I-5 Transportation Alternatives Analysis & Traffic Operational Model

FROM MOUNTS ROAD TO SR 512

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City of Lakewood

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I-5 Transportation Alternatives and Operational Traffic Model Study

Project Endorsement
April 29, 2010

We, the undersigned members of the Technical Review Committee have participated in the 18 month I-5 Transportation Alternatives Analysis and Traffic Operational Model.

Our endorsement below acknowledges that we have completed our review and oversight responsibilities and generally concur with the findings and recommendations documented in the plan.

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Introduction

The City of Lakewood is preparing a Growth Coordination Plan that will proactively address the effects of existing and anticipated growth on communities surrounding Joint-Base Lewis-McChord (JBLM). This plan will focus on a number of elements including:

- Housing
- Economic Impact
- Education
- Transportation
- Plans and Policies
- Public Utilities and Infrastructure
- Public Safety and Emergency Services
- Health
- Social Services
- Quality of Life

The I-5 Alternatives Analysis and Operations Model project is the first phase of this larger study effort. This initial phase primarily focuses on developing an operations model and identifying potential transportation improvements for I-5 and adjacent arterials. The operations model and alternatives analysis will include a number of recommendations to alleviate congestion and will provide JBLM and the region with technical numbers to support recommended transportation improvements to help address I-5 traffic impacts resulting from base growth. The transportation work to be completed as part of the larger GCP will address more regional issues extending beyond the I-5 corridor and intersecting arterials.

The operations model and recommendations from this effort will complement and be incorporated into the broader transportation element that will be prepared for the Growth Coordination Plan. The City of Lakewood and Washington State Department of Transportation (WSDOT) are partnering together on this study effort with funding primarily provided by the Office of Economic Adjustment (OEA) at the Department of Defense (DOD).This analysis represents the first phase of work necessary to inform the City of Lakewood, WSDOT, Pierce County, and other key agencies as to potential improvements that should be considered to address impacts from additional JBLM growth. These improvements could potentially be incorporated into the Washington Transportation Plan (WTP), the Puget Sound Regional Council's (PSRC's) Regional Transportation Plan (Transportation 2040), and when funding is secured, the regional transportation improvement program (TIP).

Purpose and Need

In 2005, the Department of the Army announced that the number of troops stationed at JBLM would expand as part of the new initiatives by DOD. It is projected that these initiatives will result in an additional 8,200 active duty personnel at JBLM and nearly 2,000 new civilian positions by 2011. This anticipated growth exceeds the population and employment projections developed by local jurisdictions prior to this announcement. This additional growth will likely impact the area's transportation system, specifically the interstate and local arterials in the vicinity of the base. In addition, an Environmental Impact Study is currently underway for JBLM evaluating the potential impacts of additional growth in military personnel, dependants and support services as part of the Grow the Army Initiative. This increase in base personnel will likely impact an already congested corridor that serves as the primary highway corridor for the movement of goods and people traveling north and south on the west coast of North America and within the Puget Sound Region.

To assess the potential impacts to I-5 and the adjacent local street system due to the base growth, the City of Lakewood along with WSDOT will develop an operations model for I-5 and the

adjacent arterial intersections. The operations model will be used to conduct a transportation alternatives analysis focused on developing long-term transportation improvement alternatives for I-5 and the adjacent arterial intersections to support the DOD's new growth initiatives. The alternatives will evaluate an integrated set of improvements to maintain safe, efficient and acceptable I-5 operations and address safety as well as current and future mobility deficiencies directly related to military growth. In addition to the long-term improvement alternatives, short-term strategies to address military demand will be developed and summarized for consideration by local agencies.

Growth Coordination Plan

The Growth Coordination Plan will provide a detailed analysis of issues and strategies specific to the challenges of supporting growth at JBLM. A Growth Coordination Workshop was held April 9, 2009 and was attended by over 90 study area stakeholders. At the meeting, participants identified ten functional areas as elements that needed to be analyzed in detail as part of the overall planning effort.

The plan seeks to address such questions as:

1. *Where is the future growth going?*
2. *Do the communities like where future development is headed, and do they have the tools to shape more desirable growth patterns?*
3. *Are the communities doing what is necessary to accommodate the needs of the soldiers, airmen and their families?*

The objectives of the Growth Coordination Plan are to:

1. Identify and assess existing conditions
2. Determine future needs of an increased military population
3. Develop short-term and long-term priorities and potential funding sources to accommodate this growth
4. Develop planning, coordination and implementation strategies that help achieve the long-term strategic goals of the stakeholders during this period of growth and change.
5. Maintain a central point of coordination for all major stakeholders who are impacted by the expansion of JBLM.
6. Promote regular communication with all local and regional groups and committees that discuss military installation infrastructure and service issues and concerns.
7. Establish a clear set of action steps to local communities about managing future growth and demands for services.

To meet these objectives, the Growth Coordination Plan will assist in coordinating the planning efforts for all the participating agencies. This could result in the opportunity to leverage local, state and federal funds to provide the military with local services in an effective manner according to region-wide needs and possible special districts.

The Growth Coordination Plan is not intended to supersede existing procedures and policies governing the mandates of the different service providers, but to provide an assessment and coordinated action plan to address the needs of the area specifically related to growth at the bases. It is envisioned that the Growth Coordination Plan will be used to facilitate implementation of specific action steps at both the regional and local level and therefore may be adopted in a manner as deemed appropriate by each local government agency and service provider to meet their specific implementation needs.

Transportation Element

As mentioned, the I-5 Alternatives Analysis and Operations Model project is the first phase of a larger study effort. What remains to be studied is the future transportation needs outside the I-5 corridor, such as improvements along local arterials and streets, enhancements to the public transportation system, and analysis of other state highways. This second phase will build off the work being performed as part of the I-5 Alternatives Analysis and Operations Model, but will also include other regional facilities off the I-5 corridor. The results of both study phases will be included as part of the Transportation Element of the Growth Coordination Plan. Among the issues the Transportation Element will address include improvements needed to support increased travel demand in the entire study area resulting from base growth, along with regional and local community growth. For example, on the east side of JBLM, the Roy "Y" interchange at State Route 507 and State Route 7 experiences significant congestion following the evening release of military personnel. Infrastructure needs at this newly utilized access point and other gate access bottlenecks in the study area will be evaluated as part of the Transportation Element.

This future effort will also identify regional transportation opportunities and an assessment of the long-term viability of implementing such opportunities, costs, and funding options. A list of strategies, prioritized alternatives, and new types of transportation systems and routes that would address transportation impacts by growth at the bases will be included. The work developed for the I-5 corridor will complement the larger regional list of transportation needs.

Finally, recommendations should be made on how JBLM staff can best work with the Puget Sound Regional Council, the WSDOT, the Pierce County Regional Council, the Thurston Regional Planning Council, and local transit agencies to promote regional solutions to all the identified transportation challenges.

Technical Review/Stakeholder Involvement

As part of the I-5 Alternatives Analysis and Operations Model project, the City of Lakewood created a Technical Review Committee (TRC) to review and provide input on project approach, assumptions, and outcomes. Since this initial phase is primarily technical in nature, the group is comprised of representatives from local agencies and jurisdictions that could be impacted by growth at the bases. These local agencies and jurisdictions have a first-hand interest in the outcome and/or conclusions of this study. TRC members include representatives from the following agencies:

- City of Lakewood
- Federal Highway Administration (FHWA)
- Washington State Department of Transportation (WSDOT)
- Puget Sound Regional Council (PSRC)
- Pierce County
- Thurston Regional Planning Council (TRPC)
- City of DuPont
- City of Lacey
- City of Roy
- Joint-Base Lewis-McChord
- Camp Murray
- Nisqually Tribe
- Pierce Transit
- Sound Transit
- Clover Park School District
- Office of Congressman Norm Dicks

The purpose of the TRC is to review basic analysis methodologies, evaluation criteria, and key findings. TRC meetings occur throughout the life of the project as directed by the City. In addition to the TRC meetings, interviews were conducted with some of the agencies to further discuss specific issues and outcomes they would like the study to address. Interviews were conducted with staff from the City of DuPont, Pierce Transit, JBLM, and FHWA. The following summarize the key issues/concerns that were common among the agency interviews:

- Congestion along the I-5 corridor and interchanges has worsened.
- Peak congestion and volume periods have spread across a larger time period.
- Transit reliability (on-time service) is affected by increased congestion.
- Transit service to the military installations is challenging due to security requirements.
- High Occupancy Vehicle (HOV) lanes should be extended through the study area.

As the corridor study moves forward, these issues/concerns will be considered in examining existing study area conditions and in developing improvement strategies to address existing and future conditions.

Study Area

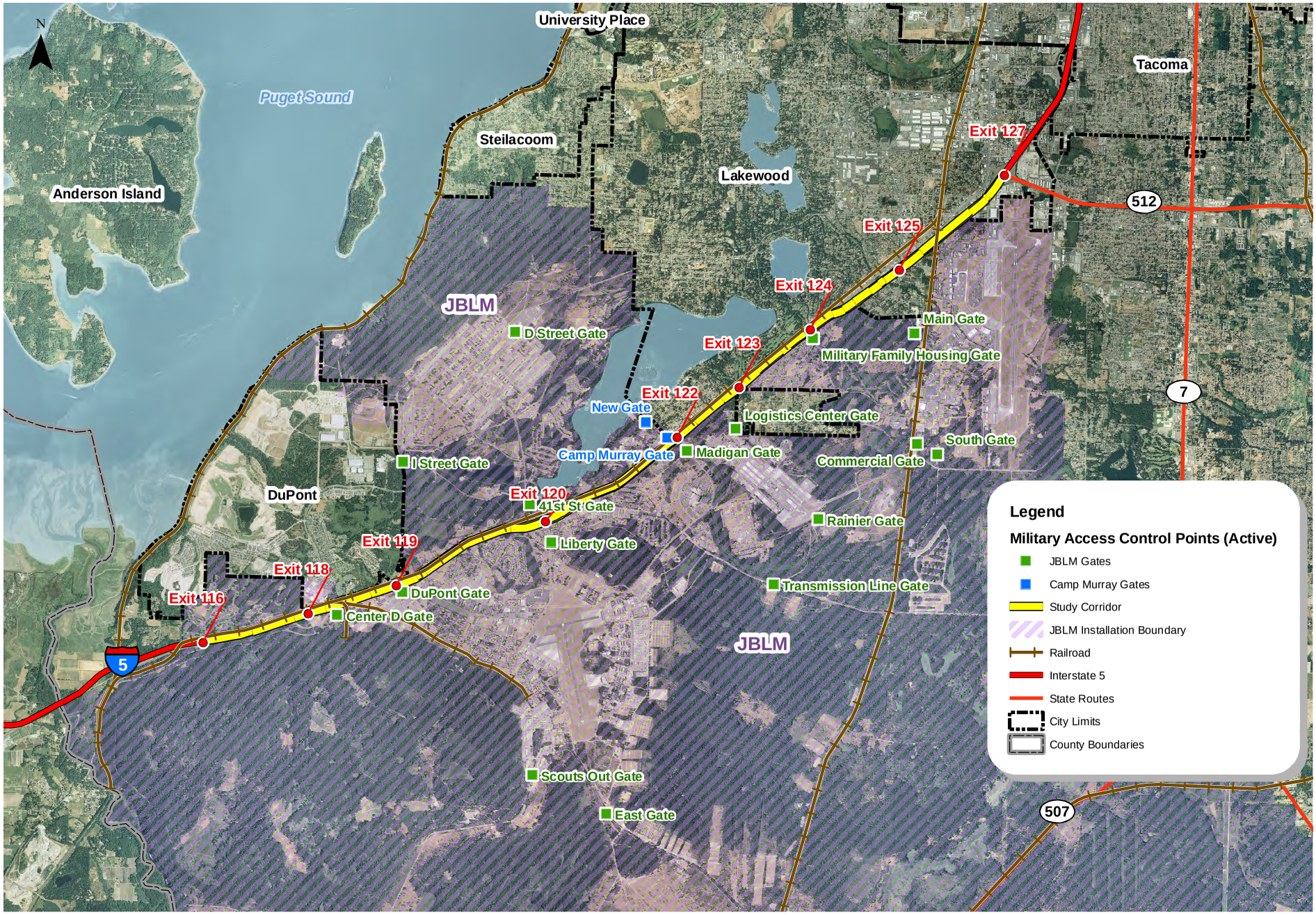
The study area extends along the I-5 corridor from the Mounts Road interchange (Exit 116, milepost 116.41), to the State Route (SR) 512 interchange (Exit 127, mileposts 127.48) as shown in Figure 1. A total of nine interchanges were identified and evaluated along with the mainline segments, ramp merge and diverge operations, and ramp terminal/arterial intersections. The study area represents an 11-mile section of I-5.

The study area was chosen based on a review of the military gate locations, usage, and resulting potential levels of impact. Recent studies completed by WSDOT evaluated HOV lanes through Tacoma, so further analysis of that section of I-5 was not needed. Furthermore, as the purpose of this study is to address the growth as it relates to the military, the further from JBLM the study area extends, the reduced level of impact from the military bases and the greater the impacts from regional traffic and anticipated regional growth. Another aspect of the study is an examination of the local street system adjacent to I-5 and potential improvements to east/west connectivity. This also includes an analysis of several arterial intersections adjacent to I-5.

Study Methodology

Technical analyses conducted for this study area are based on accepted industry standards and will include an evaluation of traffic operations and traffic safety when assessing existing deficiencies and developing future improvement strategies. The traffic operations analysis was conducted using methodologies outlined in the *Highway Capacity Manual* (2000 Edition). The assessment of safety deficiencies along the I-5 corridor is based on collision history data maintained by WSDOT.

Consistent with local and regional transportation plans, the traffic analysis will be based on a 2030 horizon year. While the primary analysis will focus on the weekday PM peak hour conditions, additional analysis will be conducted for the AM peak hour at key locations. Due to the scheduled physical training activities for JBLM soldiers, unique peaking characteristics are also observed in the morning. This morning surge of inbound base personnel results in congestion and queuing along I-5 that will be considered in the development of improvement alternatives.



Study Area

FIGURE

1

Interstate 5 Transportation Alternatives Analysis and Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\GIS\MXD\I-5 Corridor Basemap_8.5x11.mxd

City of Lakewood transpoGROUP WSDOT

Literature Review

Several studies have been conducted in the area that were used to identify existing or future issues and/or improvements that are reflected or considered as part of this current study effort. Through discussions with TRC members and other key agency staff, a list of past studies was developed and is summarized below. These studies include:

- *I-5/Fort Lewis Congestion Study*, WSDOT (December 2005);
- *Fort Lewis/McChord Crash Analysis,* Gannet Flemming (2007);
- *Pierce Transit Park & Ride Study*, Fehr & Peers/Mirai (December 2008);
- *Cross-Base Highway Final EIS: Transportation Discipline Report,* WSDOT (September 2003);
- *Point Defiance Bypass Project: Traffic & Transportation Discipline Report*, WSDOT & HDR Engineering (March 2008);
- *2007-2026 Highway System Plan,* WSDOT (December 2007);
- *Final Comprehensive Traffic Study at McChord Air Force Base,* CH2M Hill (August 2006);
- *Freeway Access Report: Interstate 5 at DuPont, Washington.* CH2M Hill (October 1995);
- *East-West Corridor Study,* Parametrix/Thurston County (1998); and
- *Woodbrook Business Park Master Plan* (not yet complete).

These studies are discussed in the following sections focusing on the scope of the study and key conclusions and recommendations as it relates to the segment of I-5 currently being studied. Note that Fort Lewis and McChord Air Field were only recently combined into a single joint base (Joint-Base Lewis-McChord).

I-5/Fort Lewis Congestion Study, WSDOT (2005) – The limits of this congestion study fall within those of this current I-5 corridor study, and include I-5 mainline traffic and interchanges from the DuPont-Steilacoom Road interchange to the Thorne Lane interchange. The study concludes that future traffic volume growth and large improvement costs prohibit anything other than short-term improvements. Recommended improvements along the I-5 corridor include the installation of ramp-meters at interchanges and construction of an auxiliary lane between the Berkeley Street and Thorne Lane interchanges.

Fort Lewis/McChord Crash Analysis, Corp of Engineers (2007) – This study examined collision rates and types along I-5 from Lacey to downtown Tacoma to determine if traffic to/from Fort Lewis and McChord AFB increased collision rates. The limits of the current I-5 corridor study fall within the same limits of this 2007 I-5 corridor study. Collision rates are lowest in Lacey and highest in Tacoma with a fairly linear increase between these two cities. The collision rate within the vicinity of JBLM is higher than the rate in Lacey but is not higher than the average overall rate for the study area. The study also noted that while collision rates are not above the average for the study area, congestion associated with gates to/from Fort Lewis and McChord AFB may increase the number of collisions at the interchanges. No specific recommendations were made to improve safety in the vicinity of Fort Lewis and McChord AFB, but additional study of congestion related collisions was recommended.

Pierce Transit Park & Ride Study, Pierce Transit (2008) – The need for new or expanded park & ride facilities throughout Pierce Transit's service area were examined within this study. Within the I-5 corridor study area, forecasted person-trips to and from JBLM showed relatively low growth. Based on projected demands and previously planned expansions including the Lakewood Station, no additional park & ride facilities were identified. However, enhanced transit service (Sounder commuter rail to Lakewood and increased bus service throughout the County) would increase park & ride demand countywide beyond baseline assumptions. Within the I-5 corridor study area, additional transit service would increase commuter demand at the DuPont

Park & Ride. This additional demand would result in the need for an additional 175 parking stalls. No additional service is planned for the military bases.

Cross-Base Highway Final EIS: Transportation Discipline Report, WSDOT (2003) – The impacts of the proposed Cross-Base Highway, which would extend from approximately the Thorne Lane interchange with I-5 to SR 7 east of the military bases, was examined within this study. Currently, little connectivity is provided between the I-5 corridor and mid-Pierce County. The proposed highway is intended to and would improve regional circulation and congestion. The study assumed that the Thorne Lane interchange would be reconstructed as a single-point urban interchange to accommodate the increase in traffic volumes from construction of the new highway. In addition, a frontage road along the north side of I-5 between Thorne Lane and Gravelly Lake Drive would also be constructed. Specific impacts to the I-5 study corridor, beyond the Thorne Lane interchange, were not presented. However, improvements to the Thorne Lane interchange would impact mainline and ramp operations within the vicinity of Thorne Lane. This interchange improvement, and the regional improvements associated with the construction of the new highway, will be considered when developing improvement strategies along the I-5 corridor.

Point Defiance Bypass Project: Traffic & Transportation Discipline Report, WSDOT Rail (2008) – This study documented the impacts of improved passenger rail service along the rail line immediately north of, and parallel to, the I-5 corridor study area. This rail line will experience an increase in rail service due to the extension of the Sounder commuter rail line to the Lakewood Station and from rerouting existing passenger rail service from the Burlington Northern Santa Fe rail line along the Puget Sound shoreline. These passenger rail services would result in approximately one train passing through the study area during each AM and PM peak period. Resulting vehicle queues at rail crossings would extend trough adjacent study intersections at Bridgeport Way, Thorne Lane, Berkeley Street and DuPont-Steilacoom Road intersections. Mitigation of these impacts would include interconnecting all north-south corridor traffic signals with one another, and installation or activation of traffic signals and turn-pocket improvements at both the Union Avenue/Thorne Lane and Union Avenue/Berkeley Street intersections. Improvements to arterial intersections to improve corridor operations along I-5 will need to consider the effects of vehicle queuing caused by the bypass project and increased rail activity.

2007-2026 Highway System Plan, WSDOT (December 2007) – The statewide Highway System Plan provides broad policy goals throughout all of Washington State, including improving congestion and safety, and identifies specific improvements through a tiered implementation strategy. Tier 1, Tier 2 and Tier 3 allow the WSDOT to effectively target its investments. Tier I focuses on low-cost projects such as active traffic management, turn lanes and ramp modifications that deliver a high return on capital investment and have short delivery schedules. Tier II focuses on moderate to higher-cost improvements such as auxiliary lanes and direct access ramps while Tier III focuses on the highest-cost projects that deliver corridor-wide benefits. These would include commuter rail, HOV/HOT lanes, and adding general purpose lanes and interchange modifications.

Within the study area several solutions are identified within all three tiers.

- Tier 1
  - I-5: Thurston/Pierce County Line to Thorne Lane – ITS (Key #55)[1]
  - I-5: Mounts Road to 48th Street Ramp Metering (Key #56)
  - SR 512: Lakewood to Puyallup – ITS (Key #87)
- Tier 2
  - I-5: Fort Lewis to Thorne Lane – Construct southbound & northbound auxiliary lanes (Key #177)
  - I-5 & SR 512 Interchange: northbound I-5 to eastbound SR 512 – Widen off ramp and add auxiliary lane on SR 512 to E Steel Street (Key #178)

[1] Key numbers refer the map 'Key' numbers identified for each improvement within Appendix J of the *2007-2026 Highway System Plan*.

  - I-5 & SR 512 Interchange: eastbound SR 512 to northbound I-5 On Ramp – Widen on ramp and add an auxiliary lane on SR 512 from E Steel Street (Key #179)
  - I-5: Mounts-Old Nisqually Road Interchange to Gravelly Lake Drive Interchange – Construct auxiliary lanes and noise walls (Key #184)
- Tier 3
  - I-5: Thorne Lane Under-crossing to Gravelly Lake Drive – Add southbound and northbound HOV lanes, new Interchange at Gravelly Lake Drive, and ITS (Key #346)
  - I-5: Gravelly Lake Drive to Burlington-Northern Railroad Undercrossing – Add southbound & northbound HOV lanes, new interchange at Bridgeport Way, and ITS (Key #347)
  - I-5: Burlington-Northern Railroad Undercrossing to S 96th Street (SR 512 Interchange) – Construct core HOV lanes, freeway-to-freeway interchange at SR 512, and ITS (Key #348)
  - I-5: I-5 & SR 512 Interchange – Construct new southbound I-5 to eastbound SR 512 two-lane flyover ramp (Key #349)

Final Comprehensive Traffic Study, McChord Air Force Base (2006) – This study examined the ability of the infrastructure on the base and in the vicinity of McChord AFB to serve existing and future traffic demands. Within the I-5 corridor study area, the study documented poor operations at the Thorne Lane interchange. Interim improvements at the Thorne Lane interchange to address deficiencies that would exist until either widening of I-5 or construction of the Cross-Base Highway and associated Thorne Lane improvements occurs, would be supported and partially funded by McChord AFB. These short-term improvements will be considered when developing improvement strategies along the I-5 corridor.

Freeway Access Report: Interstate 5 at DuPont, WSDOT (1995) – This study documents the need for additional access to I-5 with the planned development within the City of DuPont. This study assumed that Fort Lewis would ultimately relocate the DuPont gate to align with the proposed Center Drive interchange. The ultimate configuration and improvements at the Center Drive interchange would include a half diamond for the northbound ramps and a full diamond for the southbound ramps, and would provide access to the Fort Lewis Center Drive gate. The study recommended that the DuPont (DuPont-Steilacoom Road) interchange be reconstructed to accommodate forecasted traffic volume growth and noted that if inter-city passenger rail service were extended along present rail line (i.e. Sounder or Amtrak service), substantial alignment and grade separation improvements would be necessary. The DuPont interchange reconstruction recommendations will be considered in the current I-5 corridor study.

East-West Corridor Study, Thurston County (1998) – This study examined the need for improved east-west mobility within Thurston County between Lacey and Yelm. Several alternatives were considered, from constructing a new highway to improving the existing corridors. While the study does have regional significance, it did not examine any impacts within the I-5 study corridor but does illustrate the desire for increased mobility outside of the I-5 corridor.

Woodbrook Business Park Master Plan, City of Lakewood (not yet complete) – This study is not yet complete, but identifies the need for interim improvements to the northbound I-5 ramp intersection at Thorne Lane and improvements to Murray Road and 150th Street SW to accommodate increased development in the Woodbrook Business Park. Since much of the access to the area would be improved with completion of the Cross-Base Highway, the study evaluated improvements necessary to support redevelopment in the area before the Cross-Base Highway is constructed. The recommendations of the Master Plan will be considered as part of the current I-5 corridor study.

Environmental Review

A preliminary environmental review of the study area has been performed with the aid of geographic information systems (GIS). This review is not intended to take the place of a more thorough environmental assessment that might be needed in the future. Instead, the purpose of this review is to provide an indication of where environmentally sensitive areas might exist within the study area. This information can be used to raise any "red flags" or concerns in the development of improvement recommendations for the study corridor. Should any of the recommendations move forward to implementation, this review will be the first step in understanding any environmental challenges that may exist within the study corridor and that will need to be addressed for a recommendation to be implemented.

I-5 through the study area traverses a landscape that is rural at the south terminus of the study area (Mounts Road) to a more developed, semi-urban landscape at the north end of the study area (SR 512). In between this approximately 11-mile stretch of freeway lays JBLM and suburban and commercial development. The terrain is predominantly flat with some bodies of water (lakes and Puget Sound) nearby.

Several maps have been prepared and are included in Appendix A of this document, a list of which is provided below. These maps are summarized continuing in this section.

- Steep Slopes
- Wetlands
- Liquefaction
- Fish Passages
- Floodplains
- Historic Districts
- Sensitive Areas
- Environmental Justice

Steep Slopes

There are no steep slopes alongside I-5 within the study area and there are no areas directly adjacent to the interstate that are classified as either 100-year or 500-year flood zones. However, there are some locations within the study area itself that are classified as 100-year flood zones. These locations are located mostly on Joint-Base Lewis-McChord (JBLM).

Wetlands/Liquefaction/Fish Passages

The wetlands that are not classified as lakes are classified as freshwater forested/shrub wetlands that exist on the military installations themselves. Any improvements to the I-5 corridor are not likely to impact any wetland locations as they are located away from the interstate facility. The entire corridor is classified as being in either "Low" or "Very Low" risk areas for liquefaction and as such the structural designs will not likely require special seismic retrofitting for liquefaction. There are no known fish passage barriers along the corridor.

Historic Districts

There are historic sites within the study area that are located both on and off the military bases. Within the bases are two historic districts.

The McChord Field Historic District contains 31 buildings and 3 structures that date to the establishment of McChord Field and its role in World War II. Additionally, the historic district is also significant for its architecture representative of the period from 1938 through 1952. In 2008 it was listed on the National Register of Historic Places.

The DuPont Historic Village, near Exit 119 (DuPont-Steilacoom Road) is comprised of approximately 430 acres and 110 structures such as homes and commercial structures that mark the founding of the City of DuPont. In 1987 the village was placed on the National Register of Historic Places.

Sensitive Areas

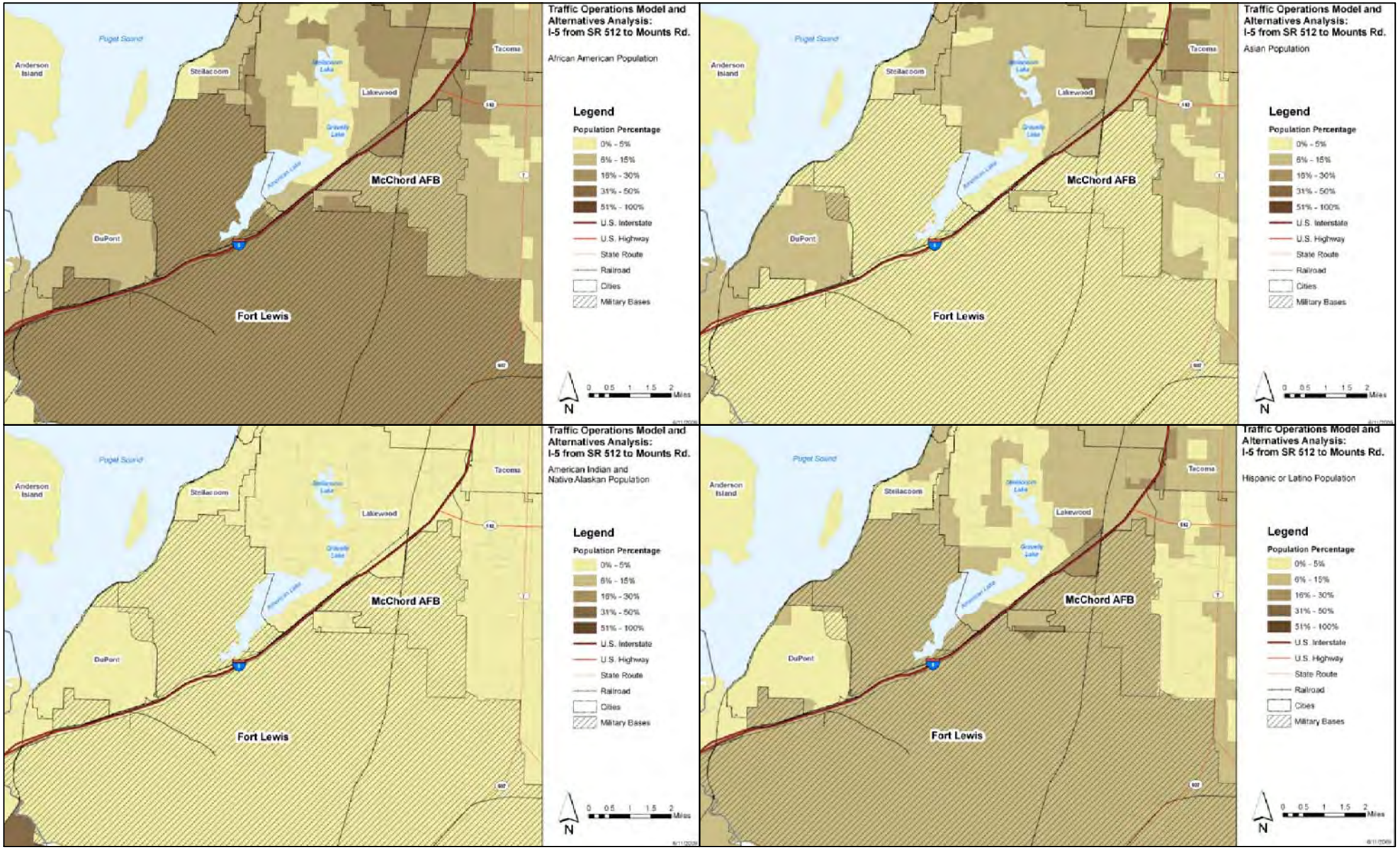
The study area contains some wildlife sensitive areas, plant or ecosystem sensitive areas and large swaths of wet prairie swales. The wet prairie swales are a subset of the prairie landscape and occur in areas with a seasonally high water table. Due to development in the South Puget Sound area many of the original plant and animal species have been exterminated or reduced in the areas designated as wet prairie swales. Nearly all of the I-5 corridor passes through designated wet prairies swales but has minimal to no contact with wildlife or plant/ecosystems sensitive areas.

Environmental Justice

Environmental Justice requires that fair treatment and meaningful requirement be given to all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws and policies. Census data from 2000 was used to determine the proportion of minority and low-income groups in census tracts in or near the study area.

As indicated by the maps in Figure 2 and census data, African-Americans comprise 0 to 30 percent of the population for Lakewood, 6 to 15 percent of the population for McChord AFB and 31 to 50 percent of the population at Fort Lewis. American Indians comprise 0 to 5 percent of the population on JBLM and in the surrounding jurisdictions. Asian residents comprise 0 to 5 percent of the population at JBLM and between 0 to 50 percent of the population of the surrounding communities, depending upon location. The Hispanic population also varies depending upon location. On JBLM they comprise 6 to 15 percent of the population while in the surrounding communities they are 0 to 30 percent of the population.

Figure 3 shows those census tracts that fall below the national poverty level. There are no census tracts below the poverty level on JBLM but there are a number of census tracts in the surrounding communities that fall below the poverty level.



Census Data Summary

FIGURE **2**

I-5 Transportation Alternative Analysis & Operations Model

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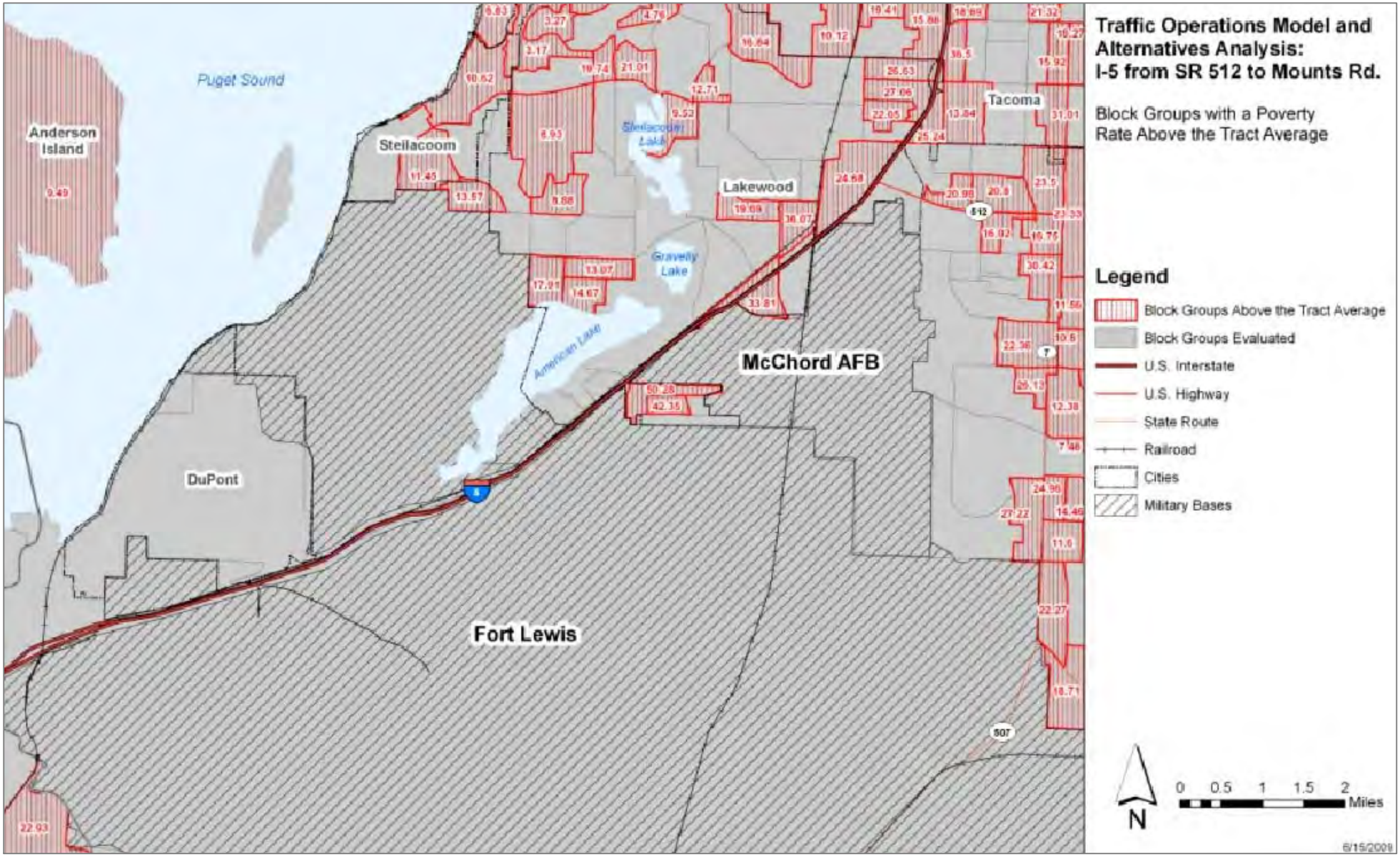

Census Tracts Below Poverty Level

FIGURE **3**

I-5 Transportation Alternative Analysis & Operations Model

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Assessment of Existing Transportation Conditions

This section assesses the existing transportation conditions within the I-5 corridor study area. The assessment identifies those transportation facilities and services currently being provided, while also evaluating their current performance. The results of the assessment will be considered in developing the future improvement strategies for the I-5 corridor. The assessment included a review of the following items:

- Inventory of Roadway Facilities
- Freight and Rail
- Transit Facilities & Service
- Collision Analysis
- Traffic Volumes
- Traffic Operations
- Joint-Base Lewis-McChord (JBLM) Travel Patterns & Trends

The assessment of existing conditions builds off of the prior studies conducted in the area and is supplemented with new information such as traffic counts, collision history, and military travel patterns.

Inventory of Highway Facilities

I-5 was built in the 1950s and 1960s as part of the Interstate Highway system to accommodate the movement of military personnel and equipment. The freeway begins in southern California and runs through California, Oregon and Washington and ends at the Canadian border. The early use of the interstate system focused more on the interstate movement of freight as well as people. As the Puget Sound region has changed and grown in the past 50 years, so has the use of the facility. Although I-5 is still the major freight route from Mexico to Canada, it also serves as the primary commute corridor for many communities. It is estimated that almost 65 percent of the population in the state of Washington lives within 15 miles of the I-5 corridor.

The inventory of highway facilities focuses on key characteristics related to I-5 such as interchange spacing, lane and shoulder widths, bridge inventory, and functional classification.

Highway Characteristics

The study corridor extends approximately 11 miles and includes a total of 9 interchanges. Most of the interchanges are spaced between one to two miles apart, with the Thorne Lane and Berkley Street interchanges spaced the closest at approximately 0.9 miles. The access points along the study corridor between the interstate and local system are shown in Table 1.

Table 1. Interchange Summary

Exit #	Interchange Name	Distance from previous Exit (south to north)
116	Mounts Road / Old Nisqually Road	2.8 miles
118	Center Drive	1.3 miles
119	Steilacoom-DuPont Road	1.1 miles
120	JBLM/ North Fort	1.9 miles
122	Berkeley Street	1.8 miles
123	Thorne Lake	0.9 miles
124	Gravelly Lake Drive	1.1 miles
125	Bridgeport Way	1.2 miles
127	State Route 512	1.6 miles

Source: WSDOT, 2009

From Mounts Road to Thorne Lane, the interstate has three travel lanes in each direction with a concrete barrier that separates the two directions of travel. From Thorne Lane north to SR 512, I-5 widens out to four travel lanes in each direction with a concrete barrier separating the travel directions. The median varies from asphalt to soil depending on the width of the median, but the majority of the median is asphalt surface. This entire stretch of I-5 currently has standard lane widths of 12 feet with 10 foot outside shoulders. A more detailed breakout of the lane and shoulder widths is shown in Table 2.

Table 2. Lane and Shoulder Widths

		# of Lanes		Width (in feet)			Median	
Begin Milepost	Ending Milepost	NB	SB	Inside Shoulder	Lanes	Outside Shoulder	Width (in feet)	Type
116.48	116.71	3	3	6	12	10	300	Guardrail
116.71	118.20	3	4	6	12	10	36	Jersey Barrier
118.20	118.70	3	4	-[1]	12	10	12	Jersey Barrier
118.70	120.05	3	3	-[1]	12	10	12	Jersey Barrier
120.05	121.35	3	3	6	12	10	24 to 36	Jersey Barrier
121.35	124.00	3	3	-[1]	12	10	12	Jersey Barrier
124.00	127.54	4	4	-[1]	12	10	12 to 16	Jersey Barrier

Source: WSDOT, 2009
1. No median. Total width between the two directions of travel is the median width with barrier in between.

The posted speed limit for this stretch of I-5 is 60 mph and the terrain for the entire area is classified as level to rolling. The interstate is classified as an Urban Interstate for almost the entire corridor. The only exception to this is in the immediate vicinity of Mounts Road where it is classified as Rural Interstate.

Bridge Inventory

There are 27 bridges in this 11 mile stretch of I-5. Of these 27, 10 bridges are considered functionally obsolete and one bridge is considered structurally deficient. Table 3 shows how many bridges were built in each decade. In all, 18 of the 27 bridges were built on or before 1960.

Table 3. Date of Bridge Construction

Date Range	Number of Bridges
Before 1960	18
1960 to 1970	4
1970 to 1980	1
1980 to 1990	0
1990 to 2000	4
Total Bridges	27

Source: WSDOT, 2009

A bridge that is classified as being functionally obsolete does not have structural issues but it may no longer meet standards for items such as lane or shoulder widths. A structurally deficient bridge is still safe to travel on, but it may have design loads that exceed the recommended loading of the bridge. This would be an issue if an overweight vehicle used the bridge and is generally the reason behind load restrictions. The only bridge in the study area that is considered structurally deficient is the DuPont Interchange crossing. The DuPont overcrossing, built in 1957, is inspected on a routine schedule and is listed as structurally deficient due to load restrictions.

Table 4 (p 16) highlights the bridge rating information for all 27 bridges in the corridor.

Route Classification

In order to employ appropriate development and design standards, all state and interstate routes in Washington are organized within various classification systems. A brief discussion of the classification systems relative to the study area follows.

Highways of Statewide Significance (HSS)

Highways of Statewide Significance (HSS) include interstate highways and other principal arterials that are needed to connect major communities in the state. This designation assists with the allocation and direction of funding and was mandated by the 1998 Legislature.[2] In 1999 the Legislature requested[3] that WSDOT, with the assistance of Regional Transportation Planning Organizations, update the HSS at least every five years. I-5 and SR 512 are both HSS routes that connect rapidly developing communities in Pierce and Thurston Counties.

National Highway System (NHS)

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) established the National Highway System (NHS). The NHS provides an interconnected system of interstate, principal arterial and other routes that serve major population centers, international border crossings, ports, airports, public transportation facilities, and other intermodal transportation facilities. In addition, these routes meet national defense requirements.

I-5 is designated as an NHS route and supports the United States strategic defense policy by providing access to JBLM and Camp Murray. I-5 also provides access to intermodal transportation facilities and accommodates interstate and interregional travel. Designation as an NHS route influences the level of design standards applied to a route and establishes greater opportunities for federal funding.

[2] RCW 47.06.140
[3] House Joint Memorial 4006

Table 4. Bridge Inspection Summary

Bridge Number	Location (milepost)	Intersects with	Structure Type	Last Inspection Date	Inspection Frequency (months)	Year Built	Operating/ Inventory Rating (tons)	Sufficiency Rating	Structurally Deficient/ Functionally Obsolete
5/405E	116.38	BNRR	Steel Girder	11/14/2000	60	1967	60/60	N/A	N/A
5/405W	116.38	BNRR	Pre-Tensioned Concrete Girder	11/9/2001	24	1936	60/60	N/A	N/A
5/406	116.7	Old Nisqually Rd OC	Pre-Tensioned Concrete Girder	8/4/2008	24	1967	43/26	89.24	N/A
5/406A	116.7	Mounts RD/BNRR OC	Concrete Slab	11/8/2007	48	1960	78/46	92.97	N/A
5/407	117.45	Center Dr OC	Pre-Tensioned Concrete Girder	2/24/2009	24	1997	67/40	76	Functionally Obsolete
5/407.5	118.33	Laundry Spur OC	Concrete Box Girder	8/4/2008	24	1957[1]	60/45	85	N/A
5/407A	117.45	Truck Ramp UC JBLM	Pre-Tensioned Concrete Girder	5/31/2005	48	1997	94/56	98.99	N/A
5/407S-N	117.45	SB Deceleration Ramp	Pre-Tensioned Concrete Girder	4/4/2007	24	1997	73/44	99.53	N/A
5/407S-S	117.45	SB Acceleration Ramp	Pre-Tensioned Concrete Girder	4/4/2007	24	1997	53/32	97.31	N/A
5/408	119.01	DuPont OC	Concrete Slab	8/4/2008	24	1957	74/44	59.71	Structurally Deficient
5/409	119.368	Pendleton OC	Concrete Slab	12/3/2008	24	1957	61/36	80	Functionally Obsolete
5/411E	120.87	JBLM Rd OC	Pre-Tensioned Concrete Girder	4/4/20078	24	1969	87/51	73.53	N/A
5/411NCD	120.87	NBCD JBLM Rd OC	Pre-Tensioned Concrete Girder	4/4/2007	24	1969	96/57	92	N/A
5/411SCD	120.87	SBCD JBLM	Concrete T-Beam	4/4/2007	24	1954	60/36	92	N/A
5/411W	120.87	JBLM RD OC	Concrete T-Beam	4/4/2007	24	1954*	60/35	86.14	N/A
5/413	122.68	Freedom Bridge	Concrete T-Beam	9/25/2007	24	1954	54/3.2	75.96	Functionally Obsolete
5/414	123.58	Thorne Rd OC	Concrete T-Beam	12/11/2007	24	1954	54/32	61.66	Functionally Obsolete
5/415	124.64	Gravelly Lake Dr OC	Concrete Slab	12/11/2007	24	1954	79/46	78.87	N/A
5/415A	124.64	BNRR OC	Concrete Slab	12/11/2007	24	1959	49/29	74.27	N/A
5/416	125.23	New York Ave Over I-5	Concrete Slab	9/25/2007	24	1957	91/54	76.1	Functionally Obsolete
5/417	125.64	Clover Creek	Concrete Slab	7/9/2007	24	1957[2]	61/36	85	N/A
5/418	125.86	Bridgeport Way OC	Concrete Box Girder	12/11/2007	24	1958	88/52	75.06	Functionally Obsolete
5/419	126.19	47th Ave SW OC	Concrete Box Girder	12/11/2007	24	1957	55/32	62.47	Functionally Obsolete
5/420	126.41	BNRR Lakeview OC	Steel Girder	11/12/2002	24	1958	60/60	N/A	N/A
5/421	127.316	S. Tacoma Way over I-5	Concrete Box Girder	12/16/2008	24	1958	54/32	71.56	Functionally Obsolete
5/421A	127.48	Union Ave SBCD OC	Pre-Tensioned Concrete Girder	5/24/2005	48	1974	68/40	79.37	Functionally Obsolete
512/1	0	I-5 OC	Concrete Slab	12/10/2007	24	1958	57/34	79.22	Functionally Obsolete

Source: WSDOT, 2009
1. Bridge re-built in 1969
2. Bridge re-built in 1974

Highway access management standards were developed in 1991.[4] The intent of the standards is to balance the competing needs of traffic movement and local land use. This goal is accomplished by minimization of disruptions to through traffic via selective placement of driveways. In an access managed section of state highway, access from private property is gained via permit and associated fees only. Five classifications have been established for access management on state highways and range from modified to full access control. Modified control provides some restrictions on access to highways but allows access where potential commercial developments preclude the implementation of partial or full control. Full access control provides almost complete freedom from disruption by permitting access connections only through interchanges at selected public roads, rest areas, viewpoints, or weighing stations.

Access control is established to preserve the safety and efficiency of specific highways and to preserve the public investment. Highway facilities with established access control are termed either limited access or access controlled highways. Facilities are further distinguished as having full, partial or modified access control. The number of access points per mile, spacing of interchanges or intersections, and the location of frontage roads or local road connections are determined by the functional classification and importance of the highway, the characteristics of the traffic (commute, freight, recreational, etc.), the present and future land use, the environment and aesthetics, the highway design and operation, and the economic considerations involved.

I-5 and SR 512 are both classified as full access controlled facilities. All access to and from the facilities within the limited access designation is controlled by WSDOT. Any new or modified access to the federal interstate system will require consultation and approval from the Federal Highway Administration (FHWA). The process requires an Interchange Justification Report (IJR) where elements such as safety, operational performance, and consideration of local plans are used to help determine if a change in access should be granted.

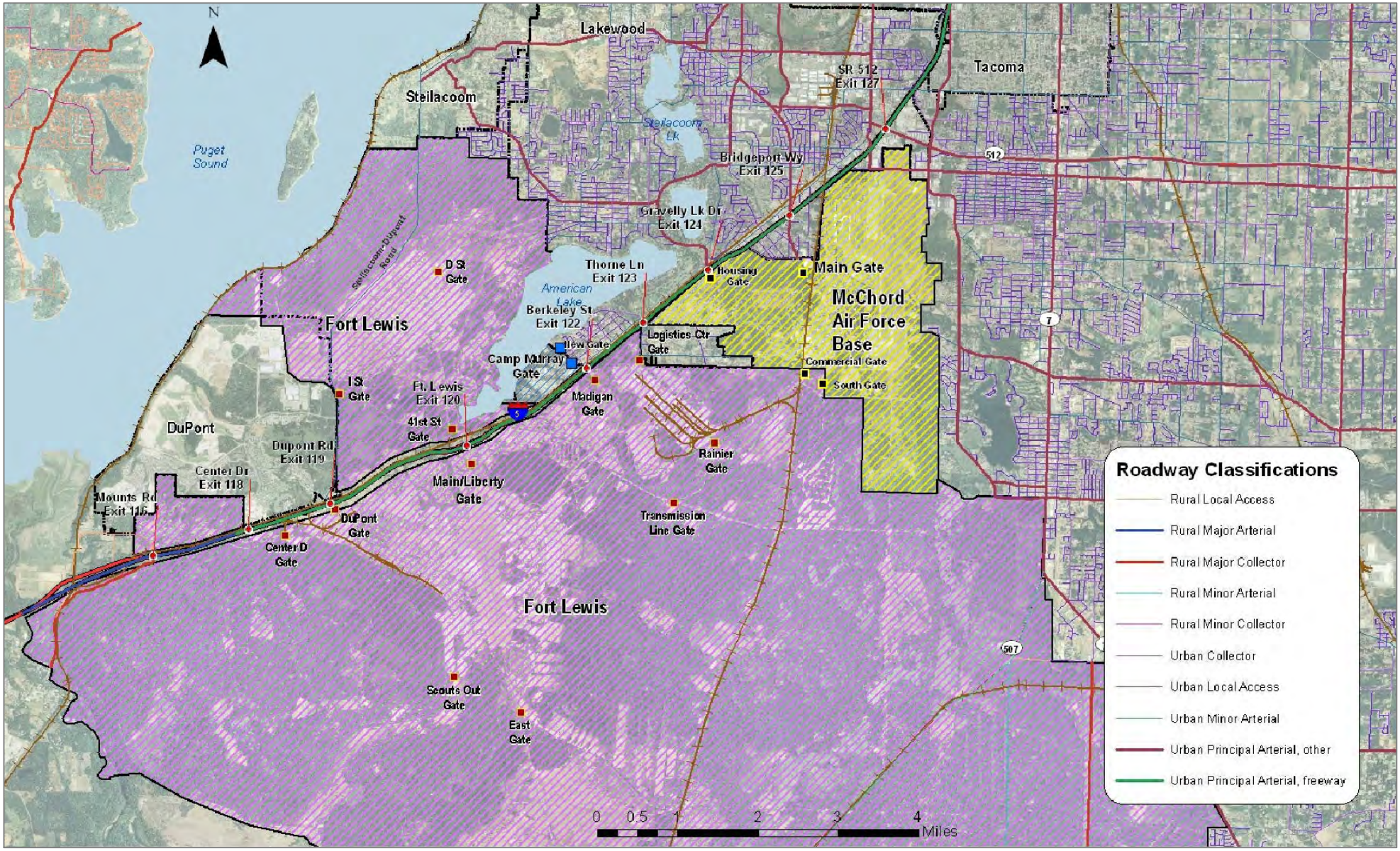
Functional Classification

Functional classification is the grouping of highways, roads, and streets that serve similar functions into distinct systems or classes within the total existing or future highway network. The objective of functional classification is to define the appropriate role (mobility vs. access) of various roadways in providing service and influencing development. Higher functional classification routes provide high volume capacity mobility, accommodate higher travel speed, serve long distance travel, and place less emphasis on local access.

In general, the functional classifications used by WSDOT include: Interstate, freeway, principal arterial, minor arterial, and collector. Within the study area, I-5 is classified as an Interstate. SR 512, located at the northern end of the study area, is classified as freeway. SR 7 is classified as a principal arterial throughout the study area and is located east of JBLM and travels through the Spanaway area. Figure 4 shows the functional classification of these and other major roadways within study area.

In general, there are few high-capacity alternative routes to I-5 within northern Thurston County or southern Pierce County. While alternative routes do exist, all are of lower functional classification (arterials and collectors) and have a relatively dense number of access locations on intersection controls. Due to the high volume north-south travel route demands, these alternative routes do sometimes experience significant congestion as drivers seek to avoid congestion along the I-5 corridor. However, due to the access restrictions of the military bases few alternative routes provide significant improvement over traveling along I-5.

[4] per RCW 47.50



Existing Functional Classification

FIGURE **4**

I-5 Transportation Alternative Analysis & Operations Model

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Freight and Goods Transportation System

A principal function of the Washington State highway system is to promote efficient movement of freight and goods. In 1990, the Legislative Transportation Committee (LTC) requested a study that analyzed the use of, benefits from, and damage to the state's highway transportation system by truck-borne freight movement.

In response to this study, a law[5] was passed directing the Transportation Commission to adopt a Freight and Goods Transportation System (FGTS) including state highways, county roads and city streets. In addition, the Commission was directed to review and provide recommendations to the legislature regarding policies governing weight restrictions and road closures that affect the transportation of freight and goods in conjunction with local governments. The Commission adopted the final FGTS System on March 16, 1995 that was developed jointly by WSDOT pavement engineers and local government engineers. Figure 5 shows the FGTS rankings for all state highways as well as the local arterials in the study area.

Truck Routes

I-5 is classified as a T1 freight route, meaning that it carries more than 10 million tons of freight per year. Trucks make up 10 to 13 percent of the total daily volume of traffic on I-5 within the study area, which equates to almost 15,000 trucks per day.

State Route 512 is also classified as T1 route, but most of the remaining transportation system within the study area is either T2 or T3 which carry 300,000 to 4 million tons of freight annually.

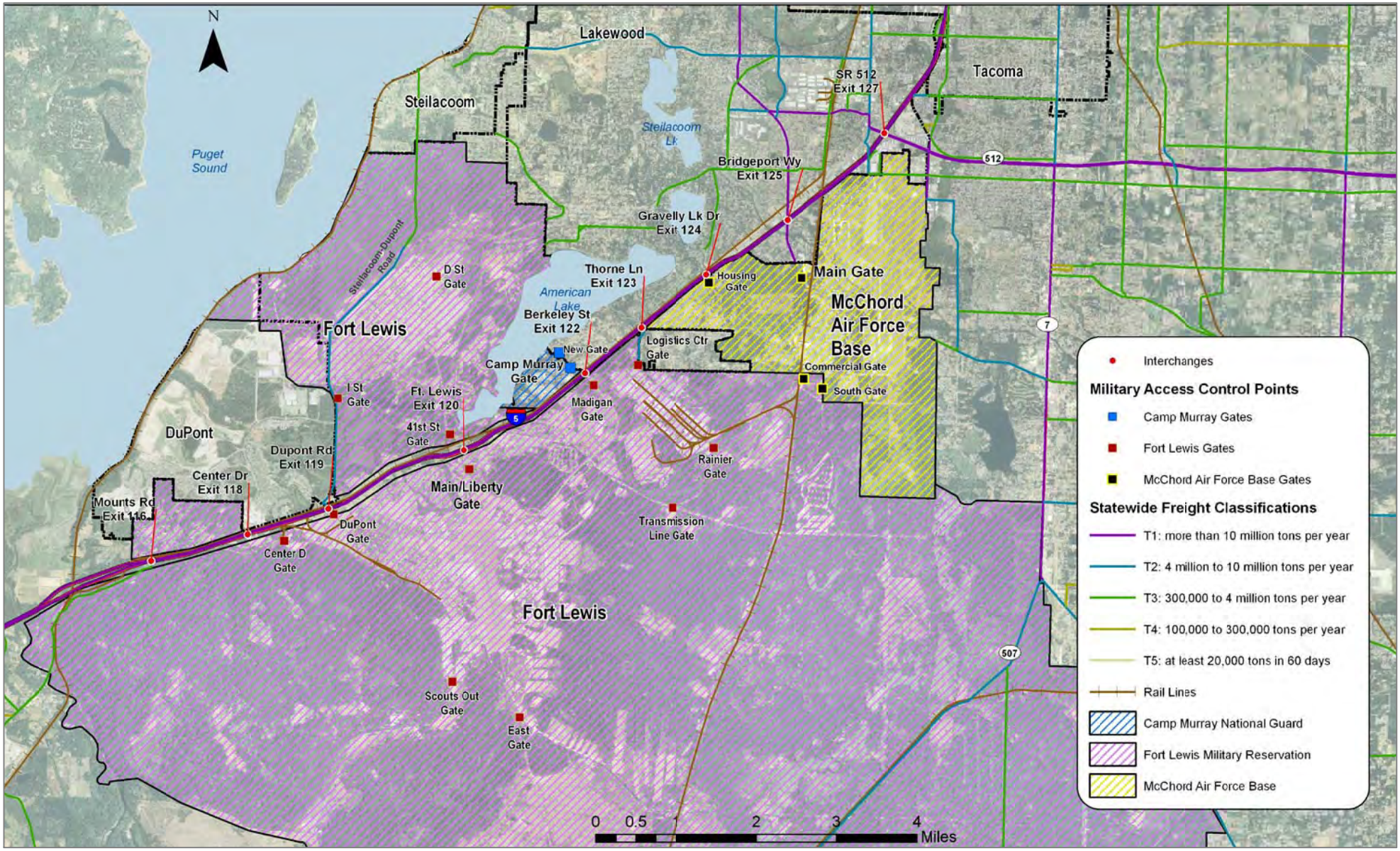
Rail

There are four rail operators who use rail lines located within the study area or the region immediately surrounding the study area: Burlington Northern Santa Fe (BNSF), Tacoma Rail, Amtrak, and Sound Transit. Within the study area these rail operators use three sets of rail tracks. One rail line travels along the coast of Puget Sound (mainline) and merges at Nisqually with a second line that runs parallel to I-5 (Lakeview). The third rail line runs through east JBLM (between I-5 and SR 7) between Roy to South Tacoma. A map of the existing rail lines within the study area vicinity is shown in Figure 5. Later sub-sections provide a more detailed description of each of these rail operators and the services they provide and are followed by a discussion of the Point Defiance Bypass Project.

Currently, BNSF and Amtrak regularly use the mainline tracks along Puget Sound. Amtrak currently operates 10 trains per day along the mainline tracks while Tacoma Rail operates two to three trains per week on the Lakeview tracks adjacent to I-5. In addition, Sound Transit will increase rail operations within the study area by extending its existing commuter rail service to the Lakewood Station, located at the northern end of the study area, by 2012.

With completion of the Point Defiance Bypass Project that is currently under construction Amtrak service will be shifted from the mainline tracks to the Lakeview tracks along I-5. This will result in increased rail crossings occurring at each of the I-5 interchanges from DuPont-Steilacoom Road to Thorne Lane. Additional information on specific impacts of this project are presented in the *Point Defiance Bypass Project: Traffic & Transportation Discipline Report* and are discussed in further detail in the earlier Literature Review section (see p 7) and also within this Rail section (p 22).

[5] The Revised Code of Washington (RCW) 47.05.021



Existing Freight and Goods Transportation System

FIGURE **5**

I-5 Transportation Alternative Analysis & Operations Model

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BNSF Railway

BNSF Railway is the major rail freight carrier in the Pacific Northwest. It operates freight trains on two separate tracks in the study area. The first set of tracks is the mainline that originates in Portland, Oregon. Near the Nisqually River the track branches off into two directions: the mainline and the Lakeview Line (for the Lakeview Line see Tacoma Rail description directly below this discussion.) The mainline tracks veer to the north and continue along the coast through DuPont, Steilacoom, Lakewood and Tacoma. Another set of tracks, from Roy to Lakeview, travel through JBLM land mainly carrying shipments about once a week from the Wilcox Farms. This set of tracks also serves MoBase, (southeast of McCord Air Field). MoBase traffic varies based on deployments from JBLM and returning deployments.

The mainline tracks are also used by Amtrak but Amtrak service will eventually be rerouted onto the Lakeview tracks (see the Pt. Defiance Bypass Project description).

The amount of freight tonnage shipped on BNSF tracks is not readily available because the company is guarded about releasing such information.

Tacoma Rail

This rail operator is owned by Tacoma Public Utilities and operates two to three times per week. Tacoma Rail's three divisions, Capital, Mountain and Tidelands move more than 20 million feet of rail equipment along 204 miles of track and serve major industries in the Puget Sound region. Most of the goods carried by Tacoma Rail have the Port of Tacoma as their origin or destination. In total, Tacoma Rail carries about 330,000 gross tons/year.

The Port of Tacoma is one of the largest container ports in North America; handling more than two million TEUs (20-foot equivalent units) per year. Tacoma Rail serves shipping companies such as Evergreen, K Line, Yang Ming and Hyundai through the Port. In addition to containerized cargo, Tacoma Rail's freight includes chemicals, automobiles, scrap metal, feed, grain, frozen food, lime, petroleum products and lumber products.

Capital Division

On November 16, 2004, Tacoma Rail started providing service on three of the Burlington Northern Santa Fe (BNSF) distribution lines. These distribution lines are:

- **Lakeview Line** parallels the I-5 corridor from Nisqually to just before SR 512 and then on to South Tacoma, consists of 15 miles of track and carries animal feed, plastic pellets, polyethylene and sand. These tracks are owned by BNSF Railway but are leased to Tacoma Rail.
- **Belmore/East Olympia Line** runs from East Olympia to Belmore. Products shipped on this line range include lumber, bricks and aluminum.
- **Quadlok Line** is the smallest of the three lines. It starts in St. Claire and heads Northwest three miles to Quadlok. It currently serves one customer who receives pulp board.

Mountain Division

In 1998, Tacoma Rail began operating the Mountain Division to provide freight rail service between Tacoma, Frederickson in South Pierce County, Morton and Chehalis; a total of 132 miles. The City of Tacoma owns the line and has contracted with Tacoma Rail to operate it.

Current customers include Boeing, Hardie Building Products, MacMillan-Piper, Medallion Foods and Harris Rebar. The Mountain Division also provides storage services for the Union Pacific and BNSF Railroads.

The Mountain Division interconnects and interchanges with the Union Pacific and BNSF railroads in Tacoma and at Centralia/Chehalis. The Mountain Division is also connected with the Puget Sound and Pacific Railroad that serves Elma, Bangor, Bremerton, Shelton, Aberdeen and Hoquiam.

Tideland Division

The Tidelands Division services are concentrated solely at the Port of Tacoma's docks and do not operate in or near the I-5 corridor study area.

Amtrak

Amtrak, the national passenger rail service, operates trains between Seattle and Vancouver, B.C and between Seattle, Portland and Los Angeles. There are a number of stops along each route. The service between Seattle, Portland and Los Angeles operates on the BNSF railway near Point Defiance. Eventually, this service will be rerouted from the section of track that hugs the coast between Nisqually and Tacoma onto tracks that are parallel with the I-5 corridor and JBLM (see Pt. Defiance Bypass Project description).

Currently, there are 10 trains per day; four round trips between Seattle and Portland and two Starlight Trains between Seattle and Los Angeles. It is anticipated that by 2014 another round trip train between Seattle and Portland will be added.

Sound Transit

Sound Transit currently operates commuter rail service between Tacoma and Seattle. As part of ST2 funding package, which was approved by voters in 2008, commuter rail will be extended to Lakewood, serving the Lakewood Station. Commuter rail service is expected to begin by 2012. This new commuter rail service will operate on tracks that are being upgraded as part of the Pt. Defiance Bypass Project. Service will operate to Tacoma and Seattle and from the new Lakewood Station.

Point Defiance Bypass Project

The Point Defiance Bypass Project, a joint effort by WSDOT and Sound Transit, will reroute passenger trains operating on BNSF tracks between Nisqually and Tacoma to an inland route. Currently, trains must slow down due to curves and single-track tunnels on the BNSF Railway main line tracks near Point Defiance and along southern Puget Sound. The bypass is on an existing rail line that runs along the west side of I-5, through south Tacoma, Lakewood and DuPont. It reconnects the BNSF Railway main line near Nisqually on the east side of I-5.

These improvements will enable the Amtrak Cascades service to avoid delays due to freight or Sounder trains; resulting in faster and more reliable service for Amtrak and its passengers. This bypass will also allow travel speeds to increase up to 79 mph, reducing travel times between Seattle and Portland by six minutes. BNSF will benefit by being able to operate more freight trains on the existing route. Part of the proposed route will also be used by Sound Transit to extend Sounder commuter rail to Lakewood.

The project is located along an 18-mile corridor owned by Sound Transit. Improvements to be made are:

- A new second track between South Tacoma and Lakewood;
- New rails, ties, and ballast along the west side of I-5 between the City of Lakewood and Nisqually;
- Improved connection to the main line near Nisqually; and
- Safety and upgrade improvements at ten road and rail at-grade crossings.

This $100 million project is funded through various sources such as vehicle weight fees, vehicle sales tax and federal funds. Construction was anticipated to be completed by 2019, but with the American Recovery and Reinvestment Act (ARRA) High Speed Rail award for this project, construction is now anticipated to be completed by the end of 2013.

Transit Facilities and Service

This section provides an overview of transit service and transit facilities available within the study area. The information describes which transit agencies operate within the study area and the type of transit service they provide such as bus routes, destinations and frequencies. Lastly, this section also gives a description and location of Park & Ride facilities within the study area.

There are currently three transit service providers that operate within the study area. These agencies are summarized in the following sections.

Sound Transit Bus Service

Sound Transit operates four regional express bus routes on the I-5 corridor within the study area. Sound Transit does not provide local bus service within the study area. The Sound Transit routes are:

- Route 592: This route serves DuPont/Lakewood/Seattle operating only on weekdays mainly during the morning commuter peak period to Seattle and late afternoon and early evening back to Lakewood and DuPont. On weekdays route 592 runs every 10-15 minutes during the AM peak period and approximately every 30 minutes during the PM peak period.

- Route 594: Lakewood to Seattle providing weekday and weekend service from the early morning to late evening. This route operates with 30 minute headways during weekdays.

- Route 574: Lakewood to SeaTac Airport operating on weekdays and weekends from the early morning to the late evening. Headways between bus departures are approximately 30 minutes until 7:00 PM when headways increase to 60 minutes.

- Route 599: Lakewood to Tacoma operating during the morning and afternoon peak periods. This is a temporary service that will end in 2012 when commuter rail service to Lakewood begins. During these peak periods, headways between buses are approximately 30 minutes apart.

Commuter Rail

Sound Transit currently operates commuter rail service between Tacoma and Seattle. Seven northbound trains depart from Tacoma every 30 minutes from 5:00 AM until 8:00 AM, and two northbound trains also depart Tacoma at 4:30 PM and 5:00 PM. Likewise, seven southbound trains leave Seattle every 25-35 minutes from 3:15 PM to 6:15 PM, while two additional trains depart at 6:10 AM and 6:50 AM.

As part of ST2, which was approved by voters in 2008, commuter rail will be extended to Lakewood, serving the Lakewood Station. Commuter rail service is expected to begin by 2012. With the exception of the 599 bus service, Sound Transit is anticipating retaining the other parallel bus routes in the study area after commuter rail service is implemented.

Pierce Transit

Pierce Transit is responsible for the local bus service and operates four routes (204, 206, 207, and 300) within the study area. In addition, route 207 operates on-site at JBLM and has three separate sub-routes.

- Route 204: Parkland to Lakewood via S 112th Street and serving the SR 512 Park & Ride. Service on this route is provided seven days a week from the early morning to late evening, with 15 minute headways during peak weekday commute periods and 30 minute headways otherwise.

- Route 206 operates between the Lakewood Transit Center and Madigan Hospital. Service is provided seven days a week from the early morning to late evening. Buses operate every 30 minutes throughout each weekday and Saturday, and 60 minute headways on Sundays.

- Route 207B: This route operates on JBLM between Madigan Hospital and Cemetery Road and 22nd Street. Service is provided on weekdays only from mid-morning (40 minute headways) to mid-afternoon (40 to 60 minute headways).

- Route 207G: This route serves JBLM and operates only during the weekend between the early morning and early evening. The route operates from the DuPont Park & Ride, JBLM bus depot, and Madigan Hospital at 6:00 AM and 7:00 PM. Service is otherwise provided every 30 minutes from 7:00 AM to 8:30 AM and from 4:00 PM until 7:00 PM.

- Route 207P: This route also operates as a loop within JBLM, serving the airfield and commissary. Service is provided every 30 minutes between 10:45 AM and 1:15 PM.

- Route 300: This route serves McChord Air Force Base operating between the Tacoma Mall Transit Center and McChord Commissary with stops at the SR 512 Park & Ride and the Lakewood Station (commuter rail). Service is provided every 30 minutes from 5:45 AM until 6:45 PM when headways increase to 60 minutes until 10:30 PM.

Due to security requirements at the bases, providing transit service for the general public to the bases is a challenge for Pierce Transit because it is not permitted to carry non-military personnel through the gates. The agency has been working with the bases to develop a method that would serve both the general public's needs of wanting to take transit to the bases and satisfying the military's need for base security.

One option being considered is a transit center adjacent to one of the JBLM gates with access for military personnel to be discharged and walk through the gate and transfer to a bus inside the gate. Though this would not enable Pierce Transit to carry non-military personnel onto the base, it would enable Pierce Transit to co-mingle military and non-military personnel on the same bus from distant locations; increasing the riders per hour.

Pierce Transit has also undertaken a study to examine its bus system (routes, schedules, etc). The results of that study should be available by the end of 2010 and any changes or modifications to the system will occur after that date.

Intercity Transit

Intercity Transit provides three routes, 603, 603A and 620, between Tacoma and Thurston County. None of these routes directly serve the bases. The Intercity Transit routes serving the study area are as follows:

- Route 601: Weekday, peak hour service only between Gig Harbor, Lakewood and downtown Olympia with stops at the SR 512 Park & Ride.

- Route 603: Weekday service only between downtown Olympia, Lakewood and Tacoma. The service is provided from early morning to mid-evening with stops at the SR 512 Park & Ride.

- Route 603A: Weekday service only between downtown Olympia, Lakewood and Tacoma. The service is provided in the early morning to Lakewood and Tacoma and in the mid to late afternoon from Tacoma and Lakewood to Olympia; making stops at the SR 512 Park & Ride.

- Route 620: Weekend service only between downtown Olympia, Lakewood and Tacoma, making stops at the SR 512 Park & Ride. The service is provided from mid-morning to mid-evening.

Park & Ride Lots

There are three Park & Ride lots in or near the study area. They are:

- SR 512, located one-half block east of the intersection of South Tacoma Way and Pacific Highway South, adjoining I-5 at exit 127 (SR 512). This Park & Ride is served by Pierce Transit Routes 204 and 300; Sound Transit routes 574, 592, 594; and InterCity Transit routes 601, 603, 603A and 620. It has 493 stalls and typically operates 3 percent over capacity.

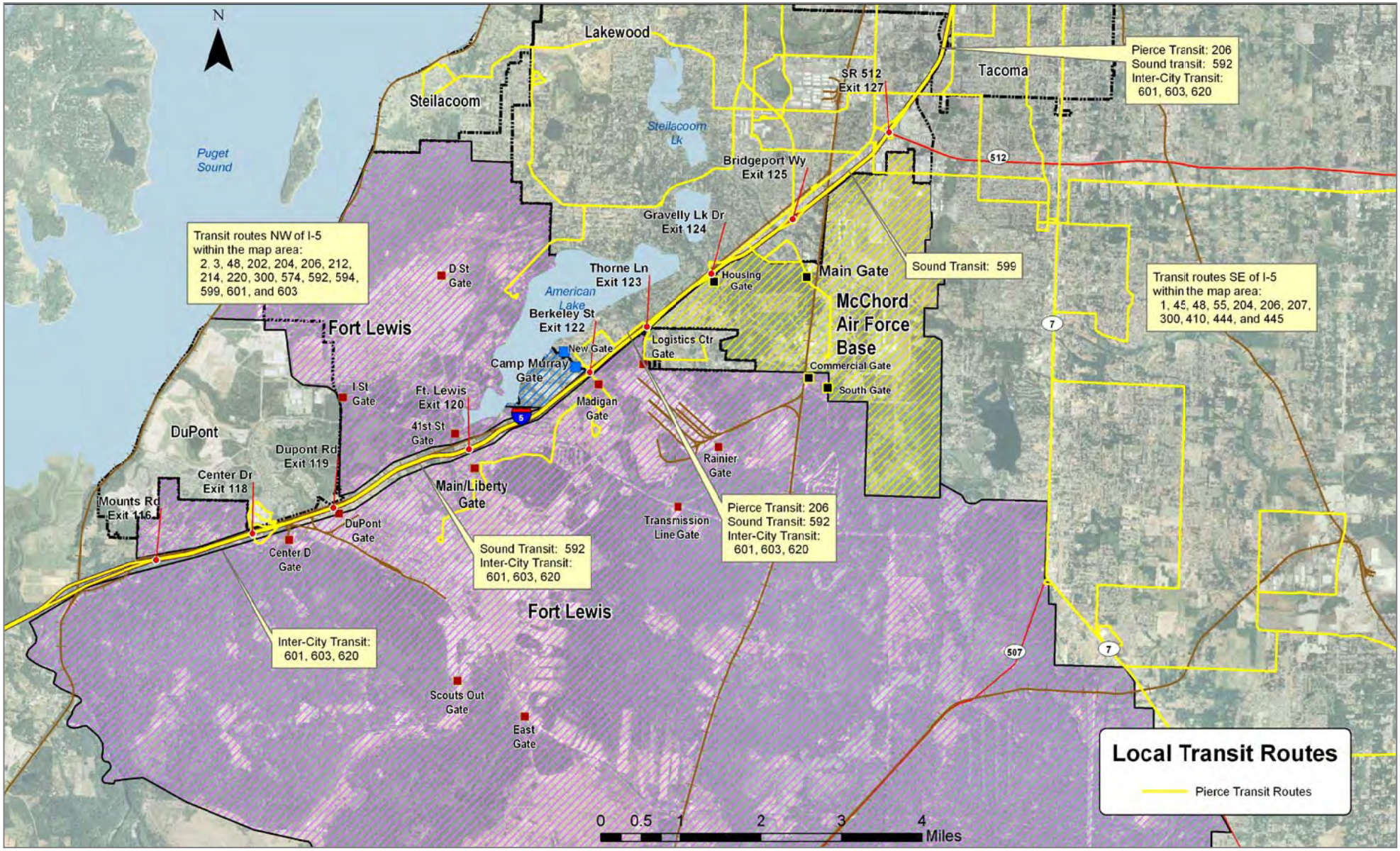
- Lakewood Sounder Station, located at 11424 Pacific Highway South and 47th Avenue SW, approximately 4/10th of a mile north of the I-5/Bridgeport Way interchange (Exit 125) and approximately 1.3 miles south of the I-5/SR 512 interchange (Exit 127). The facility opened in 2008 and contains 620 parking stalls plus shelters and kiosk ticket machines. The station is currently serving regional and local bus routes and will eventually be the south terminus for commuter rail. It is served by Pierce Transit route 300; Sound Transit route 599 and InterCity Transit routes 601, 603, 603A and 620 and has a utilization rate of approximately 40 percent. This rate is expected to increase after Sound Transit commuter rail service commences in 2012.

- DuPont, located at Wilmington Drive and Palisade Boulevard, has 125 stalls and is served by Pierce Transit route 207G and Sound Transit route 592. This facility regularly operates at 10 percent over the available capacity.

An overview of transit service within the study area is shown in Figure 6.

Challenges for Public Transit & Military Installations

Formulating successful public transportation and TDM strategies that are designed to serve both military and civilian populations, on- and off-post, in a coordinated manner is a common challenge throughout the United States. This section contains summaries of various subject areas that collectively challenge the provision of public transportation services and the abilities of these services to provide measurable impacts to congestion along the I-5 corridor.



Existing Transit Service

FIGURE

6

I-5 Transportation Alternative Analysis & Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\08301_graphic05 <Fig 6> jesseb 08/31/10 14:08

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In a transportation environment like that surrounding JBLM, where I-5 is the primary corridor for the base and between urbanized areas, the challenge becomes more complex due to a lack of parallel travel modes that also impact transit operations. These challenges are not intended to dissuade pursuit of new or enhanced services. However, the outlining of these regulatory and operational hurdles represent how difficult it can be to overcome them to introduce or maintain services within a military installation and provide for effective congestion relief.

Base Access & Security

The need for all types of vehicles to access JBLM is a key component in achieving increased usage of public transportation and TDM-related services. Whether it is a transit bus, a wheelchair equipped van, a taxi, a carpool, or a vanpool, there are challenges to providing access due to security requirements at JBLM gates. Ultimately, the success or failure of any service is highly dependent on how the vehicle interfaces with security requirements. Area transit agencies and JBLM are exploring an option that would create a transit transfer center off-post but near one of the main gates. This would allow personnel to walk through the base gates to board transit services on-post.

Parking Availability

Parking spaces at JBLM are universally available at almost all buildings and are unconstrained from a capacity perspective. In a traditional city central business district, which is not all that dissimilar from main employment areas on JBLM, the availability of parking is seen as one of the primary factors that lead to low levels of transit usage. While there are a high number of available parking spaces throughout JBLM, it is acknowledged that some areas with a high concentration of employment have a shortage of convenient spaces.
The availability of free and convenient parking means that transit options must be convenient and user-friendly, as well as comparable from a travel time perspective, to compete with single occupancy vehicle use. Other options such as providing preferential treatment for carpool and vanpool riders could also be explored or enhanced.

Streamlined Operations

The location of JBLM within the region, in combination with commute patterns, mean that several different agencies currently provide some type of bus or vanpool service to the area. Sound Transit, Pierce Transit and Intercity Transit service areas on or near JBLM in the form of express buses, local routes, vanpools and park-and-ride lots. Operating in a military environment requires JBLM's Logistics Department, which coordinates the Commuter Trip Reduction program, to coordinate with several different agencies to increase transit patronage. This will also require some level of approval from the Joint Base Commander or other base management if increased transit and TDM programs and access challenges are to be addressed.

Transit Agency Coordination

Related to the streamlining of operations is the level of coordination among transit service providers to make it as easy as possible for JBLM personnel to use services and for JBLM management to coordinate with service providers. The prospects of providing operations or access agreements, driver security clearances, and other coordination aspects of transit services can complicate the issue for base management who are not regularly working within the same regulatory framework common to the transit industry. For transit riders, a coordinated fare structure or pass system as well as a centralized billing function for passes or incentive program reimbursement can also help make transit more convenient.

Disbursement On-Base

Employment and activity centers located at JBLM are spread throughout areas within the boundaries of the base. The travel time between these locations and their arrangement in location to other activity generators can make it difficult to provide transit services to base personnel throughout the work day. To effectively serve these disparate locations it would be difficult to economically provide point-to-point service via transit for personnel without requiring a transfer, thus reducing the potential effectiveness of on-post services.
Additionally, the nature of everyday military work sometimes requires quick response to move to different areas of the base. The prospect of waiting curb side for the next bus to arrive, particularly if headways are greater than 10 to 15 minutes, can impact the mobility of personnel who have to react on a military timeline.

Deployments

Deployments are also a key factor influencing transit services and ridership on a month-to-month or year-to-year basis. Transit services, particularly specialized operations such as vanpools, can be greatly impacted by deployments as large numbers of personnel are shifted away from the base and the allocation of resources to these services can cause transit operators to be reluctant to re-employ services.

Funding

The funding shortfalls for public transportation agencies throughout the United States have been well-documented, particularly during the current economic climate where operators are trimming routes and staffing levels in order to meet budgetary constraints. The current funding issues at Pierce Transit will likely result in the elimination of some of the existing routes on JBLM.

Given the funding situation, transit operators are very receptive to partnerships and incentive programs provided outside of their operating budgets to provide and promote new services and generate ridership. Without these types of partnerships, it is difficult for operators to justify new or expanded services in hard-to-reach markets such as military installations.

Marketing of Services

The marketing of transit, carpooling and vanpooling, tailored to the needs of base personnel, is vital to the success of these services. Transit surveys across the United States reveal that lack of awareness is a reason for not opting for such transit alternatives. Further, given that military personnel are eligible for fare subsidy programs that will pay, in most instances, for the entire monthly bus, rail or vanpool fare, the concept of basic awareness should be at the forefront of any effort to encourage transit ridership to JBLM. To create awareness of existing or potential services, the area's transit agencies, JBLM, and surrounding communities could coordinate to develop joint promotional materials to inform employees about the services that are available.

Safety Analysis

With safety as the number one goal for WSDOT, the agency has adopted measures and strategies to reduce the number of collisions and the severity of collisions on state owned and operated roadways. While the geometrics of a roadway may be a contributing factor in collisions, analysis by WSDOT indicates impaired driving (alcohol and drug influence), speeding, and failure to wear seat belts are contributing factors to highway fatalities.

One of the strategies WSDOT has implemented includes "Target Zero," which identifies Washington State's traffic safety needs and guides investment decisions to achieve significant reductions in fatalities and serious injuries on all public roads. This strategy incorporates four

traditional highway safety components commonly referred to as the "four Es": enforcement, engineering, education, and emergency services.

Additionally, in September of 2009, the WSDOT Highway Safety Executive Committee issued new guidelines for analyzing, compiling, and documenting safety data for state routes. These new guidelines are highlighted by two analysis procedures that make use of GIS data to screen locations across the state. Analysis findings would be used to identify locations for potential safety projects.

The first procedure is Collision Analysis Location (CAL). The CAL is a quarter-mile analysis, using the last five years of collision data, and entered into MS Excel to generate results that are then mapped in GIS. Fatal, serious, and evident injury collisions become points for each ARM Accumulated Route Mile (ARM) along a route. These points are compared to adjacent points and if they are located within one-half mile of each other it becomes a segment and assigned a segment number with a beginning and ending ARM value.

The segments are analyzed to determine the various (Fatal, Serious, or Evident Injury) collision totals. Only if the segment has six or more Evident Injury collisions and four or more Fatal and Serious collisions, as well as no planned safety project over the next six years, is the segment retained on the CAL list.

The second procedure is the Collision Analysis Corridor (CAC.) The CAC is an analysis, using the latest five year period of collision data and MS Excel to generate results that are then mapped in GIS. Fatal and Serious collisions become points along a route. Any five mile segment with a history of 11 or 30 more fatal or serious collisions should be included in the CAC.

Assumptions and Exclusions

- All collisions, barring those occurring on spurs, couplets, and alternate routes, are considered to be mainline collisions.
- All collisions occurring within managed access areas with populations greater than 25,000, turnbacks, and ferry terminals are excluded.
- Property Damage Only and Possible Injury collisions are excluded.
- Only collisions occurring on state highways within a five-year period are included.

In order to provide greater consistency and less confusion regarding the likelihood of project recommendations and construction, the following guidance is also given:

- Use the "Potential Safety Projects List" approved by the Highway Safety Executive Committee. The regions will analyze crash frequency, severity, and contributing factors and identify cost-based incremental solutions, low cost to ultimate fix. A benefit cost analysis will be provided for each solution.
- Do not refer to design standards as criteria for identifying safety needs or recommending safety solutions.
- Include only those collision locations that are consistent with current WSDOT methodology.
- Do not propose safety projects that do not meet current WSDOT safety criteria.
- Avoid words that are not clear in meaning or that could be misinterpreted or that may express one's personal opinion.
- Project identification is to be done solely through the priority array and in accordance with RCW 47.05.

For the I-5 study corridor, the most recent safety data assembled (2004-2008) for the CAC and CAL analysis reveal no CAL along the 30-mile segment. However, one CAC was identified for a five-mile section from milepost 115 (near the Thurston/Pierce county line) to milepost 120 (Exit 120 – 41st Division Drive). According to documented safety data there were 629 collisions, including two fatalities, along this CAC.

Details of the analysis findings show that of the 629 recorded collisions, the predominant collision types were rear end (351 or 56%); striking or being struck by an object (112 or 18%); and sideswipe (99 or 16%).

The analysis also shows that the main contributing circumstances to the above referenced collisions are speeding (191 or 30%) and following too closely (136 or 22%). Lastly, the severity of the 629 collisions appears to be low. Of the total number of collisions reported, 402 (or 64%) had no injuries while 162 (or 26%) of the collisions reported possible injury. Of the two recorded fatalities, one occurred at milepost 116 (Exit 116 Mounts Road) and the other at milepost 119 (Exit 119 DuPont Steilacoom Road.)

It is likely that part of the CAC will be addressed through the recommendations that have been developed as part of this I-5 study that recommends improvements to the interchanges at Exit 119 DuPont Steilacoom Road and at milepost 120 (Exit 120 41st Division Drive.) Further discussion and description of the proposed improvements can be found under "Improvement Concepts" on beginning on page 59.

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

Safety Summary

- Rear-end and Sideswipe collisions account for the greatest number of collision type and severity, respectively.
- The type and severity of collisions are consistent with urban stop-and-go traffic.
- Fatalities are low.
- The greatest frequency of collisions occurs at Exit 127 (SR 512), McChord (Exit 125), and Exit 123 Madigan/Camp Murray.

Traffic Volumes

Regional traffic volumes on I-5 fluctuate from year to year and are affected by population and employment trends and economic cycles within the region as a whole. The rapid population growth in Washington State over the past 20 years has led to some significant changes in traffic volumes, especially on urban interstates in the Puget Sound region. Until 2007, traffic volumes have historically increased on an annual basis in the region, but recent economic conditions have led to reductions in traffic volumes across the state. Although recent data shows reductions in both traffic volumes and congestion levels, it is important to understand that the current downward trends are likely to reverse course as the economy begins to recover and employment returns to traditional levels.

Regional Population Trends

Population in the central Puget Sound region has experienced steady growth since 1990. Table 5 summarizes the population estimates for Pierce and Thurston Counties, and provides statewide estimates for comparison. In 2008, Pierce County had the second largest population in the state. Over the last 18 years, the population of Pierce County alone has increased by almost 220,000 people; this increase is greater than the entire population of Thurston County in the 2000 Census. As of April 2008, the Puget Sound region's population was estimated to have reached 3,633,000, representing more than 55 percent of the State's population. Since the 2000 Census, Pierce

County has grown by an annual average rate of 1.8 percent and Thurston County by 2.1 percent. This compares with approximately 1.4 percent annual growth for the state as a whole.

Table 5. Historic Population Trends

	Population Estimates			Annual Growth Rate		
County	**1990 Census**	**2000 Census**	**2008 Est.**	**1990 to 2000**	**2000 to 2008**	**1990 to 2008**
Pierce	586,203	700,818	805,400	1.8%	1.8%	1.8%
Thurston	161,238	207,355	245,300	2.5%	2.1%	2.4%
Washington	4,866,669	5,894,147	6,587,600	1.9%	1.4%	1.7%

Source: 2008 Population Trends for Washington State from Office of Financial Management, Tables 2 and 3

Table 6 summarizes the annual population growth between 2000 and 2008 for municipalities adjacent to JBLM and demonstrates the variation between each jurisdiction. As the table shows, the City of Tacoma grew at 0.6 percent, the Town of Steilacoom at 0.4 percent, and City of Lacey at 2.5 percent. Since 2000, the City of Lakewood's population has increased by 0.1 percent, from 58,293 to 58,780. The rate of population growth in the south Puget Sound region has been fairly steady since the 2000 Census but shows discernible population spikes after 2005 that correspond with the defense-related growth at JBLM. Much of the growth in Pierce County over the past decade has occurred in the unincorporated areas of Pierce County east of the bases such as South Hill, Graham, and the city of Puyallup as well as DuPont and Roy.

Table 6. Historic Population Trends by Local Jurisdiction

Jurisdictions	2000	2008	Net Change (2000 to 2008)	Annual Average Growth Rate
City of Tacoma	193,556	202,700	9,144	0.6%
City of Lakewood	58,293	58,780	487	0.1%
City of Lacey	31,226	38,040	6,814	2.5%
City of DuPont	2,452	7,390	4,938	14.8%
Town of Steilacoom	6,049	6,255	206	0.4%
Town of Roy	260	875	615	16.4%
City of Yelm	3,289	5,150	1,861	5.8%
Joint-Base Lewis-McChord (JBLM)	48,104	77,616	29,512	6.2%

The Pierce County communities of Roy and DuPont were the second and third (respectively) fastest growing areas in the entire state of Washington, and Yelm in Thurston County was 15th overall. A significant portion of this growth is attributable to residential developments that have specifically catered to military personnel. For example, data shows that of the 5,150 people living in Yelm, 2,211(41 percent) are JBLM soldiers, family members or civilians employed on post. Of the 7,390 citizens of DuPont, 2,985 (40 percent) are JBLM soldiers, family members or federally employed civilians. Thus the tremendous growth experienced in both DuPont and Yelm can be directly correlated to personnel growth at JBLM and related employment.

As shown in Table 6, the on-base population of JBLM personnel and their families residing on base has increased by over 29,000 people since the year 2000. This is nearly 30 percent of the total change in the population for Pierce County. The Department of the Army is conducting an Environmental Impact Statement (EIS) for options that could double the active-duty population over 2009 conditions. This growth will lead to opportunities and challenges for JBLM and the communities in the surrounding region.

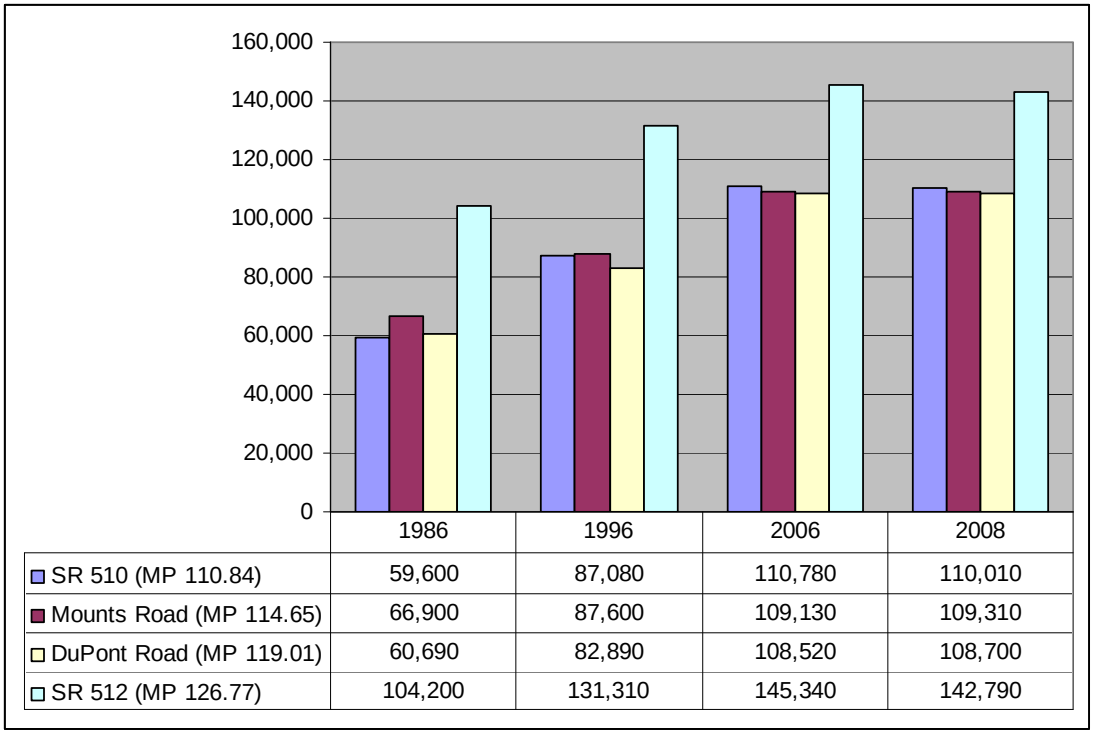
Traffic Volume Trends

Since 1990, the state's population has grown an average of approximately 1.7 percent per year (Table 5, p31). Historical data from various Automatic Traffic Recording (ATR) stations located on I-5 throughout the Central Puget Sound shows that over a similar time period (1986 to 2008), travel on I-5 in the Central Puget Sound has grown at an annual average rate of 1.8 percent. This annual average growth rate is consistent with the population growth in the region. Several locations were reviewed in the study area as well as stations north and south of the study area limits. Table 7 summarizes the traffic volumes and growth rates throughout the I-5 corridor, including the study area, and extends further north into King County for comparison purposes. Figure 7 presents a more detailed comparison of locations within the study area.

Over this 22 year time horizon, traffic volumes on I-5 in King County has increased approximately 1.5 percent annually and Snohomish County has experienced a 3 percent annual growth. It should be noted that a substantial amount of High Occupancy Vehicle (HOV) lane expansion occurred in Snohomish County over this time horizon. This expanded capacity, along with slightly more population growth than Pierce County may help explain why I-5 traffic grew faster in Snohomish County. The first expansion of HOV lanes in Pierce County has now begun and the system is planned to extend as far south as SR 512 in the future.

Table 7. Historic I-5 Traffic Volume Trends

	Annual Average Daily Traffic (both directions)				Annual Average Growth Rate			
Location	**1986**	**1996**	**2006**	**2008**	**1986 to 1996**	**1996 to 2006**	**2006 to 2008**	**1986 to 2008**
SR 510 (MP 110.84)	59,600	87,080	110,780	110,010	3.9%	2.4%	-0.3%	2.8%
Mounts Rd (MP 114.65)	66,900	87,600	109,130	109,310	2.7%	2.2%	0.1%	2.3%
DuPont-Steilacoom Rd (MP119.01)	60,690	82,890	108,520	108,700	3.2%	2.7%	0.1%	2.7%
SR 512 (MP 126.77)	104,200	131,310	145,340	142,790	2.3%	1.0%	-0.9%	1.4%
SR 167 (MP 135.32)	110,500	168,320	191,640	188,030	4.3%	1.3%	-0.9%	2.4%
SR 18 (MP 142.49)	98,200	142,180	158,030	163,490	3.8%	1.1%	1.7%	2.3%
S 188th (MP 151.96)	139,650	195,510	223,520	218,360	3.4%	1.3%	-1.2%	2.1%
Columbian Wy (MP 162.53)	184,300	215,930	232,470	223,520	1.6%	0.7%	-1.9%	0.9%
Ship Canal Bridge (MP 151.96)	217,120	278,575	277,630	272,930	2.5%	0.0%	-0.9%	1.0%
NE 145th St (MP 175.1)	153,900	177,040	198,830	188,630	1.4%	1.2%	-2.6%	0.9%
SR 104 (MP 177.17)	144,400	168,770	191,460	183,240	1.6%	1.3%	-2.2%	1.1%
SR 524 (MP 182.04)	118,300	160,670	193,070	189,700	3.1%	1.9%	-0.9%	2.2%
SR 526 (MP 189.97)	100,600	145,750	169,060	164,920	3.8%	1.5%	-1.2%	2.3%
SR 528 (MP 198.9)	76,100	108,320	137,450	134,080	3.6%	2.4%	-1.2%	2.6%
SR 520 (MP 208.99)	38,990	56,990	77,730	75,380	3.9%	3.2%	-1.5%	3.0%
Total for all segments	***1,673,450***	***2,206,935***	***2,524,660***	***2,473,090***	***2.8%***	***1.4%***	***-1.0%***	***1.8%***



	1986	1996	2006	2008
SR 510 (MP 110.84)	59,600	87,080	110,780	110,010
Mounts Road (MP 114.65)	66,900	87,600	109,130	109,310
DuPont Road (MP 119.01)	60,690	82,890	108,520	108,700
SR 512 (MP 126.77)	104,200	131,310	145,340	142,790

Figure 7. I-5 Mainline Historical Annual Average Daily Traffic* Volume
*The daily average number of vehicles for a given year.

The data highlights a variety of issues. In general, traffic growth on I-5 in the Central Puget Sound over the past 20 years has been greatest in Pierce and Snohomish Counties. Since 1986, Pierce County has averaged 2.7 percent annual average traffic volume growth on I-5. Over this 22 year period this annual average growth equates to over 160 percent more traffic on I-5 today than in 1986, or an increase of over 48,000 additional vehicles on I-5 near DuPont. This level of demand requires significant additional capacity and the additional capacity has not been constructed as the demands have increased. If population growth continues at approximately 2 percent per year until 2030, traffic volumes on I-5 near DuPont could reach levels that currently exist on I-5 north of SR 512, a location that currently provides an additional lane of capacity in each direction of travel.

From 2006 through 2008, many locations around the Puget Sound have experienced traffic volume reductions, and some locations have even reported congestion reductions due to the economic downturn. For locations north of Seattle in King County, traffic volumes on I-5 have dropped by more than 2 percent. In Snohomish County, these reductions are on the order of 1.5 percent. These percentage decreases in volumes are on the order of 5,000 to 10,000 vehicles per day on some stretches of I-5. This has led to some improvement in travel time for a few locations.

The same trend has not occurred on I-5 in the Study area. Instead of reductions in traffic volumes, there were actually minor increases in traffic at a few locations on I-5 in the study area between 2006 and 2008. This flattening of traffic would help explain why travelers on this stretch of I-5 have not seen the congestion improvements that have been reported in other areas of the region. This difference is very likely the result of the influence of the bases on I-5 traffic. Existing conditions planning model results have shown that at some locations, more than 50 percent of the traffic on I-5 is military related. With the current and future base expansions, it is likely that the travel trends on I-5 in the study area will continue to increase. As the economy recovers and the rest of the region also begins picking up again, it is highly likely that traffic growth will resume a steady climb upward.

Existing 2009 weekday PM peak hour traffic volumes throughout the I-5 corridor are summarized in Figure 8 and Figure 9.

Operations Analysis

Traffic operations are characterized through a level of service (LOS) analysis. LOS is a widely applied analysis technique for measuring the quality of traffic flow along freeway segments and through intersections. LOS values range from LOS A, which is indicative of free-flow conditions to LOS F, indicating extreme congestion and long delays. The LOS for each freeway segment and study area intersection (ramp terminals and some intersections immediately adjacent to interchanges) was calculated using methodologies presented in the *Highway Capacity Manual* (HCM), 2000.

One inherent limitation of the traffic volume data used to estimate LOS is that only the actual number of vehicles traveling through the study area during the peak hour is known while the methodology calls for the number of vehicles that *want* to travel through the study area (the demand). With congested or over-capacity conditions the flow rate of vehicles decrease significantly and long queues and congestion make it difficult to observe the vehicular demand. Thus the volumes used in the LOS analysis may underestimate the magnitude of traffic. Because of this limitation, the estimated LOS values for some study area locations may be worse than reported. While the magnitude of the congestion may be underestimated depending on the daily fluctuations in volume, the LOS analysis is indicative of existing bottlenecks in the system.

For this analysis, the Highway Capacity Software program was used to evaluate freeway segments and the Synchro software program (version 7.0) was used to evaluate intersection operations. A more detailed description of the LOS criteria has been included in Appendix B. Discussion of mainline freeway and arterial operations is presented in the following sections.

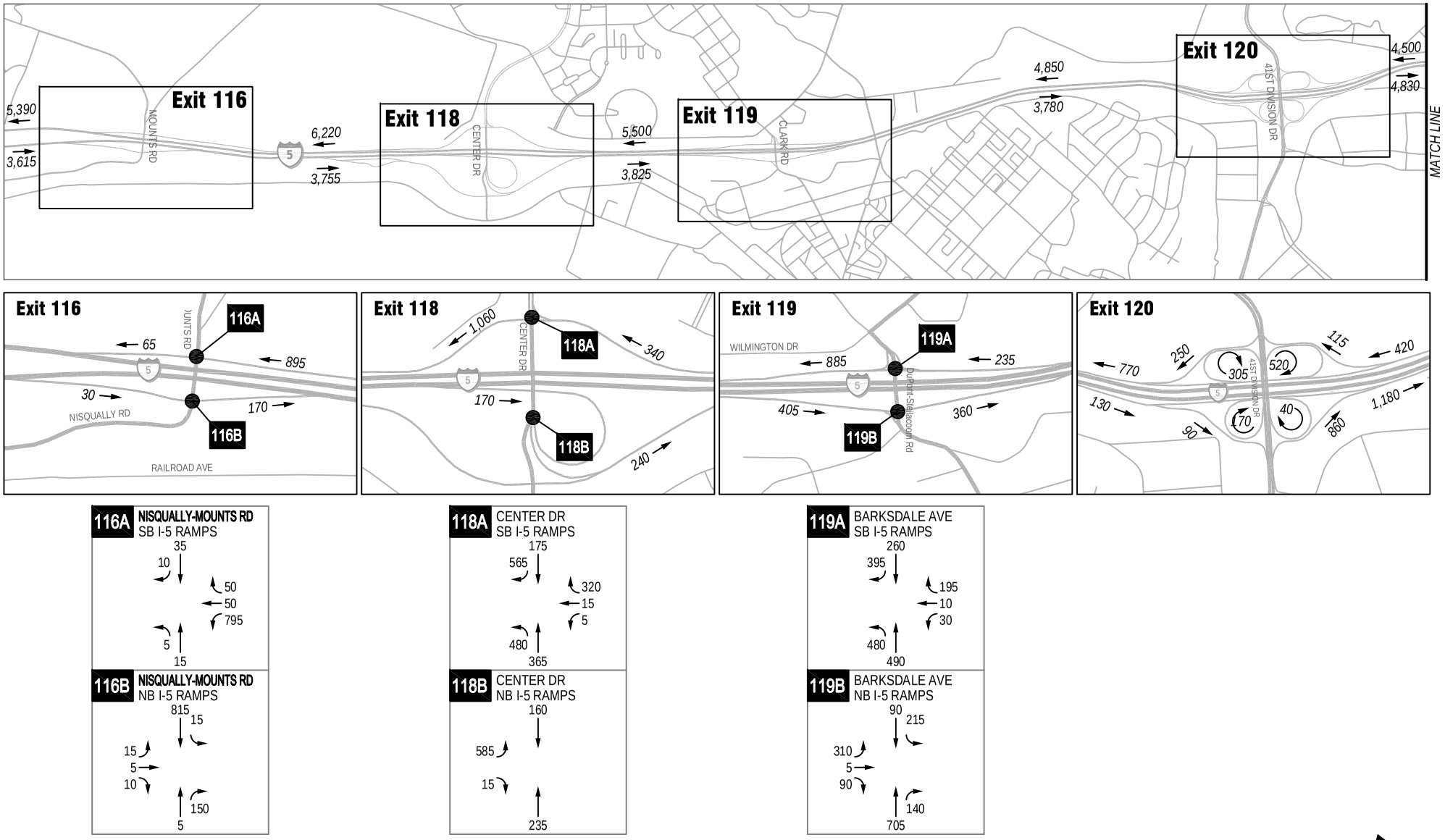
Mainline Operations

Mainline PM peak hour LOS results are summarized in Figure 10. As shown in this figure, in the northbound direction, the mainline is shown to operate at LOS D or better up to the Berkeley Street interchange (Exit 122). Berkeley Street is one of the primary interchanges used by both JBLM and Camp Murray to access I-5 and a high volume of traffic attempts to merge onto mainline I-5. As shown, the merge and mainline operations north of the ramp are shown to operate at LOS E or worse. North of Gravelly Lake Drive interchange, an additional northbound lane is provided and conditions improve until the SR 512 interchange. The northbound merge and diverge operations at SR 512 are also currently operate below LOS D.

In the southbound direction, generally the mainline operates at LOS D or better with the exception of the following areas:

a. Southbound diverge at SR 512
b. Southbound diverge at Thorne Lane
c. Mainline and ramp operations between Center Drive and Mounts Road

In addition to the PM peak hour congestion, operational deficiencies at the Berkeley Street interchange during the AM peak hour results in queuing onto the mainline. WSDOT has installed signage and congestion warning systems to alert drivers along the corridor to this condition as it occurs.



2009 PM Peak Hour Volumes (1 of 2)

FIGURE

8

I-5 Transportation Alternative Analysis & Operations Model

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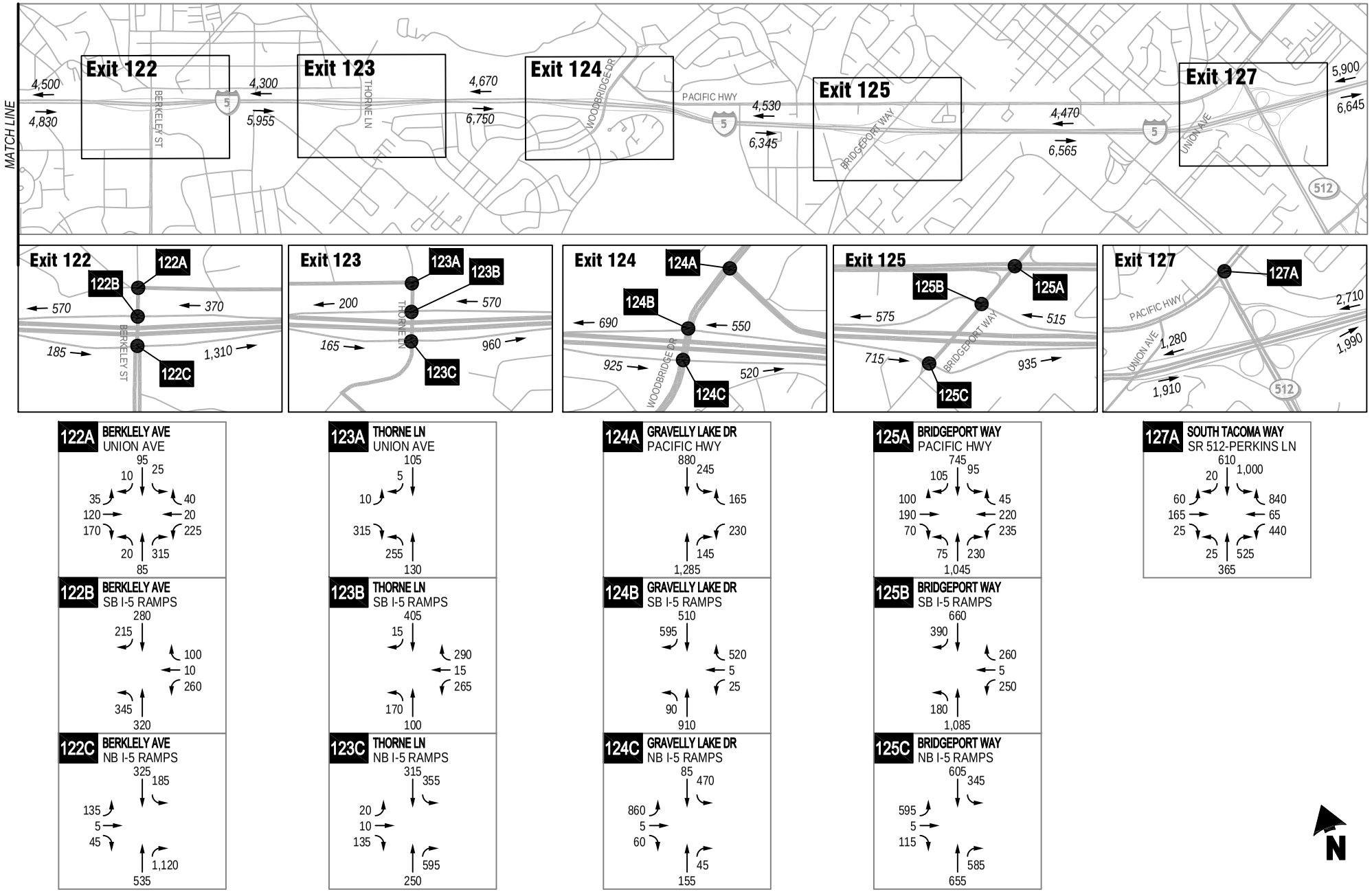

2009 PM Peak Hour Volumes (2 of 2)

FIGURE 9

I-5 Transportation Alternative Analysis & Operations Model

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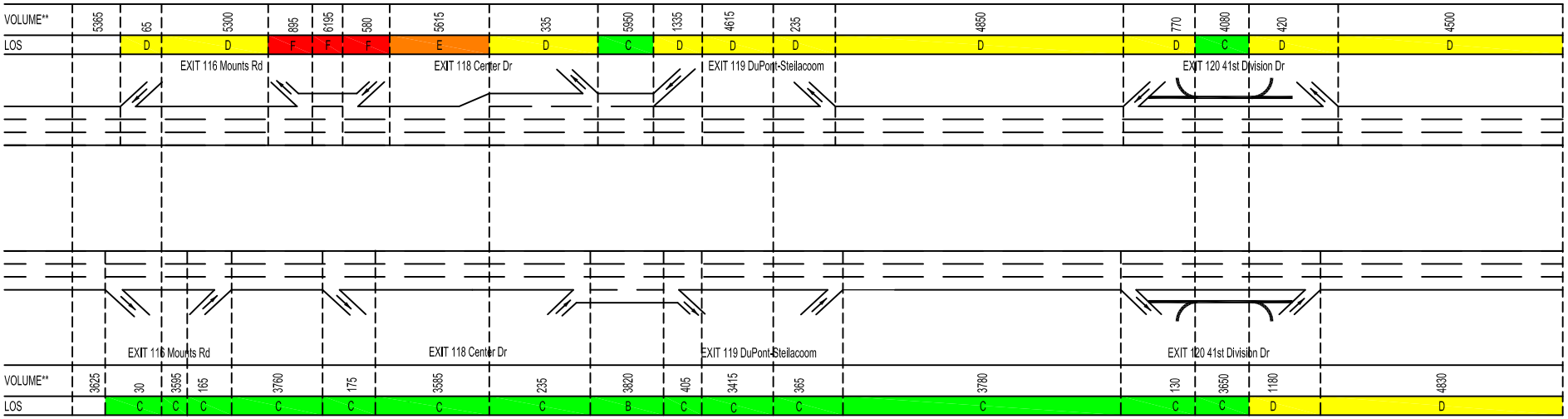
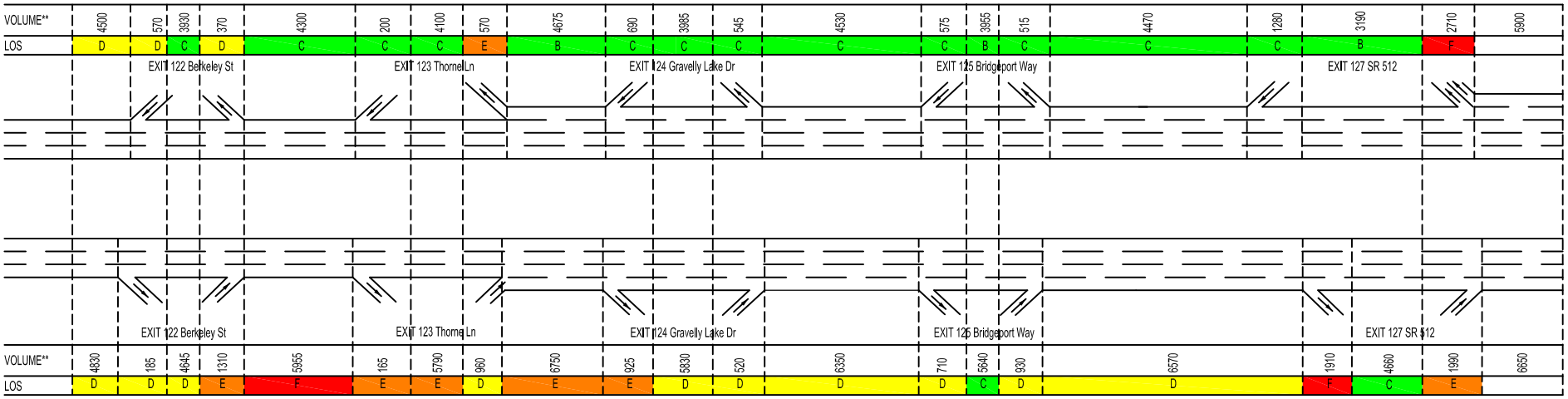
Lakewood I-5: Exit 116-Exit 120



Lakewood I-5: Exit 122-Exit 127

LOS Legend: LOS A to LOS C | LOS D | LOS E | LOS F



2009 I-5 Mainline PM Peak Hour LOS Results

FIGURE **10**

I-5 Transportation Alternative Analysis & Operations Model

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Arterials/Ramp Terminals

Existing operations results for the weekday PM peak hour at arterial intersections (ramp terminals and adjacent arterial intersections) are summarized in Table 8 (p 38).

As shown in Table 8, the ramp terminal intersections at Center Drive and Gravelly Lake Drive operate poorly at LOS E or F. The LOS standard applied by WSDOT for all urban arterial/ramp terminal intersections is LOS D. Field observations at Union Avenue/Berkeley Avenue showed operations are worse than the results shown in Table 8 due to queues from the adjacent ramp intersection that extend through Union Avenue/Berkeley Avenue. The queue impacts are caused by operations and the very close proximity to the Berkeley Avenue interchange.

Table 8. Existing (2009) Arterial/Ramp Terminal PM Peak Hour Operations Summary

I-5 Interchange Exit No.	Intersection	2009 PM Peak Hour		
		LOS[1]	Delay[2]	V/C[3] or WM[4]
117	SB I-5 Ramps/Mounts Rd	D	34.4	WB-LT[5]
	NB I-5 Ramps/Mounts Rd	C	20.6	EB
118	SB I-5 Ramps/Center Dr	E	36.6	WB
	NB I-5 Ramps/Center Dr	F	107.7	EB
119	SB I-5 Ramps/DuPont-Steilacoom Rd	B	12.7	0.78
	NB I-5 Ramps/DuPont-Steilacoom Rd	C	34.9	0.80
122	Union Ave/Berkeley Ave	B	14.1	-
	SB I-5 Ramps/Berkeley Ave	C	32.8	0.76
	NB I-5 Ramps/Berkeley Ave	C	21.6	0.80
123	Union Ave/Thorne Ln	B	11.6	EB
	SB I-5 Ramps/Thorne Ln	D	43.0	0.60
	NB I-5 Ramps/Thorne Ln	D	41.0	0.59
124	Pacific Hwy/Gravelly Lake Dr	B	18.0	0.71
	SB I-5 Ramps/Gravelly Lake Dr	D	37.5	0.77
	NB I-5 Ramps/Gravelly Lake Dr	E	61.5	0.68
125	Pacific Hwy/Bridgeport Way	C	28.0	0.66
	SB I-5 Ramps/Bridgeport Way	C	20.9	0.89
	NB I-5 Ramps/Bridgeport Way	B	18.0	0.73
127	South Tacoma Way/SR 512	C	29.7	0.68

Level of service, based on 2000 *Highway Capacity* Manual methodology.
Average delay in seconds per vehicle
1. Volume-to-capacity ratio reported for signalized intersections.
2. Worst movement reported for unsignalized intersections.\
3. WB= Westbound, EB=Eastbound, LT= Left-turn

Southbound I-5 off-ramp queues at the Berkeley Avenue interchange (aka – Madigan Army Medical Center) have been observed to extend the full length of the off-ramp and onto mainline I-5 during weekday mornings. Based on this, an operations analysis of the AM peak hour at the Berkeley Avenue ramp terminals was also completed and results are shown in Table 9.

Table 9. Existing (2009) Arterial/Ramp Terminal AM Peak Hour Operations Summary

I-5 Interchange Exit No.	Intersection	2009 AM Peak Hour LOS[1]	Delay[2]	V/C[3] or WM[4]
122	SB I-5 Ramps/Berkeley Ave	D	43.8	0.78
	Southbound Off-Ramp	*D*	*45.4*	*0.84*
	NB I-5 Ramps/Berkeley Ave	C	20.3	0.77

1. Level of service, based on 2000 Highway Capacity Manual methodology.
2. Average delay in seconds per vehicle.
3. Volume-to-capacity ratio reported for signalized intersections.
4. Worst movement reported for unsignalized intersections.

Although the analysis does not indicate poor operations at the southbound Berkeley Avenue off-ramps, field observations indicate that the vehicle queuing on the southbound off-ramp extends onto the shoulder of mainline I-5. Thus, future capacity improvements will focus on this condition despite the LOS reported for the weekday AM peak hour (Table 9).

Military Travel Patterns & Trends

In addition to regional background demands on I-5, traffic to and from JBLM is a significant contribution to traffic volumes along the I-5 corridor within the study area. Variations of these impacts can sometimes be felt on a day-to-day basis and are dependent upon military operations. These operations can change depending on troop deployments, varying security levels, or holiday leave. In addition to the short-term changes, longer-term impacts also occur. Over the past several years the overall number of troops based at JBLM has increased, and as previously discussed, is anticipated to continue to increase during the next several years. This general increase contributes to the need for this current study. 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 best address any identified impacts.

Travel Patterns

The travel patterns and distribution of traffic from the military bases throughout the regional roadway network are important considerations when evaluating likely impacts to the I-5 corridor. Impacts from military travel demand are more noticeable at interchange ramps located near access gates (Access Control Points). For purposes of this discussion, traffic patterns associated with McChord Air Field and Fort Lewis are described separately. Based on provided data:[6,7]

- 50 percent of Fort Lewis personnel and their families, and 60 percent of McChord AFB, reside and access the installations from the north (i.e. Lakewood, Tacoma, Kitsap and King Counties).
- 30 percent of Fort Lewis personnel, and 15 percent of McChord AFB, reside and access the installation from the south (i.e. Lacey, Olympia, Thurston County),
- 10 percent of Fort Lewis personnel, and 5 percent of McChord AFB, reside and access the installations from the east (i.e. Yelm, Spanaway, Pierce County), and

[6] *Fort Lewis Growth Overview* - Tom Knight, Deputy Garrison Commander. Presentation slides (April 9, 2009)
[7] Mailing address zip-code data for McChord Air Field personnel (civilian & military) provided by email, June 10, 2009

- 10 percent of Fort Lewis personnel, and 15 percent of McChord AFB, reside and access the installations from the west (i.e. DuPont and Steilacoom).[8]

The significant distribution of traffic to the north and south of the military installations (80 percent of Fort Lewis, 75 percent of McChord AFB) results in the majority of military traffic utilizing the I-5 corridor to access the installations via the gates along I-5.

Gate Access

Multiple access points are provided for the three military installations as shown in Figure 12. The estimated total traffic at each gate is shown in Figure 11.

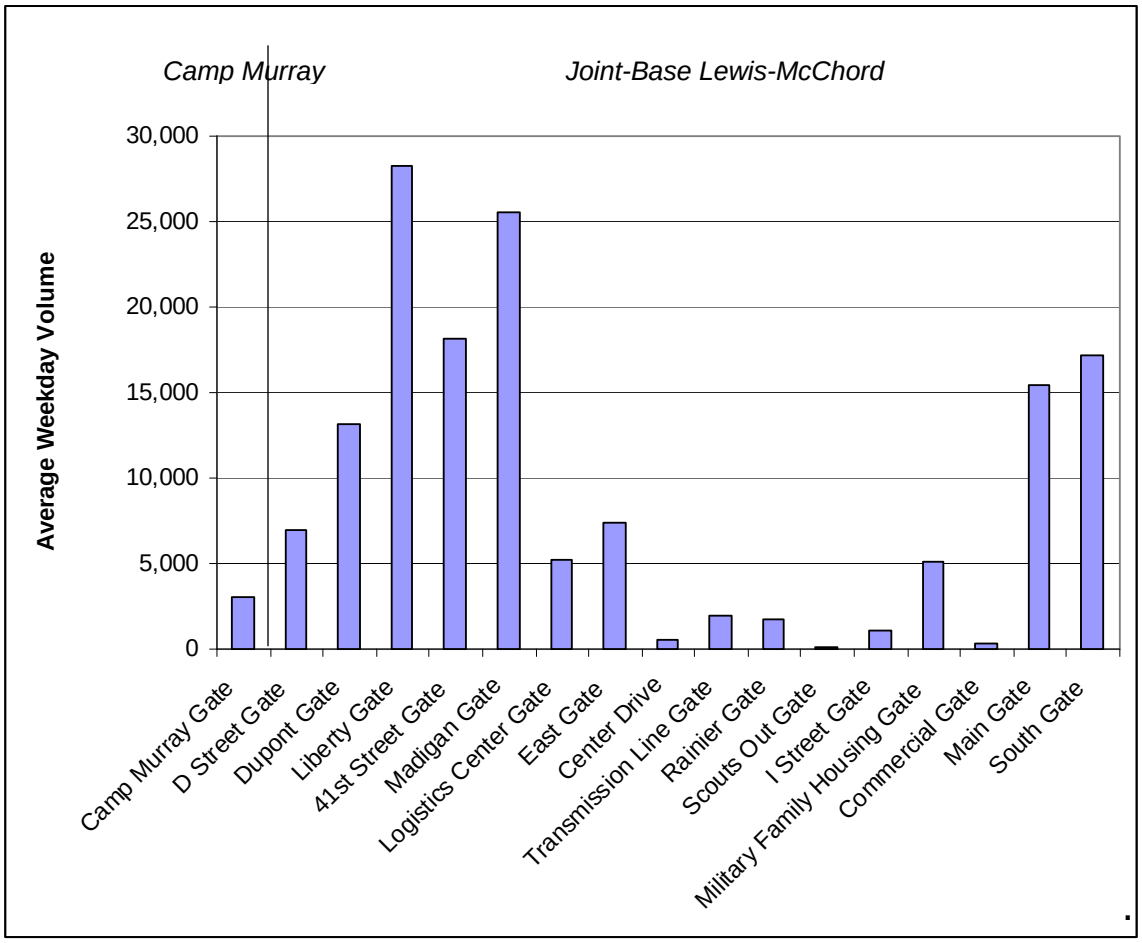
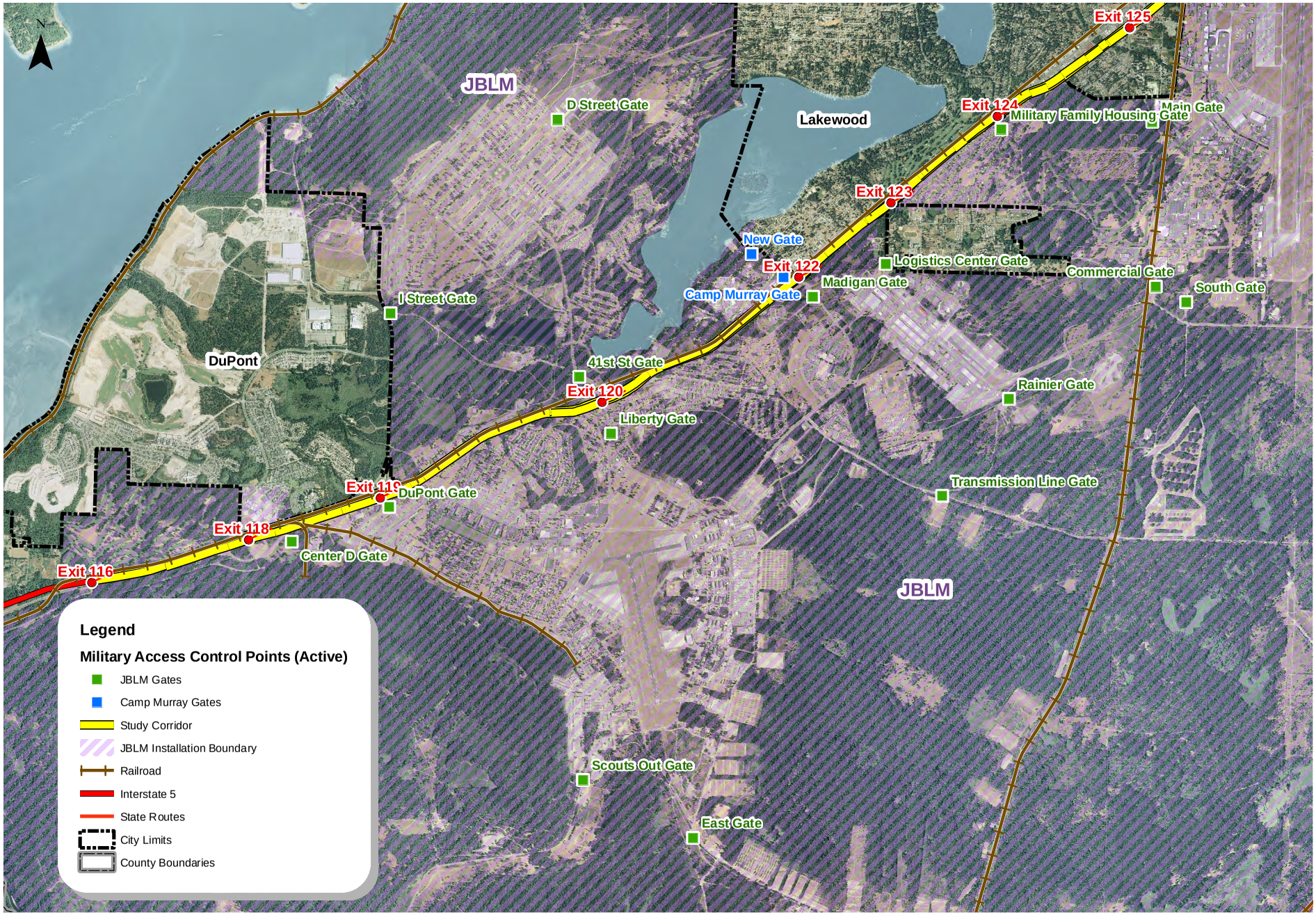


Figure 11. Total Gate Volumes (2009)

As Figure 11 shows, the majority of traffic from JBLM accesses via DuPont, Liberty, 41st Division, Madigan, Main, and South gates. As Figure 12 shows, all five of the high volume JBLM gates are located in close proximity to the I-5 corridor (DuPont, Liberty, 41st Street, Madigan, and Main). In particular the DuPont, Liberty, and Madigan gates are located immediately adjacent to, or are accessed directly, via adjacent I-5 interchanges. Because of the high volumes and close proximity to I-5, operations at these three gates immediately adjacent to I-5 are likely to have the greatest impact to mainline and ramp operations.

[8] The remaining 5 percent of McChord AFB personnel are classified as "other" within the provided data.



Military Gate Locations

FIGURE

12

Interstate 5 Transportation Alternatives Analysis and Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\GIS\MXD\I-5 Fort Lewis Gates_8.5x11.mxd

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Historically, poor gate operations have sometimes resulted in gate queues extending through ramp intersections and onto mainline I-5. Recent changes to gate operations have improved queuing at the gates such that queues infrequently extend back through adjacent ramp intersections or impact ramp and mainline traffic. However, due to the high variability of day-to-day base operations (i.e. troop deployments, security level changes) and anticipated increase in future troop levels, gate operations may impact mainline and ramp operations. As improvement alternatives are developed, potential impacts from day-to-day changes should be considered.

Historical Trends

To better understand potential long-term future military conditions, historical information can be used to show general trends. Over the past several years the number of military personnel and supporting civilian employees at JBLM has increased. The most current available data, from the first half of 2009, shows approximately 47,500 vehicles entering Fort Lewis on an average day. This includes military personnel, families residing on base, and civilian employees.

Historical trends are described separately for Fort Lewis and McChord Air Field since they were only recently combined into a single joint base.

Fort Lewis

To assess the overall historical trends observed at Fort Lewis, weekly entering traffic volumes at all gates was summarized and are shown in Figure 13. As shown, traffic to Fort Lewis has generally increased over the past several years. During this time, volumes have increased and decreased as various troop deployments occurred. From 2005 to mid-2006, traffic can be seen to generally increase, but between mid-2006 and the end of 2007 traffic volumes decreased as deployments increase. From the end of 2008 through today, traffic volumes have again increased as deployed troops have returned and the total number of troops based at Fort Lewis has also increased.

McChord AFB

In contrast to Fort Lewis, military personnel levels at McChord AFB have remained relatively constant over the past several years. Limited data is available for McChord AFB traffic volumes, but estimated volumes for 2009 show approximately 19,000 vehicles enter McChord AFB on an average weekday. This includes military personnel, families residing on base, and civilian employees. McChord AFB impacts to the I-5 corridor have not seen any appreciable change over the past several years.

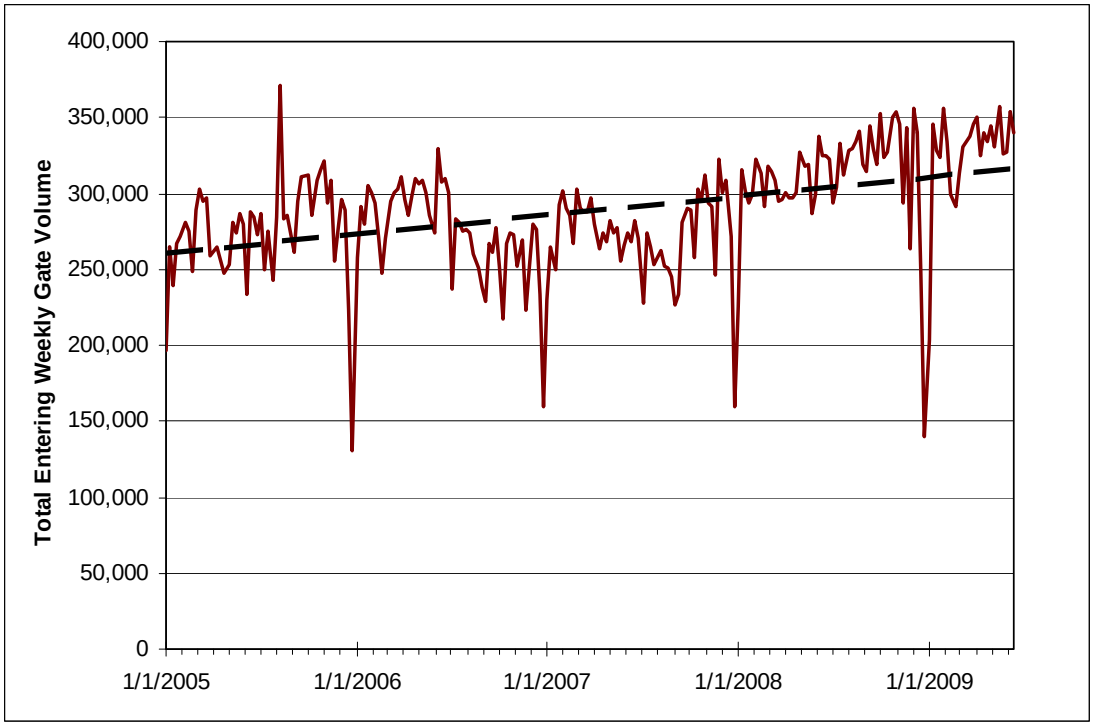


Figure 13. Fort Lewis Total Entering Weekly Volumes*

*Volumes are the total for entire week for each year and do not include data from McChord Air Field gates. Decreases in volumes around the Christmas and New Year's holidays occur due to holiday base operations.

Summary of Military Impacts

The close proximity and high volume of traffic at four of the JBLM gates (Liberty, 41st Division, Madigan, and DuPont) increases the likelihood that gate operations and volumes impact traffic along I-5 ramps or the mainline. Should any significant troop deployment or military needs alter operations on JBLM, traffic volumes and congestion levels could quickly change for better or worse. In general, troop levels at JBLM are expected to continue to grow. Given these increases, the corresponding traffic volumes, and the location of the gates, the interchanges in close proximity to JBLM gates should draw the focus for future analysis.

Existing Conditions Issues Summary

A summary of existing issues throughout the study area including collisions, geometric constraints, transportation facilities, and operations are provided in Figure 14 and Figure 15. Throughout the study area, several key issues shown in these figures are:

- Close spacing between the rail line, adjacent arterial intersections, and I-5 ramp interchanges at Thorne Lane, Berkeley Avenue, 41st Division Drive, and DuPont-Steilacoom Road. Poor operations at Union Avenue/Berkeley Avenue due to the close proximity to Berkeley Avenue interchange.

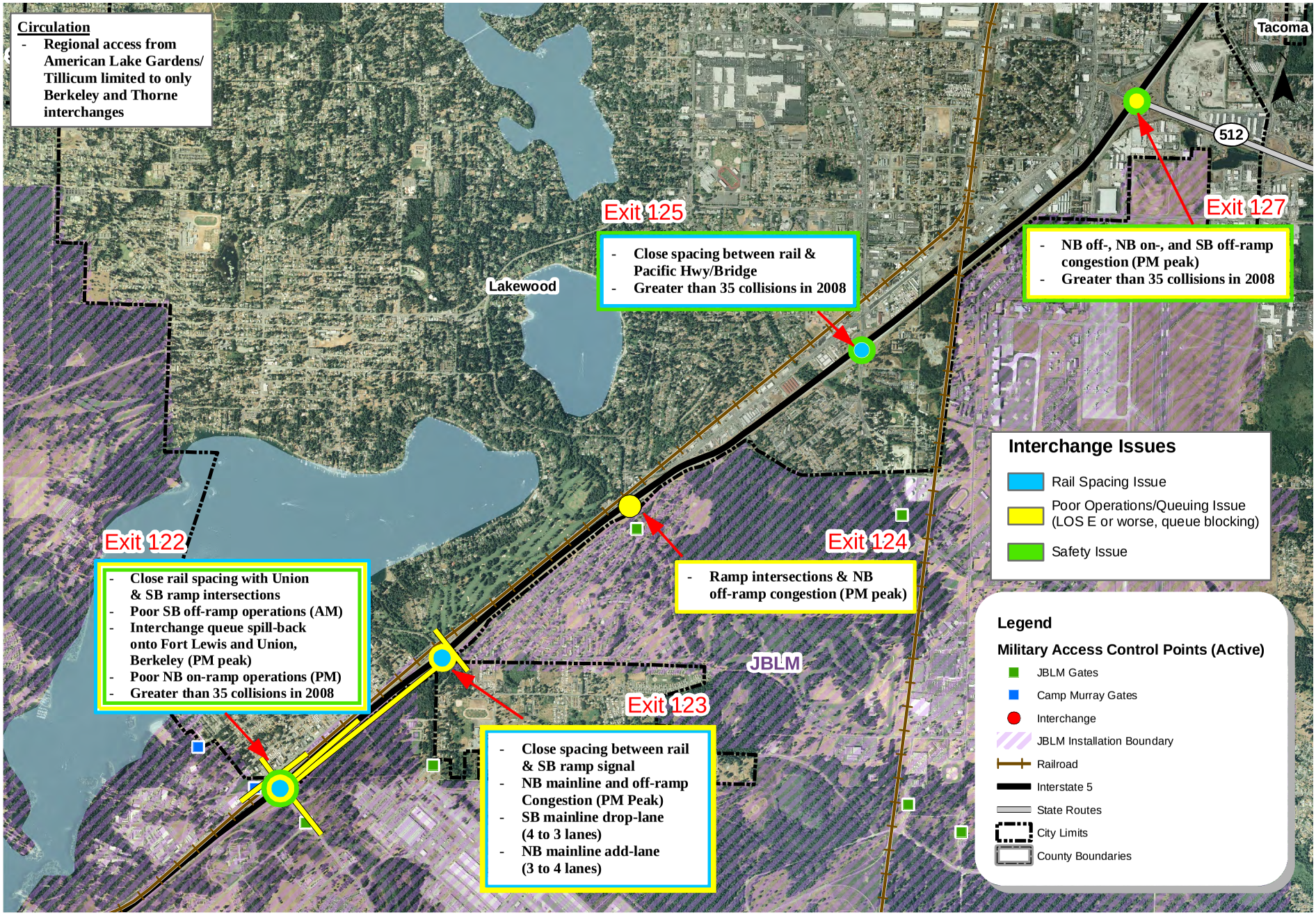
- PM peak hour I-5 mainline and ramp congestion at the SR 512 interchange, northbound Gravelly Lake Drive off-ramp, between the Berkeley Avenue northbound on-ramp and Thorne Lane off-ramp.

- AM peak hour I-5 ramp congestion at the southbound I-5 off-ramp at Berkeley Avenue.

- Poor out-bound JBLM operations at Berkeley Avenue (to northbound I-5), DuPont gate/DuPont-Steilacoom Road (to southbound I-5), and Center Drive (to DuPont and southbound I-5).

- Greater than 35 annual collisions at the SR 512/I-5, Bridgeport Way, and Berkeley Avenue interchanges.

- Poor JBLM access configuration at Center Drive.



I-5 Corridor Issues Summary (North)

FIGURE **14**

Interstate 5 Transportation Alternatives Analysis and Operations Model

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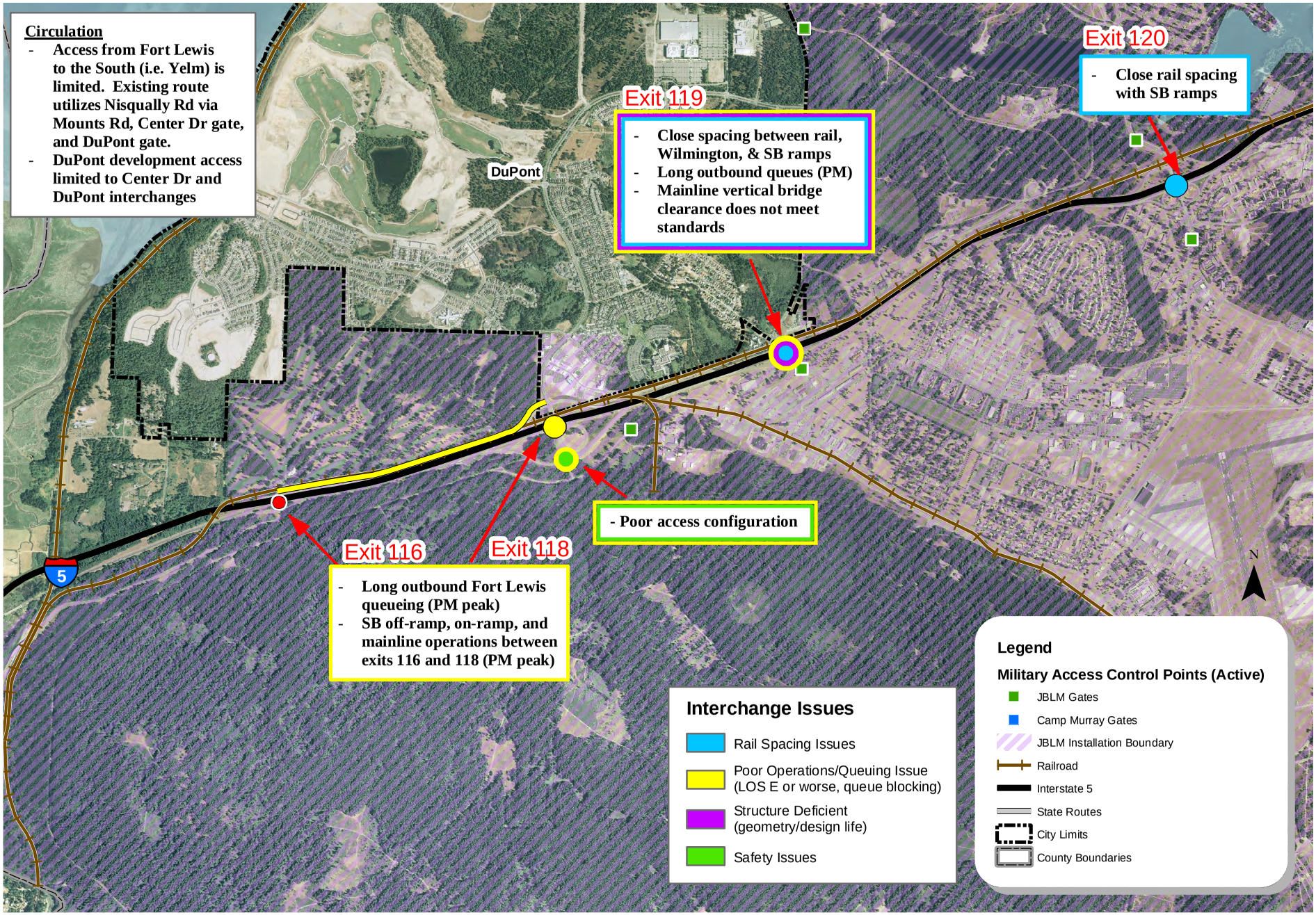

I-5 Corridor Issues Summary (South)

FIGURE **15**

Interstate 5 Transportation Alternatives Analysis and Operations Model

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Assessment of Forecast Baseline Conditions

This section documents the results of the assessment of 2030 conditions within the I-5 corridor study area. The methodology used to develop travel forecasts and the future conditions, and assessment of forecast conditions, are described in the following sections. These summaries and assessments include:

- Anticipated improvements to the transportation network,
- Forecast traffic volumes, and
- Forecast traffic operations.

To develop and assess forecast conditions several methods and tools were used. First, a regional travel demand model was used to develop forecast vehicular volumes within the study area. This travel demand model accounted for factors such as growth in the Puget Sound regional population (civilian and military) and improvements to the transportation network (i.e. expanded commuter rail, Cross-Base Highway, etc.). Once the demand volume forecasts were developed, forecast vehicular traffic operations within the study area were assessed. The results of the forecast baseline assessment will be considered in developing the future improvement strategies for the I-5 corridor.

Anticipated Transportation System Changes

The following sections document the expected changes to the transportation system within the study area.

Highway/Arterial Improvements

Several improvements and changes to the transportation network were accounted for in the forecast of 2030 conditions as identified through the literature review process. These improvements can affect region travel patterns including the study area. These changes included:

- Added High Occupancy Vehicle (HOV) lanes on I-5 between SR 16 and SR 18,
- Added HOV lanes on I-5 between SR 512 and SR 16,
- Added HOV lanes on SR 16 from I-5 to Union Avenue,
- Construction of SR 704 (Cross-Base Highway) from I-5 to SR 7 with a single-point urban interchange (SPUI) configuration at the Thorne Lane interchange, and
- Closure of the temporary egress from Joint-Base Lewis-McChord (JBLM) at Center Drive.

Of these improvements, the construction of the Cross-Base Highway has the greatest impact within the study area. Construction of this new high-capacity highway would result in a significant increase in traffic demand at the Thorne Lane interchange as described in the following sections.

Rail Activity

***Point Defiance Bypass Project: Traffic & Transportation Discipline Report*, WSDOT Rail (2008) –** This study documented the impacts of improved passenger rail service along the rail line immediately north of, and parallel to, the I-5 corridor study area. This rail line will experience an increase in rail service due to the extension of the Sounder commuter rail line to the Lakewood Station and from rerouting existing passenger rail service from the Burlington Northern Santa Fe rail line along the Puget Sound shoreline. These passenger rail services would result in approximately one train passing through the study area during each AM and PM peak period. Resulting vehicle queues at rail crossings would extend trough adjacent study intersections at Bridgeport Way, Thorne Lane, Berkeley Street and DuPont-Steilacoom Road intersections. Mitigation of these impacts would include interconnecting all north-south corridor traffic signals

with one another, and installation or activation of traffic signals and turn-pocket improvements at both the Union Avenue/Thorne Lane and Union Avenue/Berkeley Street intersections. Improvements to arterial intersections to improve corridor operations along I-5 will need to consider the effects of vehicle queuing caused by the bypass project and increased rail activity. Construction was anticipated to be completed by 2019, but with the American Recovery and Reinvestment Act (ARRA) High Speed Rail award for this project, construction is now anticipated to be completed by the end of 2013.

Transit Service

Based on projected demands and previously planned expansions including the Lakewood Station, no additional Park & Ride facilities were identified. However, enhanced transit service (Sounder commuter rail to Lakewood and increased bus service throughout the County) would increase Park & Ride demand countywide beyond baseline assumptions. Assumptions related to increased transit service in the corridor is consistent with general assumptions included in the regional PSRC model. No changes or increased transit service was assumed to JBLM.

Travel Demand Forecasts

In order to estimate the extent of traffic volume changes due to planned growth and various highway network changes, the City of Lakewood's regional travel demand model was used. In comparison with other regional travel demand models (i.e. Pierce County or Puget Sound Regional Council), this model was used because it provides a refined trip distribution process for military related traffic, a refined level of roadway network detail, and accounts for buildable lands data within the City of Lakewood. The model is a regional multi-modal travel demand model which has previously been calibrated and validated to 2008 conditions, but was updated and refined to 2009 conditions for this current I-5 corridor study.

The travel demand model utilizes a variety of assumptions for the development of the future year scenarios. Assumptions include land use forecasts as well as transportation network elements. A more detailed summary of these assumptions is presented in the following sections.

Land Use Forecast

The refined City of Lakewood model reflects PSRC and Pierce County-adopted 2030 land-use forecasts from 2009 outside of the City of Lakewood. These forecasts account for a 53 percent increase in the number of households outside of the City (129,000 households) and an employment increase of 60 percent (123,000 jobs).

Within the City of Lakewood, the land use assumptions are based upon a buildable lands inventory that was developed by the City. This inventory accounted for land available for development in 2007. To forecast future growth from 2007 to 2030 conditions, a growth rate of 0.5 percent per year was assumed for each zone with a maximum allowable limit for each zone based upon the inventory. Within the City of Lakewood, the number of households is forecast to increase by 13 percent (3,400 households) and employment is forecast to increase by 16 percent (2,500 jobs). These growth targets, which are significantly lower than those for the Pierce County as a whole, reflect the fact that the City of Lakewood is well developed today and most future development will either be buildout of existing vacant land or redevelopment of currently occupied land.

Military Travel Patterns & Traffic Forecast

For this analysis, it was important to understand how the travel behavior of the military personnel differs from the overall region and the impacts to regional traffic that can occur. The unique travel

patterns of existing military personnel and estimated increases in military-generated vehicular traffic at the installation access gates were incorporated into the regional travel demand model. As noted in the existing conditions section of this report, information was provided by JBLM as to the household distribution of off-post housing.

Access Gate Forecast

The total travel demand to and from the three military installations significantly impacts the operations of the interstate corridor. Under existing (2009) conditions there are approximately 75,000 trips that enter the three installations every weekday. Approximately 74,000 of these trips are destined to JBLM and the remaining 2,000 trips go to Camp Murray. With the various plans for base consolidation, joint operations, and the Grow Army initiatives, the total inbound gate volumes were forecast to increase by another 16,000 trips per day by 2030, a 20 percent increase over 2009 levels. This forecast was developed assuming an annual growth rate of approximately 2 percent per year at nearly all gates, except for those identified in the Army Growth and Force Realignment Programmatic Environmental EIS which were assumed to grow at an annual rate of 3.80 percent. Gate volumes grown by 3.80 percent included: D Street, DuPont, East Gate, Transmission Line, Scouts Out, and I Street.

It should be noted that the volume of traffic that accesses the gates on any given week depends heavily on how many troops at the bases are deployed. The volumes of traffic in this analysis reflect the impacts of traffic levels when the personnel are actually on base. Table 10 and Figure 16 show a detailed breakdown of the gate forecasts for both 2009 and 2030.

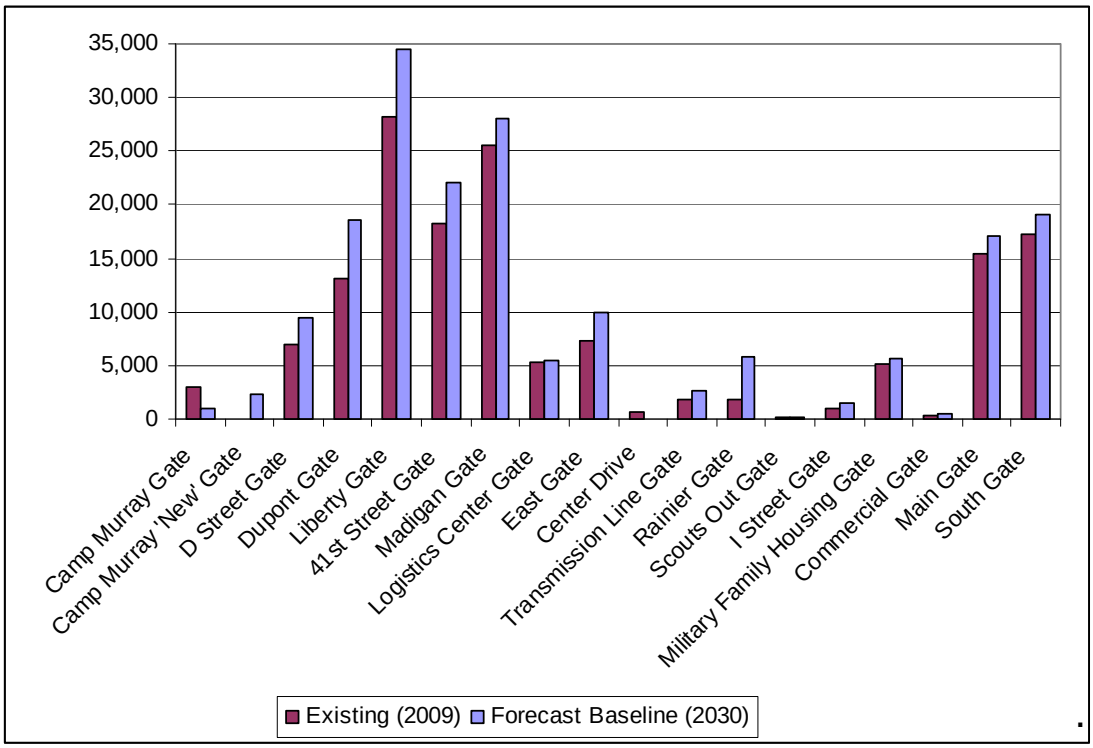


Figure 16. Total Gate Volumes

Table 10. Forecast (2030) Military Access Gate Volumes

			2009				2030			
			Daily		PM Peak Hour		Daily		PM Peak Hour	
Military Base	**Access Gate Name**	**Access Street Location**	**IN**	**OUT**	**IN**	**OUT**	**IN**	**OUT**	**IN**	**OUT**
Camp Murray	Camp Murray Gate	Union Ave	1,850	1,155	491	360	620	380	160	120
Camp Murray	"New Gate"	Portland Ave	0	0	0	0	1,440	900	380	280
Camp Murray Total			***1,850***	***1,155***	***491***	***360***	***2,060***	***1,280***	***540***	***400***
JBLM	D Street Gate	East Drive	3,493	3,493	70	274	4,070	4,070	80	320
JBLM	DuPont Gate	Barksdale Ave/Clark Rd	6,573	6,573	177	847	7,660	7,660	210	990
JBLM	Liberty Gate	41st Division Road S/I-5	14,136	14,136	740	1,740	16,480	16,480	860	2,030
JBLM	41st Street Gate	41st Division Road N/I-5	9,098	9,098	590	1,120	10,610	10,610	690	1,310
JBLM	Madigan Gate	Jackson Ave	12,797	12,797	370	1,654	14,920	14,920	430	1,930
JBLM	Logistics Center Gate	North A St	2,635	2,635	80	590	3,070	3,070	90	690
JBLM	East Gate	SR 507 & East Gate Rd	3,677	3,677	60	530	4,290	4,290	70	620
JBLM	Center Drive	Center Drive I/C	0	597	0	597	0	610	0	700
JBLM	Transmission Line Gate	SR 507	951	951	19	75	1,110	1,110	20	90
JBLM	Rainier Gate	Lincoln St	882	882	18	69	1,030	1,030	20	80
JBLM	Scouts Out Gate	SR 507	59	59	1	5	70	70	0	10
JBLM	I Street Gate	I Street	529	529	11	42	620	620	10	50
JBLM	Military Family Housing Gate	Woodbrook Dr SW	2,548	2,548	145	200	2,830	2,830	160	220
JBLM	Commercial Gate	East Lincoln Road	185	185	14	14	210	210	20	20
JBLM	Main Gate	Bridgeport Way SW	7,720	7,720	550	1,328	8,570	8,570	610	1,470
JBLM	North Gate	South Tacoma Way	0	0	0	0	0	0	0	0
JBLM	South Gate	A Street	8,613	8,613	179	676	9,560	9,560	200	750
Joint-Base Lewis-McChord Total			***73,895***	***74,415***	***3,025***	***9,761***	***85,100***	***85,710***	***3,470***	***11,280***
Total Military Installation Access Gate Volume			***75,745***	***75,570***	***3,516***	***10,121***	***87,160***	***86,990***	***4,010***	***11,680***

Source: Transpo Group & WSDOT, Department of the Army

Several gates have direct access to I-5. Assuming a restriction of access to the Center Drive interchange, the DuPont Gate has almost 1,500 vehicles exiting during the weekday PM peak hour. By 2030, this is forecasted to increase to over 1,900 peak hour users. With another 1,700 vehicles accessing I-5 from the Liberty Gate and 1,650 from the Madigan gate, I-5 traffic flow experiences significant backups today. These gates are also forecasted to increase to 2,100 and 1,800 peak hour vehicles, respectively, in 2030. To put it in perspective, one lane of interstate can handle approximately 2,000 vehicles per hour. These three gates alone are forecasted to have almost 5,800 peak hour trips amongst them by 2030.

Forecast Model Results/Traffic Volumes

Based on the results of the travel demand model, including increases in population, employment, and changes in travel patterns, overall traffic volumes on I-5 are expected to increase as shown in Table 11. Annual growth rates vary between 1.5 percent per year between DuPont Steilacoom Road and 41st Division Drive, to 0.5 percent per year to the north between Bridgeport Way and SR 512. As noted in the existing conditions, the historic rate of growth on I-5 at Mounts Road between 1986 and 2008 has average 2.3 percent per year. It is expected that growth rates observed historically would exceed those projected in the future due to the congestion and capacity constraints on I-5 through the corridor. Although not specifically factored into this analysis, this condition generally results in continued peak hour spreading. Traffic volumes at I-5 and SR 512 over this same time period averaged growth rates of 1.7 percent per year.

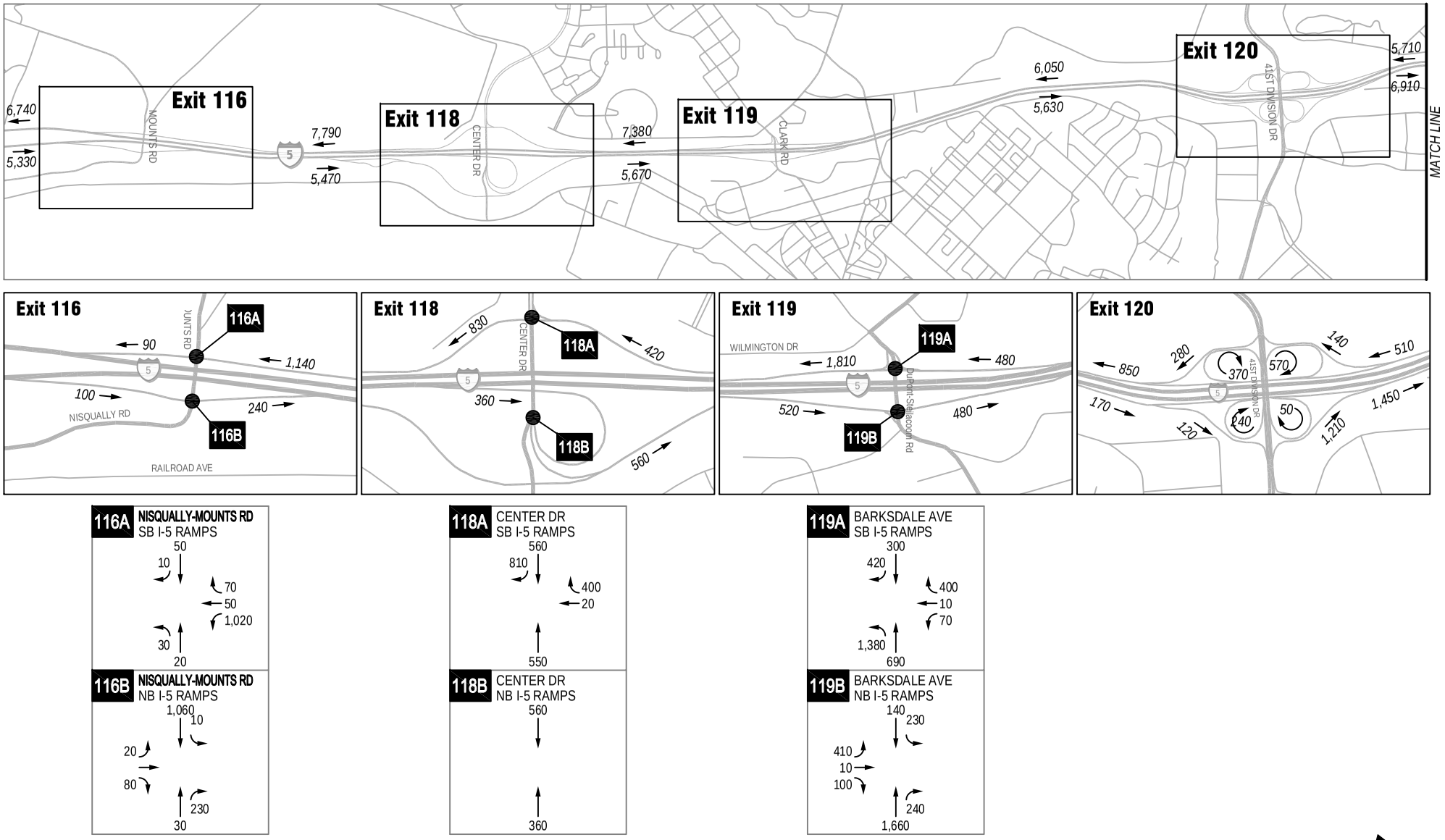
This forecast shows that approximately 3,000 more vehicles would travel on I-5 south of the Thorne Lane interchange during the weekday PM peak hour each day. North of the Thorne Lane interchange, traffic volumes during the PM peak hour would increase by 2,000 vehicles or less. Growth north of Thorne Lane is less than to the south due to the construction of the Cross-Base Highway which would divert traffic that would otherwise travel on I-5.

Table 11. Existing & Forecast 2030 Baseline PM Peak Hour Traffic Volume Growth on I-5

Location	2009	2030	Total Growth (2009 - 2030)	Average Annual Growth
South of Mounts Rd	8,988	12,070	3,082	1.4%
Mounts RD to Center Dr	9,956	13,260	3,304	1.4%
Center Dr to DuPont-Steilacoom Rd	9,770	13,050	3,280	1.4%
DuPont-Steilacoom Rd to 41st Division Dr	8,630	11,680	3,050	1.5%
41st Division Dr to Berkeley Ave	9,330	12,620	3,290	1.4%
Berkeley Ave to Thorne Ln	10,252	13,450	3,198	1.3%
Thorne Ln to Gravelly Lake Dr	11,418	13,460	2,042	0.8%
Gravelly Lake Dr to Bridgeport Way	10,875	12,410	1,535	0.6%
Bridgeport Way to SR 512	11,033	12,200	1,167	0.5%
North of SR 512	12,543	14,010	1,467	0.5%

Source: WSDOT

Forecast 2030 baseline weekday PM peak hour traffic volumes throughout the I-5 corridor are summarized in Figure 17 and Figure 18.



2030 PM Peak Hour Volumes (1 of 2)

I-5 Transportation Alternative Analysis & Operations Model

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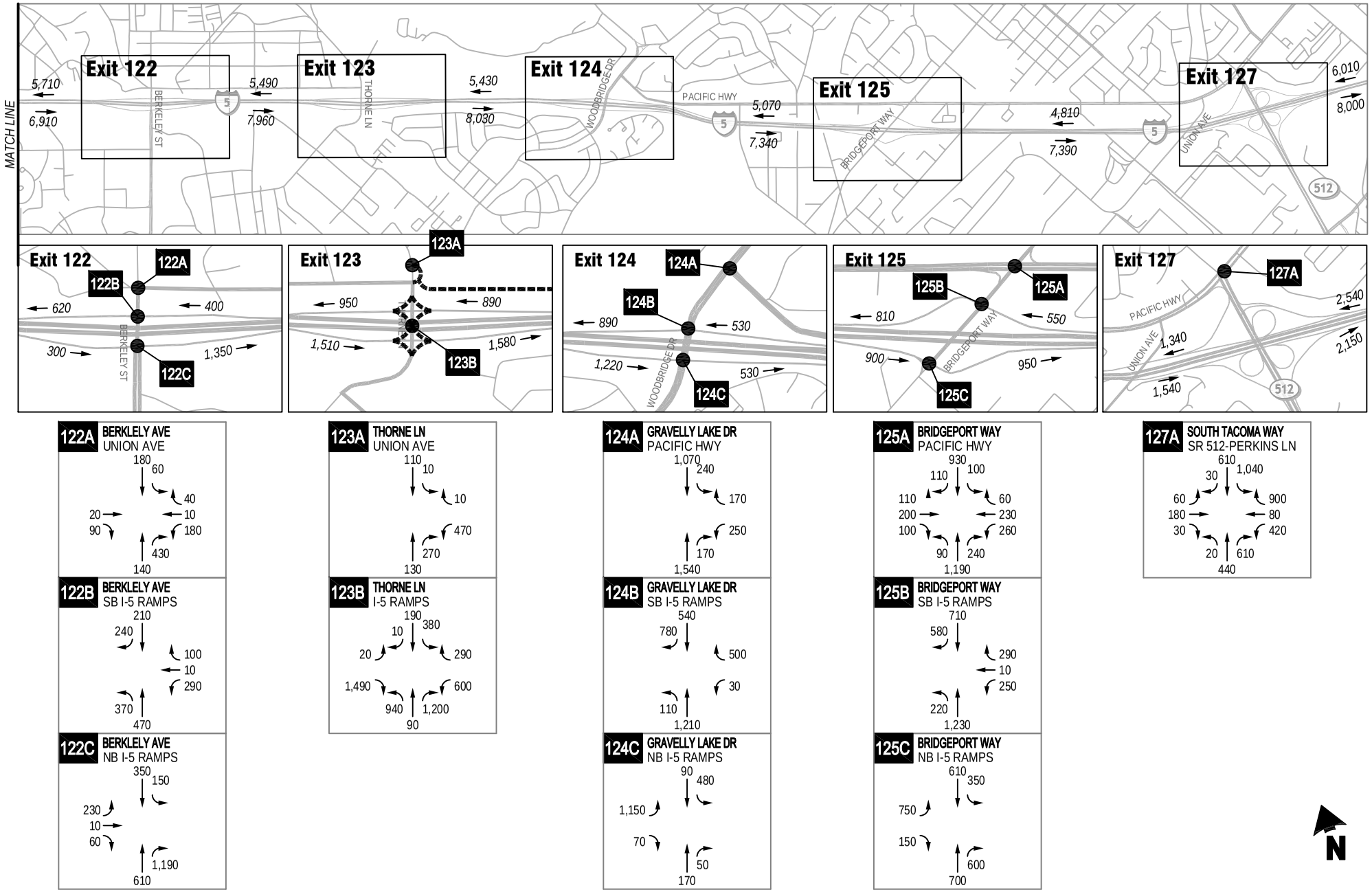
FIGURE
17



2030 PM Baseline Peak Hour Volumes (2 of 2)

FIGURE **18**

I-5 Transportation Alternative Analysis & Operations Model

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Operations Analysis

Traffic operations are characterized through a level of service (LOS) analysis. The LOS for each freeway segment and study area intersection (ramp terminals and some intersections immediately adjacent to interchanges) was calculated using methodologies presented in the *Highway Capacity Manual* (HCM), 2000. Forecast volumes as summarized in the preceding sections were used to evaluate future conditions.

Consistent with the analysis of existing conditions, the Highway Capacity Software program was used to evaluate freeway segments and the Synchro software program (version 7.0) was used to evaluate intersection operations. A more detailed description of the LOS criteria has been included in Appendix B. Discussion of mainline freeway and arterial operations is presented in the following sections.

Mainline Operations

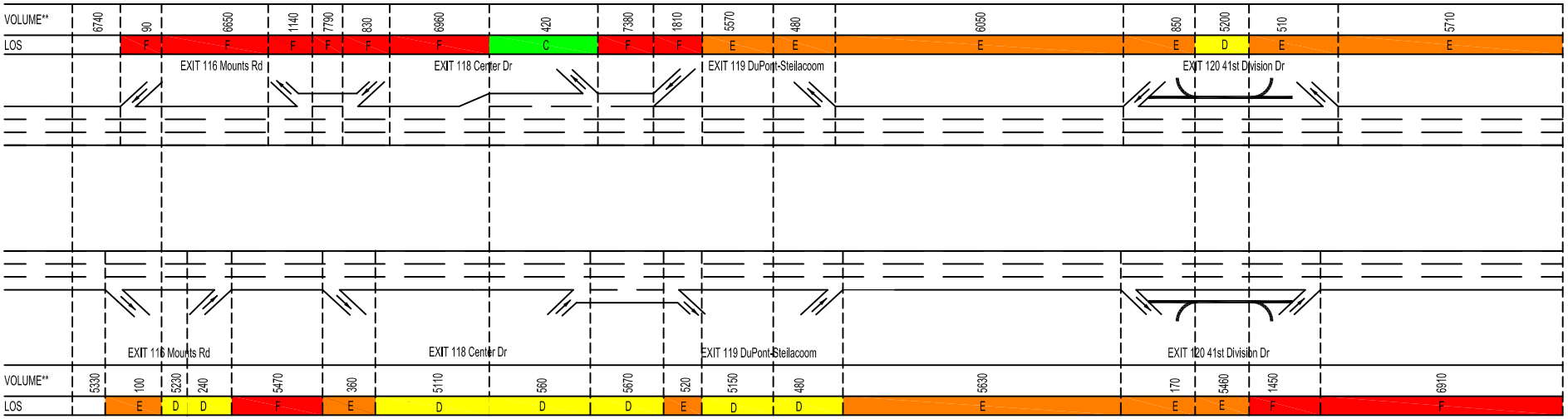
Similar to the existing conditions summary, the mainline PM peak hour LOS results are summarized graphically in Figure 19. As shown in this figure, by 2030 all northbound mainline segments as well as the merge/diverge segments are anticipated to operate at LOS D or worse. Several of the mainline segments are projected to fail, creating bottlenecks which will impact the operations of the corridor, inclusive of the on-ramp capacity. In the southbound direction all segments south of Thorne Lane are projected to operate at LOS D or worse, with the exception of the diverge movements at the Center Drive interchange. North of Thorne Lane, the I-5 mainline is anticipated to operate at LOS C. As in the case of the northbound traffic flows, the LOS F conditions southbound along I-5 will ultimately impact these sections of I-5 resulting in an LOS that is worse than reported.

Northbound and southbound capacity constraints exist due to the Nisqually Bridge. The current configuration of I-5 through the area is consistent with the current capacity of both bridges. As noted in the LOS summary, the I-5 mainline is projected to operate at LOS F in both the northbound and southbound directions.

In addition to several mainline segments projected to operate at LOS F, several key on/off-ramps are projected to operate at LOS F conditions in the future. The LOS F merge/diverge conditions are due to a combination of the merging/diverging traffic volumes combined with the traffic volumes along the mainline. The LOS F conditions will likely impact arterial operations. Due to this condition, the LOS reported in the following section for the arterial intersections likely understate the future congestion levels on the arterial system. The critical movements include the following:

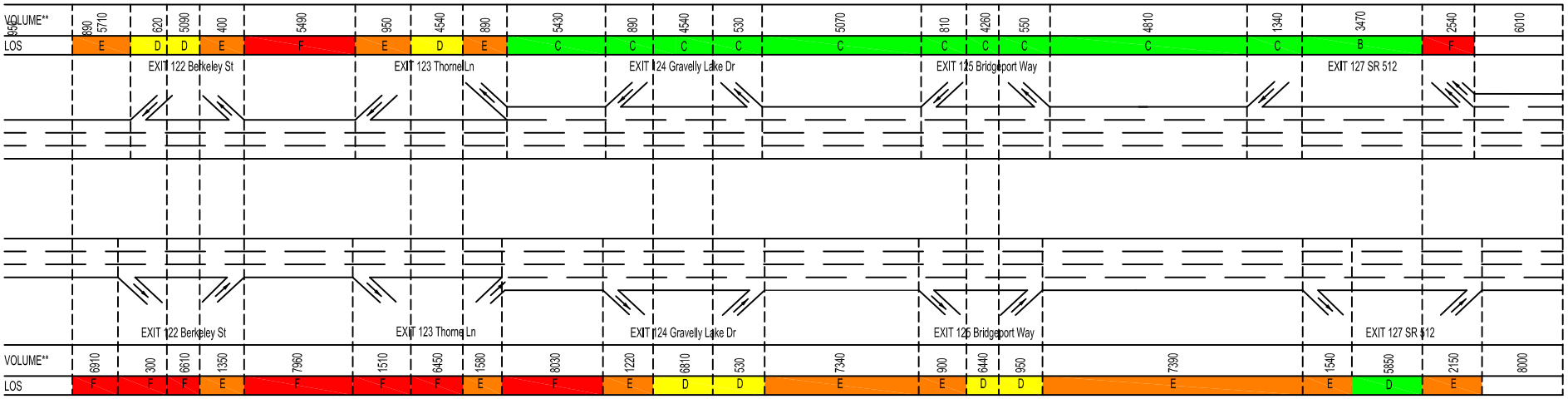
- Northbound I-5 On-Ramp at Berkeley Street
- Northbound I-5 Off-Ramp at Thorne Lane
- Southbound I-5 On-Ramp at DuPont-Steilacoom
- Southbound I-5 On-Ramp at Mounts Road
- Southbound I-5 On-Ramp at Center Drive

Lakewood I-5: Exit 116-Exit 120



Lakewood I-5: Exit 122-Exit 127

LOS Legend: LOS A to LOS C



2030 I-5 Mainline PM Peak Hour LOS Results

FIGURE 19

I-5 Transportation Alternative Analysis & Operations Model

M:\08\08301 Lakewood I-5 Growth Study\Graphics\08301_graphic05 <Fig 19> jesseb 08/31/10 14:11

Arterials/Ramp Terminals

Forecast 2030 baseline operations results for the weekday PM peak hour at arterial intersections (ramp terminals and adjacent arterial intersections) are summarized in Table 12. Results from existing (2009) conditions are also provided for comparison.

Table 12. Existing (2009) & Forecast (2030) Baseline Arterial/Ramp Terminal PM Peak Hour Operations Summary

		2009 PM Peak Hour			2030 PM Peak Hour		
I-5 Exit No.	Intersection	LOS[1]	Delay[2]	V/C[3] or WM[4]	LOS	Delay	V/C or WM
117	SB I-5 Ramps/Mounts Rd	D	34.4	WB-LT	F	174.8	WB-LT
	NB I-5 Ramps/Mounts Rd	C	20.6	EB	E	35.0	EB
118	SB I-5 Ramps/Center Dr	E	36.6	WB-Th/LT	F	55.4	WB-Th/LT
	NB I-5 Ramps/Center Dr	F	107.7	EB	-	-	-
119	SB I-5 Rmps/DuPont-Steilacoom Rd	B	12.7	0.78	F	>180	1.97
	NB I-5 Rmps/DuPont-Steilacoom Rd	C	34.9	0.80	F	>180	1.42
122	Union Ave/Berkeley Ave	B	14.1	-	B	18.9	0.39
	SB I-5 Ramps/Berkeley Ave	C	32.8	0.76	C	32.4	0.84
	NB I-5 Ramps/Berkeley Ave	C	21.6	0.80	C	26.2	0.83
123	Union Ave/Thorne Ln	B	11.6	EB	C	20.9	WB
	SB I-5 Ramps/Thorne Ln	D	43.0	0.60	C	21.9	0.97
	NB I-5 Ramps/Thorne Ln	D	41.0	0.59			
124	Pacific Hwy/Gravelly Lake Dr	B	18.0	0.71	B	18.1	0.82
	SB I-5 Ramps/Gravelly Lake Dr	D	37.5	0.77	D	54.9	0.88
	NB I-5 Ramps/Gravelly Lake Dr	E	61.5	0.68	F	88.6	0.78
125	Pacific Hwy/Bridgeport Way	C	28.0	0.66	C	30.6	0.77
	SB I-5 Ramps/Bridgeport Way	C	20.9	0.89	C	32.5	1.00
	NB I-5 Ramps/Bridgeport Way	B	18.0	0.73	C	24.0	0.78
127	South Tacoma Way/SR 512	C	29.7	0.68	C	29.4	0.71

1. Level of service, based on 2000 *Highway Capacity Manual* methodology.
2. Average delay in seconds per vehicle.
3. Volume-to-capacity ratio reported for signalized intersections.
4. Worst movement reported for unsignalized intersections.
5. WB=Westbound, EB=Eastbound, Th=Through, LT=Left turn

As shown in Table 12, the ramp terminal intersections at Mounts Road, Center Drive, DuPont-Steilacoom Road, and Gravelly Lake Drive operate poorly at LOS E or F under forecast 2030 baseline conditions. The LOS standard applied by WSDOT for all urban arterial/ramp terminal intersections is LOS D. Each of the interchanges and/or ramp terminals operating below LOS D are discussed below:

- Mounts Road (Exit 117) – Operations degrade due to the high volume of vehicles forecast to exit southbound I-5 and travel south on Mounts Road.

- Center Drive (Exit 118) – The low volume through movement from the southbound I-5 off-ramp results in LOS F operations.

- DuPont (Exit 119) – Failing conditions result because of the closure of the temporary Center Drive egress. With closure of the Center Drive egress, approximately 1,400 vehicles would instead exit JBLM via the DuPont gate and then proceed southbound on

I-5, and as a result would overwhelm the single northbound lane crossing I-5 at this interchange.

- Gravelly Lake Drive (Exit 124) – Operations are similar to existing conditions despite significant changes in travel patterns and approximately 850 additional vehicles traveling through the interchange.

Field observations of existing conditions at Union Avenue/Berkeley Avenue showed operations are worse than otherwise reported due to queues from the adjacent ramp intersection that extend through Union Avenue/Berkeley Avenue. The LOS reported for this intersection likely underestimates future congestion levels as the on-ramps are projected to operate at LOS F. The LOS F condition will likely result in queuing on the ramp that will spill back through the arterial intersection, significantly reducing the capacity.

Southbound I-5 off-ramp queues at the Berkeley Avenue interchange (aka – Madigan Army Medical Center) have been observed to extend the full length of the off-ramp and onto mainline I-5 during weekday mornings under existing conditions. These queues are expected to continue to do so into the future without any improvements to the Berkeley Avenue interchange. Based on this, an operations analysis of the AM peak hour at the Berkeley Avenue ramp terminals was also completed and results are shown in Table 13. Future AM volumes at this interchange were forecast by applying the growth rate observed between existing 2009 PM peak hour volumes and forecast 2030 volumes.

Table 13. Existing (2009) & Forecast (2030) Baseline Arterial/Ramp Terminal AM Peak Hour Operations Summary

		2009 PM Peak Hour			2030 PM Peak Hour		
I-5 Exit No.	**Intersection**	**LOS[1]**	**Delay[2]**	**V/C[3] or WM[4]**	**LOS**	**Delay**	**V/C or WM**
122	SB I-5 Ramps/Berkeley Ave	D	43.8	0.78	D	53.4	0.90
	Southbound Off-Ramp	*D*	*45.4*	*0.84*	*E*	*63.2*	*0.99*
	NB I-5 Ramps/Berkeley Ave	C	20.3	0.77	C	26.1	0.90

1. Level of service, based on 2000 *Highway Capacity Manual* methodology.
2. Average delay in seconds per vehicle.
3. Volume-to-capacity ratio reported for signalized intersections.
4. Worst movement reported for unsignalized intersections.

Although the analysis does not show failing operations (LOS F) at the southbound Berkeley Avenue off-ramps under existing conditions, field observations of existing conditions indicate that the vehicle queuing on the southbound off-ramp extends onto the shoulder of mainline I-5. Thus, future capacity improvements will focus on this condition despite the LOS reported for the weekday AM peak hour (Table 13).

Baseline Conditions Issues Summary

Highway/Arterial System

Several deficiencies up and down the I-5 corridor and at specific interchanges were previously summarized in Figure 19 and Figure 20. With the increase in the traffic these deficiencies will be exacerbated. In particular, the increase in traffic combined with the increased rail activity will increase the frequency of conflicts at these locations. Although Sound Transit and WSDOT have identified at-grade crossing improvements, the increased rail activity will continue to impact arterial street traffic operations.

The analysis of the baseline conditions showed that with the growth anticipated along the I-5 corridor and in consideration of the LOS results reported within this report, several sections will exceed capacity resulting in increased bottlenecks and decreased levels of service. With limited alternate routes, this increase in traffic volumes and decreased LOS will likely result in peak hour spreading throughout the peak period. In addition, at several interchanges including Berkeley and Thorne Lane the volume of merging and diverging traffic combined with the mainline volume will exceed the capacity for all three categories. This ultimately will result in increased delay and queuing on the on-ramps, impacting local arterial operations.

In addition, the baseline analysis assumes that JBLM no longer utilizes the Center Drive interchange in its current state as an egress point. Currently, a temporary access is used for egress traffic, primarily destined south on I-5. In the future year analyses, traffic associated with these movements were relocated to the DuPont-Steilacoom Road interchange. This increase in traffic from this shift along with general growth in traffic on JBLM results in both ramp terminals operating over capacity. In addition, the volume of traffic forecast for the southbound on-ramp exceeds the capacity of the merge with southbound mainline I-5 traffic.

Transit

Due to the lack of HOV lanes along I-5 within the study area, and in consideration of the congestion identified along the I-5 mainline and key on/off-ramps, transit will be delayed traveling through the corridor. The additional delay on transit and lack of “benefits” to users will potentially reduce ridership and impact the speed and reliability of the transit system.

Freight

As identified in the existing conditions assessment, freight traffic along I-5 represents a 10 percent to 13 percent of the total daily volume of traffic on I-5 within the study area. This equates to almost 15,000 trucks per day using this stretch of interstate. I-5 is classified as a T1 freight route, meaning that it carries more than 10 million tons of freight per year. The increased congestion along I-5 will impact the efficiency of freight and goods movements along the corridor, resulting in additional delay, and increasing the cost of moving goods along the corridor

Rail

As presented in the *Point Defiance Bypass Traffic and Transportation Discipline Report*, only limited freight would be moved on the rail system within the study area of this project under future conditions. Meanwhile, Amtrak service will increase to 12 trains traveling through the study area each day. Based upon the anticipated train schedule assumed for the bypass project, only one train is anticipated to travel through the study area during either the morning or evening peak commute hours and would likely block the rail crossing for approximately 45 seconds.

Queue lengths during the PM peak hour at at-grade rail crossings within the study area would either improve or remain approximately the same as existing conditions, except at the Bridgeport Way SW crossing. At this crossing, PM peak hour queues would remain approximately the same as existing conditions in the southbound direction, but would increase by approximately 20 percent in the northbound direction with increased rail activity and traffic volumes.

Mitigation measures in the form of updated signalized crossings, coordinated traffic signals, and at-grade improvements are anticipated to mitigate the impacts of the increased train activity at the existing train crossings.

Improvement Concept Development

This section summarizes the process used to develop and evaluate improvement concepts within the I-5 corridor study area. Three levels of screening were used to identify the location and elements of any needed improvements within the study area. The screening process was used to filter and refine improvements such that an appropriate level of effort was provided at each point in the process. The end result of the screening process was a group of preferred improvement concepts that will be further evaluated in future environmental review and operational studies as required through the Federal Interchange Justification Report process.

The level of detail of the improvement concepts and the criteria used to evaluate each concept, increase as part of each subsequent screening level. The screening levels build upon the previous outcomes and become more refined and detailed to further evaluate the remaining improvement concepts. The improvement concepts that were considered range from local arterial improvements, interchange modifications, additional freeway capacity, and concepts or strategies to better promote the use of alternative modes. The following provides a general overview of the purpose and methodology of each screening level. Technical memorandums submitted to TRC members as part of the review process are also included in Appendix C.

- **Level I Screening.** The study area included a total of 9 interchanges, more than 10 miles of interstate freeway, numerous local arterials, and many military installation gates and access roads. The budget and scope of the study did not allow the project team to develop improvement concepts to address every issue at each interchange in the study area. However, to develop specific improvement concepts that can be carried forward to subsequent phases, it was necessary to identify the locations in the study area with the greatest need of improvement and which are directly related to military operations and/or growth. This helps to develop specific improvement concepts to address issues for only the areas most impacted by military operations and which have the greatest overall need.
- **Level II Screening.** Typically a “fatal flaw” screening is conducted first. However, the Level I screening process focused on refining the study area and did not evaluate actual improvement concepts. As a result, the Level II screening process was a relatively simple evaluation of “yes” or “no” to ascertain fatal flaws with any of the proposed improvement concepts within the refined study area.
- **Level III Screening**. The Level III screening process was much more detailed than the previous two screening processes. While some of the criteria are similar to those measured previously, the Level III screening evaluates the concept groupings, rather than focusing on individual interchange improvements. This required the preparation of preliminary engineering drawings for each of the concept groupings in order to evaluate each based on the categories and metrics identified for this evaluation process.

Level I – Area of Focus

Level I screening level was not intended to eliminate strategies or higher level concepts that could be applied throughout the study area such as improved transit service or Intelligent Transportation Systems (ITS) technologies. Instead, Level I screening was used to reduce the number of locations where detailed geometric improvement concepts would be developed and evaluated. The first screening level looked exclusively at each of the nine interchanges to identify the four interchanges that more closely aligned with the criteria identified in Table 14.

Table 14. Level I Screening Criteria and Quantitative Measurements

Criteria[1]	Measurement Description[2]
Military Impact	- The percentage of future (2030) PM peak hour traffic that is attributed to the military installations. - The total number of future (2030) daily gate volumes that are directly served by the interchange.
Safety Issues	- The number of severe collisions per million vehicle miles travelled from 2002 to 2008. - The number of total collisions per million vehicle miles travelled from 2002 to 2008.
Operational Issues	- The number of existing (2009) interchange ramps, intersections, or adjacent freeway mainlines operating at LOS E or F during the PM peak hour. - The number of interchange ramps or approach legs operating above a volume-to-capacity threshold of 1.0 during the PM peak hour for year 2030.

1. General criteria used in refining the study area.
2. Describes how the criteria were measured.

Methodology

Results from the existing conditions analysis were used as a starting point to measure each of the screening criteria. A refined version of Pierce County's travel demand model, specifically focused on the installations and the cities of Lakewood and DuPont, was prepared to develop estimates of future travel demand. The model forecast year is 2030 and is consistent with all local and regional plans. The forecasts from the model were also used in measuring the screening criteria, specifically the military impact components and the future operational issues. Each interchange was then evaluated against the quantitative measurements described in Table 14. The general process included the following steps:

1. Evaluate each interchange against the quantitative measurements for each criteria;
2. Score each interchange with respect to the measurements;
3. Adjust the weighting of each criteria based on the purpose and need of the study; and
4. Compare weighted and non-weighted results, and identify the "area of focus."

The ranking of the interchanges is based on quantitative measures for each of the screening criteria. The measures are meant solely to rank each interchange relative to one another and are not intended to identify specific deficiencies or highlight every operational or safety issue at each interchange. They are measures by which the project team can easily determine and use to identify the interchanges that most closely align with the evaluation criteria highlighted in Table 14. The specific measures are summarized below.

Military Impact – (1) the total number of daily vehicles directly accessing each interchange from an adjacent military access point during the PM peak hour for the year 2030, and (2) the percentage of military traffic at the interchange as a percent of the total volume served during the PM peak hour for the year 2030.

Safety Issues – (1) the number of severe mainline or ramp-related collisions per million vehicle miles travelled between the years of 2002 and 2008, and (2) the total number of mainline or ramp-related collisions per million vehicle miles traveled between the years of 2002 and 2008. Severe collisions were defined as any involving an injury or fatality.

Operational Issues – (1) the number of existing (2009) interchange ramps, intersections, or adjacent freeway mainlines operating at LOS E or F during the PM peak hour, (2) the number of interchange ramps or approach legs operating above a volume-to-capacity (v/c ratio) threshold of 1.0 during the PM peak hour for year 2030. The v/c ratio is based on raw model volumes and link capacities, and LOS was determined using *Highway Capacity Manual* methodologies.

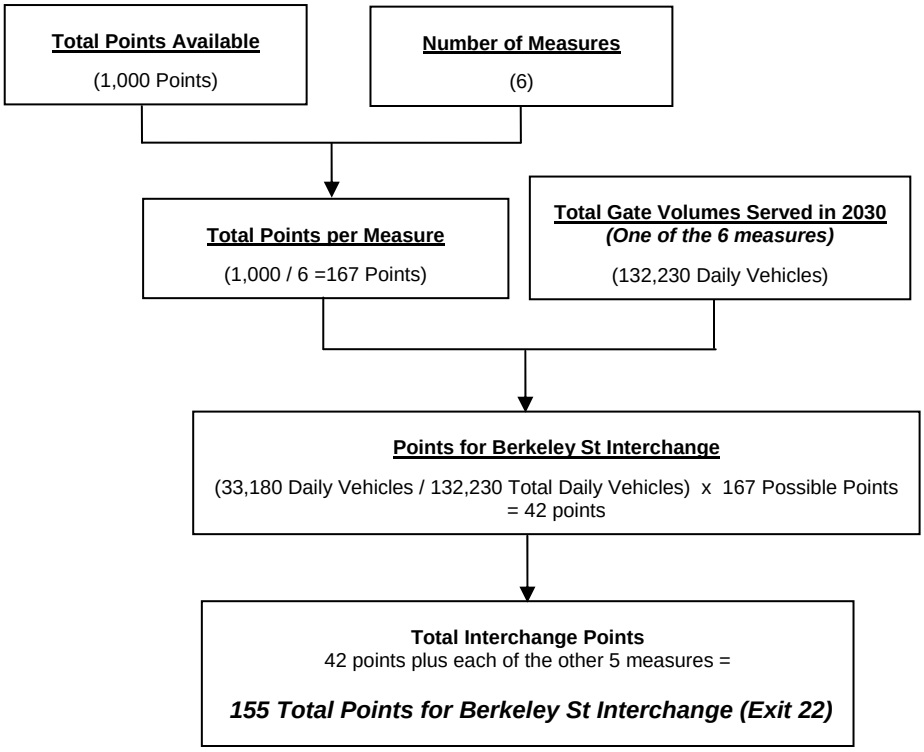
Results

Scoring (Non-Weighted Scenario)

The quantitative measures were summarized for each interchange and used to score the interchange relative to each other. A total of 1,000 points were distributed amongst the measures and individual interchanges. Since there were six measures, a total of 167 points were distributed per measure (1,000 total pts / 6 measures = 167 points). This assumes each measure is weighted equally. Each measure then had a total of 167 points to distribute amongst the nine interchanges. These points were proportionally distributed amongst the interchanges for each individual measure as shown in the example below. A higher score represents a negative result, indicating the interchange may have existing safety issues, a high military impact, or existing or future operational issues.

EXAMPLE SCORING FOR ONE MEASURE

(Military Impact: The total number of future daily gate volumes directly served by the interchange)



Once the points were distributed for each measure, the points for each interchange were summed together to calculate a total score. While there are many ways to score the measures, this methodology distributes points to each interchange based on how the interchange ranks relative to one another. This avoids having to identify specific point ranges and values for each measure and keeps the process relatively simple.

Table 15 presents the non-weighted scoring of each measure for the nine interchanges assuming each measure is weighted the same. A higher score indicates an interchange more directly impacted by the military and in greatest need of improvement.

Table 15. Level I Screening Results – Non-Weighted

	Points Assigned[1]							
	Military Impact[2]		Safety Issues[2]		Operational Issues[2]			
Interchange	**Total Daily Gate Volumes Served**	**% of Total Traffic**	**# of Severe Collisions per MVM**	**# of Collisions per MVM**	**# of Approaches LOS E/F**	**# of Segments with V/C > 1.00**	**Score[2]**	**Rank**
Exit 116 Mounts Road	0	12	11	12	15	25	**75**	**8th**
Exit 118 Center Drive	1	11	8	9	23	17	**69**	**9th**
Exit 119 DuPont-Steilacoom Rd	19	17	11	13	30	25	**115**	**5th**
Exit 120 41st Division Dr	68	26	13	15	0	42	**164**	**1st**
Exit 122 Berkeley Street	42	25	28	28	15	17	**155**	**2nd**
Exit 123 Thorne Lane	8	23	18	16	30	25	**120**	**3rd**
Exit 124 Gravelly Lake Drive	7	22	15	13	30	8	**95**	**6th**
Exit 125 Bridgeport Way	22	21	34	33	0	8	**118**	**4th**
Exit 127 SR 512	0	10	28	28	23	0	**89**	**7th**
						Total Points	***1,000***	

SHADED: The top four interchanges
1. A higher score indicates an interchange more directly impacted by the military and in greatest need of improvement.
2. See Table 14 (p 60) for descriptions of criteria and measures.
3. A total of 1,000 points have been distributed to the nine interchanges assuming all criteria are weighted equally.

Applying a Weighting Factor

Although the results presented in Table 15 assumed each measure is weighted equally, it is possible to weight each measure based on how closely it aligns with the purpose and need of the study. Typically, the application of a weighting factor will further assist in differentiating the final scores.

Since the study purpose and need of this project is tied to military growth and impacts, additional weighting was applied to the military impact criteria. In addition, the existing conditions analysis identified that a majority of the collisions in the study area were due to congestion and frequent stop-and-go traffic. Therefore, operational issues were provided more weight because addressing those issues would likely address the safety issues as well. Safety received lower weighting, not because it was less important, but because the operational measures would largely influence safety.

Table 16 summarizes the results of applying weighting factors to the measures and compares the weighted results with the non-weighted rankings. The weighting adjusted the total number of points available to each measure. For example, under the non-weighted scenario the military impact criteria had 334 total points it could distribute; under the weighted scenario it can distribute 400 total points (or 40 percent of the 1,000 points available).

Table 16. Level I Screening Results – Weighted

	Points Assigned[1]									
	Military Impact[2]		Safety Issues[2]		Operational Issues[2]					
Interchange	**Total Daily Gate Volumes Served**	**% of Total Traffic**	**# of Severe Collisions per MVM**	**Total Daily Gate Volumes Served**	**% of Total Traffic**	**# of Severe Collisions per MVM**	**Weighted**		**Non-Weighted**	
Weighting	*20%*	*20%*	*15%*	*10%*	*15%*	*20%*	***Score[3]***	***Rank***	***Score[3]***	***Rank***
Exit 116 Mounts Road	0	14	10	7	14	30	**75**	**7th**	**75**	**8th**
Exit 118 Center Drive	1	14	7	5	21	20	**68**	**9th**	**69**	**9th**
Exit 119 DuPont-Steilacoom Rd	23	20	10	8	27	30	**118**	**4th**	**115**	**5th**
Exit 120 41st Division Dr	82	32	12	9	0	50	**185**	**1st**	**164**	**1st**
Exit 122 Berkeley Street	50	30	25	17	14	20	**156**	**2nd**	**155**	**2nd**
Exit 123 Thorne Lane	9	27	16	10	27	30	**119**	**3rd**	**120**	**3rd**
Exit 124 Gravelly Lake Drive	9	26	14	8	27	10	**94**	**6th**	**95**	**6th**
Exit 125 Bridgeport Way	26	25	31	20	0	10	**112**	**5th**	**118**	**4th**
Exit 127 SR 512	0	12	25	16	20	0	**73**	**8th**	**89**	**7th**
						Total Points	***1,000***		***1,000***	

SHADED: The top four interchanges
1. A higher score indicates an interchange more directly impacted by the military and in greatest need of improvement.
2. See Table 14 (p 60) for descriptions of criteria and measures.
3. A total of 1,000 points have been distributed to the nine interchanges assuming based on the weighting factors.

Summary of the Rankings

In the end, the weighted and non-weighted rankings are very similar. The top three interchanges are ranked the same under both scenarios and include 41st Division Drive, Berkeley Street, and Thorne Lane. Under the non-weighted scenario, Bridgeport Way is ranked 4th and DuPont-Steilacoom Road is ranked 5th. The rankings for these two interchanges then reverse under the weighted scenario. Below is a general summary of each interchange and its ranking.

Mounts Road (Exit 116) – The primary reason this interchange ranks 8th is that it serves a low proportion of military demand. While there are operational issues at the interchange, they are primarily confined to one ramp during the peak periods. Much of the traffic using the interchange

is regional in nature because the interchange provides a back-door route to Yelm. A majority of the military personnel living in Yelm use the East gate rather than Mounts Road to travel to and from JBLM.

Center Drive (Exit 118) – The screening analysis assumed the Center Drive gate was closed to better reflect the issues and needs at the DuPont-Steilacoom Road interchange. The major reason JBLM opens the Center Drive gate during the PM peak period is due to the fact the DuPont-Steilacoom Road interchange is unable to accommodate the demand. This is one of several reasons why the Center Drive interchange receives the lowest ranking of the nine. The ranking in no way endorses the continuation of utilizing the Center Drive emergency access as a relief valve, but rather acknowledges that it should be a temporary situation, with the permanent solution likely being further improvements at the DuPont-Steilacoom Road interchange.

DuPont-Steilacoom Road (Exit 119) – This interchange ranks 4th under the weighted scenario and 5th under the non-weighted scenario. The analysis assumed vehicles using the Center Drive gate would instead exit the DuPont Gate. Therefore, the interchange receives a high number of points under the operational issues and military impact criteria. JBLM has plans to improve and reconfigure the DuPont Gate which could also provide an opportunity to consider improvements to the interchange.

41st Division Drive (Exit 120) – This interchange provides access to the main JBLM gate and the North Fort gate. It serves approximately one-third of all military demand. It receives the highest ranking mainly due to the military impact criteria. Since it is forecast to have operational issues in the future, it receives high scores under the operational issues criteria because of its cloverleaf design, which includes eight separate ramps.

Berkeley Street (Exit 122) – The Berkeley Street interchange provides primary access to the Madigan Army Medical Center and Camp Murray. It experiences significant congestion throughout the day, with vehicle queuing often observed onto the freeway mainline during the morning commute. It receives high scores for almost every category. There have been a number of collisions involving injuries at or near the interchange, and it has one of the highest collision rates along the corridor. It ranks 2nd under both the weighted and non-weighted scenarios.

Thorne Lane (Exit 123) – This interchange will be reconfigured as part of the future Cross-Base Highway. It provides access to JBLM while also serving regional east-west traffic that use the 150th Street corridor. Currently I-5 adds and drops a freeway lane at Thorne Lane often resulting in congestion and back-ups. It scores high in almost every category and ranks 3rd under each scenario. The future model and forecasts assume completion of the Cross-Base Highway in the future. While existing Cross-Base Highway designs would reconfigure this interchange into a proposed single-point urban interchange, this study should consider alternative concepts and possible interim improvements.

Gravelly Lake Drive (Exit 124) – The Gravelly Lake Drive interchange ranks 6th under both the weighted and non-weighted scenarios. It scores low in safety and future operational issues. While it provides access to McChord Air Field, the adjacent gate is only open for a limited number of hours. Military personnel living in Lakewood often use this interchange to exit or access I-5. Therefore, it scores high under the percent of total traffic that is from the installations. Future improvements will likely be considered at this interchange because the Thorne Lane interchange design for the Cross-Base Highway currently includes a frontage road connecting both interchanges. Therefore, the study will likely devote a limited amount of time accounting for improvements at this interchange as well.

Bridgeport Way (Exit 125) – The Bridgeport Way interchange provides primary access to McChord Air Field and the City of Lakewood. It ranks 4th under the non-weighted scenario and 5th under the weighted scenario. It receives a high overall score due to a history of high collision rates at and around the interchange. The collisions are mainly due to mainline congestion from

the add/drop lane at Thorn Lane to the south and the merging and weaving issues from/to SR 512 to the north.

SR 512 (Exit 127) – The SR 512 interchange is a major freeway-to-freeway interchange with vehicle queuing often observed on the ramps and at the adjoining intersections. The close proximity of the southbound ramp intersection with the intersection with Pacific Highway South results in sometimes significant delays for vehicles entering and exiting the City of Lakewood. While the needs are great at the interchange, they are primarily regional in nature and do not directly relate to the purpose and need of the study. Overall, the interchange ranks 7th under the non-weighted scenario and 8th under the weighted scenario.

Level I Screening - Conclusions

Based on the results of the weighted and non-weighted rankings for the Level I screening process, the following four interchanges were identified for further developing improvements:

- Exit 119 – DuPont-Steilacoom Road
- Exit 120 – 41st Division Drive
- Exit 122 – Berkeley Street
- Exit 123 – Thorne Lane

While the non-weighted rankings result in the Bridgeport Way interchange having a higher ranking than the DuPont-Steilacoom Road interchange, the Bridgeport Way interchange is further north than the other three interchanges and would result in a fragmented study area. In addition, there are significant existing issues at the DuPont-Steilacoom Road interchange that need to be addressed along with possible joint opportunities with JBLM as part of their plans to improve the DuPont Gate. Therefore, the recommendation includes the DuPont-Steilacoom Road interchange as the fourth interchange location to be included in the primary study area.

While improvement concepts for the other interchanges will not be evaluated in detail, the study will still address the future deficiencies and needs at each interchange, while also considering system level strategies that could benefit the other interchange locations.

Level II – Fatal Flaw Analysis

Typically a “fatal flaw” screening is conducted first. However, the Level I screening process focused on refining the study area and did not evaluate actual improvement concepts. As a result, the Level II screening process is still a relatively simple evaluation of “yes” or “no” to ascertain fatal flaws with any of the proposed improvement concepts within the refined study area. The fatal flaw questions are listed in Table 17.

Table 17. Level II Screening Criteria

Criteria[1]	Fatal Flaw Questions (Yes or No)[2]
Military	Does the proposed concept address a military impact or need? Does the proposed concept negatively impact military operations?
Safety	Does the proposed concept address an existing safety deficiency?
Mobility	Does the proposed concept address a future capacity and congestion issue?
Local Impacts	Does the proposed concept positively benefit local arterials and streets?
Cost Effectiveness	Is the scale of the proposed concept consistent with the benefits it would likely provide?

1. General criteria used in defining fatal flaw questions.
2. Any proposed concept that receives a "no" to any one of these questions will be judged to have a fatal flaw.

Any concept that received a "no" in any of the five criterion was judged to have a fatal flaw and was not moved forward to the Level III screening process. The first four criteria are items that can be easily assessed at this level of concept development. However, the last criterion referred to as "cost effectiveness" was more difficult to assess. Therefore, this last criterion is meant to identify those concepts that are likely very large in scale, but not likely provide a consistent level of benefits relative to other concepts that have been identified.

Methodology

The development of improvement concepts focused on four interchanges:

- DuPont-Steilacoom Road (Exit 119)
- 41st Division Drive (Exit 120)
- Berkley Street (Exit 122)
- Thorne Lane (Exit 123)

The project team conducted a more detailed analysis of the operational impacts and geometric constraints for each of the improvement concepts at each interchange location. In addition to the analysis of specific interchange improvements, additional consideration was given to the impact of system wide concepts, including mainline I-5 improvements. The following sections provide a brief overview of potential system wide concepts and related benefits as well as an overview of interchange concepts and their related benefits.

Results

Future Baseline Evaluation

The analysis of both the existing year and future baseline (2030) year results indicated one clear issue; the demand for travel on I-5 through the study area is high today and will continue to increase into the future. As demonstrated in the existing conditions analysis, key segments in the corridor experience traffic volume demands exceeding available roadway capacity. Thus, it is clear that as population and employment increases into the future, demand for travel on I-5 will increase, resulting in increased congestion at more segments and for longer periods of time. As identified in the existing conditions section of this report, most segments, merge, and diverge sections currently operate at or near capacity.

Figure 19 (p 55), in the previous baseline condition section, summarizes the results of the 2030 baseline operations analysis for the mainline, merge, and diverge operations within the full study area of the project. As shown in the figure, all segments of I-5 in the northbound direction are

anticipated to operate at LOS E or worse with the exception of the northbound merge at Gravelly Lake Boulevard and Bridgeport Way. In the southbound direction, south of Thorne Lane, all segments and merge/diverge operations are anticipated to operate at LOS E or worse with the exception of the merge from Berkley Street or the diverge at Center Drive.

Demand for travel on I-5 is forecasted to exceed the capacity of the freeway by 2030 for the segment of I-5 through the majority of the study area. In general, demands along I-5 in the future exceed the current capacity by approximately 1,500 to 2,200 vehicles during the PM peak hour. This is the equivalent of more than another full lane of freeway capacity.

System Concepts

While the Level I screening highlighted the interchanges that were evaluated at a more detailed level, there was still the need to evaluate and consider system-wide concepts that would help address the overall demand along the I-5 corridor and/or provide alternative travel choices. It is important to understand how system-wide concepts may change the need for improvements at the interchanges themselves or whether they are needed in addition to the interchange improvements. Five general system-wide concepts were considered:

- **Intelligent Transportation System (ITS) Improvements** - to improve the efficiency of the system.
- **Demand Management** - to lessen the demand for single occupant vehicle traffic.
- **Transit System Improvements** - to improve travel options for users along the corridor.
- **I-5 Mainline Improvements** – to increase capacity on the I-5 corridor.
- **Parallel Corridor Improvements** – to lessen the amount of demand destined for I-5 by constructing or improving other parallel facilities, such as SR 507 and SR 7.

ITS Improvements

WSDOT is committed to using whatever tools are available to operate the system as efficiently as possible, including technology. WSDOT has plans to improve the ITS infrastructure from Mounts Road to north of SR 512. This includes adding closed circuit cameras, increased traveler information systems, variable message signs and ramp metering at strategic locations throughout the corridor. These improvements will be included in the final study recommendations and will help provide the traveling public with more information on travel conditions as well as ways to improve the flow of traffic along I-5.

The ITS improvements are considered a first step in any improvement strategy for I-5 and are an integral part of WSDOT's Moving Washington Plan. ITS improvements can help improve the overall efficiency of the network. Ramp meters have been shown to improve traffic flow anywhere from 2 percent to 10 percent depending on their location and method of application. If a 5 percent improvement in efficiency is assumed, the I-5 corridor could conceivably accommodate another 300 to 500 vehicles. This increase in efficiency is still far less than the expected demand and has impacts on the local arterials and connections.

Demand Management

Traffic is increasing on I-5 because more people are living and working in the region. The current long-range plans all assume some basic level of population and employment growth for our region. Growth is considered an integral part of a healthy economy. This stretch of I-5 is impacted by population growth in Thurston and Pierce counties, the military bases, and growth in Washington, Oregon, and California. As the region continues to grow, the need to travel between each region along I-5 also increases.

The region recognizes that alternative modes of travel are an important consideration when evaluating improvement needs. In 2009, almost 10,000 people traveled out of the three military

installations along I-5 in the peak hour alone. This is forecasted to grow to over 12,000 by the year 2030. A majority of these trips access I-5 at some point. A freeway lane can handle approximately 2,000 vehicles per hour. This means that the demand leaving the three bases could fill up 6 lanes of freeway by themselves.

By continuing to encourage vanpools, high-occupancy travel modes and flexible work schedules, a small reduction in the total peak hour demand on the freeway could be expected. However, due to the nature of operations on a military installation, most of the reduction would be from non-military traffic. If a 10 percent reduction in non-military trips were obtained, the demand of PM peak hour trips would be reduced by 400 vehicles. This reduction in demand is very optimistic and still does not address the overall congestion issues along the corridor and in and of itself would not have a meaningful impact on reducing the levels of congestion in the corridor.

Transit Improvements

Transit can play an important role in addressing travel demand along I-5. One system level alternative tested was to extend the Sounder Commuter rail line from its currently planned terminus in Lakewood south to DuPont. This extension resulted in approximately 135 riders in the AM peak hour going northbound towards Tacoma and Seattle. The forecast for the AM bus ridership between Thurston County and Pierce County is approximately 500 riders. Without these transit services in place, an additional 600 people would be trying to use this section of I-5. However, bus routes must also use the same freeway lanes as single occupant vehicles. To expect an even larger shift to buses may be unrealistic until such time that there is travel time benefit over single occupant vehicles.

Pierce County and JBLM are currently in the process of assessing the demand and viability of increased transit service to the installation. Currently, routes access the installation with security procedures addressed at the gates. Attracting additional transit users to and from the military installations is a challenge due to the rigid scheduling of military activities and the limitations of serving a secured area.

I-5 Mainline Improvements

As noted, the increase in demand on I-5 exceeds the available capacity. By 2030, the demand for travel in the PM peak hour is forecasted to exceed the ability of the freeway to accommodate it, especially in the peak directions. Along some segments, the forecast for demand is almost 30 percent higher than the available capacity. In situations such as these, the most likely outcome is that the PM peak hour will spill over into the off-peak periods which will increase the length of the peak period.

One sensitivity test was run through the travel demand model to determine if an additional lane would meet the capacity constraints along the corridor. The existing add/drop lane at Thorne Lane was extended to Mounts Road for the analysis. In general, the widening of I-5 did not result in an increase in demand. The corridor is still largely capacity constrained due to the bridges over the Nisqually River south of Mounts Road. Therefore, very little additional “latent” demand was observed when a new lane was added. This resulted in the additional lane reducing the overall I-5 mainline volume to capacity (v/c) ratios at or below 1.0. Anything less than a v/c of 1.0 indicates the freeway demand is less than the available capacity.

Although widening of I-5 would improve the flow of the mainline, it would not address operational issues at the arterial intersections at each of the ramp terminals. In general, most of the improvements that would be proposed at each interchange are not affected with the widening of I-5. With the close proximity of the rail line to I-5, any widening of I-5 would require widening to the east of I-5.

New Parallel Corridor

I-5 is the main connection between Pierce and Thurston Counties. Travelers between Seattle and Olympia travel on I-5, often no matter how unfavorable the traffic conditions. With this in mind, the project team evaluated the possible benefits a parallel facility could have on I-5. The parallel facility tested was a new limited access facility, comparable to the existing I-5 corridor, with 3 travel lanes in each direction and a posted speed limit of 60 mph. The facility was coded in the vicinity of SR 507 and SR 7 and ran from Thurston County north to I-5 in Tacoma. The evaluation was simply a "modeling exercise" meant to understand whether a new freeway corridor would alleviate needs along I-5.

In general, the results of the analysis showed that although the parallel facility could remove some traffic from I-5, the majority of trips between Thurston County and Pierce County would still remain on I-5 itself due to the overall destinations of the trips. The parallel facility lowered traffic volumes on I-5 a total of 5 percent at the lowest point of change and almost 13 percent at its highest point. This resulted in a shift of approximately 500 to 1,000 vehicles in the PM Peak hour (2030) from I-5. Thus, the PM Peak travel demand on the parallel facility would be closer to levels experienced on I-5 today. However, the parallel corridor would, in and of itself, not alleviate congestion from I-5. Therefore, there is still a need for further improvements or traffic reductions on I-5. This, combined with the environmental, cost and neighborhood impacts that a new parallel facility would likely have, make this a parallel facility less desirable than widening of I-5 itself.

Interchange Improvement Concepts

As identified in the previous sections, without additional improvements to the I-5 mainline, the improvements to the interchanges were not as effective. As part of the analysis of the preferred alternative, additional analysis will be conducted focusing on the merge/diverge operations associated with each of the improvement concepts. Specifically, the preferred alternative was assessed to determine whether collector/distributor lanes or auxiliary lanes should be constructed along the I-5 mainline. The overall recommendation regarding the mainline improvements is based on the system needs as well as the individual interchange operations.

The concepts examined within the Level II screening did not define the mainline treatments. In general, three concepts, with the exception of 41st Division Drive, were developed for each interchange. The multiple concepts were developed focusing on near-term and long-term solutions. Based on geographical constraints and existing/future deficiencies, short-term improvements were more easily defined for some interchanges than others. Figures provided in Appendix D illustrate the improvements, present a summary of the existing/future baseline deficiencies, as well as the benefits and limitations for each concept. Table 18 provides a summary of the key interchanges, baseline conditions and LOS under the improvement concepts.

Table 18. Future (2030) Weekday PM Peak Hour LOS & Delay Summary

Interchange	Key Movement(s)	Terminal	Baseline	Concept A	Concept B	Concept C
DuPont-Steilacoom Rd (Exit 119)	Outbound JBLM to SB I-5	SB Ramps NB Ramps	F/ >180 F/ >180	B/ 14 C/ 25	C/ 26[2]	B/ 18 C/ 24
41st Division Dr (Exit 120)	On-ramp merge points onto NB & SB I-5	SB Ramps NB Ramps	F E	Improves at-grade crossing conflicts	Improves NB C/D [3] design	N/A
Berkeley St (Exit 122)	Queue spillback to Union. Outbound JBLM to NB I-5.[1]	SB Ramps NB Ramps	C/ 32 C/ 26	B/ 18 A/ 9	*Same as Concept A	B/ 12
Thorne Ln (Exit 123)	Movements between I-5 & S-leg	SB Ramps NB Ramps	C/ 22[2]	*Same as Baseline	*Same as Baseline	*Same as Baseline

1. Inbound JBLM from SB I-5 is known to operate poorly during AM conditions.
2. Southbound and northbound ramps meet at a single-point urban interchange (SPUI).
3. C/D – Collector/Distributor lanes
4. Results for NB ramps are presented in Transportation Needs Assessment for the Woodbrook Business Park Development Study. These results do not account for any increases associated with the Cross-Base Highway since Concept A would function only as a short-term improvement.

Conclusions

The results of the Level II screening analysis were presented to the TRC members at the December, 2009 TRC meeting. In general, the feedback from the TRC members supported the work that the project team had conducted. No additional improvements for the corridor were identified by the TRC members as needing to be considered in the analysis. Further analysis was conducted as part of the Level III screening, in order to identify and evaluate potential groupings of alternatives based on system need and performance levels.

Level III – Concept Group Evaluation

The Level III screening process was much more detailed than the previous two screening processes. Following the development of individual interchange improvements, further analysis focused on identifying the appropriate combination of improvements at the respective interchanges as well as the mainline related improvements (i.e. collector/distributor lanes, auxiliary lanes, etc). Three concept groupings were developed for the corridor. These groupings included varying levels of interchange and mainline improvements. The evaluation then considered the combination of improvements in evaluating overall system performance.

While some of the evaluation criteria are similar to those measured previously, the Level III screening evaluates the concept groupings, rather than focusing on individual interchange improvements. This required the preparation of preliminary engineering drawings for each of the concept groupings in order to evaluate each based on the categories and metrics listed in Table 19 (p 71).

Description of Concept Groupings

A number of system improvements were described and presented in the preceding Level II section. These system improvements, related to the I-5 corridor, included ITS improvements and mainline improvements. Other system improvements included demand management strategies, transit improvements in the area, and the construction of a new parallel corridor. The system improvement evaluation highlighted the need for additional capacity along I-5 in combination with ITS infrastructure, demand management strategies, and additional transit improvements.

Table 19. Level III Screening Criteria

Category[1]	Description of Metrics[2]
Design Feasibility	• Level of Design for On-ramp Connections • Level of Design for Off-ramp Connections • Profile Feasibility • Radius/Design Speed • Constructability
Safety	• Improvements in locations where serious & fatal collisions have occurred (ramps) • Improvements in locations where serious & fatal collisions have occurred (mainline) • Number of Modes Addressed (vehicles, peds, bikes, and transit)
Mobility / Operations	• Change in Mainline Delay (veh-hrs per PM peak hour) • Change in Average Interchange Delay (seconds per vehicle per PM peak hour) • Change in Freight / Transit / Vehicle Mobility (mainline mph) • Change in Average Military Route Travel Speed (mph)
Environment	• Number / Type of Impacted Sensitive Areas • Amount of Additional Impervious Surface • Change in VMT • No. of Impacted Historical/ Cultural Resources • Impact on JBLM Property (# of locations)
Benefit / Cost	• Estimated Construction Costs • Benefit / Cost Ratio

1. The categories are consistent and supportive with the WSDOT statewide priorities.
2. Metrics that were used to evaluate improvement concepts.

In addition to the earlier developed improvements, another interchange improvement emerged that could also address study area needs. This concept, referred to as a diverging diamond, is discussed as an alternative to the Single Point Urban Interchange (SPUI) concepts at both the DuPont-Steilacoom Road interchange as well as the Berkeley Street interchange. The construction of this type of interchange design allows for further flexibility in construction phasing and has been considered in the Level III screening evaluation.

Illustrations of the concept groupings are shown in Figure 20 through Figure 22 and are described in more detail in the following section.

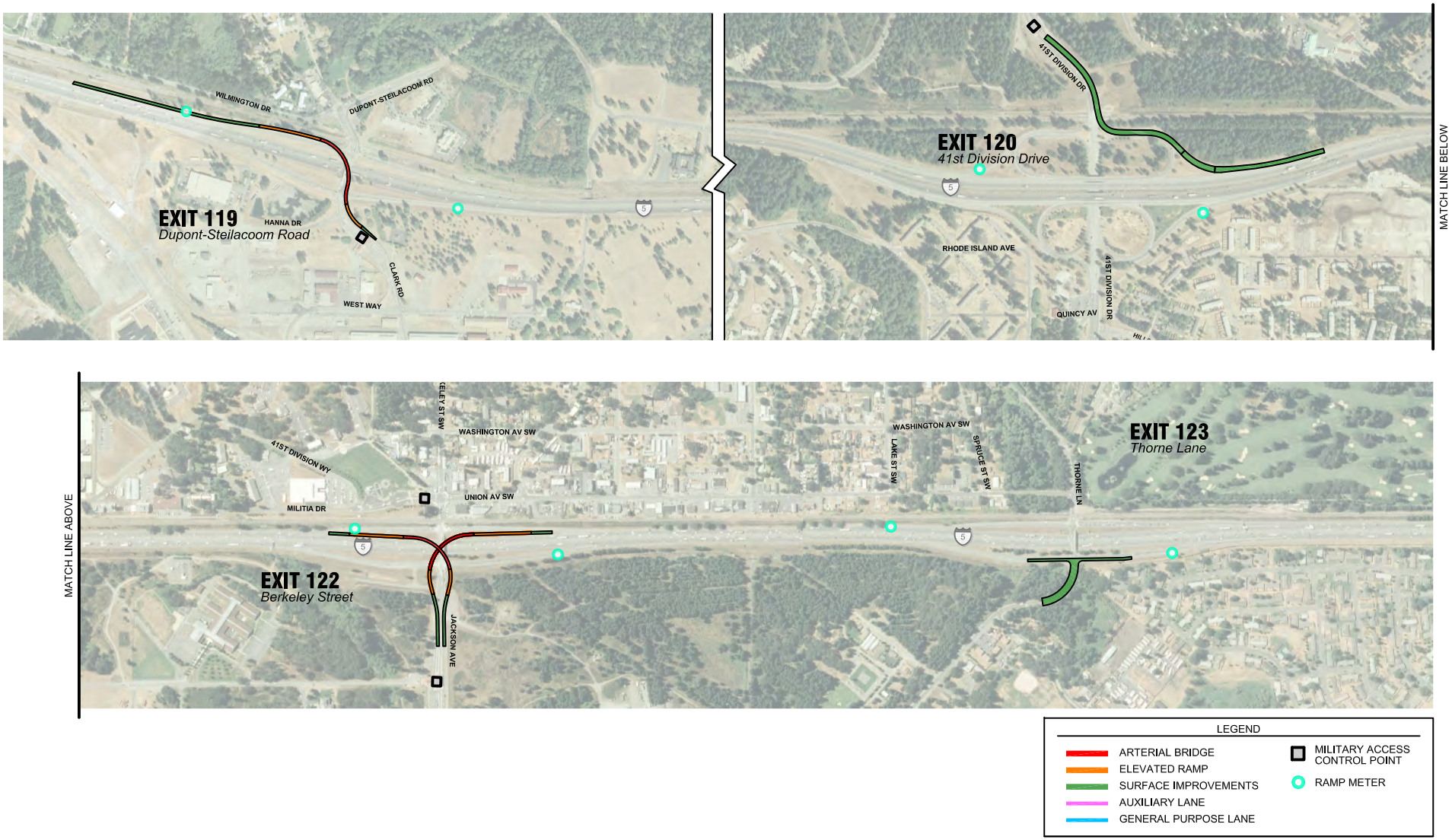
An example of a "diverging diamond" interchange configuration.

Source: Missouri Department of Transportation

Concept Grouping 1 (Figure 20)

Concept Grouping 1 includes the lowest impact/cost solutions at each of the interchanges, with no I-5 mainline improvements. The key elements of this concept grouping include:

- **DuPont-Steilacoom Road (Exit 119):** Construct a southbound I-5 flyover on-ramp.
- **41st Division Drive (Exit 120):** Widen the southbound off-ramp (access to JBLM North) to two lanes to provide additional vehicle storage/capacity.



Concept Group 1

I-5 Transportation Alternatives Analysis and Operations Model

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FIGURE
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- **Berkeley Street (Exit 122):** Construct flyover ramps for the southbound off- and on-ramps.
- **Thorne Lane (Exit 123):** Construct SPUI consistent with Cross-Base Highway design plans.
- **System Improvements:** Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.

Concept Grouping 2 (Figure 21)

Concept Grouping 2 reflects a higher level of investment to reconstruct the existing infrastructure at each interchange. It includes two potential interchange options at the Berkeley Street and DuPont-Steilacoom Road interchanges. These potential interchange improvements include either a SPUI or diverging diamond configuration. There are a limited number of diverging diamonds that have been completed in the US, although several are planned. FHWA has prepared a technical brief that provides an overview of the general operations and safety impacts of this interchange configuration. [9]

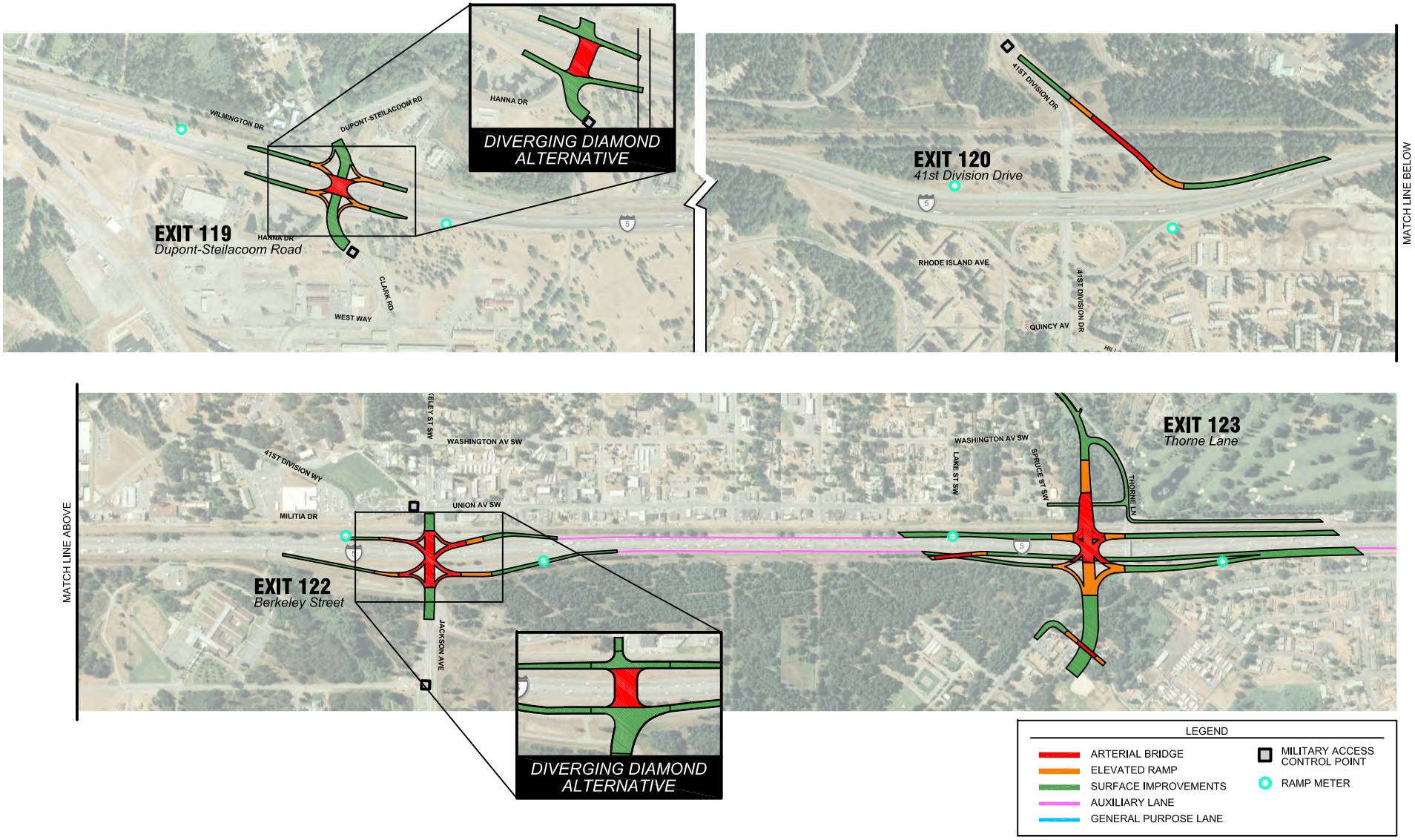
- **DuPont-Steilacoom Road (Exit 119):** Construct either a SPUI (concept 2a) or a diverging diamond (concept 2b).
- **41st Division Drive (Exit 120):** Provide grade separation for the southbound off-ramp to JBLM North access gate.
- **Berkeley Street (Exit 122):** Construct either a SPUI (concept 2a) or a diverging diamond (concept 2b).
- **Thorne Lane (Exit 123):** Construct SPUI consistent with Cross-Base Highway design plans.
- **System Improvements:**
    - Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.
    - Construct southbound auxiliary lanes between the Berkeley Street and Thorne Lane interchanges. Construct braided ramps northbound between Berkeley Street and Thorne Lane interchanges.
    - Construct a northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive.

Concept Grouping 3 (Figure 22)

Concept Grouping 3 reflects a similar level of interchange improvements as Concept Grouping 2, but includes additional improvements along the I-5 mainline. Under this concept grouping, new northbound and southbound general purpose lanes are constructed from Mounts Road to the Thorne Lane interchange. Similar to the Concept Grouping 2, both the SPUI and diverging diamond configurations are presented as options at the DuPont-Steilacoom Road and Berkeley Street interchanges.

- **DuPont-Steilacoom Road (Exit 119):** Construct either a SPUI (concept 3a) or a diverging diamond (concept 3b).
- **41st Division Drive (Exit 120):** Provide grade separation for the southbound off-ramp to JBLM North access gate. In addition, due to the widening of I-5, it is anticipated that the clover leaf design on the east (JBLM Main) side of I-5 would be reconstructed.

[9] http://www.fhwa.dot.gov/publications/research/safety/09054/index.cfm



Concept Group 2

I-5 Transportation Alternatives Analysis and Operations Model

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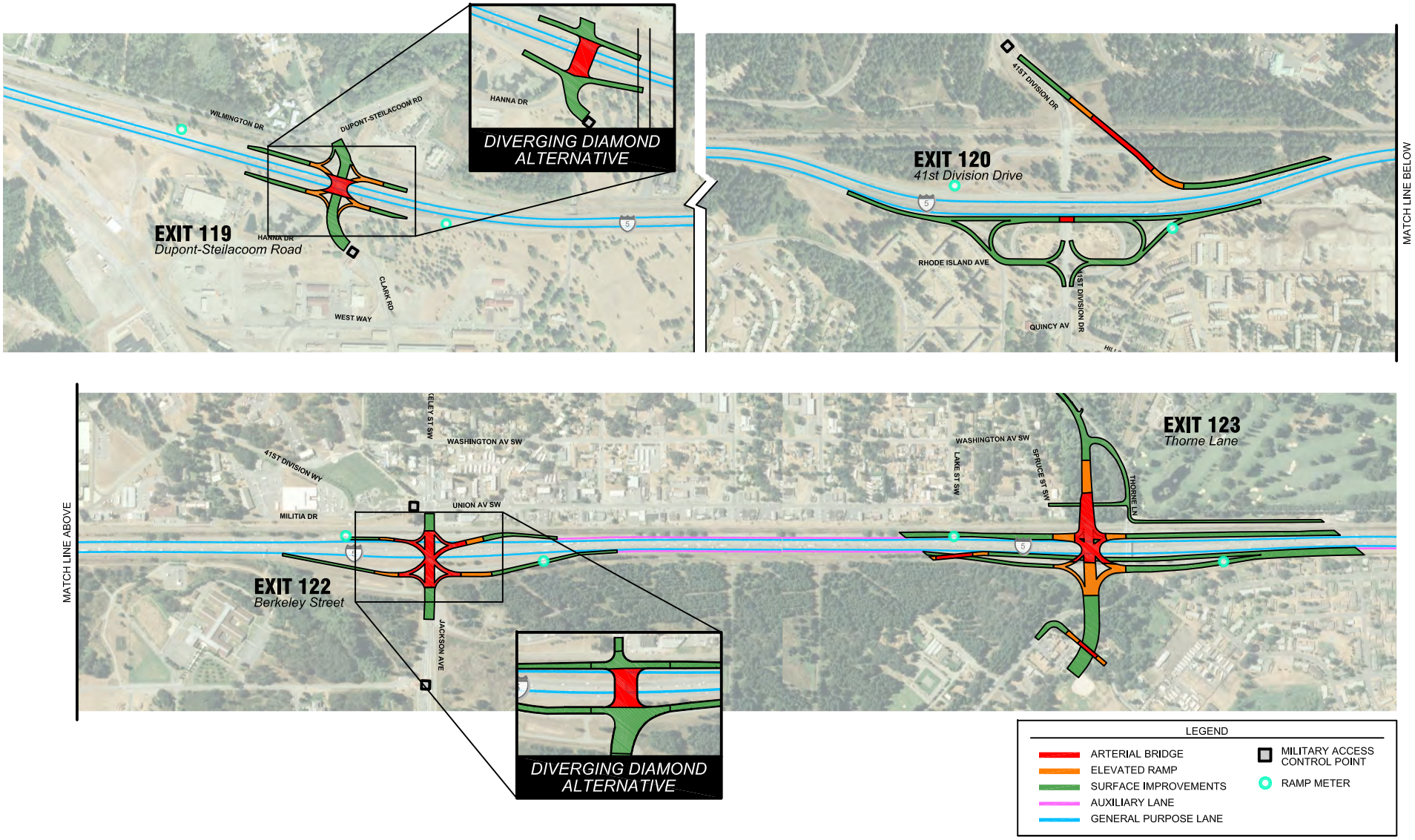

Concept Group 3

FIGURE **22**

I-5 Transportation Alternatives Analysis and Operations Model

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- **Berkeley Street (Exit 122):** Construct either a SPUI (concept 3a) or a diverging diamond (concept 3b).
- **Thorne Lane (Exit 123):** Construct SPUI consistent with Cross-Base Highway design plans.
- **System Improvements:**
    - Construct ITS improvements along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems.
    - Construct southbound auxiliary lanes between the Berkeley Street and Thorne Lane interchanges. Construct braided ramps northbound between Berkeley Street and Thorne Lane interchanges.
    - Construct northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive.
    - Construct northbound and southbound general purpose lanes from Mounts Road to Thorne Lane.

Description of the Screening Categories and Metrics

The ranking of the concept groupings was based on quantitative metrics for each of the screening categories. Results from the existing conditions and future alternatives analyses were used to evaluate each concept grouping. The screening criteria were organized by category with specific metrics identified to evaluate how a concept grouping benefited or impacted the category. A total of five categories were identified. A more detailed description of each category and the specific metrics from each are summarized below.

Design Feasibility – Measures design related components such as feasibility of the design, ability to meet targeted design standards, and overall ability to minimize construction impacts. The specific metrics included:

- *Level of Design for On-ramp Connections* – Focuses on the functional level of the proposed interchange design. Configurations with intersections at ramp terminals were scored lower than configurations with unrestricted free movements.
- *Level of Design for Off-ramp Connections* - Focuses on the functional level of the proposed interchange design. Configurations with intersections at ramp terminals were scored lower than configurations with unrestricted free movements.
- *Profile Feasibility* - Evaluates the adequacy of the vertical alignments. Steep grades have a negative impact on average vehicle speeds, particularly for trucks. Scoring was based on WSDOT's preferred, desired and minimum grades for ramps.
- *Radius/Design Speed* - Evaluates the adequacy of the horizontal alignments. Small radii designs have a negative impact on average vehicle speeds. While all concepts were designed to meet WSDOT's horizontal alignment design standards, design radii differed based on constraints.
- *Constructability* - Likelihood of potential impacts of construction phasing to adjacent jurisdictions.

Safety – Measures whether improvements are proposed in areas where serious and/or fatal collisions have occurred, and whether the improvements addressed safety for one or more modes of travel. Since future safety quantification is not able to be predicted, the measure attempts to provide points to concepts that have a <u>potential</u> for addressing existing safety related issues. The specific metrics included:

- *Improvements in locations where serious and fatal collisions have occurred (ramps)* – Focuses on whether the concept grouping includes improvements at interchanges where serious and/or fatal collisions have occurred in the past.
- *Improvements in locations where serious and fatal collisions have occurred (mainline)* – Focuses on whether the concept grouping includes improvements along the I-5 mainline where serious and/or fatal collisions have occurred in the past.
- *Modes Addressed (vehicles, peds, bikes, and transit)* – Evaluates how each concept may provide safety benefits to one or more modes of travel. The more modes it addresses, the greater number of points it receives.

Mobility / Operations – Measures the degree to which each concept grouping improves mobility and operational performance criteria when compared to baseline conditions. The specific metrics included:

- *Change in Mainline Delay (total vehicle hours per PM peak hour)* – The reduction in the number of total vehicle hours of delay along I-5 through the study area during the PM peak hour as compared to baseline conditions.
- *Change in Average Interchange Delay (seconds per vehicle per PM peak hour)* – The reduction in the average interchange delay during the PM peak hour as compared to baseline conditions. The measure is an average of each of the four interchanges.
- *Change in Freight / Transit / Vehicle Mobility (mainline mph)* – The increase in the average freight/transit/vehicle speed during the PM peak hour as compared to baseline conditions for the I-5 mainline.
- *Change in Average Military Route Travel Speed (mph)* – The increase in the average speed on key military routes during the PM peak hour. Represents prominent travel patterns of trips to and from the installation.

Environment – Measures the degree to which each concept grouping impacts the environment. The specific metrics included:

- *Number / Type of Impacted Sensitive Areas* – The number and type of sensitive areas that could be potentially impacted by the concept grouping.
- *Amount of Additional Impervious Surface* – The amount of new impervious areas as compared to baseline conditions.
- *Change in Vehicle Miles Traveled (VMT)* – The change in total vehicle miles travelled within the study area as compared to baseline conditions.
- *Number of Impacted Historical / Cultural Resources* – The number and type of historical and cultural resources that could be potentially impacted by the concept grouping.
- *Impact on JBLM Property* – The number of locations where JBLM property and/or facilities would be impacted by the concept grouping.

Benefit / Cost – Measures the benefits versus the costs (b/c) using construction cost estimates and WSDOT b/c formulas. The specific metrics included:

- *Estimated Construction Costs* – The estimated costs to construct the improvements depicted in the concept group.
- *Benefit / Cost Ratio* – The WSDOT b/c formula that compares the costs to the benefits the improvement is expected to provide.

How the Concept Groupings were Scored

The quantitative metrics were calculated and used to score each concept grouping to one another. Points were distributed amongst the metrics based on the overall benefit or impact. The maximum score any concept grouping could receive was 20 points overall. Assuming each category is weighted equally, each concept could receive a maximum of 4 points per category.

However, the study team weighted the categories based on how closely they aligned with the purpose and need of the study. Since the study purpose and need is tied to military growth and impacts, additional weighting was applied to the mobility and operations category as it addressed the accessibility and mobility to/from the JBLM. As a result, the environment and benefit / cost categories were weighted less.

In the end, a higher overall score represents a positive result, indicating a concept grouping with greater benefits and lesser impacts as compared to one another.

Results

The screening process began with the assimilation of the quantitative analytical work related to each of the major categories and associated metrics where quantitative analyses were conducted. For those categories where quantifiable numbers are available and can be easily understood, a summary or the results are provided in Table 20. The mobility/operations category metrics are based on a 2030 baseline forecast.

Table 20. Level III Screening – Quantitative Results

		Concept Group (Change from 2030 Baseline)				
Category[1]	**2030 Baseline[2]**	**1**	**2a SPUI**	**2b Diverging Diamond**	**3a SPUI**	**3b Diverging Diamond**
Mobility / Operations						
Change in Mainline Delay (total vehicle hours per PM peak hour)	1,660	0	-270	-270	-1,135	-1,135
Change in Average Interchange Delay (seconds per vehicle per PM peak hour)	124	-46	-103	-107	-103	-107
Change in Freight / Transit / Vehicle Mobility (mainline mph)	31	0	+2	+2	+15	+15
Change in Average Military Route Travel Speed (mph)	28	0	+3	+4	+13	+13
Environment						
Impacted Sensitive Areas (# of locations)	0	0	0	0	0	0
Amount of Additional Impervious Surface (1,000 sq ft)	0	+187	+1,404	+958	+3,609	+3,163
Change in Vehicle Miles Traveled (from baseline)	0	0	+1,000	+1,000	+3,000	+3,000
Impacted Historical / Cultural Resources (# of locations)	0	0	0	0	1	1
Impact on JBLM Property (# of locations)	0	1	3	1	3	2
Benefit / Cost						
Estimated Construction Costs (in $1,000)	$0	$51,300	$331,600	$232,100	$911,000	$811,500

1. Only includes categories and metrics where quantifiable numbers are available and which can be easily understood.
2. Values for the 2030 baseline are actual amounts and are shown to understand how each concept group compares.

Table 21 provides the final summary scoring of each category. As shown, weighting factors were applied to the categories in the screening process. More weight was given to the mobility/operations category as the purpose and need of the project is to improve access and

mobility for the area related to the JBLM growth. A column is also shown that illustrates the maximum number of points that could be received for each category to provide context and comparison between each of the concepts.

Table 21. Level III Screening – Resulting Scores

	Concept Group						
Category	**1**	**2a SPUI**	**2b Diverging Diamond**	**3a SPUI**	**3b Diverging Diamond**	**Scoring Weight**	**Maximum Possible Points**
Design Feasibility	2.6	2.2	2.0	2.4	2.2	20%	4
Safety	1.1	2.7	2.7	3.1	3.1	20%	4
Mobility / Operations	1.2	2.8	3.0	5.6	5.8	40%	8
Environment	1.6	1.0	1.5	0.8	1.0	10%	2
Benefit / Cost	2.0	0.5	1.3	0.3	0.5	10%	2
Total	**8.5**	**9.2**	**10.4**	**12.1**	**12.6**	**100%**	**20**

Overall, the spread of points between the concept groupings is not very significant. However, considering the total possible points, the results indicate Concept Grouping 3a/3b scored 42 to 48 percent higher than Concept Group 1. This suggests a more significant difference between each of the concepts than first appears. Below is a general summary of each concept group and its ranking.

Concept Group 1

As shown in Table 21, relative to the other concept groupings, it scored the lowest in terms of safety and mobility/operations. Concept 1 does not address mainline operations in the same way and to the same level as Concept Groupings 2 and 3, resulting in a lower overall mobility/operations scoring.

Although this concept grouping provides some level of improvement at the interchanges, the scope of the improvements are smaller than those included in Concept Groupings 2 and 3 (i.e., no improvements to the mainline), thus scores are less than the other concepts. Although the benefits to the mobility and operations are not as high as the other groupings, the lower costs of the improvements themselves outweigh the benefits and result in a higher benefit/cost ratio.

Concept Grouping 2a/2b

Relative to Concept Grouping 1, the scoring for this Concept Grouping 2a, overall, is approximately the same. The most notable differences in the categories include the safety, mobility/operations, and benefit/cost analysis. The benefits gained, in terms of safety and mobility, are offset by the high cost of the SPUI configurations at two locations. The scoring for concept 2b is a bit higher then 2a due to the lower costs of the diverging diamond configuration and similar operational benefits as 2a.

Concept Grouping 3a/3b

The Concept Groupings 3a and 3b scored the highest overall when compared to Concept Grouping 1 and Concept Grouping 2. Relative to the Concept Groupings 1 and 2, these improvements showed a significant increase in the mobility/operations scoring, almost four times higher than Concept Grouping 1. This increase was due primarily to the addition of northbound and southbound general purpose lanes through the study area. As described previously, the lanes would connect to the existing drop and add lanes north of Thorne Lane. The cost, however, for these improvements are significant, resulting in a relatively lower b/c ratio.

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Summary and Benefits of Proposed Concepts

To assess the potential impacts of growth at Joint-Base Lewis-McChord (JBLM) to I-5 and the adjacent local street system, the City of Lakewood has analyzed the I-5 corridor from Mounts Road to SR 512. This analysis focused on developing long-term transportation improvement alternatives for I-5 and the adjacent arterial intersections to support the Department of Defense's new growth initiatives. A set of improvements were developed that would work toward maintaining safe, efficient and acceptable I-5 operations and future mobility deficiencies directly related to military growth. The following sections summarize the operational issues identified within the study area, and describe the proposed improvement concepts and how they address the identified issues.

Existing Issues

Existing safety, operational, and design-related issues were identified through the review of previous work and data collected within the study area. These issues included the following:

- The rail line, adjacent arterial intersections, and I-5 ramp interchanges are closely spaced at the I-5 interchanges at Thorne Lane, Berkeley Avenue, 41st Division Drive, and DuPont-Steilacoom Road. Also, poor operations occur at the Union Avenue/Berkeley Avenue intersection due to the close proximity to the Berkeley Avenue interchange.

- Congestion occurs during weekday PM peak hour on mainline I-5 and ramps at the SR 512 interchange, northbound Gravelly Lake Drive off-ramp, and between the Berkeley Avenue northbound on-ramp and Thorne Lane off-ramp. During the AM peak hour, the southbound I-5 off-ramp at Berkeley Avenue is also congested.

- Congestion occurs in the out-bound direction from JBLM at Berkeley Avenue (to northbound I-5), DuPont gate/DuPont-Steilacoom Road (to southbound I-5), and Center Drive (to DuPont and southbound I-5).

- The temporary access to JBLM at the Center Drive intersection is poorly configured.

- The close proximity and high volume of traffic at four of the JBLM gates (Liberty, 41st Division, Madigan, and DuPont) increases the likelihood that gate operations and volumes impact traffic along I-5 ramps or mainline.

Several existing deficiencies up and down the I-5 corridor and at specific interchanges were identified, and with future increases in the traffic volumes these deficiencies will be exacerbated. In particular, the increase in traffic volumes combined with increased rail activity will result in a greater likelihood of conflicts at rail crossing locations. Although Sound Transit and WSDOT have identified at-grade crossing improvements, the increased rail activity will continue to impact arterial street traffic operations.

The analysis of the future (2030) baseline conditions showed that with the growth anticipated along the I-5 corridor several sections will exceed their capacity resulting in increased bottlenecks and decreased levels of service for transit, freight, and general purpose traffic. In addition, at several interchanges, including Berkeley and Thorne Lane, the volume of merging and diverging traffic combined with the mainline volume will exceed the capacity for transit, freight and general purpose traffic. This ultimately will result in increased delay and queuing at the on-ramps and would impact local arterial operations.

In addition, the baseline analysis assumes that JBLM no longer utilizes the Center Drive interchange in its current state as an egress point. Currently, a temporary access is used for

egress traffic, primarily destined south on I-5. In the future year analyses, traffic associated with these movements were relocated to the DuPont-Steilacoom Road interchange. This shifted traffic, along with general growth in traffic on JBLM, results in the DuPont-Steilacoom Road interchange ramp terminals and southbound on-ramp merge operating above their capacity.

Improvement Concepts

Improvement concepts were developed to address mainline congestion, interchange congestion, and access to JBLM. Based on the screening process described in earlier sections of this report, improvement concepts were developed for mainline I-5 and four of the interchanges within the study area. The concept groups are summarized in Table 22. Improvement concepts were grouped together with the focus on identifying the appropriate combination of improvements at the respective interchanges as well as the mainline-related improvements.

Table 22. I-5 Improvement Concepts

	Concept Group		
Interchanges	**1**	**2**	**3**
DuPont-Steilacoom Rd	SB I-5 Flyover On-Ramp from JBLM	Construct SPUI[1]	Construct SPUI or Div. Diamond[2]
41st Division Dr	Widen SB-off ramp to 2 lanes	Grade Separated SB Off-Ramp	Grade Separated SB Off-Ramp
Berkeley Ave	SB I-5 Flyover On & Off-Ramps	Construct SPUI or Div. Diamond	Construct SPUI or Div. Diamond
Thorne Ln[3]	Construct SPUI	Construct SPUI	Construct SPUI
System	ITS[4] Improvements	ITS, SB Aux. Lanes between Berkeley & Thorne, NB Braided Ramps between Berkeley & Thorne, NB Aux. Lanes between Thorn & Gravelly Lk	ITS, SB Aux. Lanes between Berkeley & Thorne, NB Braided Ramps between Berkeley & Thorne, NB Aux. Lanes between Thorn & Gravelly Lk., 1 NB & 1 SB General Purpose Lane

1. SPUI = Single-Point Urban Interchange
2. Diverging Diamond Interchange
3. SPUI constructed as part of Cross-Base Highway project.
4. Intelligent Transportation System (ITS) includes ramp meters and driver information systems.

System-Wide/ I-5 Mainline

In additional to anticipated growth at JBLM, increases in traffic volumes as a result of population and development growth within the region would contribute to increased congestion along I-5 within the study area. Because a limited number of regional north-south regional travel routes besides I-5 are available, the majority of travel demand would continue to travel on I-5 under future conditions. Demand for travel on I-5 is forecast to exceed the capacity of the freeway through the majority of the study area. In general, demands along I-5 in the future exceed the current capacity by approximately 1,500 to 2,200 vehicles during the PM peak hour. This is the equivalent of more than a full lane of freeway capacity. Because the majority of regional north-south travel would continue to utilize I-5 despite congestion along the corridor, system-wide concepts that would help address the overall demand along the corridor were developed and included in each concept group.

Under **Concept Group 1**, Intelligent Transportation System (ITS) improvements would be constructed along the corridor consistent with Tier 1 improvements identified in the 2007-2026 State Highway System Plan. These improvements include ramp metering and driver information systems. **Concept Group 2** would construct the same improvements as Concept Group 1, but

would include braided ramps northbound between Berkeley Street and Thorne Lane interchanges and a northbound auxiliary lane between Thorne Lane and Gravelly Lake Drive under Concept Group 2. **Concept Group 3** would include all of the improvements from earlier concepts, but also include the addition of one general purpose lane along I-5 in both the northbound and southbound directions.

DuPont-Steilacoom Road

The DuPont-Steilacoom Road interchange would operate poorly under future conditions without any improvements. The existing bridge structure across I-5 is structurally deficient and does not meet current design standards. This, the combination of the closure of the Center Drive JBLM egress location, the large PM peak period demand volume of vehicles traveling outbound from JBLM onto southbound I-5, and potential impacts by increased rail activity at the rail crossing located immediately adjacent to the interchange, would result in congested conditions at the interchange.

Under **Concept Group 1**, the high-demand volume movement of outbound JBLM traffic to southbound I-5 would be removed from the interchange by constructing a flyover ramp over the existing overpass bridge. The result is that the interchange would no longer be overwhelmed by this movement and would operate acceptably. Under **Concept Groups 2 and 3**, the construction of a Single-Point Urban Interchange (SPUI) would replace the existing deficient bridge and consolidate the two ramp intersections into a single intersection. Operations would improve with a SPUI because of the reduced number of conflict points by consolidating to a single intersection. Potential conflicts with the adjacent rail crossing would also be improved by the increased distance between the crossing and the intersection. Similarly, under **Concept Groups 2 and 3** a diverging diamond would also improve operational efficiency by reducing the number of conflict points, but would not improve the spacing to the rail crossing.

41st Division Drive

The close spacing between the adjacent rail line and I-5 is the primary issue at the 41st Division Drive interchange. With increased rail activity, the potential for vehicles traveling from southbound I-5 to North Fort to queue onto mainline I-5 is increased. Under **Concept Group 1** a second southbound I-5 off-ramp lane would be constructed to provide additional storage capacity for vehicles queued due to rail activity. **Under Concept Groups 2 and 3** the southbound I-5 to North Fort movement would be grade separated over the rail line to no longer conflict with rail traffic.

Berkeley Avenue

Congestion and associated safety concerns at the Berkeley Avenue interchange would continue to occur at the southbound I-5 off-ramp during the morning peak period. This congestion is caused by the functionally-obsolete bridge crossing at the interchange which prohibits the addition of any travel lanes crossing over I-5 and restricts flows toward the JBLM Madigan gate. During the evening peak, congestion would occur on mainline I-5 between the Berkeley Avenue northbound on-ramp and Thorne Lane off-ramp and cause queuing on the on-ramp which would extend onto JBLM. Northbound mainline traffic would operate poorly due to the large number of merging vehicles from the northbound I-5 on-ramp at Berkeley Avenue. In addition, congestion caused from rail activity at the crossing located immediately adjacent to the southbound ramps signal would also increase with the planned increased rail activity.

Concept Group 1 improvements would construct fly over ramps to serve southbound I-5 traffic traveling to and from the Madigan JBLM access control point (gate) located to the south of the interchange. This would remove a significant number of vehicles from the interchange and would improve overall interchange operations. **Concept Groups 2 and 3** would replace the existing

structure with either a SPUI or diverging diamond interchange. Either of these improvements would reduce the number of conflict points and improve operations and safety at the interchange. However, a SPUI would additionally increase the spacing between the rail crossing and the interchange, reducing the likelihood of congestion caused by rail crossings and further improve safety.

Thorne Lane

Congestion at the Thorne Lane interchange would primarily occur due to the high volume of vehicles attempting to travel between Spanaway and I-5 through the Woodbrook neighborhood and roadways bisecting JBLM (dividing McChord Air Field from the remainder of JBLM). Existing northbound I-5 off-ramp queues extend onto I-5 during the PM peak period. The functionally obsolete bridge across I-5 has two lanes and is unable to be modified to address existing and future travel demands. Because of these existing and future regional travel demands, the Cross-Base Highway project was developed.

The proposed Cross-Base Highway would extend from approximately the Thorne Lane interchange with I-5 to SR 7 east of the military bases and was assumed under baseline conditions. The proposed highway is intended to, and would improve regional circulation and reduce congestion. This study assumed that the Thorne Lane interchange would be reconstructed as a single-point urban interchange to accommodate the increase in traffic volumes from construction of the new highway, and was included under baseline conditions and all concept groups.

Opinion of Costs

Cost estimates for each of the various infrastructure improvement concepts were prepared after the schematic designs for each concept were developed. These planning level estimates included costs associated with new structures, new roadway construction, right-of-way acquisition, utilities, engineering and design fees, and contingency.

Improvement Implementation

The proposed improvement concept provides a long-term list of transportation mobility needs and investments along the I-5 corridor. Due to the need to secure additional funding and conduct environmental studies for the improvements, it is estimated that the identified improvements will be implemented over a time frame of 10 to 15 years with immediate steps taken for implementation. The next step in the process is to complete an environmental analysis of the recommendations, along with an Interchange Justification Report (IJR), to satisfy both state and federal requirements. Once these further studies have been completed, further design of the improvements can occur.

The following steps are needed to implement the proposed improvements:

Step 1: Update Regional Plans and State Highway System Plan (HSP)

Step 2: Complete an Interchange Justification Report and Conduct an Environmental Analysis of Impacts

Step 3: Prepare Final Design, Acquire Right-of-Way (if needed), Obtain Necessary Permits

WSDOT 's priorities in Moving Washington as illustrated below is a three-pronged approach including managing demand, operating efficiently, and adding capacity strategically. Consistent with WSDOT's priorities for the I-5 corridor through JBLM, the first steps are to manage demand as best as possible; implement those projects, such as ITS improvements, that allow the system to operate as efficiently as possible; and lastly, following the steps noted above to strategically add the capacity improvements as identified in this study.

To assure that steps are taken towards implementation, on-going coordination and communication between all the stakeholders is imperative and a sustained planning effort is necessary. This coordination is the foundation of the next steps of the work outlined in this report.

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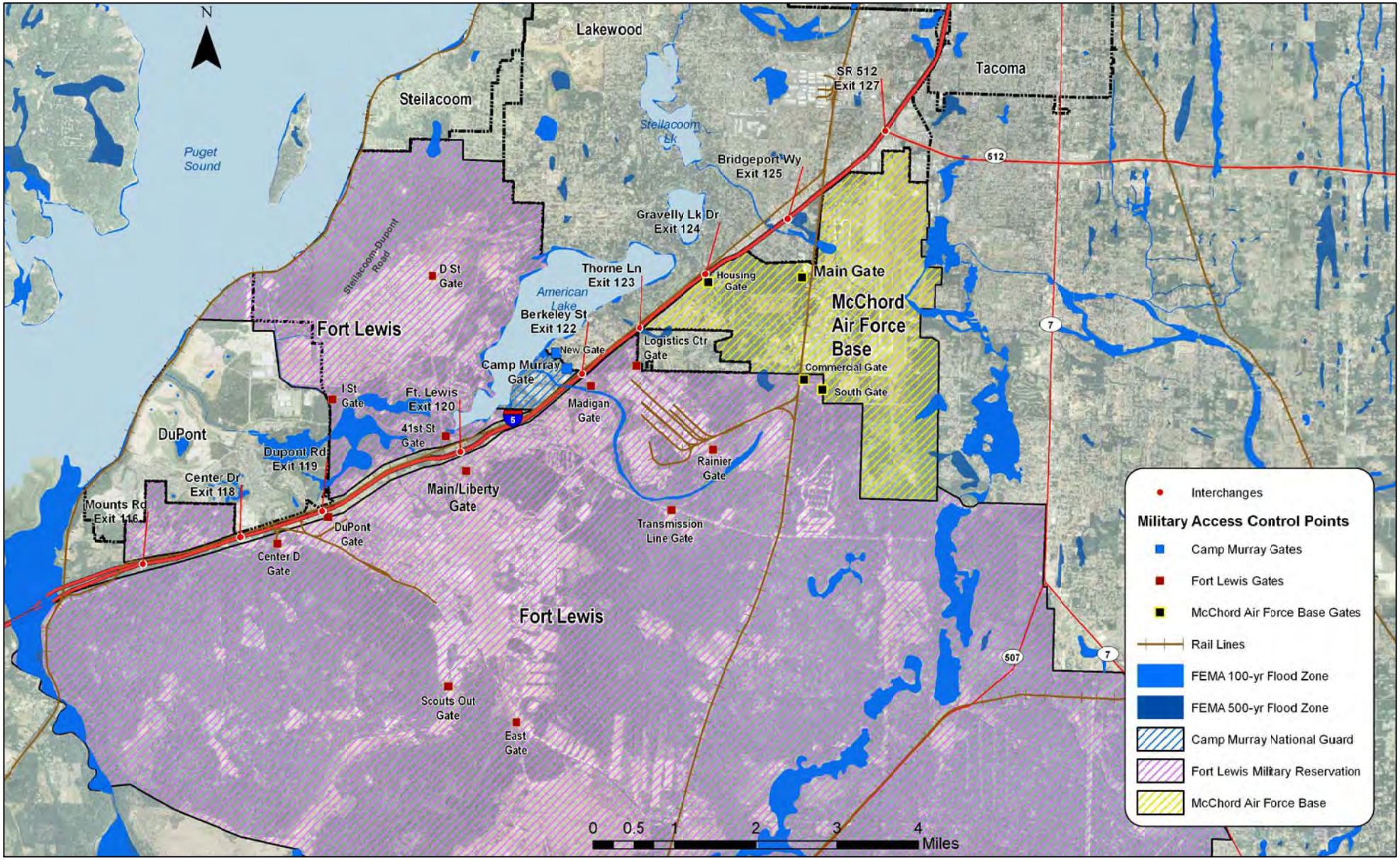
Appendix A - Environmental Review Maps



Flood Plains

FIGURE

A1

I-5 Transportation Alternative Analysis & Operations Model

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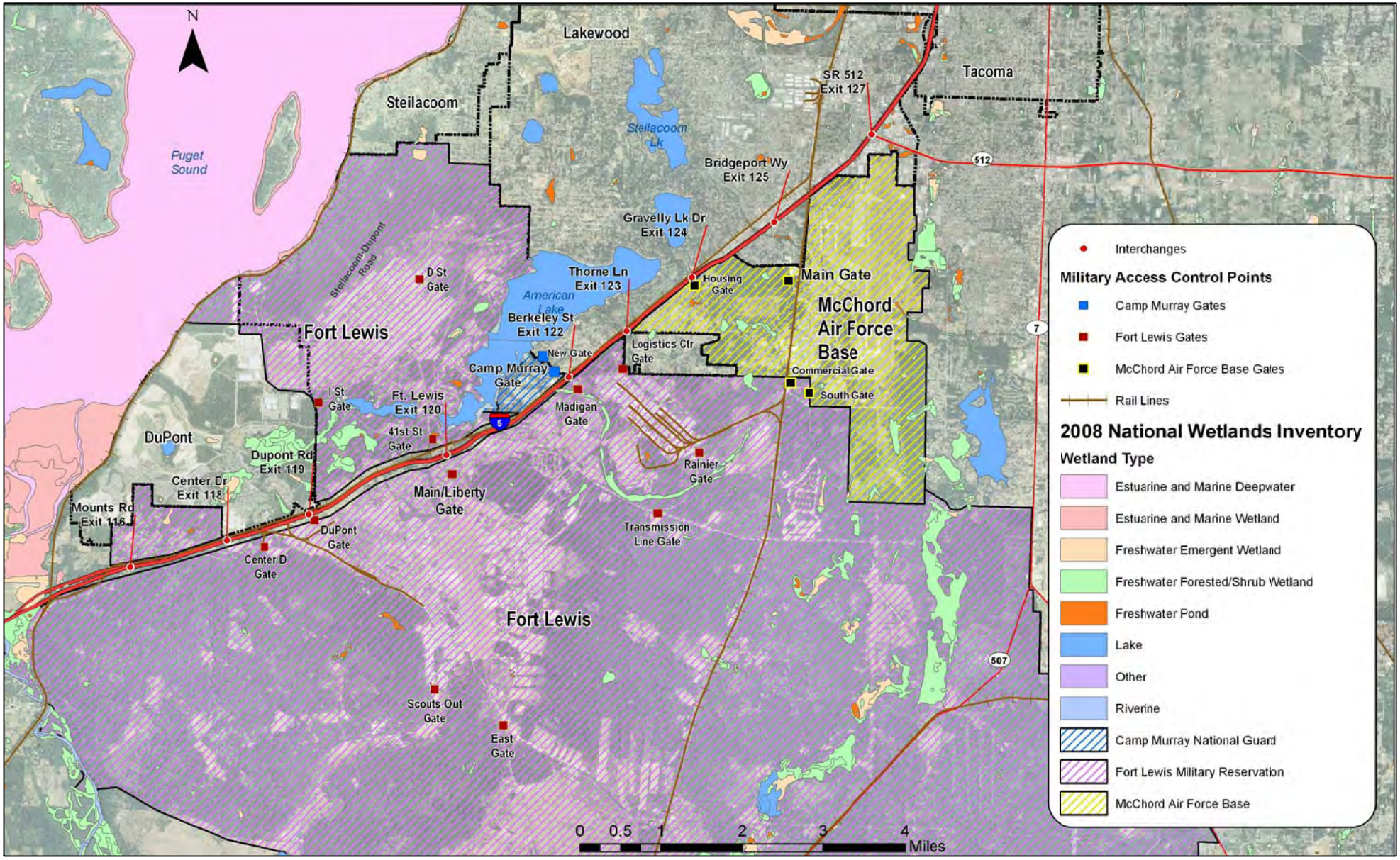

Wetlands

FIGURE

A2

I-5 Transportation Alternative Analysis & Operations Model

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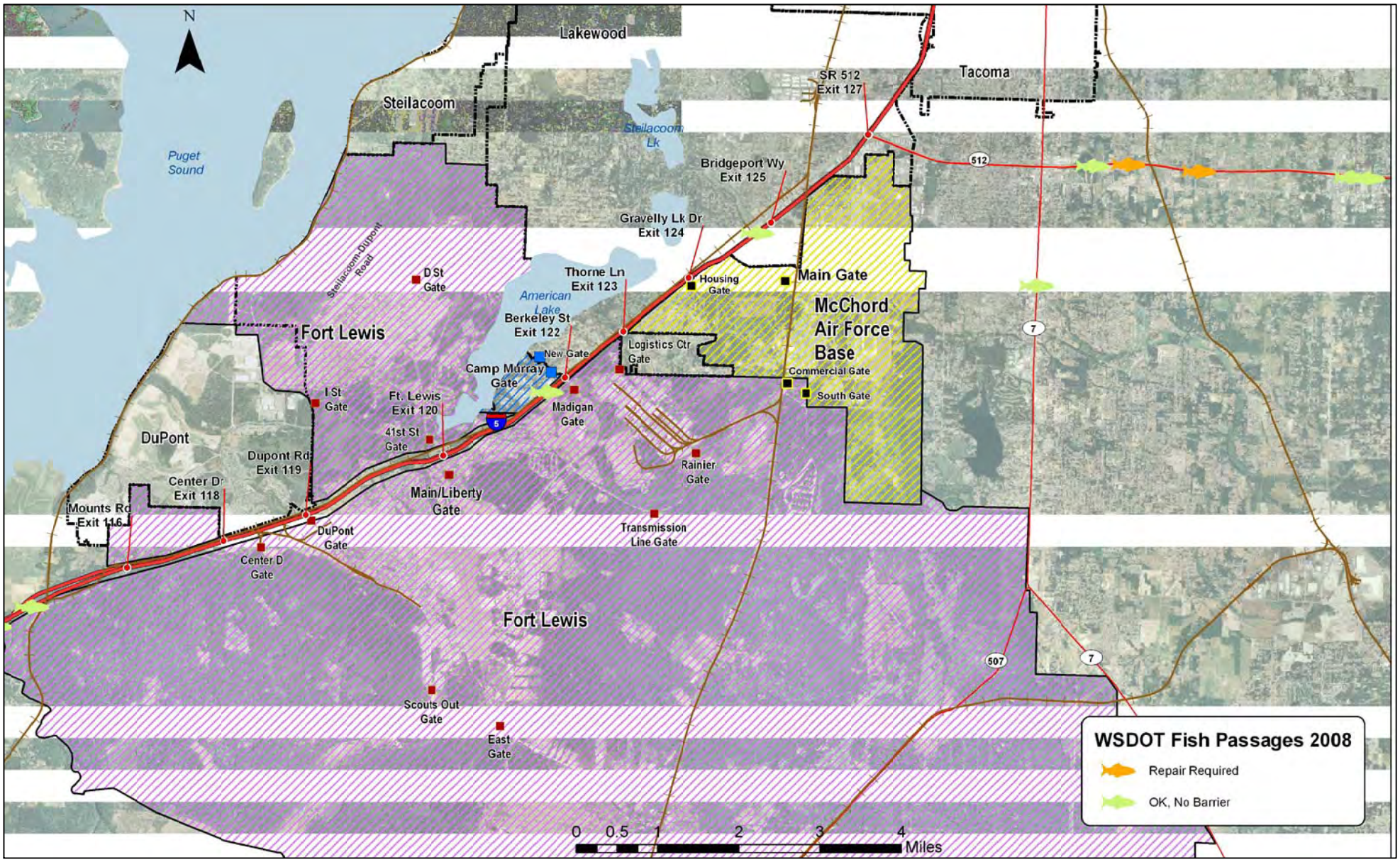
WSDOT transpoGROUP



Fish Passages

I-5 Transportation Alternative Analysis & Operations Model

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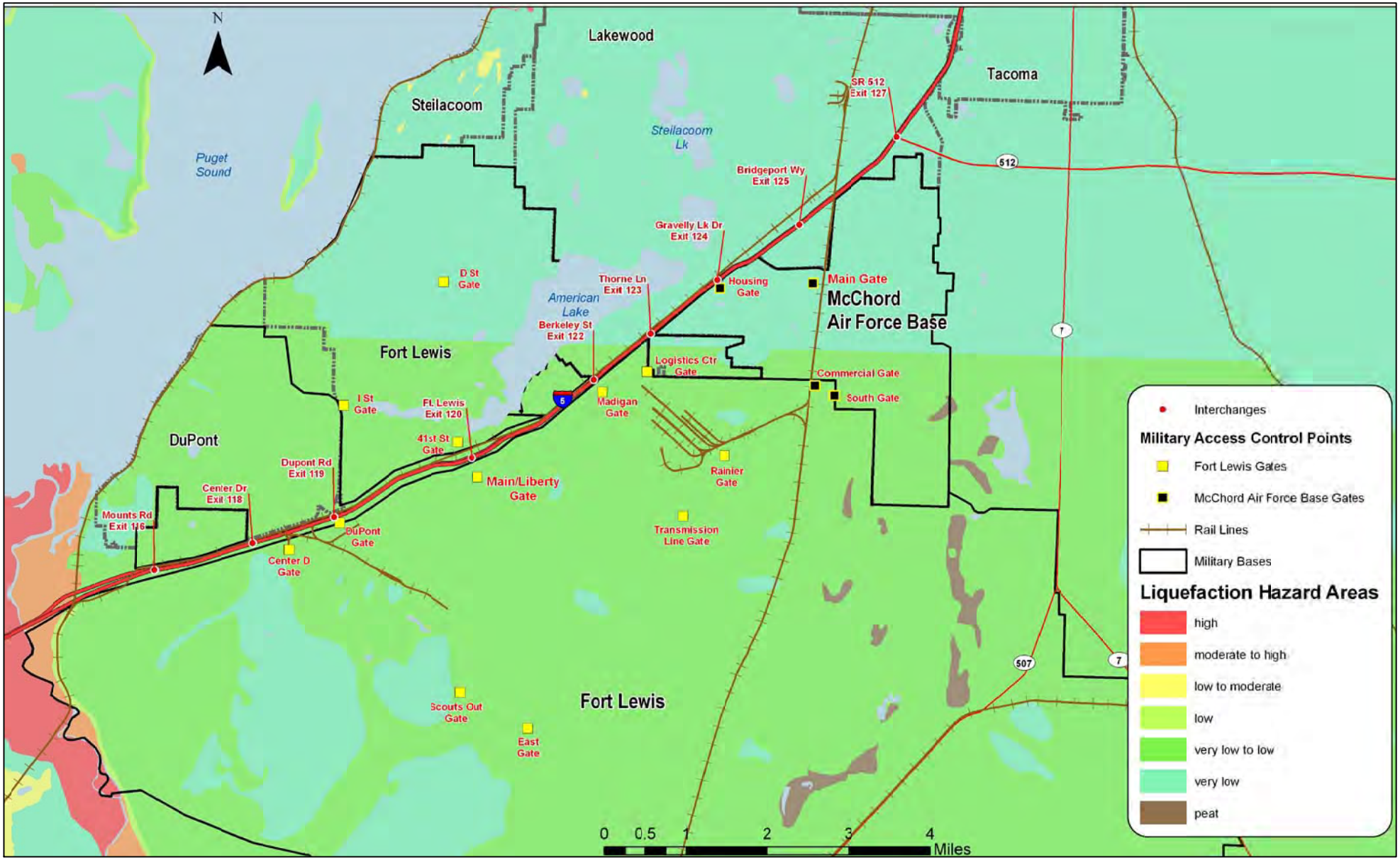
FIGURE

A3



Liquifaction

I-5 Transportation Alternative Analysis & Operations Model

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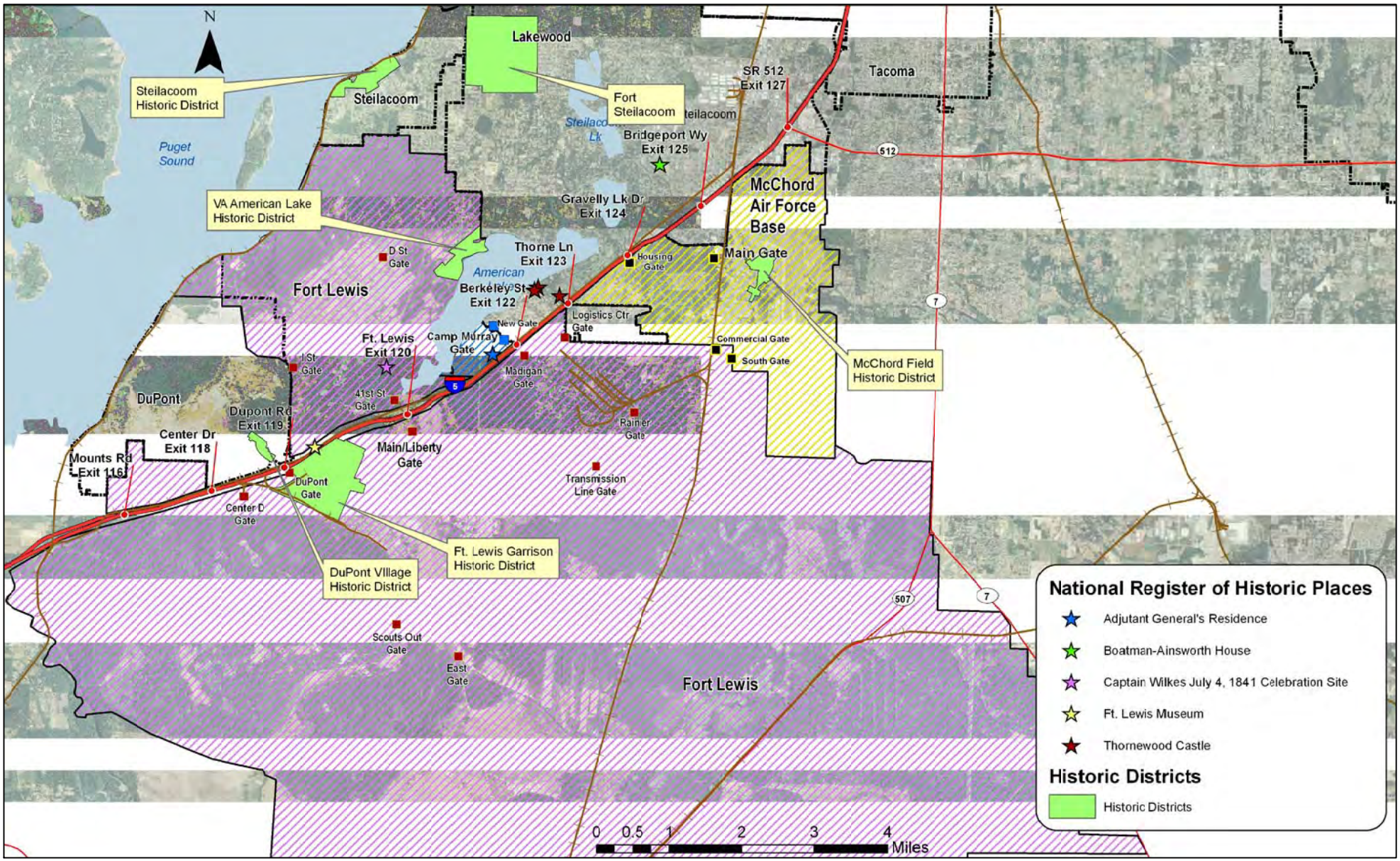
FIGURE

A4



Historic Areas

FIGURE

A5

I-5 Transportation Alternative Analysis & Operations Model

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Appendix B - LOS Criteria

Highway Capacity Manual, 2000

Signalized intersection level of service (LOS) is defined in terms of the average total vehicle delay of all movements through an intersection. Vehicle delay is a method of quantifying several intangible factors, including driver discomfort, frustration, and lost travel time. Specifically, LOS criteria are stated in terms of average delay per vehicle during a specified time period (for example, the PM peak hour). Vehicle delay is a complex measure based on many variables, including signal phasing (i.e., progression of movements through the intersection), signal cycle length, and traffic volumes with respect to intersection capacity. Table 1 shows LOS criteria for signalized intersections, as described in the *Highway Capacity Manual* (Transportation Research Board, Special Report 209, 2000).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (sec/veh)	General Description (Signalized Intersections)
A	≤10	Free Flow
B	>10 - 20	Stable Flow (slight delays)
C	>20 - 35	Stable flow (acceptable delays)
D	>35 - 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 - 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop-controlled and two-way stop-controlled. All-way, stop-controlled intersection LOS is expressed in terms of the average vehicle delay of all of the movements, much like that of a signalized intersection. Two-way, stop-controlled intersection LOS is defined in terms of the average vehicle delay of an individual movement(s). This is because the performance of a two-way, stop-controlled intersection is more closely reflected in terms of its individual movements, rather than its performance overall. For this reason, LOS for a two-way, stop-controlled intersection is defined in terms of its individual movements. With this in mind, total average vehicle delay (i.e., average delay of all movements) for a two-way, stop-controlled intersection should be viewed with discretion. Table 2 shows LOS criteria for unsignalized intersections (both all-way and two-way, stop-controlled).

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (sec/veh)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

Source: *Highway Capacity Manual*, Transportation Research Board, Special Report 209, 2000.

Appendix C - Technical Review Memorandums for Improvement Concepts

transpoGROUP
WHAT TRANSPORTATION CAN BE.

MEMORANDUM

Date:	August 14, 2009	**TG:**	08301.00
To:	Project Team		
From:	Bruce Haldors Jon Pascal Mike Swenson		
Subject:	Tier 1 Screening – Preliminary Results		

This memorandum and related attachments summarize the results of the preliminary Tier 1 screening results prepared by Transpo and WSDOT in preparation for the August 19, 2009 team meeting. Further narrative describing the overall evaluation process will be provided in the technical report and subsequent communication to TRC members. This memorandum provides an overview of the initial evaluation process.

The purpose of the Tier 1 screening process is to prioritize the needs at the nine study interchanges to narrow down to a fewer number of interchanges for detailed evaluation and option development. Future operations and improvement alternatives will then be developed for the 4 highest ranked interchanges. The general process developed for the Tier 1 screening included:

1. Define key criteria for which the interchanges would be evaluated
2. Define the relative weighting that each criteria would be given in the overall ranking calculations
3. Score each interchange with respect to the criteria identified in step 1.

The ranking of the interchanges included a process that reflected the relative weighting for several key criteria that are consistent with the purpose and need of the study. The criteria included:

Military Demand – This includes a review of the number of military access points served by the interchange as well as the percentage of military traffic at the interchange as percent of the total volume served. Future traffic volume percentages were based on year 2030 projected volumes, forecast growth in the military bases, and distribution of military traffic.

Safety Analysis – This criteria included an assessment of accident rates as well as review of the severity of the collisions at each of the interchanges. The accident rates included mainline and ramp related collisions.

Traffic Operations – Existing and forecast traffic operations were evaluated for each interchange. For the existing conditions, information regarding the number of ramp related movements operating at LOS D or worse were identified. Future interchange operations were calculated in terms of the volume to capacity ratio.

Each criteria was given a weighting based on its relevance to the overall purpose and need of the study. Individual interchanges were ranked out of a possible 100 points based on their individual scoring for each criteria. The data at each interchange for each criteria and the subsequent ranking is shown in the summary table.

The preliminary ranking shows that the following intersections were included in the top 4.

1. Berkeley Street (Exit 122)

2. Thorne Lane (Exit 123)
3. Gravelly Lake Drive (Exit 124)
4. 41st Division Drive (Exit 120)

Since improvements have already been defined at Thorne Lane, this interchange would be removed from the list and replaced with Bridgeport Way (Exit 125).

We look forward to our upcoming team meeting to review this in more detail. If you have any questions in the meantime, please do not hesitate to contact us.

Tier 1 Evaluation Category	Safety Issues				Operational Issues						Military Demand			
	Injury/Severe/Fatal Collisions per MVM		Total Collisions per MVM		Existing (2009) Levels of Service		Future (2030) Volume-to-Capacity (V/C)		Provides Direct Access to an Installation Gate		Percent of Total Traffic		Composite Score	Overall Rankings
Scoring Weight	10%		10%		15%		25%		10%		30%		100%	
Interchange	Data	Score	Data	Score	Data	Score	Data	Score	Gates Accessed	Score	Data	Score		
Exit 116 Mounts Road	0.18 - 0.01 - 0	6	0.55	7	2	11	0.99	13	0	0	28%	7	**8.3**	**9**
Exit 118 Center Drive	0.13 - 0.01 - 0	5	0.43	6	4	21	0.77	10	1	11	27%	7	**9.8**	**7**
Exit 119 Barksdale Ave	0.19 - 0.01 - 0	7	0.60	8	0	0	0.92	12	1	11	40%	10	**8.6**	**8**
Exit 120 41st Division Dr	0.22 - 0.01 - 0	8	0.71	9	0	0	0.93	12	2	22	63%	16	**11.7**	**4**
Exit 122 Berkeley Street	0.48 - 0.02 - 0	17	1.29	17	2	11	0.92	12	2	22	60%	15	**14.7**	**1**
Exit 123 Thorne Lane	0.3 - 0.01 - 0	11	0.77	10	4	21	0.90	12	1	11	53%	14	**13.3**	**2**
Exit 124 Gravelly Lake Drive	0.26 - 0.01 - 0	9	0.62	8	4	21	0.74	9	1	11	51%	13	**12.2**	**3**
Exit 125 Bridgeport Way	0.58 - 0.01 - 0	21	1.53	20	0	0	0.76	10	1	11	49%	12	**11.3**	**5**
Exit 127 SR 512	0.48 - 0 - 0	17	1.29	17	3	16	0.83	11	0	0	24%	6	**10.2**	**6**

MEMORANDUM

Date:	November 25, 2009	**TG:**	08301.00
To:	Technical Review Committee Members		
From:	Project Team		
Subject:	Level 2 Screening – Preliminary Results		

This memorandum summarizes the findings of the Level 2 screening results prepared by the project team. This memorandum includes level of service (LOS) calculations for baseline and improvement scenarios as well as a summary of benefits and limitations for each of the concepts. The project team is seeking feedback from the Technical Review Committee (TRC) on these screening results to narrow the range of improvement alternatives for further evaluation.

Background / Purpose

As discussed at the previous TRC meeting and communicated in subsequent material, the development of improvement concepts is focused on four interchanges. The four interchanges include:

- Dupont-Steilacoom Road (Exit 119)
- 41st Division Drive (Exit 120)
- Berkley Street (Exit 122)
- Thorne Lane (Exit 123)

Since the draft interchange concepts were presented to the Technical Review Committee (TRC), the project team has been conducting more detailed analyses of the operational impacts and geometric constraints for each of the improvement concepts. In addition to the analysis of specific interchange improvements, additional consideration was given to the impact of system wide concepts, including mainline I-5 improvements. The following provides a brief overview of potential system wide concepts and related benefits as well as an overview of interchange concepts and their related benefits.

Future Baseline Evaluation

The analysis to-date of both the existing year and future baseline (2030) year results indicates one clear issue; the demand for travel on I-5 through the study area is high today and will continue increasing into the future. As demonstrated in the existing conditions analysis, key segments in the corridor experience traffic volume demands exceeding available roadway capacity. Thus, it is clear that as population and employment increases into the future, demand for travel on I-5 will increase, resulting in increased congestion at ,pre segments and for longer periods of time. As identified in the existing conditions report, most segments, merge, and diverge sections are currently operation at/near capacity.

Exhibit 1 summarizes the results of the 2030 baseline LOS analyses for the mainline, merge, and diverge operations within the full study area of the project. As shown in the exhibit, all segments of I-5 in the northbound direction are anticipated to operate at LOS E or worse with the exception of the northbound merge at Gravelly Lake Boulevard and Bridgeport Way. In the southbound direction, south of Thorne Lane, all segments and merge/diverge operations are anticipated to operate at LOS E or worse with the exception of merge from Berkley Street or diverge at Center Drive.

As illustrated in the baseline LOS analysis (Exhibit 1), demand for travel of I-5 is forecasted to exceed the capacity of the freeway by 2030 for the segment of I-5 through the majority of the study area. In general, demands along I-5 in the future exceed the current capacity by approximately 1,500 to 2,200 vehicles during the PM peak hour. This is the equivalent of over another full lane of freeway capacity. Exhibits 2a and 2b summarize the 2030 turning movement counts at the ramp terminals.

System Concepts

While the Level 1 screening highlighted the interchanges that will be evaluated at a more detailed level, there is still the need to evaluate and consider system wide concepts that would help address the overall demand along the I-5 corridor and/or provide alternative travel choices. It is important to understand how system wide concepts may change the need for improvements at the interchanges themselves or whether they are needed in addition to the interchange improvements. Therefore, the project team reviewed and evaluated five general system wide concepts. They include:

- **Intelligent Transportation System (ITS) Improvements** - to improve the efficiency of the system.
- **Demand Management** - to lessen the demand for single occupant vehicle traffic.
- **Transit System Improvements** - to improve travel options for users along the corridor.
- **I-5 Mainline Improvements** – to increase capacity on the I-5 corridor.
- **Parallel Corridor Improvements** – to lessen the amount of demand destined for I-5 by constructing or improving other parallel facilities, such as SR 507 and SR 7.

Below is a summary of the initial findings regarding each of the system concepts.

ITS Improvements

WSDOT is committed to using whatever tools are available to operate the system as efficiently as possible, including technology. WSDOT has plans to improve the ITS infrastructure from Mounts Road to north of SR 512. This includes adding closed circuit cameras, increased traveler information systems, variable message signs and ramp metering at strategic locations throughout the corridor. These improvements will be included in the final study recommendations and will help provide the traveling public with more information on travel conditions as well as ways to improve the flow of traffic along I-5.

The ITS improvements are considered a first step in any improvement strategy for I-5 and are an integral part of WSDOT's Moving Washington Plan. ITS improvements can help improve the overall efficiency of the network. Ramp meters have been shown to improve traffic flow anywhere from 2% to 10% depending on their location and method of application. If a 5% improvement in efficiency is assumed, the I-5 corridor could conceivably accommodate another 300 to 500 vehicles. This increase in efficiency is still far less than the expected demand and has impacts on the local arterials and connections.

Demand Management

Traffic is increasing on I-5 because more people are living and working in the region. The current long range plans all assume some basic level of population and employment growth for our region. Growth is considered an integral part of a healthy economy. This stretch of I-5 is impacted by population growth in Thurston and Pierce counties, the military bases, and also growth in Washington, Oregon, and California. As the region continues to grow, the need to travel between each region along I-5 also increases.

The region recognizes that alternative modes of travel are an important consideration when evaluating improvement needs. In 2009, almost 10,000 people travel out of the three military

installations along I-5 in the peak hour alone. This is forecasted to grow to over 12,000 by the year 2030. A majority of these trips access I-5 at some point. A freeway lane can handle approximately 2,000 vehicles per hour. This means that the demand leaving the three bases could fill up 6 lanes of freeway by themselves.
By continuing to encourage vanpools, high occupancy travel modes and flexible work schedules, a small reduction in the total peak hour demand on the freeway could be expected. However, due to the nature of operations on a military installation, most of the reduction would be from non-military traffic. If a 10% reduction in non-military trips were obtained, the demand of PM Peak hour trips would be reduced by 400 vehicles. This reduction in demand is very optimistic and still does not address to overall congestion issues along the corridor and in and of itself would not have a meaningful impact on reducing the levels of congestion in the corridor.

Transit Improvements

Transit can play an important role in addressing travel demand along I-5. One system level alternative tested was to extend the Sounder Commuter rail line from its currently planned terminus in Lakewood south to DuPont. This extension resulted in approximately 135 riders in the AM Peak hour going northbound towards Tacoma and Seattle. The forecast for the AM bus ridership between Thurston County and Pierce County is approximately 500 riders. Without these transit services in place, an additional 600 people would be trying to use this section of I-5. However, bus routes must also use the same freeway lanes as single occupant vehicles. To expect an even larger shift to buses may be unrealistic until such time that there is travel time benefit over single occupant vehicles.

Pierce County and Fort Lewis are currently in the process of assessing the demand and viability of increased transit service to the installation. Currently routes do access the installation with security procedures addressed at the gates. Attracting additional transit users to and from the military installations is a challenge due to the rigid scheduling of military activities and the limitations of serving a secured area.

I-5 Mainline Improvements

As noted, the increase in demand on I-5 exceeds the available capacity. By 2030, the demand for travel in the PM Peak hour is forecasted to exceed the ability of the freeway to accommodate it, especially in the peak directions. Along some segments, the forecast for demand is almost 30% higher than the available capacity. In situations such as these, the most likely outcome is that the PM Peak hour will spill over into the shoulder periods and the peak will spread.

One sensitivity test was run through the travel demand model to determine if an additional lane would meet the capacity constraints along the corridor. The existing add/drop lane at Thorne Lane was extended to Mounts Road for the analysis. In general, the widening of I-5 did not result in an increase in demand. The corridor is still largely capacity constrained due to the bridges over the Nisqually River south of Mounts Road. Therefore very little additional “latent” demand was observed when a new lane was added. This resulted in the additional lane reducing the overall I-5 mainline volume to capacity (v/c) ratios to at or below 1.0.Anything less than a v/c of 1.0 indicates the freeway demand is below the available capacity.

Although widening of I-5 would improve the flow of the mainline, it would not address operational issues at the arterial intersections at each of the ramp terminals. In general, most of the improvements that would be proposed at each interchange are not affected with the widening of I-5. With the close proximity of the rail line to I-5, any widening of I-5 would require widening to the east of I-5.

New Parallel Corridor

I-5 is the main connection between Pierce and Thurston Counties. Travel between Seattle and Olympia travels on I-5, often no matter how unfavorable the traffic conditions. With this in mind, the project team evaluated the possible benefits a parallel facility could have on I-5. The parallel facility tested was a new limited access facility, comparable to the existing I-5 corridor, with 3 travel lanes in each direction and a posted speed limit of 60mph. The facility was coded in the vicinity of SR 507 and SR 7 and ran from Thurston County north to I-5 in Tacoma. The evaluation was simply a "modeling exercise" meant to understand whether a new freeway corridor would alleviate needs along I-5.

In general, the results of the analysis showed that although the parallel facility could remove some traffic from I-5, the majority of trips between Thurston County and Pierce County would still remain on I-5 itself due to the overall destinations of the trips. The parallel facility lowered traffic volumes on I-5 a total of 5% at the lowest point of change and almost 13% at its highest point. This resulted in a shift of approximately 500 to 1,000 vehicles in the PM Peak hour (2030) from I-5. Thus, the PM Peak travel demand on the parallel facility would be closer to levels experienced on I-5 today; however the parallel corridor would in and of itself not alleviate congestion from I-5. Therefore, there is still a need for further improvements or traffic reductions on I-5. This, combined with the environmental, cost and neighborhood impacts that a new parallel facility would likely have, make this a parallel facility less desirable than widening of I-5 itself.

Interchange Improvement Concepts

As identified in the previous baseline discussion, without additional improvements to the I-5 mainline, the improvements to the interchanges will not be as effective. As part of the refined analysis to be conducted on the "preferred" alternative, additional analysis will be conducted focusing on the merge/diverge operations associated with each of the improvement concepts. Specifically, the project team will assess and determine whether collector/distributor lanes or auxiliary lanes should be constructed along the I-5 mainline. The overall recommendation regarding the mainline improvements is based on the system needs as well as the individual interchange operations.

The concepts presented in this section have not defined the mainline treatments at this point. In general three concepts, with the exception of 41st Division Drive, were developed for each interchange. The multiple concepts were developed focusing on near term and long term solutions. Based on geographical constraints and existing/future deficiencies, short-term improvements were more easily defined for some interchanges than others. Exhibits 3 through 6 include an illustration of the improvement, a summary of the existing/future baseline deficiencies, as well as the benefits and limitations for each concept. Table 1 provides a summary of the key interchanges, baseline conditions and LOS under the improvement concepts.

Table 1. Future (2030) Weekday PM Peak Hour LOS & Delay Summary

Interchange	Key Movement(s)	Terminal	Baseline	Concept A	Concept B	Concept C
DuPont-Steilacoom Rd (Exit 119)	Outbound Fort Lewis to SB I-5	SB Ramps NB Ramps	F/ >180 F/ >180	B/ 14 C/ 27	C/ 30[2]	B/ 18 C/ 24
41st Division Dr (Exit 120)	On-ramp merge points onto NB & SB I-5	SB Ramps NB Ramps	F E	Improves at-grade crossing conflicts	Improves NB C/D [3] design	N/A
Berkeley St (Exit 122)	Queue spillback to Union. Outbound Fort Lewis to NB I-5.[1]	SB Ramps NB Ramps	C/ 32 C/ 26	B/ 17 A/ 9	*Same as Concept A	B/ 16
Thorne Ln (Exit 123)	Movements between I-5 & S-leg	SB Ramps NB Ramps	D/ 40[2]	- E/ 58[4]	D/ 40[2]	*Same as Concept C

1. Inbound Fort Lewis from SB I-5 is known to operate poorly during AM conditions.
2. Southbound and northbound ramps meet at a single-point urban interchange (SPUI).
3. C/D – Collector/Distributor lanes
4. Results for NB ramps are presented in *Transportation Needs Assessment* for the Woodbrook Businees Park Development Study. These results do *not* account for any increases associated with the Cross-Base Highway since Concept A would function only as a short-term improvement.

Conclusions / Next Steps

Following the December 3, 2009 TRC meeting, the project team will continue with the screening previous defined for the TRC. The Level 3 screening is much more detailed than the previous two. It measures several of the same items as the previous screening levels, but at a much more detailed level. This requires each of the remaining improvement concepts to be developed with a greater amount of detail in order to evaluate and analyze each as described by the metrics in Table 2.

Table 2. Level 3 Screening Criteria

Broad Category[1]	Items to Evaluate[2]	Description of Metrics[3]
Preservation	• Does it improve geometric deficiencies? • Does it address old or aging infrastructure in need of replacement?	• Number of geometric deficiencies addressed • Remaining life (in # of years) of infrastructure
Safety	• What are the safety benefits it provides? • Does it address safety for all modes? • Does it improve at-grade rail crossings?	• Number and severity of collisions • Number of modes addressed
Mobility	• How well does it address a capacity problem and LOS standards for the freeway and local arterials? • How well does it reduce delays at interchanges & intersections? • Does it improve conditions for all modes? • How does it specifically benefit military needs? • Does it improve or worsen freeway operations?	• Mainline volume to capacity and LOS • Interchange / Intersection volume to capacity and LOS • Total delay • Vehicle merging and queuing • Gate access & operations • Percent military traffic served
Environment	• Does it impact sensitive areas? • Does it reduce vehicle delays (emissions)? • Does it impact a historic or cultural resource? • Does it impact any military installation perimeter?	• Amount and type of sensitive areas impacted • Number of historic or cultural resources impacted • Location and type of impact on military installation • Number and type of permits needed • Total vehicle delay
Stewardship	• Are the estimated costs proportional to the benefits? • Is it feasible from a construction staging perspective? • How well would it be supported by each jurisdiction? • Does it minimize right-of-way needs or property acquisition? • Is it consistent with local and regional plans?	• Estimated construction costs • Cost to benefit ratio • Amount of property to be displaced • Relative support from participating jurisdictions • Consistency with other plans

1. The broad categories are consistent and supportive with the WSDOT Washington Transportation Plan (WTP) statewide priority categories.
2. Types of questions to answer or investigate.
3. Metrics that would be used to prioritize the improvement options.

It is anticipated that the level of analysis for each alternative will yield a more benefit/cost type of comparative study. This comparative study will provide a prioritization of these concepts and lead to a refined set of alternative improvements.

MEMORANDUM

Date:	March 19, 2010	**TG:**	08301.00
To:	Technical Review Committee (TRC) Members		
From:	Project Team		
Subject:	Level 3 Screening – Revised Results		

This memorandum presents the revised results of the Level 3 screening evaluation for three concept groupings which incorporate various interchange improvements as well as system (mainline) improvements. At the February TRC meeting several modifications to the screening and scoring were discussed. In addition to the modifications to the screening process, the analysis assumptions as it related to the Thorne Lane interchange were reviewed. The modifications to the initial screening criteria developed by the project team, as presented at the February TRC meeting includes the following:

- **Tier III Category Weighting**. The general consensus of the TRC members was that the weighting should be directed more to the mobility/operations rather than the other items. The project team indicated that the weighting would be changed to provide 60 percent to the operations criteria and the remaining split evenly between the other categories.

- **Scoring.** In addition to the weighting, the "score" would be changed to be based on a total points possible of 100 rather than the 20 that was used in the original scoring. This would provide a greater separation between the concept groupings and further identify the differences.

- **Benefit/Cost**. The benefit/cost category would be relabeled to **Project Costs** as the title and individual scoring implied a b/c ratio that was actually the scoring, not the calculated b/c ratio. The category will be changed to reflect the construction costs only, as the mobility benefits are highlighted in a separate category. The final report will address the respective b/c ratios as a separate discussion point.

- **Thorne Lane Interchange Project Costs**. Project costs as outlined in the Cross Base Highway project for the Thorne Lane interchange were further researched. Modifications to the overall project costs have been adjusted to reflect these figures.

In addition to the modifications to the screening criteria, the operations analysis for Concept Grouping 1 was updated to include the operational benefits of the Thorne Lane interchange as planned with the Cross-Base Highway project. The traffic forecasts developed for the project had included the impacts of the Cross-Base Highway, but for purposes of the operational analysis, only short-term improvements were considered. This assumption has been changed in order to provide consistency between the forecast and operational analysis assumptions.

The primary quantitative measurements are summarized in Table 1. Relative to information previously presented, those areas that changed included the following:

- Average interchange delay (Concept Grouping 1)
- Average military route travel speed
- Impervious surface totals (Concept Grouping 1)
- Change in project costs

Table 1. Level 3 Screening – Quantitative Results

Category[1]	2030 Baseline[2]	Concept Group (Change from 2030 Baseline)				
		1	2a SPUI	2b Diverging Diamond	3a SPUI	3b Diverging Diamond
Mobility / Operations						
Change in Mainline Delay (total vehicle hours per PM peak hour)	1,660	0	-270	-270	-1,135	-1,135
Change in Average Interchange Delay (seconds per vehicle per PM peak hour)	124	-112	-103	-107	-103	-107
Change in Freight / Transit / Vehicle Mobility (mainline mph)	31	0	+2	+2	+15	+15
Change in Average Military Route Travel Speed (mph)	23	+5	+8	+9	+18	+19
Environment						
Impacted Sensitive Areas (# of locations)	0	0	0	0	0	0
Amount of Additional Impervious Surface (1,000 sq ft)	0	+409	+1,404	+958	+3,609	+3,163
Change in Vehicle Miles Travelled (from baseline)	0	0	+1,000	+1,000	+3,000	+3,000
Impacted Historical / Cultural Resources (# of locations)	0	0	0	0	1	1
Impact on JBLM Property (# of locations)	0	1	3	1	3	2
Project Costs[3]						
Estimated Construction Costs (in $1,000)	$0	$348,500	$496,500	$396,900	$1,075,900	$976,400

1. Only includes categories and metrics where quantifiable numbers are available and which can be easily understood.
2. Values for the 2030 baseline are actual amounts and are shown to understand how each concept group compares.
3. Includes Thorne Lane interchange costs of 246 million as identified by the Cross Base Highway project team

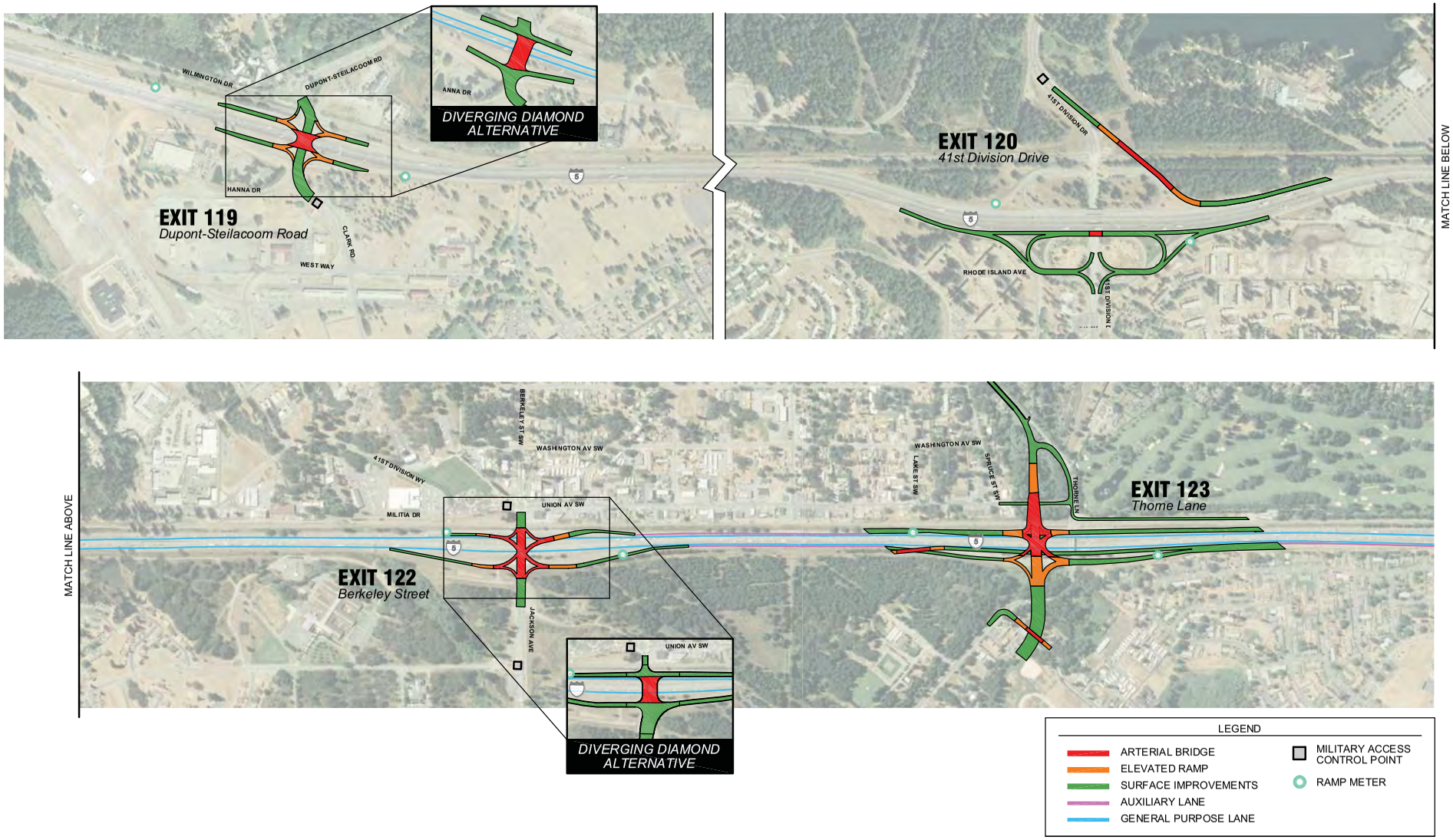
Table 2 provides the final summary scoring of each category. As shown, weighting factors were applied to the categories in the screening process. More weight was given to the mobility/operations category as the purpose and need of the project is to improve access and mobility for the area related to the JBLM growth. A column is also shown that illustrates the maximum number of points that could be received for each category to provide context and comparison between each of the concepts.

With the incorporation of the Thorne Lane interchange improvements into Concept Grouping 1, the scoring difference between Concepts 1 and 2 are minimal. This is primarily due to the marginal operational benefits between the two concepts further impacted by the higher weighting of that evaluation criteria. When compared to Concept Group 3 however, the overall ranking is approximately 15 points higher.

Table 2. Level 3 Screening – Resulting Score

Category	Concept Group					Scoring Weight	Maximum Possible Points
	1	2a SPUI	2b Diverging Diamond	3a SPUI	3b Diverging Diamond		
Design Feasibility	6.5	5.5	5.0	6.0	5.5	10%	10
Safety	2.8	6.7	6.7	7.7	7.7	10 %	10
Mobility / Operations	17.1	21.4	22.2	42.3	43.5	60 %	60
Environment	7.8	5.1	7.3	3.8	4.0	10%	10
Project Costs	7.5	7.5	7.5	2.5	2.5	10%	10
Total	**41.7**	**46.1**	**48.7**	**62.3**	**64.2**	**100%**	**100**

As noted at the TRC meeting, the project team is in the process of developing a prioritization of the improvements based on the factors previously identified in the Level I screening. The recommendations of the project team will be the focus of the next TRC meeting. In addition, further information regarding the approval process and requirements for advancing these improvements will be discussed.



Concept Group 3

I-5 Transportation Alternatives Analysis and Operations Model

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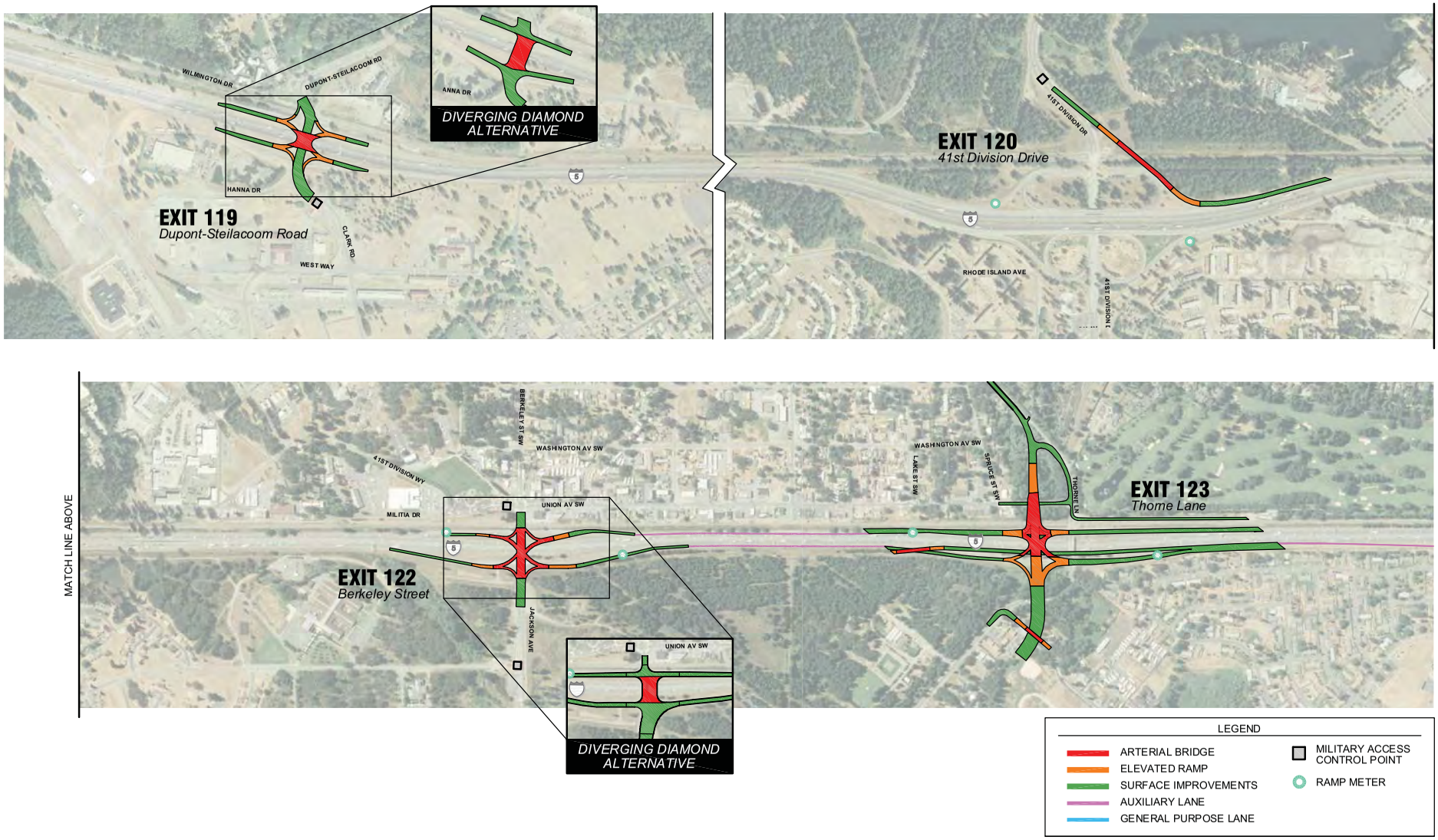

Concept Group 2

I-5 Transportation Alternatives Analysis and Operations Model

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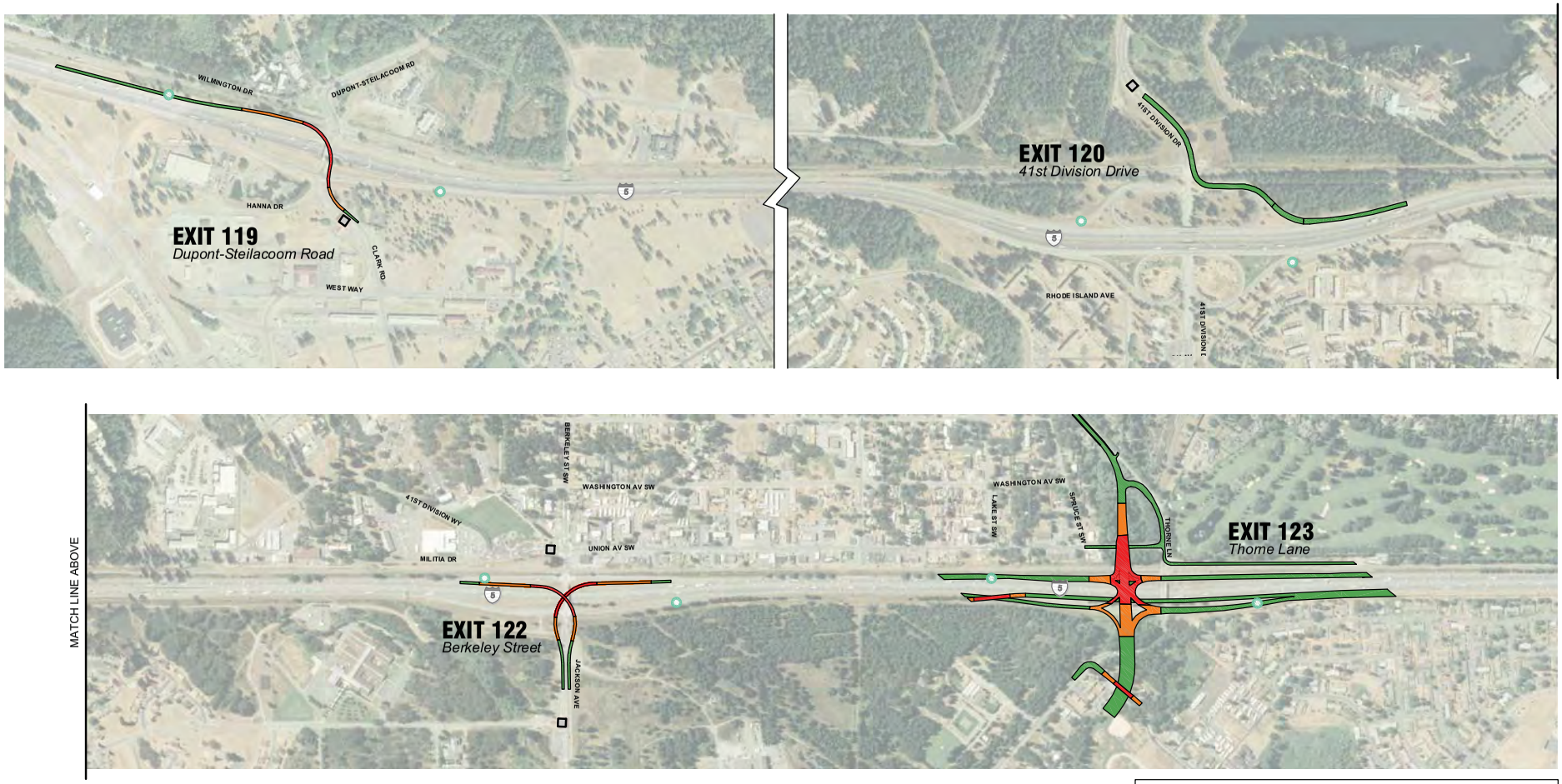

LEGEND

- ARTERIAL BRIDGE
- ELEVATED RAMP
- SURFACE IMPROVEMENTS
- AUXILIARY LANE
- GENERAL PURPOSE LANE
- MILITARY ACCESS CONTROL POINT
- RAMP METER

Concept Group 1

I-5 Transportation Alternatives Analysis and Operations Model

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A

Appendix D - Improvement Concepts

Interstate 5
Transportation Alternatives Analysis and Operations Model

TRC Meeting #4

December 3, 2009

Meeting Agenda

- Project Status
- Overview of Background/Baseline Conditions
- Summary of System Level Improvement Concepts
- Summary of Interchange Improvement Concepts
- Next Steps

Project Timeline

Historical Population Growth

Ft. Lewis	2000	2009	Net Change	% Change
Military	19,089	30,800	11,711	61.3%
Dependents	29,015	46,816	17,801	61.3%
Totals	48,104	77,616	29,512	61.3%

Counties (incl. cities)	2000	2009	Net Change	% Change
Pierce County	700,820	813,600	112,780	16.1%
Thurston County	207,355	249,800	42,445	20.5%
Totals	908,175	1,063,400	155,225	17.1%

Source: Adapted from April 9, 2009 presentation by Tom Knight, Ft. Lewis Deputy Garrison Commander using multiple sources. This includes 2009 Washington State Population Trends Report and 2012 populations figures based on estimates found in various Comprehensive Land Use Plans.

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Background Conditions - Traffic Growth

	Northbound		Southbound		Combined		Growth – Total & *(Annual)*		
Mainline Section	**2009**	**2030**	**2009**	**2030**	**2009**	**2030**	**NB**	**SB**	**Combined**
South of Mounts Rd	3,615	5,180	5,390	6,740	9,005	11,920	43% *(1.7%)*	25% *(1.1%)*	43% *(1.7%)*
Between Mounts Rd & Center Dr	3,755	5,470	6,220	7,790	9,975	13,260	46% *(1.8%)*	25% *(1.1%)*	46% *(1.8%)*
Between Center Dr & DuPont-Steilacoom Rd	3,825	5,670	5,500	7,380	9,325	13,050	48% *(1.9%)*	34% *(1.4%)*	48% *(1.9%)*
Between DuPont-Steilacoom Rd & 41st Division Dr	3,780	5,630	4,850	6,050	8,630	11,680	49% *(1.9%)*	25% *(1.1%)*	49% *(1.9%)*
Between 41st Division Dr & Berkeley St	4,830	6,910	4,500	5,710	9,330	12,620	43% *(1.7%)*	27% *(1.1%)*	43% *(1.7%)*
Between Berkeley St & Thorne Ln	5,955	7,960	4,300	5,490	10,255	13,450	34% (1.4%)	28% *(1.2%)*	34% *(1.4%)*
Between Thorne Ln & Gravelly Lake Dr	6,750	8,030	4,670	5,430	11,420	13,460	19% *(0.8%)*	16% *(0.7%)*	19% *(0.8%)*
Between Gravelly Lake Dr & Bridgeport Wy	6,345	7,340	4,530	5,070	10,875	12,410	16% *(0.7%)*	12% *(0.5%)*	16% *(0.7%)*
Between Bridgeport Wy & SR 512	6,565	7,390	4,470	4,810	11,035	12,200	13% *(0.6%)*	8% *(0.3%)*	13% *(0.6%)*
North of SR 512	6,645	8,000	5,900	6,010	12,545	14,010	20% *(0.9%)*	2% *(0.1%)*	20% *(0.9%)*

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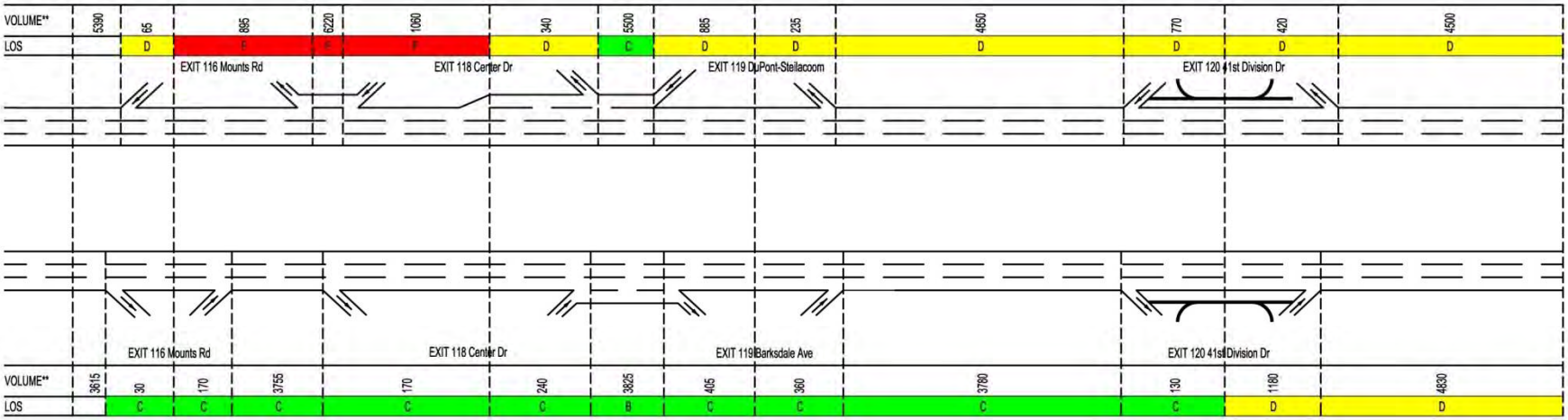
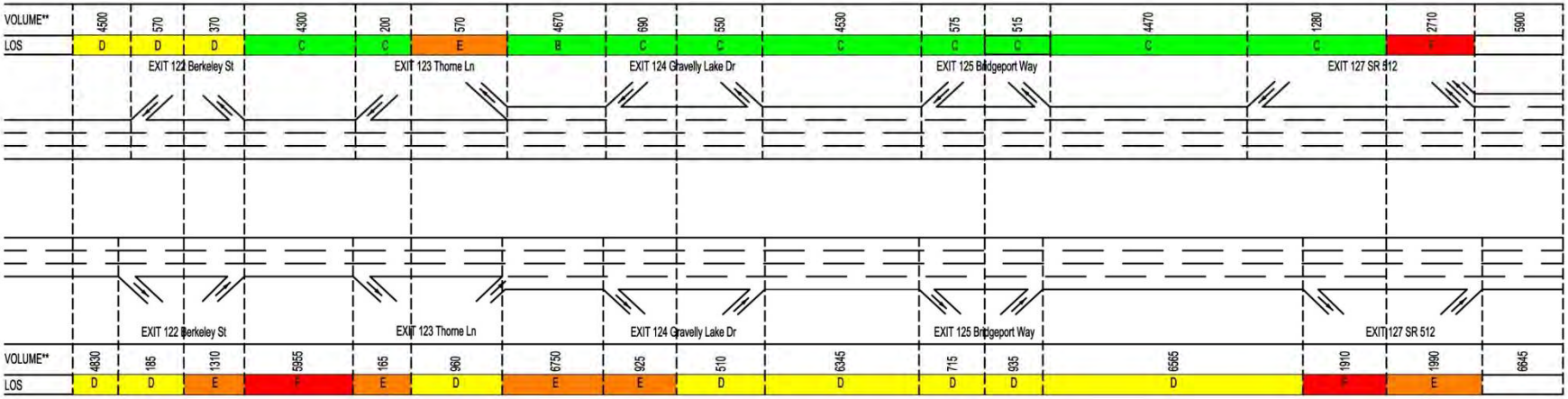
Existing (2009) Corridor PM Peak Hour LOS Summary

Lakewood I-5: Exit 116-Exit 120



Lakewood I-5: Exit 122-Exit 127

LOS Legend: LOS A to LOS C | LOS D | LOS E | LOS F



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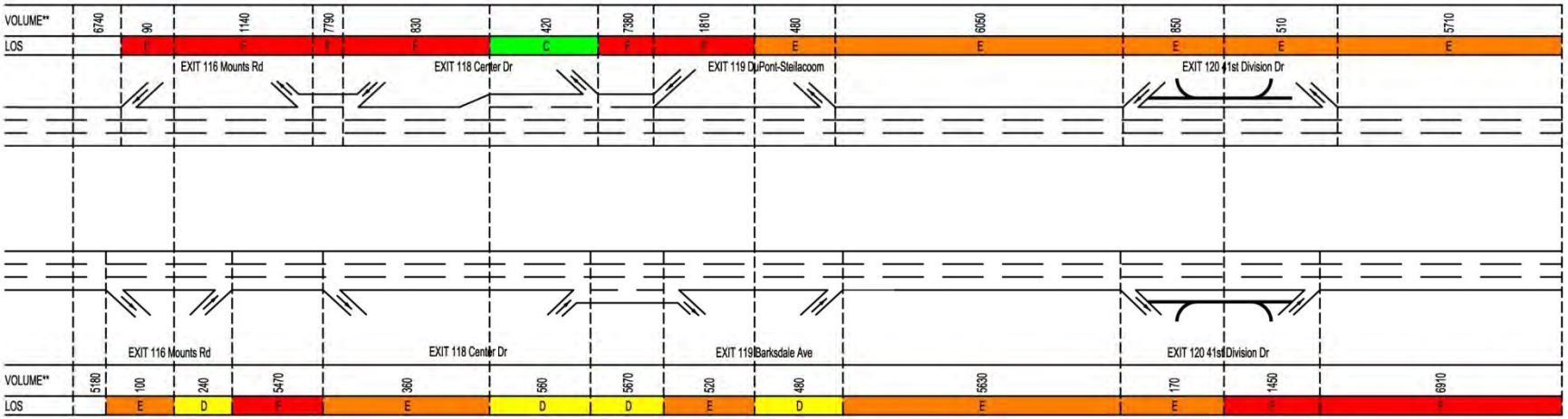
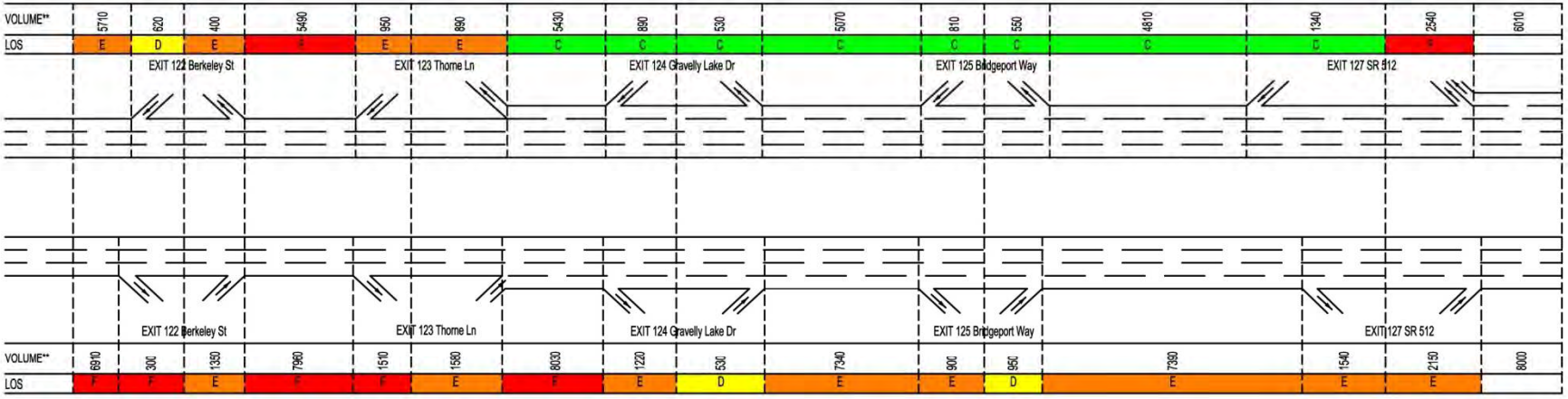
Forecast (2030) Corridor PM Peak Hour LOS Summary

Lakewood I-5: Exit 116-Exit 120



Lakewood I-5: Exit 122-127

LOS Legend: LOS A to LOS C | LOS D | LOS E | LOS F



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Ramp Terminal LOS Summary

Exit No.	Intersection	2009	2030	Focus Area Interchange?
116	SB I-5 Ramps/Mounts Rd	D	F	
	NB I-5 Ramps/Mounts Rd	C	E	
118	SB I-5 Ramps/Center Dr	E	F	
	NB I-5 Ramps/Center Dr	F	-	
119	SB I-5 Ramps/Barksdale Ave	B	F	X
	NB I-5 Ramps/Barksdale Ave	C	F	
120	I-5 Ramps/41st Division Dr	Free-flow	Free-flow	X
122	Union Ave/Berkeley Ave	B	B	X
	SB I-5 Ramps/Berkeley Ave	C	C	
	NB I-5 Ramps/Berkeley Ave	C	C	
123	Union Ave/Thorne Ln	B	C	X
	SB I-5 Ramps/Thorne Ln	D	D	
	NB I-5 Ramps/Thorne Ln	D		
124	Pacific Hwy/Gravelly Lake Dr	B	B	
	SB I-5 Ramps/Gravelly Lake Dr	D	D	
	NB I-5 Ramps/Gravelly Lake Dr	E	F	
125	Pacific Hwy/Bridgeport Way	C	C	
	SB I-5 Ramps/Bridgeport Way	C	C	
	NB I-5 Ramps/Bridgeport Way	B	C	
127	South Tacoma Way/SR 512	C	C	

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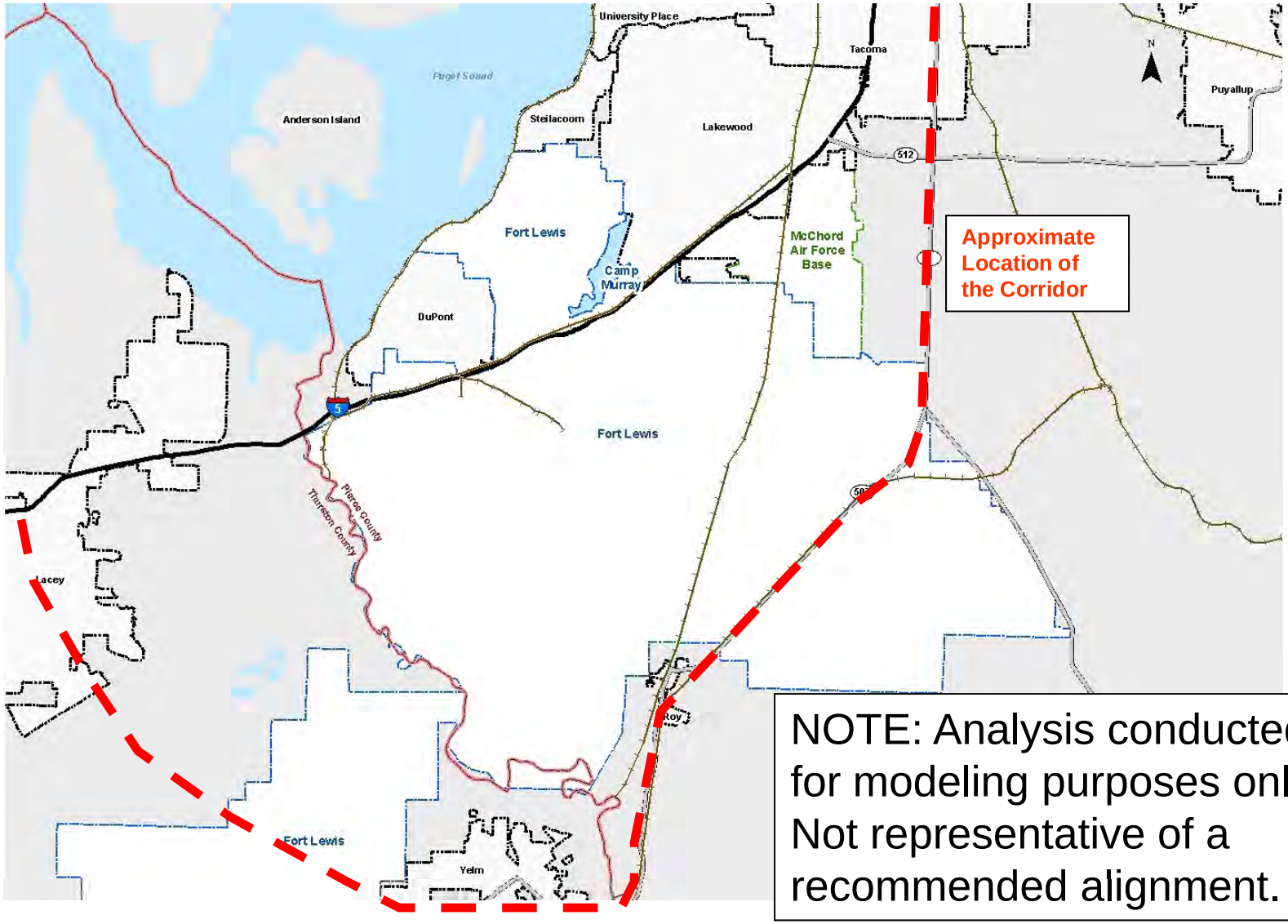
System Concepts

Concepts that were evaluated:

- ITS Improvements
- Demand Management
- Transit Improvements
- I-5 Mainline Improvements
- New Parallel Corridor

Parallel Corridor Overview



NOTE: Analysis conducted for modeling purposes only. Not representative of a recommended alignment.

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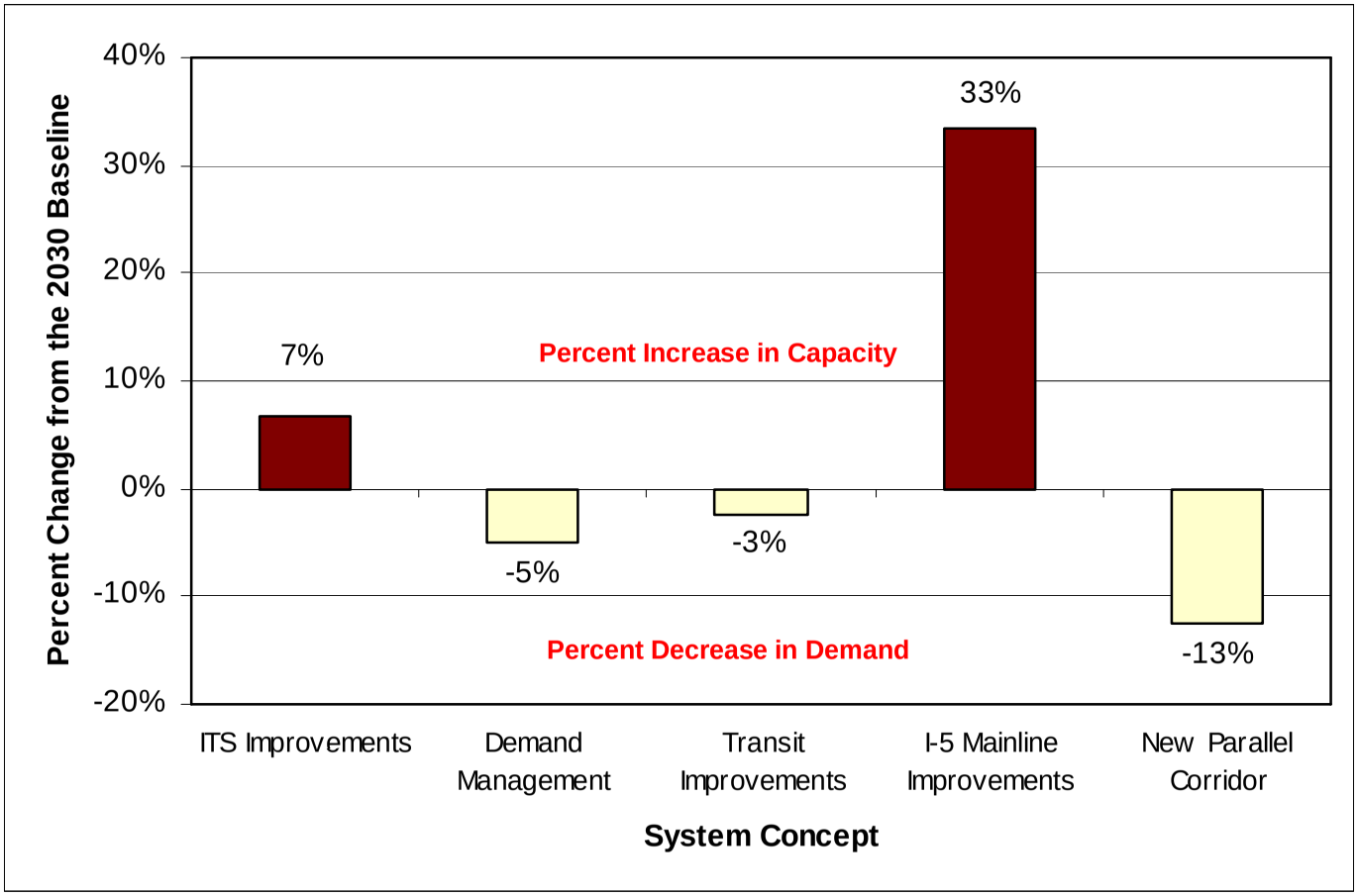
Comparison of System Concepts

Percent Change from the 2030 Baseline PM Peak Hour



*Based on 2030 forecast demand and capacity of I-5 in the northbound direction between Berkeley Street and Thorne Lane interchanges.

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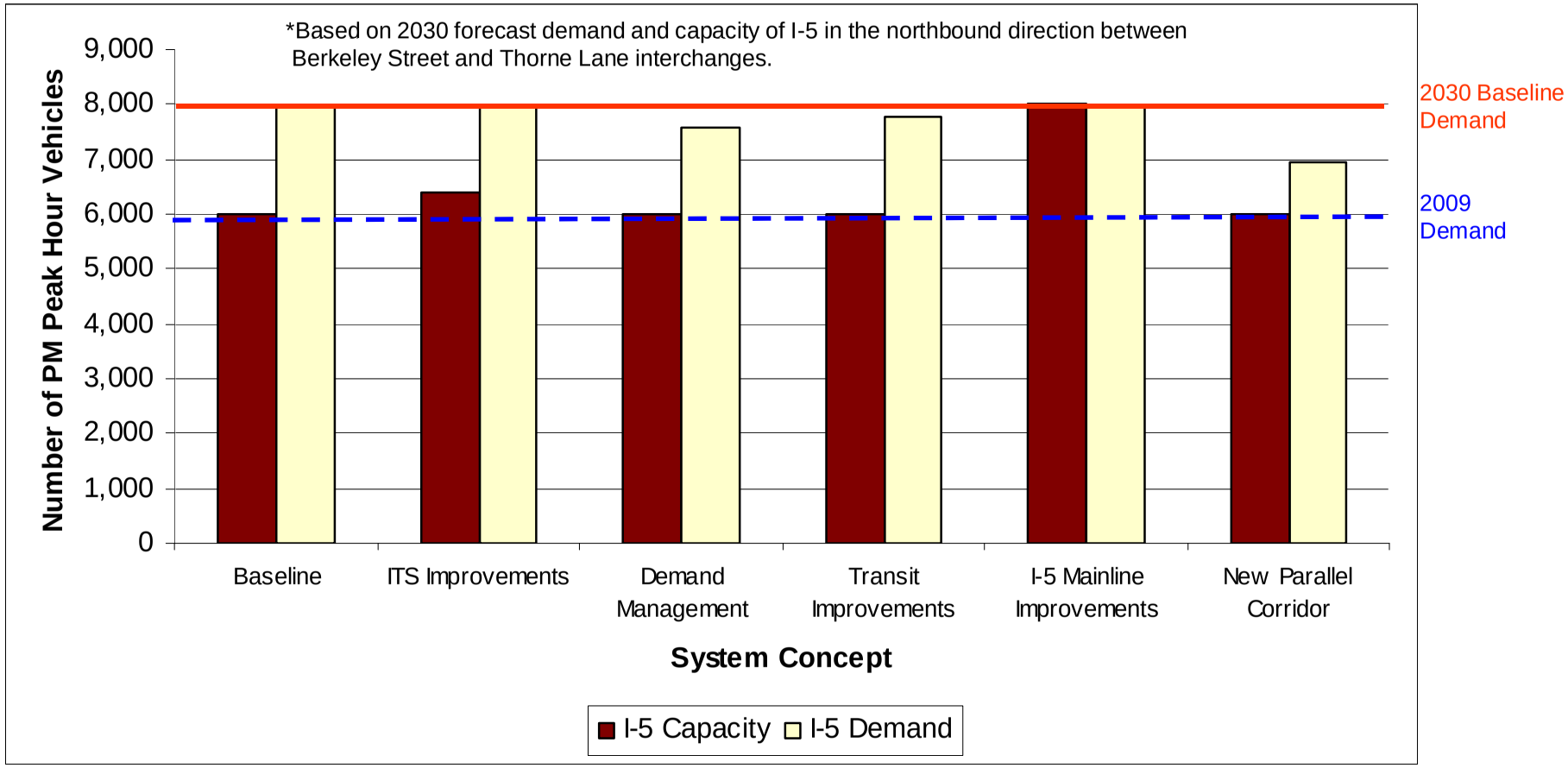
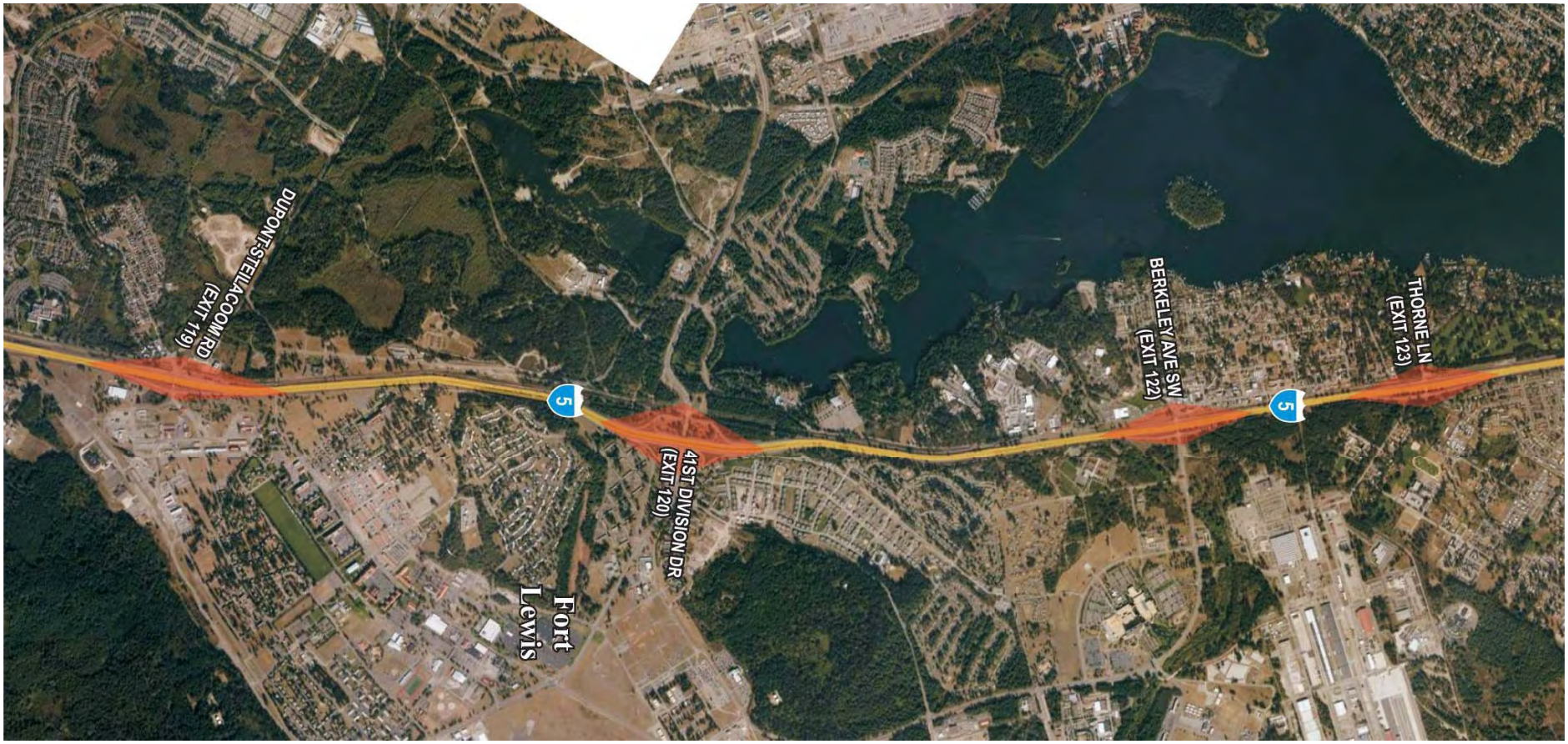
Comparison of System Concepts

2030 I-5 Mainline Capacity versus Demand



Focused Study Area



Exit 119 – DuPont-Steilacoom Concepts

Existing/Baseline Conditions & Deficiencies

- Gate traffic egress causes failure of interchange
- Close proximity to the at-grade rail crossing will further impact interchange
- Overpass is structurally deficient

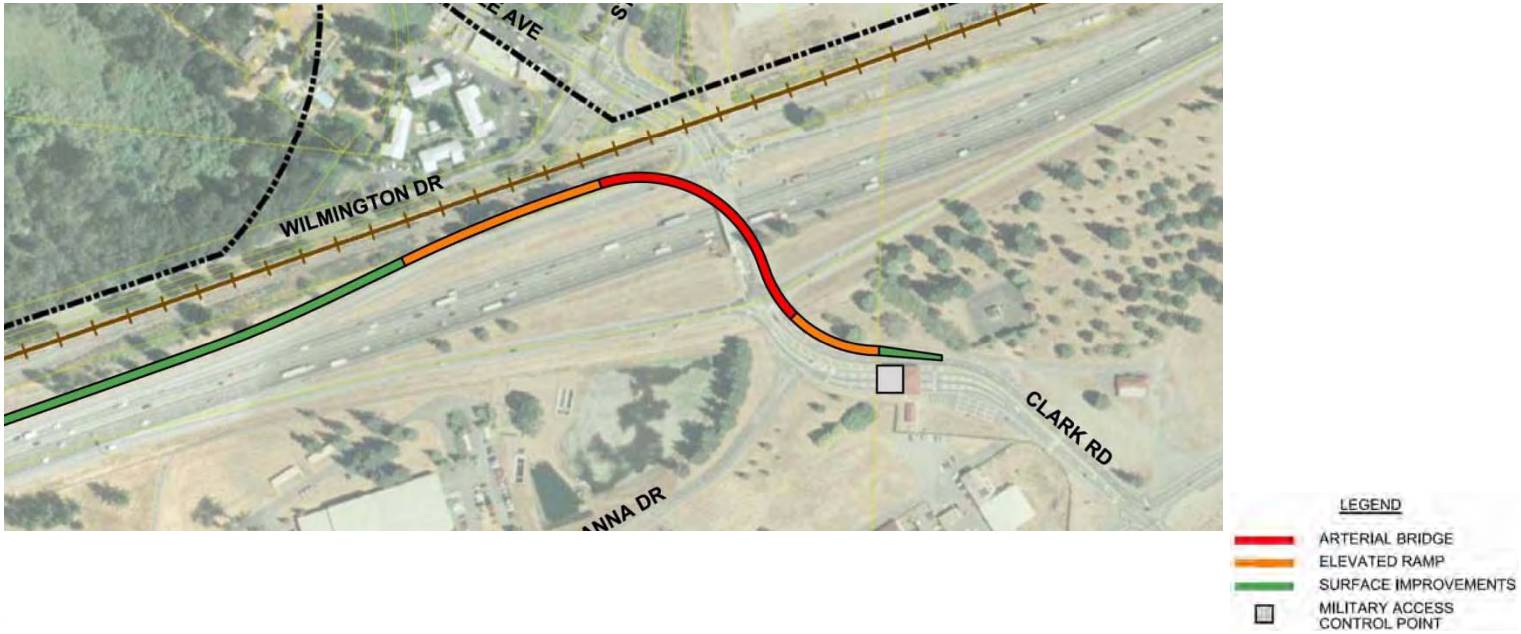
Exit 119 – DuPont-Steilacoom Concepts

Concept A Benefits

- Continuous flow for high volume movement
- Acceptable operations
- No additional I-5 mainline improvements

Concept A Limitations

- Does not address structural deficiency
- At-grade rail conflict
- Location of Fort Lewis Access Control Point (Gate)



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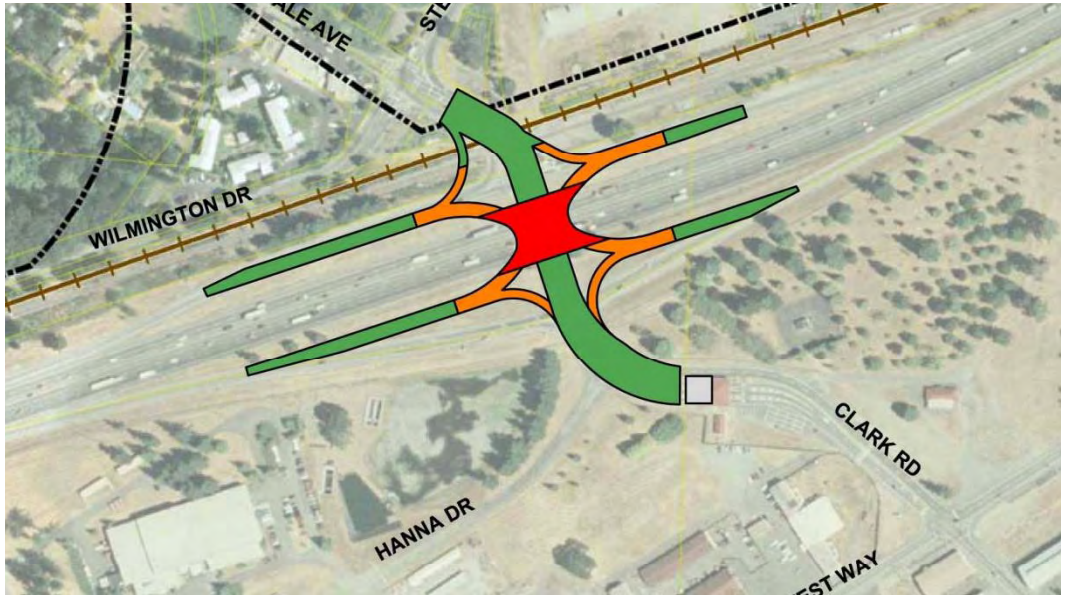
Exit 119 – DuPont-Steilacoom Concepts

Concept B Benefits

- Consolidates ramp terminals, adds turn lanes
- Improved separation from at-grade rail crossing
- Addresses structural deficiency

Concept B Limitations

- Does not eliminate conflict with at-grade rail crossing
- Construction phasing impacts to DuPont and Fort Lewis



LEGEND
- ARTERIAL BRIDGE
- ELEVATED RAMP
- SURFACE IMPROVEMENTS
- MILITARY ACCESS CONTROL POINT

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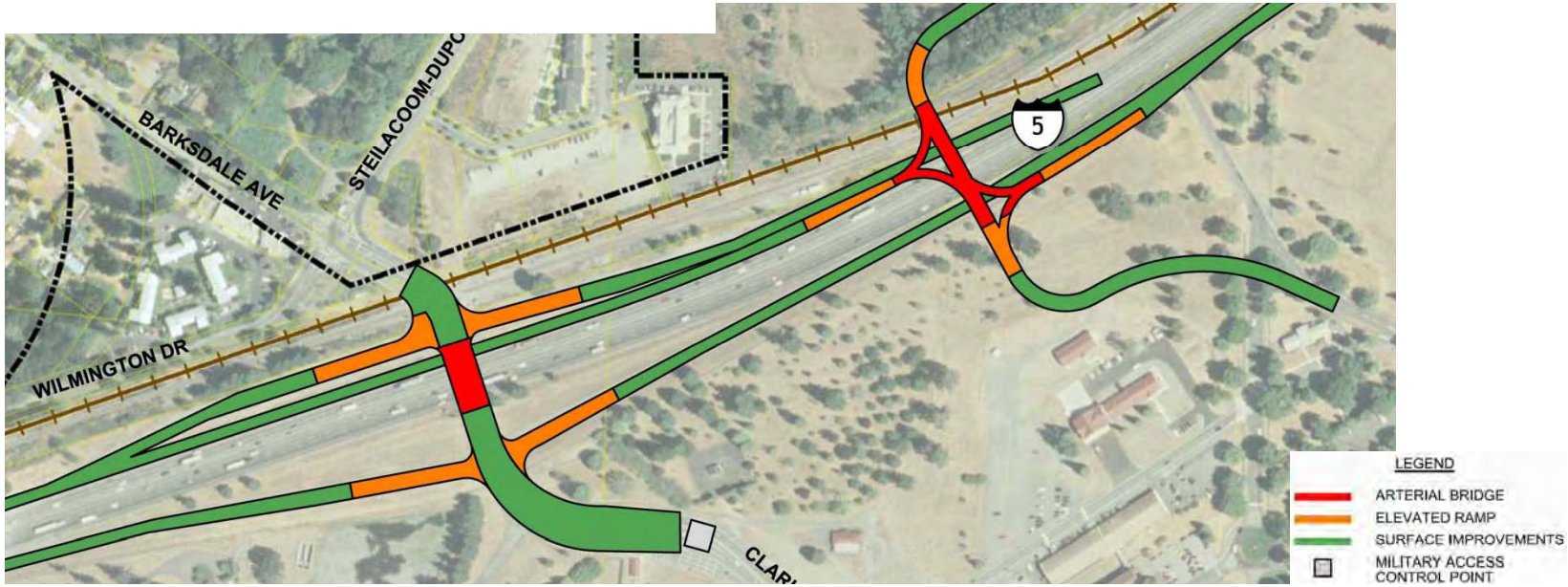
Exit 119 – DuPont-Steilacoom Concepts

Concept C Benefits

- Continuous flow for high volume movement
- Enhances Fort Lewis on-base circulation
- Interchange operates acceptably with free-flow military egress

Concept C Limitations

- Does not improve conflicts with the at-grade rail crossing.
- Requires on-base right-of-way
- Impacts military access control point
- Construction phasing impacts



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Exit 120 – 41st Division Concepts

Existing/Baseline Conditions & Deficiencies

- SB I-5 to North Fort movement experiences congestion
- At-grade rail crossing conflicts with queues from the North Fort access gate
- Mainline congestion will create vehicle queuing onto the interchange on-ramps

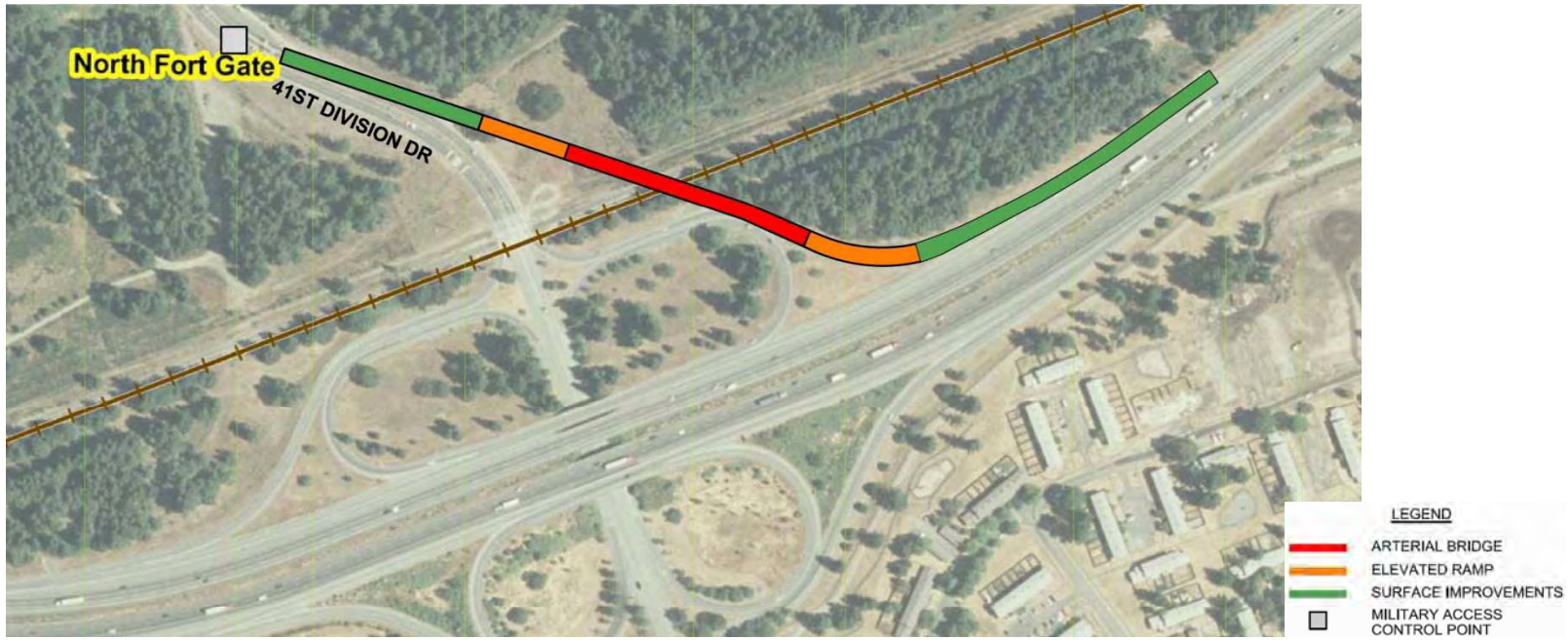
Exit 120 – 41st Division Concepts

Concept A Benefits

- Conflict with the rail crossing minimized
- Avoid impact from future rail activity

Concept A Limitations

- Only addresses SB off-ramp at-grade crossing
- Limited system benefit



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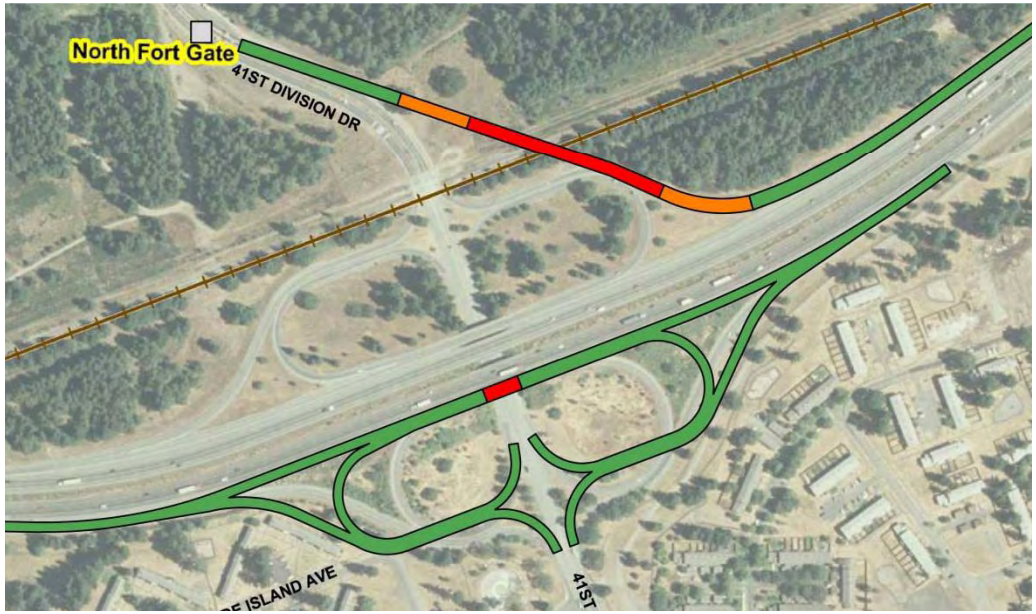
Exit 120 – 41st Division Concepts

Concept B Benefits

- Conflict with the rail crossing minimized
- Avoid impact from future rail activity
- Improved capacity for the NB collector-distributor lanes.

Concept B Limitations

- Only addresses SB off-ramp at-grade crossing
- Limited system benefit
- Additional right-of-way from base



LEGEND
- ARTERIAL BRIDGE
- ELEVATED RAMP
- SURFACE IMPROVEMENTS
- MILITARY ACCESS CONTROL POINT

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Exit 122 – Berkeley Concepts

Existing/Baseline Conditions & Deficiencies

- Poor SB I-5 off-ramp (AM) and NB I-5 on-ramp (PM) operations
- Close spacing: ramps terminals, adjacent intersection, & at-grade rail crossing.
- Queues onto Fort Lewis & into the Union/Berkeley
- Traffic diversion through Tillicum neighborhood
- Overpass is functionally obsolete.
- Mainline congestion causes vehicle queuing onto the interchange on-ramps

Exit 122 – Berkeley Concepts

Concept A Benefits

- Removes SB on/off ramp volumes from the interchange
- Improves ramp terminal operations

Concept A Limitations

- Does not address spacing
- Does not address obsolete structure.
- Does not address mainline congestion

LEGEND
- ARTERIAL BRIDGE
- ELEVATED RAMP
- SURFACE IMPROVEMENTS
- MILITARY ACCESS CONTROL POINT

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Exit 122 – Berkeley Concepts

Concept B Benefits

- Eliminates at-grade rail crossing conflict.
- Removes SB on/off ramp volumes from the interchange
- Improves ramp terminal operations
- Replaces functionally obsolete structure.

Concept B Limitations

- Does not address spacing with adjacent intersection.
- Impacts to adjacent properties, local circulation improvements within Tillicum.
- Required NB I-5 auxiliary lane
- May require gate relocation

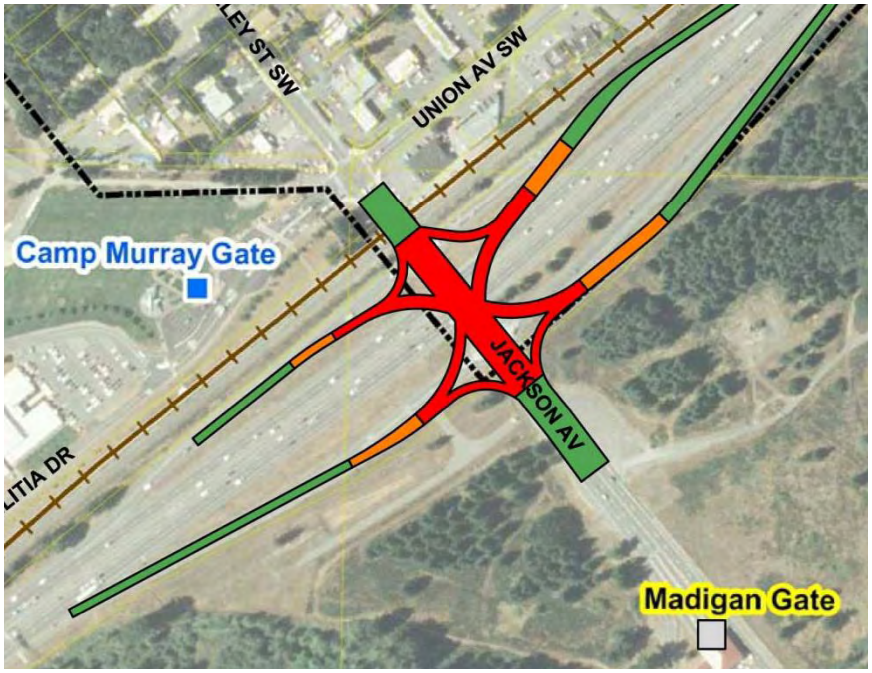
Exit 122 – Berkeley Concepts

Concept C Benefits

- Consolidates ramp terminals , adds turn lanes
- Improved spacing
- Forecast queues acceptable

Concept C Limitations

- Does not eliminate at-grade rail crossing conflict
- Construction phasing impacts



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Exit 123 – Thorne Concepts

Existing/Baseline Conditions & Deficiencies

- Congestion and operational issues between Thorne Lane and Berkeley Street
  - Reduction in lanes from 4 to 3 and large on- and off-ramp vehicle movements
- Overpass is functionally obsolete.

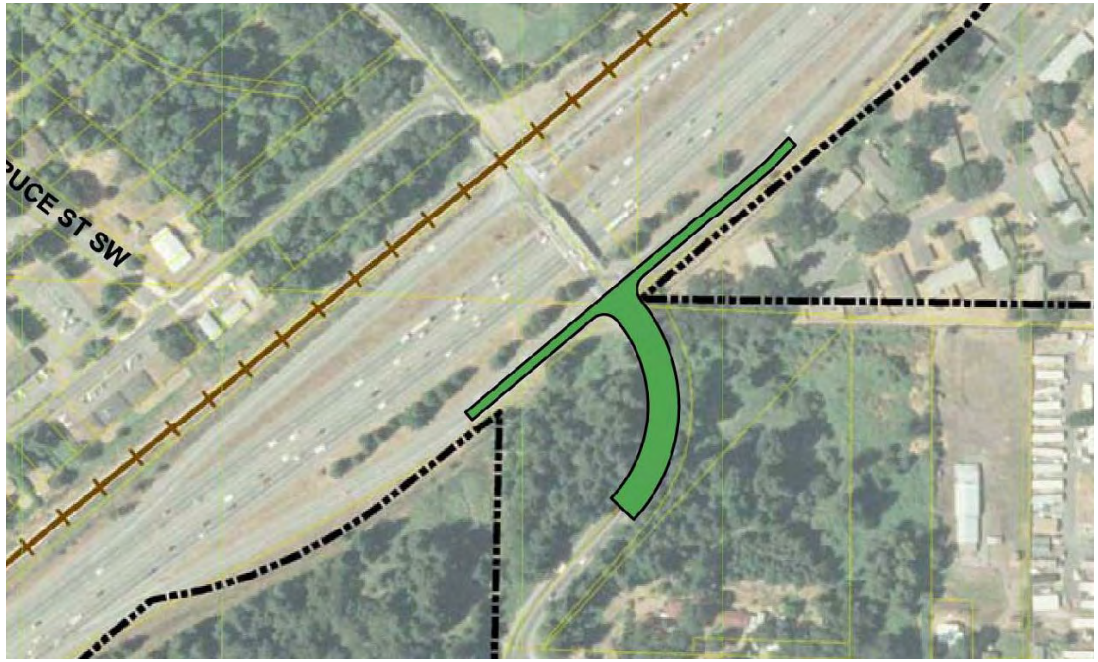
Exit 123 – Thorne Lane Concepts

Concept A Benefits

- Short-term operational improvements

Concept A Limitations

- Unable to be phased with Cross-Base Highway
- Does not address mainline operational issues



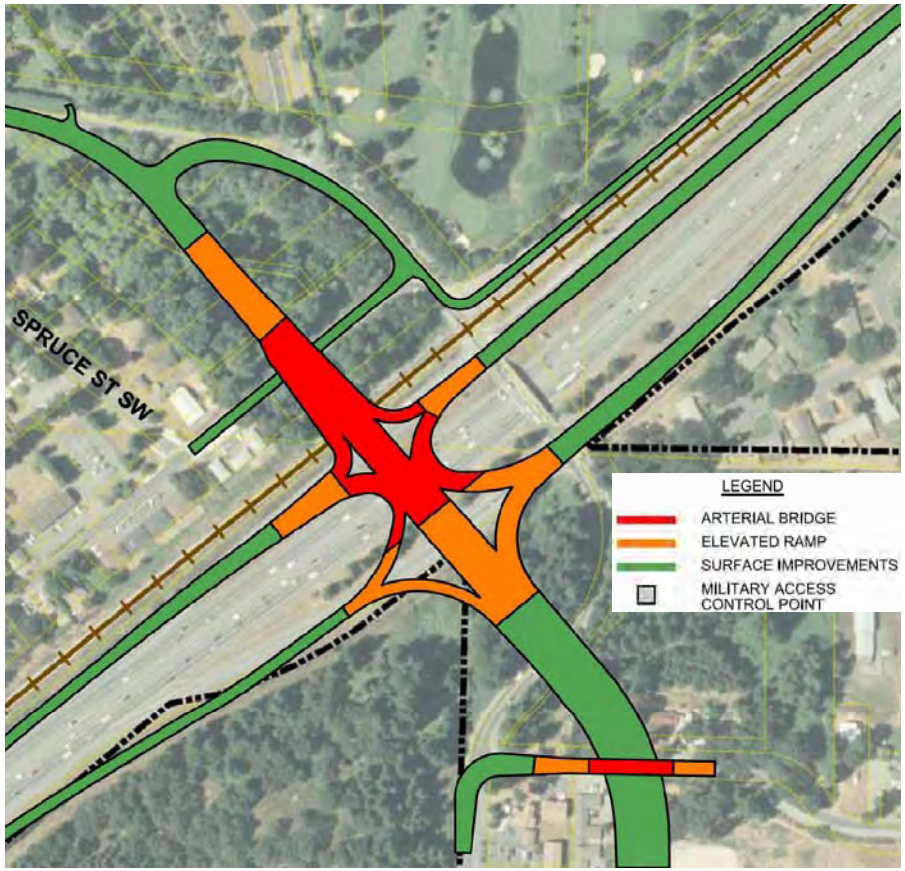
Exit 123 – Thorne Lane Concepts

Concept B Benefits

- Consolidates ramp terminals, adds turn lanes
- Improves spacing with adjacent intersection
- Consistent with Cross-Base Highway design

Concept B Limitations

- Dependent on construction of new highway
- Does not address mainline operational issues



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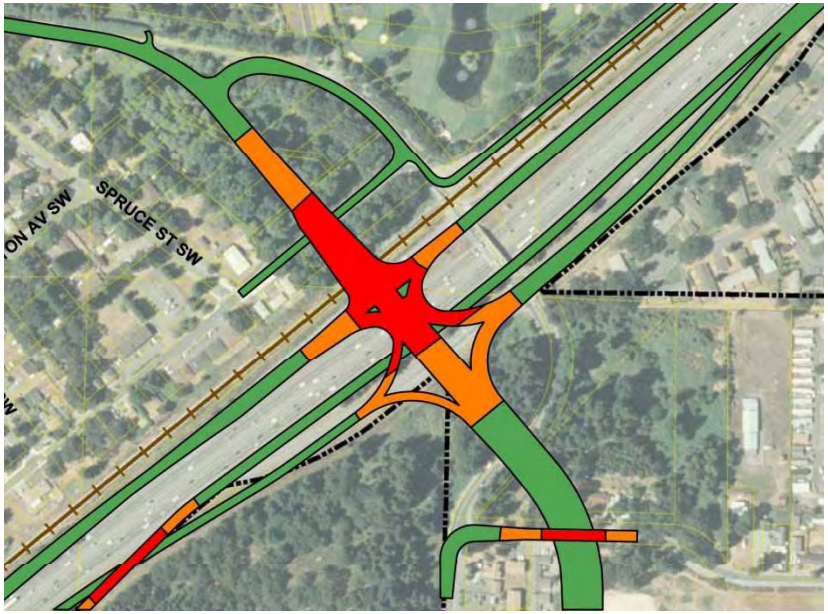
Exit 123 – Thorne Lane Concepts

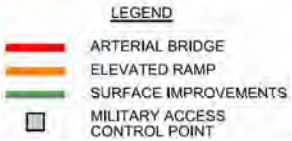
Concept C Benefits

- Consolidates ramp terminals, adds turn lanes
- Improves spacing with adjacent intersection.
- Addresses mainline operational issues

Concept C Limitations

- Dependent on construction of new highway
- Differs from Cross-Base Highway interchange design





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Next Steps
Tier III Screening Summary

Category	Focus Areas
Preservation	Structural Deficiencies
Safety	existing accident rates and high accident locations, at-grade rail crossings, etc
Mobility	Capacity improvements on the arterial streets and interface with I-5 mainline movements
Environment	Impact on sensitive areas
Stewardship	Benefit/Cost ratio, construction feasibility, etc