Washington State
Department of Transportation

Conway to Cook Interstate 5 Master Plan

Final Report

November 2008

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Acknowledgements

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FEDERAL HIGHWAY ADMINISTRATION

SKAGIT COUNCIL OF GOVERNMENTS

CITY OF MOUNT VERNON

CITY OF BURLINGTON

SKAGIT TRANSIT

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DKS ASSOCIATES

Transportation affects everyone. Whether commuting to work, delivering products, taking a vacation, or running errands, our lives and livelihood depend on a safe, efficient and reliable transportation system. Washington State's population continues to grow, as does the need to move more people and freight. The Washington State Department of Transportation (WSDOT) is dedicated to providing a safer, more efficient and reliable transportation system to demonstrate its commitment to being good stewards of the State's transportation system.

Project Decision Team Endorsement
Conway to Cook Interstate 5 Master Plan

Endorsement Statement

"We endorse the Conway to Cook Interstate 5 Master Plan and are committed to actively supporting it. Our endorsement acknowledges that we have completed our review and oversight responsibilities and agree with the findings and recommendations documented in the Master Plan."

Project Support Team

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EXECUTIVE SUMMARY

The purpose of the Conway to Cook Interstate 5 Master Plan is to identify safety and mobility needs on the interstate and connected local roads, and recommend a set of improvements to maintain efficient operations, improve safety and manage congestion. Although there is no funding currently available to implement plan recommendations, the master plan is a necessary first step toward making I-5 improvements in the future. The plan empowers the Washington State Department of Transportation and partner agencies to set priorities and pursue funding for detailed design and construction.

PROBLEMS

The analysis found a number of safety and congestion issues that have negative consequences on those who depend on I-5. These problems degrade the quality of life of people who live and work in the region, and slow the flow of commerce on this nationally-significant corridor.

- 463 collisions on I-5 lanes and ramps from 2003 to 2005.
- 17 of 30 interchange ramps are too short or curves too sharp.
- Arterial street congestion creates ramp backups onto I-5.
- Local street "connectivity" improvements are needed.
- I-5 congestion increases at high volume interchanges.
- I-5 is nearing capacity during the peak hour in 2006.
- Travel demand increases by 50 percent by 2035.
- Travel times are expected to more than double by 2035.

IMPROVEMENTS

The plan incorporates state and federal transportation policy, transportation analysis, and input from elected officials and local agency staff, stakeholders, and members of the community to recommend strategies to improve safety and help relieve congestion:

- Provide weave lanes on I-5 (northbound and southbound) between the Anderson Road and Chuckanut Drive interchanges.
- Implement active traffic management improvements including ramp metering.
- Build a new single-point urban interchange (SPUI) at College Way.
- Provide interchange improvements at Kincaid Street to correct geometric deficiencies and improve intersection operations.
- Provide interchange improvements at George Hopper Road with a five-lane roadway section on George Hopper Road across I-5.
- Provide interchange improvements at Chuckanut Drive (SR 11) to correct geometric deficiencies on the southbound on and off ramps. Preserve the proposed roundabout and ramp improvements on the east side of the interchange. Build a new four-lane roadway section bridge on Chuckanut Drive (SR 11) across I-5.
- Provide interchange improvements at Cook Road. This includes the signalization of the Cook Road ramp intersections and coordination of the ramp signals with the Old Highway 99 intersection and an additional eastbound lane between the northbound off-ramp and Old Highway 99 intersection. Build a new four or five lane roadway section bridge on Cook Road across I-5.
- Change the speed limit on I-5 from 70 mph to 60 mph from SR 20 to Cook Road by 2035.
- Preserve space in the median of I-5 for future managed lanes (one lane in each direction) to provide flexibility to accommodate future improvements addressing high capacity modal alternatives.
- Build a new I-5 bridge (or bridges) across the Skagit River to accommodate the proposed improvements (weave lanes and new managed lanes) assuming the preliminary dike setback alignment being evaluated by local agencies.
- Accommodate non-motorized transportation.

BENEFITS

The estimated cost for implementing the recommended improvements is $1.2 billion to $1.4 billion in 2008 dollars. This investment would generate the following safety and mobility benefits:

- Reduce the number of conflict points at interchanges.
- Reduce vehicle conflicts where ramp volumes are highest.
- Separate lower speed local traffic exiting and entering the interstate from regional traffic passing through the corridor.
- Reduce congestion at interchange intersections that cause traffic backups on the off-ramps.

- Reduce local arterial street congestion at interchanges which causes traffic backups on the off-ramps.
- Provide dedicated bicycle and pedestrian facilities.
- Decrease travel time by 55 percent northbound and 40 percent southbound in the peak periods.
- Generate travel time savings of 10 minutes northbound and five minutes southbound in the peak periods.
- Increase average vehicle corridor throughput by 25 percent northbound and 30 percent southbound.

The strategy proposed in the plan is ***one*** way to address safety and mobility needs on the interstate; it is not the ***only*** way. These recommendations recognize that needs change over time depending on population growth, travel patterns, new technologies, and local street improvements. In addition, there may be other strategies available to address interstate needs that merit additional review and discussion. WSDOT will revisit the plan periodically to respond to changing conditions, evaluate alternative strategies, and modify the list of improvements accordingly.

NEXT STEPS

The plan identifies over one billion dollars of needs that cannot be met within the limits of existing funding. The next step is to develop an implementation strategy that will lead to funded projects.

WSDOT will use the technical analysis and public comments generated in the development of the Interstate Master Plan to:

- Obtain approvals from the Federal Highway Administration (FHWA).
- Coordinate I-5 improvements with local land use and transportation plans.
- Partner with local agencies and private developments on funding improvements.
- Design, conduct environmental review, and construct improvements .

As funding becomes available, WSDOT will work with project partners and local agencies to move forward with design and construction of high-priority improvements.

Table of Contents

CHAPTER 1 - INTRODUCTION

Interstate 5 (I-5) is the primary highway corridor for the movement of goods and people traveling north and south on the west coast of North America. The corridor is a highway of national and statewide significance that runs north-south through the state of Washington from the Canadian border to the Oregon border. It links key population centers in the state of Washington and provides convenient access to the cities of Mount Vernon and Burlington, and surrounding cities, towns and communities in Skagit County.

I-5 from Conway to Cook Road is a nine mile corridor of divided, limited access, interstate highway. Two lanes in each direction extend from the interchange at Old Highway 99 South at exit 224, to the Cook Road interchange at exit 232. Along this stretch of I-5 there are eight interchanges and 30 ramps that provide access between I-5 and the local roadway system. Four of those interchanges provide connections to other state highways. Those connections and key regional destinations are:

- Exit 226, linking I-5 to SR 536 (Kincaid Street), provides access to downtown Mount Vernon, to Skagit Station, to residential areas east and west of downtown, and to Memorial Highway which connects with SR 20.
- Exit 227, linking I-5 with SR 538 (College Way), provides access to Skagit Valley College, growing communities in east Skagit County, and to a busy retail corridor.
- Exit 230, linking I-5 with SR 20, provides access to the Skagit Regional Airport, to Anacortes, to the Swinomish Indian Reservation, to the state ferry system serving San Juan County, and to productive agricultural land. SR 20 is the only land-based connection to Whidbey Island. To the east, SR 20 provides access to Burlington, Sedro Woolley, and to other communities and recreational activities served by the North Cascades Highway. SR 20 is a highway of statewide significance and is part of the national strategic highway network
- Exit 231 linking I-5 with SR 11 (Chuckanut Drive) provides access to the Skagit Regional Airport, and to productive agricultural land in northwest Skagit County.

State highway connections and key regional destinations

Other key destinations along I-5 include Skagit Valley Hospital (exit 226 and 227), United General Hospital (exit 230 and 231), and Cascade Mall (exit 229).

I-5 from Conway to Cook Road was originally built in two segments. The first section from Snohomish County north to the Chuckanut Interchange (exit 231) was constructed as a four-lane interstate in the mid-1950's. A third lane was added in each direction to the section south of the Old Highway 99 interchange (exit 224) in the 1970's. The second section, extending north of the Chuckanut Interchange to Whatcom County, was opened to traffic in 1965. More recent improvements include construction of the George Hopper Road interchange in Burlington and the 2006 replacement of the 2nd Street Bridge over I-5 in Mount Vernon.

Skagit County's population has more than doubled since I-5 was built, increasing from 51,000 residents in 1960 to more than 110,000 today. Traffic volumes on I-5 have increased at a faster rate than population growth. The population is expected to significantly increase by 2035, especially in the urban centers of Mount Vernon and Burlington. The resulting growth in the number of vehicles traveling on I-5 through Skagit County is expected to place greater demands on I-5 and connected local roads than they are currently designed to handle.

WSDOT's mission is to keep people and goods moving by operating and improving the state's transportation system. To accomplish the mission, WSDOT needs a current, factual understanding of the problems on I-5, and must develop and evaluate improvements to address the problems. This is the master planning process.

WHAT IS THE PURPOSE OF THE INTERSTATE MASTER PLAN?

The purpose of the Conway to Cook Interstate 5 Master Plan (IMP) is to identify the safety and mobility needs on the interstate and connected local roads, now and into the future, and recommend an integrated set of improvements to maintain safe, efficient and acceptable I-5 operations. Specific objectives to be accomplished with the IMP were as follows:

- Identify areas with congestion, high collisions, and geometric deficiencies.

- Establish a plan that provides guidance for the stewardship of resources, funding of future improvements, and the integration of interstate operations with other planned improvements in the region.
- Obtain Federal Highway Administration project approvals for I-5 improvements.
- Be prepared for funding when it becomes available.
- Enable opportunities to partner with local agencies and private developments to fund improvements.
- Enhance regional transportation planning.
- Coordinate I-5 improvements with local land use and transportation plans.

WHAT GUIDED OUR EVALUATIONS AND RECOMMENDATIONS?

The improvements considered for I-5 are guided by federal, state, tribal, and local transportation goals and policies, including those identified in the Washington State Transportation Plan, regional and metropolitan transportation plans, transit and port long range plans, and local agency and tribal transportation plans.

Most importantly, this plan is guided by the following Washington State transportation policy goals contained in RCW 47.04.280:

1. **Preservation:** to maintain, preserve, and extend the life and utility of prior investments in transportation systems and services.
2. **Safety:** to provide for and improve the safety and security of transportation customers and the transportation system.
3. **Mobility:** to improve the predictable movement of goods and people throughout Washington State.
4. **Environment:** to enhance Washington's quality of life though transportation investments that promote energy conservation, enhance healthy communities, and protect the environment.

5. **Stewardship**: to continuously improve the quality, effectiveness and efficiency of the transportation system.

How are these goals accomplished? The plan recognizes that stakeholders measure success differently and place different demands on the interstate. Local communities often value access most highly, while state and federal agencies emphasize the importance of mobility for through traffic. WSDOT's charge under state law is to consider the necessary balance between, providing for the free inter-jurisdictional movement of people and goods on I-5, and the needs of local communities using I-5.

With the guidance of the IMP, WSDOT will identify a list of improvements that can be implemented in phases and scaled to funding that may be available in the future. WSDOT recognizes that the IMP is not a perfect road map for future improvements. Though the concepts may change over time, the improvements identified through the IMP are a benchmark that will allow WSDOT to pursue funding for detailed design, environmental analysis and construction, and provide a context to evaluate other improvement strategies that may develop in the future.

WHO HELPED US DEVELOP THE INTERSTATE MASTER PLAN?

WSDOT met with the public, with local agency officials and staff, and with technical experts to guide the master plan. Public comments were received through a number of effective outreach methods. Those methods included a traveling project display, a project webpage, newspaper and radio news stories, one-on-one meetings with constituent groups, stakeholder meetings, a public open house, and through input we received via emails, phone calls and letters.

WSDOT listened to the public and integrated their thoughts, concerns and advice into the identification of I-5 problems and in the development and evaluation of improvements. Also key to the development of the plan was coordination with the Skagit Council of Governments (SCOG) on regional planning policy. SCOG is the Metropolitan Planning Organization (MPO) and the Regional Transportation Planning Organization (RTPO) in the IMP corridor. SCOG's regional transportation travel demand model is the basis for all of the forecasted growth in traffic used in the IMP.

WSDOT relied on a Project Decision Team (PDT) for review and oversight of analysis of existing and future conditions, the evaluation of improvements and the final recommendations prepared for the master plan. The PDT was comprised of representatives from the Federal Highway Administration (FHWA); WSDOT headquarters design engineering and access management offices; WSDOT region design engineering, traffic engineering, planning, and communications; and consultant staff representing design, traffic engineering, public involvement and environmental analysis. A complete list of PDT members is shown on the Project Decision Team endorsement page near the front of this report.

The cooperation and input received is referenced throughout this report where problems and needs are identified, and where improvements are recommended. The project team greatly appreciates the time and careful thought expressed by community members in their comments. This cooperation will continue well after completion of the IMP. WSDOT will engage local agency officials and the public to define improvement priorities and implement I-5 improvements.

The technical appendices to this report contain details of the public involvement activities and the feedback received, as well as information summarizing the Project Decision Team meetings.

WHAT IS IN THE REPORT?

This report describes the existing and forecasted (2035) problems on I-5, the improvements that were considered to address these problems, and the improvements that are recommended for funding and implementation over the next 25 years.

Visitors at a public open house learn about the master plan and share their thoughts about recommended improvements.

CHAPTER 2 - OVERVIEW OF FINDINGS AND RECOMMENDATIONS

The Interstate Master Plan identifies safety and mobility needs on I-5 and connected local roads, and describes potential improvements that address the physical needs of the roadway. The plan also provides flexibility for meeting the long term transportation needs of the region and the state beyond 2035. Plan recommendations incorporate feedback received from local governments and members of the community.

This chapter provides an overview, in the form of five aerial photos with graphics, describing the problems and the recommended improvements to address those problems. An in-depth analysis of the problems identified, and the improvements considered, evaluated, and recommended, is provided in subsequent chapters of this report.

WHAT DID WE LEARN?

The eight mile section of I-5 through Skagit County is experiencing a very high number of collisions as a result of on- and off-ramps that are too short and have curves that are too tight. I-5 improvements are needed to resolve these problems and meet state and federal design standards for interstate facilities.

This section of I-5 is also rapidly becoming a chokepoint because of the significant amount of local traffic entering and exiting within the corridor mixing with the growing volume of through traffic. Residential and commercial development within Skagit County has increased demand for travel on the interstate, and trips traveling through the I-5 corridor from locations outside Skagit County (Whatcom, Snohomish and King Counties) have increased as well. Local and through-traffic volumes are expected to increase significantly by 2035, and will lead to an operational breakdown of the mainline, ramps, and local intersections.

Two key chokepoints on I-5 are at the College Way and Kincaid Street interchanges. These two interchanges will experience high volumes of traffic in the future (2035) with high levels of congestion at the ramp terminal intersections. In the future, peak hour volume and demand will overwhelm the interchanges causing extreme backups and congestion on I-5.

In the northbound direction, backups on the northbound off-ramp to College Way will cause the mainline to breakdown. The impact of this congestion will create stop and go conditions in the PM peak hour on northbound I-5 from the Old Highway 99 South Road interchange to College Way. Other future (2035) northbound congestion points include backups from queuing on the off-ramps at the Anderson Road, Kincaid Street, George Hopper Road and Cook Road interchanges. The close proximity of the Cook Road off-ramps to the Old Highway 99 North Road signalized intersection and the Burlington Northern Santa Fe railroad crossing creates queuing and congestion on the Cook Road off-ramps and the northbound mainline during the PM peak periods. Ramp queues occur daily in 2008 at the northbound off ramp at Cook Road. The length and duration of queues will continue to worsen in the future.

In the southbound direction, backups on the southbound off-ramp to Kincaid Street will cause the mainline to breakdown creating stop and go conditions in the PM peak hour on southbound I-5 between College Way and Kincaid Street.

Federal interstate requirements, or design standards, are specifications that have been developed by the Federal Highway Administration and state highway officials based on years of experience designing and operating the interstate system. These standards are applied uniformly from coast to coast across the United States to ensure that drivers experience the same visual directions nationwide in order to improve safety and operational efficiency. Design problems in the I-5 corridor are identified in the master plan as geometric deficiencies. The geometric deficiencies in the I-5 corridor are the substandard ramp configuration and acceleration and deceleration lengths. The worst deficiencies occur at the following interchanges :

Kincaid Street: Short northbound on-ramp.

SR 20: Existing ramp deficiencies at the SR 20 interchange will be corrected by a funded project currently underway and to be completed in 2009, titled “SR 20 – Fredonia to I-5 Additional Lanes”.

Chuckanut Drive.: Tight curves and short on/off ramps on all four ramps. The northbound ramp deficiencies will be corrected in 2010 with a funded project currently in design by WSDOT titled “I-5 SR 11 Interchange and Josh Wilson Road Realignment.”

Cook Road: Short northbound and southbound on-ramps and short southbound off-ramp.

WHAT IMPROVEMENTS ARE RECOMMENDED TO ADDRESS SAFETY AND MOBILITY?

Improvement	Benefit
Managed Lanes	Move more people and/or freight safely and efficiently.
Weave Lanes	Improves safety and provides congestion relief. Provides longer area for merging on and off I-5. Reduces vehicle conflicts merging on and off the interstate where ramp volumes are high.
Single Point Urban Interchange	Moves more traffic through the interchange which reduces backups to the ramps and arterial streets and improves safety.
Lengthened ramps / widened ramp curves	Improves safety and reduces congestion at the ramp merge area on I-5.
Ramp Intersection Improvements	Improves ramp and arterial street safety and reduces dangerous backups at off-ramps.

Improvement	Benefit
Improve bicycle and pedestrian facilities at interchanges when they are modified or rebuilt	Provides dedicated bicycle and pedestrian facilities to improve safety and improve connections to adjacent bicycle and pedestrian facilities.
Additional lanes crossing I-5 at bridges and undercrossings	Improves safety and provides congestion relief. Reduces local arterial street congestion which causes traffic to backup on I-5 off-ramps.
Active Traffic Management	Using integrated systems and a coordinated response, both recurrent and non-recurrent congestion can be managed to improve roadway safety and traffic flows.
Improve Local Street Connections	Reduces the number of short trips on the interstate and enables better transit connections.
Replace I-5 Skagit River Bridge	Provides room for weave lanes and managed lanes to improve safety and relieve congestion.

PROBLEMS AND RECOMMENDED IMPROVEMENTS

PROBLEMS

IMPROVEMENTS

Active Traffic Management

Reserve space for future Managed Lanes

PROBLEMS AND RECOMMENDED IMPROVEMENTS

PROBLEMS

High Collisions

Future Mainline Congestion

Short On/Off-Ramps

Off-Ramp Queuing and Congestion

IMPROVEMENTS

Ramp Terminal Improvements

New Blackburn Street Bridge with Bike Lanes and Sidewalks

New SPUI Interchange at Kincaid Street

Weave Lanes

Active Traffic Management

Reserve Space for future Managed Lanes

PROBLEMS AND RECOMMENDED IMPROVEMENTS

PROBLEMS

High Collisions

Future Mainline Congestion

Short On/Off-Ramps

Ramp and Arterial Congestion

Short On/Off-Ramps

IMPROVEMENTS

New SPUI Interchange at College Way

New Skagit River Bridge

Ramp Terminal Improvements

Widen George Hopper Road to 5 Lanes with Bike Lanes and Sidewalks

Weave Lanes

Active Traffic Management

Reserve Space for future Managed Lanes

PROBLEMS AND RECOMMENDED IMPROVEMENTS

PROBLEMS

Future Mainline Congestion

Ramp and Arterial Congestion

Tight Ramp Radii and Short On/Off-Ramps

IMPROVEMENTS

SR 20 and Ramp Improvements Under Construction 2008-2009

Widen Bridge Over SR 20

Widen Bridge to 4 Lanes with Bike Lanes and Sidewalks

Ramp Terminal and Interchange Improvements

Weave Lanes

Active Traffic Management

Reserve Space for future Managed Lanes

PROBLEMS AND RECOMMENDED IMPROVEMENTS

PROBLEMS

Future Mainline Congestion

Congested (PM Peak) Stop Controlled Intersections

Ramp Queuing and Arterial Congestion

IMPROVEMENTS

New 4 Lane Bridge with Bike Lanes and Sidewalks

Ramp Terminal Improvements

Active Traffic Management

Reserve Space for future Managed Lanes

CHAPTER 3 - WHAT ARE THE PROBLEMS?

INTRODUCTION

The I-5 corridor from Conway to Cook has a number of existing problems that need to be addressed. The problems are summarized below:

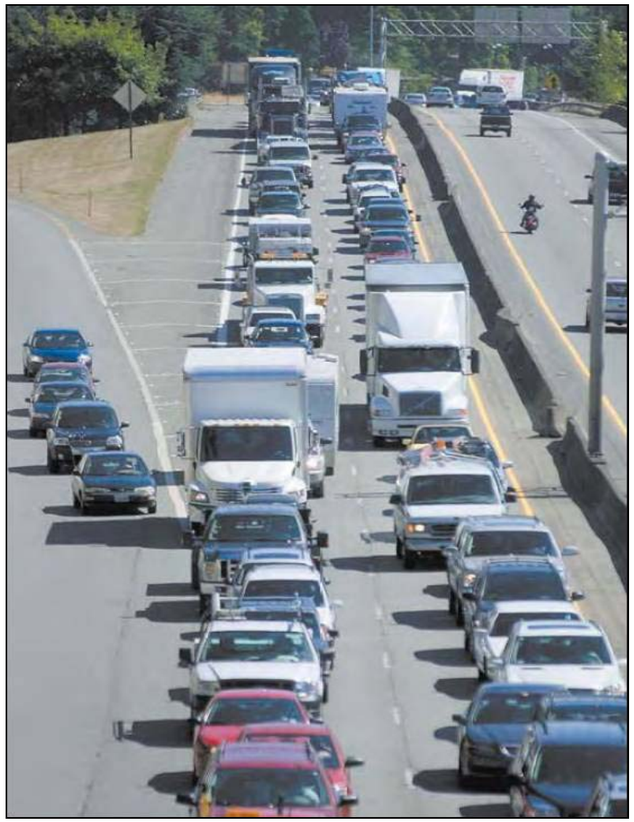
- Geometric deficiencies - 17 of 30 ramps are too short and/or the ramp curves are too tight.
- High frequency of collisions - A total of 463 collisions occurred over a three year period in the corridor. These collisions were concentrated around high volume ramps, interchanges and at the I-5 Skagit River bridge.
- Increasing congestion on I-5 - Peak hour vehicle throughput is low due to slower speeds, ramp congestion and geometric deficiencies. Travel speeds fluctuate and are highly variable throughout the corridor.
- Increasing local street congestion - Congested local streets at ramp terminal intersections cause traffic to back up onto the I-5 mainline.
- High percentage of local trips using I-5 - Approximately 50 percent of peak hour trips on I-5 are local trips traveling less than five miles.
- Lack of local routes crossing I-5 for cyclists and pedestrians - Inadequate bicycle and pedestrian facilities exist at many interchanges. There are few connections crossing I-5 between some of the interchanges.
- Aging I-5 structures and pavement - Many of the bridges and pavements are nearing the end of their useful life. Modifying some of the existing bridges may be unfeasible.

I-5 bridge over the Skagit River

These existing problems will worsen as the demand for travel on I-5 and on the connected local streets grows in the future. By 2035, population in Skagit County is expected to grow by 40 percent. Peak hour vehicle trips are expected to increase by 50 percent countywide (all roads and highways) and by 45 percent for through trips on I-5 by 2035.

This increased growth in travel will have significant implications and impacts on how I-5 is used and operates in 2035. The resultant congestion on I-5 will stress it's ability to accommodate local, regional and freight trips. More local trips will use local streets to avoid congestion on I-5. Congestion will have a detrimental affect on freight movements and on local and regional economic activity as the time and cost to transport goods will dramatically increase.

Existing and future problems on I-5, and what causes them, is explained in more detail on the following pages.



I-5 mainline congestion

EXISTING CONDITIONS (2006) PROBLEMS

- I-5 is used as a primary route for local as well as regional trips.
- Traffic volume and conditions on I-5 and connecting arterials and highways can vary greatly by season and time of day.
- The highest volumes and densities on I-5 are concentrated between the Kincaid Street and SR 20 interchanges.
- Ramp geometric deficiencies exist at some interchanges.
- I-5 operates at acceptable levels but congestion exists at some key interchanges (Kincaid Street, College Way, George Hopper Road and SR 20).
- Traffic queuing and storage is a problem at some I-5 off-ramps (Kincaid Street, College Way, SR 20 and Cook Road).
- Congestion on arterial streets and highways (Kincaid Street, College Way, SR 20 and Cook Road) can create congestion and queuing on the off-ramps which impact I-5 mainline operations.
- High collision locations include I-5 northbound between Kincaid Street and College Way and across the I-5 Skagit River bridge.

FUTURE CONDITIONS (2035) PROBLEMS

- Skagit County population is projected to increase by 40 percent by 2035 based on estimates in the adopted local comprehensive plans.
- Adopted land use changes address local and regional growth which will increase demand on the interstate and local roads.
- Travel demand will increase by 50 percent for local trips and 45 percent for through trips.
- The number of trips using I-5 to travel long distances will constitute more that 55 percent of the total traffic by 2035.
- The ability of I-5 to absorb additional traffic growth is limited .
- Peak period demand will greatly exceed existing I-5 capacity. I-5 travel time from Anderson Road to Cook Road during the p.m. peak hour will increase from seven minutes today to 17 minutes in 2035.
- High interchange ramp volumes cause breakdown of the I-5 mainline and local street intersections which will degrade throughput and safety.
- Local streets or highways that experience high levels of congestion at or near interchanges include Anderson Road, Kincaid Street, College Way, George Hopper Road, SR 20 and Cook Road.
- Insufficient local street capacity and poor local street connections contribute to congestion and safety problems on I-5.

INTERCHANGE GEOMETRIC DEFICIENCIES

While interchange deficiencies may be a less obvious problem to drivers than traffic congestion, the implications are no less important for safety and mobility. Interstate facilities are designed to operate at high speeds with limited access. Federal and state interstate standards require that stringent design standards be met in order to accommodate these higher speeds safely and efficiently. In this report we use the term *geometric deficiencies* to identify I-5 facilities (bridges, ramps and mainline lanes) that do not meet current design standards.

A total of 17 geometric deficiencies exist at the on-and off-ramps on I-5 through Mount Vernon and Burlington. These ramp deficiencies include stopping sight distance, merge and diverge distances, and acceleration and deceleration distances.

Significant lane changing, acceleration and deceleration movements occur at on- and off-ramps. Vehicles entering or leaving I-5 at less than desirable speeds due to short ramp acceleration lengths and tight curves cause other vehicles on the interstate to brake and slow down which reduces the speeds and vehicle throughput. Likewise, heavy queuing at off-ramps and a lack of storage reduces the space available for vehicles exiting the interstate, further reducing the speeds and capacity of I-5 to move vehicles.

An example of the types of geometric deficiencies that exist is shown in the graphic provided below for the I-5/Chuckanut Drive interchange.

WSDOT currently has a funded project to build roundabouts and improve the I-5 northbound on- and off-ramp geometrics at the Chuckanut Drive (SR 11) interchange. The project will begin construction in 2010. Other geometric deficiencies remain at this interchange, including the southbound on- and off-ramps which presently do not have funding for improvements. See page 4-4 for before and after photos of the improvements funded for the Chuckanut Drive interchange.

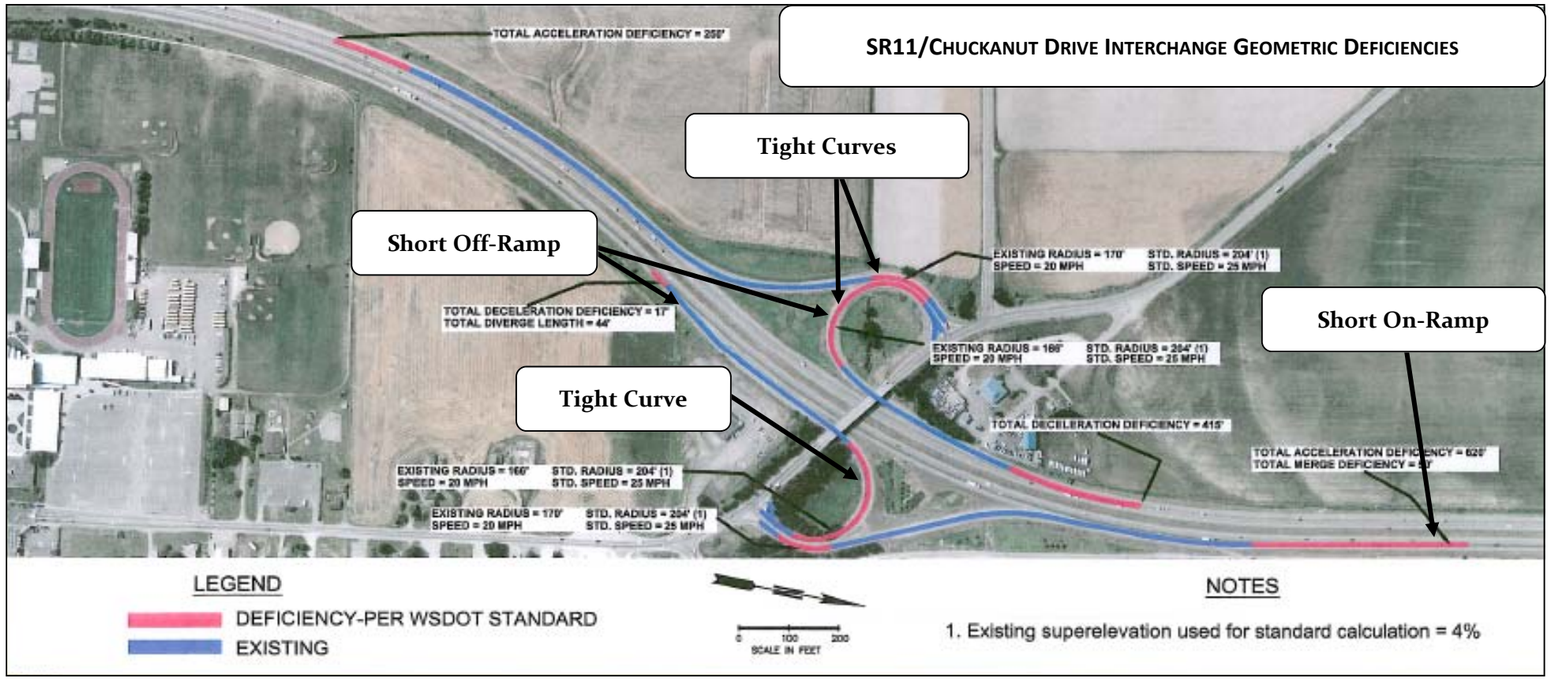
I-5 ramp improvements are also part of a larger funded project currently under construction at the SR 20 interchange, scheduled for completion in 2009. Once completed, all of the ramps at this interchange will meet current design standards. The photos in the lower right show the SR 20 interchange before and after improvements.

The funded improvements at the SR 20 and Chuckanut Drive interchanges were included as part of the baseline road network in the evaluation of 2035 traffic conditions.

Summary of Key Interchange Problems

Location	Interchange Capacity	Interchange Configuration
Old Highway 99 Interchange		√
Anderson Interchange	√	
Kincaid Interchange	√	
College Interchange	√	
George Hopper Interchange	√	√
SR 20 Interchange	√	√
Chuckanut Interchange	√	√
Cook Interchange	√	

Geometric deficiencies contribute to higher congestion and increased collisions



I-5 /SR 20 interchange before funded improvements

Conceptual photo of the I-5/SR 20 interchange after completion of 2008-2009 improvements

COLLISIONS

Future improvements need to make I-5 safer by reducing the frequency and severity of collisions. In order to reduce collisions and improve safety it is important to understand where, why, and how collisions occur on I-5 in the Conway to Cook corridor. To do this collisions for a three year period from 2003 through 2005 were analyzed from WSDOT collision records. A total of 463 collisions occurred on I-5 between the Conway to Cook interchanges. There were 354 collisions on the I-5 mainline and 109 collisions on the ramps. A high number of collision occurred in the vicinity of the interchanges. An example of the concentration of collisions near the entry and exit points to I-5 is shown for the College Way interchange (see graphic on the right).

In most cases, rear-end collisions were the primary type of collision on the ramps and mainline. Many of these collisions were caused by vehicles slowing or braking at ramp entry and exit points to I-5. Additional causes include sudden weaving or merging maneuvers as vehicles try to avoid or go around vehicles entering or exiting the interstate, and vehicles rear ending other vehicles queued on the off-ramps. This is particularly true at locations with congested off-ramps.

The highest collision location in the corridor was the northbound I-5 mainline between the College Way and George Hopper Road interchanges where 97 collisions occurred over three years. Of those, 67 collisions (69 percent) were rear-end collisions. The high volume of traffic entering and exiting I-5 at these interchanges, combined with short merging distances between the on- and off-ramps at the ends of the Skagit River bridge, and narrow shoulders and limited site distance on the bridge (crest vertical curve) were factors in the high number of collisions.

Collisions at the Chuckanut Drive interchange (see next page) illustrate the type of collisions that occur on the ramps and at the ramp terminal intersections.

It is important to recognize that driver behavior, in varying degrees, is also a factor in many collisions. Excessive speed, following too close and impaired driving are some of the factors that also contributed to the collisions.

Existing Collisions Summary (3-Year Collision Totals)

Location	Totals		Contributing Factors		
	Mainline	Ramps	Short Accel & Decel Lanes	Heavy Ramp Volumes	Off-Ramp Queues
SR 534 Interchange	9	9			
Mainline: SR 534 to Old Highway 99	24				
Old Highway 99 Interchange	6	1			
Mainline: Old Highway99 to Anderson	4				
Anderson Interchange	22	2		√	√
Kincaid Interchange	64	17	√	√	√
College Interchange	62	17	√	√	√
Mainline: College to George Hopper	55				
George Hopper Interchange	42	18	√	√	
SR 20 Interchange	21	29		√	√
Mainline: SR 20 to Chuckanut	12				
Chuckanut Interchange	12	10	√		
Mainline: Chuckanut to Cook	10				
Cook Interchange	11	6	√	√	√
Totals	354	109			

I-5 northbound lanes at the Skagit River bridge

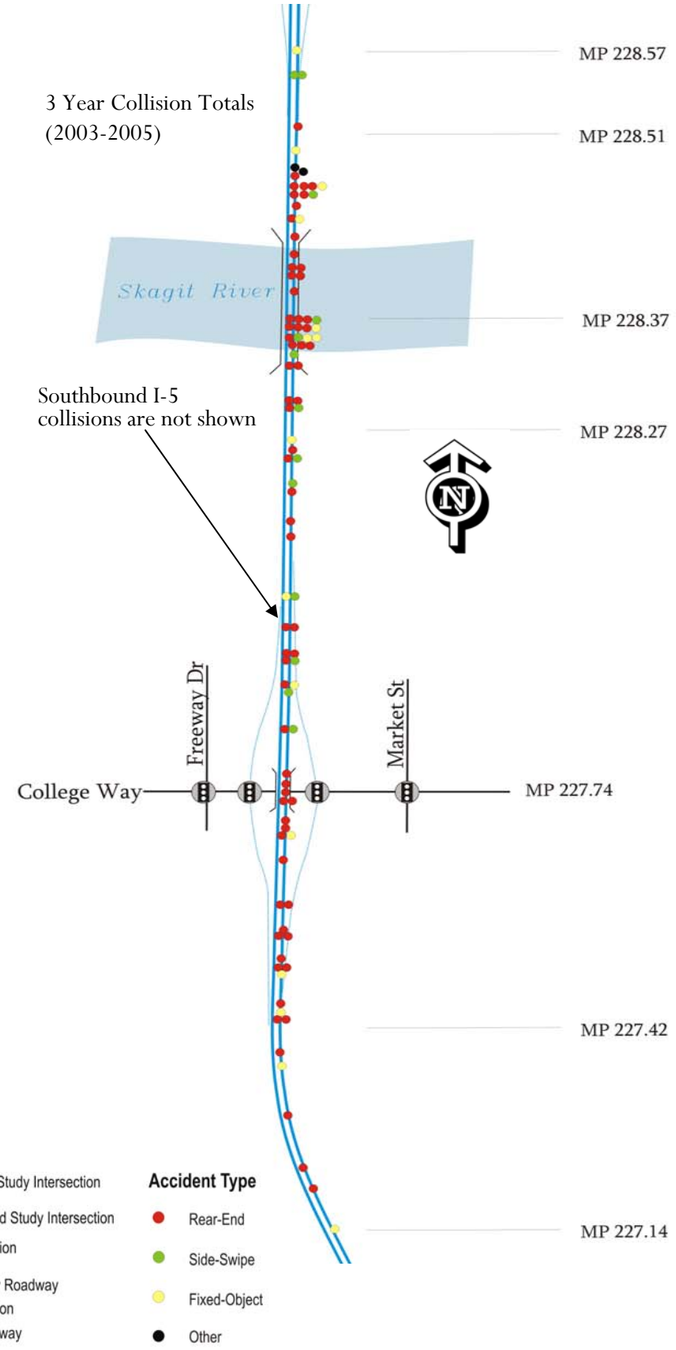
Analysis Segment: 1.43 mile
I-5 NB mainline from MP 227.14 to MP 228.57, including College Way Interchange and the segment between College Way Interchange and George Hopper Interchange. Analysis segment consists of a NB off-ramp, a NB on-ramp, and a freeway mainline section.

Total number of accident: 97
Rear-End: 67 (69.1%)
Fixed-Object: 15 (15.5%)
Side-Swipe: 13 (13.4%)
Other: 2 (2.1%)

Exceeding reasonable safe speed, failing to give right of way to other vehicles, and following too closely are contributing circumstances for 80 (82.5%) of the total accidents.

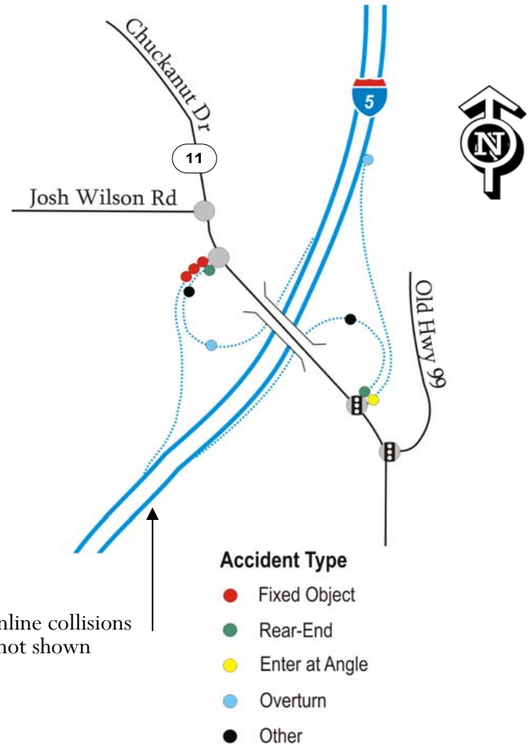
Rear-end collisions occur when drivers brake unexpectedly on the mainline and ramps due to congestion (slow moving vehicles) as vehicles enter or leave I-5, or when queuing occurs at

NORTHBOUND I-5 MAINLINE: EXIT 227 - COLLEGE WAY (SR 538) TO EXIT 229 - GEORGE HOPPER ROAD



EXIT 231 - CHUCKANUT DRIVE (SR 11)

3 Year Ramp Collision Totals
(2003-2005)



Accident Type

Total number of accidents: 10
- Fixed Object: 3 (30 %)
- Rear-End: 2 (20 %)
- Enter at Angle: 1 (10 %)
- Overturn: 2 (20 %)
- Other: 2 (20 %)

Corridor travel time will increase from about seven minutes today to 15-20 minutes or more in 2035 PM peak hour.

I-5 CONGESTION, MOBILITY, AND FREIGHT

Today, I-5 is nearing capacity with little ability to absorb additional growth in traffic volumes (see chart in lower right). With a forecasted growth in population of 40 percent in Skagit County, an increase in local vehicle trips of 50 percent, and regional through trips on I-5 forecasted to increase by 45 percent, with even higher increases anticipated for regional trucking and freight, I-5 will be significantly congested by 2035. During the 2035 PM peak hours, travelers will experience stop and go conditions in both the northbound and southbound directions. Travel time on I-5 from the Anderson Road to Cook Road interchanges will increase from about seven minutes today to 15-20 minutes or more in the 2035 PM peak hours. The duration of the peak hour with stop and go conditions is forecasted to last for more than one hour by 2035.

Congestion on the I-5 mainline and ramps will reduce the attractiveness of I-5 for local trips. Insufficient local street capacity and poor local street connections will contribute to increased congestion on I-5.

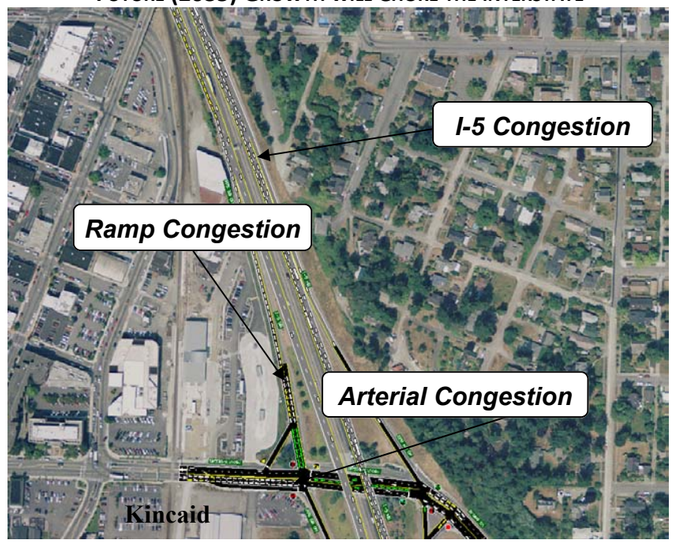
When queues at off-ramps extend onto the I-5 mainline because of congestion at the ramp intersections with local streets, the throughput on I-5 is significantly reduced and collisions increase due to the difference in speed between vehicles on I-5 and vehicles queued on the off-ramp. These backups already occur at the Cook Road interchange. In the future (2035) these backups will also occur at the Kincaid Street, College Way and George Hopper Road interchanges resulting in stop and go conditions on I-5 with long queues at the off-ramps.

The tables on the next page show the effects of congestion on the I-5 mainline and at local street intersections at or near I-5 interchanges. The degree of congestion is represented by a level of service (LOS) rating that ranges from "A" (the best) to "F" (the worst) in terms of measures of congestion and the performance of the transportation system.

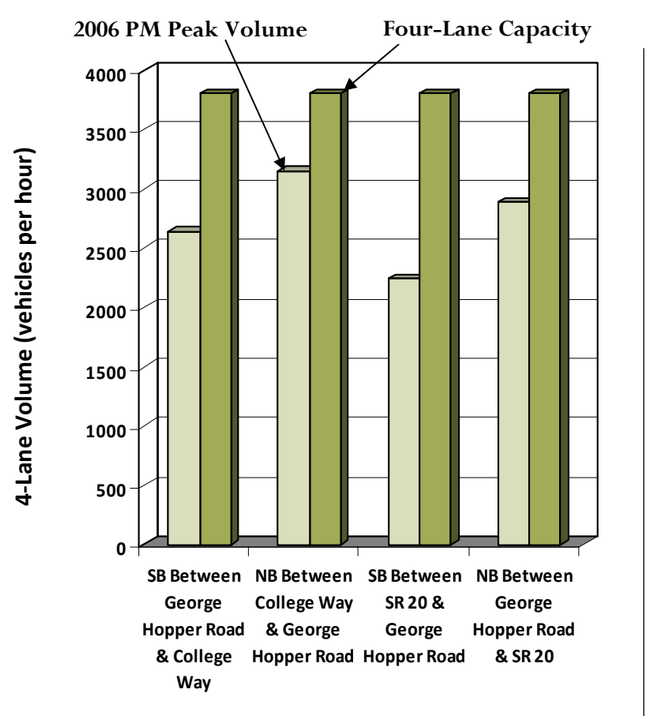
I-5 is a highly strategic and important element of the freight transportation system, serving a major role in enabling local, regional, state, national, and international commerce. A healthy, efficient, and resilient freight transportation system is vital to the state's economy, as well as to the economy of the region served in the I-5 Conway to Cook corridor. In 2006 commercial freight trucks represented approximately five percent of the traffic in the corridor. It is forecasted that by 2035 the growth in freight truck trips will outpace the growth in passenger vehicle trips on I-5.

The primary concerns for freight are the need to minimize travel time, have a reliable and predictable travel time, have access to pickup, delivery and services along the corridor, and safety. As congestion worsens, the duration of hours during the day in which it occurs also grows. These factors have a highly detrimental affect on freight transport and cost. Travel times grow as more time is spent in traffic, and the reliability of travel time through the corridor worsens as congestion occurs, sometimes unpredictably. Large trucks have much more difficulty merging on and off I-5 due to their size and weight. Short ramps, sharp ramp curves, and traffic congestion makes merging on and off I-5 more difficult and less safe for trucks.

FUTURE (2035) GROWTH WILL CHOKE THE INTERSTATE



I-5 is Nearing Capacity



Changes in Local Street Intersection PM Peak Level of Service

Intersection	Exisitng Conditions	2035 - No Build
Old Hwy 99 & NB I-5 Off-Ramp	A	D
Old Hwy 99 & SB I-5 On-Ramp	A	A
Anderson Rd & NB I-5 On/Off-Ramps	D	F
Anderson Rd & SB I-5 On/Off-Ramps	C	F
Kincaid St & NB I-5 On/Off-Ramps	C	F
Kincaid St & SB I-5 On/Off-Ramps	C	E
College Way & NB I-5 On/Off-Ramps	B	E
College Way & SB I-5 On/Off-Ramps	C	F
College Way & Freeway Dr	D	F
College Way & Market St	C	F
George Hopper Rd & NB I-5 Off-Ramp	B	C
George Hopper Rd & NB I-5 On-Ramp	B	E
George Hopper Rd & SB I-5 On/Off-Ramps	C	D
George Hopper Rd & Costco Dr	C	F
State Route 20 & NB I-5 On/Off-Ramps	E	B
State Route 20 & SB I-5 On/Off-Ramps	E	D
Chuckanut Dr & NB I-5 On/Off-Ramps	C	B
Chuckanut Dr & Old Hwy 99	D	B
Chuckanut Dr & SB I-5 On/Off-Ramps	E	B
Chuckanut Dr & John Wilson Rd	B	B
Cook Rd & NB I-5 On/Off-Ramps	F	C
Cook Rd & SB I-5 On/Off-Ramps	F	F
Cook Rd & Old Hwy 99	C	F

I-5 CORRIDOR VOLUME COMPARISONS

Interstate 5 traffic volumes from Conway to Cook are highest in the section between the College Way and George Hopper Road interchanges. On average, this section of I-5 carries approximately 71,000 vehicles per day in four lanes. Traffic volumes for other congested state highways are shown below for comparison purposes:

- Alaska Way Viaduct has 110,000 vehicles per day on six lanes.
- I-90 across Lake Washington has 130,000 vehicles per day on six lanes and a reversible two-lane center roadway.
- SR 520 bridge across Lake Washington has 115,000 vehicles per day on four lanes.
- Tacoma Narrows bridge (SR 16) has 90,000 vehicles per day on four lanes.

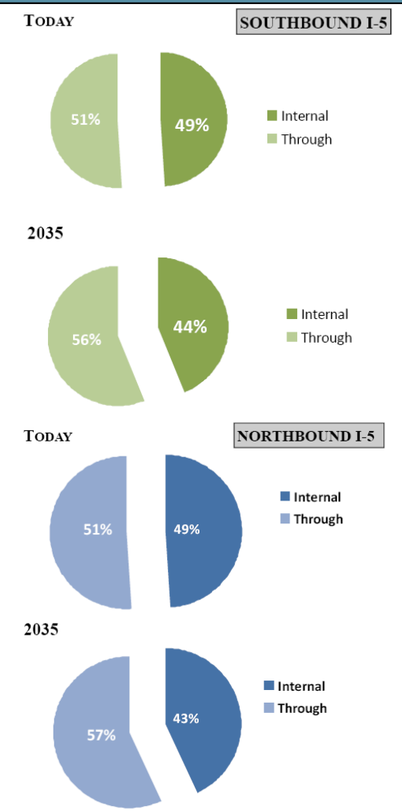
LOCAL INTERNAL VS. REGIONAL THROUGH TRIPS ON I-5

Today, 50 percent or more of trips on I-5 during the PM peak hour are local internal trips traveling less than five miles. Many of these local trips use I-5 to travel short distances from one interchange to the next. Some of the reasons I-5 is used for short local trips include:

- Existing local streets are congested.
- The interstate is faster and more convenient than local streets.
- Lack of local street connections between local destinations.

As congestion grows on I-5, the number of local trips using the interstate is forecasted to decrease as travel on I-5 becomes less convenient and travel times increase significantly. Conversely, the proportion of through trips on I-5 is forecasted to increase significantly as these trips are traveling longer distances and have fewer alternate routes. The charts to the right show the percentage of internal (local) and through (regional) trips today and how they are forecasted to change by 2035.

Congestion affects how the interstate is used. Future growth will choke the interstate and make it less attractive for short distance trips.



Changes in Mainline I-5 PM Peak Congestion (LOS)

	Existing Conditons		2035 - No Build	
Interstate Segment	Northbound	Southbound	Northbound	Southbound
Old Hwy 99 to Anderson Road	C	C	E	C
Anderson Road to Kincaid Street	C	C	F	C
Kincaid Street to College Way	C	C	F	E
College Way to George Hopper Road	D	C	D	D
George Hopper Road to State Route 20	C	A/B	C	C
State Route 20 to Chuckanut Drive	C	A/B	C	C
Chuckanut Drive to Cook Road	A/B	A/B	D	A/B

Level of service (LOS) is an estimate of congestion and performance of the transportation system.

I-5 southbound off-ramp at College Way

LOCAL CONNECTIONS FOR NON-MOTORIZED USERS

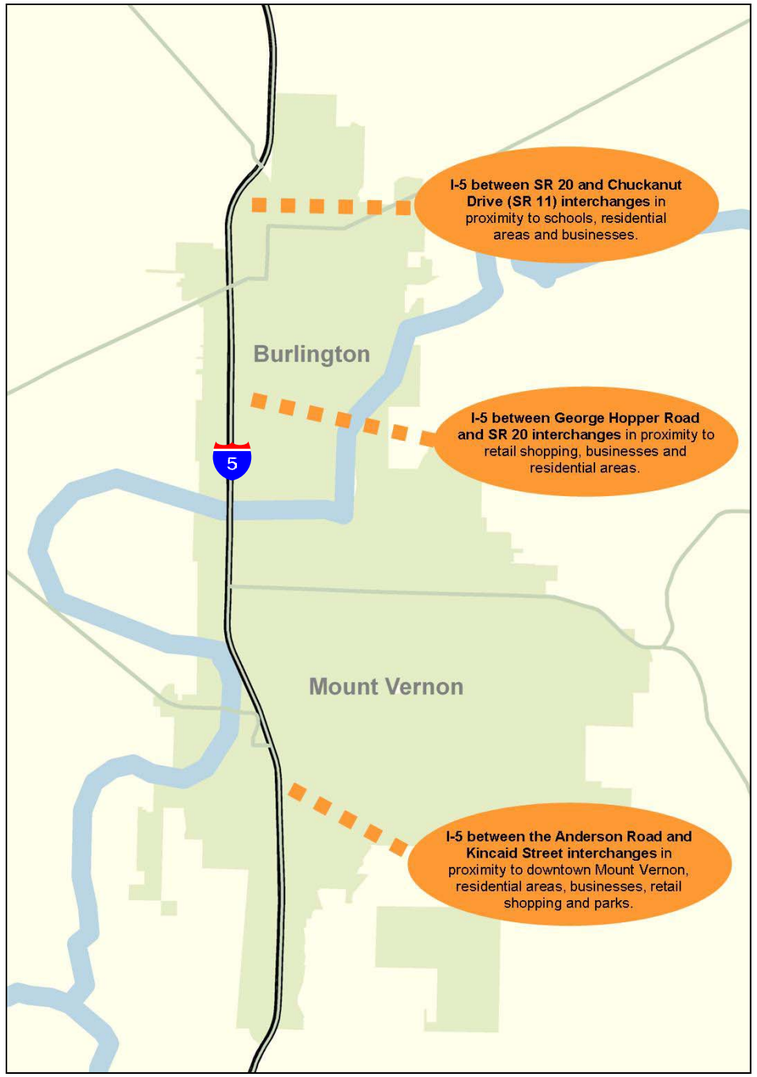
Addressing the problems facing I-5 today and in the future requires a multi-modal approach to reduce the growth in travel demand on I-5, particularly the increasing demand for local trips as the population grows. The I-5 corridor through Mount Vernon and Burlington constrains the ability to make bicycle and pedestrian trips between some areas of the community where locations to cross over or under I-5 are limited.

Of the eight I-5 interchanges from Conway to Cook, three have pedestrian sidewalks for one or both directions of travel (Kincaid Street, College Way and SR 20). There are no designated bicycle lanes (denoted by bicycle pavement markings in a separated shoulder lane) at any of the interchanges. At one interchange (George Hopper Road) bicycle and pedestrian access across I-5 is prohibited due to insufficient shoulders and high traffic volumes. The remaining seven interchanges have shoulders of varying widths that bicyclists use to cross over or under I-5. There are also local arterial streets crossing I-5 at six locations (Blackburn Road, 2nd Street, Cameron Way, Stewart Road, Whitmarsh Road and Norris Street). There are no dedicated non-motorized-only crossings of I-5.

Input received from the public as well and from field observations at each of these locations indicates a need to improve non-motorized facilities, particularly those for bicyclists which often have to share narrow shoulders or travel lanes with cars and trucks during congested travel periods.

In several sections of the I-5 corridor, where there is an opportunity to attract greater non-motorized mode share, the I-5 crossings do not provide a safe or direct route. Those sections of I-5 include the following:

- I-5 between the Anderson Road and Kincaid Street interchanges in proximity to downtown Mount Vernon, residential areas, businesses, retail shopping and parks.
- I-5 between the George Hopper Road and SR 20 interchanges in proximity to retail shopping, residential areas, businesses and recreational opportunities.
- I-5 between SR 20 and Chuckanut Drive (SR 11) interchanges in proximity to schools, residential areas and businesses.



AGING BRIDGE STRUCTURES AND PAVEMENTS

I-5 was constructed through Skagit County in two segments beginning in the mid 1950's and on into the mid 1960's. Several more bridges were built in the 1970's as interchanges were added to I-5 at Conway (SR 534), Old Highway 99 South, Anderson Road and George Hopper Road. The 2nd Street bridge in Mount Vernon was replaced with a new bridge that opened to traffic in 2006. Twelve of the 17 bridge structures in the I-5 corridor from Conway to Cook were built between 1953 and 1964 and are still in use today.

All of the I-5 bridges are structurally sound and safe. Washington State has a meticulous inspection system which rates the primary components of bridges.

The age and design of most of the oldest bridge structures in the corridor makes it economically unfeasible to modify them to accommodate I-5 widening for ramp or lane improvements or to accommodate wider arterial streets crossing I-5.

I-5 bridge over the Skagit River

I-5 pavement in the Conway to Cook corridor is primarily asphalt in both directions of travel except for a short section in the southbound lanes in the vicinity of the Cook Road interchange where the pavement is made of Portland cement. Through the years sections of pavement have been repaired or replaced on the mainline lanes and the interchange ramps. The pavement is generally in good condition but there is some rutting and cracking at a number of locations. Replacement and repair of state highway pavements, including I-5 from Conway to Cook, is prioritized regionally and statewide to ensure pavements remain safe for travel and that their useful life is optimized in order to make the best use of limited funds.

SUMMARY OF INTERSTATE PROBLEMS

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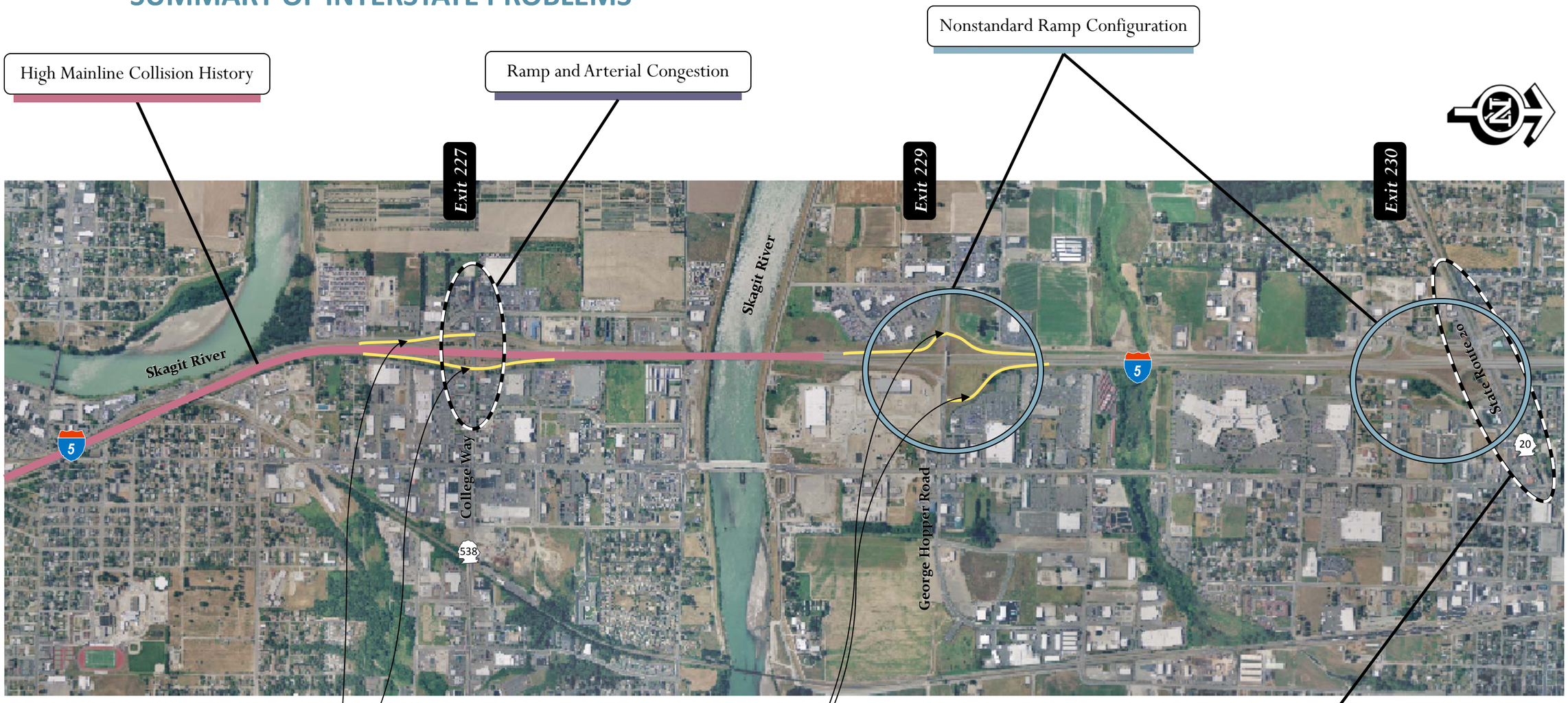

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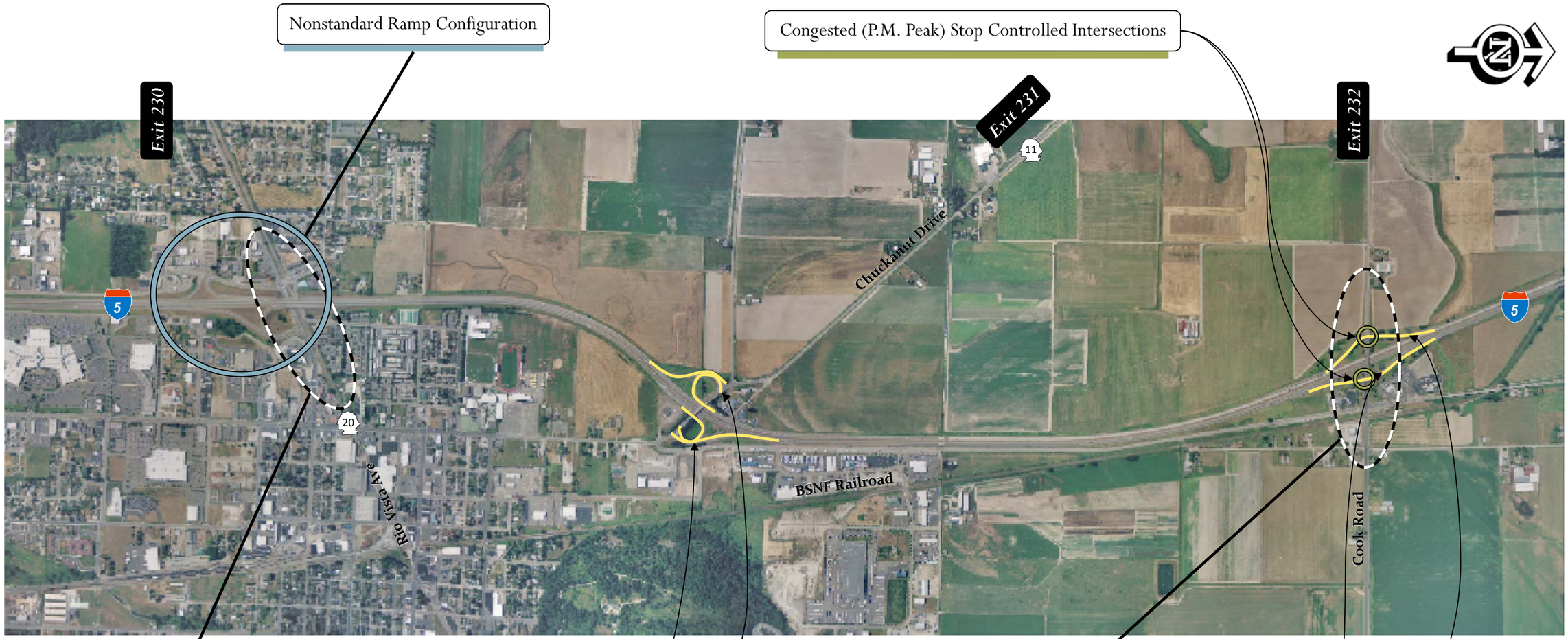


Nonstandard Ramp Configuration

Congested (P.M. Peak) Stop Controlled Intersections

Ramp and Arterial Congestion

Tight Ramp Radii and Short On/Off-ramps

Ramp Queuing and Arterial Congestion

Short On/Off-Ramps

CHAPTER 4 - EVALUATION OF POTENTIAL INTERSTATE IMPROVEMENTS

The master plan provides a set of recommendations that will guide future investment in I-5. To determine which set of improvements should be recommended as the most effective strategy, problems identified in Chapter three were examined to generate a list of improvement strategies that would resolve geometric deficiencies, improve safety, and relieve traffic congestion. Twelve types of interstate improvements (shown on the right) were analyzed and evaluated, each based on their effectiveness, benefits for the transportation system, and ability to meet project goals. The results of the evaluation are described in this chapter and were used to develop the final recommendations shown in Chapter five.

SETTING PARAMETERS FOR OUR EVALUATION

The master plan identifies existing and future problems on I-5 and evaluates numerous improvement strategies to address them. The analysis is based on the best technical information available at this time, as well as feedback received from community members and local agencies. The result is the following set of assumptions that guided the evaluation of improvements.

Traffic volumes on the interstate and local street system will continue to grow. The evaluation of improvements is based upon existing conditions and future conditions that are forecasted to exist in 2035. The forecasts, developed by the Skagit Council of Governments (SCOG) based on land use policies and zoning adopted by local governments, indicate that traffic volumes in the PM peak hour will increase by 50 percent.

Future improvements must meet interstate design standards. These standards, which are applied uniformly to interstate highways to improve safety and operational efficiency, include the accommodation of freight vehicles as well as geometric standards for high speed travel and a minimum spacing of one mile between interchanges.

Only those improvements to I-5 and to local streets that have secured funding as of 2008 are assumed to be in the baseline roadway network when conducting the future conditions analysis. WSDOT will revisit the plan and update the analysis when it is appropriate as new transportation improvements that influence traffic on I-5 are funded and constructed.

WSDOT recognizes that actual conditions may differ from those currently forecasted, even though the forecast is based on the best available information. The transportation needs may change over time depending on population growth, travel patterns, new technologies and local street improvements. Increases in fuel prices, modifications in travel preferences, or amendments to local land use policy are just a few of the changes that could result in significantly different traffic volumes in 2035. Different traffic volumes could suggest a different set of needs for I-5. WSDOT will revisit the plan periodically to respond to these changes and modify the list of improvements accordingly.

LIST OF IMPROVEMENTS CONSIDERED FOR I-5

- Add C/D roadway
- Add weave lanes
- Rebuild existing interchanges
- Improve ramps to fix geometric deficiencies
- Add one general purpose lane in each direction
- Add managed lanes (HOV, Toll, Freight or other uses)
- Improve local street connections
- Provide ramp intersection improvements
- Ramp metering
- Active traffic management
- Increase transit service
- Implement transportation demand management

The criteria used to evaluate potential improvements are listed in the graphic on the right. They were developed based upon FHWA and WSDOT standards and policies for interstate highways and from local agencies' policies and public input. The criteria reflect statewide transportation policies that mandate the preservation of prior investments, improved safety, increased mobility, protecting the environment and good stewardship of our existing transportation system.

The project team identified several criteria that were considered mandatory. Improvements must satisfy mandatory criteria in order to be included in the final set of recommendations. Improving safety was one of those mandatory criteria. Improvements also had to be effective in moving more vehicles through the corridor (improving throughput) and had to provide a safer environment for bicycles and pedestrians that cross I-5 at interchanges. Remaining criteria were used to evaluate the comparative benefits of the potential improvement strategies.

A description of each improvement strategy, and the results of our evaluation, are provided in the following sections of this chapter. The improvements considered for the I-5 corridor included a range of multimodal options, roadway improvements, and operational strategies. This section discusses the improvements that were evaluated.

Evaluation Criteria

SAFETY
- **Address the highest collision locations in the corridor.***
- **Reduce ramp or mainline collisions.***
- **Provide a safer environment for bicycles &pedestrians.***

DESIGN
- Address geometric problems
- No deviations from design standards.

OPERATIONS
- **Improve interstate throughput.***
- Maintain average mainline speed at 70 percent of posted speed.
- Improve ramp terminal operations and level of service.
- Do not degrade local street operations.

MOBILITY
- Provide future transit or HOV opportunities.
- Provide interstate management opportunities (Ramp metering).
- Improve non-motorized access across the interstate.

ACCESSIBILITY
- Maintain the same number of access points to the interstate.
- Maintain the location of the access points.

ENVIRONMENT
- Minimal impact on the natural environment.
- Minimal impact on the built environment.
- Minimal or no right-of-way required.
- Avoid sensitive and critical areas.
- Preserve existing parks and section 4(f) resources.

COST EFFECTIVENESS
- Improvement has a positive benefit/cost ratio (>1.0).

*** Bold indicates mandatory criteria that must be met in order for an improvement to be included as a final recommendation.**

ADD COLLECTOR DISTRIBUTOR LANES

All of the interchanges on I-5 meet the one mile spacing design standard. Although adding collector distributor (C/D) lanes could improve safety and reduce mainline and ramp collisions, other less costly improvements (such as weave lanes) could accomplish the same objectives. Implementation of a C/D roadway will negatively affect the built and natural environment and C/D lanes are less likely to be implementable in more affordable, independent stages. Feedback from community members stressed the importance of minimizing negative impacts and finding cost-effective solutions.

ADD WEAVE LANES

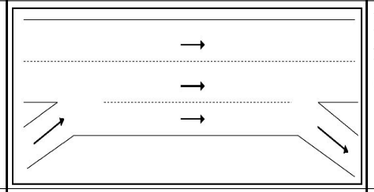
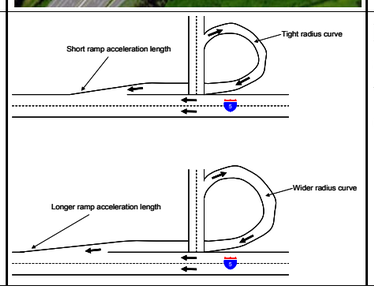
Weave lanes between interchanges would reduce collisions on the interstate by providing an additional lane for merging, weaving, and storage. They would also increase I-5 throughput. It is likely that weave lanes may impact the built and natural environment. Impacts would include noise, sensitive areas (stream crossings), and increased impervious surfaces. Weave lanes are likely to be implementable in more affordable, independent stages providing immediate benefits.

REBUILD EXISTING INTERCHANGES

Geometric deficiencies on I-5 could be addressed by fixing ramp deficiencies (short ramps and tight curves) without rebuilding interchanges. The need for rebuilding interchanges is driven by operational problems tied to safety, efficiency and capacity at the ramp intersections (long queues on off-ramps and local street congestion). These conditions occur at several interchanges: Kincaid Street, College Way, George Hopper Road and Cook Road.

IMPROVE RAMPS TO FIX GEOMETRIC DEFICIENCIES

Interchange ramp geometric deficiencies on I-5 are not substantial except at certain locations such as the northbound on-ramp at Kincaid Street, Chuckanut Drive (all ramps) and Cook Road (all ramps). At the Chuckanut Drive and SR 20 interchanges, improvements to fix some of the existing deficiencies are funded and underway. Rebuilding and reconfiguring existing interchanges to fix simple geometric deficiencies does not make economic sense unless the interchange must be rebuilt to widen the interstate for additional lanes or because reconfiguration is needed to address operational problems and to maintain safety by eliminating backups onto the mainline. Most geometric deficiencies on I-5 (which members of the public identified as problems and encouraged WSDOT to resolve) could be addressed by lengthening ramps and improving ramp curves. Lengthening existing ramps would improve safety and address most of the existing geometric deficiencies in the corridor. These improvements would not appreciably increase mainline throughput and would not address congestion problems on the local streets.

Interstate Improvement	What They Look Like	How They Work	Benefits
Managed Lanes		Provides space for higher capacity transit modes, HOV lanes, transit lane, toll lanes, freight only lanes or passenger rail.	Moves people, vehicles and freight more efficiently. Provides flexibility to adapt to changing transportation modes.
Weave Lanes		Provides a dedicated lane for merging onto the interstate from the on-ramp to the next off-ramp.	Improves safety and relieves congestion at the entry and exits to the interstate. Reduces vehicle conflicts on between high volume on and off ramps.
Ramp Metering		Signalized on-ramps manage the flow rate onto I-5 during congested periods.	Optimizes traffic flow on I-5 and prevents or prolongs breakdown of the mainline. Maintains a higher throughput on the interstate.
Single Point Urban Interchange (SPUI)		Interchange on- and off-ramps form one intersection where vehicles turn left or right onto the local arterial.	Improves safety and reduces vehicle conflicts. Increases the efficiency and capacity of the interchange to handle high volumes of traffic. Reduces dangerous backups onto I-5.
Lengthen On-Ramps & Widen Ramp Curves		Provides more distance for accelerating onto I-5. Allows vehicles to merge onto I-5 at the designed speed.	Improves safety and reduces collisions at the on and off ramps. Lessens the impact of vehicles merging onto or off the interstate.

ADD ONE GENERAL PURPOSE LANE IN EACH DIRECTION

One additional general purpose (GP) lane in each direction would accommodate forecasted 2035 travel demand on I-5, if operational problems at the interchanges are also fixed. Additional GP lanes would increase throughput and improve safety by providing another lane in each direction for weaving and merging at the ramp interchanges. However, even with additional GP lanes, interchange improvements are needed at the Kincaid Street, College Way, and Cook Road interchanges to address congestion and backups on the off-ramps that extend onto the I-5 mainline. Added GP lanes would attract more traffic to I-5 and to the I-5 interchanges. Those increased traffic volumes could increase collisions on the ramps.

ADD A MANAGED LANE IN EACH DIRECTION

A managed lane in each direction of travel could support a high-occupancy vehicle (HOV) lane, a high-occupancy toll (HOT) lane, a freight-only lane or for other high efficiency modes such as passenger rail. In order to provide incentive for use of a managed lane there must be some congestion on the mainline GP lanes. Our analysis indicates that travel demand management measures to increase HOV use by carpools, vanpools and transit would reduce demand on the GP lanes but would not eliminate congestion on the I-5 mainline and ramps. The primary cause of congestion in 2035 is operational problems at the Kincaid and College Way interchanges and not the lack of GP lane capacity on the mainline. The addition of managed lanes would increase mainline throughput and provide the flexible, multi-modal approach valued by community members. Adding managed lanes to I-5 is likely to have impacts on the natural and built environment.

IMPROVE LOCAL STREET CONNECTIONS

The analysis shows that local street improvements can reduce demand and congestion at some of the key interchanges such as College Way, George Hopper Road, and Anderson Road. For example, the analysis indicates that completion of the Laventure Road extension would decrease volume on I-5 north of the Anderson Road interchange. Additional analysis is needed to fully evaluate the benefits attributed to the Laventure Road extension. Other local street improvements had either positive or negative benefits. Some new connections increased volume at existing interchanges, while others reduced the volume. However, the changes on I-5 attributed to these new roadway links were minimal. The greatest benefits of the local street improvements were reductions in volume and demand on Burlington Boulevard and Riverside Drive. The reduction in demand on I-5 from local street improvements was not high enough to eliminate congestion on the mainline or at the interchange ramps but when combined with other I-5 improvements, improved local street connections could enhance or reduce the intensity of other needed I-5 improvements. Further analysis is needed to determine what combination of improvements yields the greatest benefits.

Interstate Improvement	What They Look Like	How They Work	Benefits
Improve Pedestrian and Bicycle Facilities		Improvements to the local streets or interchanges will include sidewalks, crosswalks and push buttons for pedestrians, and bike lanes where needed. New bike and pedestrian over crossings would be built where local plans identify the need.	Improves safety for non-motorized travel and pedestrians. Encourages walking and alternative modes of transportation. Reduces conflicts between bicycles and vehicles.
Add Lanes Crossing I-5		Add vehicular and/or bike lanes to streets that cross I-5.	Improves safety and relieves congestion. Allows vehicles that are not destined to I-5 to cross from one side of I-5 to the other.
Variable Speed Limits		Electronic speed limit signs enable WSDOT to manage the speed of traffic on I-5 during congested periods and when incidents occur that create unsafe conditions such as bad weather and accidents.	Slows traffic when needed to improve safety.
Advanced Traveler Information		Electronic variable message signs provide important information to travelers on I-5.	Improves safety by informing motorists of incidents and unsafe conditions. Enables travelers to use alternate routes to avoid incidents and delays.
Improved Ramp Intersections		Upgrades ramp intersections with improved channelization, signage and traffic control such as signals and roundabouts.	Improves safety and relieves congestion. Reduces dangerous backups onto I-5. Provides improved safety for pedestrians and bicyclists.

The traffic modeling results demonstrated that some local street improvements may provide positive benefits to I-5. They could reduce collisions and improve safety by reducing demand and congestion on the interchange ramps and ramp intersections. They also fulfill community objectives for an improved local transportation network. It is unlikely that local street improvements alone (without other improvements on I-5) would improve vehicular throughput on I-5. However, at worst these improvements would have a neutral (no degradation) impact on vehicle throughput.

Additional analysis is needed to isolate the individual benefits of each street improvement. Preliminary analysis showed that the Laventure Road extension provided the most benefits. Improved local street connections provide significant opportunities to improve the bicycle and pedestrian modal network and to increase transit and HOV opportunities.

Visitors at a public open house learn about the master plan and share their thoughts about recommended improvements.

IMPROVE PEDESTRIAN AND BICYCLE FACILITIES

Many community groups and members of the public contacted WSDOT to share their view that the master plan should address pedestrian and bicycle transportation needs. Many respondents emphasized the need for safe and efficient facilities for non-motorized traffic to cross the interstate. The project team set "providing a safer environment for bicycles and pedestrians" as a mandatory evaluation criteria. Each of the recommended interchange improvements identified in Chapter five will address non-motorized transportation.

PROVIDE RAMP INTERSECTION IMPROVEMENTS

Ramp intersection improvements could include lane channelization, signal timing improvements and access control. These improvements were tested at the Cook Road, George Hopper Road, College Way, Kincaid Street and Anderson Road intersections.

Cook Road: In 2035 severe queuing occurs at the northbound and southbound off-ramps due to high off-ramp volumes forecasted in 2035, closely spaced diamond ramp intersections, and the close proximity of the interchange to the Old Highway 99 intersection. Even today, the northbound off-ramp experiences significant queuing during PM peak periods that intermittently extends out to the ramp diverge area with the I-5 mainline. The installation of traffic signals at the off-ramp intersections would provide a significant reduction in congestion and queuing on the off-ramps. Signal timing and coordination with the Old Highway 99 intersection is critical to the installation of the off-ramp signals. However, to fully address the queuing and backups on the off-ramps, an additional eastbound lane is needed between the northbound off-ramp and Old Highway 99. Eastbound and westbound left turn lanes are needed on Cook Road to separate traffic turning left onto the on-ramps from through traffic. With these additional improvements the queuing and congestion on the off-ramps are sufficiently addressed. By eliminating the queuing and backups on the off-ramps to Cook Road, safety on the ramps and mainline is significantly enhanced and the potential for collisions is reduced. Because backups from the off-ramps create a bottleneck on the mainline, elimination of these backups will increase mainline throughput.

George Hopper Road: By 2035 significant congestion occurs on George Hopper Road between Costco Drive and Burlington Boulevard intersections. The congestion can cause backups on the northbound and southbound off-ramps during the PM peak hour. The backups dissipate fairly quickly but are still a concern. Although midday peak and holiday peak traffic was not analyzed, our observation, as well as information received from local officials, indicates that the level of congestion can be significantly worse on the George Hopper Road off-ramps during these shopping peaks. Based upon CORSIM traffic modeling of the 2035 peak hour volume, a partial diamond (northbound ramps) and partial cloverleaf (southbound ramps) interchange (with no offset intersections), along with an additional lane in each direction on George Hopper Road bridge crossing over I-5, and a lengthened left turn lane across the bridge for left turns to the northbound on-ramp, will adequately handle the forecasted 2035 traffic volume.

College Way: Several funded improvements provide benefits to College Way. These improvements include:

Off-ramp improvements. Channelization improvements that add capacity to the northbound and southbound off-ramps, along with signal timing changes, funded by retail development mitigation.

Intersection improvements. Added left and right turn lanes at the Riverside Drive/College Way intersection funded by the City of Mount Vernon.

Exit 231 (SR 11/Chuckanut Drive) before (*top)* and after (*bottom)* ramp and intersection improvements. This funded project will be constructed in 2010.

Although these improvements enhance traffic flow on College Way, they do not eliminate the congestion and backups on the College Way off-ramps. The closely spaced diamond interchange ramps do not have sufficient capacity to handle the high volumes of traffic forecasted to use the I-5 on- and off-ramps in 2035. A significant problem is the lack of storage for the high volume of left turn movements from the off-ramps to College Way, and from College Way to the on-ramps. Modeling has shown that a Single Point Urban Interchange (SPUI) or some other type of higher capacity interchange configuration is needed to adequately handle the forecasted 2035 volumes. Without interchange improvements the northbound off-ramp queue spills back onto the I-5 mainline causing breakdown of mainline capacity and the potential for dangerous rear-end collisions.

Kincaid Street: Improvements are needed at the Kincaid Street interchange to address ramp queuing and congestion at the ramp terminals. Modeling has shown that the existing diamond interchange configuration will work adequately with improved signal timing coordination at both ramp terminal intersections along with the addition of dual eastbound left turn lanes from Kincaid Street to the I-5 northbound on-ramp. The dual left turn lane is needed to provide additional storage for the high volume left turn movements to the on-ramp. Providing room for the dual left turn lane on Kincaid Street may not fit within the existing interchange bridge structure. A new interchange bridge structure may be needed in which case a highly efficient interchange design like a SPUI would provide greater benefit at a similar cost to a rebuilt diamond interchange.

Kincaid Street at the I-5 northbound ramps

RAMP METERING

Ramp metering the on-ramps can be an effective way to manage I-5 congestion and improve safety during periods of peak travel demand. In the analysis of 2035 traffic conditions, installation of ramp meters on all of the on-ramps from Anderson Road to Cook Road, with a maximum meter rate of 600 vehicles per hour, produced mixed results. At heavily congested interchanges such as Kincaid Street and College Way, the ramp meters caused additional congestion on the local street system which created more congestion on the off-ramps. In order for ramp metering to be effective and work properly, additional storage is needed on the I-5 on-ramps at these congested locations. In addition to ramp storage improvements, ramp metering would also likely require some changes in signal timing and coordination to better manage traffic on local streets.

With almost 50 percent of trips on I-5 originating as local trips in 2035, ramp metering could have significant benefits to I-5 by effectively reducing local trips during peak demand periods, provided that there is sufficient queue storage on the on-ramps. Ramp metering would not only reduce the volume of traffic at the entry points (on-ramps) to I-5, it would also significantly reduce the volume at the exit points (off-ramps). The reduction in volume would reduce collisions on I-5 and improve safety, but could degrade safety on the local street system due to added congestion, unless sufficient ramp storage is provided. Lengthening and widening existing interchange on-ramps to accommodate ramp meters could have environmental impacts. Ramp metering could provide opportunities for transit and HOV bypass lanes on the on-ramps.

ACTIVE TRAFFIC MANAGEMENT

Active Traffic Management represents a wide range of technologies and strategies that may be used to optimize traffic operations during periods of peak travel demand or when incidents and events occur that affect traffic operations and safety. Active traffic management can be a highly cost effective strategy to improve the efficiency and safety of I-5. Active traffic management on I-5 could include lane use control signs, variable message signs, variable speed limits, incident management, adaptive ramp metering, adaptive signal systems, and other emerging ITS (intelligent transportation system) technologies. These technologies would be used to improve I-5 efficiency and provide travelers with real-time information about conditions, congestion, and incidents enabling them to make better decisions about how and when to use I-5 and when to use alternate routes or other modes of travel. The analysis indicates that active traffic management would be most effective when combined with other improvements.

INCREASE TRANSIT SERVICE

Improvements to I-5 that would enable an increase in transit service and an increase in transit ridership were evaluated. The evaluation looked at an additional transit/HOV lane on I-5 in each direction and assumed that additional transit service would exist in 2035 resulting in a significant shift in the number of work trips using transit. Based upon the analysis, a reduction in demand on I-5 could be achieved with a significant increase in transit ridership. However, these reductions assume very high transit use (assumes 5 percent to 10 percent of all work commute trips in Skagit County use transit). Research of similar size communities around the country that have achieved or set high transit ridership goals indicates that a 5 percent to 10 percent ridership share may be difficult to achieve in Skagit County. This analysis also assumes that the transit trips use the managed lanes on I-5 even if it is for a very short distance (two miles). High transit use would not eliminate congestion on the I-5 ramps and mainline. Improved transit usage would increase person throughput on I-5 if transit utilizes the transit/HOV lanes. Adding an additional transit/HOV lane to I-5 would likely have impacts on the natural and built environment.

IMPLEMENT TRANSPORTATION DEMAND MANAGEMENT MEASURES (TDM)

Transportation demand management promotes a variety of strategies for commute options including the use of carpools, vanpools, buses, bicycling, walking, compressed work hours, or working from home. Using strategies that increase the carrying capacity of the transportation system, such as enabling greater use of HOV, shifting trips out of rush hours, and eliminating the need for a trip altogether, helps us get the most out of our transportation investments. In the I-5 corridor from Conway to Cook Road interchanges, the analysis indicates that TDM strategies would reduce demand on I-5 but would not eliminate congestion and queuing on the mainline and ramps. However, even small reductions in demand would result in positive safety benefits to I-5. TDM measures would have a positive impact on the built and natural environment and would provide opportunities to increase transit service.

SUMMARY

The project team utilized technical analysis and feedback from the public to evaluate numerous improvement strategies for I-5. We found that each strategy resolved I-5 problems in a different way, producing benefits, but also generating potential impacts on the built and natural environment. The evaluation criteria allowed us to compare and contrast the improvements, and determine a final set of recommendations to guide future investment on I-5. The recommendations are described in detail in Chapter five.

CHAPTER 5 - RECOMMENDATIONS

The proposed plan maintains, preserves, and extends the life and utility of prior investments made in the I-5 corridor statewide and in Skagit County. Without additional investments, regional and local freight and vehicular mobility through Skagit County will be significantly impaired. These investments are necessary to improve safety, preserve the economic vitality of the region and provide for the safe and predictable movement of goods and people through the I-5 corridor. The benefits of these investments flow to local and regional users of the interstate system. The proposed plan would facilitate freight movement in the corridor and support economic opportunities both north and south of the border that rely on the I-5 corridor for the movement of goods and people. Statewide environmental objectives are furthered by enhancing the quality of life for residents in Skagit County and those traveling through the corridor. Air quality is improved and auto emissions are reduced when vehicles travel at constant speeds through the corridor rather than the stop and go conditions that are projected in 2035. The recommendations for the I-5 corridor include improvements that address deficiencies on I-5 and other improvements that address deficiencies on the connecting roadways.

RECOMMENDED INTERSTATE IMPROVEMENTS

- Implement weave lanes between the Anderson Road and Chuckanut Drive interchanges to ease weaving and merging.
- Rebuild interchanges at Kincaid Street and College Way and lengthen ramps at other interchange locations to meet current interstate safety and operational standards.
- Provide ramp improvements to ease congestion at local roadways.
- Preserve space in the median of I-5 for future transit, carpool, freight, toll lanes or other high efficiency use (one lane in each direction) to provide flexibility for future regional transportation improvements.
- Maintain and preserve the long term health of I-5 infrastructure in the corridor.
- Build a new I-5 bridge across the Skagit River to accommodate the proposed improvements (weave lanes and new managed lanes) and future dike setbacks.
- Implement active traffic management improvements to better manage congestion and roadway incidents.

Estimated cost in year 2008	Estimated cost in year 2025	Estimated cost in year 2035
$1.1—$1.4 Billion	$1.7—$2.1 Billion	$2.3—$2.8 Billion

RECOMMENDATION #1 - MAKE IMPROVEMENTS TO THE INTERSTATE

Improvements are needed on I-5 to address geometric deficiencies, improve safety, relieve congestion, and provide for the efficient management of the interstate for all users and modes of travel. The following improvements are recommended. Also, see pages 5-7 through 5-9 for graphical displays of the recommended improvements.

Weave Lanes

Build a weave lane between every interchange on I-5 (northbound and southbound) from the Anderson Road interchange to the Chuckanut Drive interchange. Weave lanes are needed to improve safety and accommodate high merging and weaving traffic volumes that will occur in 2035 between the interchanges as ramp volumes grow. The weave lanes will eliminate congestion at the ramp merge that causes backups and queuing on the mainline. The recommended weave lanes would start as an add lane from the on-ramp and end as a drop lane at the downstream interchange off-ramp. The weave lanes would not extend through the interchange areas. Weave lanes would fix operational problems at the ramp terminals. Weave lanes also provide better flexibility for implementing the improvements in stages.

Rebuild Interchanges

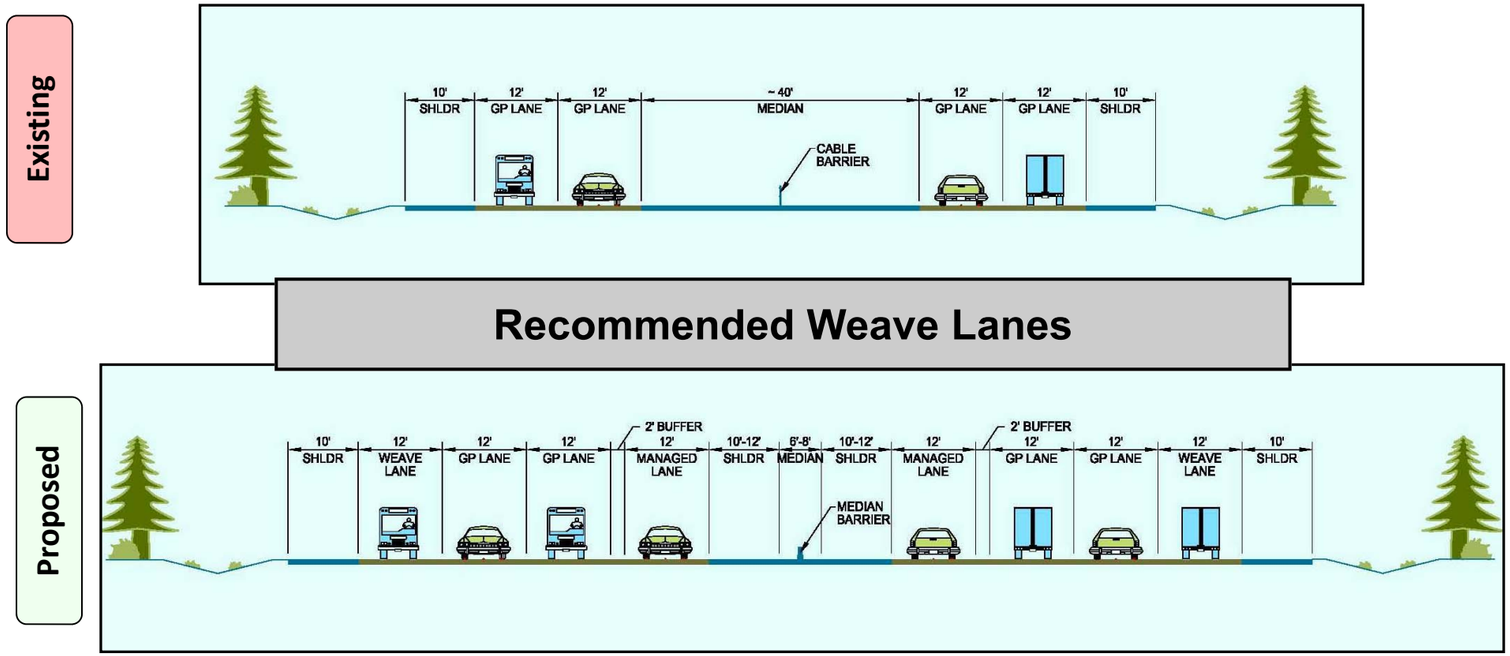
Build new SPUI interchanges at the Kincaid Street and College Way interchanges to handle the forecasted 2035 traffic volumes and to eliminate forecasted backups from the off-ramps onto the I-5 mainline. CORSIM modeling has shown that the new SPUI interchanges together with already funded local street improvements on College Way will address the congestion and backups at the Kincaid Street and College Way off-ramps.

Ramp Improvements

Implement ramp and ramp intersection improvements where existing interchanges are not rebuilt. This would include improvements at the Anderson Road, George Hopper Road, Chuckanut Drive, and Cook Road interchanges. Improvements would include modifying the ramps to address existing acceleration and deceleration deficiencies and improving traffic control, signal timing, and channelization at the ramp terminal intersections with new signals or roundabouts.

Recommended improvements at the Anderson Road interchange call for new traffic signals and/or roundabouts at the ramp terminal intersections to handle forecasted traffic volumes.

Improvements at the George Hopper Road interchange would include revised ramp configuration to eliminate the northbound ramp offset intersections, and reconfiguring the southbound ramps into a partial cloverleaf design to improve the acceleration length onto I-5 for the southbound on-ramp which also



improves traffic operations at the ramp terminal intersection. In addition, replace the existing George Hopper Road bridge over I-5 with a new five lane bridge.

At the Chuckanut Drive interchange improve to the southbound on- and off-ramps to correct ramp geometric deficiencies, replace the existing Chuckanut Drive bridge over I-5 with a new four lane bridge, integrate these recommended improvements with the funded improvements to both ramp intersections and the realign the northbound ramps which are scheduled for construction in 2010.

Improvements at Cook Road would include new signals at the ramp intersections, coordination of the ramp signals with signals at the Old Highway 99 North intersection, and an additional eastbound lane between the northbound off-ramp and Old Highway 99 intersection. In addition, replacing the existing Cook Road bridge over I-5 with a new four lane bridge is recommended. Furthermore, changing the posted speed limit on I-5 from 70 mph to 60 mph from SR 20 to Cook Road by 2035 is recommended as part of the improvements at the Cook Road interchange.

Also recommended is further analysis and consideration to improve the Old Highway 99 South interchange (exit 224) into a fully directional interchange by adding a northbound on-ramp and southbound off-ramp. This interchange is the only partial access interchange in the corridor, consisting of a northbound off-ramp and a southbound on-ramp. Based on current regional traffic modeling, the analysis indicated that there were no operational or safety problems on I-5, either today or by 2035, that would be improved by making Old Highway 99 South a full interchange. However, there are benefits that merit consideration outside the scope of the IMP analysis. Proponents of a full interchange at Old Highway 99 South include the city of Mount Vernon, Skagit County, and the Regional Transportation Planning Organization who view this interchange as a vital link to future development of the Urban Growth Area (UGA), including potential siting of regionally significant facilities such as a funded park-and-ride and a future county jail site. The local agencies are concerned that the lack of a fully directional interchange would hinder development within the City's UGA, increase traffic volume at adjacent interchanges, and increase emergency response time in south Mount Vernon. The IMP recommendation is for further analysis and consideration to improve the Old Highway 99 South interchange into a fully directional interchange.

Managed Lanes

The recommendation includes preserving the right-of-way to create space in the median of I-5 for future managed lanes (one lane in each direction) as well as providing flexibility to accommodate future bus and high capacity transit improvements. Where new permanent structures, overpasses, and interchanges are built; they should be built so as to accommodate and not preclude future managed lanes. Future managed lanes could include HOV/transit, HOT lanes, freight, bus rapid transit, or other high capacity modes such as passenger rail. As local agencies such as Skagit Transit, SCOG, Skagit County, and the cities of Mount Vernon and Burlington refine their plans for future transit improvements, additional details can be added to the IMP to accommodate the need for direct access ramps to support regional facilities such as transit centers and park-and-rides once the locations for these facilities have been identified. The locations for direct access ramps, HOV lane access, and other transit improvements should be done as part of ongoing efforts focused on addressing long term regional transportation needs for Skagit County.

Build a New Bridge Across the Skagit River

The recommendation includes building a new and wider I-5 bridge over the Skagit River in order to accommodate the addition of the recommended weave lanes and to provide space for future managed lanes along with the existing four GP lanes. The new bridge should be built to accommodate proposed dike setbacks for the Skagit River.

Active Traffic Management

Implement active traffic management improvements to increase efficiency and provide better management of I-5 for local trips and regional through trips. Active traffic management would include lane use control signs, variable message signs, variable speed limits, more incident management resources, adaptive ramp metering, adaptive signal systems, and other emerging Intelligent Transportation Systems (ITS) technologies.

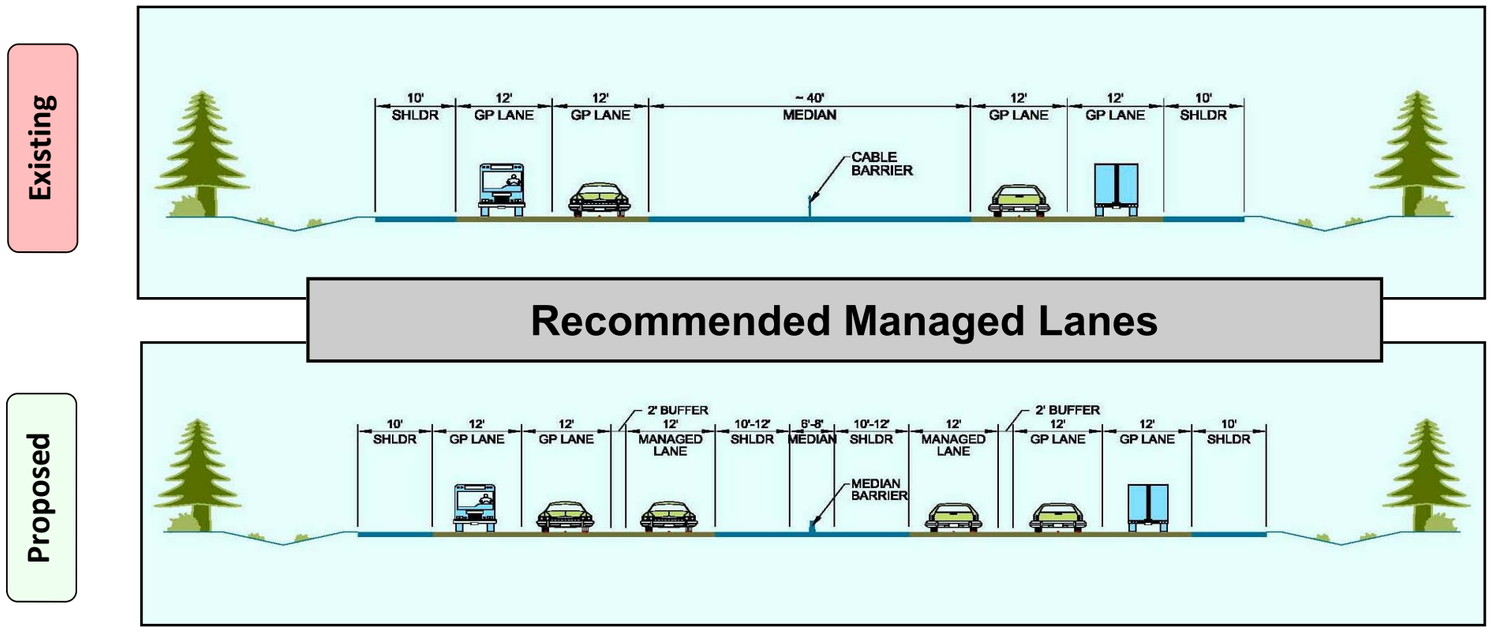
SAFETY BENEFITS OF INTERSTATE IMPROVEMENTS

A primary benefit of the recommended interstate improvements is enhanced highway safety for all roadway users. Interstate highways are high speed, access controlled facilities, with stringent design standards. When collisions occur on these high speed facilities, the result may be injuries, property damage and economic loss, and in the worst cases, disabling injuries and fatalities.

Contributing factors for collisions on I-5 in the Conway to Cook corridor include:

- Short acceleration and deceleration lanes on ramps.
- Heavy on- and off-ramp traffic volumes.
- Long backups on the off-ramps impacting mainline traffic.

The recommended improvements address all the roadway factors that contribute to collisions on I-5 in the Conway to Cook corridor. The recommended improvements will reduce the frequency and severity of collisions by using weave lanes that separate and reduce the merging and



Recommended Improvements	Safety Benefits
Managed Lanes	Moves more people and freight safely and efficiently in separate or dedicated lanes.
Weave Lanes	Improves safety in high congestion areas. Weave lanes provide more room for merging on and off the I-5 mainline and reduces vehicle conflicts where ramp volumes are highest.
Single Point Urban Interchange (SPUI)	Improves safety by reducing the number of conflict points at ramp terminal intersections, and moves more traffic through the interchange which reduces backups to the ramps, on the mainline, and on local arterial streets.
Lengthened Ramps / Widened Ramp Curves	Improves safety by providing longer ramps and more gradual curves for acceleration on, and deceleration off, the I-5 mainline.
Ramp Terminal Intersection Improvements	Improves ramp and arterial street intersection safety with improved geometry, sight distance and traffic control, and reduces dangerous backups at off-ramps.
Improve Bicycle and Pedestrian Facilities at Interchanges	Provides dedicated bicycle and pedestrian facilities at interchanges to improve safety for bicycles and pedestrians.
Additional Lanes Crossing I-5 at Bridges and Undercrossings	Improves safety by reducing local arterial street congestion which causes traffic to backup on the I-5 off-ramps and on local streets.
Active Traffic Management	Using integrated systems and a coordinated response, both recurrent and non-recurrent congestion can be managed to improve I-5 safety and traffic flow.

weaving movements on the mainline. Without improvements, heavy on- and off-ramp volumes in combination with limited capacity at the ramp terminals will cause long backups on key off-ramps. Off-ramp queues that spill back onto I-5 create unsafe conditions for mainline travelers. A critical goal of the IMP is to reduce or eliminate off-ramp queues that spill back onto the I-5 mainline.

Single-Point Urban Interchanges (SPUI) and ramp intersection improvements will reduce conflicts, increase capacity and reduce queuing on the off-ramps and arterial streets. Active traffic management will allow for reduced speeds on I-5 when traffic and weather conditions, or other incidents require slower speeds to improve safety and manage throughput.

TRAFFIC OPERATIONS AND LEVEL OF SERVICE (LOS) BENEFITS

After incorporating the recommended improvements, I-5 operates at LOS D or better with the forecasted (2035) volumes except at the following diverge areas:

- Northbound off-ramp diverge at the Anderson interchange (LOS E)
- Northbound on-ramp diverge at the Cook Road interchange (LOS E)

With the weave lanes and interchange capacity improvements, mainline I-5 traffic flows at or greater than 45 mph throughout the corridor. With the weave lanes improving, weaving and merging movements on the mainline, vehicle safety and throughput are significantly improved.

Interchange and ramp terminal improvements eliminate backups from the local street system onto the mainline which greatly improves safety and operations.

Several key improvements are critical to maintain LOS D operations on the mainline. These improvements include:

- Weave lanes at high volume ramps.
- SPUI interchange at College Way.
- SPUI interchange at Kincaid Street.

The 2035 PM peak LOS on the local street system does not change significantly with the recommended improvements except at the ramp interchanges where ramp and intersection improvements are proposed. A comparison of these changes is summarized in the table to the far right.

I-5 Mainline 2035 PM Peak Level of Service

2035	No Build		Build	
Interstate Segment	Northbound	Southbound	Northbound	Southbound
Old Hwy 99 to Anderson Road	E	C	D	D
Anderson Road to Kincaid Street	F	C	D	C
Kincaid Street to College Way	F	E	C	C
College Way to George Hopper Road	D	D	C	C
George Hopper Road to State Route 20	C	C	C	C
State Route 20 to Chuckanut Drive	C	C	A/B	A/B
Chuckanut Drive to Cook Road	D	A/B	D	C

With the proposed improvements, mainline I-5 will operate at acceptable levels of service (LOS D or better) while maintaining an average speed of 45 mph or more. Some congestion (LOS C or D) is likely to occur at ramp terminal locations at the Old Hwy 99 South, Anderson Road, College Way, Chuckanut Drive, and Cook Road interchanges (see table below). However, these levels of congestion at the ramp terminals do not impact mainline traffic flow. There are several improvements that are critical to the operations of the I-5 mainline. These include:

- Configuration of the SPUI interchanges at Kincaid Street and College Way.
- Addition of weaving lanes between interchanges from Anderson Road to Chuckanut Drive both in the northbound and southbound directions.
- New traffic signals at the Anderson Road and southbound Cook Road ramp terminals.
- Roundabouts at the Chuckanut Drive northbound and southbound ramp terminals.

Ramp Intersection 2035 PM Peak Level of Service

Intersection	No Build	Build
Old Hwy 99 & NB I-5 Off-Ramp	D	D
Old Hwy 99 & SB I-5 On-Ramp	A	A
Anderson Rd & NB I-5 On/Off-Ramps	F	B
Anderson Rd & SB I-5 On/Off-Ramps	F	D
Kincaid St & NB I-5 On/Off-Ramps	F	B
Kincaid St & SB I-5 On/Off-Ramps	E	B
College Way & NB I-5 On/Off-Ramps	E	C
College Way & SB I-5 On/Off-Ramps	F	C
College Way & Freeway Dr	F	D
College Way & Market St	F	D
George Hopper Rd & NB I-5 Off-Ramp	C	B
George Hopper Rd & NB I-5 On-Ramp	E	B
George Hopper Rd & SB I-5 On/Off-Ramps	D	B
George Hopper Rd & Costco Dr	F	F
State Route 20 & NB I-5 On/Off-Ramps	B	B
State Route 20 & SB I-5 On/Off-Ramps	D	D
Chuckanut Dr & NB I-5 On/Off-Ramps	B	B
Chuckanut Dr & SB I-5 On/Off-Ramps	B	C
Cook Rd & NB I-5 On/Off-Ramps	C	A
Cook Rd & SB I-5 On/Off-Ramps	F	D
Cook Rd & Old Hwy 99	F	F

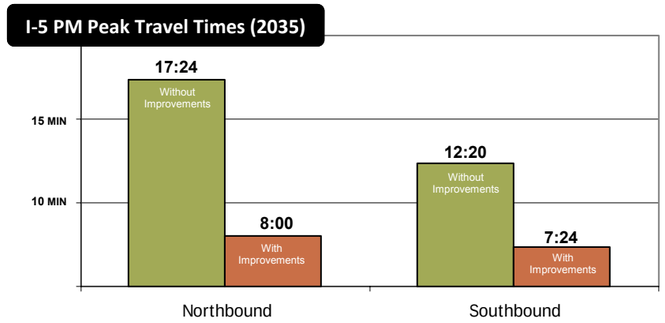
FREIGHT BENEFITS

Interstate-5 is a highly strategic and important element of the freight transportation system, serving a major role in supporting local, state, national, and international commerce. Congestion and safety problems on I-5 have a significant affect on the movement of freight by increasing the duration and unpredictability of travel times. This can lead to higher freight transportation and distribution costs. Over time, higher freight costs drive up the cost of goods purchased and sold, which affects local, regional, and state economies. Addressing existing and future congestion and safety problems will provide significant benefits to the freight industry, to its customers, and to the economic vitality of the community and state. The recommended interstate improvements will generate benefits for all vehicles traveling on I-5, including freight traffic that relies on the corridor for travel and commerce. Freight haulers operating on I-5 will experience five key benefits:

- Improved safety.
- Improved access to destinations off I-5 provided by improved interchanges and the reconfiguration of ramps and intersection improvements.
- Decreased travel time.
- Reliable trip durations.
- Improved traveler information.

TRAVEL TIME BENEFITS

The PM peak travel times on I-5 from the Conway to Cook interchanges were measured for 2035 traffic conditions with and without the recommended improvements. The results are shown in the chart to the right. The times shown represent the average travel time on mainline I-5. The improved mainline travel time with the recommended improvements is a result of improved interchange capacity and the separation of merging and weaving movements onto the weave lanes.



THROUGHPUT BENEFITS

Throughput represents the total number of vehicles traveling across a given section of I-5 in the peak hour. The table below summarizes total vehicle throughput at various locations on I-5, comparing the throughput with (proposed) and without (no build) the recommended improvements. With the recommended improvements, significantly more vehicles are moved through the I-5 corridor versus the throughput without I-5 improvements. The average throughput increase is 24 percent northbound and 27 percent southbound. Of specific interest, the section between Kincaid Street and Chuckanut Drive where a majority of the improvements were recommended, the throughput increased by an average of 35 percent in the northbound direction and 30 percent in the southbound direction. The maximum increase in throughput (43 percent) was observed between Kincaid Street and College Way in the northbound direction, while a maximum increase in southbound throughput (35 percent) was observed between College Way and George Hopper Road.

2035 PM Peak Throughput

Location	2035 Throughput (vph)					
	Southbound		Northbound		% Change	
	No build	Proposed	No build	Proposed	SB	NB
Before Exit 224 (Old Hwy 99)	2900	3730	3556	3982	29%	12%
Exit 224 (Old Hwy 99) - Exit 225 (Anderson Rd)	2763	3574	3272	3745	29%	14%
Exit 225 (Anderson Rd) - Exit 226 (Kincaid St)	2990	3913	3532	4423	31%	25%
Exit 226 (Kincaid St) - Exit 227 (College Way)	2957	3938	3114	4441	33%	43%
Exit 227 (College Way) - Exit 229 (George Hopper Rd)	3101	4195	3202	4319	35%	35%
Exit 229 (George Hopper Rd) - Exit 230 (SR 20)	2734	3655	2792	3859	34%	38%
Exit 230 (SR 20) - Exit 231 (Chuckanut Dr)	2768	3281	2572	3479	19%	35%
Exit 231 (Chuckanut Dr) - Exit 232 (Cook Rd)	2344	2778	3199	3376	19%	6%
After Exit 232 (Cook Rd)	2373	2758	2956	3133	16%	6%
				AVERAGE	27 %	24 %

RECOMMENDATION #2 - MAKE LOCAL STREET IMPROVEMENTS

Implement local street improvements that directly benefit I-5 by reducing demand on the mainline, ramps or connecting arterials. The IMP acknowledges the need for local street improvements and the benefits that flow to I-5 and the surrounding street system. Local street improvements alone will not address the safety, geometric, and congestion problems on I-5 but they could enhance the effectiveness or reduce the intensity of other recommended improvements.

Completion of the SPUI interchanges at Kincaid Street and College Way provide opportunities to improve local street connections. Adding lanes on the bridges crossing over I-5 at George Hopper Road, Chuckanut Drive, and Cook Road provide additional opportunities for local street improvements and connections. This would help relieve congestion that impacts not only I-5 but the local streets as well. Traffic modeling has shown that completion of the Laventure Road extension would improve local street connectivity and could relieve some congestion on I-5 depending upon its configuration and northern terminus.

The analysis assumes that the funded local street connections (see table below) will be completed by 2035. Additional local street improvements will be needed beyond currently funded projects. Evaluated on an individual basis, most local street improvements provide little benefit to I-5, but collectively they can provide a network that will attract significant volumes of local traffic off of I-5 as well as enhance transit and non-motorized connections. Listed in the table to the right are the local street improvements analyzed at the request of local agencies to determine if the local street improvements benefit I-5 by improving safety and relieving congestion. Many of these improvements did not show measurable benefits to I-5, but some did. The plan recommends continued evaluation of local street improvements to reduce the need to use I-5 to travel short distances as well as to provide more modal options for local trips.

Funded Local Street Improvements

Road	Location	Change
Burlington Boulevard	Avon to SR 11	Widen to four lanes and install roundabout at SR 11
Roosevelt Avenue	Riverside Drive to Cameron Way	Connect Roosevelt Avenue from 26th to College
SR 11/I-5 Interchange	Josh Wilson Road and Interchange Ramp	Partial interchange rebuild
SR 20	SR 536 to I-5	Construct four lane highway and interchange improvements
College Way	Intersection of College Way and Riverside Drive	Intersection improvements
College Way/I-5 Interchange	NB/SB off-ramps	Ramp improvements

LOCAL STREET IMPROVEMENTS ANALYZED

- East Gilkey Road Connector: Extend East Gilkey Road east to connect South Burlington Boulevard and South Anacortes Avenue. This new roadway would be grade separated over the rail road.
- Whitmarsh Connector: Extend Whitmarsh Road south to connect to Continental Place across the Skagit River.
- George Hopper Road Interchange Local Traffic Circulation Improvements: Move the southbound on-ramp west to align with the southbound off ramp to form a diamond-shaped interchange; Extend McCorquedale Road east over I-5. Provide frontage road along east side of I-5 from SR 20 to McCorquedale Road. Provide east-west Mall Access Road north of Costco to connect South Burlington Boulevard and the frontage road. Change the intersection located at Costco Drive & South Burlington Boulevard from signalized to two-way-stopped control. Provide signalized control at the new intersection located at Mall Access Road & S Burlington Boulevard.
- Bouslog Road and Freeway Drive Connector: Extend Bouslog Road from Whitmarsh Road across the Skagit River, connecting with Freeway Drive south of the Skagit River.
- Kincaid Street to West Division Street Connector: Extend Kincaid Street from Main Street east of Skagit River to west of Skagit River, connecting with South Wall Street.
- Anderson Road to Laventure Road Extension: Extend Laventure Road south to East Blackburn Road. Extend Anderson Road northeast to meet South Laventure Road at East Blackburn Road.

RECOMMENDATION #3 - MAKE NON-MOTORIZED IMPROVEMENTS

A multimodal strategy that significantly reduces single-occupant vehicle trips in the I-5 corridor during peak travel demand periods, may delay or reduce the need for some of the improvements identified in this plan. Improving bicycle and pedestrian connections across and along the I-5 corridor is part of a multimodal strategy to encourage greater non-motorized mode share, while simultaneously reducing demand for vehicle trips on the interstate and local streets.

State and Federal policies require that new or improved non-motorized facilities be considered in all new highway construction and reconstruction, including I-5 interchanges and crossings. Factors to be considered in establishing non-motorized facilities are:

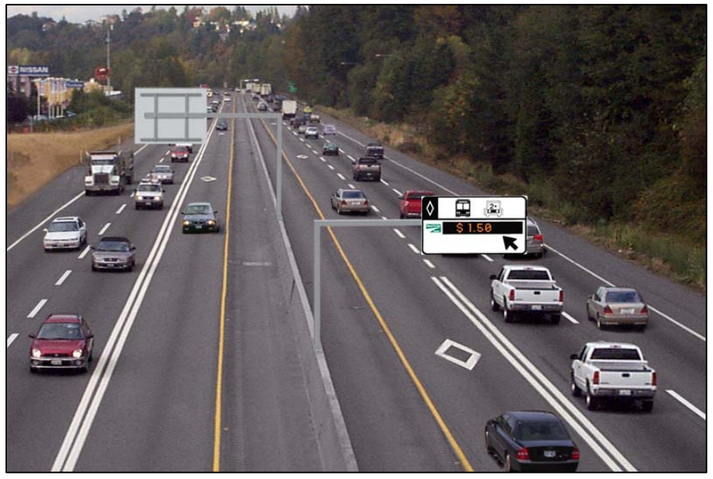
- Public Safety.
- The cost of the non-motorized improvement compared to the need or probable use.
- Inclusion of the non-motorized facility in a plan for a comprehensive non-motorized system adopted by a city or county in a state or federal plan.

When constructing non-motorized facilities, they must be designed to be accessible to and usable by people with disabilities. The following improvements to non-motorized facilities are recommended in the I-5 Conway to Cook corridor:

- Maintain existing non-motorized crossings when I-5 improvements are made.
- Include non-motorized facilities when new interchanges and over or under crossings are designed and constructed.
- Partner with local agencies to create, improve or expand non-motorized connections across I-5, including pedestrian/bicycle only crossings that link local designated non-motorized transportation routes with employment, housing, educational, commercial and recreational centers. A specific example of this is the potential for a new bicycle/pedestrian crossing under I-5 at Gages Slough.

RECOMMENDATION #4 - PLAN FOR FUTURE TRANSPORTATION OPTIONS

The recommended improvements should provide flexibility for future regional transportation improvements by preserving space in the median of I-5 for future transit, carpool, freight, or toll lanes (one lane in each direction) or other high occupancy modes such as passenger rail. Throughout this report we have referred to this space in the median as *managed lanes*. Where new permanent structures such as bridges, overpasses and interchanges are built, they should be constructed so as to accommodate, and not preclude, future construction of managed lanes for transportation modal improvements that will be needed beyond the IMP forecast year of 2035.



RECOMMENDATION #5 - ADOPT THE IMP INTO STATE, REGIONAL, TRIBAL, AND LOCAL PLANS

The IMP was developed by WSDOT in partnership with local governments and the Skagit Council of Governments. The recommended improvements establish a vision for I-5 that feeds into state, regional, tribal, and local transportation planning processes. In order to begin implementation of the recommended improvements, the following actions need to occur:

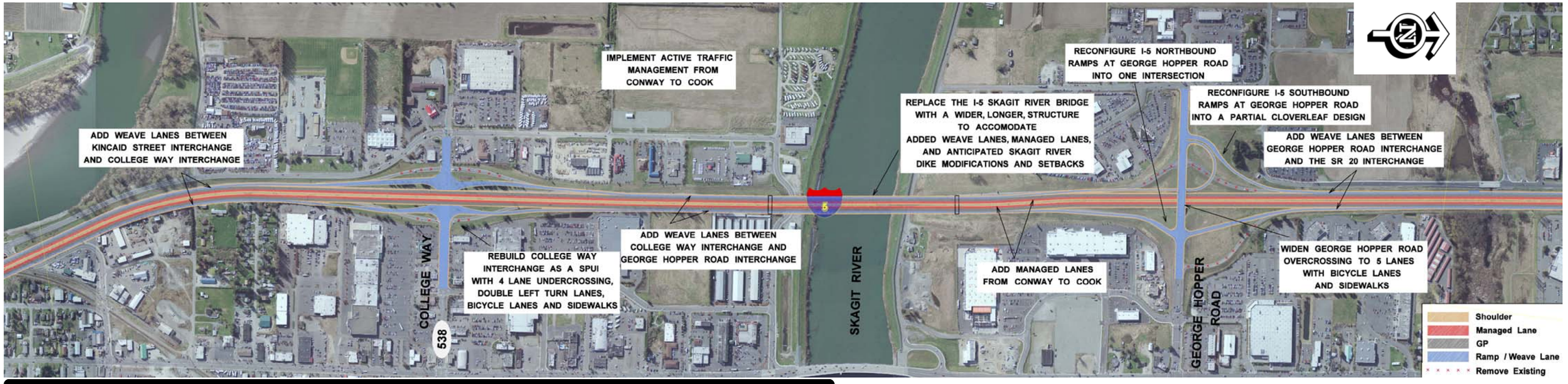
- Inclusion of the IMP into the State Highway System Plan, consistent with the Washington State Transportation Plan.
- Adoption of the IMP into the Skagit Metropolitan and Regional Transportation Plans.
- Local, regional, and tribal governments should consider the IMP recommended improvements in the development of their transportation plans and policies.

WSDOT will maintain the IMP and keep it current by revisiting the assumptions and recommendations in the IMP as local, regional, and tribal plans are updated.

Recommended Improvements at Conway Interchange

Recommended Improvements at Old Highway 99 South Road Interchange

Recommended Improvements from Anderson Road Interchange to Kincaid Street Interchange



Recommended Improvements from College Way Interchange to George Hopper Road Interchange

Recommended Improvements from State Route 20 Interchange to Chuckanut Drive Interchange

Recommended Improvements at the Cook Road Interchange

CHAPTER 6 - IMPLEMENTATION

The completed IMP sets a direction for future improvement of I-5 through Skagit County and serves as the first step in obtaining funding for improvements. The plan identifies over one billion dollars of needed improvements that cannot be met within the limits of existing funding. The next step is to develop an implementation strategy that will facilitate project prioritization and delivery.

The Interstate Master Plan identifies over a billion dollars of needed improvements that cannot be met within the limits of existing funding sources.

Transportation partners - including WSDOT, stakeholder groups, and local agencies - must work together to be successful in implementing improvements for I-5. To be successful, regional partners should focus on a targeted set of improvements that provide strategic, cost effective benefits.

WSDOT will utilize the technical analysis and public comments generated in the development of the Interstate Master Plan to:

- Define short-, mid- and long-term improvements.
- Estimate cost/benefit ratio for identified improvements.
- Identify funding opportunities.
- Determine partnerships and actions needed to implement the Interstate Master Plan.

As funding becomes available, WSDOT will work with our partners to move forward with design and construction of high-priority improvements.

DISCRETE PROJECTS - BUILDING BLOCKS TO IMPROVE I-5

Many of the improvements identified in the IMP are costly and some will require many years and hundreds of millions of dollars to construct. So where do we begin? While the plan identifies several large and costly projects, the technical analysis revealed how implementation of discrete projects, scaled to more realistic funding levels, could be completed and still provide significant benefits to I-5 stakeholders. When designed and sequenced properly, smaller scale projects can serve as short-, mid- and long-term building blocks that will eventually integrate together into a much more significant set of improvements. The scale and timing of discrete projects is ultimately determined by available funding, which is currently unknown. The following list of discrete projects (in no particular order of implementation) emerged from the IMP analysis. The list will be further refined with additional evaluation of the timing, scale and operational performance of individual elements:

- Construct a new SPUI interchange at College Way.
- Construct a new SPUI interchange at Kincaid Street.
- Construct interchange improvements at George Hopper Road, including partial cloverleaf at southbound on– and off-ramps and replace existing bridge over I-5 with a new five lane bridge.
- Construct interchange improvements at Chuckanut Drive, including modifications to southbound on and off ramps and replace bridge with four lanes across I-5.
- Construct ramp terminal improvements at Cook Road: coordination of the ramp signals with the Old Highway 99 North intersection and add an additional eastbound lane between the northbound off-ramp and the Old Highway 99 North intersection.
- Construct interchange improvements at Cook Road: replace existing bridge with a new four lane bridge across I-5.
- Change the speed limit on I-5 from 70 mph to 60 mph from SR 20 to Cook Road.
- Build a new bridge (or bridges) across the Skagit River to accommodate weave lanes and future managed lanes.
- Construct weave lanes.
- Replace the Blackburn Road overcrossing to accommodate widening of I-5 for weave lanes and managed lanes.
- Implement elements of active traffic management.

IDENTIFYING AND ASSESSING RISK

"Risks" are red flags indicating problems that may develop that could negatively affect completion of projects on-time and on-budget. Identifying these risks is a critical component of early project planning and scoping, contributing to more reliable preliminary designs and cost estimates. Assessing risk provides decision makers with a realistic view of the costs of construction and challenges likely to affect projects.

The IMP includes a preliminary risk analysis that addresses corridor-wide issues that may affect project implementation. This analysis is just the first step; WSDOT will revisit these issues in more detail during scoping and design of individual improvement projects.

RISK EVALUATION SUMMARY

Flood Plains

- Approximately 80 percent of the project area is within the mapped Skagit River floodplain.

River and Stream Crossings, and Aquatic Resources

- Sensitive fish and other aquatic habitat are likely to be affected.
- Fall, Spring and Summer Chinook; Bull trout; and Summer and Winter Steelhead are likely to be affected.

Wetlands

- Approximately 3.2 acres of wetlands will be affected.

Wildlife Habitat

- Bald eagle nest is located within the I-5 corridor.

Geotechnical/Physical Resources

- The geology is receptive for seismic induced liquefaction and soil settlement.

Land Use / Socio-Economics

- 8.0 acres of residential, 12.25 acres of commercial, and 2.0 acres of agricultural lands are affected (approx. 110 parcels).
- It does not appear that low income or minority populations would be affected disproportionately.

Historic and Cultural Resources/Parks and Public Lands

- It does not appear that there are affects to historical and cultural resources.
- Some parks and public land may be affected.

RISK EVALUATION

The purpose of this preliminary environmental analysis is to identify whether major hurdles or fatal flaws exist for constructing the recommended improvements from an environmental or permitting aspect, based on a review of existing sources of data and current regulatory requirements. This review evaluates the environmental risks associated with each improvement and the potential for impacts to floodplains, rivers, streams, wetlands, wildlife habitat, endangered species, and major geological features. The environmental review also evaluates the potential for impacts on existing land use, socio-economic elements, and known historic or cultural resources. As recommended IMP improvement projects are funded in the future, detailed environmental analysis will be required. Measures to avoid, minimize and mitigate for potential impacts will be an element in future project scoping, design and construction. Following are the findings that relate to the degree of impact to the environment if the proposed improvements in the Conway to Cook corridor are constructed.

FLOOD PLAINS

Approximately 265 acres of the proposed 332-acre project footprint lie within the currently mapped Skagit River floodplain. From Anderson Road (Exit 225) to just north of the Kincaid Street exit (Exit 226), the entire area west of I-5 is within the mapped 100-year floodplain, and the entire area east of I-5 is outside the 100-year floodplain. North of Kincaid Street, and south of Anderson Road the entire I-5 corridor is within the 100-year floodplain with the exception of an area west of the George Hopper Road interchange (Exit 229). New lanes and ramps will be built on fill that will displace flood storage volume. Consequently, compensatory flood storage is required to mitigate for the impacts of placing fill in the 100-year floodplain. Overall, it is expected that constructing the proposed improvements will have impacts on the existing floodplains. Proper permitting certifications must be obtained for encroachments on the floodplains. The I-5 corridor is within the Mount Baker Inundation Zone I which is the pathway for eruption-related lahars due to large flank collapses or pyroclastic flows, or floods in the Skagit River valley caused by displacement of water in reservoirs by lahars.

RIVERS AND STREAM CROSSINGS, AND AQUATIC RESOURCES

The I-5 Conway to Cook corridor crosses Joe Leary Slough, Gages Slough, the Skagit River, Kulshan Creek, Maddox Creek, and an unnamed tributary to the South Fork of the Skagit River. The major recommended improvement in the IMP calls for the construction of a new bridge over the Skagit River. Other recommended improvements include bridge widening over Gages Slough and Joe Leary Slough, and relocating Maddox Creek into a new channel east of the present channel. Fish species, listed under the federal Endangered Species Act, are present in the Skagit River and in the streams that cross I-5. Development in or near the Skagit River or any of the streams or sloughs that support these species will require consultation with the National Marine Fisheries Service and/or the U.S. Fish & Wildlife Service.

WETLANDS

There are number of wetland sites adjacent to I-5 in the Conway to Cook corridor. Based on analyzing the existing wetland conditions, the recommended improvements are likely to impact approximately 3.2 acres of wetlands located within Skagit County, the city of Burlington, and the city of Mount Vernon. Wetland impacts should be avoided or minimized at every opportunity and any unavoidable impacts must be compensated. Standard buffer widths, development standards and mitigation requirements for unavoidable wetland impacts as provided in federal, state and critical area ordinances must be accomplished.

Wildlife Habitat

Wildlife habitat identified in proximity to recommended I-5 improvements include:

- A trumpeter and tundra swan wintering and resting area.
- An osprey nest.
- Merlin nests.
- Bald eagle nest.

Over time, the presence and location of wildlife habitat will change. As recommended IMP improvement projects are funded in the future for scoping and design, detailed environmental analysis will be required, including consultation with the Washington Department of Fish and Wildlife.

Geological Conditions

No geo-hazards are identified on maps of potential landslide and erosion areas in Skagit county. However, the narrow zone of older undifferentiated material along the bluff overlooking the Skagit River has been known to exhibit shallow landslide activity. This steeply sloping area is therefore considered a potential landslide hazard.

The Everson Deposit soils in the south half of the alignment typically present no significant hazards to future roadway development, and are expected to provide satisfactory foundations for roadways and structures. The soils are not susceptible to liquefaction during seismic activity, and have no history of landslide activity.

The character of alluvial floodplain soils in the north half of the alignment was assessed by means of the published geologic data and boring logs from previous projects in the vicinity. The soils in this area are primarily granular in nature (sand or silty sand), and may be loose in the upper 50 to 60 feet.

Granular soils are considered to be prone to liquefaction during seismic shaking. The profile typically includes soft silts or clays and zones of organic matter that may be prone to consolidation under highway embankment static loads. The seismic liquefaction could result in settlement or stability failures of highway embankments, or large deformations from the "lateral spread" phenomenon that could occur along the banks of the Skagit River. Deep foundation support at the bridge locations must be designed to prevent settlement of the static loads from the bridge structure, and to resist lateral loads imposed by ground shaking and lateral spread. Therefore, it is cautioned that the nature of the geology in the project area is receptive and construction activities should be exercised with extreme caution.

Land use and Socio-Economic Elements

The Conway to Cook corridor includes approximately, 40 percent residential, 15 percent agricultural, 40 percent commercial, and five percent light industrial types of land use. All residential areas along the I-5 corridor are middle class in character with populations that include blue collar and professional working families. Although some minority home-owners would be affected by this alternative, the majority of the impacts would be to non-minority residents. Businesses along the I-5 corridor include various retail operations, restaurants, and a landscape/nursery operation. From a field review of the businesses, there is no evidence of a predominance of minority ownership or minority employment associated with these operations. Hence it is expected that there are no apparent major environmental justice impacts that would be caused as a result of implementing the recommended improvements.

The number of residential and business structures that would be needed for widening I-5 could be considerable. Most of these properties are in established neighborhoods in Mount Vernon. Commercial and industrial properties along I-5 will likely be the most expensive to purchase. Other properties along the corridor would also be affected by permanent and/or temporary easements and partial property purchases.

Historic and Cultural Resources/Parks and Public Lands

Historic settlements are identified to be outside the proposed project footprint. However, a local archaeologist/historian would be needed to conduct periodic inspections and be on-call in case of suspected archeological resource discoveries.

It is expected that some parks and public lands may be impacted, including Hillcrest Park, Lions Park, parkland west of I-5 in Mount Vernon, public land east of I-5 in Burlington, including four parcels owned by Burlington Edison Schools, two parcels owned by the city of Burlington, and public land southwest of the College Way interchange owned by the Mount Vernon public utility district. The potential for and extent of encroachment on these parcels is not known at the planning stage of project development.

SETTING PRIORITIES

Prioritization of the improvements identified in the I-5 Master Plan will be an ongoing effort requiring participation from numerous stakeholders. Priorities will be based on a range of criteria such as safety and congestion benefits, multi-modal benefits, and connections to local plans. WSDOT's preservation and replacement schedules for bridges and other infrastructure in the corridor will also be considered. The availability of funding to design and construct improvements will be a major driver in setting project delivery priorities.

High-priority projects will exhibit:

- High ratio of benefits to costs.
- Low total cost.
- Financial partnership between WSDOT, local government, developers.
- Regional and local support.
- Significant safety and operational improvements.
- A clearly defined improvement concept.

Benefit/cost ratio

Benefit-cost analysis is used to compare projects. This analysis weighs the positive outcomes generated by a project against the financial impact of constructing and maintaining the improvement over time. A benefit-cost ratio of 1 or more indicates that an improvement creates value that equals or exceeds its cost. Inputs to benefit-cost analysis include:

- Traffic throughput
- Level-of-service
- Total societal impact of traffic collisions (in dollars)
- Project costs (design, construction and maintenance)

Detailed analysis is required to conduct a credible benefit-cost analysis. The information and level of detail provided by the Interstate Master Plan will enable this work. WSDOT will initiate benefit-cost analysis when the plan is completed, as part of our effort to develop an implementation strategy.