- Very good: removes several friction/conflict relief points
- Good: provides some friction/conflict relief point
- Fair: provides minimal friction/conflict relief points
- Poor: provides zero friction/ conflict relief point

Other improvements, such as additional GP lanes, would also provide some friction/conflict point reduction through added mainline capacity.

This metric is only scored for the overall corridor, not by individual corridor segments or by direction.

Environmental Impacts

As a measure of performance, the scoring of environmental impacts at this conceptual level of analysis is a comparative rating of how each scenario performs in relationship to the other scenarios, as shown in the environmental scoring to the right. For example, the scenario with the widest footprint of area will receive the highest impact and therefore the lowest score. The environmental metric is estimated by the overall corridor, not by individual corridor segments.

Environmental scoring range

- Lowest impact
- Moderately low impacts
- Moderate impacts
- Moderately high impacts
- Highest impacts

Cost

The cost metric is estimated for the overall corridor width and length, not by individual corridor segments. As a measure of performance, scoring of the cost factor reflects a comparative magnitude of capital costs considering the amount of improvements in each scenario relative to the others. This assessment was based on the total additional lane miles of freeway, and/or CD roads that were included in the scenario. The higher additional lane mileage was related to a higher magnitude of cost. The cost of interchanges was assumed to be comparable for each scenario.

Cost scoring range

- Excellent: lowest magnitude of capital cost
- Very good: second lowest magnitude of capital cost
- Good: middle range of capital cost
- Fair: second highest capital cost
- Poor: highest magnitude of capital cost

Scoring Process and Range

Each scenario was divided into the following segments and values estimated for speeds, hours of congestion and person trips:

- Mounts Road to Steilacoom-DuPont Road
- Steilacoom-DuPont Road to Berkeley Street
- Berkeley Street to Thorne Lane
- Thorne Lane to Bridgeport Way

Ratings for each metric were then assigned to each scenario based on scoring ranges for both the AM and PM peak hours in the northbound and southbound direction for metric. An example of this scenario analysis by corridor segment is illustrated in Figure VI-39.

Weighted corridor averages for speeds and person trips were then developed based on the length of each segment. For example the speed data was converted to travel time based on the length of each section and then totaled for the corridor. This corridor travel time was then divided by the overall corridor length to get the average speed along the corridor. This average speed was then rated using the above metric.

Person trips were converted into person miles for each segment and totaled. The person miles total was divided by the corridor length to get the average person trips along the corridor and then evaluated using the above metric.. This data was summarized by AM and PM and by direction. For corridor hours of congestion, the longest period of congestion along any segment was used to show the duration of congestion in the corridor. An example of scenario analysis by corridor averages is illustrated in Figure VI-40.

Each of the color balls for AM and PM ratings on the corridor summary sheet was assigned a point value, based on the scoring system shown on the right. Using these values, scores for AM and PM values were averaged by metric to determine its overall rating. Scores were also added for friction/conflict reduction, environmental impacts, and costs.

Scoring Points Range

- 5 points
- 4 points
- 3 points
- 2 points
- 1 point

An example of the scenario analysis by corridor averages is illustrated in Figure VI-41.

To assess the overall performance, a weighting system was developed for each metric based on the guidance and principles of the *Moving Washington* initiative. The following weights were assigned to each metric:

- GP Speed 1.0
- HOV Speed 1.0
- GP Hours of Congestion 1.5
- HOV Hours of Congestion 1.0
- Person Trips 2.0
- Friction/Conflict Reduction 1.5
- Environmental Impacts 1.0
- Cost 1.0

These weights were deliberately developed to provide higher value to metrics aligned with moving people through the corridor in accordance with the principles of *Moving Washington*. More weight was also given to congestion-related metrics, since addressing congestion is a principal objective of this study.

These weights were then applied to the metric scores and the weighted scores were totaled to give an overall performance score for each scenario.

Because of the different methodologies used to estimate travel speed and hours of congestion, there is some discontinuity between the results. During the next project phase, these issues will be re-analyzed using VISSIM simulations for AM and PM hours to estimate average travel speeds and hours of congestion.

Figure VI-39: Example of Evaluation of Scenario by Segment

AM Peak Hour

Location	Speed (mph) GP Lanes		Speed (mph) HOV Lane		Hours of Congestion* (hrs) GP Lanes		Hours of Congestion* (hrs) HOV Lane		Person Trips		Friction/ Conflict Relief	Environmental	Cost
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB			
Mounts - Steilacoom-DuPont	23	61	56	59	3	0	0	0	9,020	5,840	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	35	52	57	59	3	1	0	0	8,200	6,570			
Berkeley - Thorne	44	42	56	58	2	0	0	0	7,680	7,260			
Thorne - Bridgeport	58	49	55	57	0	0	0	0	8,360	8,150			

PM Peak Hour

Location	Speed (mph) GP Lanes		Speed (mph) HOV Lane		Hours of Congestion* (hrs) GP Lanes		Hours of Congestion* (hrs) HOV Lane		Person Trips		Friction/ Conflict Relief	Environmental	Cost
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB			
Mounts - Steilacoom-DuPont	37	19	57	52	0	7	0	0	6,780	10,090	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	22	18	57	54	5	3	0	0	7,200	8,410			
Berkeley - Thorne	25	15	50	52	4	0	0	0	9,050	7,590			
Thorne - Bridgeport	52	32	47	49	0	0	0	0	9,980	8,540			

Figure VI-40: Example of Evaluation of Scenario by Corridor

AM Peak Hour

Location	Speed GP Lanes		Speed HOV Lane		Hours of Congestion* GP Lanes		Hours of Congestion* HOV Lane		Person Trips		Friction/Conflict Relief	Environmental	Cost
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB			
Overall - AM	34	52	56	59	3	1	0	0	8,400	6,850	See Below		

PM Peak Hour

Location	Speed GP Lanes		Speed HOV Lane		Hours of Congestion* GP Lanes		Hours of Congestion* HOV Lane		Person Trips		Friction/Conflict Relief	Environmental	Cost
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB			
Overall - PM	29	20	53	52	5	7	0	0	7,970	8,780	See Below		

Figure VI-41: Example of the Summary Scoring Evaluation by Scenario

Scoring Summary

Location	Speed GP Lanes		Speed HOV Lane		Hours of Congestion GP Lanes		Hours of Congestion HOV Lane		Person Trips		Friction/Conflict Relief	Environmental	Cost
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB			
	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score	Score
Scenario 1A	2	3.5	5	5	1.5	2.5	5	5	3.5	3	2	3	4

Evaluation of I-5 Scenarios

This evaluation and scoring process was applied to each of the I-5 mainline improvement scenarios. The results and key findings of this evaluation process are summarized below by scenario.

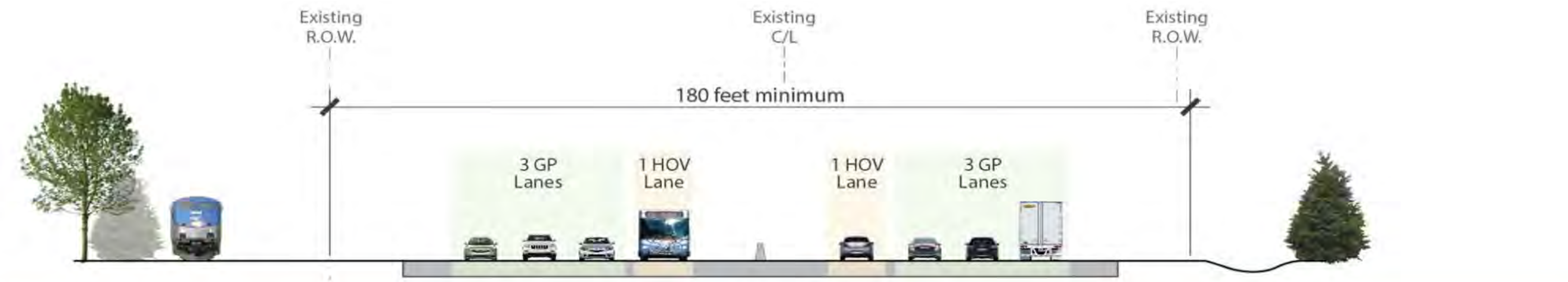
Scenario 1a

Figure VI-42 displays the scoring summary by segment and period using 2040 data. Figure VI-43 displays the corridor summary results.

Scenario 1a would add an HOV lane in each direction along the corridor. With this improvement the 2040 results show:

- The I-5 corridor would remain highly congested
- Travel speeds would be slow for GP lanes but close to posted speed for the HOV lane
    - GP lanes Speeds
        - AM peak northbound speeds average 34 mph
        - AM peak southbound speeds average 52 mph
        - PM peak northbound speeds average 29 mph
        - PM peak southbound speeds average 20 mph
    - HOV Speeds
        - AM peak northbound speeds average 56 mph
        - AM peak southbound speeds average 59 mph
        - PM peak northbound speeds average 53 mph
        - PM peak southbound speeds average 52 mph
- Congestion would be high
    - AM Hours
        - GP lanes would have moderate duration of congestion, especially northbound between Mounts Road and Berkeley Street
        - HOV lanes would be free flowing
    - PM Hours
        - GP lanes would have long duration of congestion, especially northbound between Steilacoom-DuPont Road and Berkeley Street and southbound south of Steilacoom-DuPont Road
        - HOV lanes would be free flowing
- A moderate level of person trips
- Little improvement to friction/conflict points
- A moderate level of environmental impacts
- Lower costs than other scenarios

Figure VI-42: Scenario 1a – 3 GP Lanes and HOV Lane - Segment Evaluation Summary



AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	23	61	56	59	3	0	0	0	9,020	5,840	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	35	52	57	59	3	1	0	0	8,200	6,570			
Berkeley - Thorne	44	42	56	58	2	0	0	0	7,680	7,260			
Thorne - Bridgeport	58	49	55	57	0	0	0	0	8,360	8,150			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	37	19	57	52	0	7	0	0	6,780	10,090	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	22	18	57	54	5	3	0	0	7,200	8,410			
Berkeley - Thorne	25	15	50	52	4	0	0	0	9,050	7,590			
Thorne - Bridgeport	52	32	47	49	0	0	0	0	9,980	8,540			

Figure VI-43: Scenario 1a – 3 GP Lanes and HOV Lane - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	34	52	56	59	3	1	0	0	8,400	6,850	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	29	20	53	52	5	7	0	0	7,970	8,780	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 1A	2	3.5	5	5	1.5	2.5	5	5	3.5	3	2	3	4

Note:
* Based on 12 hour period

Scenario 1b

Figure VI-44 displays the scoring summary by segment and period using 2040 data. Figure VI-45 displays the corridor evaluation summary results.

Scenario 1b would add CD roads in specific locations along the corridor with auxiliary lanes connecting the CD roads in both directions. With these improvements the 2040 results show:

- The I-5 corridor would still remain highly congested, especially in the PM peak period
- Travel speeds would be slow, especially in the PM peak hour
  - GP lanes Speeds
    - AM peak northbound speeds average 48 mph
    - AM peak southbound speeds average 54 mph
    - PM peak northbound speeds average 31 mph
    - PM peak southbound speeds average 22 mph
- Congestion would be high
  - AM Hours
    - GP lanes would have moderate to high duration of congestion, especially northbound between Berkeley Street and Thorne Lane
  - PM Hours
    - GP lanes would have moderate to high duration of congestion, especially northbound north of Berkeley Street and southbound between Thorne Lane and Berkeley Street and south of Steilacoom-DuPont Road
- Capacity provided by the CD road or auxiliary lanes would be filled back up by latent demand (i.e., new trips attracted to the corridor because of the additional available capacity).
- Traffic volumes would be high on the CD roads especially northbound in the AM peak
- A moderate level of person trips
- No HOV facility to encourage alternative modes of travel
- Significant relief in friction/conflict points
- A moderate level of environmental impacts
- A mid-range of costs

Figure VI-44: Scenario 1b – 3 GP Lanes with CD Roads - Segment Evaluation Summary

AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	33	59			2	0			9,310	6,400	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	59	58			2	0			8,660	7,300			
Berkeley - Thorne	63	49			6	1			8,150	8,230			
Thorne - Bridgeport	50	48			2	1			8,300	8,600			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	29	17			0	3			6,970	10,390	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	28	23			0	2			7,630	8,390			
Berkeley - Thorne	36	22			4	5			9,310	7,490			
Thorne - Bridgeport	37	29			4	0			9,540	7,700			

Figure VI-45: Scenario 1b – 3 GP Lanes with CD Roads - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	48	54			6	1			8,680	7,490	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	31	22			4	5			8,110	8,630	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 1B	3	3.5			1.5	2.5			3.5	3.5	4	3	3

Note:
* Based on 12 hour period

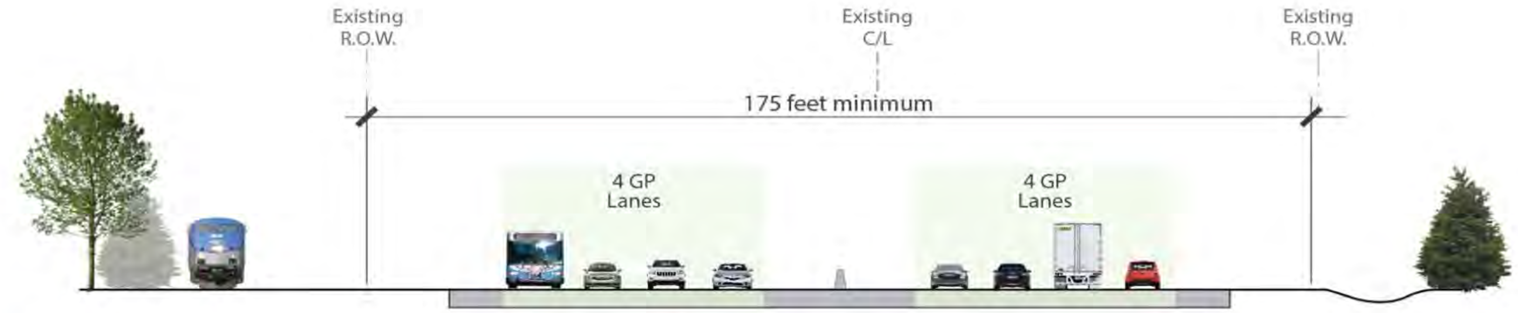
Scenario 2

Figure VI-46 displays the scoring summary by segment and period using 2040 data. Figure VI-47 displays the corridor summary results.

Scenario 2 would add a GP lane in each direction, south of Thorne Lane. With this improvement the 2040 results show:

- The I-5 corridor would remain moderately congested, especially during the PM peak period
- Some travel speeds would be slow in the peak direction
  - GP lanes Speeds
    - AM peak northbound speeds average 37 mph
    - AM peak southbound speeds average 55 mph
    - PM peak northbound speeds average 42 mph
    - PM peak southbound speeds average 26 mph
- Congestion would be moderate
  - AM Hours
    - GP lanes would have moderate duration of congestion throughout the corridor study area
  - PM Hours
    - GP lanes would have moderate duration of congestion, especially northbound, north of Berkeley Street and southbound, south of Steilacoom-DuPont Road
- A moderate level of person trips
- No HOV facility to encourage alternative modes of travel
- Little improvement to friction/conflict points due to high on and off-ramp movements
- A moderate level of environmental impacts
- Lower costs than other scenarios

Figure VI-46: Scenario 2 – 4 GP Lanes - Segment Evaluation Summary



AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	29	60			2	0			9,670	6,570	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	40	57			2	0			8,780	7,170			
Berkeley - Thorne	40	50			2	0			8,170	8,110			
Thorne - Bridgeport	43	50			2	1			8,240	8,450			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	63	18			0	4			7,050	10,670	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	57	27			0	2			7,420	8,440			
Berkeley - Thorne	31	34			3	0			9,010	7,390			
Thorne - Bridgeport	26	33			3	0			9,290	7,620			

Figure VI-47: Scenario 2 – 4 GP Lanes - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	37	55			2	1			8,810	7430	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	42	26			3	4			8,700	7950	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 2	3	3.5			2.5	3			4	3	2	3	4

Note:
* Based on 12 hour period

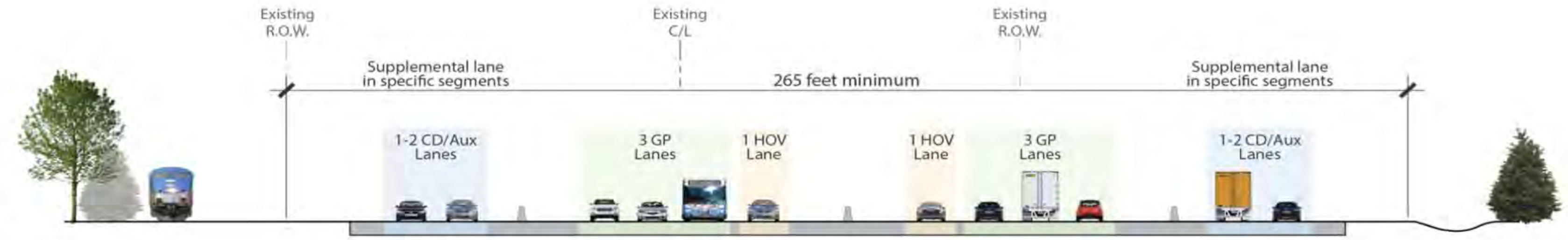
Scenario 3

Figure VI-48 displays the scoring summary by segment and period using 2040 data. Figure VI-49 displays the corridor summary results.

Scenario 3 would add an HOV lane in each direction along the corridor with CD roads connected with auxiliary lanes. With this improvement the 2040 results show:

- The I-5 corridor would have moderate periods of congestion
- Travel speeds would be moderate
  - GP lanes Speeds
    - AM peak northbound speeds average 55 mph
    - AM peak southbound speeds average 56 mph
    - PM peak northbound speeds average 39 mph
    - PM peak southbound speeds average 31 mph
  - HOV Speeds
    - AM peak northbound speeds average 56 mph
    - AM peak southbound speeds average 59 mph
    - PM peak northbound speeds average 53 mph
    - PM peak southbound speeds average 50 mph
- Hours of congestion would be moderate
  - AM Hours
    - GP lanes would have moderately high duration of congestion northbound between Berkeley Street and Thorne Lane and moderately low durations of congestion southbound
    - HOV lanes would be free flowing
  - PM Hours
    - GP lanes would have moderately high duration of congestion northbound north of Berkeley Street and moderate congestion southbound south of Steilacoom-DuPont Road
    - HOV lanes would be free flowing
- A high level of person trips
- HOV lanes would run at 90% of capacity north of Thorne Lane
- Fewer friction/conflict point with CD roads
- CD roads may need to have two lanes in each direction, since they would be close to capacity in the northbound direction north of Berkeley Street in the PM peak, and in the northbound direction north of Mounts Road in the AM peak
- A moderately high level of environmental impacts
- A moderately high cost level

Figure VI-48: Scenario 3 – 3 GP Lanes and HOV Lane with CD Roads - Segment Evaluation Summary



AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	40	60	56	59	0	0	0	0	9,660	6,020	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	64	59	56	59	1	0	0	0	9,260	7,120			
Berkeley - Thorne	65	55	56	58	3	1	0	0	8,950	7,950			
Thorne - Bridgeport	57	51	55	57	0	0	0	0	9,200	8,570			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	39	30	58	50	0	2	0	0	6,860	10,990	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	32	31	57	51	0	0	0	0	8,110	9,560			
Berkeley - Thorne	46	27	48	52	3	0	0	0	10,660	8,690			
Thorne - Bridgeport	53	33	46	49	3	0	0	0	10,870	9,050			

Figure VI-49: Scenario 3 – 3 GP Lanes and HOV Lane with CD Roads - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	55	56	56	59	3	1	0	0	9,320	7,280	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	39	31	53	50	3	2	0	0	8,730	9,710	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 3	4	3.5	5	4.5	2	3.5	5	5	4	4	4	2	2

Note:
* Based on 12 hour period

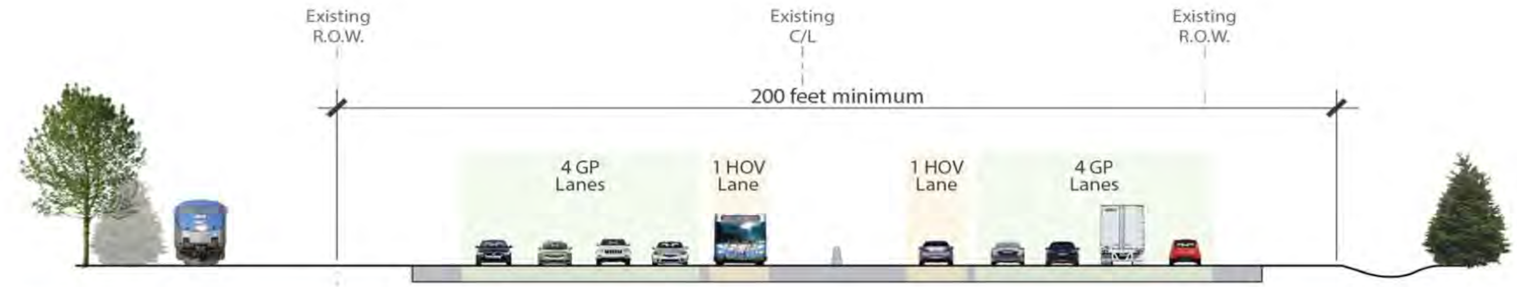
Scenario 4

Figure VI-50 displays the scoring summary by segment and period using 2040 data. Figure VI-51 displays the corridor summary results.

Scenario 4 would add an HOV lane in each direction along the corridor and a fourth GP lane in each direction south of Thorne Lane. With this improvement the 2040 results show:

- The I-5 corridor would have moderate congestion
- Travel speeds would be improved
  - GP lanes Speeds
    - AM peak northbound speeds average 45 mph
    - AM peak southbound speeds average 57 mph
    - PM peak northbound speeds average 53 mph
    - PM peak southbound speeds average 29 mph
  - HOV Speeds
    - AM peak northbound speeds average 56 mph
    - AM peak southbound speeds average 58 mph
    - PM peak northbound speeds average 52 mph
    - PM peak southbound speeds average 52 mph
- Congestion would be moderate
  - AM Hours
    - GP lanes would have moderate duration of congestion in the northbound and low congestion southbound
    - HOV lanes would be free flowing
  - PM Hours
    - GP lanes would have moderate duration of congestion northbound, especially northbound, north of Berkeley and moderately high congestion southbound, south of Steilacoom-DuPont Road
    - HOV lanes would be free flowing
- A high level of person trips
- Some improvement to friction/conflict points with the addition of the fourth GP lane
- A moderate level of environmental impacts
- A moderate cost level

Figure VI-50: Scenario 4 – 4 GP Lanes and HOV Lane - Segment Evaluation Summary



AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	39	61	56	59	2	0	0	0	9,800	6,000	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	47	59	57	59	1	0	0	0	9,130	7,070			
Berkeley - Thorne	50	53	56	58	0	0	0	0	8,900	7,940			
Thorne - Bridgeport	50	54	55	57	0	0	0	0	9,070	8,530			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	65	17	57	54	0	4	0	0	7,020	10,670	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	61	35	57	54	0	0	0	0	7,740	9,510			
Berkeley - Thorne	43	41	48	52	2	0	0	0	10,260	8,780			
Thorne - Bridgeport	41	43	42	49	2	0	0	0	10,560	9,140			

Figure VI-51: Scenario 4 – 4 GP Lanes and HOV Lane - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	45	57	56	58	2	0	0	0	9,260	7,250	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	53	29	52	52	2	4	0	0	8,510	9,640	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 4	4.5	3.5	5	5	3	3.5	5	5	4	4	3	3	3

Note:
* Based on 12 hour period

Scenario 5

Figure VI-52 displays the scoring summary by segment and period using 2040 data. Figure VI-53 displays the corridor summary results.

Scenario 5 would add an HOV lane in each direction along the corridor, a fourth GP lane in each direction south of Thorne Lane, and CD roads connected by auxiliary lanes. With this improvement the 2040 results show:

- The I-5 corridor is expected to be mostly free flowing
- Travel speeds would be at or near the posted speed limits
  - GP lanes Speeds
    - AM peak northbound speeds average 60 mph
    - AM peak southbound speeds average 60 mph
    - PM peak northbound speeds average 60 mph
    - PM peak southbound speeds average 52 mph
  - HOV Speeds
    - AM peak northbound speeds average 56 mph
    - AM peak southbound speeds average 59 mph
    - PM peak northbound speeds average 54 mph
    - PM peak southbound speeds average 52 mph
- Congestion is low
  - AM Hours
    - GP lanes are expected to be free flowing
    - HOV lanes would be free flowing
  - PM Hours
    - GP lanes are expected to be free flowing
    - HOV lanes would be free flowing
- A high level of person trips
- CD road would reduce the number of friction/conflict points
- A high level of environmental impacts because of its wide footprint
- A high level of cost because it has the highest number of travel lanes.

Figure VI-52: Scenario 5 – 4 GP Lanes and HOV Lane with CD Roads - Segment Evaluation Summary

AM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	63	62	57	59	0	0	0	0	9,880	6,000	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	63	62	57	59	0	0	0	0	9,380	7,110			
Berkeley - Thorne	58	59	56	58	0	0	0	0	9,050	8,000			
Thorne - Bridgeport	56	56	55	57	0	0	0	0	9,240	8,610			

PM Peak Hour

Location	Speed (mph) GP Lanes NB	Speed (mph) GP Lanes SB	Speed (mph) HOV Lane NB	Speed (mph) HOV Lane SB	Hours of Congestion* (hrs) GP Lanes NB	Hours of Congestion* (hrs) GP Lanes SB	Hours of Congestion* (hrs) HOV Lane NB	Hours of Congestion* (hrs) HOV Lane SB	Person Trips NB	Person Trips SB	Friction/ Conflict Relief	Environmental	Cost
Mounts - Steilacoom-DuPont	65	53	58	54	0	0	0	0	6,880	11,160	See Summary Table	See Summary Table	See Summary Table
Steilacoom-DuPont - Berkeley	61	54	57	53	0	0	0	0	8,070	10,060			
Berkeley - Thorne	59	52	51	52	0	0	0	0	10,590	9,170			
Thorne - Bridgeport	53	47	46	49	2	0	0	0	10,760	9,310			

Figure VI-53: Scenario 5 – 4 GP Lanes and HOV Lane with CD Roads - Corridor Evaluation Summary

AM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - AM	60	60	56	59	0	0	0	0	9,440	7,290	See Below		

PM Peak Hour

Location	Speed GP Lanes NB	Speed GP Lanes SB	Speed HOV Lane NB	Speed HOV Lane SB	Hours of Congestion* GP Lanes NB	Hours of Congestion* GP Lanes SB	Hours of Congestion* HOV Lane NB	Hours of Congestion* HOV Lane SB	Person Trips NB	Person Trips SB	Friction/Conflict Relief	Environmental	Cost
Overall - PM	60	52	54	52	2	0	0	0	8,690	10,060	See Below		

Scoring Summary

Location	Speed GP Lanes NB Score	Speed GP Lanes SB Score	Speed HOV Lane NB Score	Speed HOV Lane SB Score	Hours of Congestion GP Lanes NB Score	Hours of Congestion GP Lanes SB Score	Hours of Congestion HOV Lane NB Score	Hours of Congestion HOV Lane SB Score	Person Trips NB Score	Person Trips SB Score	Friction/Conflict Relief Score	Environmental Score	Cost Score
Scenario 5	5	5	5	5	4	5	5	5	4	4	4	2	1

Note:
* Based on 12 hour period

Evaluation Scoring Summary

A summary of the I-5 mainline evaluation scoring is shown in Figure VI-54. The 2040 Base Condition scoring was added as a comparative measure and was not considered a viable alternative because it would not meet the goals of the project. As the study progressed, Stakeholders viewed Scenario 5 as over-building the corridor for the 2040 design year and determined it to be unviable and was not considered for further evaluation. These two scenarios remained in the study as low and high 'bookend' scenarios for comparison purposes.

The scores for each scenario were compiled across all metrics and the category weights added in Figure VI-55. The scores for Scenario 1a through Scenario 4 ranged from 24.38 to 37.38. The scenarios with the most consistent high performance and point totals were Scenario 3 (3 GP lanes and an HOV lane with CD roads connected with auxiliary lanes) and Scenario 4 (4 GP lanes and an HOV Lane).

These two scenarios showed improved GP lane speeds, free flowing HOV lanes with high utilization, limited hours of congestion, high person trip estimates, and reduced impacts of multiple friction/conflict points. However their moderate to moderately high level of environmental impacts and costs need to be better researched and analyzed to differentiate between them.

Improvements for Phase II Evaluation

Based on the results of this Corridor Plan Feasibility Study, the following improvements will advance into the Phase II IJR Study to further evaluate the operation benefits, environmental impacts and costs associated with them:

- I-5 Mainline Improvements
  - Scenario 3 (3 GP lanes and an HOV lane with CD roads connected with auxiliary lanes)
  - Scenario 4 (4 GP lanes and an HOV Lane)
- Interchange Improvements - Recommended interchange configurations include diverging diamond, tight diamond, SPUI, and cloverleaf improvement concepts recommended at:
  - Steilacoom-DuPont Road Interchange
  - Main Gate Interchange
  - Berkeley Street Interchange
  - Thorne Lane Interchange
- Local Improvements - Unfunded local improvements will also be analyzed to determine if they can help relieve congestion and improve I-5 operations. Some of the local improvements that will be investigated include:
  - Gravelly Lake Connector
  - HOV by-pass lanes on ramps
  - Intra-base Connector that links Fort Lewis and McChord Field
  - Other planned improvements from local and county plans

Figure VI-54: Evaluation Summary of i-5 Mainline Scenario Improvements

Evaluation Summary of I-5 Mainline Improvement Scenarios

Scenario	Speed GP Lanes	Speed HOV Lanes	Hours of Congestion GP Lanes	Hours of Congestion HOV Lanes	Person Trips	Friction/Conflict Relief	Environmental	Cost	Score
Category Weight	*1.00*	*1.00*	*1.50*	*1.00*	*2.00*	*1.50*	*1.00*	*1.00*	*10.00*
	Score	Score	Score	Score	Score	Score	Score	Score	
2040 Base Condition	2.25		1.5		2.75	1	5	5	**21.50**
Scenario 1A	2.75	5	2	5	3.25	2	3	4	**32.25**
Scenario 1B	3.25		2		3.5	4	3	3	**25.25**
Scenario 2	3.25		2.75		3.5	2	3	4	**24.38**
Scenario 3	3.75	4.75	2.75	5	4	4	2	2	**35.63**
Scenario 4	4	5	3.25	5	4	3	3	3	**37.38**
Scenario 5	5	5	4.5	5	4	4	2	1	**38.75**

The 2040 Base Condition and Scenario 5 represent bookend scenarios that were used to qualitatively score the other scenarios. They are not under consideration as viable solutions

Legend

General	Scoring Values
Excellent	4.5 - 5
Very Good	3.5 - 4.49
Good	2.5 - 3.49
Fair	1.5 - 2.49
Poor	0 - 1.49

VII. Interchange Concepts Considered

To improve I-5 operations and congestion, interchange types and operational characteristics were reviewed and analyzed. This analysis focused on the four I-5 interchanges in the heart of the study:

- Steilacoom-DuPont Road (Exit 119)
- Main Gate/41st Division Drive (Exit 120)
- Berkeley Street (Exit 122)
- Thorne Lane (Exit 123)

Interchange Types Being Considered

Previous studies like the *I-5 Transportation Alternatives Report*, managed by the City of Lakewood with WSDOT participation, began the process of examining interchange types and evaluating operations at these interchange locations along I-5. This feasibility study has expanded the scope to include various mainline scenarios, as discussed previously, so that proposed interchange improvements will be compatible with the future mainline facility.

Using the previous studies as a starting point, many interchange configurations were considered at the four focus interchanges in this feasibility study. Based on discussions with the study team and stakeholders, the most promising configurations were advanced for further consideration and refinement. The following four urban interchange types were determined to be the most appropriate for implementation in the study area:

- Tight Diamond Interchange
- Diverging Diamond Interchange (DDI)
- Full Cloverleaf Interchange
- Single Point Urban Interchange (SPUI)

These interchange configurations are illustrated in Figure VII-1.

Interchange Configurations

Each interchange location was evaluated to determine the most appropriate configurations to be carried forward for consideration in the IJR in Phase 2. These interchange configurations were reviewed with the Core Technical Team and the Stakeholder Technical Group.

Two to four interchange configurations were identified at each of the interchange locations. These configurations will be further refined during the IJR process and a final recommendation will be made when the IJR document is approved. The refinement process will ensure that the chosen interchange configuration is effective with the selected mainline improvement scenario. Interchange configurations for each focus interchange are described below.

Figure VII-1: Interchange Configurations

TIGHT DIAMOND INTERCHANGE

This is the simplest and perhaps most common type of Interchange. This Interchange has two on-ramps and two off-ramps and forms the shape of a diamond when viewed from the air.

FULL CLOVERLEAF INTERCHANGE

A two-level Interchange where left turns are handled by physically-separated, free-flowing ramps. When viewed from the air this Interchanges resemble a four-leaf clover.

DIVERGING DIAMOND INTERCHANGE (DDI)

This Interchange configuration improves left and right turn movements by removing them from the signal operations into free or yield movements. It also reduces the signal operation to two phases and provides more green time for through traffic.

SINGLE POINT URBAN INTERCHANGE (SPUI)

This Interchange configuration reduces the number of signals to one location in the center rather than two signals with the diamond configuration. It combines left turn movements at a single and more efficient intersection.

Steilacoom-DuPont Road Interchange (Exit 119)

The Steilacoom-DuPont Road Interchange serves the City of DuPont, the Town of Steilacoom, and JBLM, both Lewis North and Lewis Main areas. On the east side of I-5, Steilacoom-DuPont Road becomes Clark Road and accesses JBLM through the DuPont Gate. On the west side of I-5, Steilacoom-DuPont Road crosses the railroad at-grade with the crossing approximately 80 feet west of the southbound ramp intersection. Steilacoom-DuPont Road also intersects with Barksdale Avenue and Wilmington Drive about 300 feet west of the at-grade railroad crossing.

Interchange improvement concepts identified for further study at Steilacoom-DuPont Road are summarized below.

Concept A – Offset Diverging Diamond Interchange

The offset diverging diamond concept, shown in Figure VII-2, relocates the interchange approximately 1,000 feet north of the existing interchange which increases the spacing to the Center Drive Interchange. The alignment of Steilacoom-DuPont Road is revised to connect with the new interchange location. Wilmington Drive is extended along the old Steilacoom-DuPont Road alignment and tees into the realigned Steilacoom-DuPont Road. The realigned Steilacoom-DuPont Road is grade-separated over the railroad and crosses over I-5 as a four-lane roadway. It will loop around the historic Stone Station, located on the east side of I-5, under Steilacoom-DuPont Road and connect to Pendleton Avenue. The existing DuPont Gate to JBLM will be relocated on the new roadway alignment.

The offset diverging diamond concept simplifies the signal timing at the ramp intersections and allows free right and left turns at the ramp intersections. This concept increases spacing to the Barksdale Avenue intersection, grade-separates the railroad, increases the interchange spacing to the Center Drive Interchange, provides more storage space from the interchange to the relocated DuPont Gate, provides an opportunity for transit service at the Stone Station building (within the loop, just outside the ID check area), and increases the vertical clearance under the overpass. The existing interchange would be removed.

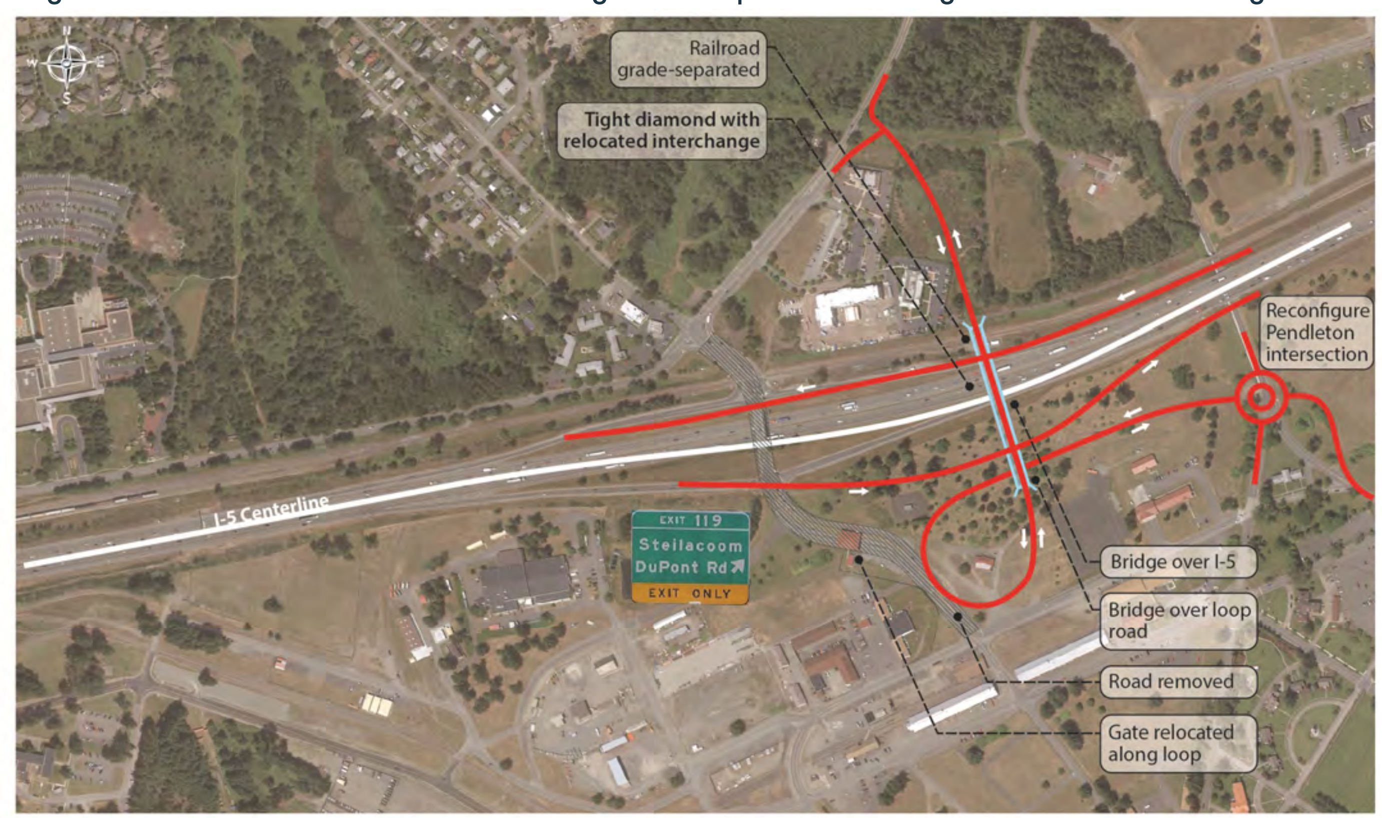
Concept B – Offset Tight Diamond Interchange

The offset tight diamond concept, shown in Figure VII-3, is similar to concept A with a few noted differences. The tight diamond will require a fifth lane on the bridge to accommodate left-turn storage at the ramp intersections, as compared to a four-lane bridge for concept A. Signal timing at the ramp intersections may require four phases, whereas, the diverging diamond concept needs two signal phases.

The offset tight diamond concept increases spacing to the Barksdale Avenue intersection, grade-separates the railroad, increases the interchange spacing to the Center Drive Interchange, provides more storage space from the interchange to the relocated DuPont Gate, provides an opportunity for transit service at the Stone Station building, and increases the vertical clearance under the overpass. The existing interchange would be removed.

Figure VII-2: Steilacoom-DuPont Interchange - Concept A – Offset Diverging Diamond Interchange

Figure VII-3: Steilacoom-DuPont Interchange - Concept B – Offset Tight Diamond Interchange

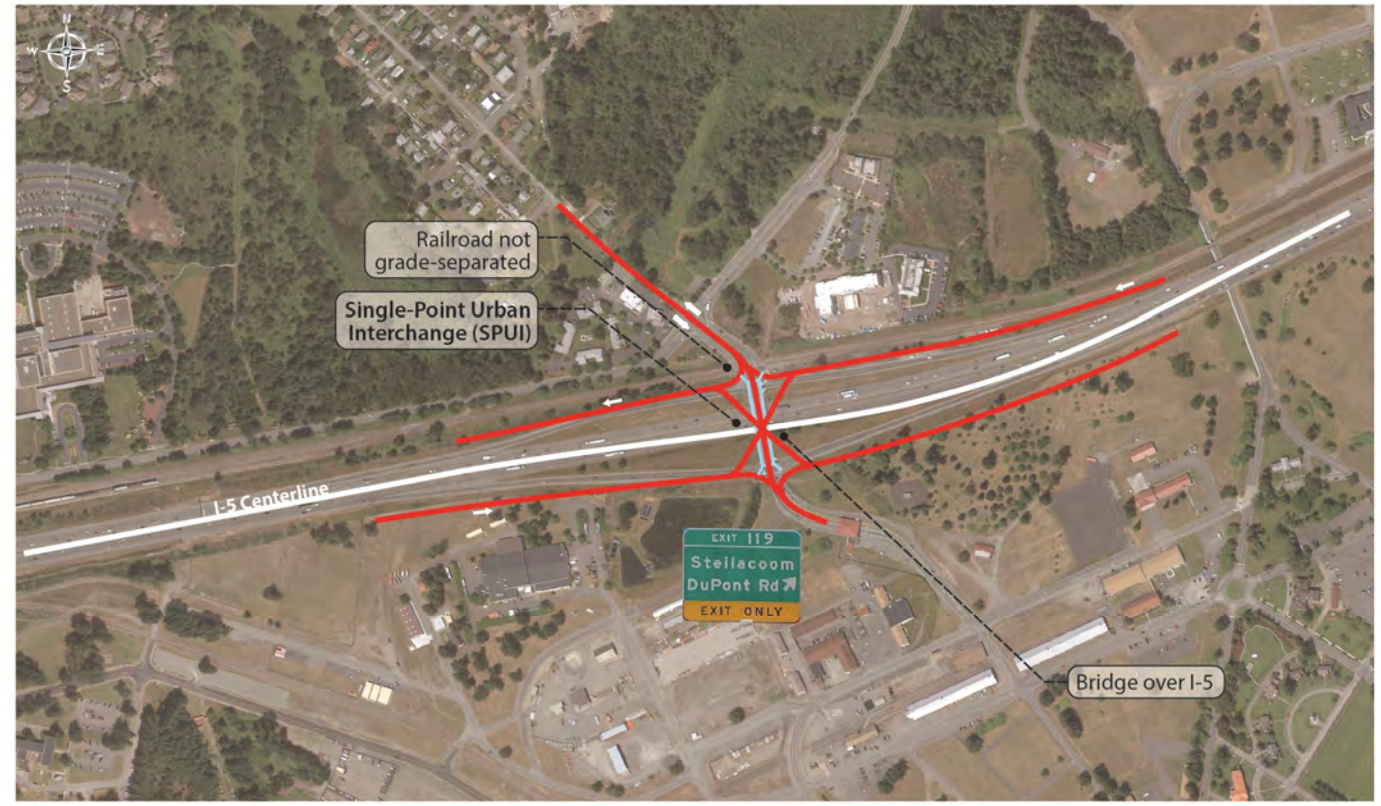


Concept C – Single Point Urban Interchange (SPUI)

The *I-5 Transportation Alternatives Report* recommended a SPUI concept, as shown in Figure VII-4, as one of the preferred interchange configurations for the Steilacoom-DuPont Road Interchange to be considered for additional evaluation. This concept widens Steilacoom-DuPont Road Interchange over I-5 to a five-lane cross section with bike lanes and sidewalks. The fifth lane provides storage area for left turns. This configuration consolidates ramp signals to one location for efficiency and somewhat increases the space between the I-5 ramp intersection and the Barksdale Avenue intersection.

It would maintain the current location of the interchange, the existing at-grade railroad crossing just west of the interchange, the existing minimum spacing with the Center Drive Interchange, and the new overpass would provide standard vertical clearance over I-5. With the widened I-5 lanes, this concept reduces the queue distance to the DuPont Gate to JBLM and it would be much more difficult to maintain existing traffic operations during construction.

Figure VII-4: Steilacoom-DuPont Interchange - Concept C – Single Point Urban Interchange (SPUI)



41st Division Drive/Main Gate Interchange (Exit 120)

The 41st Division/Main Gate Interchange is currently designed as a cloverleaf and only provides access to JBLM. It serves as the primary access to Lewis Main on the east side of I-5 and to the Lewis North area on the west side. 41st Division Drive crosses the railroad at-grade.

Interchange improvement concepts identified for further study at the 41st Division/Main Gate Interchange are summarized below.

Concept A – Cloverleaf Interchange with a Grade-Separated Southbound Off-ramp to Lewis North (41st Division Gate)

The *I-5 Transportation Alternatives Report* recommended a modified cloverleaf interchange, as shown in Figure VII-5. This concept realigns the northbound loop ramps to provide space for mainline widening and to provide more weaving distance between loop ramp junctions. It also provides a grade-separated southbound off-ramp to the Lewis North (41st Division) Gate to avoid traffic back-ups onto the at-grade railroad crossing. This also provides more queuing distance for drivers waiting to enter the Lewis North area.

The cloverleaf concept maintains existing gate operations, and somewhat improves access to Lewis North. However, it impacts JBLM housing, reduces the queue area to the Liberty Gate, and maintains the existing at-grade railroad crossings for 41st Division Drive.

Concept B – Diverging Diamond Interchange with a Realigned I-5 and a New Inter-Base Connection

This concept reconfigures the interchange into a diverging diamond configuration, as shown in Figure VII-6. It realigns and lowers I-5 to existing ground level, and raises 41st Division Drive over I-5. The 41st Division Drive ends just south of the railroad at the intersection of the southbound ramps. It also provides a grade-separated Inter-Base Connector road that connects to 16th Street, south of the interchange and to 41st Division Drive in the Lewis North area. The intersection of 41st Division Drive, Colorado Avenue and Ohio Avenue are redesigned as a multi-lane roundabout.

The diverging diamond concept simplifies the signal phasing at the I-5 ramp intersections, allows free right and left turns, and eliminates the need for a left-turn lane on the bridge over I-5. It eliminates the need for the 41st Division Gate and requires all persons to enter through the Liberty Gate. The new Inter-Base Connector allows cross base traffic free access without having to re-enter through one of the gates. It eliminates the at-grade railroad crossing, provides more queue space on the south side of the interchange, and provides an opportunity for a transit drop-off area outside the gate. However, it may require modifications to Liberty Gate. Operational modeling during Phase 2 will evaluate the functionality of the single gate as well as the multi-lane roundabout at Colorado Avenue.

Figure VII-5: Main Gate Interchange - Concept A – Cloverleaf Interchange with Grade-Separated SB Off-Ramp

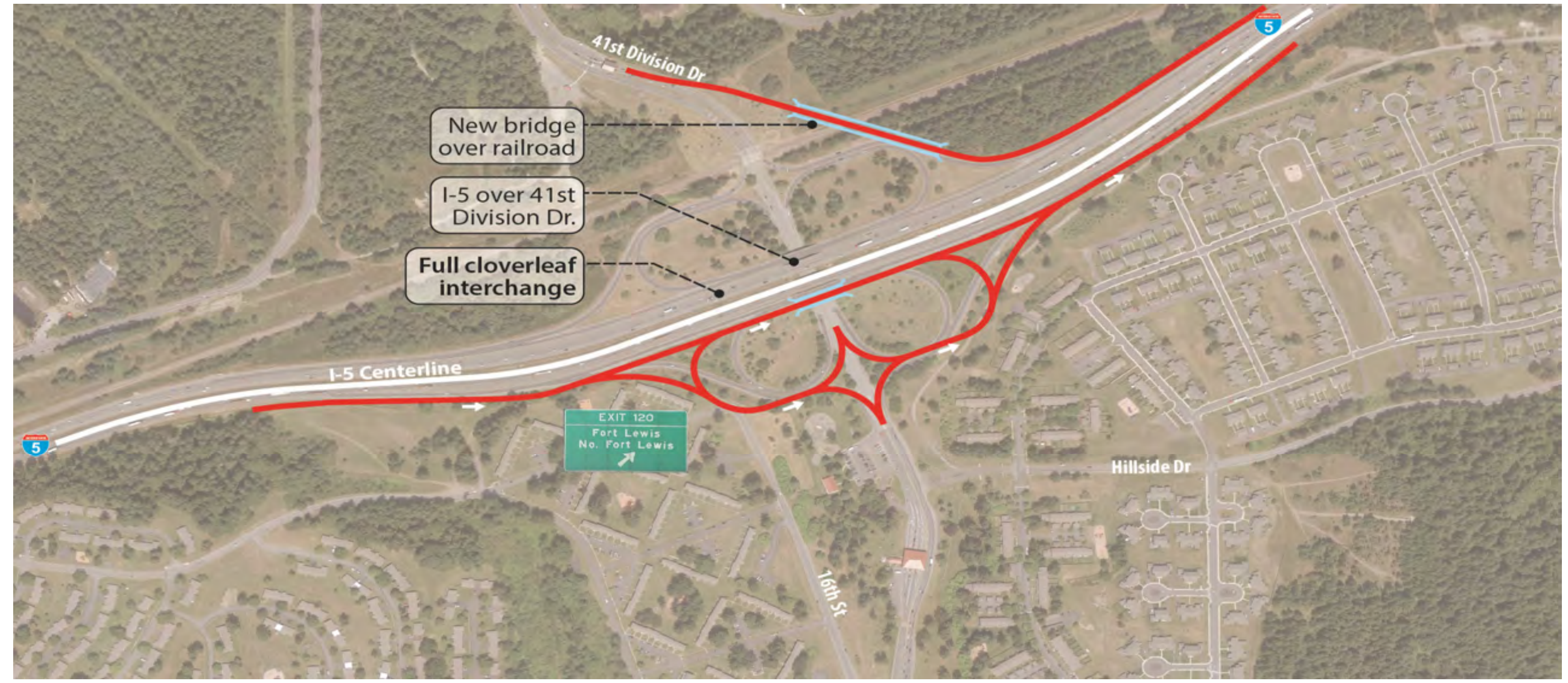
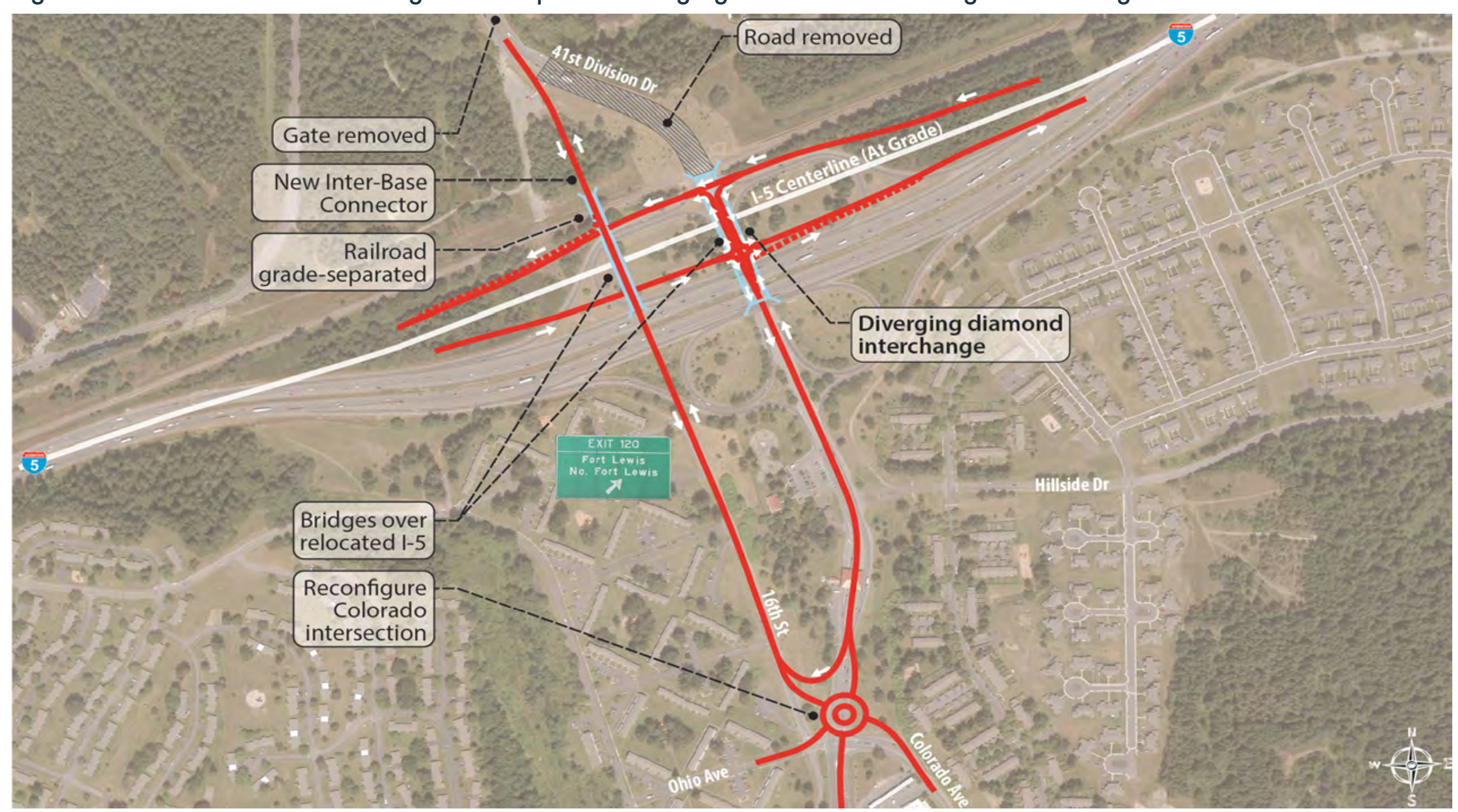


Figure: VII-6: Main Gate Interchange - Concept B – Diverging Diamond Interchange with Realigned I-5 and Inter-Base Connection



Concept C – Tight Diamond Interchange with a Realigned I-5 and a New Inter-Base Connection

This concept reconfigures the interchange into a tight diamond configuration, as shown in Figure VII-7. Other features are the same as discussed for Concept B.

Concept D – Tight Diamond Interchange with a Realigned I-5 and a New Inter-Base Connection and Maintains Both Existing Gates

Concept D is similar to Concept C except that it maintains the 41st Division Gate, and extends 41st Division Drive over the railroad from the interchange to the gate. The grade-separated Inter-Base Connector is shifted south to provide clearance for the south side ramps from the higher 41st Division Drive bridge over the railroad.

This concept maintains the need for the 41st Division Gate and separates traffic destined to the Lewis North traffic from the Liberty Gate. This concept requires two grade separations to eliminate the at-grade railroad crossing. Other features are the same as discussed for Concept B.

Figure VII-7: Main Gate Interchange - Concept C – Tight Diamond Interchange with Realigned I-5 and Inter-Base Connection with Both Existing Gates

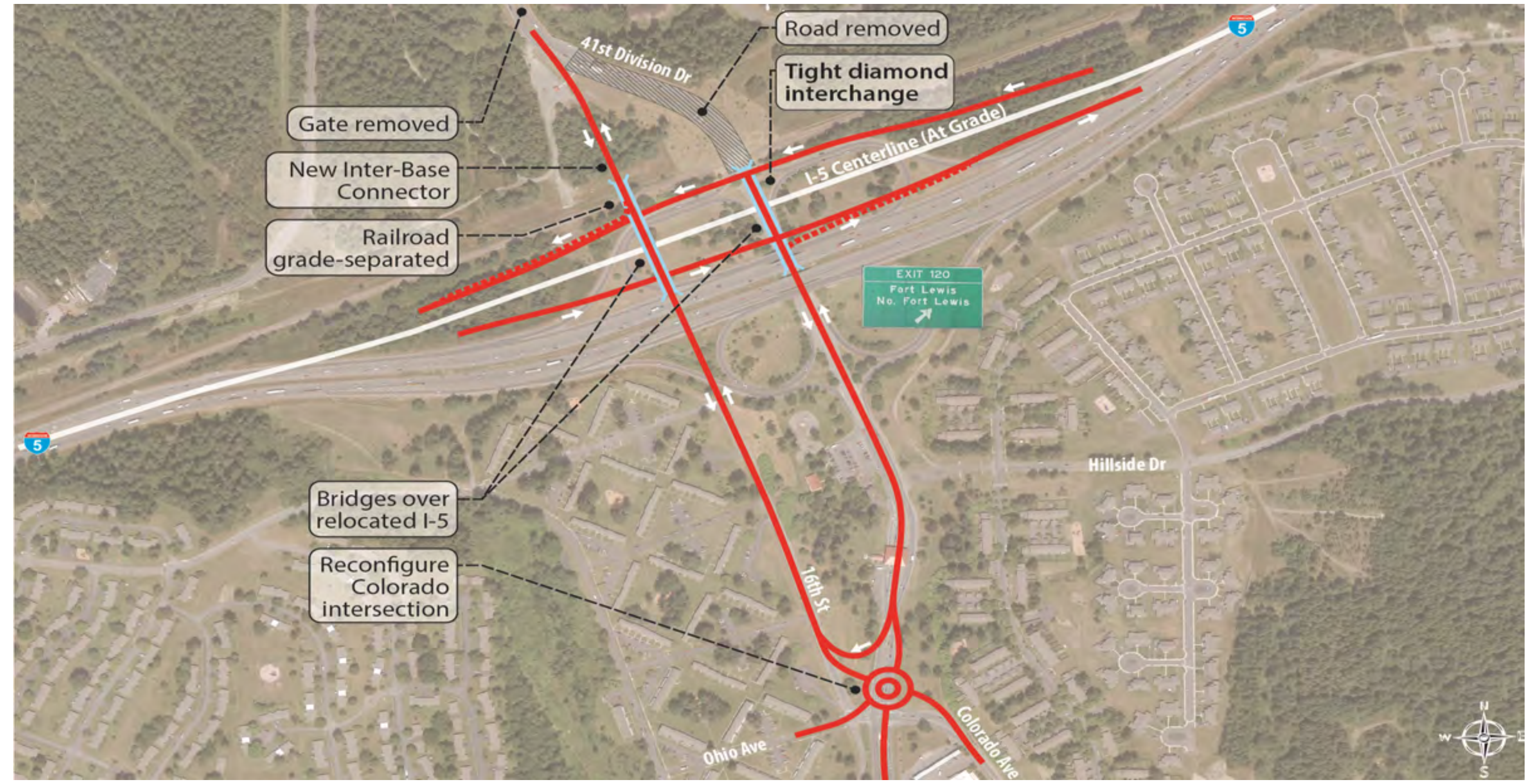
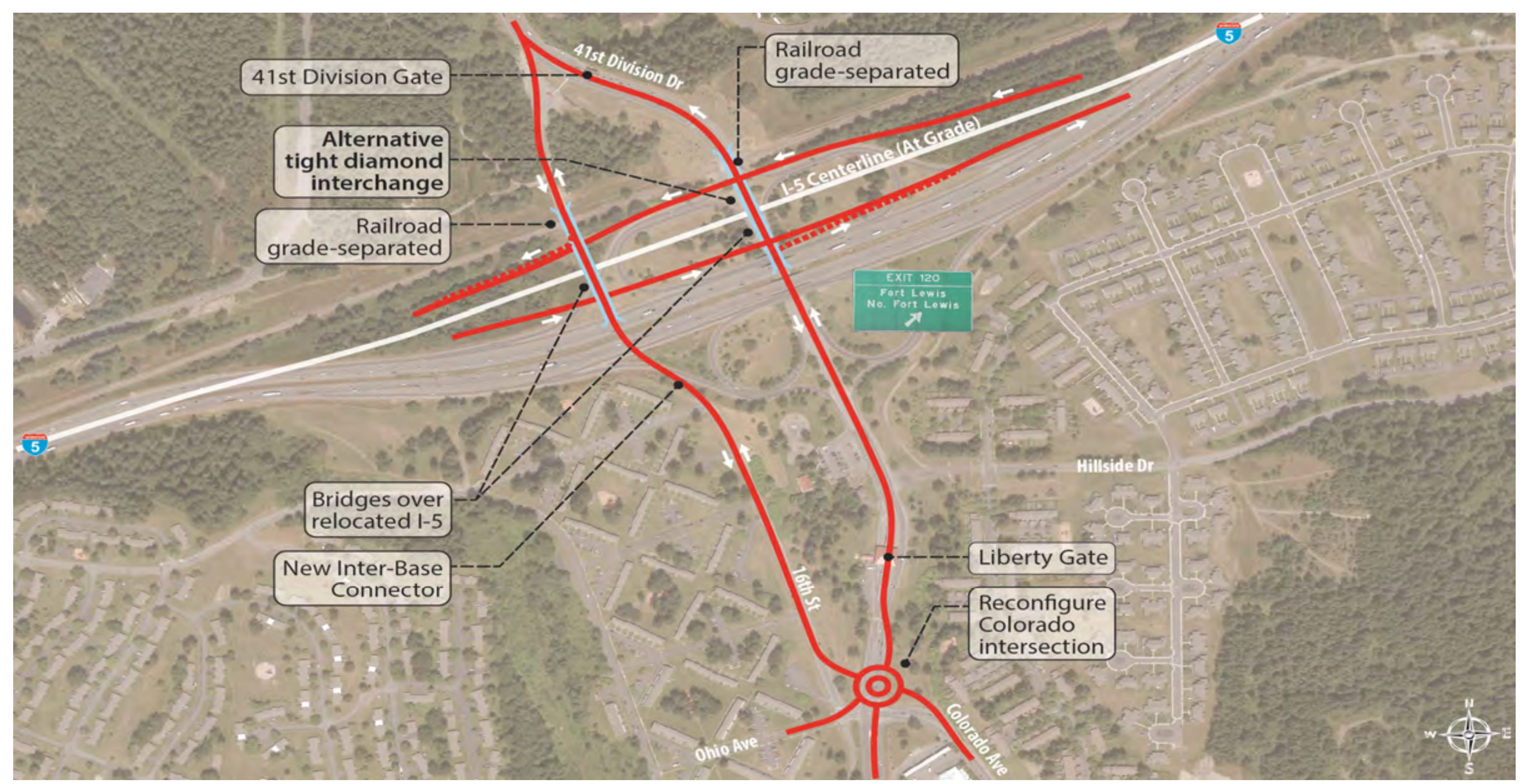


Figure VII-8: Main Gate Interchange - Concept D – Tight Diamond Interchange with Realigned I-5 and Inter-Base Connection with Lewis North



Berkeley Street Interchange (Exit 122)

The Berkeley Street Interchange provides access to the Tillicum neighborhood and Camp Murray on the west side of I-5. East of the freeway, Berkeley Street becomes Jackson Avenue and provides access to JBLM through the Madigan Gate.

Interchange improvement concepts identified for further study at the Berkeley Street Interchange are summarized below.

Concept A – Tight Diamond Interchange

This concept maintains the existing tight diamond interchange configuration, as shown in Figure VII-9. Berkeley Street is widened to a five-lane cross section over I-5 with bike lanes and sidewalks. The fifth lane provides storage area for left turns.

This concept would maintain the existing at-grade railroad crossing just west of the interchange, and the existing interchange spacing with the Thorne Lane Interchange. It provides more capacity for traffic crossing I-5 and more capacity for turning vehicles.

To allow for widening of the I-5 mainline, the northbound ramp terminal intersection moves towards the Madigan Gate. This would reduce the storage area for queues at the gate.

Concept B – Single Point Urban Interchange (SPUI)

The *I-5 Transportation Alternatives Report* recommended a SPUI as one of the preferred interchange configurations for the Berkeley Street Interchange, as shown in Figure VII-10. This configuration consolidates ramp signals to one location for efficiency and increases the space between the interchange ramp intersection and the Union Avenue Intersection. The Berkeley Street overpass is widened to a five-lane cross section with bike lanes and sidewalks. The fifth lane provides storage area for left-turns.

This concept would maintain the existing at-grade railroad crossing just west of the interchange, and the existing interchange spacing with the Thorne Lane Interchange. It also increases the intersection spacing to the Berkeley Street/Union Avenue intersection.

Figure VII-9: Berkeley Street Interchange – Concept A – Tight Diamond Interchange

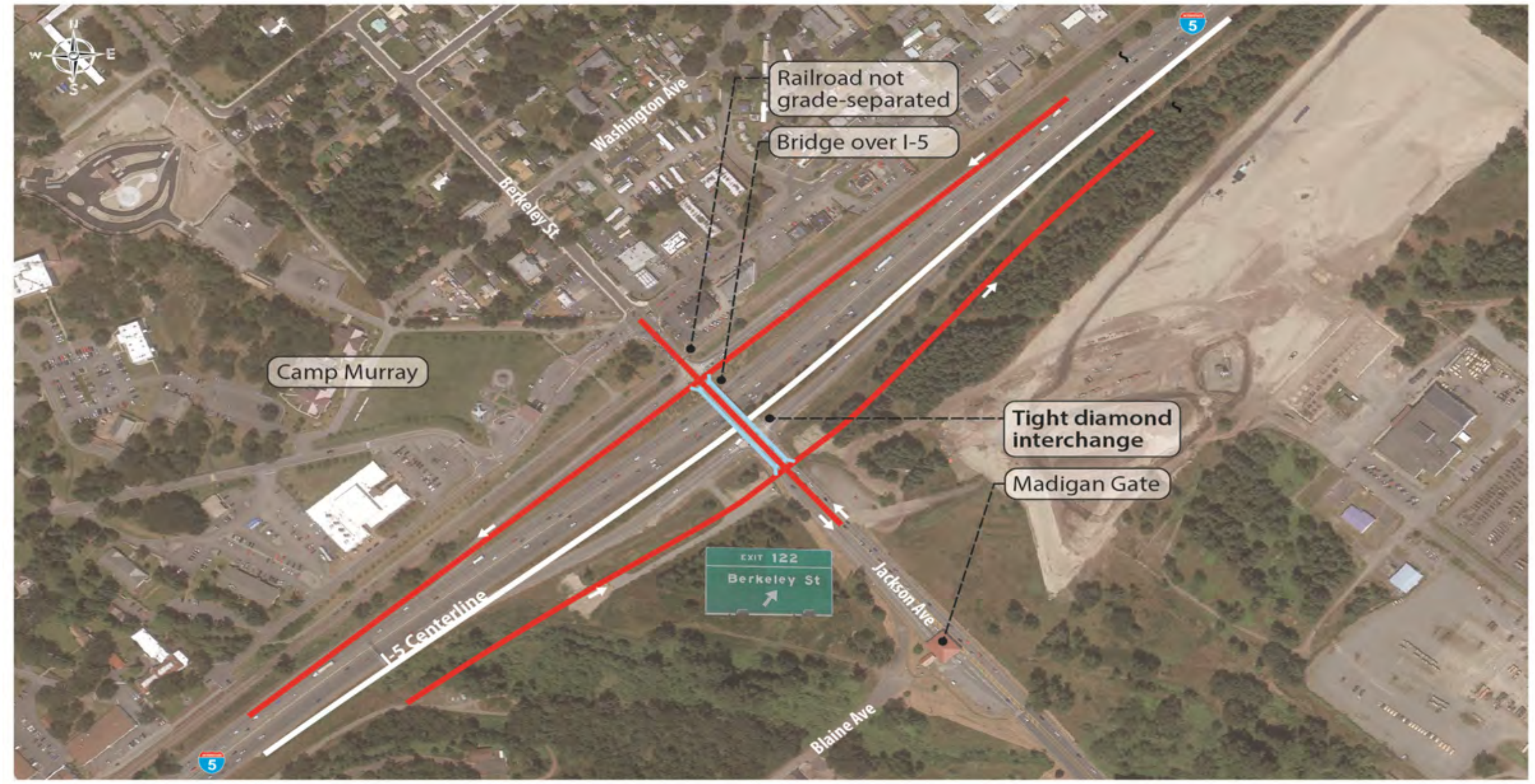
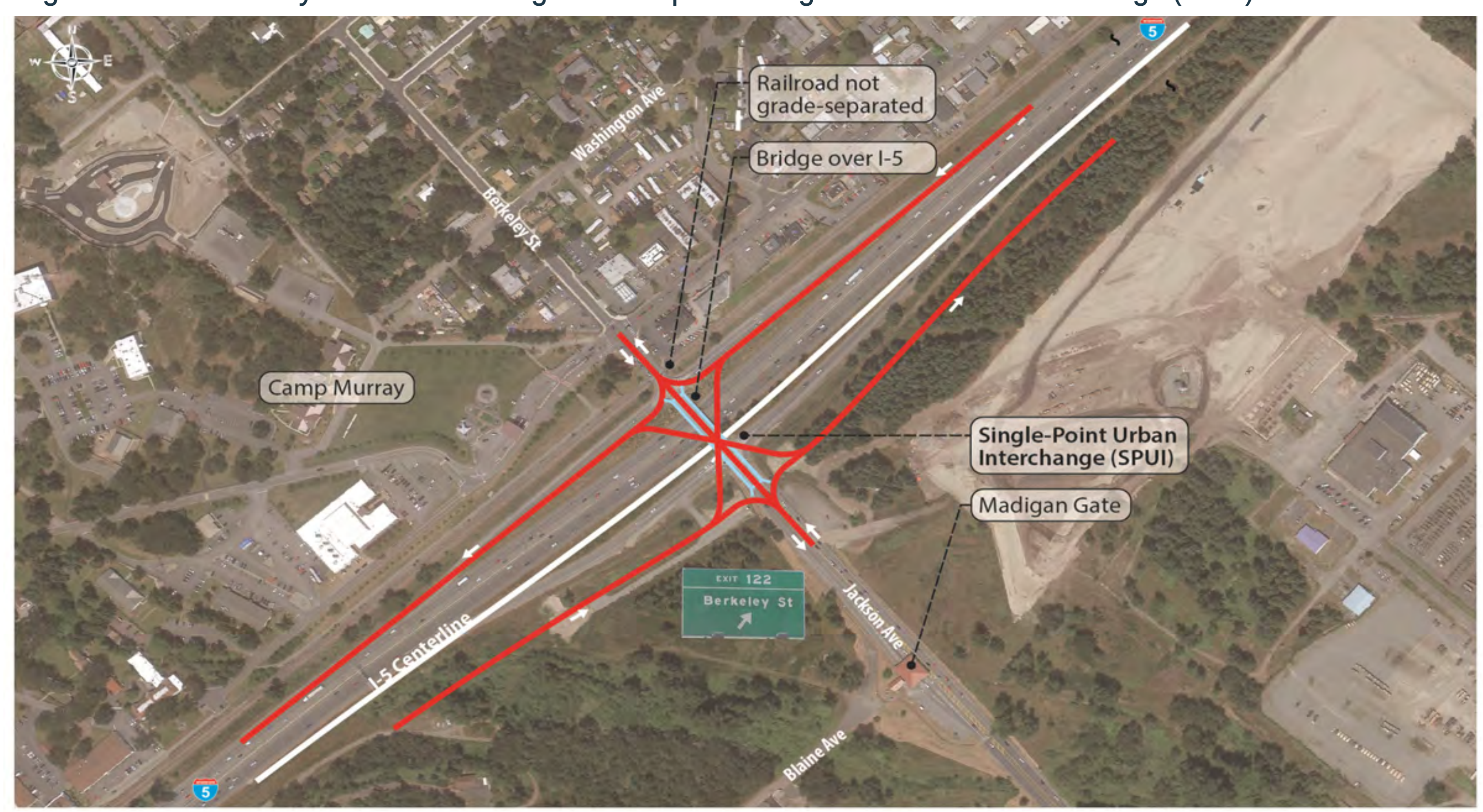


Figure VII-10: Berkeley Street Interchange - Concept B – Single Point Urban Interchange (SPUI)



Thorne Lane Interchange (Exit 123)

West of I-5 Thorne Lane accesses the Tillicum neighborhood. East of the freeway, Thorne Lane becomes Murray Road and accesses a small portion of the City of Lakewood east of I-5 and the Logistics Gate to JBLM.

Interchange improvement concepts identified for further study at the Thorne Lane Interchange are summarized below.

Concept A – Offset Diverging Diamond Interchange

This offset diverging diamond concept, as shown in Figure VII-11, grade-separates Thorne Lane over the railroad and Union Avenue. Thorne Lane is widened to a four-lane cross section. The interchange is shifted approximately 300 feet south to better align with Murray Road on the south side of I-5. A new loop road is added to provide access to Union Avenue. This concept will reduce the interchange spacing with the Berkeley Street Interchange.

The offset diverging diamond concept will simplify the signal phases at the ramp intersections and provide free left and right turning movements. It eliminates the at-grade railroad crossing and provides more capacity for crossing and turning traffic. It may impact the existing stormwater facility and would impact wetland areas on both sides of I-5. Impacts to JBLM's leased housing area are likely although these impacts might be reduced with large retaining walls.

Concept B – Offset Tight Diamond Interchange

This concept is the same as Concept A, but maintains the existing tight diamond configuration, as shown in Figure VII-12. The primary difference between the two concepts is Thorne Lane would be widened over I-5 to a five-lane cross section to provide storage area for left turns. All other design elements are the same.

This concept also eliminates the at-grade railroad crossing and provides more capacity for crossing and turning traffic. It will impact wetland areas on both sides of I-5. Impacts to JBLM's leased housing area are likely although these impacts might be reduced with large retaining walls.

Figure VII-11: Thorne Lane Interchange - Concept A – Offset Diverging Diamond Interchange

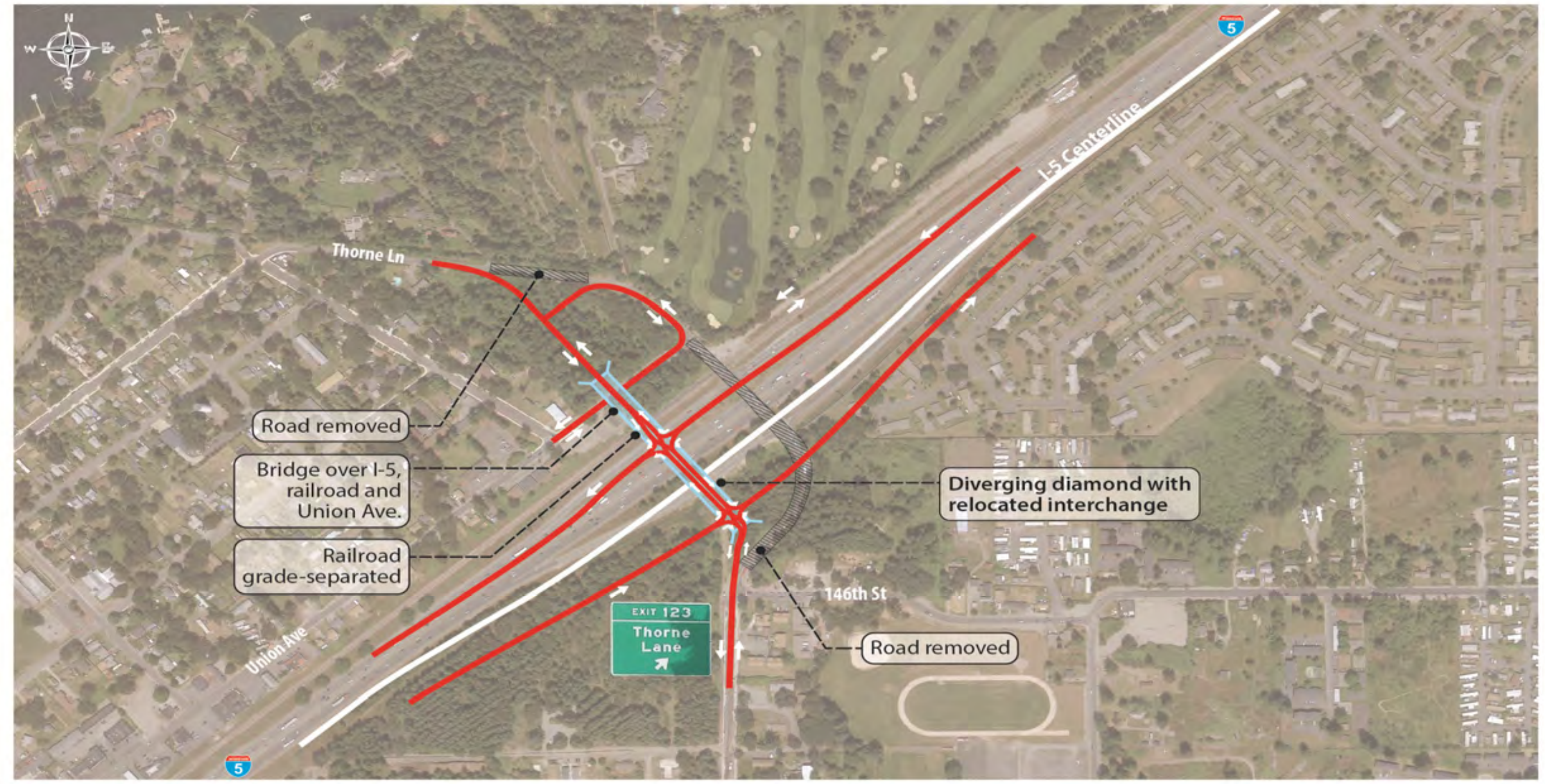
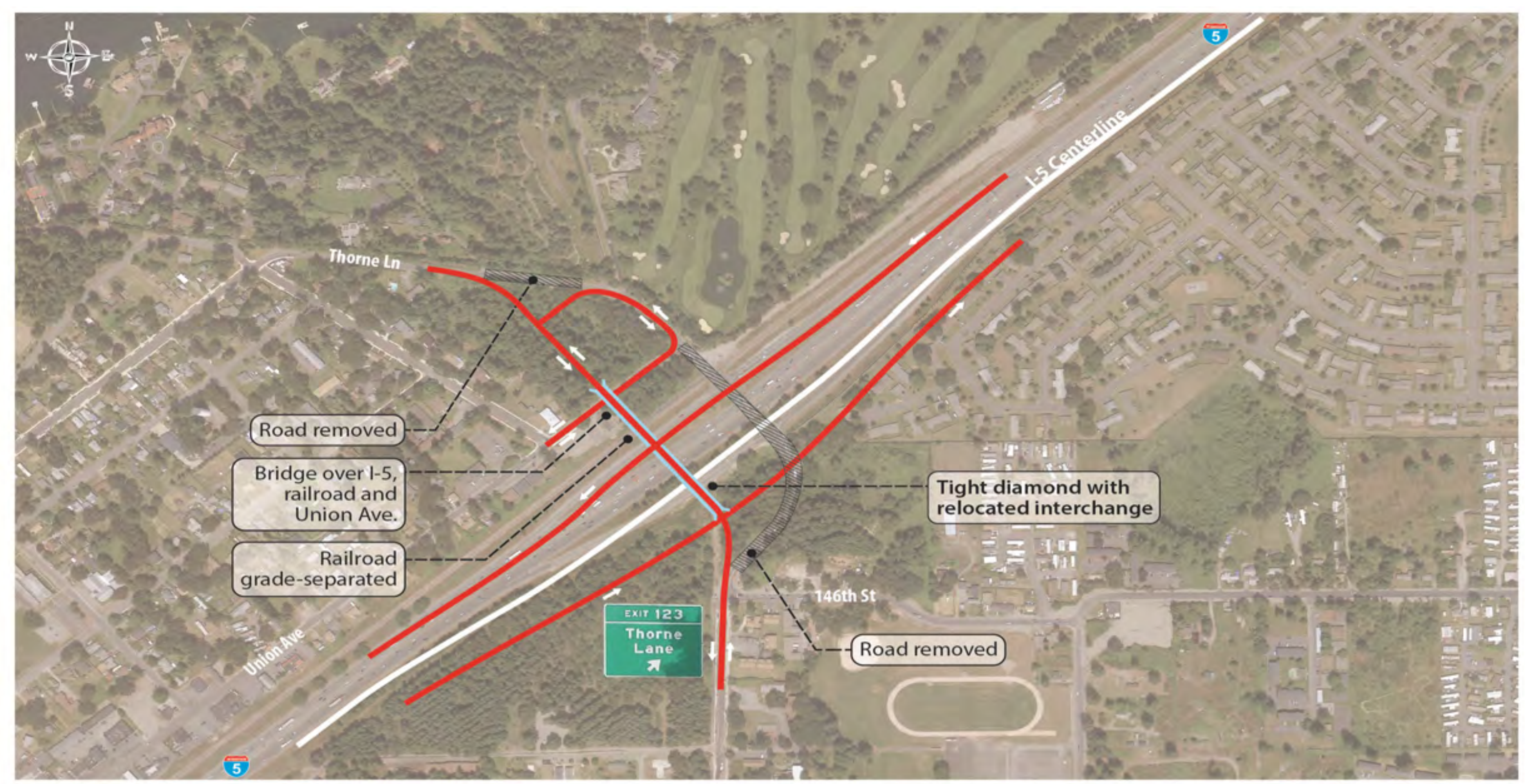


Figure VII-12: Thorne Lane Interchange - Concept B – Offset Tight Diamond Interchange

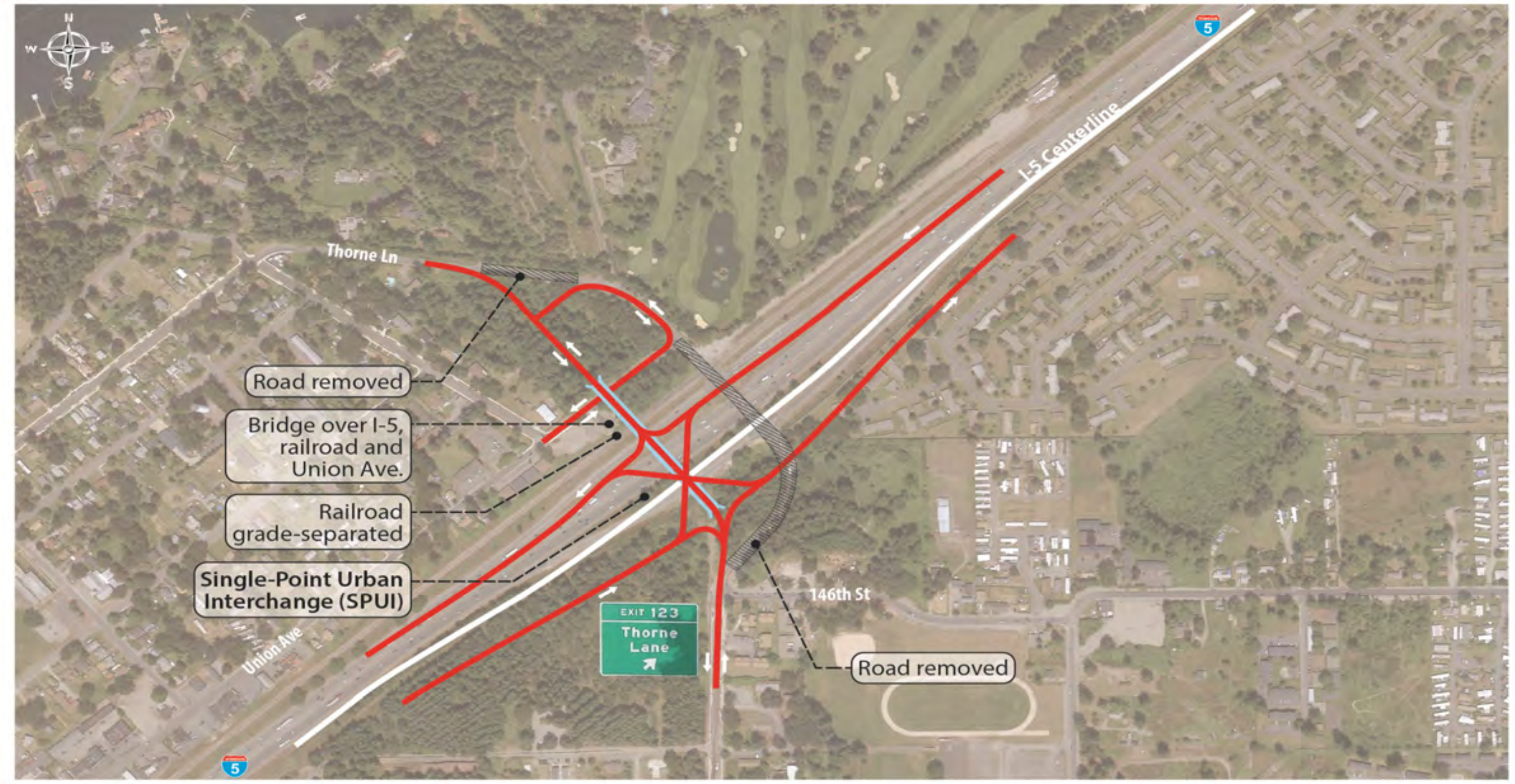


Concept C – Offset Single Point Urban Interchange (SPUI)

The *I-5 Transportation Alternatives Report* recommended a SPUI as one of the preferred interchange configurations for the Thorne Lane Interchange, as shown in Figure VII-13. Like the previous concepts, the SPUI concept grade-separates Thorne Lane over the railroad and Union Avenue. Thorne Lane is widened to a five-lane cross section over I-5 with bike lanes and sidewalks. The fifth lane provides storage area for left-turns. The new interchange is shifted approximately 300 feet south to better align with Murray Road on the south side of I-5.

This configuration consolidates ramp signals to one location for efficiency and provides more capacity and storage for crossing and turning traffic. A new loop road is added to provide access to Union Avenue. This concept also will reduce the interchange spacing with the Berkeley Street Interchange. Impacts to JBLM's leased housing area are likely although these impacts might be reduced with retaining walls.

Figure VII-13: Thorne Lane Interchange - Concept C – Offset Single Point Urban Interchange (SPUI)



Summary Interchange Conceptual Review

A summary of the conceptual findings for the optional interchange improvements for the four focus interchanges is shown on Table VII-1. The key issues and opportunities for each interchange concept are summarized by the following three categories:

- Mobility
- Environmental
- JBLM Access

These concepts will be further evaluated as part of the IJR process.

Table VII-1: Summary of Interchange Conceptual Review Findings

Interchange Option	Description	Mobility		Environmental		JBLM Access	
		Issues	Opportunities	Issues	Opportunities	Issues	Opportunities
Steilacoom-DuPont Road Interchange Concept A	Concept A – Offset Diverging Diamond Interchange over I-5 located north of existing interchange 	• Alters routing/access to commercial properties • Changes local street connections	• Simplifies signal phasing and allows free left and right turns • Grade separates over the railroad • Improves spacing to the Barksdale intersection • Addresses the northbound off ramp queue to JBLM • Increases the spacing to the Center Drive I/C • Offset interchange reduces mobility impacts during construction • Improves vertical clearance under the overpass	• Impacts wetlands • Moves ramps away from commercial areas • Impacts JBLM historic district/memorial groves • Runs near an historic building and the emergency services facility • Improve vertical clearance under overpass	• Simplifies construction (built offset)	• Requires coordination with JBLM gate relocation	• Provides opportunities to improve gate entry • Provides an opportunity to increase I-5 clearance over Pendleton Avenue • Increases gate queuing capacity
Steilacoom-DuPont Road Interchange Concept B	Concept B – Offset Tight Diamond Interchange over I-5 located north of existing interchange 	• Alters routing/access to commercial properties • Changes local street connections	• Grade separates over the railroad • Improves spacing to the Barksdale intersection • Addresses the northbound off ramp queue to JBLM • Increases the spacing to the Center Drive I/C • Offset interchange reduces mobility impacts during construction • Improves vertical clearance under the overpass	• Impacts wetlands • Moves ramps away from commercial areas • Impacts JBLM historic district/memorial groves • Runs near an historic building and the emergency services facility • Improve vertical clearance under overpass	• Simplifies construction (built offset)	• Requires coordination with JBLM gate relocation	• Provides opportunities to improve gate entry • Provides an opportunity to increase I-5 clearance over Pendleton Avenue • Increases gate queuing capacity
Steilacoom-DuPont Road Interchange Concept C	Concept C - Single Point Urban Interchange (SPUI) over I-5 	• Does not grade separate the railroad • Crosses the railroad on a curve • Does not improve close spacing of interchanges	• Consolidates ramp terminals to one signal • Slightly increases spacing to Barksdale intersection • Improves vertical clearance under the overpass	• Complicates construction (built on existing footprint) • May impact drainage ponds to the southwest • May impact memorial groves • Improve vertical clearance under overpass	• Likely does not impact wetlands	• Requires coordination with JBLM gate relocation	
Main Gate Interchange Concept A	Concept A – Cloverleaf Interchange with rebuilt northbound ramps and grade separated southbound off ramp 	• Does not improve weave for southbound ramps • Does not grade separate the railroad • Reduces space for the Liberty Gate queue	• Increases weave distance for northbound ramps • Reduces traffic crossing the railroad at-grade • Addresses the SB off ramp queue to Lewis North	• Impacts leased housing area (land/buildings) • Moves noise source closer to JBLM		• Does not improve gate operations • Does not enhance inter-base circulation	• Improves access to Lewis North from southbound I-5
Main Gate Interchange Concept B	Concept B – Diverging Diamond Interchange over a realigned I-5 with inter-base street connection via bridge over I-5 		• Simplifies signal phasing and allows free left and right turns • Eliminates at-grade rail crossing for the interchange • Provides space for possible transit facilities • Removes inter-base traffic from the interchange • Addresses the SB off ramp queue to Lewis North	• Impacts airspace clearance • Increases traffic adjacent to JBLM housing	• Moves I-5 and ramps away from JBLM housing • May provide space for storm water facilities • Reduces noise levels for adjacent residences • Avoids impacts to leased housing areas	• Requires modifications to Liberty Gate	• Eliminates 41st Division Gate • Enhances inter-base circulation across I-5 • Increases Liberty Gate queuing capacity

Table VII-1: Summary of Interchange Conceptual Review Findings Continued

Interchange Option	Description		Mobility		Environmental		JBLM Access	
			Issues	Opportunities	Issues	Opportunities	Issues	Opportunities
Main Gate Interchange Concept C	Concept C – Tight Diamond Interchange over a realigned I-5 with inter-base street connection via bridge over I-5			• Eliminates at-grade rail crossing for the interchange • Provides space for possible transit facilities • Removes inter-base traffic from the interchange • Addresses the SB off ramp queue to Lewis North	• May impact airspace clearance • Increases traffic adjacent to JBLM housing	• Moves I-5 and ramps away from JBLM housing • May provide space for storm water facilities • Reduces noise levels for adjacent residences • Avoids impacts to leased housing areas	• Requires modifications to Liberty Gate	• Eliminates 41st Division Gate • Enhances inter-base circulation across I-5 • Increases Liberty Gate queuing capacity
Main Gate Interchange Concept D	Concept D – Tight Diamond over a realigned I-5 with inter-base street connection via bridge over I-5		• May require 8-10% grade on ramps to the south to pass under new cross base connector and tie in to 41st Division Drive • Requires second grade separated bridge over railroad • Does not address queue to Lewis North	• Eliminates at-grade rail crossing for the interchange • Provides space for possible transit facilities • Removes inter-base traffic from the interchange	• May impact airspace clearance • Increases traffic adjacent to JBLM housing	• Moves I-5 and ramps away from JBLM housing • May provide space for storm water facilities • Reduces noise levels for adjacent residences • Avoids impacts to leased housing areas	• Requires modifications to Liberty Gate. • May require relocation of 41st Division gate • Requires continued operation of two gates	• Enhances inter-base circulation across I-5 • May increase Liberty Gate queuing
Berkeley Street Interchange Concept A	Concept A - Tight Diamond Interchange over I-5		• Does not grade separate the railroad	• Operates acceptably in the opening year • May operate acceptably in the design year (2040) • Improves vertical clearance over I-5	• May impact Murray Creek	• Simplifies the bridge and reduces structures costs		
Berkeley Street Interchange Concept B	Concept B - SPUI over I-5		• Does not grade separate the railroad	• Consolidates ramp terminals to one signal • Improves spacing to the Union intersection • Improves vertical clearance over I-5	• Complicates bridge design and increases costs • May impact Murray Creek			

Table VII-1: Summary of Interchange Conceptual Review Findings Continued

Interchange Option	Description	Mobility Issues	Mobility Opportunities	Environmental Issues	Environmental Opportunities	JBLM Access Issues	JBLM Access Opportunities
Thorne Lane Interchange Concept A	Concept A – Offset Diverging Diamond Interchange over I-5 with grade separation over the railroad 	• Requires loop road back to Union Avenue	• Simplifies signal phasing and allows free left and right turns • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange reduces mobility impacts during construction • Improves vertical clearance over I-5	• Impacts wetlands		• Requires realignment of Murray Road • May impact JBLM stormwater facility on west side of I-5	
Thorne Lane Interchange Concept B	Concept B – Offset Tight Diamond Interchange over I-5 with grade separation over the railroad 	• Requires loop road back to Union Avenue	• May operate acceptably in the design year. • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange reduces mobility impacts during construction • Improves vertical clearance over I-5	• Impacts wetlands		• Requires realignment of Murray Road • May impact JBLM stormwater facility on west side of I-5	
Thorne Lane Interchange Concept C	Concept C – Offset SPUI over I-5 with grade separation over the railroad 	• Requires loop road back to Union Avenue	• Consolidates ramp terminals to one signal • Grade separates over the railroad • Does not preclude possible Cross-Base Highway • Offset interchange improves mobility during construction • Improves vertical clearance over I-5	• Complicates bridge design and increases costs • Impacts wetlands		• Requires realignment of Murray Road • May impact JBLM stormwater facility on west side of I-5	

Other Interchange Concepts Considered but Rejected

Other interchange concepts were considered but rejected as part of this conceptual review for the Steilacoom-DuPont Road Interchange, Main Gate Interchange and Thorne Lane Interchange. These rejected concepts are summarized below:

- Steilacoom-DuPont Road Interchange Concept D – This concept replaces the existing interchange with a new JBLM-only tight diamond interchange over I-5 located north of the existing interchange between West Way and Main Street, while maintaining the existing Steilacoom-DuPont overpass without ramps, as shown in Figure VII-14.

  This concept was rejected because:

  - It is only connected from the interstate to internal JBLM roads.
  - It does not provide public access to the Town of Steilacoom or the City of DuPont.
  - It requires two new gates be located on the new alignment to process vehicle traffic from I-5.
  - It forces all Steilacoom and DuPont traffic through Center Drive Interchange.
  - It impacts wetland areas near the JBLM dog daycare.
  - It is not conducive to allowing traffic circulation to the new Wharf Gate.

- Main Gate Interchange Concept E – Modified cloverleaf interchange with revised routing using the existing interchange, as shown in Figure VII-15.

  This concept was rejected because:

  - All southbound I-5 traffic to Lewis North is moved to the mainline merge-weave, reducing mainline speeds.
  - Northbound traffic to Lewis North is likely to queue onto I-5 with all Lewis North traffic now in the Liberty Gate queue.
  - Northbound traffic exiting by mistake must go through the JBLM security gate to return to I-5.
  - It does not account for widening I-5 to five-lanes in each direction.
  - All traffic in and out of Lewis North crosses the railroad at-grade.
  - All traffic between gates must continue to go through both gates.
  - All traffic to the visitor center must go through gate because of barrier separating traffic.

- Thorne Lane Interchange Concept D – Tight diamond interchange over I-5 with grade separation over the railroad and connection to Spruce Street, as shown in Figure VII-16.

  This concept was rejected because:

  - It connects to a two-lane residential street.
  - It has high residential impact.
  - It impacts the local circulation system.
  - It closes city street access to residential properties.
  - It is not consistent with the possible Cross Base Highway.
  - It impacts residential properties along Spruce Street.
  - It requires realignment of Murray Road.
  - It requires a new signal at the 146th/Murray Road intersection.

Figure VII-14: Steilacoom-DuPont Interchange - Concept D – Relocated Tight Diamond Interchange

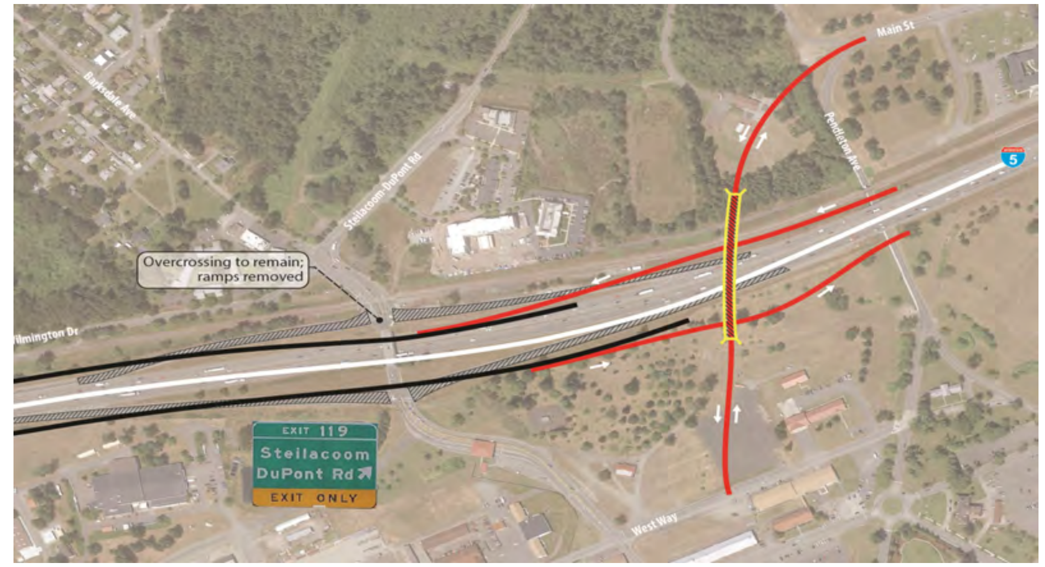


Figure VII-15: Main Gate Interchange - Concept E – Modified Cloverleaf Interchange

Figure VII-16: Thorne Lane Interchange - Concept D – Relocated Tight Diamond Interchange

VIII. Environmental Scan Summary

An environmental scan was performed as part of the *Corridor Plan Feasibility Study* and included the following disciplines:

- Wetlands streams and listed species
- Groundwater, surface water and floodplain
- Hazardous materials
- Cultural resources and section 4(f) and 6(f)
- Air quality, and noise
- Socioeconomic and environmental justice
- Geology and soils

Existing documentation used in this scan included GIS data, construction as-built documents, environmental reports, surveys, and maps from sources such as City of Lakewood, Pierce County, JBLM, WSDOT, and federal agencies such as U.S. Fish and Wildlife Service, the Federal Emergency Management Agency, and the Environmental Protection Agency. This data was reviewed and used to summarize the study area existing environmental conditions. Field visits were performed for the wetland and stream reconnaissance, the federal and state listed species and priority habitats scan, and the geology and soils scan. Impacts associated with the mainline scenarios were then evaluated for each environmental discipline. Figure VIII-1 shows the cross sections widths of each of the mainline scenarios. The following is a summary of the environmental scans completed.

Existing Environmental Conditions

A description of the existing environmental conditions along the I-5 corridor through the study area is presented below by discipline. See Figures VIII-8 through VIII-13 for graphics addressing each element.

Wetlands, Streams and Listed Species

The wetland and stream reconnaissance identified twelve potential wetlands and two potential streams within the study area. The wetlands were given a preliminary categorization and streams were identified by their stream type. Impacts to these natural resources will be greatest at the Thorne Lane interchange, at the Murray Creek stream crossing (see Figure VIII-2), and potentially at the Steilacoom-DuPont interchange. As individual projects identified during Phase 2 advance towards construction, wetland delineations and final categorizations will need to be performed as part of the permitting process. Mitigation will be needed to offset impacts to wetlands and streams.

Several federally listed species, such as Taylor's checkerspot butterfly, the streak horned lark, Roy prairie pocket gopher, Western gray squirrel, and white-top aster are found in the project vicinity and may occur within the project area. A peregrine falcon nest has been documented within the study area but will not be directly impacted. As projects advance, species surveys will be completed for those species with the potential to occur within the study area. As part of the NEPA review process a biological assessment will be completed for Endangered Species Act review.

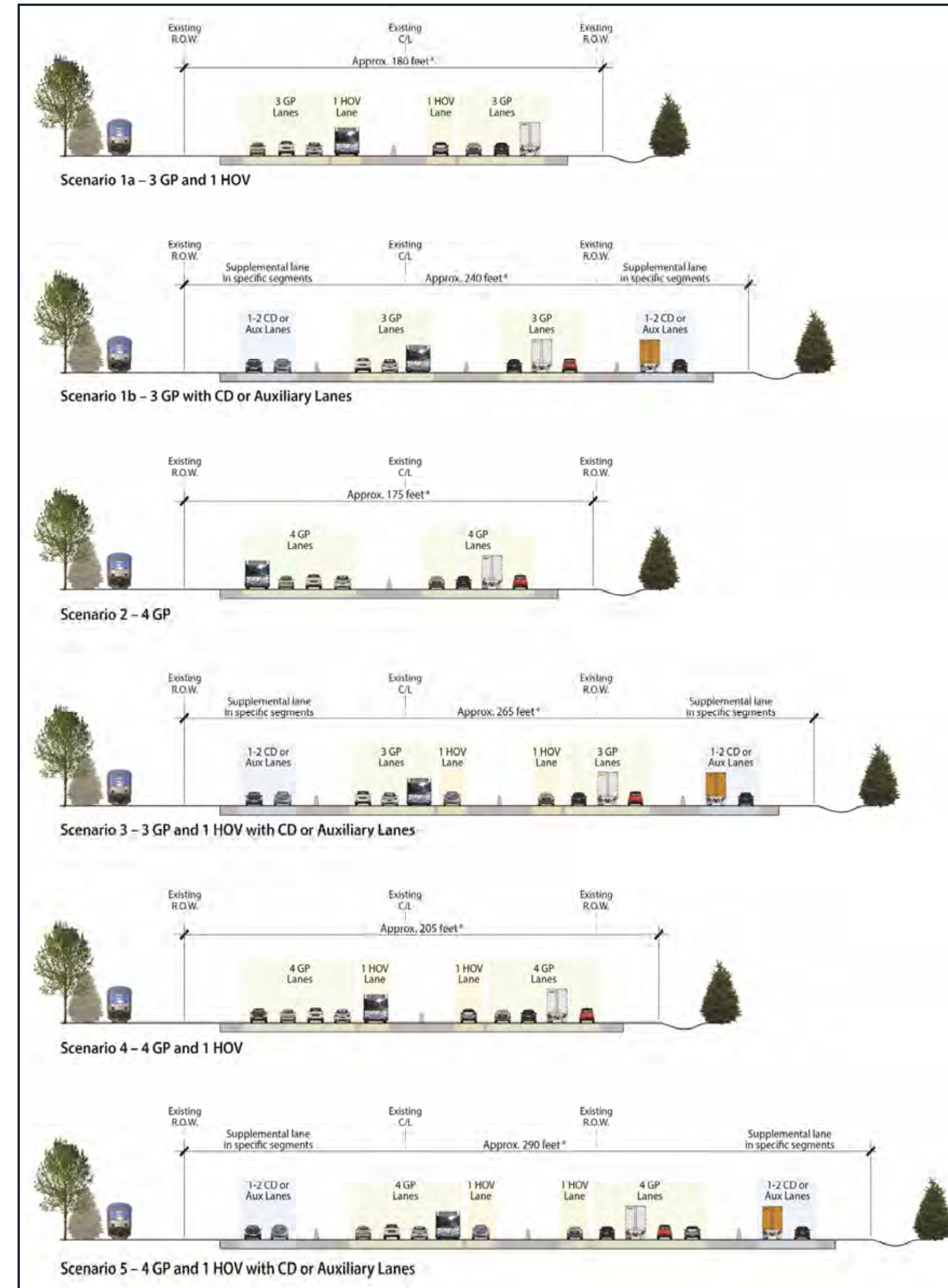
Groundwater, Surface Water and Floodplains

Thousands of groundwater wells are located within the vicinity of the study area. Of those, 55 are Class A and B water supply sources. One water supply well will require relocation or replacement due to impacts for all mainline scenarios. Approximately 9 to 17 monitoring wells may be directly impacted, depending on the scenario selected. The main risk to ground water resources stems from the risk of spills of hazardous material on the interstate or during construction.

Stormwater design will be developed as projects advance. It is assumed projects will be designed to current WSDOT Highway Runoff Manual standards and therefore impacts to water quality and quantity from surface water runoff will be minor.

Figure VIII-2: Murray Creek and Wetland Area South of Berkeley Street

Figure VIII-1: I-5 Mainline Improvement Scenarios



* These distances indicate approximate roadway prisms and do not include areas for stormwater management, clear zone, and other roadside features.

Floodplains are mapped in three locations along the I-5 corridor within the study area. At the Murray Creek crossing the project footprint is within the 100-year floodplain and all of the scenarios have varying degrees of floodplain impact, depending on the width of each mainline scenario. At the Thorne Lane interchange, the wetlands were mapped as part of the 500-year flood hazard areas (see Figure VIII-3). Floodplain impacts will also occur at the Thorne Lane interchange because of anticipated wetland fills. At the Steilacoom-DuPont interchange floodplains are mapped in association with the Bell Marsh wetland system. Depending on what interchange improvements are selected for that area, wetland impacts may occur, and associated floodplain impacts will also have to be addressed in phase 2.

Figure VIII-3: Wetland Area at Thorne Lane Interchange

Hazardous Materials

The review of documented hazardous materials identified 51 sites within a 1-mile radius of the I-5 corridor within the study area with the potential for the presence of hazardous materials and/or hazardous waste. Twenty of those sites have the potential to impact construction. The site with the largest potential impact is a set of infiltration galleries associated with a JBLM pump-and-treat system located north of the Berkeley interchange on JBLM property near the southeasterly I-5 right of way line. During construction, the galleries will have to be relocated southeast in coordination with JBLM.

In Phase 2, an environmental site assessment will need to be completed that identifies all of the potential or known contamination. During construction, any contamination encountered would need to be treated and disposed of appropriately.

Cultural Resources and Section 4(f), 6(f)

The environmental scan reviewed the known locations of cultural and historical resources located along the I-5 corridor within the study area and assessed whether USDOT Act of 1966 Section 4f and Land and Water Conservation Funds Act Section 6f lands are located within the study area. Based on this review, no Section 6f lands are located near the study area. Lewis Park (see Figure VIII-4) is considered a Section 4f land and under all the interchange improvements considered at the Main Gate, direct impacts are anticipated along the perimeter of the park. In Phase 2, these impacts will need to be quantified and mitigated.

Figure VIII- 4: Meriwether Lewis Memorial at Lewis Park

Multiple cultural and historical resources were identified near and within the study area. Direct impacts will occur primarily to resources located very close to the southeast side of the freeway. Generally, the impacted sites include several Memorial Oak trees, preserves, and arboretums; Liberty Gate; Stone Station; Parkway housing; the Logistic Center Gate; Hudson's Bay Trail Monument; and work adjacent to the Family Resources Center. In Phase 2, all impacts to these resources will need to be evaluated and quantified through a formal cultural resources assessment and all impacts will need to be mitigated.

Air and Noise Quality

The initial air quality review shows that the study area is located in a Carbon Monoxide (CO) maintenance area, and a particulate matter ($PM_{2.5}$) nonattainment area. Air quality impacts were assessed to consider the potential to cause new air quality violations, worsen existing violations, or delay attainment of air quality standards. Air quality conditions considered at the regional level are not typically affected by a single program or project, and variations at the program or project level can be assumed to have no effect on regional air quality. Localized air quality at sensitive land uses adjacent to roadways is most influenced by traffic volumes and their levels of congestion. All of the build scenarios are expected to improve traffic flow and reduce congestion which should result in improved localized air quality. In Phase 2, an Air Quality Analysis will be required, including a qualitative evaluation of particulate matter, mobile source air toxics, and a CO micro-scale hot-spot analysis for all intersections effected.

The scan reviewed the potential impacts from noise on noise-sensitive land uses in the study area. The improvements are considered a Type 1 improvement according to the WSDOT Noise Policy and therefore will require additional noise analysis. Noise impacts are expected along I-5 and at the interchanges. Since noise is dependent on traffic volumes and the distance between the roadway and the receiver, each build scenario has similar impacts to adjacent noise-sensitive properties. Because housing and businesses are located within the study area, impacts will need to be mitigated. Noise abatement will likely take the form of noise barriers. In Phase 2, noise analyses will be completed, sensitive receptors will be better identified, and applicable noise abatement recommendations will be determined.

Socioeconomics and Environmental Justice

Demographic and low income data from the Cities of Lakewood and DuPont and Joint Base Lewis McChord were reviewed. Environmental Justice requires that all people, regardless of race, culture, or income be treated equally with respect to the implementation and enforcement of environmental laws and policies. Low income and minority populations are found within the study area. Construction activities will result in temporary noise level increases and air quality impacts from dust and equipment emissions. Because road widening is proposed to occur along the southeast side of the freeway to avoid the existing railroad on the northwest side, direct project displacements may occur to JBLM housing. In Phase 2, impacts to JBLM housing areas will be confirmed. In addition, other impacts to businesses or local amenities such as public transportation or housing will need to be identified as the roadway alignments are better defined.

Geology and Soils

A review of the existing information to characterize the site geology and review potential geologic hazards was completed within the study area. Geologic maps show the study area is underlain with glacially derived sediment deposits, including thick deposits of recessional outwash of sand and gravel with cobbles and boulders. Potential geologic hazards that may affect the study area include volcanic, landslide and seismic-related hazards. Preliminary construction recommendations for foundations were developed based on the background review. In Phase 2, roadway alignments are refined and foundation needs are identified, subsurface explorations will be required in conformance with WSDOT guidelines. In general, geotechnical and geologic hazards should not substantially affect the proposed improvements.

Summary of Possible Environmental Impacts

The following section discusses the possible environmental impacts associated with the I-5 mainline and interchange improvement concepts. At this conceptual level of design and analysis, only general impacts are assessed based on general right-of-way requirements. More detailed assessments will be made during Phase 2 and as individual projects advance.

Scenario 1a (one HOV/managed lane and three GP lanes)

The right of way width of this mainline scenario is approximately 180 feet. Scenario 1a is the second narrowest scenario, yet still has some impacts to wetlands and streams with likely impacts at the Thorne Lane interchange and the Murray Creek stream crossing. Floodplain impacts at Murray Creek will occur with this alignment but are considered minor. The JBLM pump and treat system located north of the Berkeley Street interchange on the southeast side of the freeway will potentially be impacted, however it is possible that with detailed location information, it may be shown the system can be avoided. This scenario will likely impact some historic and/or archaeological sites (i.e., the grove marker pictured in Figure VIII-5), however it is anticipated to have the relatively minor impacts because of the narrow width. Noise impacts are not expected to significantly worsen under this scenario. Air quality is expected to improve as traffic congestion will improve. Direct displacements are anticipated; however they may be minor under this scenario. These likely displacements are JBLM housing and we anticipate the displaced families will be relocated to other on-base housing.

Figure VIII-5: Commanders Grove Marker at a Memorial Tree near JBLM Main Gate Interchange

Scenario 1b (CD road with three GP lanes)

The right of way width of this scenario is approximately 240 feet. Because of the wider footprint this scenario will have higher impacts to wetlands, streams, floodplains, historic and archaeological sites, including the Fort Lewis Logistics Center Gate. The JBLM pump and treat system located north of the Berkeley Street interchange on the southeast side of the freeway will need to be relocated. This scenario will also have more housing displacements than the narrower options. While noise impacts are not expected to be significantly worse, the sensitive receptors will be closer in proximity to the source.

Scenario 2 (four GP lanes)

The right of way width of this scenario is approximately 175 feet. Similar to Scenario 1a, this scenario will likely impact wetlands at the Thorne Lane interchange and the Murray Creek stream crossing. Floodplain impacts at Murray Creek will occur with this scenario but are considered minor. The JBLM pump and treatment system located north of the Berkeley Street interchange on the southeast side of the freeway will potentially be impacted, however since this is the narrowest improvement option being considered, it is possible detailed location information may show the system can be avoided. This scenario will likely impact some historic and/or archaeological sites; however it is anticipated to have the least impacts because it is the narrowest corridor. Noise impacts are not expected to significantly worsen under this scenario. Air quality is expected to improve as traffic congestion will improve. Direct displacements are anticipated; however they are likely minor under this scenario. Displacements are JBLM housing and we anticipate the displaced families will be relocated to other on-base housing.

Scenario 3 (one HOV/managed lane with three GP lanes and CD road)

The right of way width of this scenario is approximately 265 feet. Because of the wider footprint this scenario will have higher impacts to wetlands, streams, floodplains, historic and archaeological sites including the Fort Lewis Logistics Center Gate and memorial oaks along I-5 (see Figure VIII for an example). Additionally, because of the proximity to the Family Resources Center this option will more significantly impact the area around that historic building. The JBLM pump and treat system located north of the Berkeley Street interchange on the southeast side of the freeway will need to be relocated. This scenario will also have more significant impacts from housing displacements than the narrower options. While noise impacts are not expected to be significantly worse, the sensitive receptors will be in closer proximity to the source.

Scenario 4 (one HOV/managed lane with four GP lanes)

The right of way width of this scenario is approximately 205 feet. This mid-range width scenario will have more impacts to wetlands and streams than Scenarios 1a, and 2. Some impacts to wetlands at the Thorne Lane interchange and the Murray Creek stream crossing will likely occur. Floodplain impacts at Murray Creek will occur with

Figure VIII-6: Remnant Boulevard of Remembrance Memorial Oak Trees along I-5 near Berkeley Street Interchange

this alignment but are considered minor. The JBLM pump and treat system located north of the Berkeley Street interchange on the southeast side of the freeway will need to be relocated. This option will likely impact some historic and/or archaeological sites, but further refinement of the scenario is needed to determine the extent. Noise impacts are not expected to significantly worsen. Air quality is expected to improve as traffic congestion will improve. Direct displacements are anticipated; however they may be relatively minor. These likely displacements are JBLM housing and we anticipate the displaced families will be relocated to other on-base housing.

Scenario 5 (one HOV/managed lane with four GP lanes and CD road)

The right of way width of this scenario is approximately 290 feet. Because this scenario has the widest footprint, it will have highest impacts to wetlands, streams, floodplains, historic and archaeological sites including the Fort Lewis Logistics Center Gate and the Liberty Gate entrance to Fort Lewis (see Figure VIII-7). Additionally, because of the proximity to the Family Resources Center, this option will more significantly impact the area around that historic building. The JBLM pump and treat system located north of the Berkeley Street interchange on the southeast side of the freeway will need to be relocated. This scenario also has more housing displacements than the narrower options. While noise impacts are not expected to be significantly worse, the sensitive receptors will be in closer proximity to the source.

Figure VIII-7: Liberty Gate located near the Main Gate Interchange

Figure VIII-8: Wetlands and Streams

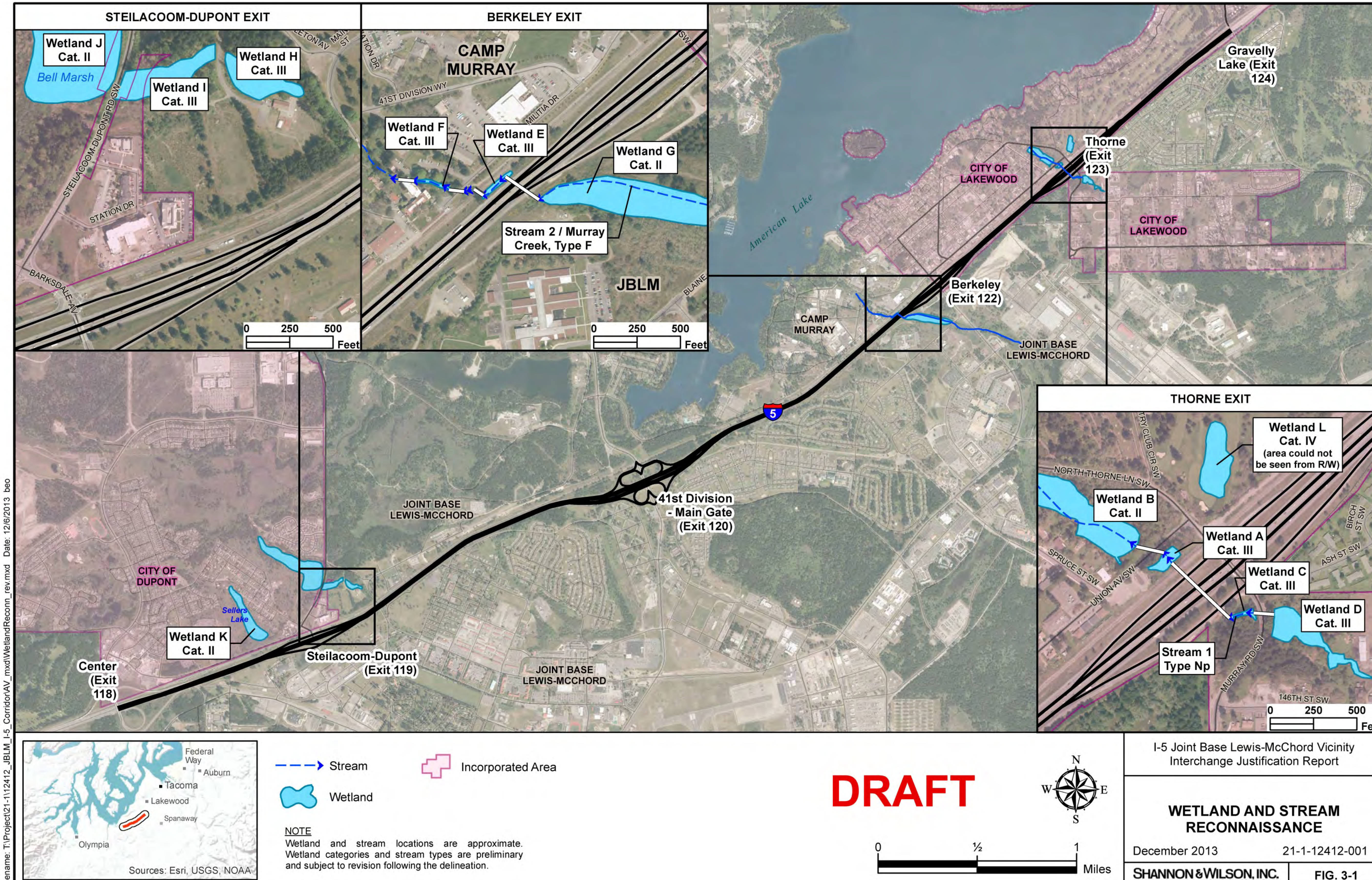
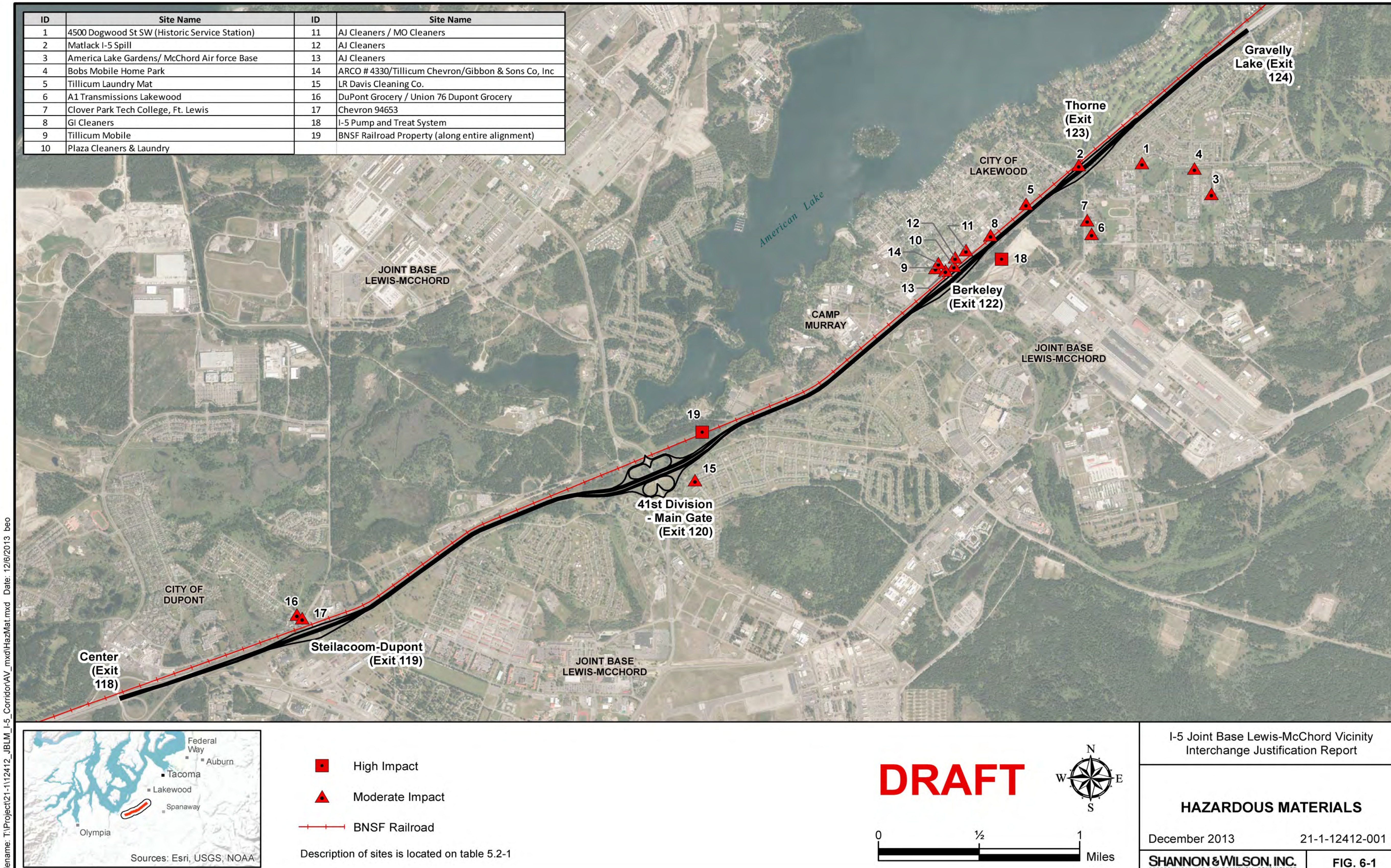


Figure VIII-9: Hazardous Materials



ID	Site Name	ID	Site Name
1	4500 Dogwood St SW (Historic Service Station)	11	AJ Cleaners / MO Cleaners
2	Matlack I-5 Spill	12	AJ Cleaners
3	America Lake Gardens/ McChord Air force Base	13	AJ Cleaners
4	Bobs Mobile Home Park	14	ARCO # 4330/Tillicum Chevron/Gibbon & Sons Co, Inc
5	Tillicum Laundry Mat	15	LR Davis Cleaning Co.
6	A1 Transmissions Lakewood	16	DuPont Grocery / Union 76 Dupont Grocery
7	Clover Park Tech College, Ft. Lewis	17	Chevron 94653
8	GI Cleaners	18	I-5 Pump and Treat System
9	Tillicum Mobile	19	BNSF Railroad Property (along entire alignment)
10	Plaza Cleaners & Laundry		

Figure VIII-10: Drinking Water Sources

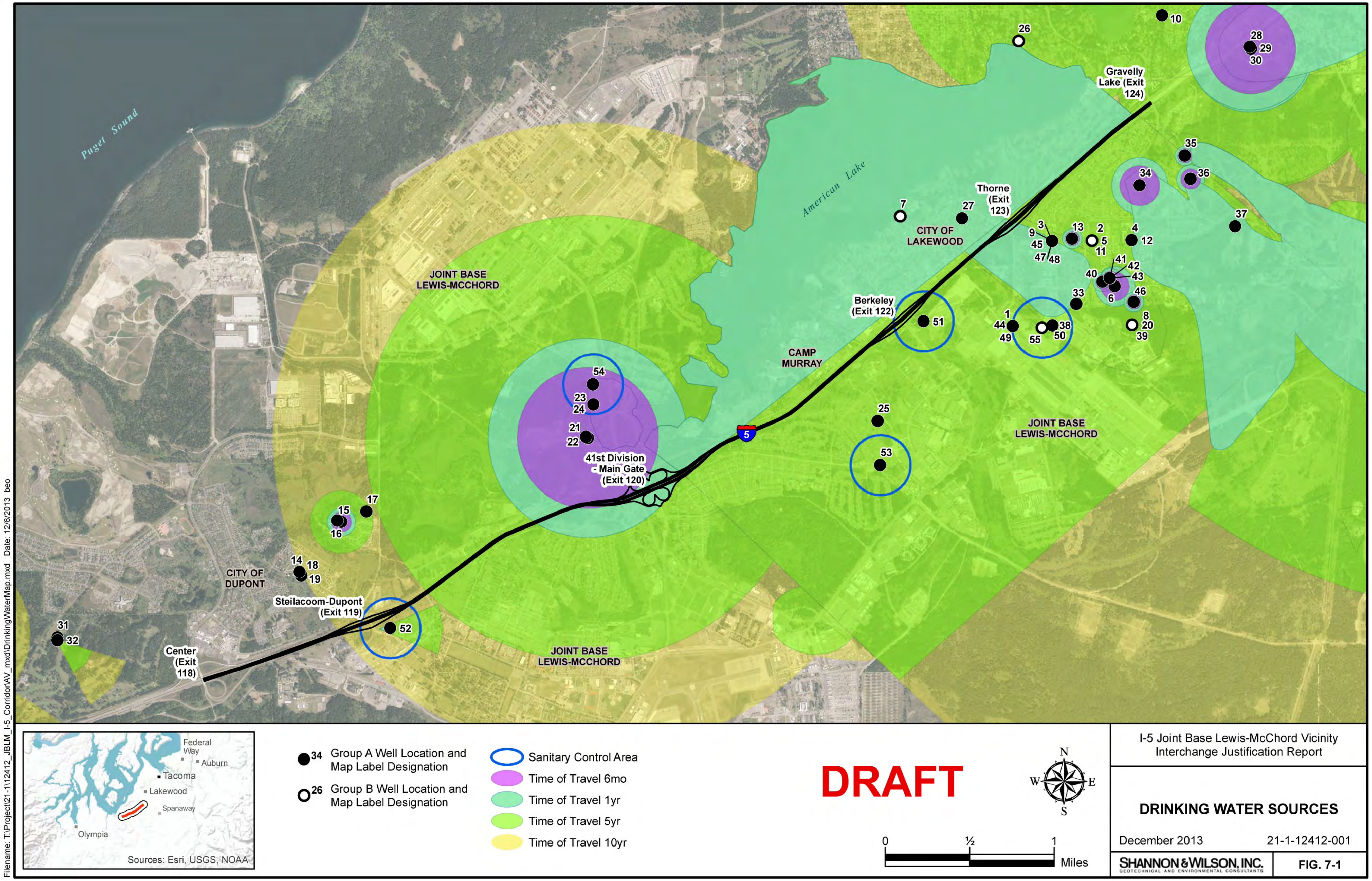


Figure VIII-11: Floodplains

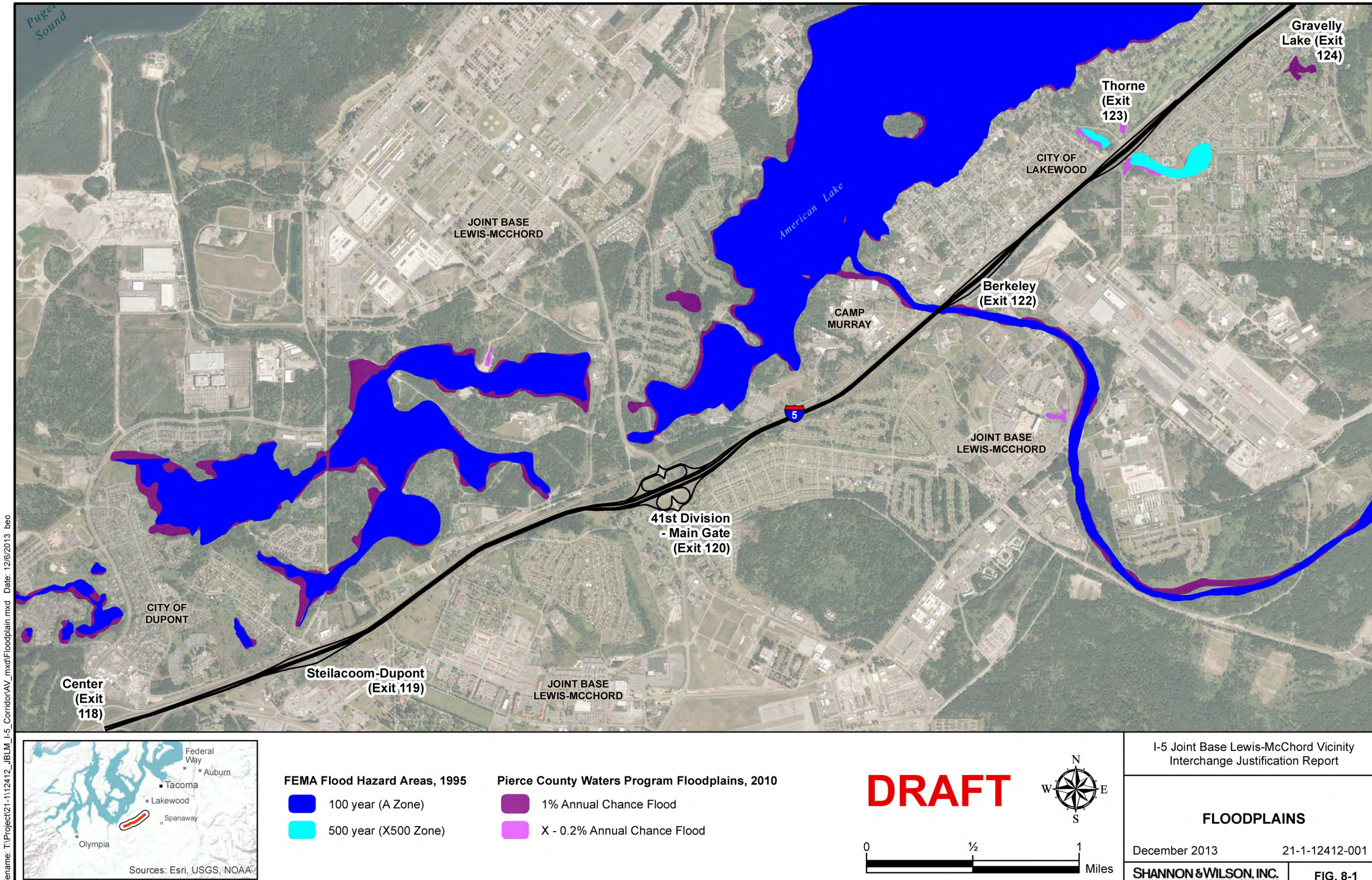


Figure VIII-12: Cultural Resources

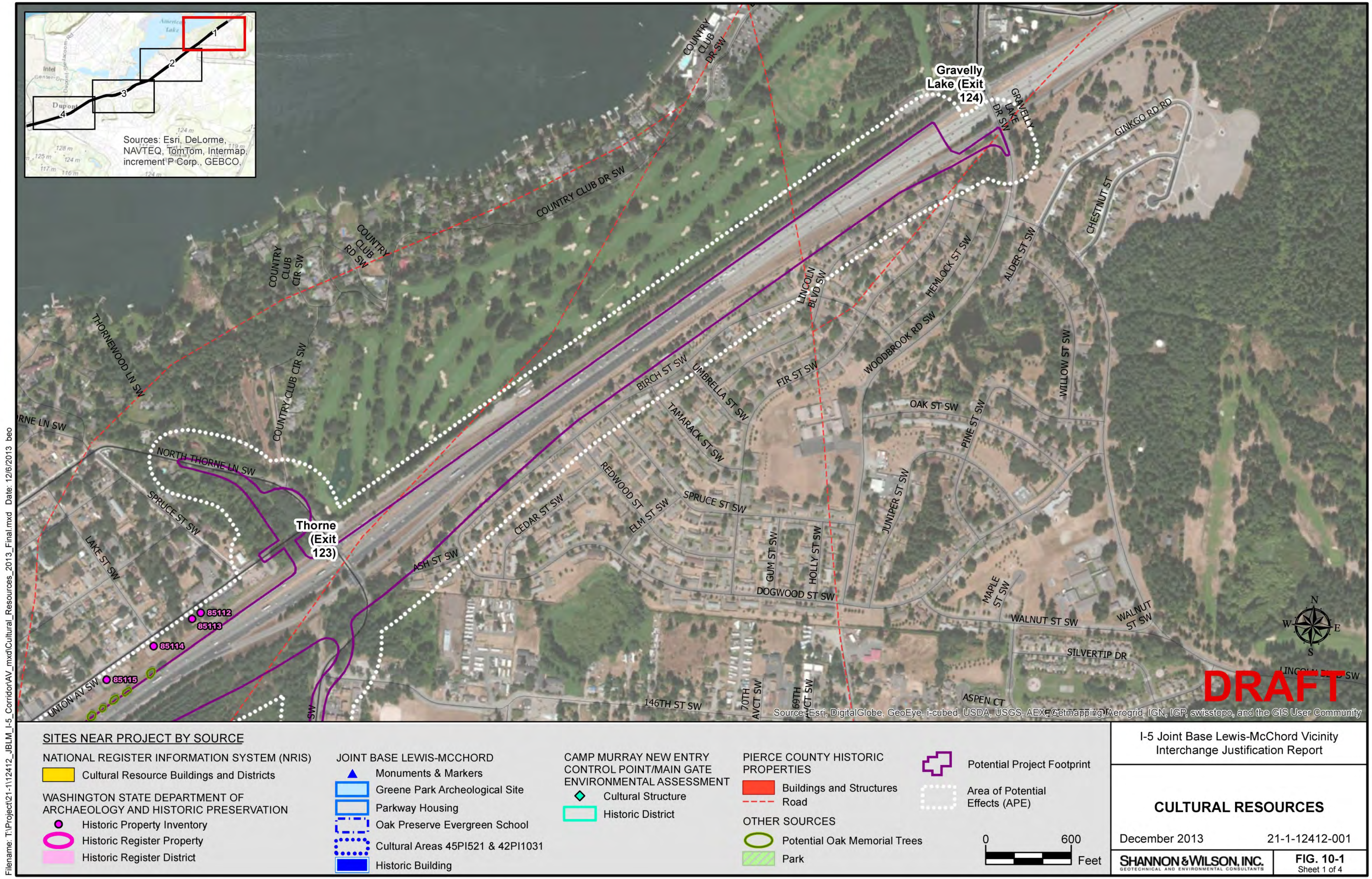


Figure VIII-12: Cultural Resources continued

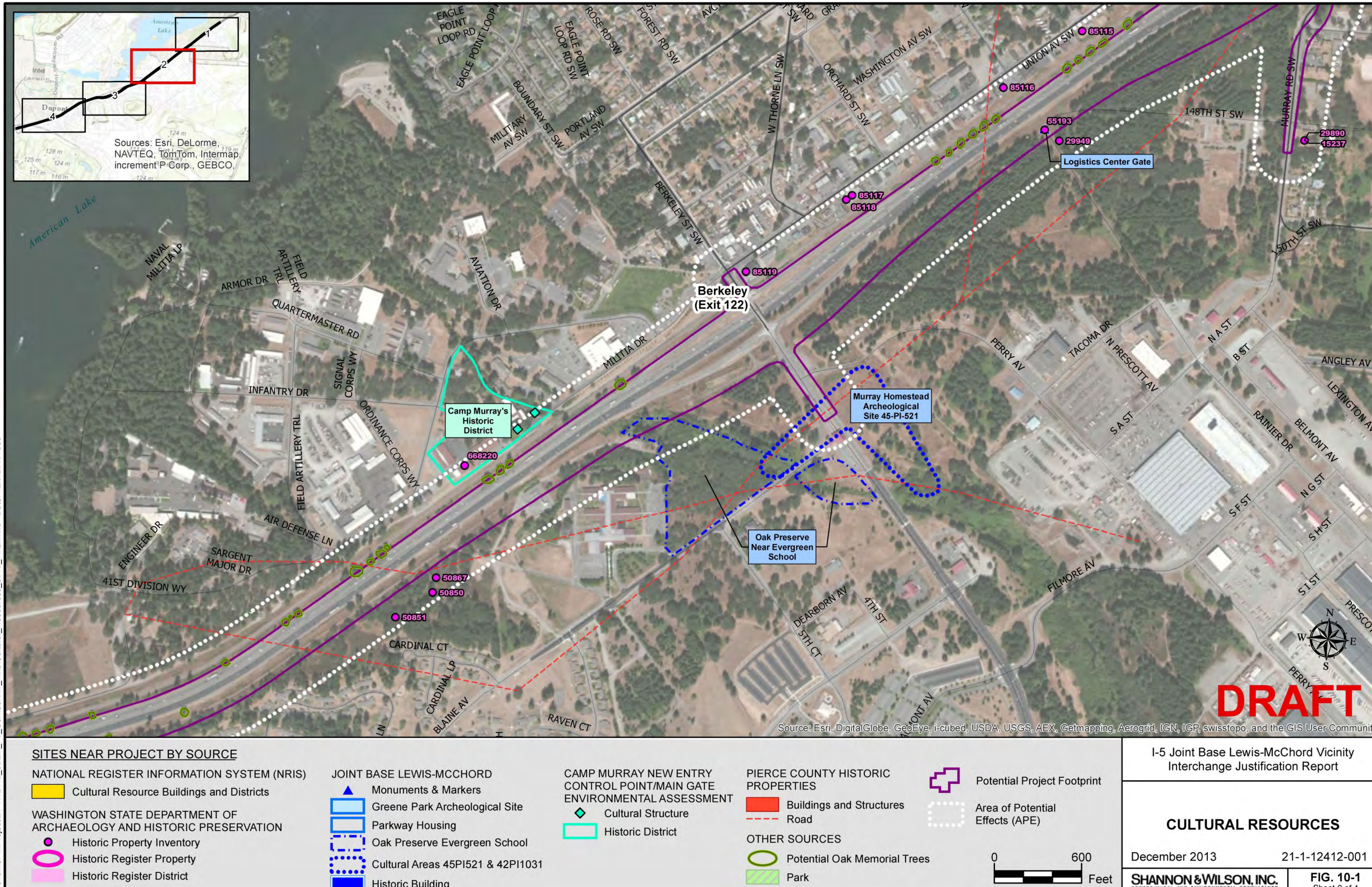


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Figure VIII-12: Cultural Resources continued

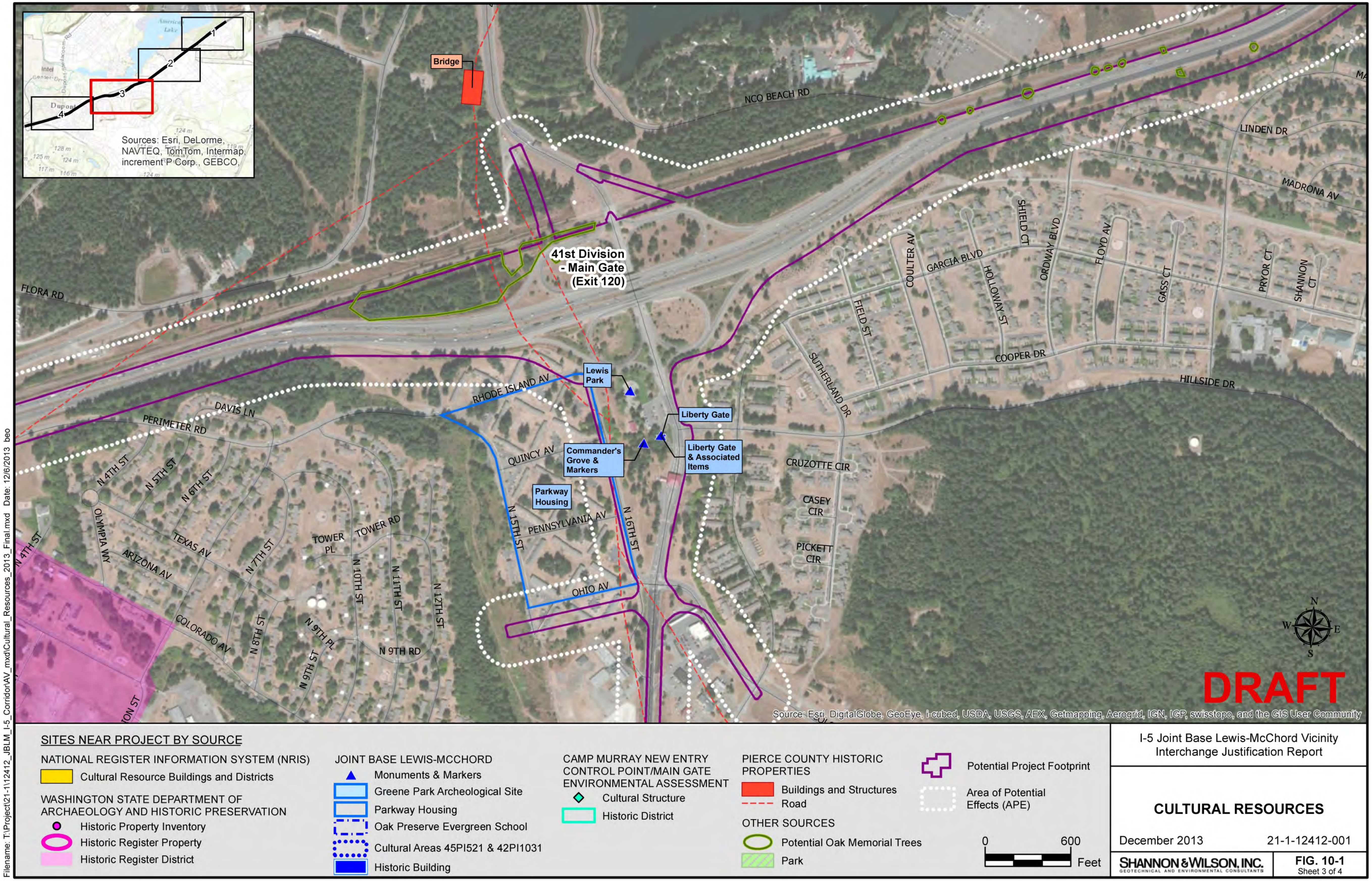


Figure VIII-12: Cultural Resources continued

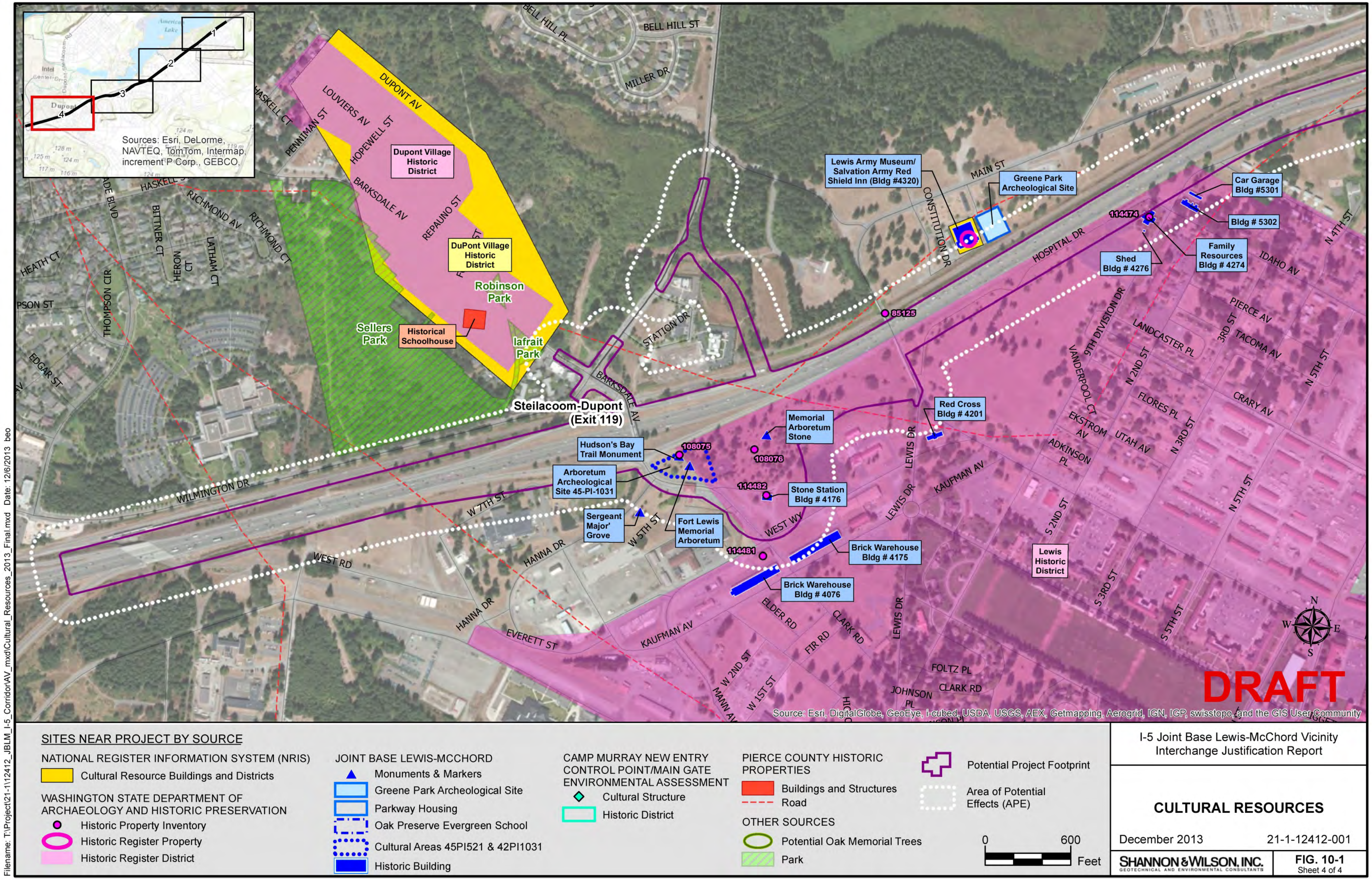
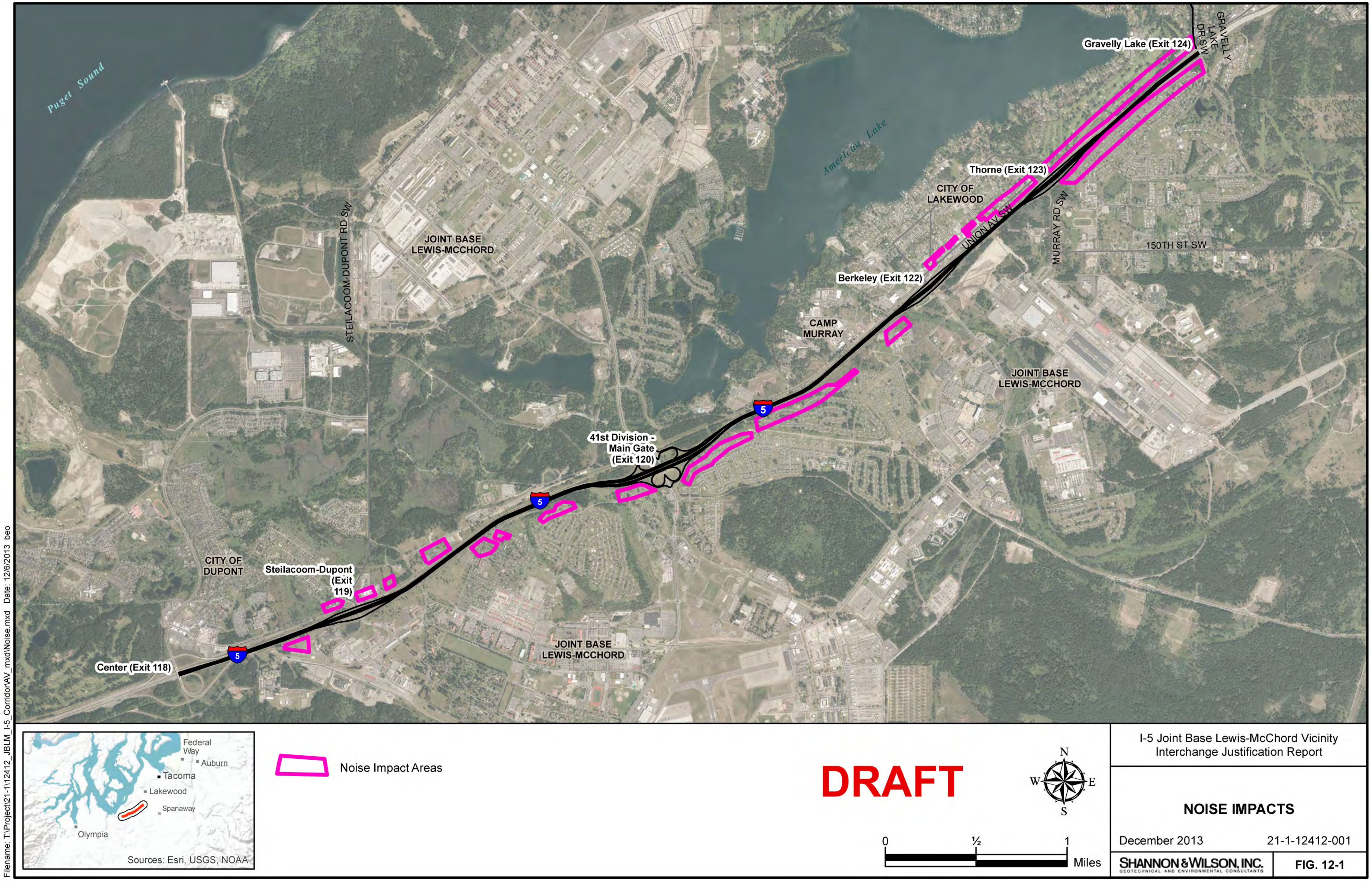


Figure VIII-13: Noise Impacts



IX. Findings and Recommendations

This project is being completed in two main phases. The analysis, findings and recommendations of Phase 1 are presented in this *Corridor Plan Feasibility Study*. The intent of Phase 1 is to identify existing and expected future (2040) deficiencies along I-5 through the JBLM study area, and to establish a vision and broad improvement strategy for the I-5 corridor to achieve a specific series of objectives:

- Relieve congestion on I-5 within the study area;
- Improve local and mainline system efficiency;
- Enhance mobility;
- Improve safety and operations;
- Increase transit and Transportation Demand Management (TDM) opportunities

The findings and recommendations of Phase 1 will be further analyzed in the Phase 2 study effort including a multi-modal Alternatives Analysis and NEPA/SEPA environmental documentation. If interchange modifications are included in the preferred alternative, an IJR will be prepared. Through the Alternative Analysis and environmental processes, the Phase 2 work will recommend phased improvement projects to reduce congestion along the I-5 corridor. This priority array will be used to assist policy makers in endorsing the initial set of improvements for funding and implementation, as well as overall project sequencing.

The framework established by the *Corridor Plan Feasibility Study* will also validate and support prioritizing those improvements in the Puget Sound Regional Council (PSRC) 2040 plan, as well as on-going planning and future programming by JBLM and the partnering agencies. The public acceptance and awareness of a strategic plan to improve I-5 through the JBLM area will provide significant momentum as the process advances into the next phase of development.

Phase 2 of the project will identify a preferred alternative that may include I-5 mainline enhancements, recommended interchange configuration for each of the I-5 focus interchanges, a list of local highway improvements, and/or alternative travel modes. It will define the highest priority projects (those with most benefit and reasonable implementation timelines), and prepare the necessary environmental documentation with supporting engineering for the project.

Recommendations and Findings

The guidance provided by Phase 1 includes the following specific actions and I-5 improvement recommendations that will be further explored and developed in Phase 2 with other local highway improvements and alternative travel modes.

Recommended I-5 Mainline Scenarios

From the traffic operational analyses and mainline evaluations presented previously, Scenario 3 and Scenario 4 have demonstrated the most benefit to achieve the project's objectives. General cross sections for these selected scenarios are as shown in Figure IX-1.

- Scenario 3 would add an HOV lane and CD road or auxiliary lanes in each direction along the corridor.
- Scenario 4 would add a fourth general purpose lane and an HOV lane in each direction along the corridor.

The combination of CD roads or auxiliary lanes, coupled with through lane capacity will be further evaluated in Phase 2.

Multimodal Benefits – Both of these scenarios include HOV lanes to encourage multi-modal users, such as carpools, vanpools and transit service. The faster speeds associated with the HOV lanes will improve transit and ride-share services, and enhanced Transportation Demand Management (TDM) activities. Transit priority options and flyer-stop opportunities will be further explored in Phase 2.

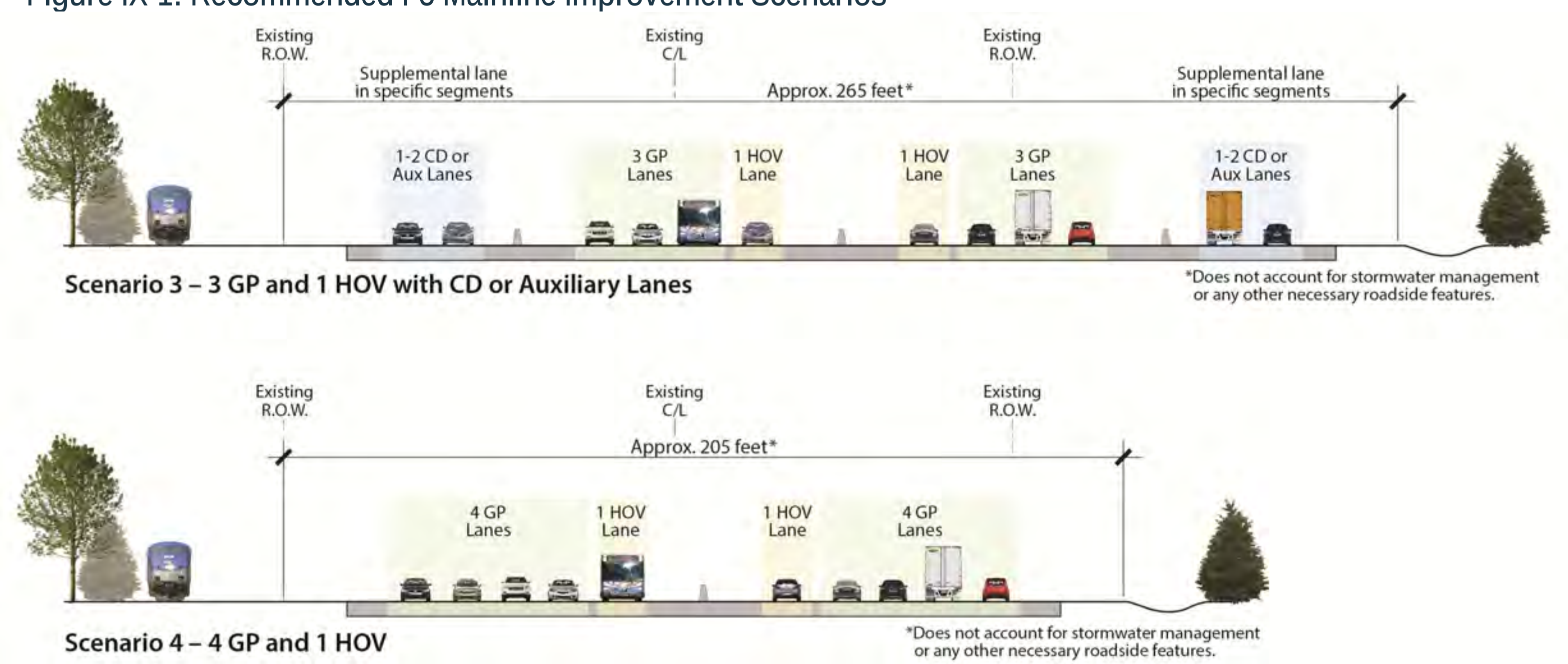
Reduce Side Friction – Both of these scenarios provide extra lanes to reduce the side friction effect of traffic merging and weaving across several lanes. Scenario 3 adds a combination of CD roads or auxiliary lanes to reduce the number of mainline I-5 entrances and exits and places some of the merging and weaving activity on the CD roads. Some traffic may only use the CD roads for short trips between interchanges and never enter the I-5 mainline.

Scenario 4 adds an extra GP lane to increase capacity of I-5 through the JBLM area to allow more space for drivers to enter and exit I-5.

The advantages and disadvantages of both of these scenarios to address the heavy on and off-ramp volumes, merging and weaving issues, and short trips on I-5 will be examined in Phase 2.

Maintain Flexibility – These scenarios provide long-term flexibility in implementing each component of the preferred mainline improvement plan as the corridor evolves over time. This includes providing interchange structures sufficiently wide to accommodate recommended mainline and interchange improvements and to define sufficient right-of-way to meet long-term needs. The process of acquiring added right-of-way from the Department of Defense will be long, challenging, and unique for WSDOT. If improvements are made that affect the military residential areas, the process to adjust the easement will also involve a private enterprise with a long-term lease on housing facilities. It will be important to identify long term right-of-way needs to avoid repeating this process again in the future.

Figure IX-1: Recommended I-5 Mainline Improvement Scenarios



Recommended Interchange Concepts for Further Analysis

Together with the Technical Support Team, the study team reviewed various interchange concepts from previous study and developed several others based on the congestion issues and JBLM gate operations at the four focus interchanges. Each interchange location was analyzed to determine the most appropriate configurations to be carried forward for consideration in the IJR in Phase 2. These focused interchange locations are:

- Steilacoom-DuPont Road (Exit 119)
- Main Gate/41st Division Drive (Exit 120)
- Berkeley Street (Exit 122)
- Thorne Lane (Exit 123)

Based on the review of various interchange types, the Technical Support Team selected four types of interchanges for consideration. The four types of interchanges, as shown in Figure IX-2, include:

- Tight Diamond Interchange
- Diverging Diamond Interchange (DDI)
- Full Cloverleaf Interchanges
- Single Point Urban Interchange (SPUI)

Two to four interchange concepts were recommended at each of the interchange locations for more detailed analysis and evaluation. These concepts will be further refined during the IJR process and a final recommendation will be made when the IJR document is approved. The refinement process will ensure that the chosen interchange configuration fits with the selected mainline improvement scenario.

Interchange concepts for each focus interchange are listed below:

- Steilacoom-DuPont Road Interchange Concepts
  - Concept A – Offset Diverging Diamond Interchange over I-5 located east of existing interchange
  - Concept B – Offset Tight Diamond Interchange over I-5 located east of existing interchange
  - Concept C – Single Point Urban Interchange (SPUI) over I-5 at the existing interchange location
- Main Gate/41st Division Drive Interchange Concepts
  - Concept A – Cloverleaf Interchange with rebuilt northbound ramps and grade separated southbound off ramp
  - Concept B – Diverging Diamond Interchange over a realigned I-5 with inter-base street connection via bridge over I-5
  - Concept C – Tight Diamond Interchange over a realigned I-5 with inter-base street connection via bridge over I-5
  - Concept D – Tight Diamond over a realigned I-5 with inter-base street connection via bridge over I-5 and connection to North Fort Gate

Figure IX-2: Interchange Types

- Berkeley Street Interchange Concepts
  - Concept A – Tight Diamond Interchange over I-5
  - Concept B – SPUI over I-5 at existing interchange location
- Thorne Lane Interchange Concepts
  - Concept A – Offset Diverging Diamond Interchange over I-5 with grade separation over the railroad and Union Avenue, relocated south of existing interchange
  - Concept B – Offset Tight Diamond Interchange over I-5 with grade separation over the railroad and Union Avenue, relocated south of existing interchange
  - Concept C – Offset SPUI over I-5 with grade separation over the railroad and Union Avenue relocated south of existing interchange

Improve JBLM Gate Efficiency – Each of these interchange concepts will consider optimization of JBLM gates operations to improve accessibility to the base and reduce back-ups into the interchange and along I-5 ramps. Each of the interchanges has unique opportunities and challenges and will be analyzed separately, as well as a total improvement package with I-5 mainline improvements.

Local Street Improvements – Local street improvements can also help reduce demand at the interchanges and along the I-5 mainline. These local improvement projects can reduce the traffic volume wanting to get on I-5 for short trips, provide better connectivity within local communities, provide alternative routes to using I-5, and reduce congestion at interchange ramp intersections. Local street options, including within JBLM, will be considered within the context of the mainline and interchange improvement options that are being carried forward.

Next Steps

This *Corridor Plan Feasibility Study* is the first phase of the I-5 *JBLM Vicinity IJR and Environmental Documentation Project*. Phase 2 of the project will include the following work elements:

- Alternatives Analysis – A comprehensive multi-modal Alternatives Analysis will be conducted to analyze and evaluate the selected I-5 improvement scenarios with reasonable modal and multimodal alternatives. This analysis will investigate the benefits of non-interstate improvements, such as frontage roads, parallel roadways and transit improvement strategies, to reduce travel demand on I-5.

  The transportation planning process for the Alternatives Analysis:
  - Includes an assessment of a wide range of multimodal alternatives, which will address the mobility issues along the I-5 corridor through the JBLM area;
  - Provides ample information to justify the study findings;
  - Supports the selection of a locally preferred alternative; and
  - Enables the Stakeholders to adopt the locally preferred alternative as part of their long-range transportation plan.

- Environmental Documentation for NEPA/SEPA Compliance – Building on the initial environmental scan conducted for Phase 1, an environmental process will be developed to support the Alternatives Analysis. This work will include detailed discipline reports to assess the environmental benefits and consequences associated with each of the alternative improvements. The results of these discipline reports will be combined with the Alternatives Analysis to select a preferred alternative.

  Early in Phase 2, an appropriate level of environmental documentation will be identified with affected agencies. After which an environmental scoping Notice of Intent will be prepared and released for public comment. This Notice starts the formal NEPA/SEPA process that will ultimately lead to appropriate environmental clearance and an impact mitigation strategy.

  Corridor-level designs of the various modal and multi-modal alternatives will be prepared to determine the impacted area and the level of impacts for the environmental discipline reports. The result of this process will be the formal environmental report issued for public comment. Based on the comments received the final environmental documentation will be prepared.

- Agency and Public Involvement – Coordination with the Executive Committee and the Technical Support Team will continue through Phase 2. Focus group meetings will also be held on specific issues with key stakeholders to take a more detailed look into their concerns and solutions.

  A broader public outreach will also be conducted as part of the alternatives analysis environmental process to solicit ideas, concerns and comments from the general public. This will include updates to the current project web site, open houses and presentations to city and county councils.

- Implementation Strategy – With the selection of a recommended set of improvement projects within the study area, proposed sequencing of implementation will be developed. This strategy will be based on the evaluation process conducted during Phase 2. It will include:
  - A list of recommended improvements for inclusion in local, regional and state plans; and
  - A sequence of improvement projects that include both short-term actions that can be implemented to address immediate problems, as well as long-term actions to address the consequences of growth. This priority array will be available to identify funding needs over time.
- Corridor-Level Interchange Justification Report (IJR) –If the preferred alternative includes interchange modifications, a corridor level IJR will be developed and sent to FHWA for approval. The IJR will use the traffic and safety operations data from the Alternatives Analysis and environment process. The IJR document is required to be completed to justify new and/or revised ramp configurations connected to limited access freeways, such as I-5. FHWA, as the approving agency for all access revisions to the interstate system, will have final acceptance of the IJR. The IJR will document:
  - The need for the proposed improvements to interchanges;
  - Evaluation of all other reasonable alternatives (including roadways other than I-5);
  - Analyses and evaluation of the proposed improvements;
  - The proposed improvement is compliant with current design criteria;
  - Coordination with local, regional and state land use and transportation plans; and
  - Environmental impacts of the proposed improvements.