SEATTLE DEPARTMENT OF TRANSPORTATION

Additional Review of the Impacts of Deep Bored Tunnel Tolling Diversion on City Streets; Identification of Mitigation

DRAFT FULL REPORT

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EXECUTIVE SUMMARY

This report is intended to provide supplemental analysis of the Alaskan Way Viaduct Replacement Project (AWVRP) from the perspective of the City of Seattle, the jurisdiction that will realize a majority of the project's benefits or impacts. It comes in response to the Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft Environmental Impact Statement (AWVRP 2010 SDEIS) findings. The SDEIS finds that between 50% and 55% of traffic projected to use a deep bored tunnel would divert back to city surface streets and I-5 when tolls are assessed at levels needed to cover $400 million in revenue bonds.[1]

As more information about required toll levels to meet project financing gaps and the impacts of tolling at that level has been developed, questions have arisen as to whether a tolled tunnel meets key city goals. A quick look back at recent project history shows how city interests have been incorporated.

In the spring of 2007, the Seattle City Council requested that the Seattle Department of Transportation (SDOT) develop an Urban Mobility Plan (UMP) as a solution for replacing the Alaskan Way Viaduct. The UMP utilizes a systems approach, including enhanced transit service, surface street highway improvements, and other transportation programs and policies to address traffic needs after the removal of the Viaduct. The UMP proposed an approach that relied on travel demand management, more efficient use of existing streets and freeways, and improved transit rather than replacing Viaduct capacity through construction of a new highway. It also focused on the key principle of improving movement of people and goods to and through Downtown, moving away from the previous project focus of maintaining the vehicle capacity of the existing SR 99 corridor.

The goals of the UMP set forth in the initial City Council resolution were to:

- Improve mobility for all users
- Create a pedestrian-friendly waterfront
- Maintain the economic health of the city
- Improve the environment

Ultimately, the UMP was incorporated into the 2008 Alaskan Way Viaduct and Seawall Central Waterfront Replacement Partnership Process (referred to in this report as the

[1] The Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft Environmental Impact Statement, Chapter 9, p. 214, is the source for the "project" alternative, the lower estimate of diversion. EMME modeling plots for the 2015 Deep Bored Tunnel Toll Scenario C "Program," provided by Parsons Brinkerhoff and WSDOT in January 2011, are the source for the higher estimate of diversion. The "Program" alternative includes the Elliott/Western connector to Alaskan Way.

Partnership Process), thereby providing surface and transit alternatives that were developed and analyzed jointly with highway replacement alternatives. As part of this process, eight options to replace the Viaduct were studied intensely. The Partnership Process was a joint undertaking of the Seattle Department of Transportation (SDOT), the Washington Department of Transportation (WSDOT), and King County Metro.

By combining these processes into a single alternatives investigation, the intent of the UMP was fulfilled through the development of several demand management and system efficiency alternatives. The Surface, Transit, and I-5 Hybrid (ST5 Hybrid) scenario was supported by the Stakeholder Advisory Committee (SAC) as one of two most viable options for replacing the Viaduct. The ST5 Hybrid was the outcome of three surface and transit options that were modeled and shown to be viable, and in many respects, desirable alternatives for maintaining mobility after the removal of the Viaduct.

Note: ST5 is the abbreviation used in this report for surface, transit, and I-5 solutions to replace the Alaskan Way Viaduct. A number of variations of a surface, transit and I-5 design have been evaluated. This report considers two of those: (1) the **ST5 Hybrid** as developed in the Partnership Process and evaluated in the early SDEIS alternatives screening; the ST5 Hybrid included an Alaskan Way/Western Avenue traffic couplet designed to increase traffic capacity on the waterfront, and (2) **ST5 Scenario B** from the Partnership Process included a 4-lane Alaskan Way on the Central Waterfront north of Colman Dock.

The 2008 Partnership Process evaluated a number of alternatives and conducted an extensive stakeholder process before recommending the bored tunnel alternative as the primary recommendation. The stakeholder group supported both the deep bored tunnel and ST5 as viable alternatives. Some SAC members supported the bored tunnel as a back-up to the ST5 alternative, to be implemented only if traffic conditions following implementation of ST5 were problematic. (A small minority supported an elevated option.) Subsequently, in early 2009, the State, City, and County selected the bored tunnel as the preferred option consistent with project guiding principles and concerns of the majority of stakeholders.

The selection of the bored tunnel option is formally documented in the report, *"AWVSRP Central Waterfront Tri-Agency Partnership Executives' Recommendation Report"* (August 2009), signed by State of Washington, City of Seattle, and King County Executives.

At the time the Executives from the three agencies signed the report, only a preliminary analysis of tolling, looking at whether tolls could raise $400 million, had been completed. In fact, the report is silent on any option to use toll revenue to support project financing, the inclusion of tolls as a project element, and on the impacts of tolling a deep bored tunnel.

A set of Guiding Principles was developed and used to guide project selection in the Partnership Process [2] are well aligned with City transportation policy goals. These Guiding Principles include:

- Keep goods and people moving today and into the future
- Stay within the State's $2.8 billion funding cap for AWV replacement and bring other funding partners into the mix
- Take advantage of Seattle's unprecedented opportunity to reinvent its waterfront
- Keep the city's waterfront businesses and other economic interests as strong and as viable as possible both during and after construction
- Support investment in transit, bicycle, and pedestrian improvements and other efforts that help diminish the reliance on single-occupancy vehicles
- Improve the environment

With recent findings in the SDEIS regarding the transportation system response to a tolled tunnel, there is reason for the City of Seattle to consider whether these Guiding Principles are being served. As the Alaskan Way Viaduct Replacement Project approaches finalization of the NEPA process and nears construction, there are a number of unresolved issues that require additional analysis. This report is intended to examine such issues, including:

- If facility tolling is needed to fund the bored tunnel, what types and levels of mitigation will be needed for Seattle streets and neighborhoods? Who will pay for mitigation and what impacts will mitigation measures have on project costs?
- Are key City policy goals (e.g., greenhouse gas reduction, carbon neutrality, a multi-modal transportation system) fulfilled through the current project direction?
- How consistent is project travel demand modeling with recent trends in personal mobility and how do those factors ultimately affect alternative selection? How might rising energy prices, which increase the cost of driving a private automobile, impact travel demand in the project area? How do changing real estate location preferences change the future demand for travel in Seattle?
- Is there a need to resurrect elements of a surface and transit solution if 50% to 55% of traffic projected to use the tunnel diverts to other streets, facilities or modes due to tolling? Might Seattle be better off with a systems solution that reduces overall auto travel demand and improves the surface street environment?

Some key findings of this report are highlighted in the remaining sections of the Executive Summary. More extensive discussion of these issues follows in the report chapters.

[2] AWVSRP Central Waterfront Tri-Agency Partnership Executives' Recommendation Report, August 2009, p. 15, http://preview.tinyurl.com/AWVSRP-ExecRecommendationAug09

There is a Need for Surface Street Traffic, Pedestrian, and Transit Investments to Mitigate Impacts of a Tolled Tunnel

The AWVRP 2010 SDEIS projects high traffic diversion caused by tolling. The amount (40,000 to 48,000 daily vehicle trips) and likely routing of diverted traffic will require capital projects to mitigate impacts on city surface streets and provides a strong argument for implementation of programs, services, and projects that reduce overall trip demand in and through the Center City. Transit and transportation demand management (TDM) measures identified as part of the AWRRP have been mostly eliminated from the current project or are threatened due to funding limitations. Further, increased pressure placed on I-5 raises the question of whether highway investment might be more effectively spent implementing I-5 capacity enhancements recommended in the ST5 Hybrid alternative, which would also provide an opportunity to perform needed maintenance on the I-5 mainline through Seattle. Recommended mitigations are summarized in Chapter 2.

Analysis of the Elliott/Western Connector, Not Included in the SDEIS Tolling Analysis, Shows More Diversion to City Streets

One footnote to the SDEIS tolling analysis is extremely important. The definition of the "project" used in the SDEIS, including the tolling analysis traffic forecast, excludes an important street connection between Alaskan Way and Elliott/Western. However, this critical surface street link will be constructed if a deep- bore tunnel alternative is selected and would have a substantial impact on the distribution of auto traffic through the city. The SDEIS confirms "these improvements [Alaskan Way-Elliott/Western connector] would provide an attractive alternative to the bored tunnel for some drivers, which could lead to increased diversion from SR 99 if it [the tunnel] were tolled."[3] Therefore, impacts on city streets, including Alaskan Way, could be greater than estimated in the SDEIS analysis as the connector provides another viable option for auto travelers to avoid paying the toll. The majority of the additional diversion modeled when the connector is included is traffic that would use Alaskan Way to bypass downtown. Tolling diversion on this route is projected to be high during the midday period when surface street congestion is low. This corresponds with peak visitor and tourist use of the Central Waterfront, requiring design and traffic management on Alaskan Way to ensure a safe and comfortable pedestrian environment.

The State did model a 2015 "program" alternative (including the connector) with Toll Scenario C, but the results are not reflected in the SDEIS.[4] In this model, 38,000 daily trips were forecasted to use the tunnel, compared to 86,000 without a toll. The State's analysis suggests that with the planned Elliott/Western connector tolling diversion from the tunnel could be as high as 55% of daily traffic. [5]

[3] AWVRP 2010 SDEIS, p. 208, page side note.

[4] This analysis was provided to the authors by WSDOT in preparation for reviewing the SDEIS.

[5] AWVRP EMME Plots showing volumes for Deep Bored Tunnel Toll Scenario C (2015) provided by WSDOT (analysis conducted by Parsons Brinkerhoff).

Traffic is Declining and City and State Policies Encourage that Trend

While it is easy to speculate about the nature of personal mobility in 2030; it is harder to predict exactly what choices travelers will face and how they will respond. Traffic planners have little data to predict the price of fuel over the long term and the impact of fuel price on mode choice, although 2008 price spikes showed a clear tipping point around $4 per gallon. Sticking to what we know, Seattle Center City is projected to become much denser in the next 20 years. Density of housing and jobs is the best indicator of travel mode choice; regardless of income, ability, housing tenure, and other demographic factors, there is a direct and measurable decline in per capita driving as density increases. It is telling that following a boom of high- and moderate-density development in the early 2000s, both per capita and overall traffic in Seattle have declined. Since 2003 total vehicle trips made in Seattle are down by 8%. Traffic in downtown Seattle hasn't grown in over 10 years.

Seattle plans to accommodate 20-year growth of about 126,000 jobs and 44,000 residents[6] in the Center City and adjacent neighborhoods with no significant new surface street rights-of-way planned. This will require transportation solutions that allow travelers to conveniently use higher occupancy modes and to travel safely on foot and by bicycle. This is a matter of geometric constraint, not of political philosophy. A deep bored tunnel will encourage status quo behavior and make needed future mode shift more challenging. A majority of trips on SR-99 today are directly related to travel into and out of the Center City and immediately adjacent neighborhoods, or are short trips to bypass downtown. Maintaining or enhancing a travel shed that allows people to cover greater distance in the same amount of time is likely to encourage more driving, more downtown congestion, and more auto-centric development.

Traffic research has shown continually, and without contradiction, that new urban road capacity provided in a congested area will quickly fill up (assuming it is not priced). This phenomenon is called "induced demand." Since urban congestion is a given, regardless of investments in new roads, cities such as Vancouver, New York, Chicago, and San Francisco have accepted high levels of urban congestion and are focusing transportation investments on improving conditions for pedestrians, cyclists, and transit users. These cities have among the most vital urban centers in North America.

Seattle is making progress toward meeting VMT (Vehicle Miles Traveled) and greenhouse gas reduction goals. The "reverse induced demand" effect of an approach focused on managing transportation demand through the provision of high quality alternatives and incentives would continue progress toward City and State goals. A deep bored tunnel, or any new highway facility, has the potential to slow this progress.

Aggressive Demand Management Measures Should Be Adopted

The SR 99 bored tunnel alternative presented in the SDEIS does not include a funded TDM or transit element. While one could argue those financial responsibilities were assumed by King County Metro and the City of Seattle in the Executive agreement for the Bored Tunnel, there is a clear lack of focus on these elements in the current project analysis. To a large degree, the project is responding to current funding conditions. However, in light of mitigation needs created by tolling diversion,

[6] Based on PSRC projections.

decreased cost effectiveness of a tunnel that carries fewer people, and clear policy directives to reduce per capita driving (e.g., GhG reduction, human health, etc), financing challenges alone cannot justify one of the region's largest transportation projects failing to invest in transit or demand reduction.

The 2008 Partnership Process approached alternatives refinement by developing a number of system components for each of eight AWV replacement options, including ST5 and highway replacement options. Planners working on this effort recognized that demand management programs to shift travelers to transit and non-motorized modes was an important component of each and every alternative, particularly those that attempted to make more efficient use of existing transportation infrastructure and services (e.g., existing transit seat capacity). Since the travel demand model used to project traffic volumes and mode choice has limited ability to evaluate the impacts of TDM measures, the project team developed a three-tiered approach to assessing TDM benefits. The effectiveness of various TDM packages was measured using: (1) the U.S. Environmental Protection Agency Commuter Model, (2) an experiential approach that evaluated actual results of various TDM investments, and (3) an approach that recalibrated cost parameters in the travel demand model.

Arguably, this was the most robust modeling conducted in the overall AWV replacement analysis process given the three-level approach. For example, the Urban Mobility Plan Briefing Book[7] provided peer traffic and travel conditions from cities experiencing similar land use changes and facing similar transportation challenges; this included information that showed downtown traffic in decline and highway replacements that had transformative impacts without causing gridlock. However, peer experience was largely discounted as a method for assessing future automobile travel demands or patterns.

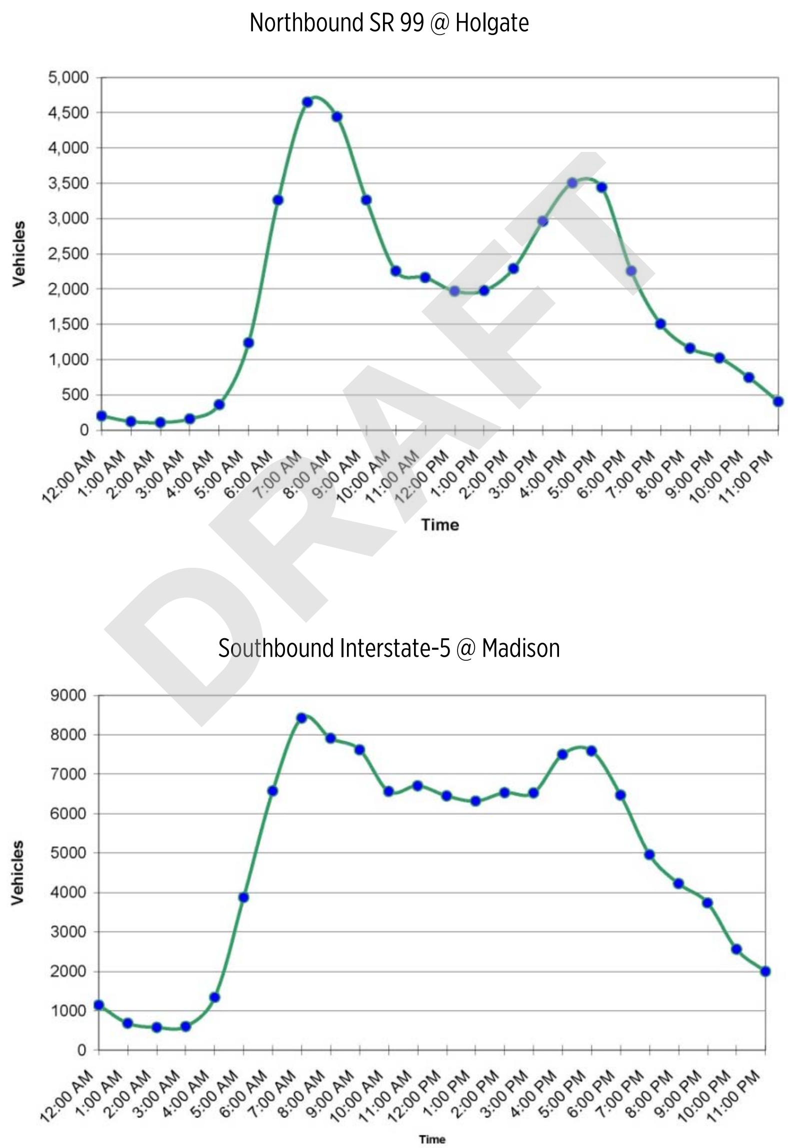
Midday hourly traffic volumes on the Viaduct are comparable to volumes carried by several four-lane arterial streets in Seattle. The highest volumes occur during peak periods. City policies suggest that shifting commuter trips to transit and alternative modes should be a high priority; commuters are a captive market and vehicle capacity and storage used in the urban core for commute trips is arguably not among the highest and best use of limited rights-of-way or real estate. Seattle transportation policies and programs attempt to reduce commuter travel in favor of high-value trips, such as retail shopping and goods movement. The highly peaked travel demand on the AWV suggests that a well designed TDM program focusing on commuter travel needs could be highly effective. In fact, the Partnership Process team working on Transportation Demand Management, which was led by King County, developed a TDM program at the conclusion of the Partnership Process. This TDM program had an estimated effect of shifting as many as 15,000 daily Center City automobile trips to transit and non-motorized modes. The estimated cost was $385 per trip reduced each year over a ten year span. In other words, an expenditure of $57 million over ten years would permanently remove 15,000 daily auto trips that occur in Center City. This projection was in addition to TDM actions and programs already in place, which have produced well-documented mode shift benefits.[8]

[7] http://www.seattle.gov/transportation/briefingbook.htm

[8] AWV Central Waterfront TDM Program, King County Metro, November 2008.

Figure ES-1 illustrates hourly levels of traffic on the Alaskan Way Viaduct (upper panel) around the commute peaks, compared to Interstate-5 (lower panel), which carries a much more diverse set of Center City access, mid-range local, and regional through trips throughout the day. Midday volumes on the Viaduct are at levels that can be handled by a four-lane surface street.

Figure ES-1 Hourly Vehicle Traffic Volumes on (a) SR-99 and (b) I-5 by Time of Day



Source: WSDOT, 2007. From Seattle Urban Mobility Plan Briefing Book, Transportation in the Center City Today, Figure 21 (p. 3A-25) and Figure 23 (p. 3A-26)

Funding any new TDM or transit measures would require funding sources not identified today, a particularly significant challenge given King County Metro's current financial challenges. This alone is not a reason to abandon demand management and transit improvement strategies, the right combination of which could provide the most cost-effective long-term mitigation for potential traffic diversion and better align with key City policy goals. Other funding challenges related to the project have yet to be resolved, but do not appear to be holding back progress on highway construction elements of the project. For example, the State Legislature has not approved tolling for SR 99, but toll revenues are assumed in the funding package. Given tolling impacts, even a deep bored tunnel alternative with tolls will require aggressive TDM to measures to maintain quality access to downtown for all modes and travelers.

Perhaps most importantly, all the best industry thinking on ways to improve social equity in transportation, travel affordability, and human and environmental health point to programs that promote a robust and affordable set of travel options.

Transit Needs Protection from Delay Caused by Tolling Diversion

Despite King County Metro's current funding "crisis" there are projects being implemented that will increase transit use in SR 99 corridor travel markets. RapidRide, Metro's on-street bus rapid transit program, is set for implementation in three of the major SR 99 travel shed corridors, including North Aurora, Ballard, and West Seattle. The ridership response to King County Metro's first RapidRide deployment—the International Boulevard "A Line"—suggests that these enhanced services combined with a solid package of TDM programs are effective in shifting travelers to transit. Ridership on Metro's "A Line" increased by 25% after just six months of operation.

A 25% increase in ridership on the three Seattle RapidRide lines would be equivalent to more than 5% of current AWV daily travelers.[9] The success of these new services, which will require significant investment in service and capital, will be dependent on ensuring transit vehicles are able to efficiently bypass congestion. Travelers making trips in the SR 99 corridors bound for the opposite side of the Center City or traveling through the Center City are likely to find transit less attractive than an uncongested freeway. Travelers able to afford toll rates will find driving much more convenient, while those using transit due to income restrictions or personal choice, may be faced with slower and less reliable travel due to traffic diversion from the freeway to city streets, which also carry bus services. This important social equity issue is recognized in the SDEIS, but no mitigation is suggested.

The clear mitigation path is to fund robust infrastructure investments that ensure transit speed and reliability, particularly for downtown approaches and on downtown avenues. Transit priority treatments between the north portal and the Third Avenue Transit Spine are well designed. The south end provides more significant challenges and may require another more comprehensive look the variety of options for transit pathways between West Seattle and downtown.

[9] Nelson\Nygaard analysis based on Fall 2009 King County Metro ridership in future RapidRide corridors in SR 99 travel shed.

Regional Tolling is Needed and Could be a Game Changer

State policy makers and transportation professionals are faced with a hard reality—roadway maintenance and replacements costs are increasing rapidly and traditional transportation funding sources (e.g., gas tax) are in steady, if not rapid, decline. Among the most important and viable long-term solutions is a regional congestion pricing program. A regional approach to highway tolling, particularly one that assesses tolls based on level of use and time of travel, would provide more revenue for highway maintenance and capital improvement projects and would provide a more equitable method for collecting revenue. Any major infrastructure investment, including the AWV replacement, should be evaluated with consideration to how a regional congestion pricing program might alter future demand.

In the Seattle region, a 2005 PSRC study tracked 275 volunteer drivers to assess their responses to road pricing charges. It found that travelers decreased trip making by 0.4% for each 10% change in price, and that study participants with access to the best transit service decreased travel by 1.6% per 10% change in price. When PSRC incorporated these results into the regional travel demand model, it found that the total number of regional trips projected decreased about 5%, with greater decreases in the AM and PM peak periods. Additionally, the total number of vehicle miles driven declined by 8%.[10] To provide some perspective, removing 10% of the total vehicles from a gridlocked freeway is typically enough to eliminate congestion and create a free-flow condition.

Regional tolling has, at once, two substantial benefits. First, a well-designed tolling program will generate revenue necessary to maintain transportation infrastructure. Second, regional tolling can be used as a tool to ensure we get the most efficient use out of our highway systems. With legislative changes, tolling revenues could also be used to support transit, TDM and alternative mobility programs that benefit vulnerable populations most impacted by increased travel costs from tolling.

Regional tolling could decrease overall demand on the regional highway system, including an SR 99 deep- bore tunnel, and provide a critical revenue stream to support major capital projects and system maintenance. A well-designed regional tolling program would not create the type of artificial imbalance in the system created by a facility-only toll. There are substantial political and implementation challenges to such a program. While it is highly unlikely to be implemented by the projected date for closing of the AWV portion of SR 99, it is not unreasonable for the City, State and regional partners to be looking toward such a future.

Highway Ramps are a Primary Cause of Surface Street Traffic Congestion in Seattle

Most surface street congestion in Seattle Center City occurs as the result of highway ramps (the other major cause is skewed intersections resulting from colliding street grids). Signalized intersections act as meters for highway on-ramps when freeways are congested and heavy turn volumes at intersections leading to highway on-ramps often conflict with pedestrian crossings, allowing only a few turning cars through each signal cycle. This suggests that a deep bored tunnel replacement of the AWV will shift intersection bottlenecks to streets in the two portal areas that feed freeway ramps.

[10] PSRC, Traffic Choices Study Summary Report, April 2008, http://www.psrc.org/assets/37/summaryreport.pdf

The relocation of SR 99 downtown access points to the stadium area removes congestion points at Seneca and Columbia; it relies on Alaskan Way to provide access to downtown, as well as through downtown for some trips. However, new ramps located at the two portals are likely to create a new set of intersection bottlenecks. This is a concern given the valuable historical resources in the Pioneer Square area and the highly constrained street network and already high traffic volumes in the vicinity of the north portal. For example, Mercer and Denny are two of the most congested arterials in the Center City due to the disruption in the street grid created by Seattle Center and the fact that both streets provide connections to I-5. Projected growth of residents and employees in the Uptown/South Lake Union area will also increase pedestrian crossing volumes in intersections leading to freeway ramps. Substantial employment gains in this area have led to noticeable increases in pedestrian activity in just the last 12 months.

Nelson\Nygaard reviewed travel demand modeling and traffic operational modeling for the SDEIS. Due to the complexity of downtown transportation conditions model estimates are often unreasonable compared to actual conditions; human judgment is then used to assign traffic volumes estimates to certain streets for evaluation with the operational model (the model that predicts intersection delay and traffic operations on city surface streets). These adjustments are significant in several cases, particularly in the portal areas where new ramps dramatically change demand patterns. While this is normal modeling procedure used to best estimate real life conditions, it is also a reminder that modeling tools have a wide margin of error. Traffic data that is presented as a singular number in SDEIS documents may have already been adjusted by a substantial margin and represents a point of estimate among a range of possible outcomes.

Environmental Analysis Does Not Consider Changes in Real Estate Location Choice Due to Transportation Investments

Touted as a leader in environmental policy, Seattle has adopted an aggressive Climate Action Plan and the City Council has identified an aggressive goal of achieving carbon neutrality as a top priority. The State of Washington has also made reduction of greenhouse gas (GhG) emissions a policy priority. As part of these emissions reduction goals, House Bill 2815[11] requires a 50% reduction in per capita VMT by 2050 from a statewide baseline level, setting as interim benchmarks an 18% reduction by 2020 and 30% reduction by 2035. These aggressive benchmarks present an opportunity, if not a mandate, to consider strategies that reduce overall per capita automobile travel demand in Seattle (e.g., parking management, TDM and transit improvements). SDEIS analysis has shown that a tolled tunnel is the worst of all evaluated scenarios for greenhouse gases.[12] Analysis of GhG impacts for roadway projects often skirts the important reality that long-term changes in land use are needed to curb mobile source emissions. An alternative that relied on demand management and better temporal and spatial use of existing streets (e.g. ST5) would encourage residents and employers to make a different set of location decisions than a deep bored tunnel. Modeling tools that consider these dynamic relationships are being developed in the Puget Sound Region, but are not currently in use. This issue related to project modeling is discussed in more detail in Chapter 3.

[11] http://apps.leg.wa.gov/documents/billdocs/2007-08/Pdf/Bills/Session%20Law%202008/2815-S2.SL.pdf

[12] See discussion of “Energy and Greenhouse Gases” in AWVRP 2010 SDEIS, Chapter 9, p. 222

The AWV Portion of SR 99 is Important for Local Goods Movement and Deliveries

In the course of the Partnership Process great attention was focused on the function of SR 99 and its relationship to freight traffic. It was found that only freight using SR 99 directly is impacted by the choice of an alternative to replacing the Alaskan Way Viaduct. Freight movement between the Port of Seattle and regional highways is enhanced by the "Moving Forward" projects currently under construction and is essentially unaffected by the choice of a Central Waterfront replacement alternative. Perhaps the most significant project impacts on regional and interstate freight movement are related to the amount of traffic diverted from the corridor to I-5. A tolled tunnel project diverts approximately 15,000 daily vehicles to I-5 compared to a non-tolled tunnel and includes no significant I-5 improvements.[13] While the ST5 Hybrid increases I-5 volumes by 34,000 daily vehicles, it also invests in new I-5 lane capacity and flow improvements estimated to increase daily throughput by approximately 30,000 vehicles.[14]

The freight pathways most impacted by the choice of an SR 99 replacement alternative are those that connect the SODO/Duwamish Manufacturing and Industrial area with the Ballard/Interbay Manufacturing and Industrial area. Interestingly, of the major infrastructure alternatives considered in the Partnership Process, a deep bored tunnel produced travel time results closest to the Surface and Transit Alternatives for this particular freight route. This is primarily due to the fact that the Elliott/Western corridor can only be reached by surface Alaskan Way in the Deep Bored Tunnel Alternative as well as the ST5 alternative considered.

Finally, it must be recognized that SR 99, as a freight route, is very different than I-5. I-5 has a higher percentage of trucks, including many full-sized semis. SR 99 has a much lower percentage of truck traffic with very few semis. Most freight traffic on SR 99 is local in nature and is accommodated on lightweight trucks, including many vans and pickup trucks. Given the overwhelmingly higher volumes of trucks traveling I-5 each day compared to SR 99, it seems I-5 improvements included in ST5 could have greater short- and long-term benefits for regional and long-haul freight travel.

The SDEIS Purpose and Need of the Project is Narrowly Focused on Maintaining Highway Capacity Compared to Partnership Process Guiding Principles

In the current NEPA process, the AWVRP is being treated as a highway corridor project (as opposed to the transportation system project envisioned by the City's Urban Mobility Plan) and is subject to NEPA and FHWA requirements. Several important planning principles developed and used throughout the UMP and Partnership Process were not carried through when the City, State and FHWA updated the purpose and need of the project for the Second SDEIS (an SDEIS was developed in 2006 prior to the 2007 vote and the Partnership Process). While there is no requirement that these principles be considered in the NEPA process, it does represent a loss of work developed by a highly engaged group of stakeholders and

[13] AWVRP 2010 SDEIS, Chapter 9, p. 214.

[14] SR 99 Alaskan Way Viaduct Replacement Updated Cost and Tolling Summary Report, January 15, 2010, p. 37.

partner agencies. Unlike the larger study area considered during the Partnership Process, the SDEIS analysis considers a relatively narrow corridor on either side of SR 99. This approach is counter to the consideration of alternatives that promote a systems approach to managing travel demands or that promote optimization of existing transportation infrastructure.

It is important to note that the ST5 alternative was eliminated from consideration in the SDEIS because it did not maximize replacement capacity in the narrowly defined SR 99 corridor. In the context of the Partnership Process Guiding Principles it was identified as feasible and desirable compared with a number of other alternatives. Ultimately, a major factor that led to support of the deep bored tunnel was the ability to build the project with very limited traffic disruption.

The SDEIS purpose and need statements render meaningless well-researched arguments that Seattle's transportation system and the travelers that use it have the capacity to adapt to a different set of travel choices that don't include a freeway. This is challenging in light of SDEIS analysis of a tolled tunnel, which suggests many travelers will treat a tolled tunnel as if it did not exist.

Moving Forward

The question at hand is whether tolling changes the calculus of decision making completed to date. Does the amount of needed mitigation for a tolled tunnel limit the project's intended contribution to mobility as well as broader social, economic, and environmental goals?

The purpose of this report is to identify important issues and concerns relevant to the City of Seattle as the AWVRP NEPA process moves into final stages and decisions are made regarding the project, tolls, and mitigation. The report summarizes proposed mitigations to manage tolling diversion impacts to pedestrians, transit users, and neighborhood residents and businesses faced with higher levels of traffic congestion. A separate report (currently in draft form) provides a more detailed set of mitigation recommendations.

1 INTRODUCTION

A. Purpose of this Report

This report responds questions that have arisen about the transportation benefits and impacts of a tolled tunnel, including its diversion effects. It also summarizes work done to identify specific mitigation needs related to tolling diversion and provides direction to support upcoming discussions at the Advisory Committee on Tolling and Traffic Management to determine a final SR 99 tolling approach and concurrent mitigation needs.

The report also revisits the benefits of ST5 alternatives that have been developed and analyzed at various points over the last several years in light of the diversion impacts on surface streets, many of which will require mitigation projects to enhance surface streets, improve transit mode share are reduce peak hour driving. The report attempts to bring an objective perspective to information used to inform decision making and to address issues not typically addressed within the NEPA (EIS) structure.

Given legislative direction that establishes the need for tolling as a funding mechanism, this report builds on and interprets the information included in the SDEIS to determine the impacts on Seattle's streets and neighborhoods from a tolled tunnel. For this report we have assumed that tolling is required to complete the project finance package and would need to retire the $400 million bond debt as indicated in the SDEIS.[1] Further, we have assumed that SDEIS projected estimates of traffic diversion are reasonably accurate and facility tolling would cause diversion of 50% of traffic using a non-tolled tunnel, if not higher.

The introduction of tolling as a new project element and the resulting impacts may change the rationale and criteria for selecting a replacement alternative. Given the impacts of tolling, which will reduce tunnel use and increase traffic on surface streets (which do not currently have dedicated mitigation funding), it is reasonable to ask:

- Is a tolled deep bored tunnel a cost-effective investment given the projected level of traffic diversion?
- If the tunnel is constructed and tolled, are mitigation measures sufficient to address impacts on the City of Seattle?

In addition, this report asks a more fundamental question:

- Does the project contribute to broader social, economic, and environmental goals in its current form? Since tolls are a form of taxation, who will pay this new tax and who will be the beneficiaries and who might be negatively impacted?

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[1] WSDOT SR 99 Alaskan Way Viaduct Replacement Updated Cost and Tolling Summary Report, Page 11, January 15, 2010. http://www.wsdot.wa.gov/NR/rdonlyres/3FBD89BD-FCE8-4769-BF4A-5C4CB95C7FD9/0/SR99_Cost_Tolling_Summary_Jan10.pdf

- Given 50% of projected users abandon a tolled tunnel, could the project goals be met at lower cost with a package of improvements on city streets, public transit service and on I-5.

The above questions are not intended to add to the cost of project development or to extend the time required for implementing a Viaduct replacement solution. However, new information, developed as part of the SDEIS, particularly the tolling analysis which shows reduced tunnel use and increasing unmitigated demands on city streets merits renewed discussion and more detailed project planning. Further, many recent examples of tolled highways have resulted in high diversion and financial under-performance, lending credence to the State's projection of high diversion and suggesting a need for caution in using toll revenues to support project financing.

This report is not intended as a critique of work done by the State of Washington, the City of Seattle or others involved in preparing the AWVRP 2010 SDEIS.

B. Historical Overview

Removal of the existing Alaskan Way Viaduct (AWV), a double-deck highway travelling along the Seattle waterfront, is a required outcome for the 50-year-old structure that suffered significant damage in the 2001 Nisqually earthquake. Washington State Department of Transportation (WSDOT) and the City of Seattle, co-leaders of the Alaskan Way Viaduct Replacement Project (AWVRP), narrowed a list of 76 viaduct replacement concepts to five for the initial Draft Environmental Impact Statement (DEIS) in 2006. In March 2007, Seattle residents were asked to vote on two replacement options: a cut-and-cover tunnel and a new replacement viaduct. Neither option received enough voter support to move forward.

Seattle City Council responded to Seattle voters by adopting what is known as the Urban Mobility Plan (UMP) Ordinance.[2] This ordinance essentially directed Seattle Department of Transportation (SDOT), in cooperation with WSDOT and King County, to develop a plan to replace the central waterfront portion of the Alaskan Way Viaduct. The alternative development was to be guided by the following policy language in the ordinance:

> *"Regional transportation projects within the City should demonstrate consistency with the City's land use, economic, and environmental goals, including improving access to and through downtown for all modes of travel and groups using the transportation system (e.g., transit, freight, vehicles, bicycles, pedestrians, tourists, and cruise ship and ferry passengers, and commuters). Any such transportation projects should protect the City's economy, recognize Seattle's role as a global trade gateway, enhance freight mobility, and provide for the efficient movement of people and goods, with the least amount of disruption during construction. Development of transportation projects for accommodating trips made on the central waterfront section of the Alaskan Way Viaduct shall prioritize the movement of people and goods…."*

The ordinance went on to specifically establish elements of the UMP to:

[2] City of Seattle Ordinance 122406, adopted May 29, 2007

"prioritize the movement of people and goods through:

- Improvements to the entire downtown street grid, major entry points to downtown, and the Alaskan Way corridor along the central waterfront
- Strategic investments in transit including use of priority treatments and other mechanisms to enhance transit service
- Other traffic-management techniques including trip-reduction strategies to reduce the number of vehicles on downtown streets
- Early implementation of the urban mobility measures identified in Section 6 of this ordinance"

The ordinance also established Guiding Principles for the development of alternatives:

"a) Enhance Urban Mobility Throughout the City:

1. *Consider transportation demand strategies such as lane prioritization, congestion pricing and regional tolling*
2. *Look broadly for opportunities to enhance access to and through downtown, including advancing the goals of the Center City Access Strategy; improving regional transit service; increasing opportunities for alternative forms of transportation; limiting parking on downtown streets during peak periods; and creating dedicated bus lanes through downtown*
3. *Expedite implementation of Transit Now and Rapid Ride through investing in capital projects supporting bus rapid transit, and advocating for increased bus service hours in order to increase mobility prior to beginning work on the Viaduct projects that have been identified by the Governor, County Executive and Mayor as projects that are necessary irrespective of the option chosen for replacing the central waterfront section of the Viaduct (Moving Forward: Early Safety and Mobility Projects) and to reduce carbon emissions*
4. *Look for ways to improve the overall efficiency of I-5 for through trips*
5. *Enhance and connect bicycle access routes, including facilities to accommodate bicyclists, in order to increase bicycling as a safe and convenient mode of transportation*
6. *Enhance various types of pedestrian street crossings in order to increase transit ridership and pedestrian safety in traveling to and from work, school, and other destinations*

b) Protect Economic Health of Businesses - Avoid or minimize construction and long-term traffic impacts to protect the economic health of:

1. *Downtown businesses - retain and promote downtown as a healthy business environment*
2. *Waterfront businesses - retain and promote waterfront businesses, including restaurants, shops, tourism-related businesses and the Port of Seattle harbor and shipping and rail functions, with the least amount of disruption*

3. *Freight and commercial businesses - maintain traffic movement and large vehicle access to downtown, including re-examining existing restrictions on large truck access to downtown, evaluating priority access at certain times of day, and enhancing access to and from key locations including the Port of Seattle and the designated manufacturing and industrial centers to the south and north of downtown*

c) *Maximize Public Open Space and Create a Pedestrian-Friendly Environment on the Waterfront - Design the central waterfront to be pedestrian-friendly through maximizing the amount of open space and incorporating measures to increase pedestrian safety, including furthering the goals of the Complete Streets policy*

d) *Improve the Environment - Enhance all aspects of the environment, including air, noise, water quality, and near shore habitat*

e) *Use Innovative Transportation Solutions - Use creative approaches to develop holistic transportation solutions to carry out the (UMP) policy direction."*

Over the last five years, every poll or public vote has shown divided public opinion concerning the optimal replacement option for the AWV is divided, with no clear majority for any replacement option. Recognizing the wide-ranging public opinion, it was clear to all the parties involved that an informed political decision was needed to move this important project forward. To this end, the State of Washington, the City of Seattle, and King County agreed to merge the City's UMP project with a larger effort aimed at advancing and analyzing a number of alternatives for replacement of the Alaskan Way Viaduct on the Central Waterfront. In 2008, the three agencies undertook an intensive, year-long partnership to determine a direction for replacement of the Viaduct. The Alaskan Way Viaduct and Seawall Replacement Program -- Central Waterfront process, often referred to as the "Partnership Process," included monthly meetings with a 30-member Stakeholder Advisory Committee (SAC).

The Partnership Process study area was broad, stretching from Seattle's southern city limits to 85th Street NE and from Elliott Bay to Lake Washington. A set of Guiding Principles was developed during the Partnership Process and used as the basis for analyzing AWV replacement options. These include:

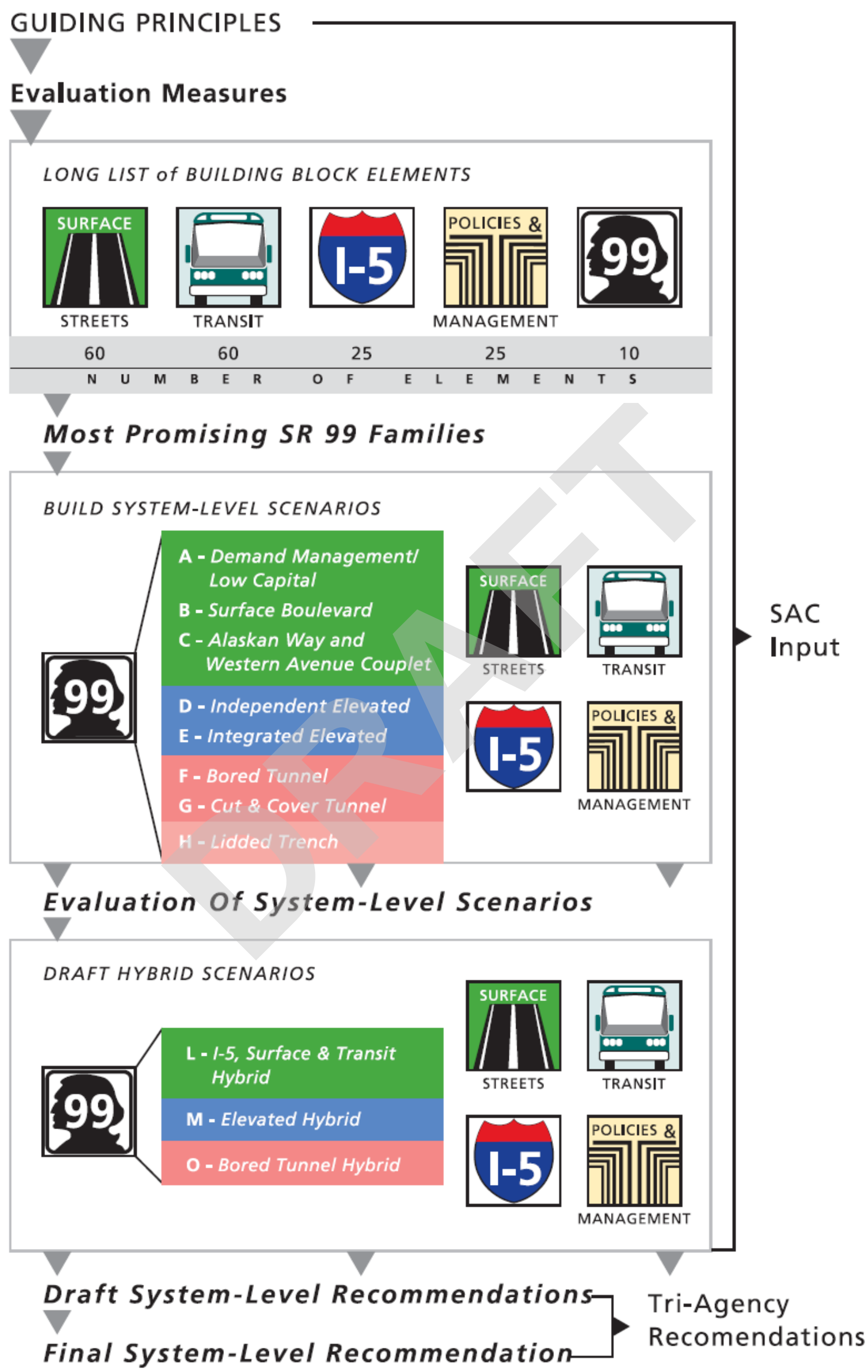
- **Guiding Principle 1: Improve public safety.** Replacing the viaduct is an urgent public safety issue. Any solution to the Alaskan Way Viaduct must improve public safety for current viaduct users and along the central waterfront.
- **Guiding Principle 2: Provide efficient movement of people and goods now and in the future.** Any solution to the Alaskan Way Viaduct must optimize the ability to move people and goods today and in the future in and through Seattle in an efficient manner, including access to businesses and port and rail facilities during and after construction.
- **Guiding Principle 3: Maintain or improve downtown Seattle, regional, port, and state economies.** Any solution to the Alaskan Way Viaduct must sustain the economic vitality of the city, region, port, and state during and after construction.

- **Guiding Principle 4: Enhance Seattle's waterfront, downtown, and adjacent neighborhoods as a place for people.** Any solution to the Alaskan Way Viaduct must augment Seattle's reputation as a world-class destination.
- **Guiding Principle 5: Create solutions that are fiscally responsible.** Any solution to the Alaskan Way Viaduct must make wise and efficient use of taxpayer dollars. The State's contribution to the project is not to exceed $2.8 billion in 2012 dollars.
- **Guiding Principle 6: Improve the health of the environment.** Any solution to the Alaskan Way Viaduct must demonstrate environmental leadership, with a particular emphasis on supporting local, regional, and state climate change, water quality, and Puget Sound recovery initiatives.

Replacement scenarios were developed using a systems approach that included a number of project elements or "building blocks." In other words, every alternative included capital and program elements including surface street improvements, transit enhancements, TDM policies, and I-5 improvements. From the building blocks, eight distinct scenarios for replacing the AWV were developed and analyzed. Figure 1-1 below illustrates the flow of the process used in the development of the eight scenarios and ultimately the development of three hybrid scenarios. At the conclusion of the 2008 Partnership Process, there was support from the SAC for the Hybrid Scenario L (the Surface, Transit, and I-5 Hybrid) and for the Hybrid Scenario O (Bored Tunnel Hybrid). The ST5 Hybrid Scenario L was evaluated earlier in the SDEIS process and eliminated from further consideration.[3]

[3] Alaskan Way Viaduct Replacement Project 2010 SDEIS Appendix C—Transportation Discipline Report Attachment A

Figure 1-1 Partnership Process Systems Evaluation Process



Source: AWVSRP Central Waterfront Tri-Agency Partnership, Executives' Recommendation, August 2009

The following is the recorded outcome from the Stakeholder Advisory Committee's final meeting in December 2008:

- The SAC showed a clear interest in moving away from long-held individual positions to identify an approach capable of being supported by a majority of the members. There was strong interest among many in finding common ground.
- SAC members generally felt it was important to limit the State's contribution to $2.8 billion, and they called on the other partners and the region to identify funding sources able to cover costs associated with transit service, improvements to city streets, and other aspects of the project.
- Members felt it was important that any solution reliably meet the area's mobility needs now and in the foreseeable future, but they called on the Partnership to do so in a way that would make it possible for the city to take advantage of a rare opportunity to reconnect the central waterfront with the downtown.
- While many members saw the I-5/surface/transit hybrid as an attractive approach, and possibly a first phase of an ultimate recommendation, there was also broad interest in taking a bored tunnel forward for further consideration. Many felt that the tunnel's costs might be reduced as a result of evolving technology and that additional funding might be found for a scenario with such broad appeal.
- There was only support from a handful of SAC members for an elevated solution.

As a result, 22 of the 25 active members of the SAC signed a letter addressed to Governor Gregoire, King County Executive Sims, and Seattle Mayor Nickels supporting an approach to formulate a hybrid solution that included consideration for a large-diameter single-bore bypass tunnel.[4] At that point, some SAC members supported a phased approach where ST5 elements would be implemented and a deep-bore tunnel would be a second phase option in the case that unacceptable levels of traffic congestion resulted from an ST5 alternative.

Between the end of the Partnership Process and late January 2009, the project team, assisted by a group of international tunneling experts, launched an intensive investigation of current tunneling technology and costs involved in building a deep bored tunnel. As a result, the three Partners' Executives signed a cooperative agreement to replace the Alaskan Way Viaduct with a deep bored tunnel, a new waterfront surface street, new transit service and transit capital improvements and some local street improvements in the portal areas and waterfront.

There were, as in any major transportation investment decision, a number of value tradeoffs at play in their recommendation. However, tolling the facility was considered only from the perspective of revenue generation and not the potential diversion impacts. The agreement also included commitments for enhanced transit service provision and transit-related capital improvements pending State legislation allowing

[4] Alaskan Way Viaduct and Seawall Replacement Program Central Waterfront Tri-Agency Partnership Executives' Recommendation, August 2009. Page 27.

new transit funding sources. Arising from this difficult decision making process, the current Alaskan Way Viaduct Replacement Project 2010 SDEIS (AWVRP 2010 SDEIS), released in October 2010, recommends that a bored tunnel alternative would be the "preferred alternative".

The addition of tolling as a funding mechanism for the deep-bore tunnel was introduced during the 2009 legislative session. The State Legislature found that there was insufficient committed funding to cover all SR 99 AWVRP program costs. The legislature directed the committed funding shortfall, $400 million, be bonded and that debt be retired using toll revenue from an SR 99 toll. Tolling was not analyzed in detail or included as part of the recommendations signed by the three Partner Agency Executives. In addition, the SDEIS suggests that tolling be used as a critical funding element for the tunnel and further acknowledges that the addition of tolling at the levels necessary to pay for the tunnel will divert substantial traffic from the tunnel onto city streets. The SDEIS does not identify mitigation to address the impacts of diversion on city streets.

Complicating this analysis is the complexity of the National Environmental Protection Act (NEPA) review process. Because tolling would require legislative approval, which has not yet been granted, tolling is not considered as part of the official project definition in the AWVR 2010 SDEIS document.[5] Rather, tolling is evaluated in one chapter and a tolled tunnel project is compared only to a deep-bore tunnel that is not tolled, rather than to a range of project alternatives. The ambiguous treatment of tolling in the environmental document makes it difficult to determine its impacts in comparison to other alternatives and to assess a full range of needed mitigations. Tolling is not considered an official project element in the SDEIS alternatives selection and comparative analysis; however, the fact that it is projected to change behavior for 50% of travelers who would otherwise use the tunnel, while recognized, does not appear to be given any weight in project development or design.

A description of the Alaskan Way Viaduct Replacement Project history through January 2009 is provided by WSDOT on their project website.[6]

C. How Did We Get Here?

A review of the transition from the Partnership Process to where the AWVRP stands today is important historical context when gauging project direction.

From Partnership Process Decision to EIS Process

Following the Executives' recommendation issued in early 2009, WSDOT and the City of Seattle were required to commence work on the Second Supplemental Draft Environmental Impact Statement for the AWVRP in accordance with NEPA regulations. This process requires the development of a project purpose and need statement, a screening of alternatives, and a detailed analysis of a viable range of alternatives to select a preferred project alternative. An initial release of this work is documented in the AWVRP 2010 SDEIS.

There were several decisions that occurred at this point that are worth recognition:

[5]. The AWVRP 2010 SDEIS provides a rationale for not evaluating a tolled tunnel alternative in Chapter 9: Tolling, p. 205. (See #3.)

[6] http://www.wsdot.wa.gov/NR/rdonlyres/1F6CC069-5199-4787-9283-16142CFB308A/0/AWVProjectHistoryReport_Sept09.pdf.

- The Partnership Process' use of a broader Center City study area that allowed for analysis of system approach alternatives was not adopted; like the 2006 SDEIS, the 2010 SDEIS uses a study area that encompasses the corridor and a narrow boundary on either side (a map of the Partnership Process study area is included in Figure 1-3).
- The Guiding Principles developed in the Partnership Process were not integrated into the official purpose and need statement for the project.
- Facility tolling, based on direction from the legislature became a project feature that was evaluated in the SDEIS, but was not considered in the formal comparison of alternatives.

The Alaskan Way Viaduct Replacement Project 2010 SDEIS defines the purpose and need of the project as:[7]

- Reduce the risk of catastrophic failure in an earthquake by providing a facility that meets current seismic safety standards
- Improve traffic safety
- Provide capacity for automobiles, freight, and transit to efficiently move people and goods to and through downtown Seattle
- Provide linkages to the regional transportation system and to and from downtown Seattle and the local street system
- Avoid major disruption of traffic patterns due to loss of capacity on SR 99
- Protect the integrity and viability of adjacent activities on the central waterfront and in downtown Seattle

The AWVRP 2010 SDEIS purpose and need statement is a fundamental policy shift from the AWVSR Partnership Process Guiding Principles (listed earlier). Most importantly, the AWVSR Partnership Process focused on the "efficient movement of people and goods," recognizing that Seattle must accommodate greater mobility and provide access for many more people by making more efficient use of existing street rights-of-way and shifting travel patterns and demands.

Private automobiles lose efficiency as a means of personal mobility as a city becomes denser. This is a matter of geometry, not politics or philosophy. The 2010 purpose and need statement changed the project focus by shifting the key planning principle to "providing *capacity* to move people and goods" (emphasis added). While this may seem like a verbal nuance, the difference is important. The SDEIS alternative selection is based on a stated need to maintain highway lane capacity, primarily to bypass the Center City, almost regardless of travel demand or consumer needs. Because highway lane capacity, not function, is stressed in the purpose and need statement, the decreased efficiency of a tolled tunnel does not affect alternative selection.

In 2009, consistent with the Executive recommendation from the Partnership Process, the City of Seattle agreed to the current AWVRP 2010 SDEIS purpose and need statement as a co-lead for the AWVRP.

[7] *AWVRP 2010 SDEIS, Chapter 3, pg. 53*

Because the AWV was constructed as a single link in a freeway system that was never completed, its value is constrained to a relatively limited travel market. From our perspective, the current purpose and need devalues the question of what market connections and mobility needs the transportation project is trying to solve in the interest of maintaining the facility. That said, the purpose and need statement is the guidance for project decision making.

Figure 1-2 attempts to illustrate key differences between the Partnership Process Guiding Principles and the 2010 SDEIS purpose and need statement.

Figure 1-2 Comparison of 2010 Purposes and Need and 2008 Guiding Principles

	Partnership Process Guiding Principles (2008)	2010 SR 99 Bored Tunnel SDEIS Purpose & Needs
Reduce seismic vulnerability	PR	N
Improve traffic safety	PR	P; N
Bicycle and pedestrian safety and accessibility	PR	
Provide capacity to move people and goods		P; N
Provide efficient movement of people and goods	PR	
Provide transportation system linkages	PR	N
Avoid major disruption of traffic patterns due to loss of capacity		N
Protect the integrity and viability of adjacent Activities on the Central Waterfront and in downtown Seattle	PR	N
Maintain or improve downtown Seattle, regional, and state economies	PR	
Develop fiscally responsible solutions	PR	
Foster an environmentally sound approach (emphasis on climate change initiatives)	PR	

KEY: P = Purpose, N = Need, PR = Principle

NOTE: EIS purpose and need statements do not address economic concerns, so items related to economic conditions are naturally omitted in the NEPA process.

Another important consideration is the project study area boundary. The Urban Mobility Plan identified the use of a narrow highway corridor study area in the 2006 DEIS as problematic given the complex nature of the urban transportation system and multiple travel corridors parallel to SR 99. Consequently, a broader study area was adopted for the UMP and used in 2008 Partnership Process. However, the 2010 SDEIS returned to a narrow study corridor similar to that used in 2006.

Together, the purpose and need of the project and the narrowed study area almost explicitly disallow consideration of transportation systems solutions, including ST5 alternatives. The focus on maintaining vehicle capacity within this narrow corridor sets up the exclusion of any alternative that makes better use of existing surface street capacity and shifts travel to other modes. The SDEIS summarily dismisses surface transportation and transit based on the following points[8]:

- Mobility for trips heading to and through downtown would be reduced, and for some trips, travel times would increase substantially compared to existing conditions or bypass concepts
- North-south capacity would be reduced, resulting in added congestion on city streets and I-5

Figure 1-3 Study Area for Partnership Process Systems Planning Approach

Source: WSDOT, Alaskan Way Viaduct Replacement Project History, Chapter 2, p. 26.

A ST5 alternative would represent a change in transportation policy at the local, regional and state levels. The comparison between an infrastructure-heavy alternative, like the deep-bore tunnel or the existing Viaduct, and a multimodal systems approach such as a ST5 alternative is a comparison that is laden with value-based public policy tradeoffs. These types of comparisons are easily laid out and debated in the public arena, but the comparisons are severely limited when faced with the statutory necessities imposed by NEPA and the modeling requirements established by the Federal Highway Administration (FHWA); that is, project-level modeling must use the same basis to model project benefits and impacts as used by the regional MPO (PSRC) to forecast future traffic conditions in the region. The regulations and case law surrounding these comparisons tend to limit comparisons based on community value assessments or the use of evaluative tools that are not in common use for transportation projects.

The AWVRP 2010 SDEIS purpose and need statement establishes the criteria for evaluation of alternatives. In the final analysis, the ST5 alternative requires the functional implementation of many policies that are not currently adopted or even under consideration. While some may wish that these policies were endorsed and adopted at the City, Regional, and State levels, the EIS process and FHWA-required modeling process do not consider aspirations. Instead, the evaluation is constrained to what is known and how well each alternative fulfills the purpose and need statement. Based largely on the purpose and need focus on "maintaining capacity," it was determined that the ST5 alternative does not meet this key element of the project purpose and need.

[8] *AWVRP 2010 SDEIS, Chapter 3, pg 54*

While the dismissal of ST5 may meet NEPA process requirements, its early dismissal in the SDEIS process is questionable given that it was among the two options identified as most viable and beneficial in the Partnership Process. This is particularly poignant given the application of tolling, which was considered as a "building block" element early in the Partnership Process, but ultimately identified as beyond the scope of the project and dropped from consideration. Consequently, tolling was not considered as a project element in establishing the "hybrid" scenarios which included the ST5 and Deep Bored Tunnel alternatives. The appearance of tolling in the SDEIS dramatically changes the nature of a deep bored tunnel project and the comparison between alternatives, which was completed absent any tolling or pricing component.

It is important to remember that while NEPA regulations structure the EIS documentation; ultimately, the EIS process is to identify environmental impacts. The selection of a final alternative remains a broader process reliant on local and state decision makers and consideration of issues beyond those confined to the NEPA process.

2 A TOLLED DEEP BORED TUNNEL

A. Tolling the Tunnel – What Does It Mean for Seattle?

The Partnership Agreement Letter of Understanding (January 2009), signed by the State of Washington, City of Seattle and King County executives, and the Alaskan Way Viaduct and Seawall Replacement Program Executives' Recommendation (June 2009) establish the deep bored tunnel as the most favored alternative for replacing the earthquake-vulnerable Alaskan Way Viaduct. Neither document mentions tolling or implies that tolling is considered a potential funding strategy. Analysis of tolling conducted as part of the Partnership Process suggested that tolling would be most effective if developed as part of a regional strategy, rather than being applied to a single facility. For this reason partner agencies chose to drop tolling from the discussion of solutions for replacing the AWV.

The Executives' agreement outlined the responsibilities of each agency partner with respect to funding and project development of the tunnel and other project elements. The State committed to funding $2.82 billion as part of the project with no mention of using tolls as a possible revenue source. In the 2009 session of the State Legislature, after the partnership agreement documents were signed, a funding gap was identified and tolling was proposed as an additional revenue source to back revenue bonds to close this gap. The January 15, *2010 Cost and Tolling Update Report to the Washington State Legislature* provides some insight into how the amount of needed tolling revenue was determined. An inventory of committed State, Federal and local funding resources, weighed against an updated cost estimate, found the State to be $400 million short of its $2.82 billion dollar commitment to the project. The Legislature suggested that this financial gap be filled by tolling the facility and directed WSDOT to report back in the 2010 session, with the necessary toll levels and any impacts.

Although tolling has been suggested by the Legislature as a necessary component of project financing, no legislative action has been taken and tolling is not fully evaluated in the SDEIS (i.e., it is not considered an element of project alternatives). Chapter 9 of the 2010 SDEIS provides an explanation as to why tolling is not fully evaluated as part of the project: [1]

> *"Legislative action is required to toll this facility, so the evaluation of the untolled Bored Tunnel Alternative in this Supplemental Draft EIS accurately reflects the current status of the project. Including a tolled alternative in this Supplemental Draft EIS would be premature for three additional reasons (see below).*

[1] AWVRP 2010 SDEIS, Chapter 9: Tolling, p. 205

1. ***A tolled alternative would impede the decision-making process by blurring the distinction between the alternatives.*** *This Supplemental Draft EIS is intended to inform the lead agencies' decision-making process as they choose a replacement for the Alaskan Way Viaduct along the central waterfront. This is done by documenting the potential environmental effects of the Bored Tunnel Alternative, and making an apples-to-apples comparison of these effects with the potential effects of the Viaduct Closed, Cut-and-Cover, and Elevated Structure Alternatives. Tolling one or more of these alternatives makes this apples-to-apples comparison difficult, since the effects of tolling, in some cases, cannot be separated from the effects of the replacement facility.*

2. ***None of the facilities require tolling to operate, yet all of the facilities could operate if tolled.*** *Since tolling is not a required element of any of the alternatives, but could be applied to any alternative, if needed, it is better evaluated as a design option available to all alternatives, rather than as an integral part of the design of any individual alternative.*

3. ***Unlike the design of the replacement facilities, the tolling approach is expected to change as needed in the future.*** *Tolling is a revenue-generation and traffic management strategy that must have the flexibility to adapt to changing travel patterns. These changes will require additional analysis and public involvement. The decisions regarding toll approach, therefore, are necessarily on a shorter-term planning horizon than choosing the replacement facility for the viaduct and should not be paired with a facility in the form of an alternative."*

The first point in this list recognizes that tolling a highway facility can fundamentally change the mobility function and benefits of the project. The third point then goes on to say that tolling is a short-term mechanism and should not be considered as part of the project. This conclusion is concerning in the light of a string of recent tolled highway projects where traffic diversion due to tolling has caused financial underperformance. Given that tolling diversion is projected to be high (approximately 50% of users) and other toll road projects in the Northwest and around the world have underperformed, how would this gap be filled if the SR 99 deep bored tunnel does not meet projections? Would tolling be expanded to other facilities to pay for the SR 99 tunnel? Would state gas tax revenues be used to back revenue bonding not covered by toll revenue?

The limitations of the SDEIS process made it impossible to fully evaluate the impacts of a tolled facility on the City of Seattle or on the cost effectiveness of this major investment strategy. However, the analysis that is included in the SDEIS makes clear that additional analysis is necessary to fully understand the impacts of a tolled tunnel.

> *"If the Washington State Legislature decides to use tolling to fund a portion of the project, potential effects of tolling need to be evaluated and documented. This Supplemental Draft EIS evaluates the potential effects of*

three toll scenarios, as explained below in Question 6, to the extent that tolling is understood at this time.[2]”

Despite the question of whether tolling is or isn't included in the project, the SDEIS presents what appears to be a reasonable framework for how traffic would respond to a tolled facility. The *WSDOT Cost and Tolling Study* (January 2010) estimated the level of tolling necessary to meet revenue targets dictated by the project funding need to retire $400 million in bond debt. Projected toll rates needed to meet that requirement ($4.21 during peak hours and $2.44 at off peak times) are high enough to cause diversion. For this analysis, WSDOT enlisted the aid of leading experts in modeling for tolled freeway facilities, so there is reason to believe that these numbers are reasonably accurate for planning purposes. The need to be conservative (on the high side) when projecting traffic diversion is supported by many recently opened toll roads, bridges and tunnels have underperformed against traffic projections (see two examples on following pages). Figure 2-1 presents a brief digest of the three toll scenarios carried through in the SDEIS analysis including toll rates and expected traffic volumes.

Figure 2-1 Toll Levels and Traffic Volumes for Various Alternatives

Bored Tunnel With:	Toll Level			Alaskan Way @ Seneca	Surface Street AW to I-5	I-5	Surface Streets East of I-5 @ Seneca	Total Elliott Bay to Lake Washington @ Seneca	SR 99 Tunnel	Percent Average Daily Traffic Diverted
	Low	Average	High							
No Toll	0	0	0	15,800	117,100	263,900	139,100	535,900	86,000	-
Toll A	$0.84	$2.16	$3.37	22,400	133,300	277,700	150,200	583,600	46,700	46%
Toll C	$0.84	$2.44	$4.21	22,900	135,200	279,100	152,000	589,200	41,600	52%
Toll E	0 *	$1.87	$2.35	17,300	120,600	266,300	143,000	547,200	77,400	10%

Source: AWSRP 2010 SDEIS, Chapter 9

Notes: *No off-peak toll in Toll Scenario E.

One footnote to the SDEIS tolling analysis is extremely important. The tolling analysis was based on only the SR-99 Alaskan Way Viaduct Replacement (including Holgate to King and King to Roy) project being completed. A very important connection for SR-99 between Alaskan Way and Elliott/Western was not contemplated as part of this traffic/tolling forecast. This connection is not part of the SR 99 Alaskan Way Viaduct Replacement Project as defined for the SDEIS. The Alaskan Way to Elliott/Western Connector is a City project that will be covered in a separate environmental document. This connection will be constructed if a tunnel is built and would create another option for drivers to bypass the tunnel. Had it been included in the tolling evaluation even more tunnel users would likely have diverted to city streets. The SDEIS concurs that "These improvements would provide an attractive alternative to the bored tunnel for some drivers, which could lead to increased diversion from SR 99 if it [the tunnel] were tolled."[3]

[2] AWVRP 2010 SDEIS, Chapter 9: Tolling, p. 205. Note Question 6, to which this refers is on page 207 and refers to tolling alternatives studied for the corridor.

[3] AWVRP 2010 SDEIS, Chapter 9: Tolling, p. 208

The State did model the 2015 Program (including the Elliott/Western Connector) with Toll Scenario C, but the results are not included in the SDEIS.[4] In the model forecast including the connector, 38,000 daily trips use the tunnel, compared to 86,000 without a toll. The State's analysis suggests that with the planned Elliott/Western connector tolling diversion from the tunnel could be as high as 55% of daily traffic, versus approximately 50% without the connector.[5]

[4] This analysis was provided to the authors by WSDOT in preparation for reviewing the SDEIS.

[5] AWVRP EMME Plots showing volumes for Deep Bored Tunnel Toll Scenario C (2015) provided by WSDOT (analysis conducted by Parsons Brinkerhoff).

A Tale of One Tunnel: CLEM7

Brisbane North-South Bypass Toll Tunnel

The recent opening and early operations of a tolled highway bypass tunnel project in Brisbane, Australia (population just over 2 million in 2010) provides a cautionary tale for Seattle. This project description is not provided to suggest that modeling done for WSDOT as part of the SDEIS is faulty, but rather to support the preliminary findings that toll rates in the $3.00 - $4.00 range can cause diversion rates of 50% of average daily traffic or higher.

The Clem Jones (CLEM7) tunnel is a new bored tunnel bypass in Brisbane, Australia. The tollway is 6.8 km (4 miles) in length with twin 4.8 km (3 mile) 2-lane bored tunnels.[a] The tunnel was designed to provide a traffic bypass to surface roadways in the center city that have about 24 signalized intersections, with a potential travel time savings estimated at 15 minutes. (To be fair, in comparison to the AWV, the CLEM7 Tunnel did not replace a current highway segment.) The project was delivered 7 months ahead of schedule at a cost of $3.0 billion.[d] The project has been contentious due to use levels far below estimates. A report delivered to investors on Sept 21, 2006 by a consultant working on the tunnel project forecast an estimate of 90,000 average daily traffic within six months of opening. A separate report delivered to the City forecast a lower 58,000 average daily traffic. Volumes were forecast to exceed 100,000 daily trips within 18 months of opening.[b]

However, the CLEM7 tunnel is carrying traffic at about one-third to one-half of projected levels and toll revenues receipts are running at less than a third of projections. When the tunnel opened a year ago (March 2010), traffic was allowed toll-free for the first three weeks, with a planned toll level of $4.28. Traffic averaged nearly 62,000 vehicles on weekdays. Even with discounted tolls of $3.50 and then $3.00, weekday traffic dropped to 20,600 and remained at that level. The operating company was forced to reduce the toll to $2.00 in July 2010; traffic increased to 26,000 vehicles each weekday.[c] Traffic volumes have ranged from about 28,000 to 34,000 vehicles since the toll reduction. Tolls were increased to $3.00 as of November 15, 2010 and are scheduled to increase from $3.00 to $3.95 on April 4, 2011.[a]

As a result of usage (and toll revenue) that is still far below projections, RiverCity Motorway has been unable to make interest payments on $1.3 billion in debt. Its stock (nearly $690 million raised in 2006) is nearly worthless and it went into receivership in February 2011.[d]

While conditions are arguably different in a number of ways, this project does show that travelers will divert from tolled roadways at high rates where parallel travel opportunities are available.

Sources:

a. RiverCity Motorway Website, http://www.rivercitymotorway.com.au/content/2036/Clem-Jones-Tunnel
b. RiverCity Motorway Investor Presentation, May 10, 2010. http://www.rivercitymotorway.com.au/userfiles/file/ASX%20Announcements/Investor%20Presentation_10%20May%202010.pdf
c. http://www.brisbanetimes.com.au (Various articles)
d. http://www.abc.net.au (Various articles)

A Northwest Toll Facility Example: The Golden Ears Bridge

TransLink, the regional transportation authority in the Vancouver, B.C. region, opened the new Golden Ears Bridge and a supporting 14-kilometer road network in June 2009. This new toll bridge was designed to provide a quick link from Pitt Meadows and Maple Ridge to Langley and Surrey. A ferry route that previously served this crossing was decommissioned when the bridge opened.

Bridge users have the option of opening a tolling account that provides them use of an electronic tolling device, or transponder, that is mounted on the vehicle's windshield. The transponder detects usage of the bridge, allowing toll charges to be automatically billed to the driver's account. Vehicles without an electronic tolling device have their license plates identified through an automated video recognition system, and are billed accordingly. Toll rates vary depending on method of payment. Those with an electronic toll device pay $2.80 per crossing while those without a device pay between $3.35 and $3.95.[a]

The total project costs were over $800 million dollars. TransLink is paying for the project with revenue from tolls and a $5.2-million annual subsidy redirected from the now-closed Albion Ferry. However, revenue is falling behind the debt payments. TransLink documents say the monthly payment to Golden Crossing, the consortium that built the bridge, will increase from $3 to $4 million in July 2011. Translink is also required to pay for $166 million—up to $14 million a year— in direct financing costs for property acquisition, toll equipment, project development and third-party commitments.[b]

Traffic projections for the bridge estimated that with initial toll rates, the bridge would carry about 30,000 daily vehicles. After a year of operation, traffic volumes have leveled out at approximately 22,000 – 23,000 daily vehicle trips and toll revenues are 17% below projected.[cd] Officials have been surprised by the lengths that some travelers are apparently going to avoid the tolled facility, including making trips up to an hour longer to use the Port Mann bridge. TransLink has estimated there will be a $33-million shortfall in 2011 as toll revenues will fall short of what TransLink is obligated to pay.

It is also reported that the BC Trucking Association has weighed in that the cost of transponders ($10.00 refundable lease) and tolls ($8.40 to $9.50 for large trucks) may be driving truckers to the Port Mann or other Fraser crossings.[d]

The lesson learned from this series of events has one thematic parallel to the SR 99 bored tunnel: traffic will divert from a tolled facility if there are parallel routes available. In some of the parallel routes reportedly accessed to avoid the Golden Ears bridge, the time penalty is substantial.

Sources:

a. Translink Project Website: http://www.translink.ca/en/Driving/Golden-Ears-Bridge.aspx
b. Maple Ridge Times reporting: http://www.mrtimes.com/business/Golden+Ears+bridge+tolls+meeting+targets/4308091/story.html#ixzz1Jl8Y73Rg
c. Vancouver Sun reporting: http://www.vancouversun.com/Golden+Ears+toll+reduced+cent/4559303/story.html#ixzz1Jl9WVSvd
d. Reporting from Transport Action BC: http://transportactionbc.wordpress.com/2010/06/14/golden-ears-bridge-traffic-below-forecasts/

B. How Does Tolling Change Project Performance?

According to analysis conducted by WSDOT and documented in the Alaskan Way Viaduct Replacement Project 2010 SDEIS, the preferred tolling scenario studied would divert traffic from the tunnel to parallel Center City surface streets, I-5, and streets east of I-5 if the tunnel is tolled to the degree necessary to support the proposed funding.[6] When compared with a non-tolled tunnel, tolling scenarios that cover the bond debt, in this case SDEIS Toll Scenario C, have the following diversion impacts:

- 40,000 to 48,000 daily vehicle trips diverted to surface streets and I-5
- 16,000 to 18,000 of those daily trips are diverted to downtown surface streets
- 15,000 of the trips find their way to I-5
- 1,500 more PM peak hour vehicle trips traveling through Pioneer Square as a result of diversion

Since tolling is not officially part of the SDEIS project definition, no mitigation solutions are offered. However, mitigation would be needed in a tolled tunnel scenario and should be considered as part of the project cost.

SDEIS Exhibits 9-9, 9-11, 9-12, and 9-13 compare traffic volumes on SR 99, City surface streets, Alaskan Way, and I-5 for the Bored Tunnel alternative (no tolls) and three possible tolling scenarios. For the purpose of this analysis, we assume that impacts related to Toll Scenario C are most relevant, as it is the tolling scenario that delivers revenue commensurate with financial plan revenue needs.

Figure 2-2 reproduces the SDEIS Exhibits 9-9, 9-11, and 9-13, providing these traffic volume comparisons for baseline conditions, the Bored Tunnel alternative (No Tolls), and Toll Scenario C.

[6] WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, p. 214

Figure 2-2 Comparison of 2015 Vehicle Volumes

		BORED TUNNEL		CHANGE FROM BASELINE 2015	
	Existing Viaduct	No Tolls	Toll Scenario C	No Tolls	Toll Scenario C
2015 Vehicle Volumes at Screenlines on Parallel Arterials					
Harrison Street Streets between Elliott Bay & Aurora	103,500	106,500	131,300	2.9%	26.9%
Harrison Street Streets between Aurora & I-5	71,600	81,600	80,500	14.0%	12.4%
Seneca Street Streets between Alaskan Way & I-5	117,100	117,100	135,200	0.0%	15.5%
Seneca Street Streets between I-5 & Lake Washington	138,300	139,100	152,000	0.6%	9.9%
S. King Street Streets between SR 99 & I-5	81,000	103,200	120,100	27.4%	48.3%
S. Spokane Street Streets between SR 99 & I-5	109,800	114,100	131,000	3.9%	19.3%
2015 Vehicle Volumes at Screenlines on Alaskan Way					
North of Pine	11,700	15,100	22,300	29.1%	90.6%
North of Seneca	10,200	15,800	22,900	54.9%	124.5%
South of S. King	26,500	30,300	36,900	14.3%	39.2%
2015 Vehicle Volumes at Screenlines on I-5					
South of SR 520	317,800	318,300	320,700	0.2%	0.9%
North of Seneca	262,600	263,900	279,100	0.5%	6.3%
South of I-90	270,400	272,800	282,400	0.9%	4.4%

Source: WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, Exhibits 9-11, 9-12, and 9-13, p. 214

The SDEIS analysis also shows that a tolled tunnel performs worse on a number of other critical transportation performance measures. Figure 2-3 provides the modeled results for the Seattle Center City area. VMT decreases in both tolled and non-tolled bored tunnel scenarios compared to baseline 2015 levels, while vehicle hours traveled (VHT) and vehicle hours of delay (VHD) increase. While VMT decreases by slightly less than 1.5% for both scenarios, there are more significant differences between the no toll case and Toll Scenario C, with larger increases in VHT and VHD in Toll Scenario C. The SDEIS attributes the difference to anticipated traffic diversion on slower surface facilities that are likely to be congested during peak hours.

Figure 2-3 Comparison of VMT, VHT, and Hours of Delay for Seattle Center City

		BORED TUNNEL		CHANGE FROM BASELINE 2015	
	Existing Viaduct	No Tolls	Toll Scenario C	No Tolls	Toll Scenario C
2015 Vehicle Miles Traveled (VMT)					
AM	433,100	427,100	427,600	-1.4%	-1.3%
PM	537,500	530,700	529,900	-1.3%	-1.4%
Daily	2,432,700	2,407,500	2,397,000	-1.4%	-1.3%
2015 Vehicle Hours Traveled (VHT)					
AM	16,800	17,200	18,400	2.4%	9.5%
PM	23,200	24,600	26,700	6.0%	15.1%
Daily	87,200	88,600	94,900	1.6%	8.8%
2015 Vehicle Hours of Delay (VHD)					
AM	5,300	5,700	6,600	7.5%	24.5%
PM	9,100	9,900	11,800	8.8%	29.7%
Daily	22,700	24,400	29,600	7.5%	30.4%

Source: Adapted from WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, Exhibits 9-3, 9-4, and 9-5, p. 208

By comparison, there are relatively small increases in all four measures for the four-county region, shown in Figure 2-4. The SDEIS finds that the relatively small percentage increase in delay in the tolled scenario is not "meaningfully different" from the bored tunnel without a toll.

Chapter 3 discusses some reasons why travel demand modeling results for this project should be considered with caution.

Figure 2-4 Comparison of VMT, VHT, and Hours of Delay for Four-County Region

		BORED TUNNEL		CHANGE FROM BASELINE 2015	
	Existing Viaduct	No Tolls	Toll Scenario C	No Tolls	Toll Scenario C
2015 Vehicle Miles Traveled (VMT)					
AM	18,028,300	18,021,600	18,035,200	0.0%	0.0%
PM	21,233,700	21,230,700	21,245,700	0.0%	0.1%
Daily	97,233,000	97,225,200	97,259,500	0.0%	0.0%
2015 Vehicle Hours Traveled (VHT)					
AM	747,200	747,800	749,800	0.1%	0.3%
PM	858,100	859,300	863,000	0.1%	0.6%
Daily	3,311,100	3,313,800	3,324,000	0.1%	0.4%
2015 Vehicle Hours of Delay (VHD)					
AM	253,500	254,200	255,400	0.3%	0.7%
PM	271,700	272,800	275,600	0.4%	1.4%
Daily	678,200	680,300	687,700	0.3%	1.4%

Source: WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, Exhibits 9-3, 9-4, and 9-5, p. 208

C. What are the Impacts of a Tolled Tunnel that Require Mitigation?

Traffic diversion from the SR 99 bored tunnel creates a number of impacts that need to be mitigated. Some impacts from projected traffic diversion are identified in the SDEIS Chapter 9 (Tolling Analysis). Being careful to tie impacts only to tolling and not the project, the SDEIS states that the following effects would be "not acceptable" as part of a "long-term tolling solution." These include:

- Slower travel times on north and southbound arterials in downtown Seattle
- Increased intersection delays at a number of downtown intersections particularly those in Second and Fourth Avenues, including the intersections of: Second and Marion, Second and Spring, Second and Pine, Second and Virginia, Fourth and Columbia, Fourth and Madison, Fourth and Marion, Fourth and Spring, and Fourth and Seneca
- Disproportionately high impacts on low-income populations including higher travel costs, decreased reliability, and increased travel times
- Increased traffic volumes on Alaskan Way through the Central Waterfront during mid-day times when visitation is high and pedestrian volumes are at peak levels

The SDEIS applies a uniform approach in dealing with these "not acceptable" impacts. For each the SDEIS states, "Therefore other scenarios would be evaluated and reasonable optimization measures would be applied and analyzed before tolling would be implemented," or "Therefore other scenarios would be evaluated and reasonable optimization measures would be applied and analyzed before tolling would be implemented." These examples are quoted from pages 215 and 219 of the SDEIS, which discusses surface street travel time impacts and impacts on low-income populations.

Other impacts of tolling diversion are important to the City of Seattle. These include:

1. Increased traffic in Center City neighborhoods, particularly the Pioneer Square historic district
2. Increased delay and reduced reliability for critical transit services, resulting in lower transit ridership
3. Threatened progress toward State and City of Seattle greenhouse gas emission reduction goals
4. Potential impacts on transportation affordability and convenience for vulnerable populations

The SDEIS tolling analysis compares the impacts of various tolling options for the Deep Bored Tunnel alternative, but not the use of tolling compared to a tolled baseline alternative or across a range of other project alternatives which could have included a ST5 alternative. This observation is completely consistent with the explanation provided in the SDEIS and quoted earlier in this section. The SDEIS states that a tolled comparison against other infrastructure alternatives, e.g. a re-built viaduct, would have similar results. The Partnership Process did analyze a ST5 scenario with tolling and found that it performed well.

The following sections briefly summarize some critical impacts of tolling. More detailed analysis of each issue is included in Appendix A. Each of these issues needs to be fully reconciled in the design and funding elements of a final project. Currently none are fully resolved.

1. Increased Traffic Volumes and Congestion in Center City Neighborhoods

Tolling an SR 99 deep bored tunnel would increase traffic volumes in the City's historic neighborhood, Pioneer Square, compared to non-tolled tunnel. Pioneer Square's location in relation to the South Portal ensures that any Center City traffic diversion will be concentrated in this historic district before diffusion into the broader transportation system or convergence to return to the SR 99 corridor. To ensure pedestrian safety and comfort and to protect small businesses in Pioneer Square, improvements to the pedestrian environment and traffic calming measures are needed.

WSDOT's modeling for the SDEIS tolling analysis projects that 16,000 to 18,000 daily vehicles will divert from the tunnel and use Center City streets in order to access neighborhoods on the opposite side of downtown. In total approximately 1,500 additional vehicles will travel through Pioneer Square during the PM peak period.[7] However, diversion rates are actually higher as a percent of total traffic during the

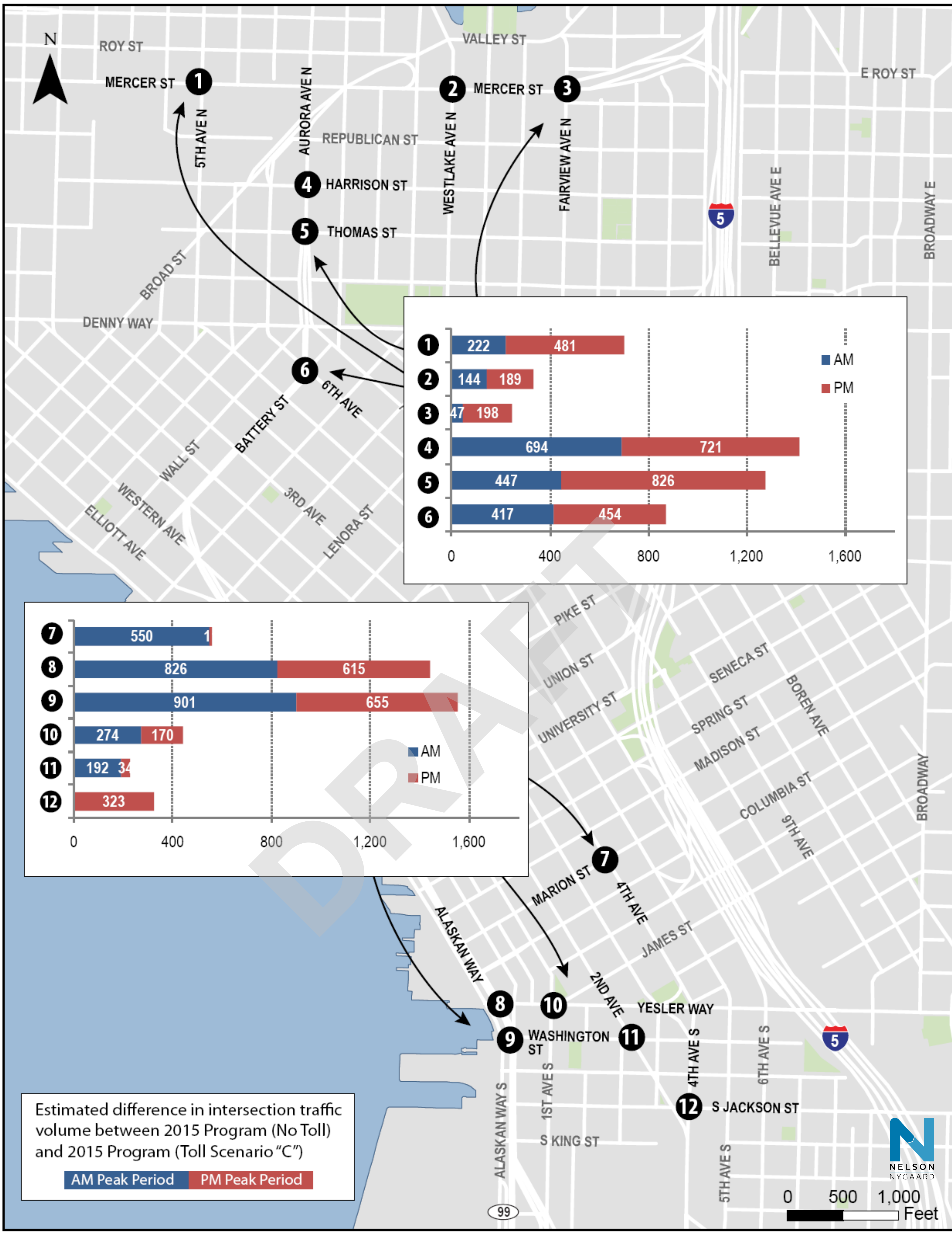
[7] The 1,500 vehicles number was calculated by evaluating the difference in the number of vehicles crossing an artificial cordon that roughly matches the Pioneer Square neighborhood boundary between the Bored Tunnel alternative and the Bored Tunnel Toll Scenario C.

midday period, at a time when there is typically relatively moderate traffic volume on streets in this area. This added traffic will place a burden on Pioneer Square's residents and businesses, who depend upon the district's longstanding pedestrian-friendly, walkable environment; it could also denigrate the quality of the street environment in one of Seattle's most important and fragile retail/small business districts. The net increase in traffic will also increase the likelihood of pedestrian conflicts, especially in locations where a high increase in both vehicle and pedestrian volumes is expected; this includes the full length of First Avenue in Pioneer Square as well as portions of S. Jackson Street, Second Avenue Extension, and Fourth Avenue. Tolling diversion effects on the pedestrian environment in Pioneer Square are not called out in the SDEIS as one of the "not acceptable" consequences of a tolled tunnel. The level of analysis in the SDEIS does not examine the contextual nuance of traffic impacts, such as the type of businesses reliant on street users for access, or the pedestrian orientation of the street design and fronting businesses.

Another important point that is not mentioned in the SDEIS is that all the worst points of surface street congestion in Seattle Center City are caused by highway ramps (and to a lesser degree Seattle's intersecting grids). Surface street traffic signals act as meters for highway access; at peak periods traffic often queues on surface streets, impeding local circulation. A transportation solution that relies on a few ramps to access a high-volume, limited access freeway will increase traffic in portal areas. A toll that encourages drivers to divert at each portal will heighten this impact.

Figure 2-5 illustrates a sample of intersections in each portal area that are most impacted by tolling diversion as modeled for the SDEIS. The graphic shows the number of additional vehicles expected to enter various intersections in 2015 with the Toll Scenario C levels of tolling compared with a non-tolled tunnel.

Figure 2-5 Highest Tolling Diversion Impacted Intersections (AM and PM Peak Periods)



GIS Data Source: Seattle DOT

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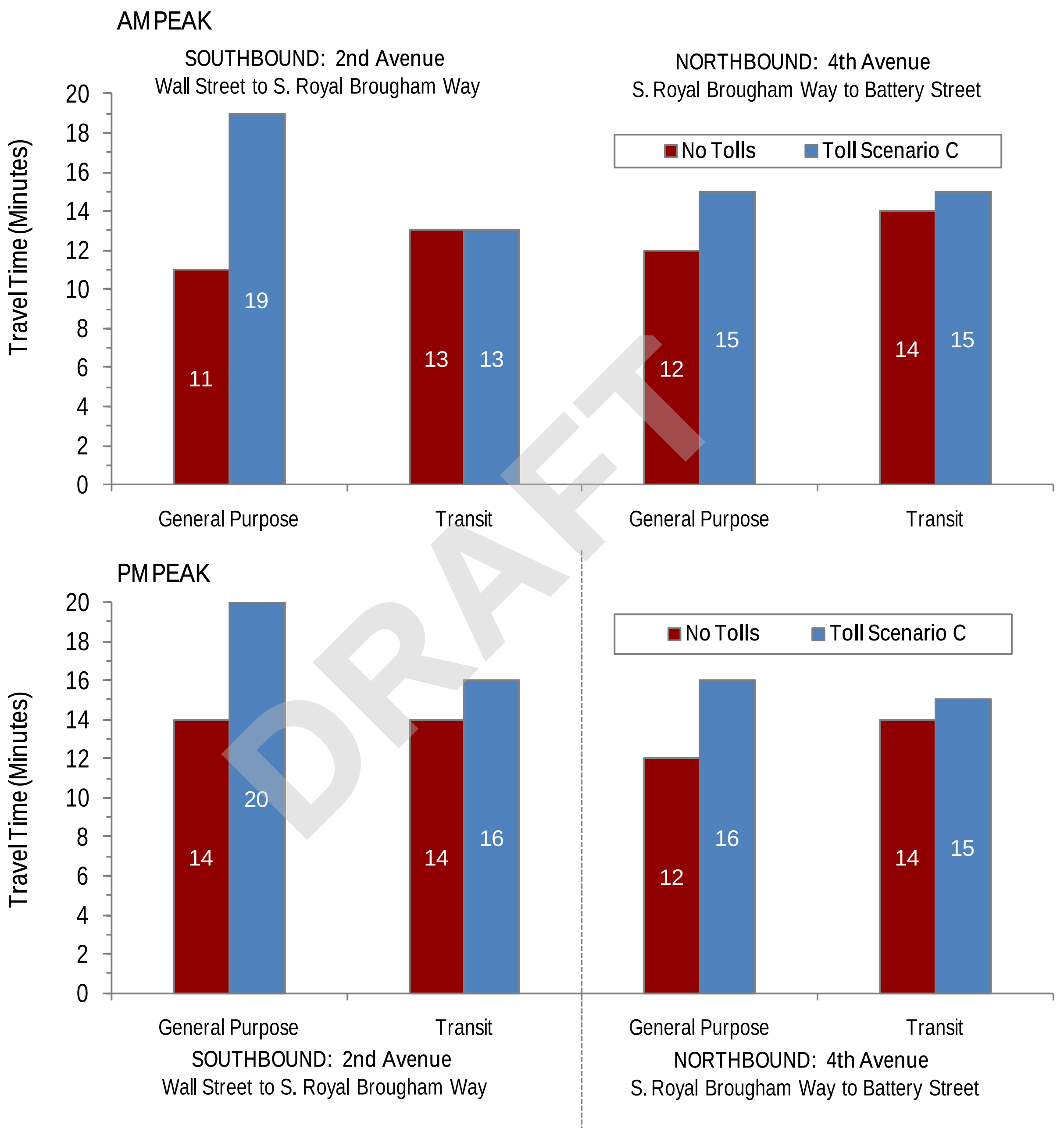
2. Increased Delay and Reduced Reliability for Critical Transit Services

This report is being written at a time when King County Metro is facing one of the most difficult financial periods of its existence as a transit provider. Any increase in operating costs to maintain existing levels of service (e.g., due to increased delay on transit-carrying streets over the next decade), will mean less service is provided in some part of the Metro system. The SDEIS establishes that surface street conditions, particularly at the tunnel portals will be sub-optimal as a result of the project and the need to toll the project as part of the financing package. The SDEIS clearly states that optimization of surface traffic will be required.[8] The SDEIS finds that a tolled tunnel would create an additional one to two minutes of delay for buses operating on Second and Fourth Avenues between SODO and Belltown. This finding seems like a low estimate given that transit operates in traffic and in dedicated transit lanes that share turning movements with vehicles on these streets. The "skip stop" operation on all major downtown transit streets also relies on a relatively free flowing adjacent general purpose travel lane to facilitate buses being able to pass another stopped bus. Additional auto queuing in these lanes will increase transit delays. Considering that over 200 buses use these corridors during a peak hour,[9] even small increases in delay will have a substantial impact on operating costs.

[8] e.g., p. 215 of the SDEIS.

[9] Based on 2007 data collection by Nelson\Nygaard at 2nd Avenue & Marion Street and 4th Avenue & Pike Street, between 4:30 pm to 5:30 pm.

Figure 2-6 Comparison of Travel Times for General Purpose Travel and Transit with Untolled Bored Tunnel and Toll Scenario C, for AM Peak and PM Peak



Source: WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, Exhibit 9-17

Increased travel time could also have a negative impact on ridership and is most likely to impact people that are dependent on transit for financial reasons or due to disability. In particular, low-income travelers that use transit to travel through downtown will be put at a disadvantage by a tolled tunnel. The underutilized tunnel will provide a rapid bypass option for those who can afford the toll. Those who cannot will need to use slower surface routes, a more congested I-5 freeway, or transit that may be subject to increased delay.

Demographic profiles from the City of Seattle's Transit Master Plan, included in Appendix A, show that the SR 99 corridor travel markets include areas with among the highest concentrations of low-income people, people with disabilities, and seniors over the age of 65 in Seattle. Vulnerable populations living in the SR 99 corridor may also be among those in the city most likely to face challenges accessing transit.

Transit improvements including increased service frequency, access improvements, shorter travel times, and single-seat trips through downtown could be a meaningful way for the project to address impacts on vulnerable populations. No such improvements are recommended in the SDEIS.

3. Threatened Progress Toward City and State Adopted Greenhouse Gas Reduction Goals

State law[10] requires the reduction of per capita vehicle miles traveled as part of a framework for reducing greenhouse gas (GhG) emissions. House Bill 2815, which went into effect in 2008, requires a 50% reduction in per capita VMT by 2050, setting as interim benchmarks an 18% reduction by 2020 and a 30% percent reduction by 2035. These aggressive benchmarks present an opportunity, if not a mandate, to consider strategies that reduce overall per capita travel demand in Seattle (e.g., parking management, TDM and transit improvements). Furthermore, tolling diversion increases total daily hours of traffic delay and increases total hours of congested conditions on city streets. While regional impacts are small, within the study area tolling diversion would increase greenhouse gas emissions by as much as 9% relative to the untolled tunnel, as discussed in the SDEIS analysis of potential impacts on "Energy and Greenhouse Gases":[11]

The SDEIS analysis of impacts clearly indicates that the project (with or without tolls) is moving in the opposite direction from adopted City of Seattle, King County and State of Washington policy to reduce GhG emissions that are the result of personal transportation. An unavoidable impact of this, and many other roadway improvement projects, is that they increase VMT over their lifespan. It is not acceptable in light of the adopted policies to simply accept these consequences as inevitable. Rather, actions must be taken to mitigate these impacts and ensure that they do not prevent the City, County, and State from meeting their GhG emissions reduction targets.

Projects such as the Alaskan Way Viaduct replacement represent the very best opportunity to rethink transportation policy to address long-term growth in greenhouse gas emissions. Prevailing research on the topic is clear: meaningful reductions in mobile source emissions from private automobiles will require land use changes that promote shorter trips and mode shift to non-auto travel.[12] However, since project modeling does not include a dynamic assessment of how transportation

[10] House Bill 2815, http://apps.leg.wa.gov/documents/billdocs/2007-08/Pdf/Bills/Session%20Law%202008/2815-S2.SL.pdf

[11] AWVRP, 2010 **SDEIS, Chapter 9, p. 222**

[12] For example, Moving Cooler (Cambridge Systematics, 2009) cites land use strategies as creating particular synergies that enhance the emissions reduction effects of individual measures standing alone (p. 5).

investments change job or housing location choice or long-term development patterns, it is difficult to fully evaluate project impacts.

4. Potential Impacts on Transportation Affordability and Convenience for Vulnerable Populations

The SDEIS does address equity and environmental justice impacts of tolling the tunnel:

> *…based on the analysis of Scenarios A, C, and E, it appears that tolling SR 99 could have the potential of a disproportionately high and adverse effect on some low income populations, especially those without access to transit or who are dependent on their cars, unless proper optimization measures are implemented.*[13]

For some potentially affected populations, impacts might be mitigated through improved transit access into downtown. For others, travel on the current transit network may be too time consuming or unreliable; for example, people who live in Northwest Seattle and work in SODO or live in Southwest Seattle and work in South Lake Union. Further analysis conducted through the Seattle Transit Master Plan and further discussed in Appendix A, suggests that the SR 99 corridor provides significant mobility to vulnerable populations. A potential reaction to a tolled tunnel might be a shift in residential/employment location choices for low wage workers. The degree or impact of this shift is unknown but it may further erode traffic levels in the tunnel as workers adjust their living and working situations to avoid toll payment. For example workers in SODO or Georgetown may locate in southwest Seattle to avoid SR 99 over a longer span of time. For people choosing the transit option, there is one additional consideration also covered in Appendix A; the areas where many vulnerable residents reside also have some of the highest priorities for addressing substandard pedestrian conditions. The City of Seattle continues to work at these, but it is unlikely that all will be addressed in a way that will optimize transit access for people in the Northwest and Southwest portions of Seattle on a timeline that will keep pace with the SR 99 project.

The SDEIS suggests that low-income residents of Seattle, those who often have the fewest choices of residential and employment locations, are likely to be disproportionally impacted by high tolls. Seattle needs to provide affordable residential choices with affordable transportation options for low-income and other disadvantaged populations, or run the risk of having a city where only higher- income people can live.

Implementing a tolled tunnel could also have negative impacts on Center City employers who need access to lower-wage employees, for example, retail employers. The tolling could create a mix of economic and equity/environmental justice impacts. While the SDEIS identifies neighborhoods with residential populations at risk from a tolled tunnel, it does not identify the locations or concentrations of businesses that may be impacted by access and affordability issues for workers.

In summary, implementing a tolled tunnel without “proper optimization measures” could have negative impacts on some of Seattle’s vulnerable low-income families. The

[13] AWVRP 2010 SDEIS, Chapter 9, p. 222.

Nelson\Nygaard *Center City Surface Street Traffic Mitigation Plan (Draft)*[14] identifies measures that could be enlisted to address some of the equity issues of a tolled tunnel. In the long run the issue of mitigating the impacts of tolling on vulnerable populations must be treated with care to ensure that access to jobs, schools, and other life needs is not negatively impacted by assessment of tolls and the financial influences that naturally follow.

D. What Would a Program to Mitigate a Tolled Tunnel Include?

The primary impact of tolling the deep bored tunnel is the displacement of large volumes of traffic to city streets and to I-5. This has resulting effects on transportation cost, emissions, pedestrian comfort and safety, and project financing. Mitigation strategies will be needed to reduce displacement impacts by moving more traffic back to the tunnel or reducing overall travel demand, and to ensure pedestrians remain safe and comfortable on streets to which significant traffic is diverted.

There are two paths to mitigating the impacts of traffic diversion from a tolled tunnel.

1. Eliminate tolls or rapidly move forward with a regional congestion pricing program that would assess fees on most major highways in the region on a per mile basis, thus making diversion less attractive as an option to escape toll payment
2. Implement a comprehensive mitigation package that reduces single occupant vehicular demand, protects pedestrian safety and comfort, and prioritizes transit and HOV access to downtown

1. Tolling/Congestion Pricing Approach

One mitigation approach is to eliminate tolling entirely or to move more quickly to a regional congestion pricing program that imposes a cost on all freeway users in the region.

A Tunnel with No Tolls

While finding an additional $400 million in funds to supplant toll collection is not beyond possibility, it remains unlikely given competition for construction funds for other large WSDOT projects. For example, another project of direct interest to the City of Seattle, the SR 520 Replacement from I-5 to Medina, remains $2.2 billion short in construction funds, despite the inclusion of tolling at an early stage of project construction.

Regional Tolling

With SR 520 tolls a few months from implementation, the legislative authorization to charge tolls on four lanes of I-405 from Bellevue to Swamp Creek, and discussion of I-5 tolling, the region seems positioned to move toward a coordinated regional congestion pricing program.

[14] Center City Surface Street Traffic Mitigation Plan—Tolled Tunnel Mitigation Strategy, Discussion Draft, 3/11/2011

The revenue generation potential from a regional tolling program, even one that is implemented only on State routes, is significant and could well be a partial answer to funding many area transportation capital project needs and major maintenance requirements. A congestion pricing program could, if implemented effectively, also act as a means to balance regional traffic flow. The concept is explored at length in Transportation 2040, the Puget Sound Regional Council's Metropolitan Transportation Plan.[15] The plan sets forth a policy direction that establishes tolling as both a revenue source and a transportation demand management tool. However, political support for implementation of regional tolling is lacking. The State Legislature has specifically chosen to only apply tolling and the subsequent revenues for construction of specific state highway infrastructure projects. While acknowledging the potential for demand management, there seems to be little interest in implementing this concept as state policy, at least not without a great deal of active advocacy by local jurisdictions. From a local perspective, regional tolling has been discussed, but a cogent, regional policy and approach and a local champion for that approach remain absent.

The Puget Sound Regional Council's Transportation 2040 Plan, adopted in May 2010, stresses the need to:

> *"Recognize the critical role of price in reducing vehicle miles traveled and emissions, transition the region over time to a user fee/roadway pricing system."*[16]

This statement is one part of a four-part strategy which also includes deployment of smart land use, new transportation choices, and improved technology. While the current project- by-project (e.g., SR 520 and AWV replacement projects) approach to tolling may be necessary and the only viable approach to getting important projects built in the current political environment, it may be counter-productive in achieving goals to reduce VMT and GHG that have been set forth by the region and the state.

In the case of the SR 99 deep bored tunnel project, the proposed tolling strategy only partially meets regional goals in that it establishes a user fee for this section of roadway. A more comprehensive approach, reached through a cooperative effort by the City and the State, is needed to ensure that the longer-term strategy carefully laid out in Transportation 2040 is not undermined. On the positive side, unlike the imminent toll implementation on SR 520 with the resulting traffic and travel pattern changes, SR 99 tolling is not proposed to begin until the deep bore tunnel is open to traffic. This estimated five years of "down time" provides a period for the City and State to develop a more comprehensive plan for tolling designed to avoid or mitigate the diversion impacts, provide the revenue necessary to fund bond payments, and begin to provide positive benefits such as reducing greenhouse gas emissions and traffic congestion.

It is particularly important to the City of Seattle that future tolling strategies include allocation of a percentage of tolling funds for activities and initiatives that reduce demand on the state highway system and incentivize use of transit and non-motorized transportation, thereby managing demand, and ensuring less congested access to the one of the state's top employment centers. House Bill 1773, the 2008 State legislation

[15] http://psrc.org/transportation/t2040

[16] PSRC, Transportation 2040 Final Plan, Adopted May 2010, p. 34. http://www.psrc.org/transportation/t2040

that defines the framework for imposing tolls, only allows toll revenue to be used for toll facility construction, management, maintenance, and operation. City streets are not part of the state highway system; therefore they are not eligible for corridor or system management funding (for construction period mitigation such use is allowable) under current legislation.

2. Demand Reduction Approach

Given the low probability that a deep bored tunnel can be financed without tolling revenues to cover part of the financing, the City will likely need a mitigation program that manages the impacts of traffic diversion caused by tolling. The causal link between increased traffic volumes and necessary mitigation revolves around several factors outlined in the previous section, including:

- Impact on neighborhood character, small business viability, and pedestrians, particularly in Seattle's historic Pioneer Square neighborhood
- Impacts on transit speed and reliability for important City and regional transit routes
- Disproportionate impact of tolling and tolling-related congestion (travel time and trip reliability) on low-income populations and other vulnerable populations such as seniors and people with disabilities (who are more likely to rely on transit)
- Disruption of progress toward State and local greenhouse gas reduction goals

The primary strategies recommended in the Nelson\Nygaard *Center City Surface Street Traffic Mitigation Plan*[17] align with a recently released study, which was funded by WSDOT to examine the impacts of VMT strategies on vulnerable populations. The report, *Impacts of VMT Reduction Strategies on Selected Areas and Groups*,[18] investigates the equity impacts of the State of Washington's VMT reduction targets and ways to minimize negative impacts on disadvantaged populations.

Summary findings from the Nelson\Nygaard mitigation (draft) report include:

- Mitigation should be considered as a comprehensive package that includes four primary elements: (1) transit speed, reliability and service improvements, (2) TDM and parking management, (3) tolling assessment, and (4) pedestrian and bicycle safety and comfort.
- A robust transit and TDM program has the potential to shift 15,000 daily trips away from driving and to transit and other high occupancy modes. This is approximately equivalent to the amount of tolling diversion traffic projected to enter the city's surface streets each day.
- Pedestrian conditions in the Pioneer Square historic district require detailed design attention to ensure drivers understand they are in a pedestrian-oriented retail zone. An important cultural resource is at stake and many small businesses that operate on the margin could be impacted.

[17] Center City Surface Street Traffic Mitigation Plan—Tolled Tunnel Mitigation Strategy, Discussion Draft, 3/11/2011

[18] http://www.wsdot.wa.gov/research/reports/fullreports/751.1.pdf

- Any tolling solution for SR 99 should dedicate a percentage of revenues to transit and transportation demand management solutions that help to reduce diversion impacts on city neighborhoods.
- A robust mitigation plan is needed to cover the 18 to 24 month time period between tunnel opening and opening of a fully-connected Alaskan Way surface street, including the Elliott and Western connections. Importantly, this should be treated as a long-term opportunity to shift travel patterns.

Figure 2-7 summarizes the potential mitigation strategies recommended in the Nelson\Nygaard mitigation plan report. Some of the mitigation elements are also included in the 2009 Partnership Agreement; however, new programs and approaches are needed since that agreement did not consider tolling as part of the project.

Washington State, King County and the City of Seattle are all national leaders in transportation demand management. The sidebar below identifies existing TDM programs at various levels of government.

Existing City, County, and State TDM Programs

City of Seattle	King County	State of Washington
ePark [1] Provides real-time information on short-term parking in downtown City garages **Way to Go, Seattle!** [2] Resources, information, and encouragement for walking, biking, riding transit, and carpooling **Transportation Management Program** [7] Encourages property managers at large buildings, institutions and employment sites to reduce "drive-alone" commuting	**In Motion** [3] Neighborhood-based promotion of transit and active travel options **ORCA Employer Options** [4] Programs to allow businesses to add "e-voucher" funds to employee ORCA stored value cards or offer annual transit passes **Commute Solutions** [5] Resources for employers, including those required to develop CTR programs	**RideshareOnline.com** Carpool, vanpool, and bike partner matching **Commute Trip Reduction (CTR)** [6] Works with local governments and large employers to develop programs to reduce vehicle trips and VMT

1 http://www.seattle.gov/transportation/epark
2 http://www.seattle.gov/waytogo/default.htm
3http://www.kingcounty.gov/transportation/kcdot/MetroTransit/InMotion.aspx
4 http://metro.kingcounty.gov/cs/employer/ctr-buspassprograms.html
5http://www.kingcounty.gov/transportation/CommuteSolutions.aspx
6http://www.wsdot.wa.gov/TDM/CTR/overview.htm
7 http://www.seattle.gov/waytogo/TMP.htm

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Figure 2-7 Summary of Potential Seattle Center City Traffic Diversion Mitigation Measures

Mitigation Measure	Description	Focus/Area	Effectiveness	Cost
Transit				
99 to Downtown Seattle Transit Priority Pathways	Evaluation to determine most effective transit pathway from south; capital improvements	South/Southwest Seattle to Downtown Transit Connections	Needs comprehensive evaluation to determine most effective pathway	$2 to $50 million depending on selected route and extent of transit priority delivered
RapidRide Expansion	Two additional RapidRide lines serving the Delridge and SR 522 corridors	Delridge and Lake City Way corridors	25 – 30% increase in corridor ridership	Each of the two new proposed Rapid Ride lines would carry capital development costs in the range of $30 to $35 million (including buses) and $7 to 10 million per year in operating cost.
Transit Circulation and Identity Improvements	Reorganization of bus service around a series of place-based transit nodes along Third Avenue; reduction of turn movements from Third Avenue; improved wayfinding	Center City	Highly effective for enhancing downtown circulation; improves park-once environment; encourages visitor use of transit; simplifies downtown transfers increasing ease of use for regional transit customers	The electric trolley modifications needed for the proposed downtown reorganization proposed would cost $1 million to $2 million to fill in small gaps in trolley wire. Additional capital costs for signage, facilities and public information required to implement the service reorganization is estimated at $25 to $30 million.
Downtown Bypass Services	Addition of peak express service in the SR 99 corridor that bypasses downtown in the tunnel, serving Uptown/South Lake Union to the north and South Downtown to the south	Providing direct access to commuter markets north and south of downtown	Effective, but would likely serve limited population and be financially unrealistic in the short- to mid-term; interlining of planned RapidRide services may provide a better short-term strategy for serving these markets	$2 million for capital (buses) and $2.5 million per year for operations
Transportation Demand Management and Parking Management				
Downtown ORCA card distribution program	All Center City employees provided with a free transit pass – or a $100 monthly value on an Orca card	Center City business districts	Combined program estimated to shift 15,000 trips	$7.5 – 10 million annual program for the first 5 years and $4 – 5 million for the second five years for a ten tear total of $57-75 million.
Expanded residential outreach program	Expansion of King County Metro In Motion program; increasing frequency of neighborhood activity	SR 99 affected neighborhoods		<$1 – 1.5 million per year
Manage Center City Parking for Short-Term Access	Continuation of SDOT parking management project to shift on street short term parking stalls to garages; expand ePark; create standardized off-street rates for short-term parking	Center City with focus on Central Waterfront and Pioneer Square	Aggressive program could lead to 5 to 10% reduction in downtown VMT	Much of this is underway and could be advanced
Parking Cashout Requirement	Require employers who provide free parking for their employees also provide the cash value of that parking for employees who choose not to drive	Center City	Similar regulations have been highly effective in California and for select Seattle employers	Costs are primarily for legislative work and outreach

Mitigation Measure	Description	Focus/Area	Effectiveness	Cost
Pedestrian				
Signal Modernization	Upgrade traffic signals to improve visibility, including signal interconnect system to optimize traffic flow Install pedestrian countdown signals where missing Upgrade Washington Street/3rd Avenue to a signalized intersection Upgrading Western Avenue and Yesler Way to a signalized intersection, including a pedestrian countdown signal head, high visibility crosswalks, and curb ramps.	Pioneer Square and South Downtown	Signal modernization allows for improved traffic flow and more efficient traffic diffusion, while managing traffic speeds. The speed management function would significantly improve pedestrian safety while signal timing will reduce pedestrian delay. New traffic and pedestrian signal heads will improve pedestrian crossing safety by improving the visibility of the signals. Use of leading pedestrian intervals will mitigate safety issues due to higher turn volumes by allowing pedestrians a 3 – 5 second head start before the right turn queue can progress.	$9-15 million
Curb Ramps and Extensions	Install curb ramps that meet current ADA standards Construct curb extensions and parking lane street tree wells where appropriate	Pioneer Square (First Avenue, Jackson, Fourth, Western)	Projected increases in turn volumes will require greater awareness on the part of pedestrians. Curb ramps with paving techniques that differentiate the sidewalk-street interface will effectively signal to pedestrians that there are entering a conflict zone. The preferred application for curb ramps and extensions must respect Pioneer Square's existing sidewalk design guidelines, while minimizing ramp grades and cross slope	$1.5-3 million
Sidewalk and Crossing Enhancements	Add highly visible continental crosswalks Reconstructing the sub-standard sidewalks on both sides of Western between Yesler Way and Columbia Street. This will require curb and gutter construction. Reconstructing the sub-standard sidewalks on both sides of Western between Yesler Way and Columbia Street. This will require curb and gutter construction.	Pioneer Square (First Avenue, Jackson, Fourth, Western)	Highly visible crossings have been shown to increase motorist awareness of pedestrians and reduce vehicle speed. These facilities would also maintain or enhance pedestrians' perception of safety. Curb extensions will not only minimize the length of crosswalks at intersections with high turn volumes, but the reduced turn radius will also force motorists to slow down before making their turn. High visibility crosswalks are critical facilities to ensure that motorists can expect pedestrians in the crosswalk.	$1-3 million
Other Streetscape Enhancements	Add street trees and curb planters to mitigate emissions, reduce noise and create buffers for pedestrians. Improve pedestrian lighting Improved transit stops and information	Pioneer Square (First Avenue, Jackson, Fourth, Western)	Attractive landscape buffers and street trees could re-establish a street's attractiveness relative to the increase in or presence of traffic. More importantly, curb zone planters and street trees located in the sidewalk's furniture zone offer a buffer zone between the path and moving vehicles. Lighting would enhance the pedestrian realm by highlighting aspects of the sidewalk zones, store frontages, and pedestrian impediments, while improving pedestrian visibility by motorists, and thereby improving pedestrian safety. Reinforcing the pedestrian connection between King Street Station and the International District Station by increasing pedestrian capacity, improving transfer legibility, and modernizing passenger amenities and street furniture to reduce dwell times at bus stops.	$0.75 million

The SR 99 Travel Market is Ideal for Focused Mode Shift Strategies/Programs

The SDEIS does not provide a detailed analysis of tolling diversion by time of day other than to say that diversion rates are lower during the peak periods due to greater delay penalties on diversion routes.

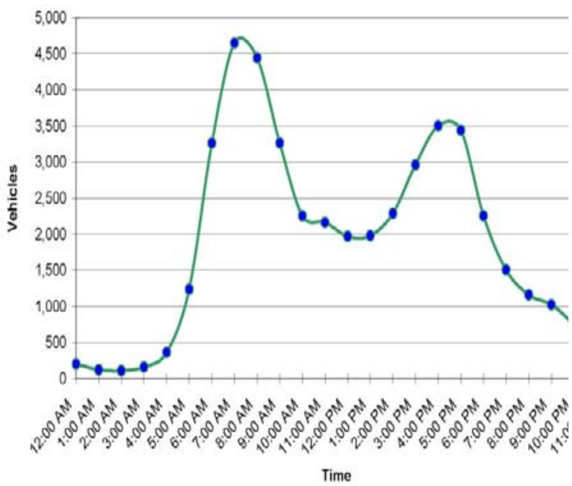
Currently, SR 99 in the Center City has heavy peak-hour use and moderate midday use; its primary use during the most congested peak travel periods is for Center City access or short downtown bypass trips, not regional through trips. In the midday when more surface street capacity is available, the Viaduct becomes an attractive bypass due to the relatively low numbers of vehicles that use it during this time; however, it provides limited benefit during this period given surface streets are not congested. This is revealed in that fact that, while midday tolls in Toll Scenario C are lower than peak tolls, diversion rates at this time are higher. Since there is much less travel time penalty for diverting to surface streets, even a lower toll rate is a deterrent. It is worth keeping in mind that modeling in the SDEIS tolling analysis does not include the Alaskan Way – Elliott/Western connector roadway; in place, this roadway will further reduce the time penalty for diverting, particularly in travel markets where a tunnel trip actually adds distance, such as Ballard to the southern CBD.

Diversion during the midday and PM peak are of concern to the city of Seattle as they coincide with periods of peak pedestrian activity in the Central Waterfront and Pioneer Square areas and with the start of many sporting events at Qwest and Safeco Fields.

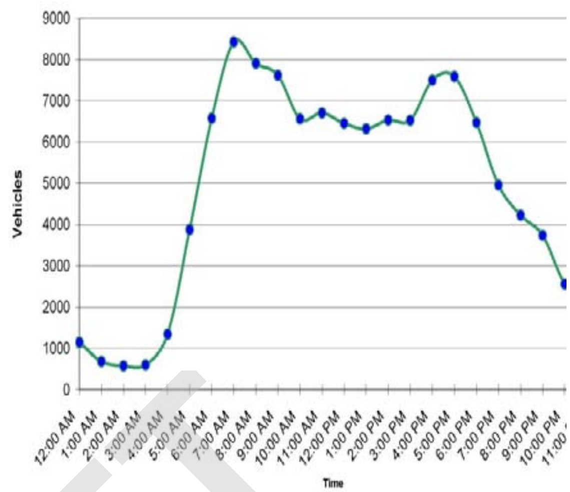
Figure 2-8 illustrates how traffic demand is "peaked" on the current Alaskan Way Viaduct (left panel), compared to Interstate-5 (right panel), which carries a much more diverse set of Center City access, mid-range local, and regional through trips. Midday volumes on the Viaduct are comparable to volumes carried by a four-lane surface street. It is notable that today all the worst surface street congestion (e.g., high intersection delay and increased queuing) in the Center City occur on streets that feed I-5 and SR 99 ramps. Improving highway operations on SR 99 and reducing the number of on- and off- ramps to downtown logically suggests that these congestion issues will be relocated to a new set of streets feeding SR 99 portal areas on ramps. This problem is heightened by traffic diversion resulting from a tolled tunnel.

Figure 2-8 Hourly Vehicle Traffic Volumes on (a) SR-99 and (b) I-5 by Time of Day

(a) Northbound SR 99 @ Holgate



(b) Southbound Interstate-5 @ Madison



Source: WSDOT, 2007. From Seattle Urban Mobility Plan Briefing Book, Transportation in the Center City Today, Figure 21 (p. 3A-25) and Figure 23 (p. 3A-26)

3 PROJECTING FUTURE TRAVEL: DO WE HAVE THE RIGHT TOOLS?

Thirty years ago the idea that smoking in bars and public buildings would be banned or that we'd recycle over 50% of our waste was the realm of fantasy.[1] Today, many people find it similarly difficult to conceive of a future with less driving or different preferences for personal mobility. However, just as with smoking and recycling, many public policy makers have decided that such a future is essential to maintain the health of our environment and our children. Energy prices are volatile, real estate preferences appear to be shifting to more walkable, urban living, and when provided with safe options to walk and bike, people are increasingly shifting to more active transportation modes. No single one of these factors may be convincing in isolation, but this section argues that in total they form a strong case for a future with lower per capita driving.

This section first reviews the limitations of traffic modeling results for Alaskan Way Viaduct Replacement Project (AWVRP) alternatives that estimate steady increases in traffic levels into the future, and then presents data that show traffic levels in Seattle have in fact been declining since 2003. It then discusses trends that could have an impact on travel demand in the SR 99 corridor and traffic patterns in Seattle generally, although they are not well recognized in official AWVRP documents. While it is politically and procedurally challenging to shape a major transportation decision around trends and factors that are not fully predictable and may not fall within the legal or typical construct of a corridor-based highway NEPA evaluation, they are nonetheless important and are worth considering prior to such a large public investment.

A. What does traffic modeling for the AWVRP tell us and what are its limitations?

Travel demand modeling is used extensively throughout the AWVRP 2010 SDEIS to compare various outcomes and measures of impact and effectiveness for considered alternatives. Comparisons are made between alternatives selected early in the process, all of which retain a limited access freeway through Central Seattle.

The EMME2 travel demand model used in the SDEIS analysis is the four-step travel demand model most commonly used in the United States. (Appendix B describes in more detail how the model works.) It was used and refined through the Partnership Process and revised prior to the SDEIS analysis, as documented in the Travel Demand Model Refinement and Validation Report prepared by Parsons Brinkerhoff. Even so, no travel demand model is a perfect tool, and each modeling approach has its strengths

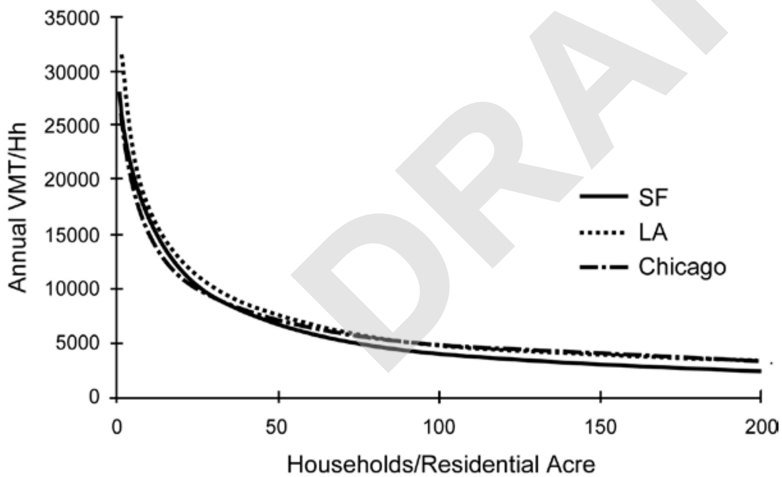
[1] City of Seattle Recycling Report, July 2009. Seattle Public Utilities.

and weaknesses. Travel demand model outputs are, at best, an estimate of future demand based on the historic patterns that have been built into the model. As such, a model may not anticipate potential shifts in these historic patterns; Part C of this chapter presents evidence suggesting that such trends may be underway. Predictions from a model can also inhibit a community's efforts to change historic patterns and move to a desired vision. Policies aimed at reducing vehicle miles travelled (VMT) and Greenhouse Gas (GhG) emissions are a case in point. An increase in VMT forecast by a model may be accepted as an unchangeable "future" if travel model outputs are adopted as the official future.

Example of Model Limitations: VMT Declines as Density Increases

One of the limitations of the travel demand model is its inability to recognize changes in travel making behavior as a result of external factors. The model uses a static set of land use assumptions and trip generation rates, generally assuming that traffic will grow consistent with population and job growth. In fact, we know that levels of per capita driving decrease in a dramatic fashion as development in moderate density neighborhoods intensifies. Figure 3-1 illustrates this relationship based on national research.

Figure 3-1 Relationship between driving (VMT per Household) and Residential Density



Source: John Holtzclaw et al., Location Efficiency: Neighborhood and Socioeconomic Characteristics Determine Auto Ownership And Use – Studies In Chicago, Los Angeles And San Francisco, Transportation Planning and Technology, 2002, Vol. 25. Figure 4, p. 15.

In Seattle, it is known that some of the vehicle traffic demand being created and assigned to the road network in the 2015 model is directly attributable to growth in housing and employment in the Center City. Yet actual data shows that housing and employment do not necessarily increase traffic demand, as indicated by the trend in city of Seattle traffic growth shown in Figure 3-3 below).

Clearly the outcome of the travel demand model used for the SR 99 analysis does not match the trend evident in this diagram. Yet, such outcomes are possible if the model is appropriately calibrated to create such conditions. One of the reasons the model is not calibrated in such a way is that model validation is typically accomplished for a singular year. The model then assumes that most independent factors, other than what is installed as the land use layer, remain constant for the year of evaluation. So observed trends, like the one shown in Figure 3-1, are not typically accounted for in a modeling environment.

In all cases, the underlying land use layer contemplates an increasing intensity of development in Seattle Center City. Overall increases in activity levels for the Center City included in the land use layer of the model include a 34% increase in employment, 31% increase in housing units and a 31% increase in overall daily person trips from 2005 to 2015. Trip generation rates have not been adjusted for the "new urban situation" seen in many cities on the West Coast, leading to an ongoing increase in "background growth" of vehicle traffic between the existing condition and baseline scenario. The "new urban situation" is the condition observed in Seattle where vehicle trips entering the Seattle CBD have remained flat, or even declined, over time even in the presence of intensifying land use. The situation is very similar to other major CBDs as they have seen measurable declines in total vehicle trips, even as their jobs and populations have increased dramatically—Vancouver BC and Arlington VA offer useful examples of declining trips, and San Francisco provides an example of flat vehicle trips. As a result of not recognizing this trend and adjusting the trip generation and mode choice assumptions in the EMME2 model, the modeling scenarios may over-estimate total vehicle trips with a concomitant increase in traffic congestion.

Example of Model Limitations: Land Use Assumptions Are Fixed

The 2015 and 2030 land use forecasts used in modeling for the SDEIS and Partnership Process analyses are fixed forecasts. While they do use best available practices in Seattle to determine future economic drivers and real estate conditions, there is no modeling feedback loop that provides indicators of how a deep bored tunnel bypass or a surface and transit solution would alter future land use patterns. If experience from other cities is an indicator, highway investment will promote higher levels of auto use and increase reliance on private vehicles for access to jobs and businesses. Given the heated public policy discussions currently playing out in Seattle around reallocation of limited street rights-of-way (e.g., road diets, bike lane additions, etc), a forward-looking transportation strategy must consider heightened demand for all modes. Basic geometry dictates that use of private single-occupant automobiles in dense urban areas is spatially inefficient, heightens conflicts with other modes, and if retained as the dominant mode, limits access to jobs, businesses, freight mobility, and recreational opportunities.

The Seattle metropolitan area does not use a system of modeling that evaluates the dynamic effects of transportation investments on land use and vice versa. The Puget Sound Regional Council (PSRC) regional travel demand model estimates future changes in travel patterns based on fixed land use projections for future years. However, there is no complementary model (econometric or real estate location) that evaluates the changes in land use created by transportation investments. This is a gap in project planning since we know that transportation infrastructure projects change household and employment location choice and affect how and where developers chose to build.

In Portland, the regional governing body Metro, uses such a model (actually a series of models) called MetroScope, in tandem with its travel demand model to evaluate land use changes resulting from investments programmed in the Regional Transportation Plan. MetroScope consists of model elements that include:

- **Economic Model**: predicts region-wide employment by industry and the number of households in the region by demographic category.
- **Travel model**: predicts travel activity levels by mode (bus, rail, car, walk, or bike) and road segment and estimates travel times between transportation analysis zones (TAZs) by time of day.
- **Real Estate Model**: predicts the locations of households and employment and also measures the amount of land consumed by development, the amount of built space produced, and the prices of land and built space by zone in each time period.

While PSRC is working to incorporate these types of capabilities into its regional model, it will be several years before the results of this effort could be applied to the SR 99 dialogue. Researchers at the University of Washington have employed a similar modeling process to examine some very specific transportation metrics related to the Alaskan Way Viaduct. It is difficult to address questions about project impacts, particularly related to emissions, without fully understanding the land use response to the transportation investment. Transportation market needs change dynamically based on location decisions made by residents and businesses, in which both accessibility to employment and accessibility to population play essential roles.[2] Research shows that a typical city dweller changes home location approximately every seven years; many urban renters move much more frequently. While industrial job center locations tend to be stable, office employment and retail locations are more transitory and redevelopment of attractive office settings can cause major shifts in employment, as evidenced in South Lake Union.

While finite analysis of these dynamics is not currently available, this “model issue” should be considered in contemplating the outputs of the AWVRP 2010 SDEIS or the Partnership Process evaluation based on current travel demand model outputs.

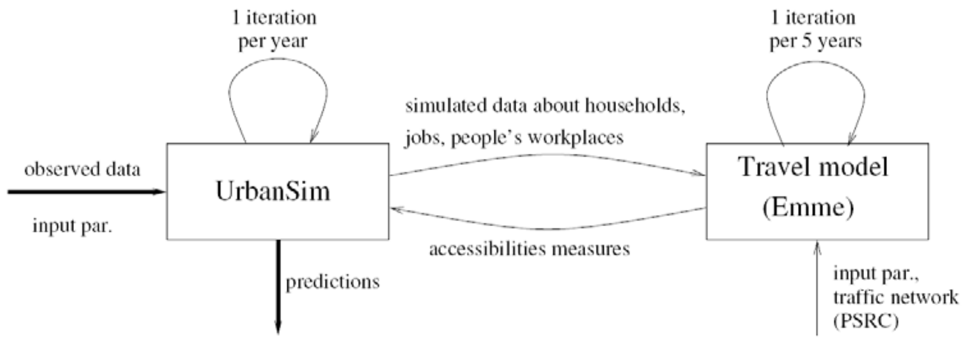
A study by Hana Ševčíková, Adrian Raftery and Paul Waddell used the Alaskan Way Viaduct to challenge the relevance of fixed land use forecasts for modeling future transportation conditions.[3] Importantly, the study also illustrated the uncertainty of travel modeling forecasts, which are often presented as factual outcomes rather than the broad ranges of outcomes that are possible. The research conducted for the report incorporates UrbanSim modeling, an example of the software cited above, into an integrated econometric (real estate location choice) and travel model platform. Much like the Portland process, the UW team was able to predict shifts in residential and employment location choice driven by real estate trends and travel conditions, creating a more realistic 2020 forecast. The report focuses on one important element of project evaluation—end-to-end travel time for representative regional trips.

Figure 3-2 is an illustration from the study that describes how real estate and job location choice and travel conditions are jointly considered.

[2] Hansen, 1959; Guttenberg, 1960; Huff, 1963).

[3] Hana Ševčíková, Adrian E. Raftery and Paul A. Waddell, Assessing Uncertainty About the Benefits of Transportation Infrastructure Projects Using Bayesian Melding: Application to Seattle's Alaskan Way Viaduct, 3/26/2009. University of Washington , Center for Statistics and the Social Sciences, Working Paper no. 90.

Figure 3-2 Illustration of Integrated UrbanSim and Emme Travel Demand Models



Source: Ševčíková, Raftery, and Waddell, 2009.

More detailed findings from the report are summarized in Appendix B. Among the findings are: (1) there is a wide degree of variability in possible travel times for all trips, (2) regional trips outside the AWV corridor see little impact even in worst-case scenario where the Viaduct is removed, but not replaced, and (3) trips made in the SR 99 corridor generally have longer travel times for the worse-case scenario, but the model shows overlap in the possible range of travel times for each trip.

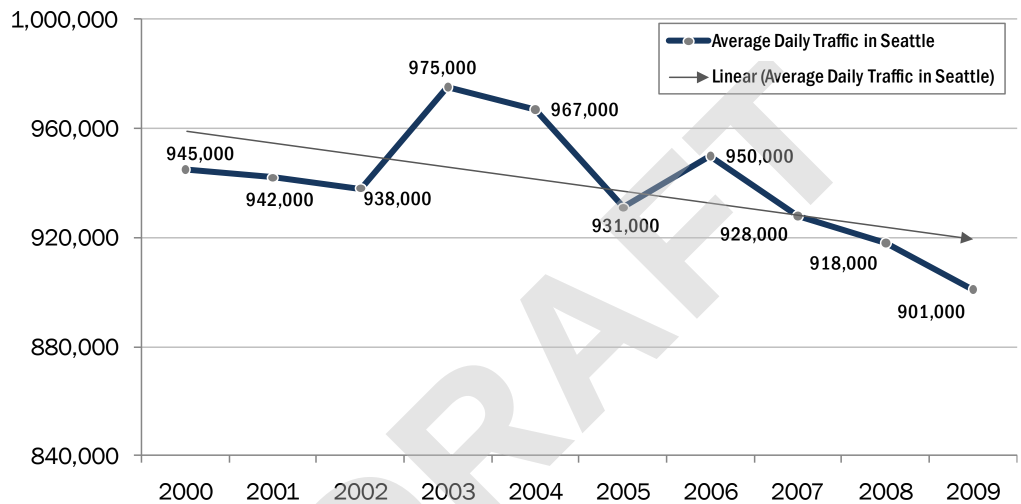
Models Present Possible Outcomes, Not Facts

Nelson\Nygaard reviewed travel demand modeling and traffic operational modeling for the SDEIS. This included detailed outputs of four step travel demand modeling, a process that used the Seattle Travel Demand model (a version of the PSRC EMME 2 regional travel demand model) to project changes in traffic volumes on streets and highways, and operational modeling conducted primarily with Synchro, a modeling software package that allows traffic planners to more carefully model traffic operations (e.g., delay, turning movements, queuing, etc) on the street system and for individual intersections. Due to the complexity of downtown transportation conditions model estimates are often unreasonable compared to actual conditions; human judgment is then used to assign traffic volumes estimates to certain streets for evaluation with the operational model (the model that predicts intersection delay and traffic operations on city surface streets). These adjustments are significant in several cases, particularly in the portal areas where new ramps dramatically change demand patterns. While this is normal modeling procedure used to best estimate real life conditions, it is also a reminder that modeling tools have a wide margin of error. Traffic data that is presented as a singular number in SDEIS documents may have already been adjusted by a substantial margin and represents an estimate among a range of possible outcomes.

B. Seattle Traffic Is Declining

Traffic data from the Seattle Department of Transportation (SDOT) for 2009, illustrated in Figure 3-3, shows that traffic levels are trending downward, and that these effects are not simply the result of the economic recession. Average daily traffic declined by about 8% from its peak in 2003 and about 5% from the level in 2000. While the recent economic downturn is certainly responsible for some share of the most recent decline in traffic, the downward trend started at a time when the economy was strong. As discussed in more detail below, a steady increase in gas prices from 2004 to mid-2008 (e.g., Figure 3-9) coincides with pre-downturn traffic reductions shown in Figure 3-3.

Figure 3-3 Average Daily Traffic in Seattle, 2009



Data Source: Seattle Department of Transportation, 2009 Traffic Report, 2011

A similar trend can be seen in travel time and travel delay data from the a National Traffic Scorecard[4] published annually by INRIX, a provider of traffic information that combines data from traffic sensors on freeways and other limited access highways with information from GPS-equipped "probe" vehicles. The scorecard shows Seattle dropping from the sixth to the tenth most congested Metro area between 2006 and 2010. It is based on a travel time index (TTI)—the ratio of congested travel times to uncongested, free flow travel times. In contrast to the more commonly known Urban Mobility Report[5] from the Texas Transportation Institute, the use of data from probe vehicles allow INRIX to directly measure congestion and delay using actual travel times and uncongested travel speeds. INRIX converts the portion of a TTI value above 1.0 (representing congestion) to a percentage representing the additional time required to complete an average trip due to congestion and reports this value as a "travel time tax." Among the 100 largest metro areas, Seattle experienced the third largest absolute decline in travel time tax between 2006 and 2010—by 9.2 percentage points to 19.8 points, a decline of 32%. On average, the top 100 Metro areas

[4] http://inrix.com/scorecard/default.asp

[5] http://mobility.tamu.edu/ums/

experienced a decline of just 1.2% in the travel time tax. In summary, travel congestion has been decreasing annually in Seattle and at a higher rate than many other regions.

The decline has occurred as Seattle's economy remains stronger than the other Metro areas with large absolute declines; only Seattle had a below average decline in employment (3.5% compared to over 9% for the others). In addition, comparing congestion levels based on a travel time index is seen as penalizing compact, higher density areas like Seattle where trips are shorter; a shorter trip with the same TTI as a longer trip still involves less total travel time.[6]

[6] For example, Todd Litman, Congestion Reduction Strategies, http://www.vtpi.org/tdm/tdm96.htm; CEOs for Cities, Driven Apart, http://www.ceosforcities.org/work/driven-apart

Traffic Congestion in Vancouver B.C.

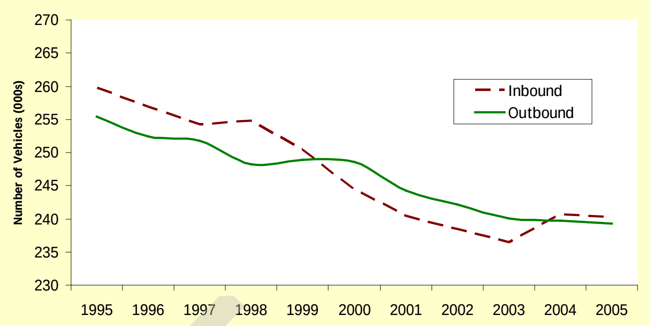
Vancouver is the only major North American city that does not have a freeway running through its core city. In Seattle both I-5 and State Route 99 run through downtown Seattle. In 1967, Vancouver residents defeated a proposal to build a freeway into downtown Vancouver, known as the "Great Freeway Debate."[7] The city and region encouraged walking and bicycle use and developed transit options including its automated SkyTrain system.

Traffic congestion has worsened in Vancouver since the early 1990s. However, Vancouver is the only one of Canada's six largest urban areas where average commute time did not increase between 1992 and 2005.[8] More people are traveling via other modes, so overall travel times and congestion costs have decreased significantly.

Vancouver's downtown population increased by over 60% between 1991 and 2002 (to 76,000) without any increase in vehicle trips to and from downtown. About 81% of all trips within downtown, 60% of all trips to and from downtown and 40% of all trips citywide are made by walking, bicycling, or public transit. (Some attribute this to the fact that employers are deserting downtown Vancouver. However, this is not borne out by jobs numbers. Employment has actually increased and Vancouver's CBD has seen an uptick in development of commercial office space in recent years.) Comparatively, more than half of trips during the peak hour in downtown Seattle are by automobile. The economic cost of traffic congestion in Vancouver has been calculated to be much lower than for Seattle and other more auto-oriented cities. The annual per capita cost of congestion is approximately $220-$340 in Vancouver, compared to $780 in Seattle (U.S. dollars, 2006, Includes cost of time, fuel, vehicle costs and external costs).

During the 10-year period illustrated in the graph above (Figure 3-4) the total number of person trips in and out of downtown increased by 22% and the number of vehicle trips dropped 7%.

Figure 3-4 Vehicles Entering/Leaving Vancouver,B.C. CBD in a 24-Hour Period



Note: Reliable data for 2001, 2002 and 2004 (outbound only) was not available and has been extrapolated.
Source: City of Vancouver Annual Cordon Count Program

Figure 3-5 Comparisons of Seattle and Vancouver, B.C.

	Seattle	Vancouver
Population[1]	582,490	578,041
Center City Jobs	230,000	200,000
Bus and Light Rail Boardings per Capita[2]	120 *	130
Public Transit Mode Share[3]	18%	25%
Walk/Bike Mode Share[3]	11%	16%
Downtown Parking Rates[4]	$25	$18

Table Notes: * King County Metro West Subarea, which includes Shoreline and West Forest Park.

Table Sources: 1. American Community Survey, 2008; Canadian Census, 2006. 2. National Transit Database, 2008; Canadian Urban Transit Association, 2008. 3. American Community Survey, 2006-2008; Canadian Census, 2006. 4. Colliers International, CBD Global Parking Rate Survey, 2010; Downtown Seattle Association Neighborhood Profile.

Case Study Sources: Seattle Urban Mobility Plan, except as noted in text; Graham Senft, "The conscious city: Traffic congestion and change toward sustainability in metro Vancouver," Urban Environment, Vol. 3, 2009, p. 93-103.

[7] Graham Senft, "The conscious city: Traffic congestion and change toward sustainability in metro Vancouver," Urban Environment, Vol. 3, 2009, p. 93-103.

[8] Statistics Canada, The Time it Takes to Get to Work and Back, http://www.statcan.gc.ca/pub/89-622-x/89-622-x2006001-eng.pdf

C. What Trends Will Shape Our Transportation Future?

Traffic congestion is a function of traffic volume and speed. The relationship is non-linear; a small reduction in peak traffic volumes can reduce delay by a relatively large amount. A 5% reduction in traffic volumes on a congested highway (for example, from 2,000 to 1,900 vehicles per hour) may cause a 10-30% increase in average vehicle speeds (for example, increasing traffic speeds from 35 to 45 miles per hour).[9] Conversely, a small increase in volumes can have a much greater percentage reduction in travel speed.

Traffic levels are sensitive to a number of trends and policies that affect demand for vehicle travel by influencing the cost of and preferences related to driving. A brief scan of any news source reveals political instability in oil rich nations, rising health care costs, high rates of inactivity related diseases, and a declining suburban real estate market and low-income flight from cities. Although predicting these trends is subject to considerable uncertainty, the effects of different factors are reviewed below, including land use patterns, transportation costs (gas prices), policies to reduce greenhouse gas (GhG) emissions, active transportation, and regional congestion pricing. These trends are important for cities and regions, including Seattle, to consider as they align land use and transportation policies to address these issues.

Low-VMT Development Patterns

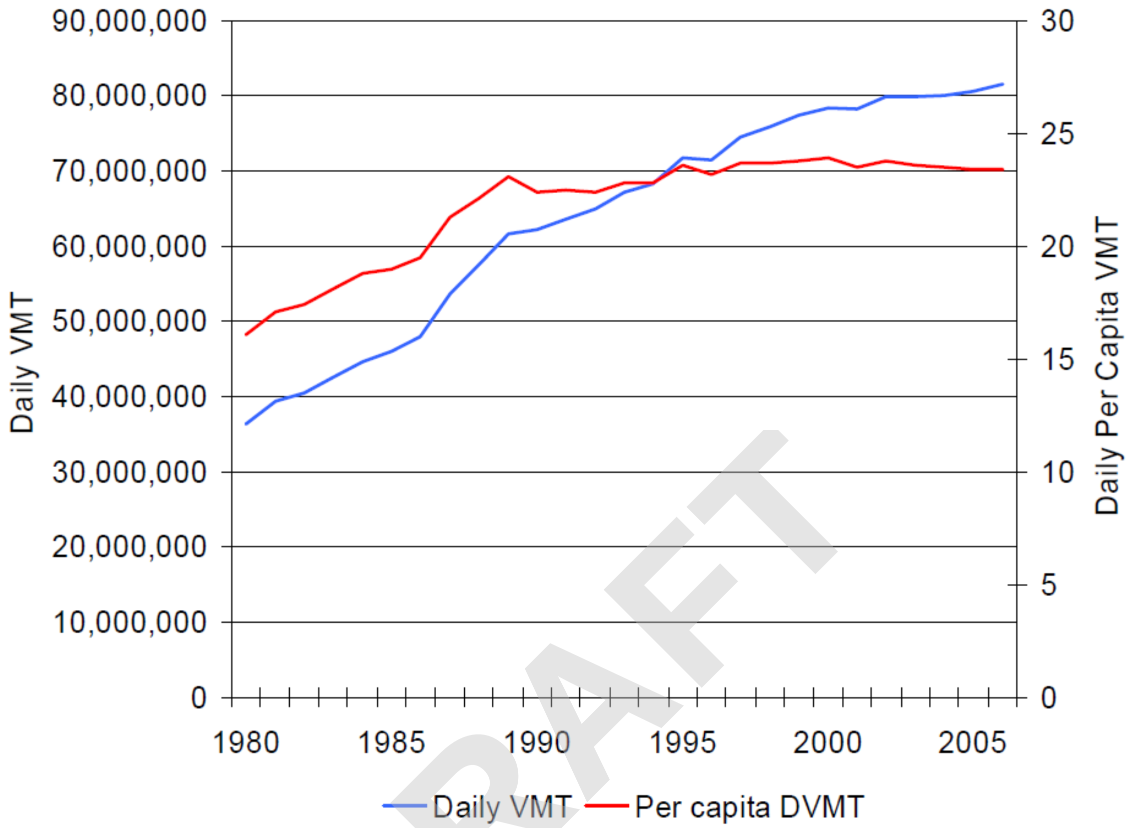
Vehicle-miles traveled (VMT) measures the aggregate distance traveled by motor vehicles and is related to congestion and vehicle emissions. As discussed in this and subsequent sections, even small reductions in overall VMT can have a large positive effect on traffic congestion. For example, a 20% increase in gas prices from 2007 to 2008 corresponded to a 3% reduction in VMT nationally and reduced the travel time index by approximately the same percentage (3.5%).[10]

As shown in Figure 3-6, total VMT growth in the Seattle region leveled off briefly in the mid-2000s before starting to increase, although at a relatively low rate. However, Figure 3-6 also illustrates that after accounting for population growth, Seattle region VMT is decreasing gradually. For the Seattle region the increase in total VMT is also occurring at a lower rate than growth in gross domestic product (GDP).

[9] VTPI, Congestion Reduction Strategies, http://www.vtpi.org/tdm/tdm96.htm

[10] INRIX, National Traffic Scorecard, 2008

Figure 3-6 Seattle Region Daily and Per Capita VMT

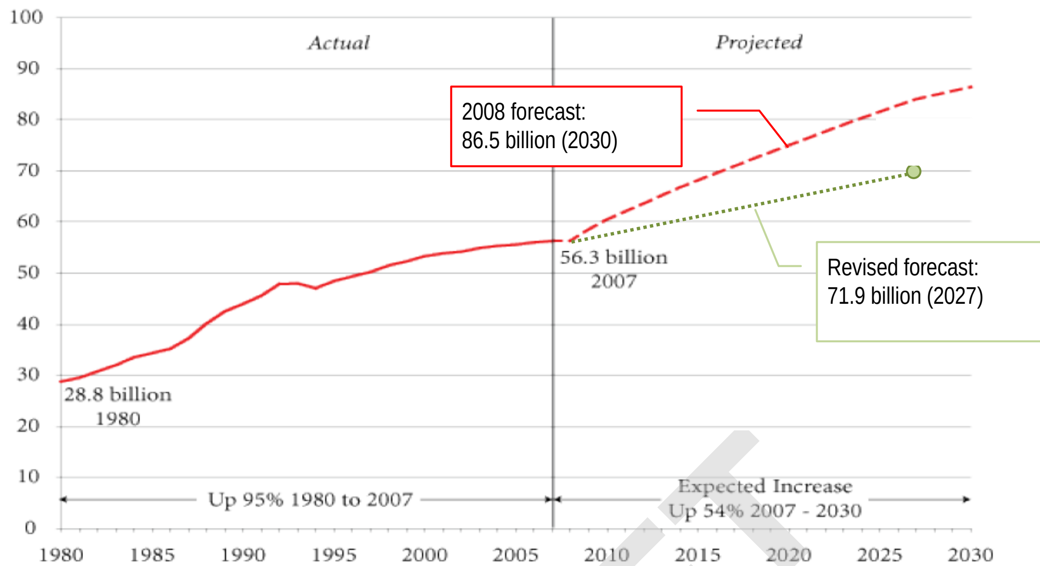


Source: PSRC

Recent revisions to statewide VMT forecasts further illustrate a flattening of VMT growth. VMT projections made as recently as 2008 still forecast statewide VMT growth of 54% through 2030, or about 2.3% annually, as shown in Figure 3-7. However, these projections are not consistent with the actual statewide VMT growth of about 0.7% annually from about 2000 to 2008 (which compares to a national average of 1.2% over this period). A new forecasting model released by a WSDOT working group in 2010, based on economic activity, vehicle registrations, and gas prices, revised the 2008 projections for VMT growth downward by 15% through 2025. The new forecast, also shown in Figure 3-7, is for average annual growth of 1.3% between 2009 and 2027.[11]

[11] WSDOT VMT Forecasting Working Group, Final Report, 2010. http://www.wsdot.wa.gov/NR/rdonlyres/380A1F61-EC09-478D-990C-4AA9B9292AFE/0/VMTForecastWorkGroupSummaryMay2010final.pdf

Figure 3-7 State of Washington Historical and Projected VMT (Billions), 2008 and Revised



Source: WSDOT, 2008. (Revised forecast added.)

One factor controlling VMT growth in Seattle compared to national peers is its land use policies. Policies and market forces are driving growth in urban centers and urban villages throughout the city. These designated centers and villages are projected to absorb 63% of population growth and 91% of employment growth through 2030. About a quarter of the residential and half of the employment growth is expected to go into downtown. In other words, the densest neighborhoods will get denser over time.

Compact, mixed-use development is the norm in these areas. New parking regulations have decreased parking requirements for multi-family housing located in urban villages and near transit. The availability of transit and good walking and bicycling infrastructure naturally reduces VMT as residents are able to meet their daily needs without using a car, even if they own one. These effects are captured in the "4D" indicators of the built environment: Density, Diversity (mix of uses), Urban Design, and Regional Destination Accessibility (this factor accounts for the benefits of regional clustering and locating development along strategic transportation corridors).

Figure 3-8 shows estimates of "typical" effects that Reid Ewing and Robert Cervero derived from 50 empirical studies of travel impacts and the built environment, shown for a 10% change in each "D" indicator. For example, a 10% change in density alone would typically result in a 0.5% decrease in vehicle trips and a 0.5% decrease in VMT. The cumulative impact on vehicle trips and VMT, totaling all four indicators, can be significant. A 10% change in all indicators would reduce vehicle trips by 1.3% and reduce VMT by 3.3%.

Figure 3-8 Effects of a 10% Change in 4D Indicators on Vehicle Trips and VMT

4D Indicator	Vehicle Trips (VT)	Vehicle Miles Traveled (VMT)
Density	-0.5%	-0.5%
Diversity (Mix)	-0.3%	-0.5%
Urban Design	-0.5%	-0.3%
Regional Destination Accessibility	Not evaluated	-2.0%

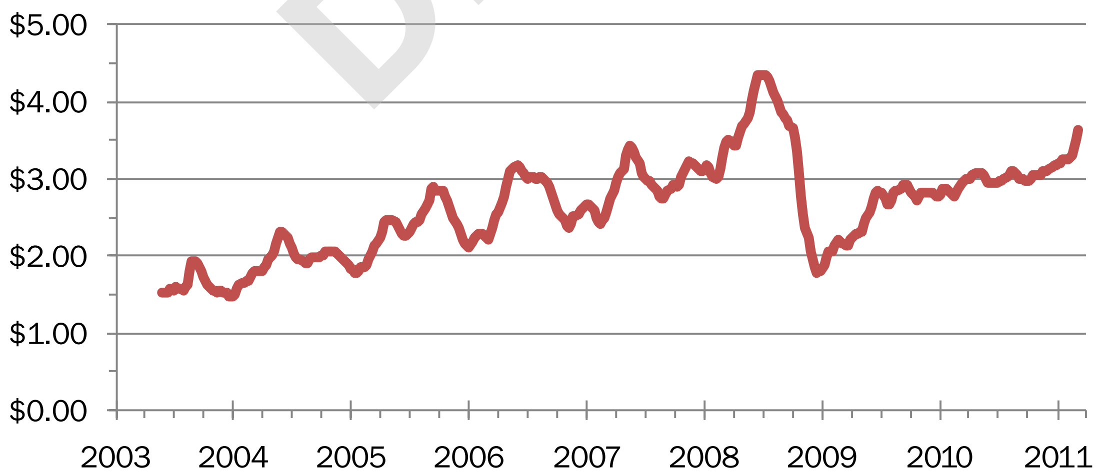
Source: Ewing and Cervero, Travel and the Built Environment—Synthesis, 2001. These results are based on the concept of elasticity—a measure of responsiveness or how much one factor changes another—and are presented in this table for a 10% increase in each of these indicators.

Given the city's land use policies and these estimates for the effects of such land development practices on VMT, population and employment growth in Seattle is likely to be accommodated with much lower VMT growth overall and a continuation of the downward trend in VMT per person, even with economic growth—if Seattle can provide a transportation system that provides equitable, cost-effective access from around the city and region to downtown/Center City destinations.

Transportation Cost (Gas Prices)

The cost of gas is typically the most significant variable (non-fixed) cost in driving. As shown in Figure 3-9, retail gas prices in the Seattle area increased steadily from 2004 to 2008 (with normal seasonal variation). Gas prices reached a peak of over $4.00 per gallon before they declined sharply in mid-2008 when the onset of the economic downturn reduced travel demand. Between 2009 and 2010, prices began to increase once again as economic growth recovered and global demand expanded. In early 2011, fears about global oil supply disruption caused a sharp increase in prices.

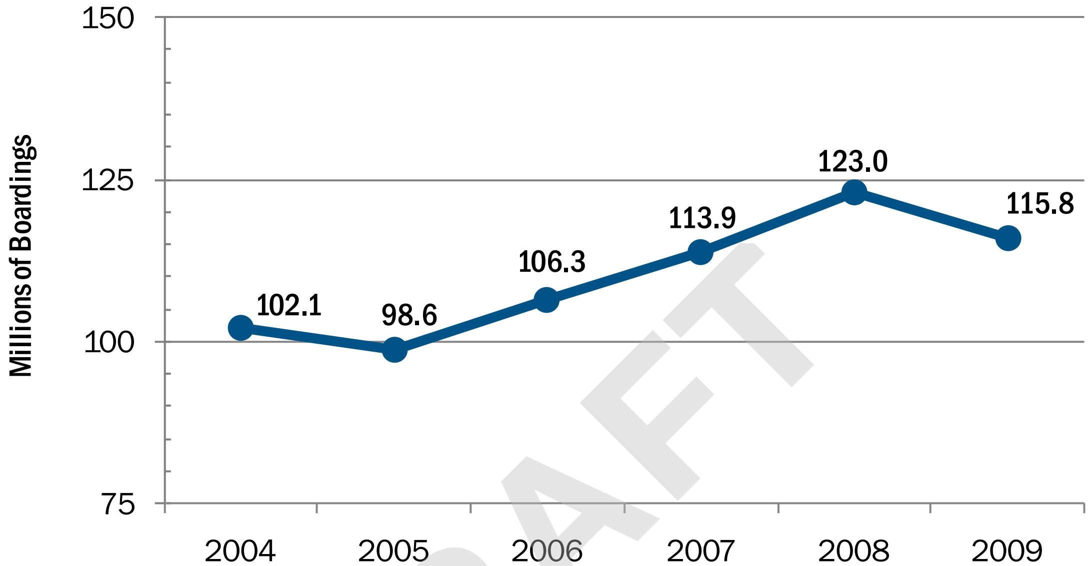
Figure 3-9 Seattle Weekly Retail Gasoline Prices, 2003 to 2011



Data Source: Energy Information Administration. Retail price for regular, conventional gasoline.

The recent increases in gas prices have demonstrated that higher prices are correlated with reduced driving. For example, a 20% increase in gas prices from 2007 to 2008 reduced VMT by 3% and reduced highway traffic congestion— the travel time index declined by 3.5% nationally.[12] Changes in gas prices can make alternatives to driving alone more or less attractive. The increased gas prices from 2004-2008 can be compared to King County Metro transit ridership over the same period, shown in Figure 3-10. As gas prices approached $3.00 in 2005, they appeared to reach a tipping point where drivers were attracted to transit.

Figure 3-10 King County Metro Ridership, 2004-2009



Data Source: National Transit Database, 2009

The general effects cited in the research literature for increased automobile operating costs, based on elasticity (a measure of how a change in one factor changes another), include:

- **Transit Ridership:** For a 10% increase in automobile operating costs, a short-term increase of 0.5% to 1.5% (elasticity of 0.05 to 0.15) and a long-term increase of 2% to 4% (elasticity of 0.2 to 0.4).[13]
- **VMT:** For a 10% increase in gas prices, a short-term decrease of 1.0% to 1.6% (elasticity of -0.1 to -0.16) and a long-term decrease of 2.6% to 3.1% (elasticity of -0.26 to -0.31), as drivers are able to adjust their travel patterns. One recent study estimated decreases lower than those listed above, accounting for purchases of more fuel-efficient vehicles that mitigate the effects of higher fuel prices—a "rebound" effect: for 1997-2001, 0.2% to 0.3% in the short-term and 1.1% to 1.5% in the long-term; for 1966-2001, a short-term effect of 0.4% and 2.2% in the long-term.[14]

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12 INRIX, National Traffic Scorecard, 2008.

13 Todd Litman, Transit Price Elasticities and Cross-Elasticities, VTPI, 3/1/2011, Table 14: Recommended Transit Elasticity Values. http://www.vtpi.org/tranelas.pdf

14 Congressional Budget Office, Effects of Gasoline Prices on Driving Behavior and Vehicle Markets, 2008; http://www.cbo.gov/ftpdocs/88xx/doc8893/01-14-GasolinePrices.pdf, Kenneth Small and Kurt Van Dender, Fuel Efficiency and Motor Vehicle Travel: The Declining Rebound Effect, 2007.

The results of several specific studies of recent gas price increases provide the following conclusions for the effects on VMT and transit ridership:

- A Congressional Budget Office (CBO) study based on data for California's four primary metropolitan areas from 2003-2006 found that driver response depends on the availability of a high-quality transit alternative. A 20% increase in gas prices (e.g., $2.00 to $2.50 or $3.00 to $3.60) reduced weekday highway traffic volumes by 0.7% where parallel rail transit existed. Ridership on the parallel light rail or subway systems increased by 1.9% on average.[15]
- A study of the increase in U.S. gas prices from 2007-2008 found that VMT declined by 3.5% through October 2008. On a month-by-month basis, the declines were 6.0% in July, 5.6% in August, 4.4% in September, and 3.5% in October and occurred in nearly all states (e.g., 48 states for September). The study estimated that 5% of reduced vehicle travel shifted to transit, although at higher rates in larger cities with generally higher quality transit services. The elasticity of transit ridership with respect to gas prices was 0.13, at the high end of the short-term range provided above. Transit ridership nationally increased by 4% from 2007 to 2008, with increases reported by 86% of agencies. [16]
- A study of transit ridership in Washington State from 2004-2008 found that gasoline prices significantly impacted ridership for seven of the 11 systems studied, with effects ranging from 0.9% to 4.7% increases for each 10% increase in gas prices. The overall statewide impact was found to be a 1.7% increase in ridership.[17]
- Two studies suggest that there is a tipping point when gas prices trend higher than $4.00 per gallon toward increased transit ridership and shifted travel patterns. An analysis of transit data from Philadelphia (PA) found a non-linear relationship between gasoline prices and transit ridership from 2001-2008 and projected a 15% increase in SEPTA City Transit (bus, heavy rail, and light rail) ridership if gas prices increase from the $3.00-$4.00 range to the $4.00-$5.00 range and a 21% increase in ridership if prices increase from the $4.00-$5.00 range to the $5.00-$6.00 range.[18] A study of gas price increases in Austin (TX) in 2005 found that $4.00 was a "significant breakpoint" in reducing single-occupant vehicle commuting and spurring purchases of more fuel-efficient vehicles.[19]

Although future gas prices are nearly impossible to predict, they are currently perhaps the most important and dynamic variable in personal transportation costs. Gas prices generally follow the price of crude oil, which comprises about 48% of the price of a gallon of gasoline.[20] Three sets of oil price projections that are produced annually by

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[15] CBO, 2008

[16] Dan Brand, Impacts of Higher Fuel Costs in Innovations for Tomorrow's Transportation, Federal Highway Administration, Issue 1, May 2009.

[17] Victor Stover and Christine Chang-Hee, Impact of Gasoline Prices on Transit Ridership in Washington State, Presented at TRB 90th Annual Meeting, 2011.

[18] APTA, 2011, summarizing Donald Maley and Rachel Weinberger, Rising Gas Price and Transit Ridership: Case Study of Philadelphia, Pennsylvania, TRR 2139, TRB, 2009.

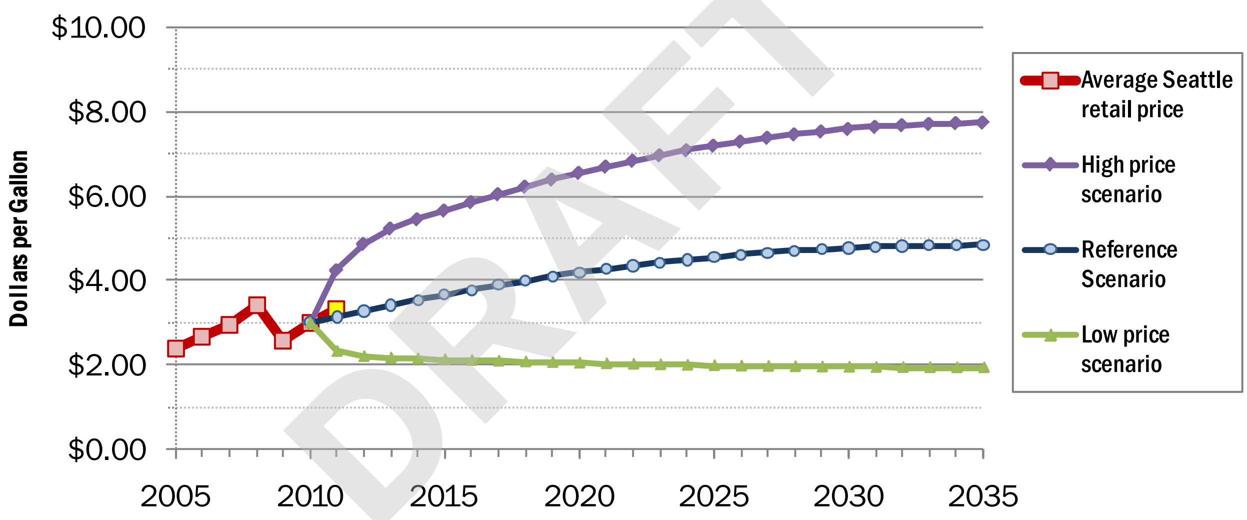
[19] Matthew Bomberg and Kara Kockelman, Traveler Response to the 2005 Gas Price Spike, Presented at TRB 86th Annual Meeting,2007.

[20] General Accounting Office, 2004 Analysis of EIA Data

the Energy Information Administration (EIA) identify factors in the uncertainty over future gas prices—a "reference" case bracketed by low and high price scenarios. The reference case assumes current practices, politics, and market access continue in the near- to mid-term, with significant economic recovery and rebounding demand and prices. The low-price scenario assumes greater competition, international cooperation, and policies favorable to private investment in production. The high-price case assumes long-term restrictions on supply due both to political decisions and resource limitations with significant use of high-cost domestic production methods.

Figure 3-11 applies the three EIA gas price scenarios to 2010 average retail gasoline prices in Seattle, ranging from a low cost of $2.00 per gallon to nearly $5.00 per gallon by 2035 under the reference case and nearly $8.00 under a high price scenario. The data point for the first quarter of 2011, illustrated with a yellow dot, lies just above the reference case trajectory.

Figure 3-11 EIA Projections Applied to Seattle Average Annual Retail Gas Prices

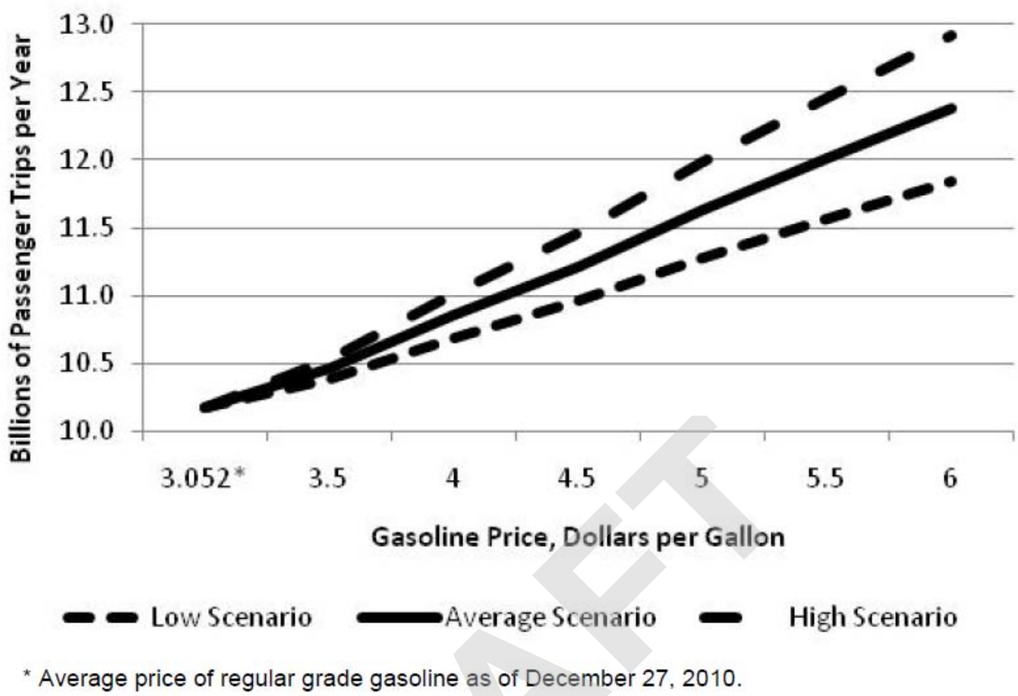


Data Source: Energy Information Administration. Retail price for regular gasoline in Seattle (2005-2011). Projections are based on 2010 average price and EIA 2010 low, reference, and high scenarios.

Gas prices that increase based on the EIA's reference or high price scenarios could put Seattle at a strategic disadvantage if it does not take advantage of opportunities to develop better transit infrastructure in advance of a spike in prices. A recently released report[21] by the American Public Transportation Association (APTA) predicted significant increases in transit ridership if gas prices reach the $4.00 to $6.00 range, and called for additional transit capacity to address those needs. It cited recent news articles reporting that T. Boone Pickens expects gas prices to exceed $4.00 in 2011 and that the former president of Shell Oil predicts retail gas prices over $5.00 by 2012. Figure 3-12 illustrates the ridership levels predicted in the APTA analysis for gas prices ranging from $3.05 at the end of 2010 to a potential price of up to $6.00.

[21] APTA, *Potential Impact of Gasoline Price Increases on U.S. Public Transportation Ridership, 2011 – 2012, 3/14/2011*

Figure 3-12 Projected Range of Transit Ridership by Level of Gas Prices



Source: American Public Transportation Association

As gas prices increased to $4.00 several years ago, Metro struggled to fulfill passenger demand as buses were overcrowded and instances of pass ups (waiting passengers left at the curb because buses were at peak capacity) were high. However, Metro (along with other transit agencies nationwide) was also impacted financially by high fuel prices as well as the cost of meeting passenger demand. In 2007 and 2008, 85% of transit agencies reported capacity constraints even though nearly half added service in response to increased ridership, and 39% reported turning away passengers.[22] Metro's current economic problems could create even more significant challenges given another such spike in fuel prices.

GhG Emissions

Greehouse gas emissions (GhG) are linked to VMT and factors such as motor vehicle fuel efficiency and the share of zero-GhG emission vehicles in the vehicle fleet. The Seattle 2008 Greenhouse Gas Inventory showed that emissions from cars and light trucks increased by almost 8% from 1990 to 2005, an increase of about 0.5% per year. However, this trend reversed from 2005 to 2008 as emissions from this sector declined by 1.4%, a nearly 0.5% annual decline.

Of all sectors, mobile source CO_2 from private transportation is the most challenging to address. All current research suggests that the most effective solutions must

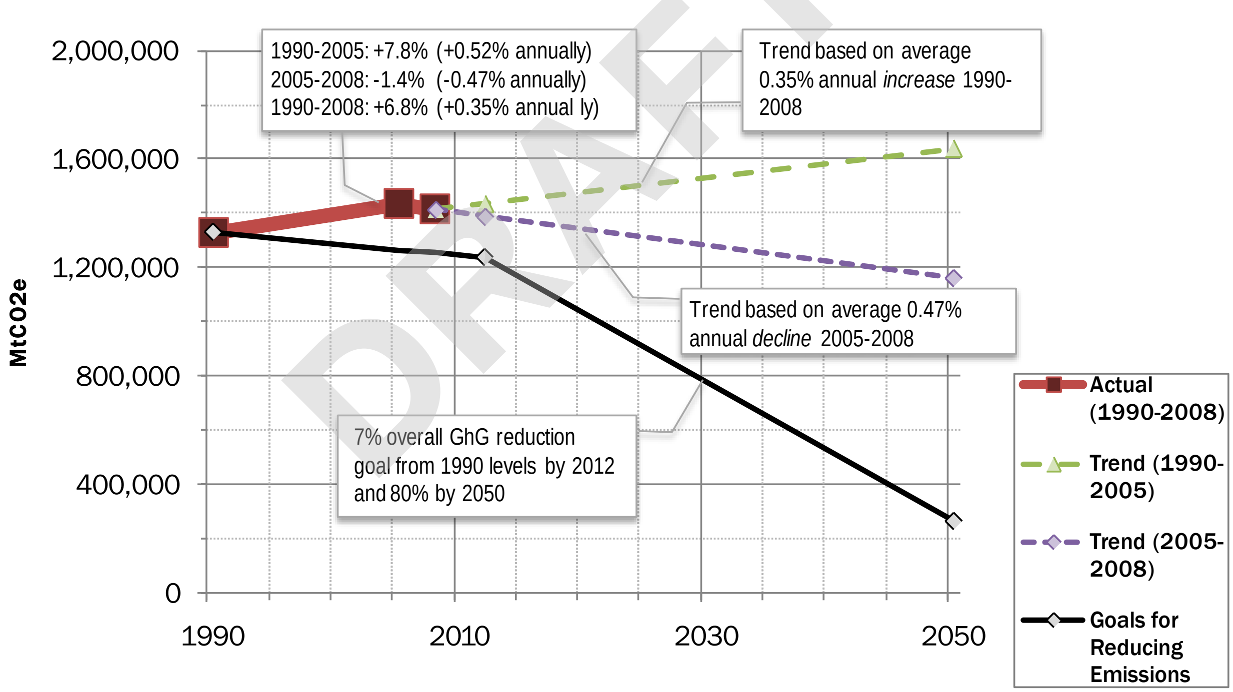
[22] American Public Transit Association, 2011.

involve coordinated land use and transportation planning – technology will help, but without compact walkable development it will be challenging to move the dial.

Seattle's 2006 Climate Action Plan set a goal of a 7% overall reduction (from all sectors) in GhG emissions from 1990 levels by 2012 and a much more ambitious reduction of 80% from 1990 levels by 2050. Figure 3-13 illustrates actual GhG emissions for light car and trucks for 1990-2010 from the City's 2008 GhG Inventory. It then shows three possible future scenarios based on:

- An average annual increase of 0.35%, based on the emissions rate for cars and light trucks from 1990-2008.
- An average annual decrease of 0.47%, assuming the average annual 0.47% decline in emissions for this sector from 2005-2008 continues.
- The City's overall GhG reduction goals for 2012 and 2050.

Figure 3-13 GhG Emissions and Trends for Cars and Light Trucks, 1990-2050



Data Sources: Emissions and trends from Seattle Greenhouse Gas Inventory, 2008. Goals from Seattle Climate Action Plan, 2006.

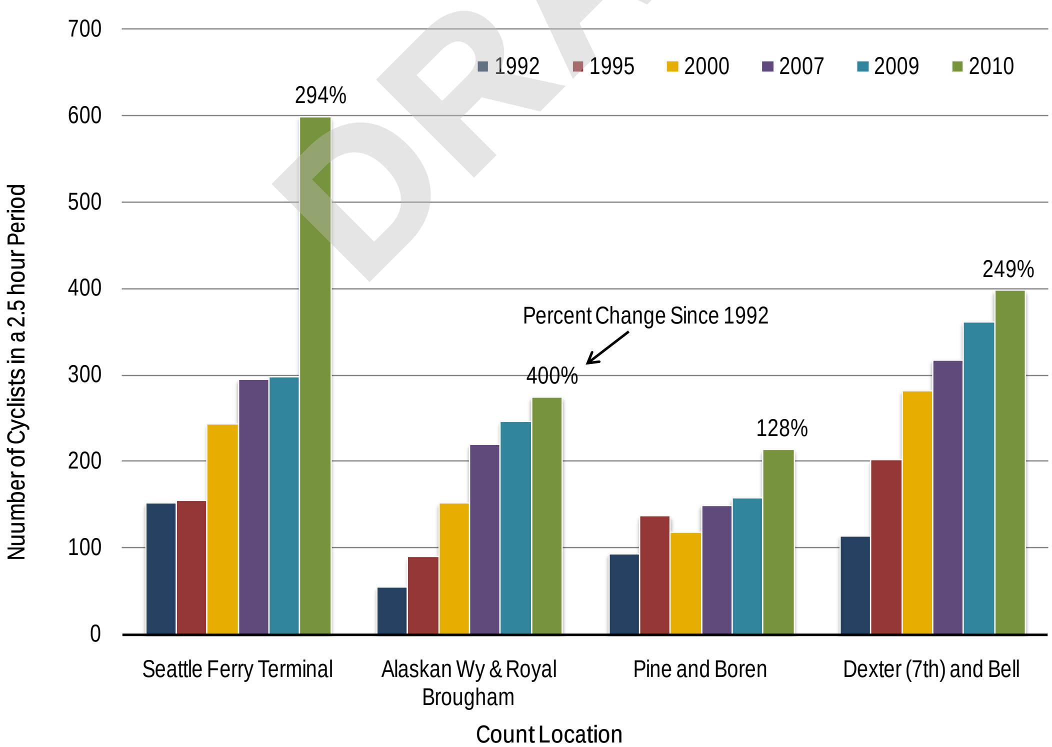
Figure 3-13 helps to show that fuel efficiency changes to the vehicle fleet are only part of the solution. Reducing overall demand for driving through mode shift and developing of walkable, neighborhoods must remain essential components of the City and State's GhG reduction strategies. No analysis of a highway replacement alternative (e.g., a deep-bore tunnel) relative to a ST5 type alternative has been conducted to understand the land use and real estate location choice impacts that would occur as a result of different transportation investment models.

Demand for Active Transportation

Active transportation refers to making typical daily trips on foot or bike. It can also include public transit, since getting to transit typically involves walking some distance. More people traveling on bikes and foot reduce traffic and emissions, but more importantly improves human health and well being. Bicycling has exploded in many U.S. cities as an important transportation mode. Relegated to less than 1% of total travel in most U.S. cities a few years ago, many cities are now recording 5% to 6% of all trips on bicycles. In some areas of Portland, Oregon close to downtown, it is estimated that as many as 25% of all work trips are made on bicycles. Minneapolis, Chicago, New York and many other cities are also experiencing a bicycling renaissance.

Seattle has made substantial improvements to bicycle infrastructure and has seen results to match. In the Seattle region, the combined share of transit, walking, and "other" (e.g., bicycling) trips increased by about 3.0% from 1999-2006.[23] In the city of Seattle, counts at four locations demonstrated large increases in the number of cyclists from 1992-2010, as shown in Figure 3-14. Cycling distances also increased from a weighted average of 3.1 miles in 1999 to 4.3 miles in 2006. Figure 3-15 depicts the percentage change in cycling trips of different distances. Continued infrastructure investment to support active transportation complements the City's land use policies and supports its VMT and GhG emission reduction goals.

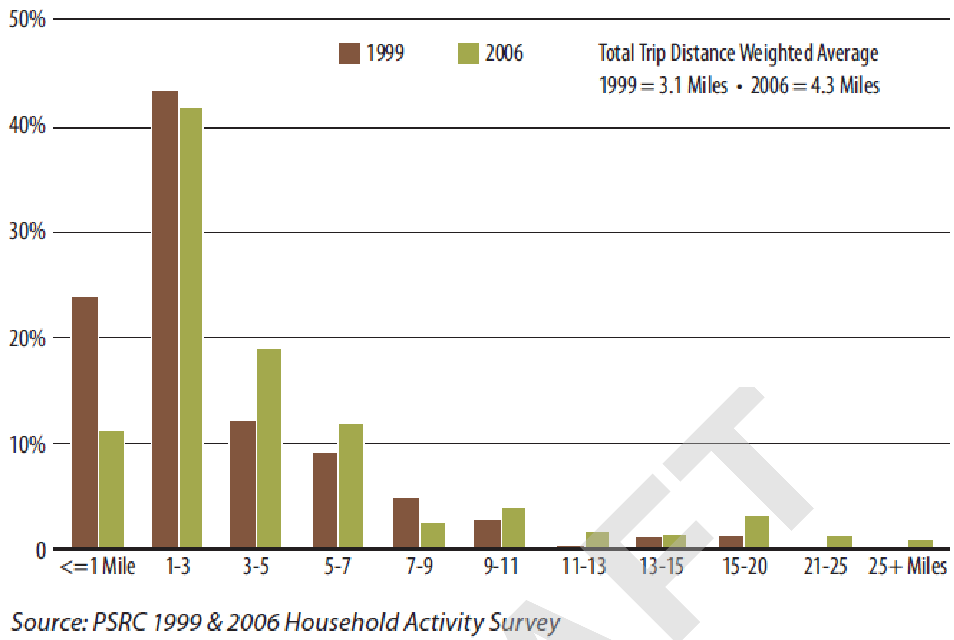
Figure 3-14 City of Seattle Bicycle Counts, Cyclists per Year and % Change, 1992-2010



[23] PSRC, 1999 and 2006 Household Travel Survey, http://psrc.org/assets/811/t3jan09.pdf

Source: City of Seattle Historic Bike Counts 1992-2010. City of Seattle.

Figure 3-15 Bicycle Trip Distances, Percent of Total Bike Trips, 1999 and 2006

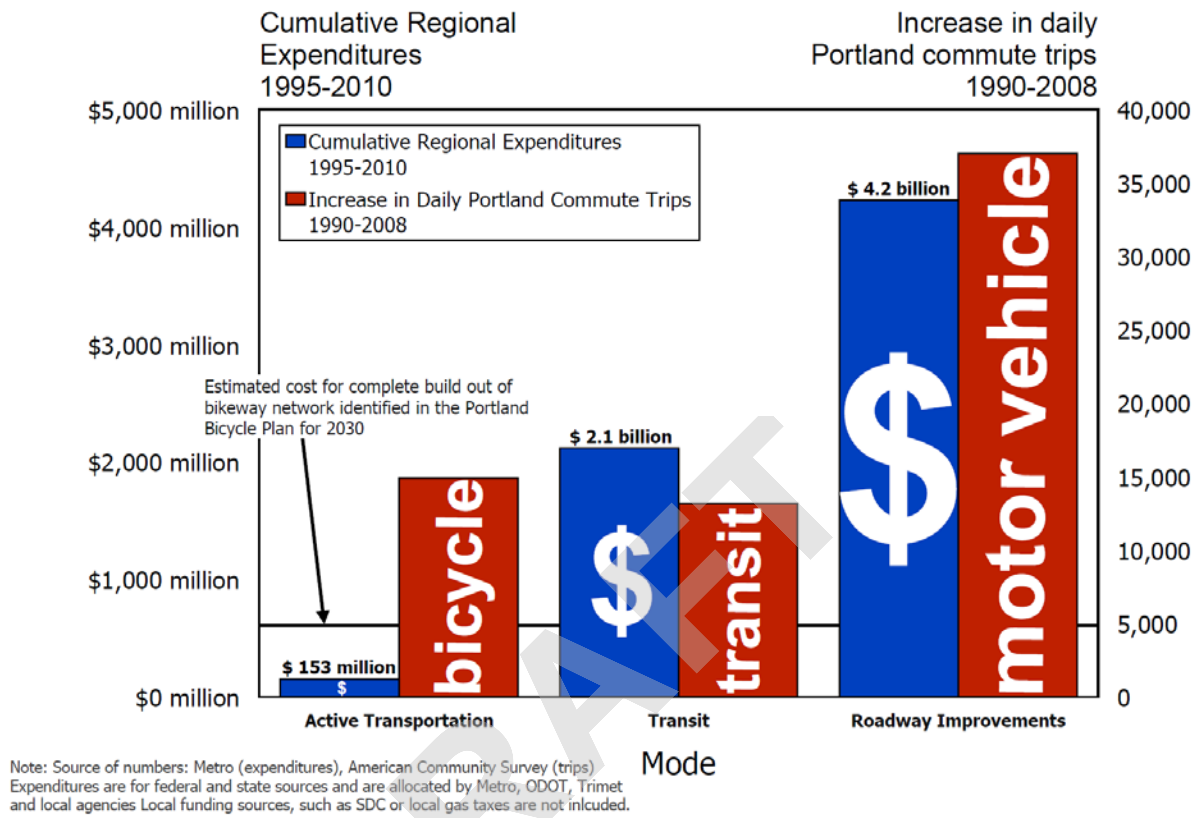


Source: PSRC, 1999 and 2006 Household Travel Survey, http://www.psrc.org/assets/2121/t17jul09.pdf

In Portland, the City compared the cost of building its present bicycle infrastructure (based on current replacement cost), as well as the estimated cost of completing its recently adopted Bicycle Master Plan, to the number of new trips served on that infrastructure. It then compared the results to the costs and outcomes for regional transit and roadway improvements. The results are shown in Figure 3-16.[24] Although bicycle infrastructure investments cost a fraction of the cost of transit and roadway improvements, the new trips served exceeded transit and approached half of the increase in roadway commute trips. These results serve as a reminder that relatively small investments in active transportation infrastructure serve significant transportation purposes as well as providing health and other benefits.

[24] A description of the analysis by the League of American Bicyclists contains additional detail. See http://www.bikeleague.org/blog/2011/02/the-cost-effectiveness-of-active-transportation-investments/.

Figure 3-16 Regional Expenditures and New Trips by Mode, Portland, OR



Source: League of American Bicyclists

Why These Trends Matter

In total, these trends point to a future where urban travelers face a markedly different set of decision factors than those faced today or ten years ago. While we don't know with certainty how these variables will impact future travel and land use decisions, we do know that these are real trends and phenomenon measurable with data. It is also clear that project modeling has not fully considered the implications of these trends or measured alternatives against a metric of adaptability in alternative futures (e.g., $7 gas prices, continued declines in automobile travel, etc).[25]

[25] We recognize that FHWA requirements and procedures encourage more traditional modeling approaches when analyzing highway investments.

4 ST5 APPROACH BENEFITS IN LIGHT OF TOLLED TUNNEL PERFORMANCE

The AWVRP 2010 SDEIS projects that 40,000 to 48,000 daily vehicles could divert from a deep bored tunnel to surface streets and Interstate-5 if the tunnel is tolled at the level required to retire $400 million in bond debt. Changes in performance of a deep bored tunnel alternative with tolling have caused many to question the investment and to reconsider the value offered by a tunnel compared to other alternatives. A tolled tunnel will need surface street enhancements, demand management measures, transit capital investments and other program elements included in the surface, transit and I-5 (ST5) approach.

A. What is ST5 and How Does it Work?

One of the key distinctions of the ST5 alternative is that it includes a program of investments over a wide area and in multiple modes of transportation. This makes direct comparisons between the ST5 alternative and a single highway facility, such as a bored tunnel or a rebuilt Viaduct, challenging. This chapter provides a brief overview of ST5 alternatives and how they work. ST5 was validated through extensive analysis in the Partnership Process and matched or outperformed the deep bored tunnel alternative and other highway replacement alternatives for many of the evaluation measures used in that process.

What is ST5?

ST5 is an approach to replacing the Alaskan Way Viaduct using improvements to surface streets, transit, and I-5 to increase transportation capacity and move people more efficiently to, from, through and within Seattle Center City. ST5 includes investments in new transit service, transportation demand management (TDM) measures, I-5 capacity improvements, and a combination of “many small improvements” to increase capacity and efficiency of city surface streets.

A number of ST5 scenarios were studied as part of the AWVRP, however ST5 Scenario B from the 2008 Partnership Process is most consistent with the current City’s Central Waterfront project in that it included a four-lane Alaskan Way surface street north of Marion. At the conclusion of the Partnership Process, a ST5 “hybrid” scenario was also developed. It is essentially the same as Scenario B, but the waterfront surface street design consists of a one-way couplet (Alaskan Way and

Note: ST5 is the abbreviation used in this report for surface, transit, and I-5 solutions to replace the Alaskan Way Viaduct. A number of variations of a surface, transit and I-5 design have been evaluated. This report considers two of those: (1) the **ST5 Hybrid** as developed in the Partnership Process and refined and evaluated in the early SDEIS alternatives screening; ST5 Hybrid included an Alaskan Way/Western Avenue traffic couplet designed to increase traffic capacity on the waterfront, and (2) **ST5 Scenario B** from the Partnership Process included a 4-lane Alaskan Way on the Central Waterfront north of Colman Dock.

Western Avenue) that the City has already rejected. A couplet would improve surface street vehicle capacity, but would also negatively alter the character of Western Avenue, including around Pike Place Market and Pioneer Square.[1]

Figure 4-1 describes the project elements or "building blocks" that were used in the Partnership Process to develop eight initial alternatives and later three hybrid alternatives to replace the Alaskan Way Viaduct.

Figure 4-1 Partnership Process Building Blocks

Source: WSDOT

Figure 4-2 recounts the cost components of the ST5 Hybrid scenario developed at the conclusion of the Partnership Process. The "Fact Sheet" that summarized this information was developed at a point in the process when the ST5 Hybrid and an elevated bypass hybrid were advanced as the leading options to replace the Alaskan Way Viaduct. (a copy of this fact sheet is included in Appendix D). The document reads:

> *The bored tunnel was not carried forward due to its high cost. However, it does have advantages associated with avoiding some of the construction on the central waterfront. The agencies will continue to investigate the costs of the bored tunnel as a future project that could be constructed if the I-5/surface/transit hybrid alternative is agreed upon.*

It was shortly after this time that single-bore technology was introduced as a more cost-effective boring option, compared with the previously assumed double-bore approach.

Figure 4-2 Cost Elements of the ST5 Hybrid

	Capital Cost (escalated to years of expenditure)
SR 99 Alaskan Way/Western Avenue couplet and seawall replacement	$929 million
Changes to I-5	$553 million
Changes to city surface streets	$216 million
Transit improvements	$476 million
Transportation policies and management	$37 million
Scenario Total	**$2.2 billion**
Construction traffic mitigation	$30 million
Alaskan Way Viaduct's Moving Forward projects and prior program expenditures	$1.1 billion
Alaskan Way Viaduct and Seawall Replacement Program total	**$3.3 billion**

Source: AWVSRP Partnership Process I-5/Surface/Transit Hybrid Scenario Fact Sheet, December 2008.

[1] See AWVRP Project History Report (Appendix S to 2010 SDEIS), p. 58-61

In addition to these capital costs, the ST5 Hybrid scenario included a $55 million per year annual operating cost. Many see ongoing operating costs associated with transit operations and demand management programs as a major hurdle for an ST5 approach.

How Does the ST5 Approach Compare to a Deep Bored Tunnel?

A deep bored tunnel is a very large but relatively easily conceived infrastructure project. The ST5 alternatives on the other hand, take a systems approach comprised of numerous capital projects that would be implemented on a number of Center City streets and also includes demand management programs and new transit services (as shown in Figure 4-3). While ST5 has many comparative strengths—including cost effectiveness, system redundancy, flexibility to respond to future travel changes, environmental benefits, etc.—it is much harder to communicate and evaluate. The ST5 approach would benefit a far greater number of people, since improvements would be made to transit, new transit subsidies might be offered, pedestrian enhancements would be made, streets would be improved in and outside the corridor, and I-5 improvements would be made. Despite this, many seem to view the ST5 approach simply as a loss of capacity rather than the wide-reaching set of mobility investments it constitutes.

Several factors make it difficult to directly compare the ST5 alternatives with the deep bored tunnel alternative modeled in the 2010 SDEIS:

- The SDEIS includes limited analysis of the ST5 Hybrid scenario, which includes the one-way couplet surface street design that the city has already rejected. Comparison to the Partnership Process ST5 Scenario B is more appropriate, but that alternative was modeled with a different iteration of the travel demand model making it harder to provide apples-to-apples comparison.
- The SDEIS analysis of the ST5 Hybrid scenario was only completed for the 2030 analysis year, not for 2015 (whereas the focus of the Partnership Process modeling was on 2015).
- Assumptions used for some model parameters differed between the Partnership Process and the SDEIS analysis. For example, the Partnership Process used the parking price variable in the model to better represent TDM effects on mode choice.
- Much of the SDEIS analysis of the deep bored tunnel alternative does not include the Elliott/Western Connector.

Figure 4-3 provides a high-level summary[2] of ST5 improvements, organized by the Partnership Process building blocks and compared to a deep bored tunnel approach. The comparison is based on ST5 Scenario B, which assumes a four-lane Alaskan Way surface street (the Alaskan Way surface street design is the primary difference between Scenario B and the ST5 Hybrid alternative).

Figure 4-4 illustrates improvements included in the Partnership Process ST5 Scenario B, while Figure 4-5 shows the Deep Bored Tunnel alternative.

[2] A more detailed comparison of project elements is provided in Appendix C.

Figure 4-3 High-Level Summary of ST5 Building Blocks and Elements

Project Partnership Building Blocks	Surface, Transit & I-5 (ST5) "Scenario B"	Deep Bored Tunnel Key Differences from ST5
SR 99 Mainline and Surface Streets	• ST5 Scenario B: SR 99 is replaced by a 4- to 6-lane surface street (4 lanes north of Colman Dock), with transit lanes south of Washington St. and signalized connection to Elliott and Western Avenues* • Battery Street Tunnel reused as connector between Aurora Ave N. and Elliott/Western	• 4- to 6-lane surface street is constructed on the Central Waterfront • Transit lanes are focused around the transitions between SR 99 and the tunnel portals • Battery Street Tunnel decommissioned
I-5	• Capacity increased through variable speed signs; addition of lanes or conversion from HOV to managed; various conversions of ramps and addition of transit-only ramps	• Only variable speed signs are included (but independent of the Deep Bored Tunnel)
Surface Streets	• Addition of general purpose lanes and transit lanes on various downtown surface streets (primarily though on-street parking restriction) • All-day through travel restrictions on 3rd Ave	• Grid improvements are focused along Alaskan Way surface street and around tunnel portals and SR 99 access streets • Mercer widening at SR 99
Transit	• Rapid Trolley Network improvements • Enhanced service on planned RapidRide routes • 3 new RapidRide routes (Delridge, Lake City, & Ballard – UW) • Ballard/Fremont, U-District, & First Ave Streetcars • Enhanced peak express bus service	• Tri-agency agreement assumes a number of planned transit investments, including RapidRide and Streetcar lines. However, transit improvements are contingent on new transit funding, which does not appear likely given current financial challenges.
Transportation Demand Management	• TDM package including: parking management, parking regulation, transit pass programs, employer-based programs, educational programs and policies	• No demand management component, other than program support during Holgate to King construction
Freight Routes	• I-5, Surface Alaskan Way • Large trucks allowed on 2nd and 4th	• AWV replaced with tunnel; Alaskan Way surface street remains freight route
Bicycle	• Bike lanes/trails on Alaskan Way • Trails connecting Alaskan Way to East Marginal Way and Mountain to Sound Greenway Trail • New east-west connections between Uptown and South Lake Union • Bicycle lanes eliminated on 2nd and 4th Ave • Other Bike Master Plan elements in Center City	• Bike lanes would remain on 2nd and 4th Ave, with no conversion to general purpose lanes • No additional elements from the Bike Master Plan
Pedestrian	• Improved east-west and north-south connections to Waterfront • I-5 crossing improvements	• I-5 crossing improvements are not included

Source: Summary Comparison of Potential Scenarios, Draft August 28, 2008; 2010 SDEIS, Chapter 5: Bored Tunnel Alternative and Appendix C: Transportation Discipline Report.

* In the ST5 Hybrid alternative SR 99 is replaced by a one-way couplet comprised of two 3-lane surface streets (Alaskan Way and Western Ave). This scenario was used in the SDEIS, but is not consistent with the City's approach to redeveloping the Central Waterfront.

Figure 4-4 Partnership Process Scenario B

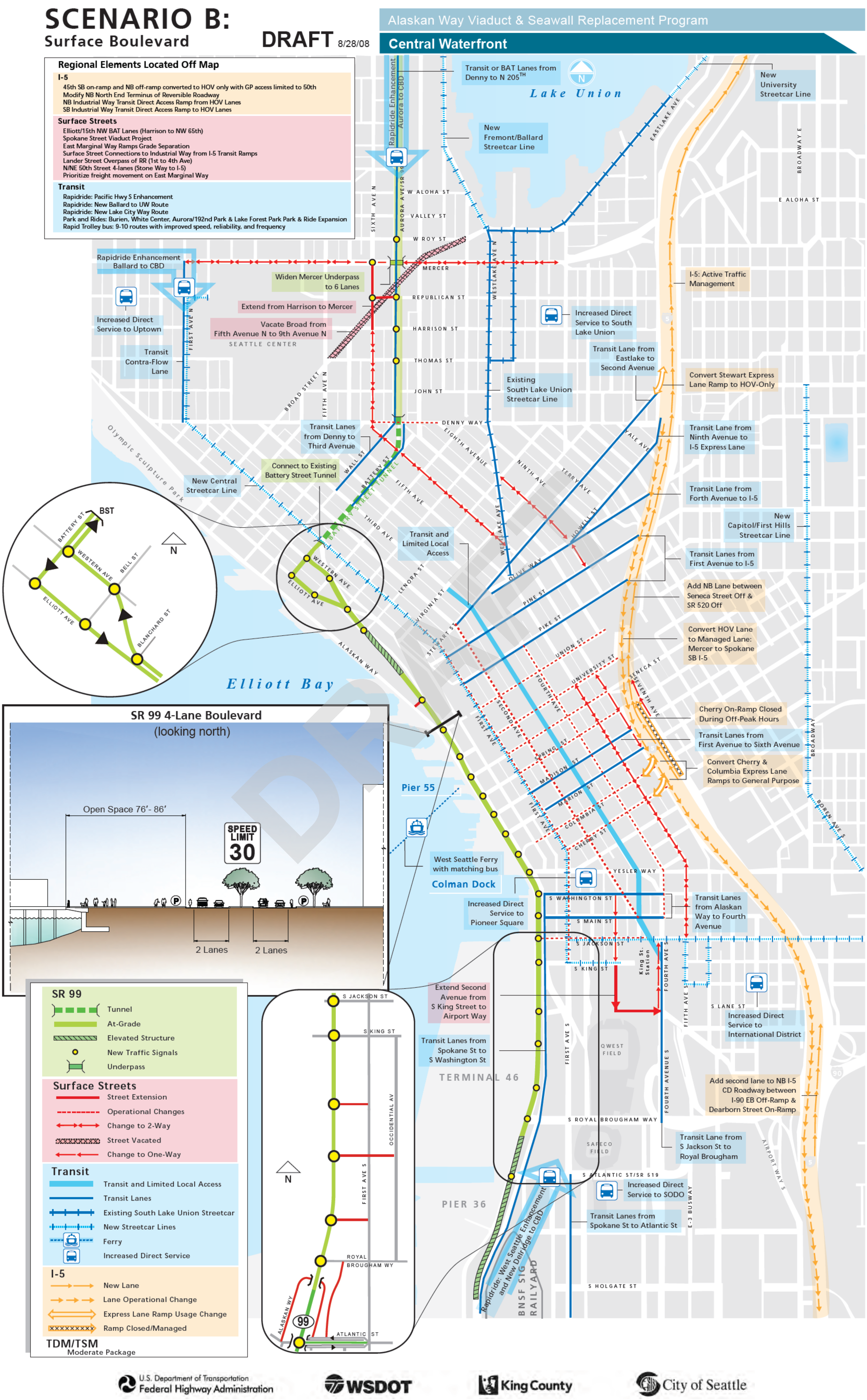


Figure 4-5 Deep Bored Tunnel Alternative, 2010 SDEIS

How Does an ST5 Approach Work?

ST5 works by increasing the person movement capacity of existing streets and highways, reducing bottlenecks where most freight travel occurs, and by creating incentives and opportunities for people to travel more easily, safely and comfortably by transit, bicycle and walking. The approach includes a number of surface street projects or management strategies that increase peak-hour capacity for vehicle movement, I-5 mainline capacity enhancements, and transit and TDM investments that reduce overall demand for auto travel to and from the Center City. ST5 investments are made over a wider transportation system, dispersing demand over multiple routes where capacity is available and moving people in modes that require less right-of-way. Trips would be made on the route and via the mode that is most convenient for that individual trip—when the Viaduct is no longer an option, different travelers will choose different paths. This approach is reinforced by the tolling analysis, which showed that when tolls are introduced, many of the trips assumed for the tunnel would instead be made over a broader network of alternative streets.

ST5 also works in ways that current modeling tools cannot describe, but is critical for Seattle and the region to meet goals set by policy makers to reduce per capita driving over time. In short, the ST5 approach:

- Changes demand patterns through a phenomenon called “reverse induced demand.” In other words, when the highway capacity is removed people make slight changes in the times that they travel to avoid the most congested periods, thereby making better use of existing roadways, switch to other modes of travel, and/or change their trip patterns by making shorter trips or eliminating unnecessary travel. These changes happen both immediately (e.g., shift trip to just before peak period) and over time (e.g., walk to local grocery instead of driving across town).
- Changes land use patterns over time. We know that major transportation investments influence land use development. As Seattle is attempting to reduce per capita miles traveled by car, curb emissions, and create more quality space for bicycles and pedestrians, an SR 99 highway replacement will promote driving as a primary access mode for Seattle Center City. A ST5 alternative can increase the competitive advantage for urban residential development and discourage auto-oriented development. Because Seattle uses a fixed land use forecast in its travel demand modeling, this effect is not captured.

B. Strengths of the ST5 Approach

In light of SDEIS findings about traffic diversion from a tolled tunnel, a comparative analysis shows the ST5 approach includes elements that may be needed to mitigate tunnel diversion and that it provides distinct benefits when implemented as a standalone alternative. This section highlights benefits of the ST5 approach that are particularly relevant to attainment of City of Seattle transportation goals, including those related to GhG reduction, social equity, and provision of multimodal mobility options.

The ST5 Approach Delivers a Lower Traffic Future

The ST5 Hybrid alternative was eliminated in an early SDEIS screening process because it did not maintain the same level of traffic capacity in the SR 99 corridor as other bypass alternatives (i.e., a deep bored tunnel). Were the broader Partnership Process study area used instead of the much narrowed SDEIS study area or if person movement capacity were considered in the purpose and need of the project, this conclusion would have been much more tenuous, if possible at all.

Figure 4-6 compares 2015 daily traffic volumes for AWV replacement options, including a non-tolled tunnel, a tolled tunnel, and ST5 Scenario B (as modeled in the Partnership Process).

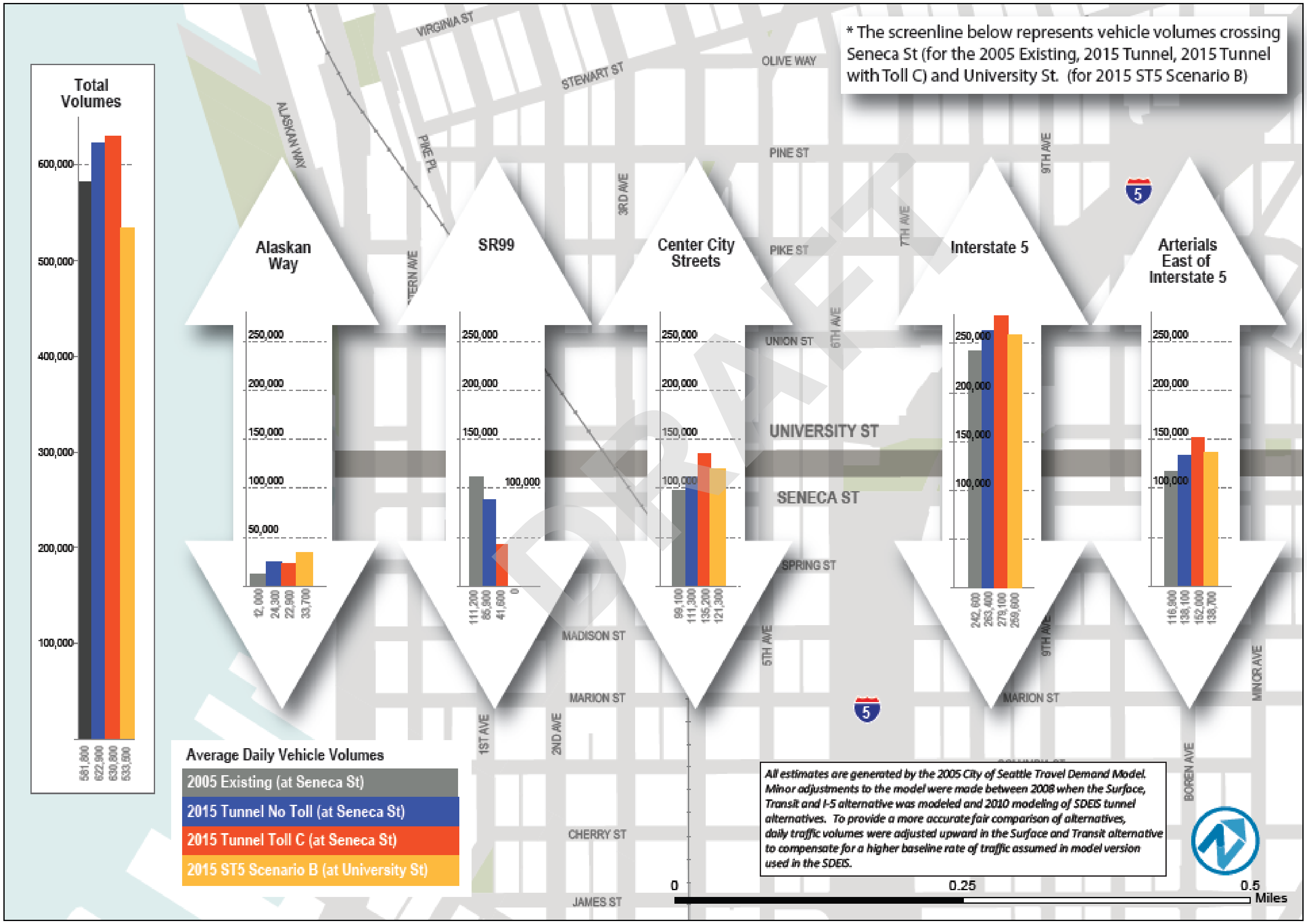
It is important to note that Figure 4-6 takes data from two separate modeling processes—the SDEIS modeling and the Partnership Process modeling (the SDEIS process did not model the ST5 Hybrid for 2015). Both use the same base travel demand model. Changes were made to model parameters resulting in higher baseline traffic projections in the SDEIS modeling; to account for this projected ST5 traffic volumes from the Partnership Process modeling are adjusted upward to match. While the adjustment is consistent with the difference in the baseline traffic volumes between the two modeling efforts, it does not necessarily reflect how the multi-step model works.

While traffic is higher on the new Alaskan Way surface street under ST5 Scenario B, the total number of vehicles traveling through Seattle between Elliott Bay and Lake Washington (on all streets and highways) is projected to be in the range of 85,000 less than a non-tolled tunnel and 95,000 less than a tolled tunnel (Toll Scenario C). This is explained both by mode shift, more people using transit, walking and biking, and some adjustment of travel patterns to make shorter local trips that would no longer cross the screenline.

Modeling for 2015 projects more traffic on downtown surface streets (measured at a University/Seneca screenline), I-5, and surface streets east of I-5 in the tolled tunnel alternative than the ST5 alternative.

Alaskan Way has higher traffic volumes in the ST5 alternative than tunnel alternatives. The most significant differences in traffic are on Alaskan Way, where ST5 Scenario B draws 9,000 to 11,000 more daily vehicles.

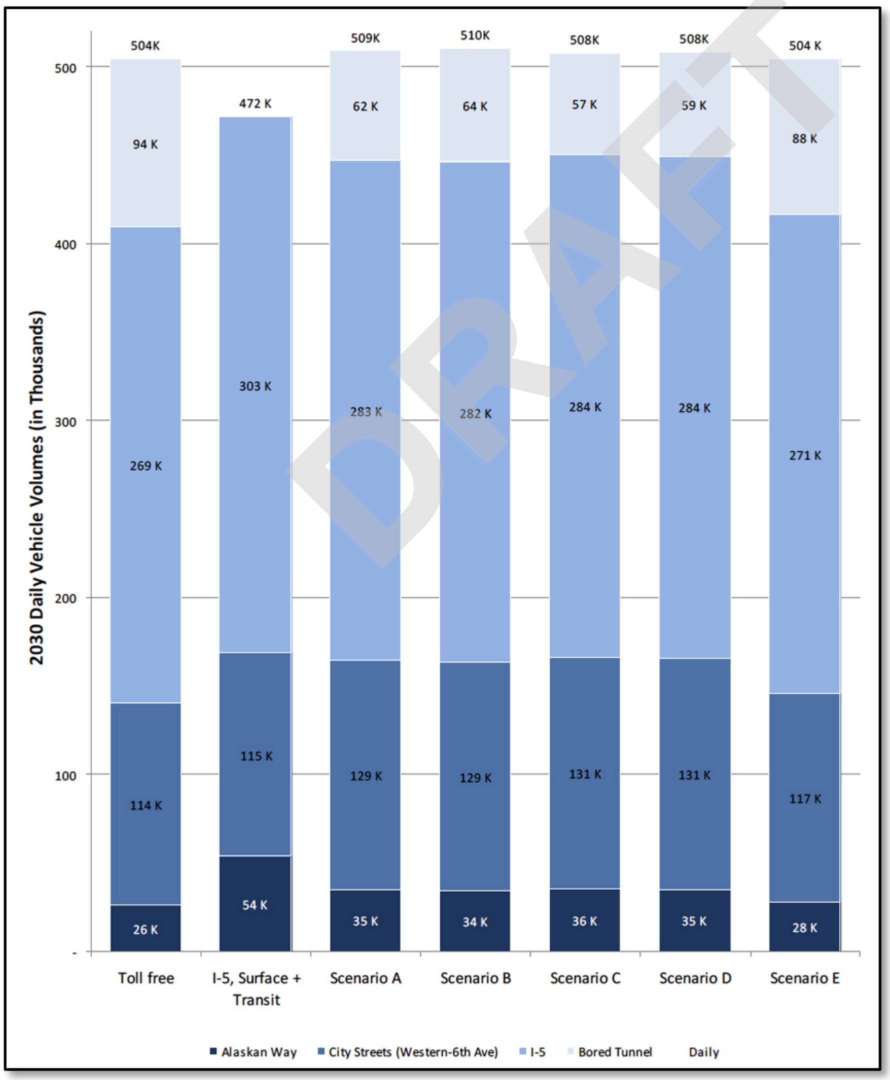
Figure 4-6 2005 and 2015 Projected Average Daily Vehicle Volumes



Source: SDEIS Chapter 9

While Figure 4-6 (above) is an adjusted comparison from two different studies, the Technical Analysis to Support the SR 99 Finance Plan (WSDOT, January 2010) provides a direct comparison of the ST5 Hybrid alternative (2030) to various tunnel alternatives, both tolled and non-tolled (Figure 4-8). Here again, the analysis shows significantly lower overall weekday traffic through the downtown in 2030 for the ST5 Hybrid alternative—by 32,000 to 37,000 trips per day compared with any of the tolling options and by 31,000 trips per day compared to the deep bored tunnel without any toll. Looking at the "City Streets" portion (that is, north-south surface streets from Western to Sixth Avenue), of the projections in Figure 4-7, the ST5 Hybrid alternative is projected to carry nearly identical volumes on city streets as compared with the tunnel without a toll and 14,000 to 16,000 fewer trips than for tolling scenarios A through D.

Figure 4-7 2030 North and South Weekday Traffic through Downtown by Scenario including Surface Scenario (at Seneca Street)



Source: WSDOT, SR 99 Alaskan Way Viaduct Replacement Updated Cost and Tolling Summary Report to the Washington State Legislature, 2010, p. 37.

These findings are not surprising. Urban theorists and mathematicians have developed theories and formulas to describe why increasing highway capacity often makes traffic conditions worse. One of the most relevant is the induced demand theory explained by Anthony Downs as "triple convergence." Downs created this theory to explain why attempts to reduce peak-hour congestion on highways by expanding capacity continuously fail. His research shows that in response to adding highway capacity three immediate effects occur: (1) drivers using alternative routes begin to use the expanded highway, (2) those previously traveling at off-peak times shift to the peak, and (3) public transport users shift to driving their vehicles.[3] Recent freeway removal projects in major cities have proven that this theory also works in reverse. When freeway capacity is removed, travelers adapt by shifting schedules, using transit and alternative modes, and reconsidering their trip or travel path.

Impacts of Traffic Volumes on Alaskan Way

One persistent concern about the ST5 alternative is that it places higher traffic demand on the proposed Alaskan Way surface street than any other modeled alternative. It is important to recognize that different variants of ST5 put varying levels of traffic on the waterfront street. The ST5 Hybrid alternative, which was modeled for 2030 conditions in the SDEIS, assumes Alaskan Way and Western operate as a couplet, increasing traffic carrying capacity in the Central Waterfront. ST5 Scenario B, modeled in the Partnership Process and used to calculate volumes in Figure 4-8, assumes a four-lane street will be constructed in the Central Waterfront (with six lanes south of Colman Dock).

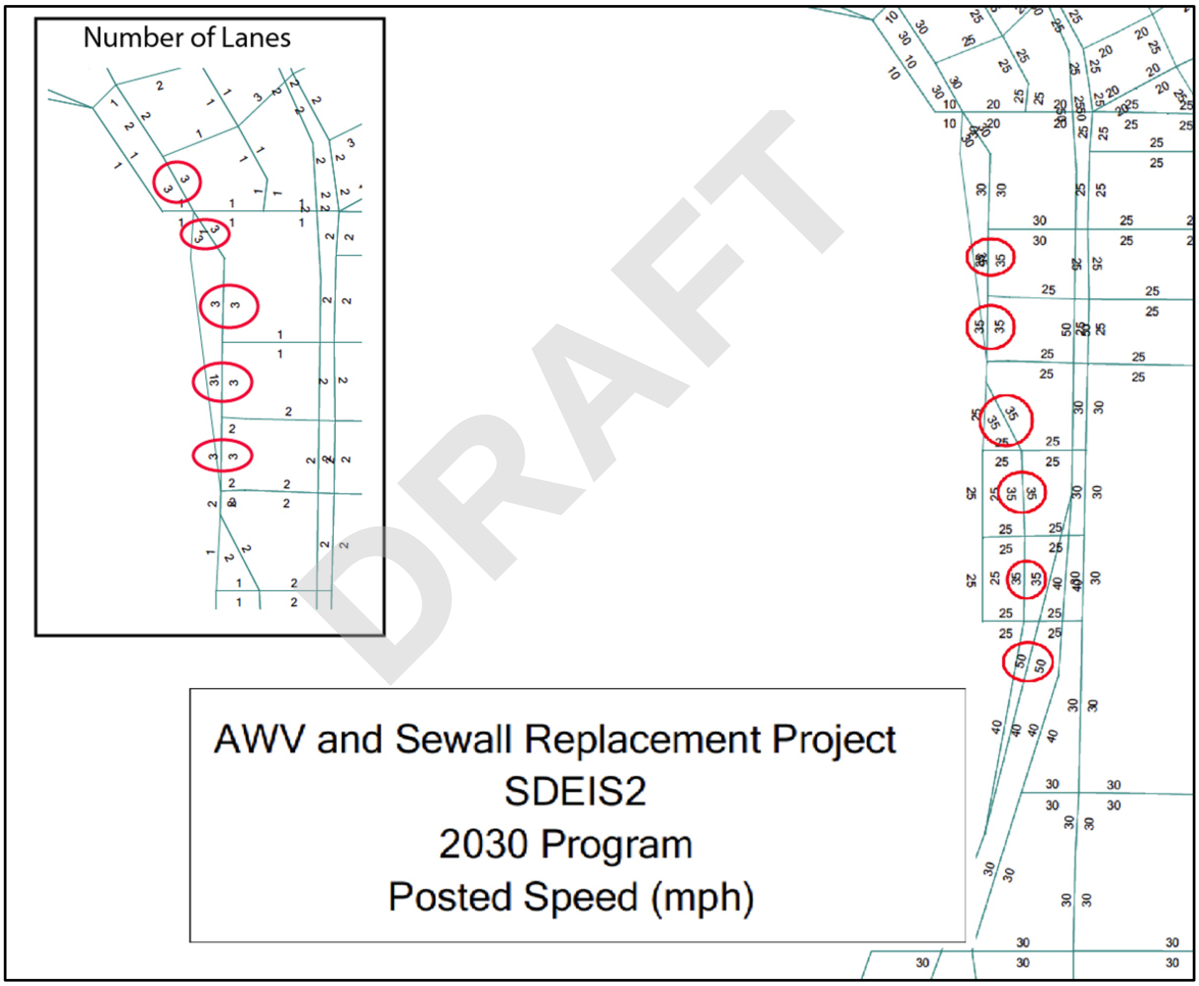
Concern about high volumes of traffic on the Central Waterfront is understandable given the investment being made to create a world-class waterfront public space. Traffic volumes are an important consideration when measuring future pedestrian quality and safety; however, travel speed and street design are more important to the quality of the pedestrian experience. The fact that higher 2030 volumes are projected on Alaskan Way under ST5 should not be emphasized to the exclusion of other key points, which include:

- **The City plans to build a four-lane street on the Central Waterfront (north of Marion).** This street will have a limited vehicular capacity and should be managed for slow speeds. The 2030 modeling done by the SDEIS team portrays a seemingly intolerable vehicle volume situation on Alaskan Way at Seneca Street with 54,000 daily vehicle trips. This is modeled assuming the ST5 Hybrid design, which is not on the table as a design option for the Waterfront. (The SDEIS team likely made a reasonable decision to use this version because it best fits within the narrow confines of the project purpose and need). The same scenario modeled using the planned Alaskan Way configuration would likely redistribute traffic to other parts of the system or to other modes.
- **Modeling parameters for Alaskan Way could better match its planned design and operation.** The 2030 ST5 Hybrid modeled in the early SDEIS process

[3] Downs, Anthony, *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion*, The Brookings Institution: Washington, DC. 1992

shows only 1,000 more trips per day on the downtown surface streets than a toll-free tunnel (without the Elliott/Western connector). Given the level of investment in this scenario to provide higher levels of downtown throughput on surface streets, additional traffic could be accommodated on this part of the system. SDEIS traffic modeling assumes three lanes in each direction with operating speeds of 30 to 35 miles per hour (see Figure 4-8). If this model was coded to treat Alaskan Way as an urban arterial with speeds of 25 miles per hour (like other downtown streets), it would attract fewer trips.

Figure 4-8 Lane and Speed Assignments Alaskan Way



Data Source: AWVRP. Based on data from the WSDOT/PB operational model used in the SDEIS.

Great Streets That Carry High Volumes of Traffic

"Great Streets," both historically and today, do much more than simply move cars. These examples demonstrate that the capacity of urban streets to handle significant motor vehicle traffic volumes is not mutually exclusive with providing an attractive pedestrian and/or bicycle environment and serving as an important community asset and amenity. Notably, two of these streets are examples of locations where freeways were removed and replaced with a surface thoroughfare.

The Embarcadero, San Francisco—52,000 ADT

The Embarcadero, which replaced a freeway damaged in San Francisco's 1989 Loma Prieta earthquake, has generous median refuges and a waterfront esplanade to make a street with six travel lanes, bicycle lanes and a median transitway inviting to pedestrians. Curbside parking further buffers pedestrians from traffic. This street carries almost twice the traffic volume projected on Alaskan Way and is a favorite place for pedestrians.

Image from: Flickr user "BigBlueOcean"

Avenue des Champs Élysées, Paris—83,000

The most famous of Europe's grand boulevards has wide sidewalks and double-rows of street trees to buffer pedestrians from traffic, although it is over 100 feet across, with only a narrow median to offer refuge at crossings.

Image from: Andy Hay

West Side Highway, New York City—69,000-81,000 ADT

The old West Side Highway was a freeway. The modern boulevard includes a landscaped median with refuges and waterfront bicycle and pedestrian paths.

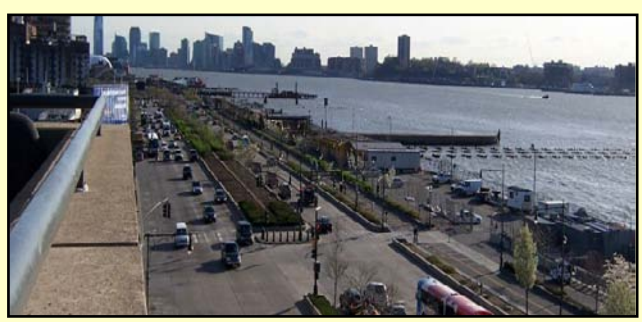


Image from: Flickr user "BlastOButter 42

I-5 Improvements Included in ST5 Approaches Could Benefit Many

Roughly one-fourth of the projected cost of ST5 alternatives (e.g., $563 million of $2.2 million for the ST5 Hybrid) would be spent on improvements to Interstate-5. Those changes include a number of project elements that would allow for more efficient operations through downtown and increase capacity:

- A new northbound lane would be created between Seneca Street and SR 520 using the existing shoulder of the highway. This new lane would be managed and the Cherry Street on-ramp would be closed at night.
- Changes would be made to allow general purpose traffic to use the southbound HOV lane between Mercer Street and S. Spokane Street during peak periods
- The express lane switch-over would be automated
- The Stewart Street express lane ramp would be converted to HOV only
- The Cherry Street and Columbia Street express lane ramps would be converted to general purpose
- Additional active traffic management would be implemented

These improvements were estimated to provide additional capacity of approximately 30,000 daily vehicles on this segment of I-5. A tolled tunnel diverts over 15,000 vehicles daily to I-5 according to the SDEIS, but does not include project elements to handle additional demand.

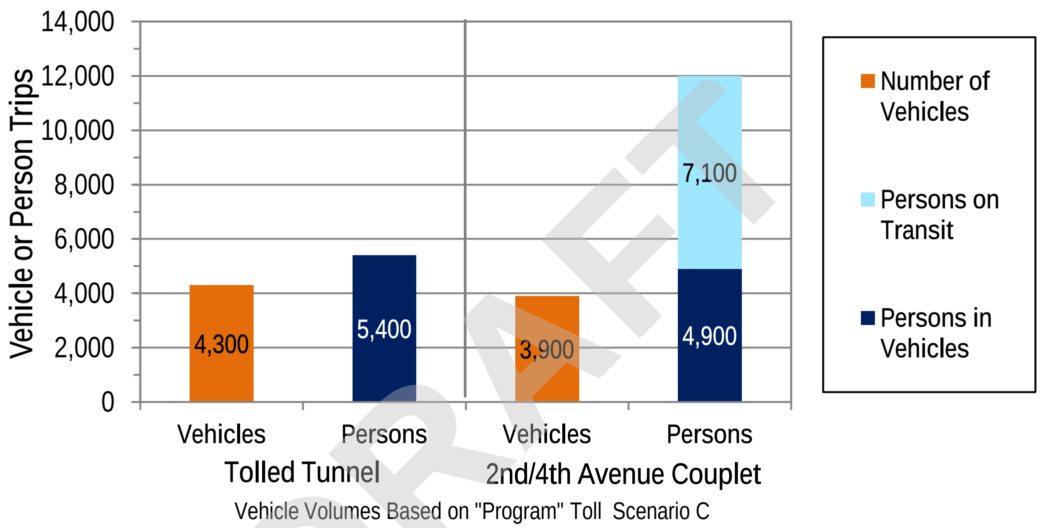
I-5 is a heavily used truck route and carries a number of transit vehicles. Improving capacity and reducing congestion on I-5 could provide greater benefit to local, regional and long-haul (interstate) freight haulers than investments in SR 99.

The ST5 Approach Focuses on Access to the Center City

More people travel to and from Seattle Center City daily than any other place in the northwestern United States; this number overwhelms the number that bypass the Center City, particularly on the west side of downtown. The ST5 alternative has a higher *person capacity* for travel *to* and *from* the Center City in future years. This means it can deliver more workers and customers with less environmental impact and leave more surface street capacity for local circulation, accommodation of new transit services, and creation of pedestrian and public spaces. ST5 includes projects to increase capacity on I-5, increase surface street capacity/functionality, and add transit service/seat capacity that are not provided in the tunnel alternatives. The ST5 alternatives also included important Center City transit circulation elements including the development of a First Avenue streetcar line and electric trolley bus improvements (Rapid Trolley Network). These improvements would make internal circulation in the Center City more viable without a private automobile.

In the Toll Scenario C tunnel alternative, the tunnel carries 41,000 daily trips (38,000 when the Alaskan Way- Elliott/Western connector is included). SDEIS modeling of Toll Scenario C for the year 2015 shows about 4,300 vehicles are projected to use the SR 99 tunnel during the PM peak hour (5:00 – 6:00 PM). This is slightly greater than the 3,900 peak-hour vehicle trips carried on the Second and Fourth Avenue couplet in downtown Seattle in this same alternative. The tolled tunnel carries about 5,400 *person*-trips during the PM peak hour compared to 4,900 person-trips in personal autos on Second and Fourth Avenues.[4] However, Second and Fourth Avenues are also very important transit corridors and carry over twice as many people as the tunnel—12,000 person-trips including an estimated 7,100 peak hour transit passengers.[5] Figure 4-9 illustrates the number of vehicles and people carried during the PM Peak hour by a tolled tunnel and the Second/Fourth Avenues couplet (2015 Toll C alternative). This comparison is not meant to liken the different facilities, but rather to illustrate the relatively limited mobility function provided by a tolled tunnel when compared with surface streets carrying transit vehicles.

Figure 4-9 Comparison of Tolled Tunnel and Surface Street Utilization: Persons and Vehicles Carried During Peak Hour (SDEIS Toll C Alternative)



Notes/Sources: Volumes for the tunnel and surface streets are based on the 2015 Toll C Program for the PM peak hour (5:00 PM to 6:00 PM), in the vicinity of Seneca Street. A PM peak hour of 4:30 PM to 5:30 PM was used for transit. Footnotes for above discussion provide additional details on sources and methodology.

If programmed transit investments included in ST5 are realized, the ability for the transportation system to bring more people to downtown and the Center City would be greatly increased. This is a critical economic development consideration, since over 50 percent of Seattle's projected 20-year growth in housing and jobs will occur in the Center City and adjacent neighborhoods (as shown in Figure 4-10). No new

[4] AWVRP EMME Plots showing volumes for Deep Bored Tunnel Toll Scenario C (2015) provided by WSDOT (analysis conducted by Parsons Brinkerhoff).

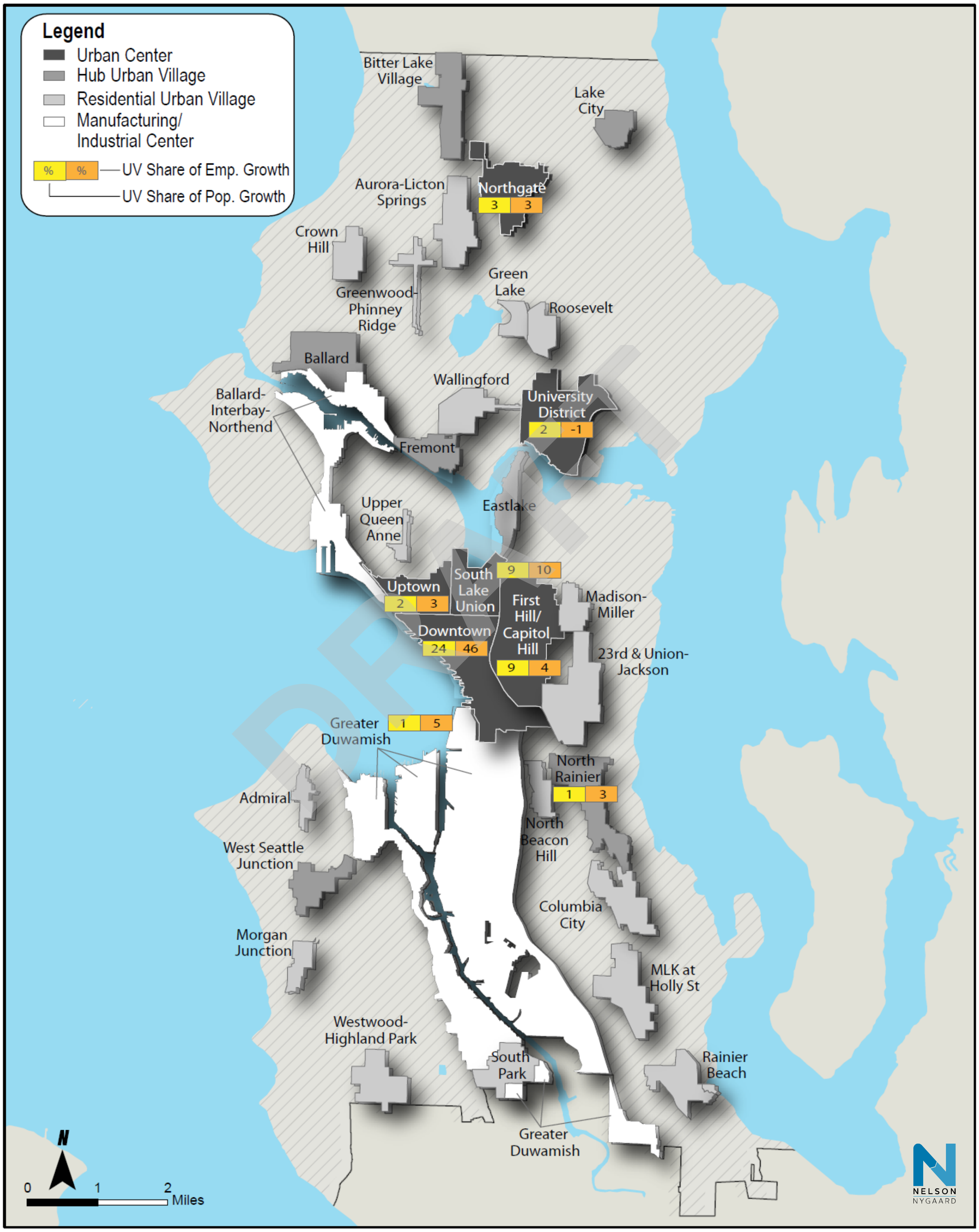
[5] Vehicle occupancy of 1.26 passengers per vehicle was used to calculate vehicle person trips, derived from overall vehicle and person-trips in the downtown area (SR 99, I-5, and surface streets) as documented in the SDEIS, Chapter 4, p. 73. Transit person trips were based on 252 buses per hour on 2nd/4th combined during the PM peak hour (4:30 – 5:30 PM), from Nelson\Nygaard data collected in 2007 for King County Metro, Sound Transit, and Community Transit buses at 2nd Ave & Marion Street and 4th Ave & Pike Street. An average bus capacity of 50 seats was used based on King County Metro APC data from 2007, with occupancies of 66% assumed on 2nd Avenue and 48% on 4th Avenue, based on UVTN data for 2nd/4th Avenues at Seneca Street. This yielded an average load of 28 passengers per bus.

Center City surface streets can be built to accommodate increased travel demand from this growth—transit, pedestrian and bicycle infrastructure will need to do the heavy lifting.

The modeling done for the AWVRP 2010 SDEIS projects very little mode shift to transit, carpool, vanpool, walking, or biking. This is true even in scenarios that were modeled with major investments in new transit service. Modeling of 2015 conditions for ST5 Scenario B conducted during the Partnership Process shows lower average daily traffic levels measured at a downtown screenline. A number of changes were made to this version of the model to more accurately reflect mode shift created by transit investments and TDM elements included in ST5 and highway replacement alternatives modeled during the Partnership Process.

Even assuming additional transit service is not added due to financial constraints, the State's SDEIS modeling appears to be insensitive to funded and planned improvements such as RapidRide and Link extensions. King County Metro's first RapidRide project (the A Line) has seen ridership increases of 25% in the first six months of operation. This aligns closely with a peer-based analysis of ridership increases from similar rapid bus deployments around the country. In the SDEIS analysis, inclusion of two new RapidRide lines (in addition to the three planned for Seattle) appear to produce negligible change in projected transit ridership or mode share. While Nelson\Nygaard did not review route-level transit forecasts, this seems counterintuitive. The SDEIS modeling also did not include adjustment to future parking prices (above the baseline growth for all future scenarios) to account for TDM effects on mode shift, a practice used in the Partnership Process.

Figure 4-10 Projected 2030 Population and Employment Growth in Urban Villages



Source: City of Seattle

The ST5 Approach Invests in Active, Human-Scale Transportation

The use of traffic models (both demand and operational) as primary analysis tools skews accounting and perception of project impacts by focusing discussion on vehicle counts and travel time. This report is guilty on this count as it relies on existing analysis.

Our modeling tools are best at predicting the number and distribution of vehicles; hence traffic volumes and intersection delay tend to be the foci of analyses. However, street design details, signalization, and traffic management are often more important to the way a street is experienced by drivers, pedestrians and bicyclists. Visual cues in the streetscape, lane widths, presence of bicyclists, and frequency of crossings all signal drivers about how to act. Typically, these details are not fully designed or understood until well after a traffic solution has been selected and detailed design is underway.

It is the design details that define the function and quality of an urban transportation system; these details are not well captured in the level of evaluation conducted for the SDEIS. The relatively blunt level of design consideration at the alternatives selection phase of an EIS is a disadvantage to the ST5 alternative. The selection of a mega-project alternative is certain to focus transportation resources on design and construction of facilities for automobiles, possibly leaving details that most benefit pedestrians and cyclists unconsidered or unfunded.

Important details that run under the radar at the SDEIS level of evaluation include:

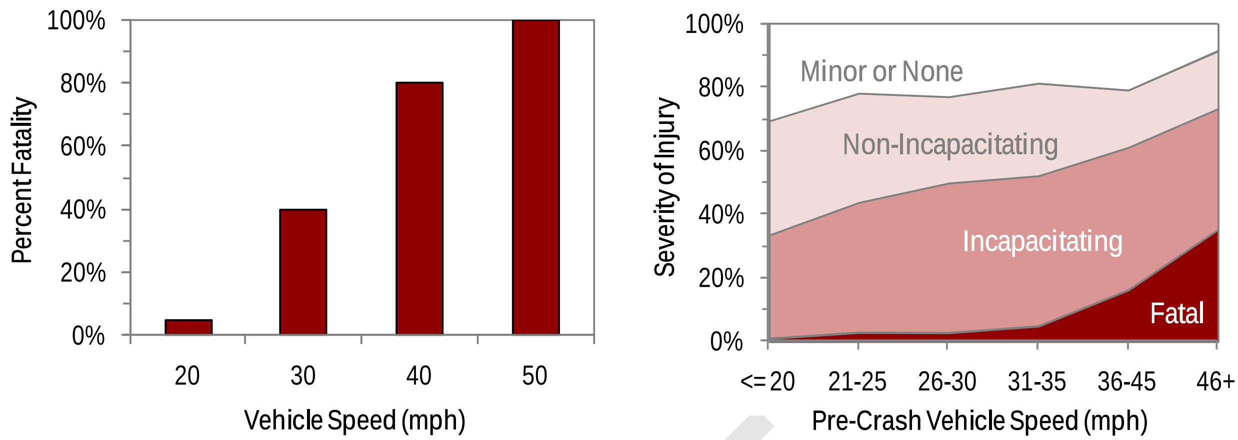
- Traffic speed is a more significant contributor to sense of safety (or lack thereof) and severity of pedestrian-vehicle incidents. On Alaskan Way, for example, assuming the street cross section will not exceed four lanes of general purpose traffic capacity (north of Marion), measured surface street traffic volumes may be less consequential to the quality of the street environment that traffic speeds.

  The speed of a vehicle is a major determinant of the severity of a pedestrian crash. According to one study (and several other studies have found similar results), a pedestrian hit at 40 miles per hour has an 80% chance of fatality, while a pedestrian hit at 20 miles per hour has only a 5% chance of fatality, as shown in the left graphic in Figure 4-11.[6] Nearly all pedestrian fatalities occur at speeds above 30 mph, as shown in the right graphic in Figure 4-11.[7] Pedestrians can intuitively sense this difference and are more comfortable on streets where speeds are consistently slow and design or even congestion eliminate the opportunity for higher-speed travel. To the pedestrian, a well-designed street operating at 25 mph with volumes of 35,000 daily vehicles may provide a more comfortable walking environment than one that carries 20,000 vehicles at 35 mph.

[6] , W. and Preusser, D. Literature Review on Vehicle Travel Speeds and Pedestrian Injuries, US DOT NHTSA (DOT HS 809 021), 1999, p.4.

[7] US DOT, National Highway Traffic Safety Administration, 2002, Table 2 (US 1994-96 Data)

Figure 4-11 Pedestrian Injury Severity Based on Vehicle Speeds



A vehicle traveling at higher speeds takes longer to stop and the severity of injury increases. Nearly all fatal pedestrian injuries occur at speeds above 30 mph.

Sources: Leaf and Preusser (US DOT NHTSA), 1999, p. 4. Right: US DOT NHTSA, 2002, Table 2 (US 1994-96 Data).

- Well-designed signal systems can help to move traffic more efficiently, but also increase the quality of service for pedestrians by allowing more dynamic adjustments to pedestrian phases when pedestrian volumes are high or traffic volumes are low.
- Mode choice is driven by small environmental or experiential factors as much as it is about macro-level network design. How traffic is managed is often as influential as the volume of traffic when people make personal decisions about whether a street is safe for bicycling. In downtown Portland, traffic signals are timed to 12 to 15 mph progressions to ensure that bicycles are comfortable riding in traffic. At these speeds, dedicated lanes are not needed for cyclists since riding in-lane with traffic is more comfortable and likely safer since conflicts with parked vehicle are reduced.
- On-street parking provides a way for drivers to access businesses and helps to buffer pedestrians from street traffic. However, this space can be used flexibly for transit or general purpose travel throughput at peak times. This is a common practice in Seattle and was a strategic element in various ST5 alternatives. In places where more of this capacity is needed for vehicles, there are relatively simple and low-cost strategies to address the parking and pedestrian comfort impacts of this removal. In Chicago, the city regularly uses linear planters along such streets to buffer pedestrians and beautify streets (see Figure 4-12). For lost parking, an off-street supply of commonly priced and branded parking can help to make up for lost street stalls. The City of Seattle is already working to develop such a system, called ePark and shown in Figure 4-12.

Figure 4-12 Mitigation Strategies for On-Street Parking Removal

Linear planters in Chicago buffer pedestrians from traffic and beautify the street.

Source: Iris Shreve Garrott, Creative Commons License 2.0

Seattle's ePark Parking Management System provides off-street parking with uniform pricing and branding.

Source: Nelson\Nygaard

C. Evidence of Transportation System Adaptability

The Urban Mobility Plan Briefing Book highlighted over half a dozen urban freeway removal projects that have been implemented with little or none of the expected traffic congestion or delay. While none presents exactly the same set of conditions as the SR 99/AWV project, a particular example that shows strong evidence of transportation system adaptability is the removal of an elevated highway in Seoul, Korea. This example is most compelling because of the similar function of the removed freeway and the fact that a modest set of surface and transit improvements was implemented as a transportation replacement.

Cheonggye Elevated Highway Removal Project, Seoul, Korea

Many have pointed to U.S. freeway removals, such as of the Central Freeway and Embarcadero Freeway in the San Francisco Bay Area, as important parallels for Seattle to illustrate the feasibility of traffic management after a freeway removal. However, neither San Francisco freeway fully bypassed the city. The Seattle Urban Mobility Plan Briefing Book highlighted the removal of a heavily used urban elevated freeway in Seoul Korea that may be a better comparison when evaluated for travel patterns and traffic volumes and describes the project as follows: [8]

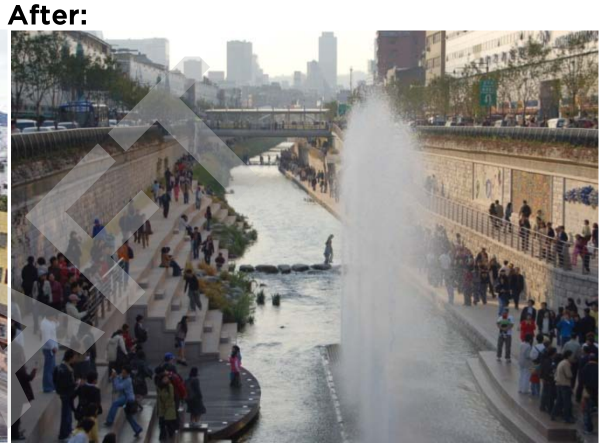
[8] http://preview.tinyurl.com/SeattleUMPBB-FreewayRemoval

> *Cheonggyecheon ("clear valley stream") is a former seasonal waterway in the city center of Seoul, South Korea. Between 1958 and 1976, the stream was covered and replaced by the Cheonggye Road and Cheonggye Elevated Highway, or Cheonggye Expressway. Prior to demolition, combined traffic counts on both roads were approximately 168,000 vehicles per day, about five-eighths of which was through-traffic. Between 2003 and 2005, the roads were removed and the stream was restored. The stream is the centerpiece of a 3.6-mile linear park. New two-lane, one-way streets are on each side of the park.*

Figure 4-13 Cheonggye Expressway, Before and After

Before:

After:



Sources: Seoul Metropolitan Government (left), Flickr user Rinux (right)

Like the Alaskan Way Viaduct, Cheonggye Expressway was adjacent to the central business district, and like the AWV, it primarily served as a bypass for regional traffic. The 5.8 kilometer-long expressway and parallel surface streets carried approximately 168,000 daily vehicle trips before its removal. It is estimated that 70% of trips on the facility were directed to the adjacent downtown area.

Kee Yeon Hwang of Korea Transport Institute and Kee Min Sohn of the Department of Urban Design and Studies at Choong-Ang University in Seoul reported on the transportation outcomes of this project in a 2004 report published in the Journal of the Korean Society of Civil Engineers and recently translated into English by Andy Hong, a student at the University of Washington. The study abstract describes a familiar situation: [9]

> *"There were many concerns with the project, including relocation of hundreds of small merchants around Cheonggyecheon, yet traffic issue created the most heated debate. Some critics argued that removal of urban highways, coupled with reduced road capacity*

[9] Kee Yeon Hwang and Kee Min Sohn, The Impact of Cheonggyecheon Restoration on Traffic and Travel Behavior, Journal of the Korean Society of Civil Engineers, Issue 24, Volume 2, 2004, pp187-194 (Translated from Korean by Andy Hong, Nelson\Nygaard, 2011).

> *would worsen traffic congestion in the central district, leading to a city-wide traffic crisis from the outset. Proponents of the project argued that the project would not seriously degrade traffic condition because it would discourage private motor vehicle trips while encouraging more transit use. Because of these contrasting arguments concerning the impact of the construction, there were considerable interests in understanding the actual impact of the project on traffic."*

The complementary programs implemented by the City of Seoul as part of the project included a series of surface street and transit service improvements:[10]

- Subway hours of operation were expanded by one hour incrementally and bus routes were reorganized.
- An adjacent stadium was used as a temporary parking lot to provide parking space for nearby merchants.
- The road system was restructured by adding alternative streets for bypassing and increasing thoroughfare.
- Adjacent streets within a few miles of Cheonggyecheon were transformed into reversible lanes to efficiently manage traffic entering and leaving the central district.

Notable findings of Hwang and Sohn's study follow. These results are based on before and after monitoring for the project with the before condition including full operation of the freeway and parallel surface streets and the after condition including the removal of the four-lane freeway and two lanes of parallel surface street capacity in each direction.

- Travel times in the city as a whole decreased by 4.8%; travel times on downtown streets decreased by 1.2% overall; urban highway travel times in the city rose by 11%.
- Traffic volumes on parallel roadways in the vicinity of the removed freeway dropped.
- Figure 4-14 shows change in AM and PM traffic following the freeway removal. These figures do not include the traffic removed from the freeway, which constituted 7% of all traffic traveling in and out of the city.
- Peak-period traffic shifted to travel at earlier and later times. Figure 4-15 shows clearly how peak-hour traffic, previously occurring between 8:00 and 9:00 AM, shifted to the 7:00 AM hour. This is a common phenomenon called peak spreading.
- Public transit use on the city's subway system increased by 1.6% overall following construction, but much more sharply in the downtown area. Bus transit use, however, fell due to increased traffic delay on transit-carrying streets, which do not provide priority treatments for rubber-tired transit.

[10] Hwang and Sohn, 2004. (Translated from Korean by Andy Hong, Nelson\Nygaard, 2011).

- Freeway removal had little impact on inter-neighborhood trips made by residents, but 4% of commuters shifted from single-occupant driving modes to transit.
- 88% of corridor commuters surveyed for the study indicated their commute travel time did not change as a result of the removal.

Figure 4-14 Cheonggyecheon Restoration, Change in Traffic Volumes on Parallel Roadways

	Before Construction		After Construction	
	Inbound	Outbound	Inbound	Outbound
AM Peak	49,846	31,983	48,754 (-2.24%)	30,558 (-4.66%)
Afternoon	39,030	37,480	36,487 (-6.97%)	33,715 (-11.17%)
PM Peak	35,289	41,175	35,314 (+0.07%)	37,747 (-9.08%)

Figure 4-15 Cheonggyecheon Restoration, Peak Traffic Time (Peak Spreading)

		Before Construction		After Construction		
	Interval	Inbound	%	Inbound	%	% Change
All Monitoring Sites	07:00 – 07:15	5,106	10.2	5,303	10.9	0.63
	07:15 – 07:30	5,906	11.8	5,873	12.0	0.20
	07:30 – 07:45	6,211	12.5	6,162	12.6	0.18
	07:45 – 08:00	6,714	13.5	6,339	13.0	-0.47
	Subtotal	**23,936**	**48.0**	**23.675**	**48.6**	**0.54**
	08:00 – 08:15	6,708	13.5	6,362	13.0	-0.41
	08:15 – 08:30	6,615	13.3	6.264	12.8	-0.42
	08:30 – 08:45	6,466	13.0	6.251	12.8	-0.15
	08:45 – 09:00	6,122	12.3	6,203	12.7	0.44
	Subtotal	**25.910**	**52.0**	**25.079**	**51.4**	**-0.54**
	Total	**49,846**		**48,754**		

Hwang and Sohn provide a poignant summary of key urban transportation planning principles:

> *However, in large metropolitan cities where traffic demand is high and alternative transportation is well supplied, the traditional supply-side theory cannot explain peak-hour traffic congestion. Downs (2002) argues that adding new roads in large cities only escalates traffic congestion based on his Triple Convergence theory. Braess*

> *Paradox also supports that adding new roads in cities creates more turning movements, thereby increasing traffic delays (Pas and Principio, 1997). Other researchers including Decorla-Souza (2002), Wachs, Thompson, and Mogridge also support this view that adding more road capacity would worsen traffic congestion in large cities (Hwang and Kim, 2003). A good example of improving traffic congestion through reduction in road capacity can be found in the Namsan 2nd Tunnel when it was completely closed for renovation. The 2-km long tunnel is one of the main entrances to the City of Seoul, and quite contrary to the City's expectation, neighborhood traffic condition was actually improved after its closure (Hwang, 2001). Also, when the City built an urban circular highway, it was expected to alleviate urban traffic congestion as it allowed drivers to bypass the busy central district; however, induced demand generated more traffic, and aggravated traffic condition in downtown area (Hwang and Kim, 2003).*

The Cheonggye Expressway removal project may provide a glimpse at the future of urban transportation, particularly in this time when our major infrastructures are approaching end of useful life and financial resources for major project investments are increasingly scarce; that is, one focused on changing people's travel behavior rather than expanding and maintaining new infrastructure.

Figure 4-16 summarizes the Cheonggye Expressway case in relation to the AWV and cases from San Francisco and Portland.

Figure 4-16 Summary of Freeway Removal Cases

City	Roadway	Volume Before	Surface Replacement Volume	Mitigation Efforts	Changes in Travel Patterns	Relevance to Alaskan Way Viaduct (AWV)
Seattle	Alaskan Way Viaduct	Up to 138,300 [1]	-	-	-	-
Seoul, South Korea	Cheonggye Expressway, removal of 5.8-km elevated highway and reduction of surface street from 4 to 2 lanes. Roadways carried 7% of total inbound and outbound peak hour (8-9 AM) traffic to/from downtown.	168,000 (expressway and surface street)	N/A (Replaced by parks and two-lane surface street))	Subway hours increased and bus routes reorganized, including BRT with median bus-only lanes. Road system restructuring, e.g., adjacent streets within a few miles converted to reversible lanes. TDM measures including incentive-based no-driving days.	9.1% decrease in traffic passing through Seoul, and 5.1% decrease citywide. Based on monitoring of alternate routes during construction, drivers shifted to earlier times (7:00-8:00 AM and particularly 7:00-7:15) from 8:00-9:00 AM peak hour. Increase in subway ridership. Decline in bus ridership (due to congestion).	Adjacent to CBD and bypass route for regional traffic.
San Francisco	Central Freeway, replaced by surface Octavia Blvd.	100,000	45,000	Unknown	In follow-up study, no observed traffic increases of more than 10% on alternate routes, while traffic decreased on three of the routes. In a survey six weeks after freeway closure, only 2.2% of former freeway drivers shifted to transit and only 2.8% no longer made trips, however 20% made fewer trips.	Not a CBD bypass. Replacement boulevard congested at peak hours with some spillover into neighborhoods, though mitigated by signal timing.
San Francisco	Embarcadero Freeway, replaced by surface boulevard	60,000	26,000	Unknown	No decline in LOS on alternate routes.	Served a more limited market than AWV. Adjacent grid is better developed. Not a through city facility.
Portland	Harbor Drive Freeway, removed and replaced with Waterfront park	25,000	N/A (Replaced by park)	An alternate route, I-405, was opened the previous year and creates a freeway loop on the west side of downtown. Downtown streets were converted to one-way with timed signals.	9.6% fewer vehicle trips on nearby roads and formerly connecting bridges.	Closure was originally dismissed; the roadway was projected to carry 90,000 vehicles by 1990. However, the task force decided that traffic would redistribute itself onto the network.

Notes: (1) Based on projected 2015 traffic volumes for existing viaduct at highest volume location; WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, p. 214.

Sources: Seattle Urban Mobility Plan Briefing Book, January 2008, Freeway Removal Case Studies, http://preview.tinyurl.com/SeattleUMPBB-FreewayRemoval. Kee Yeon Hwang and Kee Min Sohn, The Impact of Cheonggyecheon Restoration on Traffic and Travel Behavior, Journal of the Korean Society of Civil Engineers, Issue 24, Volume 2, 2004, pp187-194 (Translated into Korean by Any Hong, Nelson\Nygaard, 2011).

D. ST5 Challenges

While many seem ready to portray ST5 as an easy-to-launch alternative, it too is a large project, or rather many smaller projects that cumulatively have a significant effect. While implementation of a surface, transit and I-5 solution is viable, it would face a number of challenges and could possibly take as long or longer to implement in full than the deep bored tunnel alternative.

This section describes several key challenges to ST5 implementation.

State of Washington Project Funding

The State of Washington has committed $2.8 billion of available funding for the AWV Replacement Project. According to a 2009 law, the State will not spend beyond this limit, even if the project faces cost overruns. While this money is dedicated to the SR 99 corridor, State officials have indicated it is only available for construction of an SR 99 freeway and directly related facilities. Ultimately how these funds are used in the corridor is a decision partially in the hands of the State Legislature and partially in the hands of the FHWA, and is restricted by the 18th Amendment to the Washington State Constitution, which limits uses of gas tax funds to highway purposes. Whether decision makers would be willing to consider using these funds on an alternative that does not include a new freeway connection is an open question, but one that seems to be largely answered.

Funding Transit and Demand Management

As described, funding realities color the comparison between alternatives. King County Metro Transit is in a difficult financial situation and faces upcoming cuts to transit service. The agency is not positioned to fund new services in the SR 99 corridor or elsewhere. Even if new funding sources currently being pursued in the State Legislature are approved, new revenues are unlikely to fully offset recent loss of revenue due to reduced sales tax revenue.

The 2007 stakeholder outreach process conducted by the City indicated that a major concern among stakeholders was a lack of trust that government would be able to deliver on the "transit" element of a surface and transit solution. A number of stakeholders indicated they would support a surface and transit solution if they had confidence that all its elements, including transit, would be delivered.[11]

Given King County Metro's current budget deficit, which may require Metro to make major service cuts across the region, public confidence that a robust transit and TDM package could be delivered is low.

However, if King County is successful in attaining new funding—for example, the State Legislature is currently considering a bill that would allow for a $20 "congestion reduction charge" to fund transit operating and capital needs," in the short-term, subject to voter approval[12])—there may be opportunity to add service in key corridors identified in the Partnership Agreement. Examining the details of how freeway

[11] MIG, AWV Stakeholder Interview Report, 2007

[12] SB 5457, http://apps.leg.wa.gov/billinfo/summary.aspx?bill=5457&year=2011

removals in other communities have worked, none have led to dramatic mode shifts to transit. In most cases, transit mode share increased by no more than 1% to 3% in the affected corridor. The SR 99 corridor has good bus transit today, with improved level and quality of service planned through the King County Metro RapidRide program. Significant investments in transit service beyond what is planned may not be needed to support an ST5 alternative if capital improvements are made to ensure current and planned transit services are competitive with driving in terms of both speed and reliability. Even if public perception about transit delivery needs is larger than reality, funding constraints remain a very real issue.

Implementation Timing and Complexity

The construction phasing plan set forth in the SDEIS suggests that traffic stoppages on the SR 99 mainline will be relatively short in duration—a matter of three weeks—as the completed tunnel is attached to the SR 99 mainline and surface ramps.[13] An additional 12 to 24 months of AWV deconstruction, Alaskan Way construction and connection to Elliott/Western will still take place following the opening of the SR 99 tunnel. However, the current construction phasing plan presents an attractive option for corridor users since either Alaskan Way or SR 99 would be available at all times during construction. The SDEIS does not discuss whether the tunnel would be tolled during the construction of Alaskan Way and the Elliott/Western connector, when tolling diversion combined with construction closures could be more impactful.

Since the ST5 alternative was never developed to the level of design or implementation detail that the deep bored tunnel receives in the SDEIS, it is difficult for most to conceive how ST5 would be developed and impacts managed. The ST5 alternative takes a systems approach to managing mobility and access for people and goods; by nature it includes a much more nuanced and complex set of projects. It relies on financial incentives and improved services to shift traveler choices, both for mode of travel and where goods and services are accessed.

Larger than the issue of disruption from construction is that of behavior modification. Many have a difficult time conceiving how this would happen. In fact, there are many good examples of instances when Seattle and the region made significant adjustments to travel patterns. The Urban Mobility Plan Briefing Book recaps these and explains why they provide instructive examples of transportation system adaptability (http://www.seattle.gov/transportation/docs/ump/02%20SEATTLE%20traffic%20congestion.pdf).

WSDOT, King County, and the City of Seattle have managed major highway construction projects through programs designed to shift travel behavior very successfully in the past. A common belief seems to be that these short-term shifts in travel could not be sustained. Experience in other cities suggests otherwise.

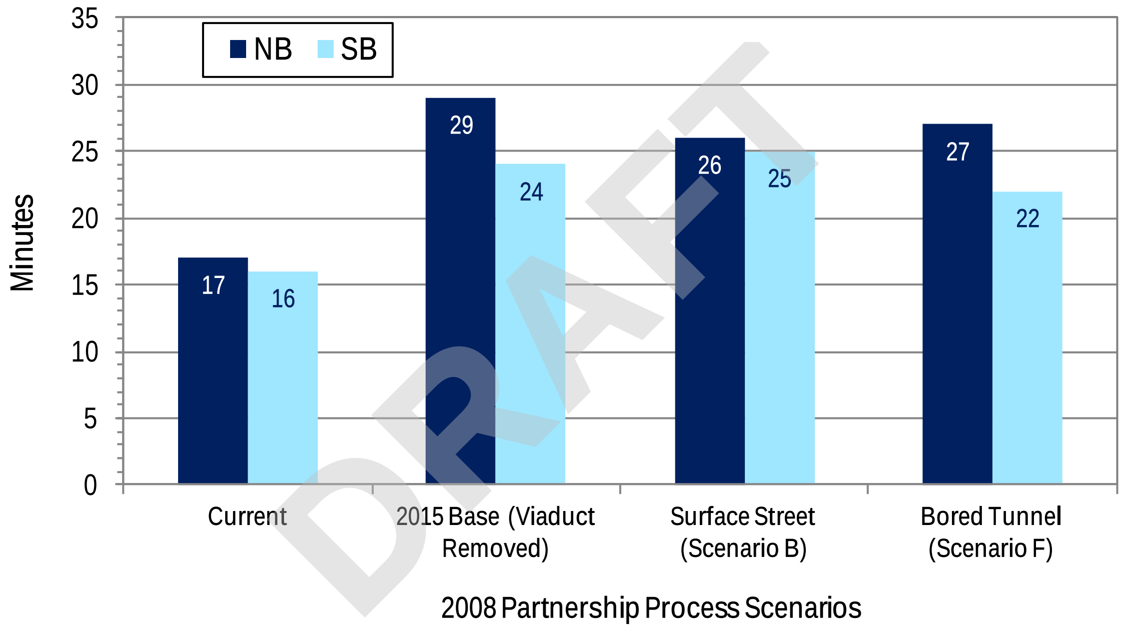
Freight Access and Mobility

While downtown-bound commuters have travel options including bus services and current and future rail extensions, freight haulers traveling through the Center City have fewer options. Longer travel times and decreased reliability projected with the ST5 alternative was a concern for many stakeholders from the industry and

[13] 2010 SDEIS, Chapter 6 (Construction), p. 138

manufacturing sectors who participated in the Stakeholder Process. Figure 4-17 illustrates results from the 2008 partnership process. Freight travel times increased both due to growth and removal of the viaduct. An ST5 alternative (Scenario B) reduced travel times slightly in the northbound direction on the Ballard/SOD route used to move freight, compared to 2015 base (with the viaduct removed) and a bored tunnel scenario, but increased travel times slightly in the southbound direction. The Partnership Process analysis noted that the most significant differences between alternatives were those through the Center City (shown in Figure 4-17) but that system improvements (such as the added lane on I-5 in the ST5 alternative) mitigate some impacts.

Figure 4-17 Comparison of Freight Travel Times, 1st Ave S. to Interbay via AWV/Elliott Ave, AM Peak



Data Source: Partnership Process Guiding Principle 2 Results, 11/13/2008

Freight traffic movements entering and exiting the Port of Seattle have been improved by recent projects including the SR 519 connector, the Spokane Street Viaduct, and the SR 99 Moving Forward projects for the south end. Most of this freight traffic connects to I-5 or travels south; the treatment of SR 99 north of the interchange at Dearborn should have relatively little impact on freight movement between the Port facilities south of downtown and regional highways.

SR 99, as a freight route, is very different than I-5. I-5 has a higher percentage and total volume of trucks, including many full-sized semis. SR 99 has a lower percentage of truck traffic with very few semis. Most freight traffic on SR 99 is local in nature and is accommodated on lightweight trucks, including many vans and pickup trucks. 1,900 trucks pass through the Battery Street Tunnel on a daily basis.

The freight pathways most impacted by differing alternatives on SR 99 are those that connect the SODO/Duwamish Industrial area with the Ballard/Interbay Industrial area. Interestingly, of the major infrastructure alternatives considered, the Deep Bored Tunnel produced travel time results closest to the Surface and Transit Alternatives for this particular freight route. This is primarily due to the fact that the Elliott/Western connection can only be reached by surface Alaskan Way in the Deep Bored Tunnel Alternative as well as the ST5 alternative considered. It should be noted that for freight haulers, reliability and redundancy are as important as average travel times; options with more lane capacity provide more assurance of reliable operations.

A New Supplement to the EIS Would Likely Be Needed

Because the ST5 alternative was eliminated in the SDEIS, reintroducing it as viable option now would add significant time to the NEPA process. The delay could easily range from 16 to 30 months, time required to:

- Revisit the purpose and need for the project
- Conduct a new alternatives screening process
- Develop a new Supplement Draft EIS and a Final EIS

Momentum

While these issues are real, each has either been addressed in the Partnership Process/Urban Mobility Plan, or could be managed with project planning comparable to that being dedicated to tunnel construction and mitigation. Clearly the biggest challenge facing the ST5 solution is a trail of decisions and procedural constructs now in place, all pointing toward a deep bored tunnel as the replacement alternative to be selected. A committed partnership of the State of Washington, the City of Seattle and King County could deliver a ST5 solution by 2015. However, this would require a significant change in project direction and consensus support from agency leadership.

5 CONCLUDING QUESTIONS AND A WAY FORWARD

This report raises some critical questions that should be answered prior to finalizing the NEPA Environmental Impact Statement process for the Alaskan Way Viaduct Replacement Project. Raising these questions now will be unpopular with many, but is reasonable given the vague treatment of tolling in the SDEIS and the unresolved impacts created by traffic diversion.

- Given the fact that tolling for SR 99 isn't approved and we now know that tolling will have impacts, how will mitigation measures to address diversion be incorporated into the environmental document?
- Are important City policy goals (e.g., greenhouse gas reduction, carbon neutrality, a multi-modal transportation system) fulfilled through the current project direction?
- How do rising energy prices which increase the cost of driving impact travel demand overall and for a tolled bypass tunnel? How do changing real estate location preferences change the future demand for travel in Seattle? Most importantly, how are factors driving future travel decision making integrated in to project modeling?
- What if overall traffic and per capita driving continue to decline in Seattle for the next 10 years? Is it worth a look at replacement alternatives under such a scenario, rather than simply assuming traffic will grow steadily in coming decades?
- If facility tolling for a deep bored tunnel alternative is needed to fund the project, what types and levels of mitigation will be needed? Who will pay for mitigation and what impacts will mitigation measures have on project costs?
- Understanding that tolling at a substantial rate is needed to support the current project funding package and that such tolling could reduce tunnel use by 50% or more, diverting traffic to City streets and I-5, might Seattle be better off with a systems solution that reduces overall auto travel demand and improves the surface street environment?

As much as any party, the City has a vested interest in moving the replacement of the Alaskan Way Viaduct forward. The City has signed agreements with WSDOT and King County committing to develop key components of a replacement alternative. However, the AWVRP 2010 SDEIS suggests that further action is needed to determine the effects of tolling and related mitigation. Specifically, the SDEIS makes clear that tolling is an essential part of the project, because there is no other obvious option for funding a significant portion of the project cost. It follows that a process is needed to evaluate more fully the impacts of tolling and to provide for and fund mitigations. With tolling at levels needed to support project financing, needed mitigations may make the project more expensive.

APPENDIX A

Impacts of a Tolled Tunnel

This appendix provides information to supplement the assessment of tolled tunnel impacts described in Chapter 2.

Increased Traffic Volumes and Congestion in Center City Neighborhoods

Addressed in Chapter 2.

Travel Time on Downtown Streets

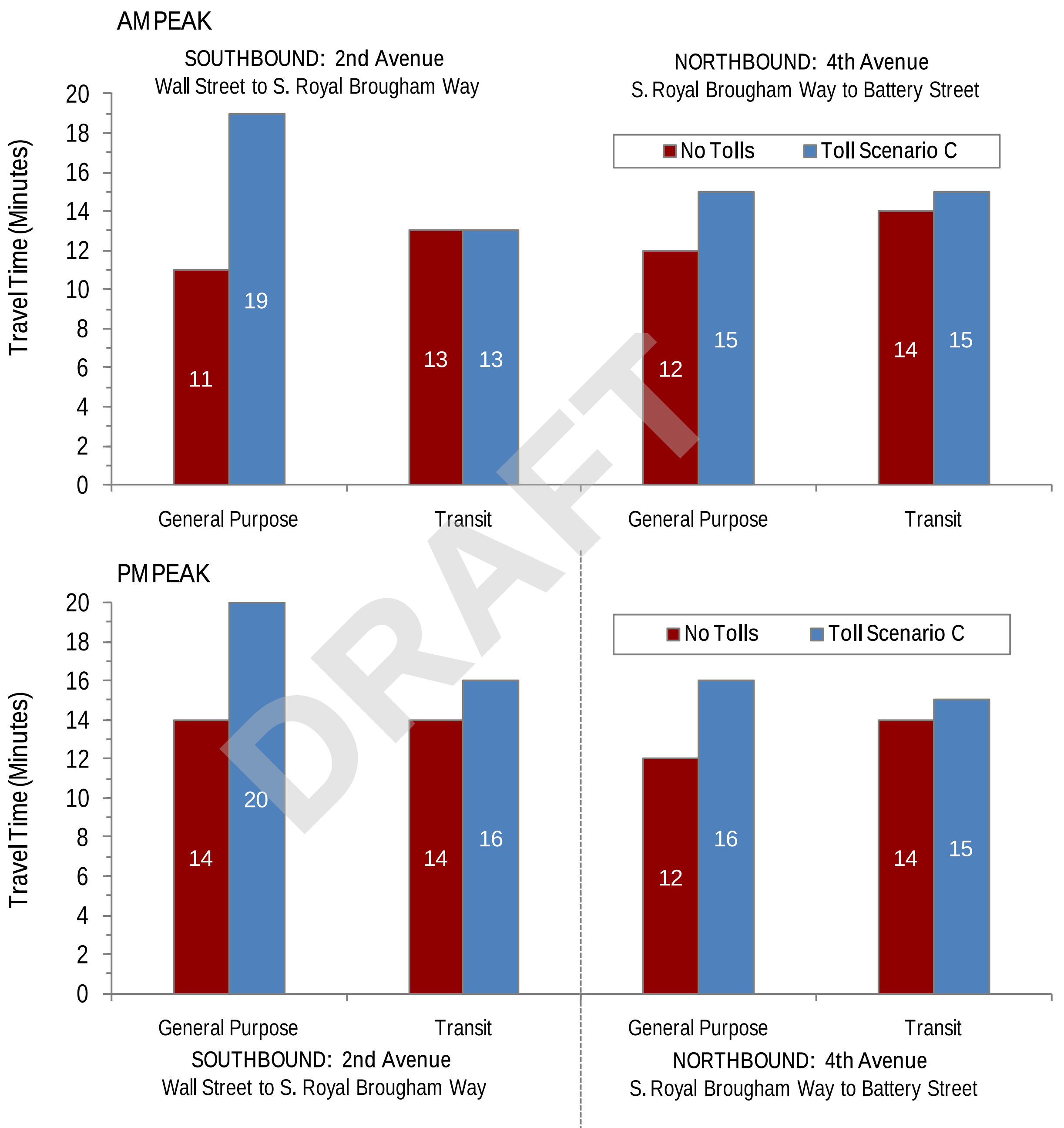
The SDEIS assesses impacts to travel times on downtown streets caused by traffic volume increases from diversion due to tolling. The primary effect is increased travel time for general purpose travel of up to three additional minutes at peak times on Second Avenue southbound and up to eight minutes of additional travel time on Fourth Avenue northbound between roughly Wall/Battery Streets and Royal Brougham Way, as shown in Figure A-1.[1] The SDEIS analysis shows little to no impact on transit travel time in these corridors, with the greatest effect being a two-minute increase on Second Avenue during the PM peak. The SDEIS categorizes the general purpose travel time impacts as "not acceptable" but simply concludes that "other scenarios would be evaluated and reasonable optimization measures would be applied and analyzed before tolling would be implemented," however such scenarios and measures are not identified or analyzed in the SDEIS.

A number of travel time analyses were conducted for the Partnership Process evaluation of the surface, transit, and I-5 (ST5) alternatives. During the Partnership Process, the technical team stressed the importance of point-to-point travel times, attempting to reflect the actual experience of travelers who most utilized the SR 99 corridor. For example, travel time analyses were made for trips such as Ballard to SODO, West Seattle to Uptown, Fremont to CBD, Burien to CBD, and Greenwood to Airport. In all cases, these analyses were conducted for general purpose traffic and for transit users to provide a full description of impacts.

Since SDEIS and Partnership Process travel time analyses used different end points, data comparison presents some challenges. However, there is some opportunity for comparison on Fourth Avenue, which is the highest volume downtown arterial street. Analysis conducted as part of the Partnership Process for the Surface and Transit Scenario B (four-lane Alaskan Way) estimated northbound travel time on Fourth Avenue between Edgar Martinez Way and Cedar Street at 12 minutes. This compares with SDEIS travel time estimates for northbound traffic on Fourth Avenue between Royal Brougham Way and Battery Street of 12 minutes for a non-tolled bored tunnel and 16 minutes for a tolled tunnel (Toll Scenario C). The segment analyzed for the ST5 analysis is three blocks longer than the segment analyzed in the SDEIS tunnel analysis.

1 2010 SDEIS, Figure 9-17, p. 215

Figure A-1 Comparison of Travel Times for General Purpose Travel and Transit with Untolled Bored Tunnel and Toll Scenario C, for AM Peak and PM Peak



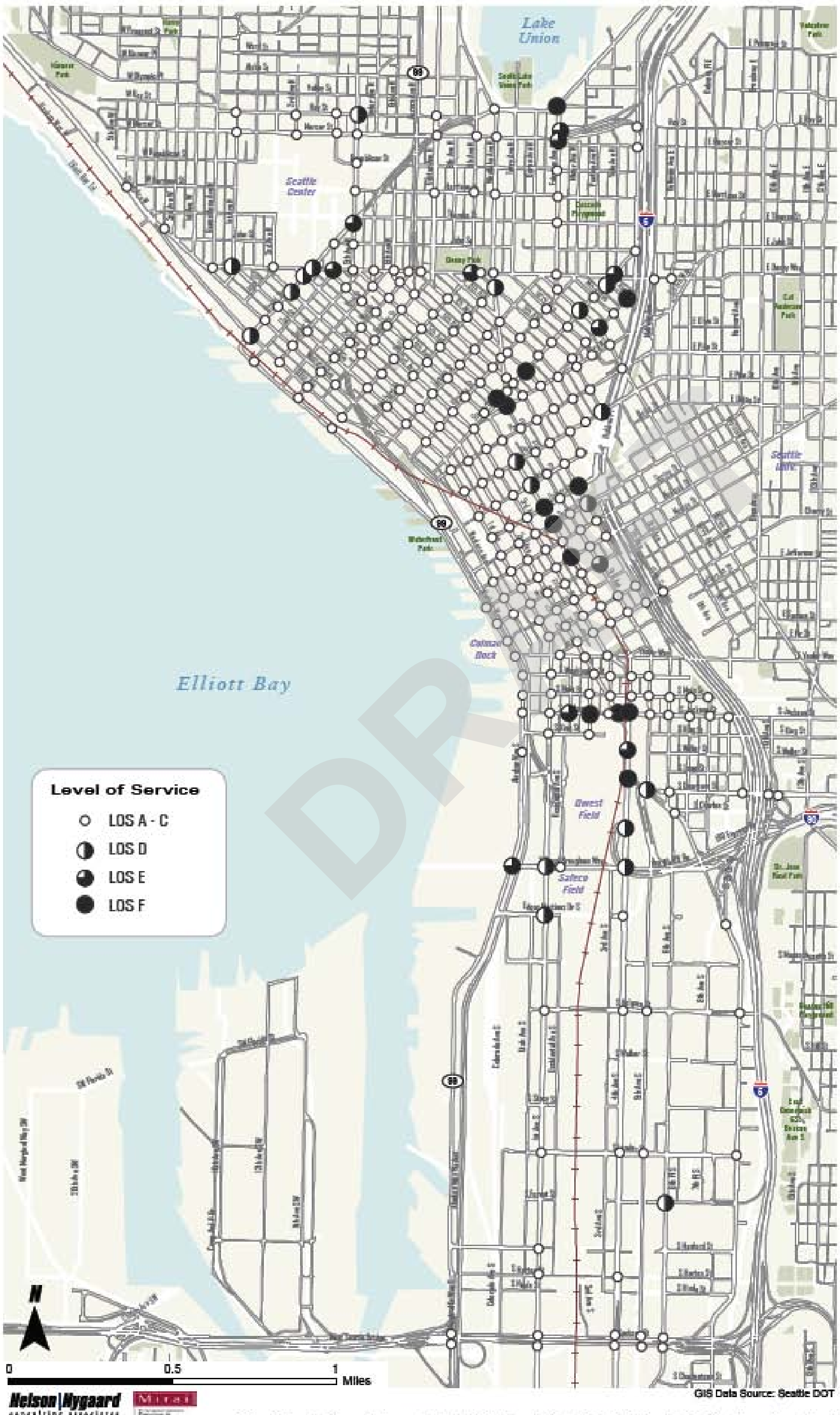
Source: WSDOT Alaskan Way Viaduct Replacement Project 2010 Supplemental Draft EIS, Chapter 9, Exhibit 9-17

Highway Ramps are a Key Cause of Congestion in Seattle's Center City

When compared with the existing Alaskan Way Viaduct, the SR 99 deep bored tunnel maintains a comparable mainline capacity and reduces the number of downtown ramps. When the tunnel is tolled, congestion impacts are projected to occur on surface streets connecting to the north and south portal ramps. The SDEIS tolling analysis illustrates that tolling the tunnel will magnify these impacts by relocating some trips from the tunnel to surface streets and to I-5. Increased surface street traffic has the potential to create a lower quality and/or level of service for pedestrians (e.g., potential for longer signal cycles for vehicles, reduced spacing for street crossings, more turning conflicts, etc.).

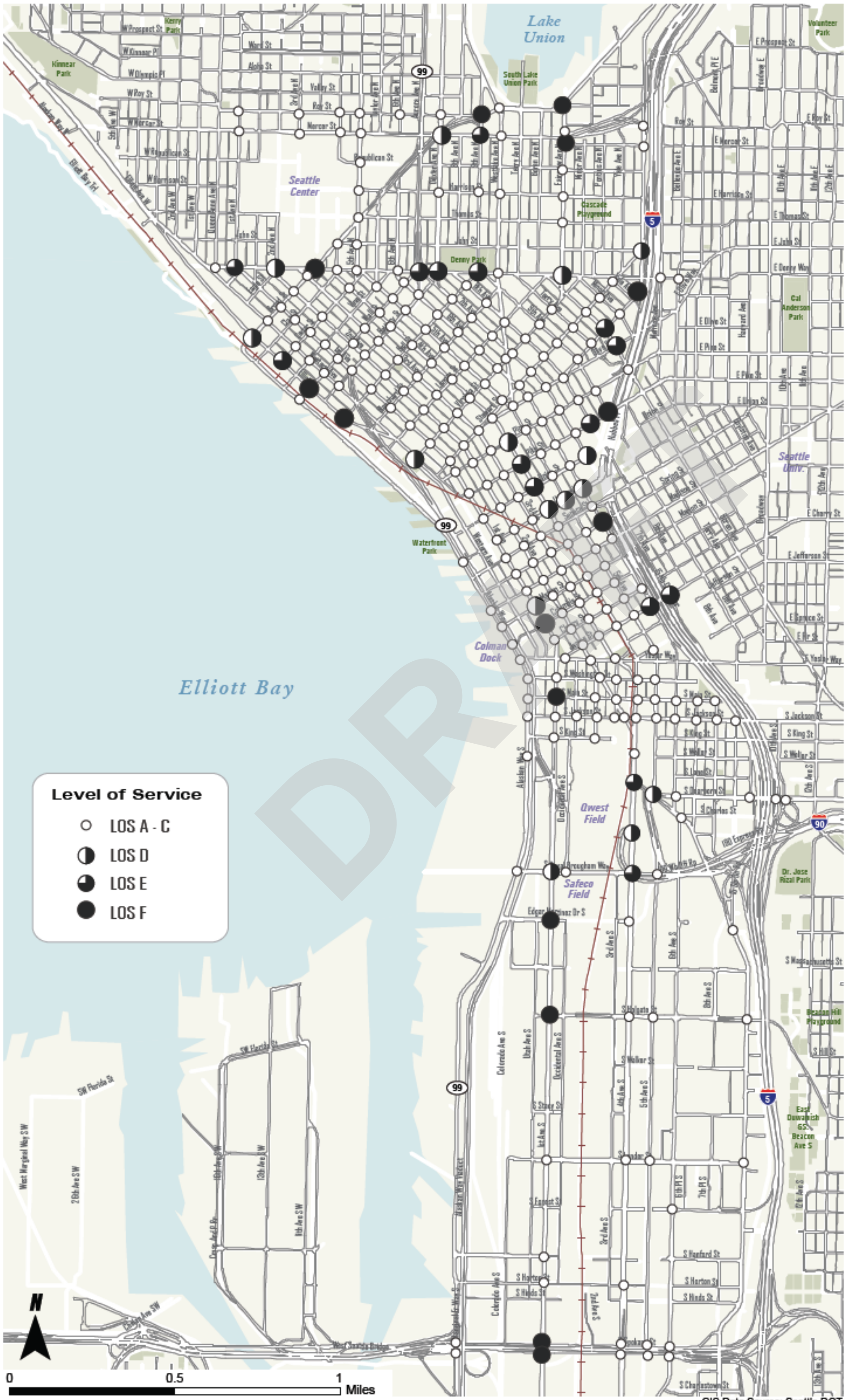
Figure A-2 and Figure A-3 illustrate where the highest levels of intersection delay exist in the downtown area, based on 2006 data. This data remains relevant since overall traffic volumes in the city have actually decreased over each of the last five years and there have been no major changes to highway ramps. Almost every intersection with peak period LOS of D, E, or F (poorest performance) is either affected by a nearby highway on/off-ramp or is at an intersection where downtown's many grid systems meet. With the deep bored tunnel project and tolling, higher volumes of traffic are projected to access downtown with fewer on and off opportunities than currently provided, funneling traffic onto a small number of surface streets.

Figure A-2 AM Peak Hour Intersection Level of Service (2006)



City of Seattle Travel Demand Model (2005) and City of Seattle Syncho Traffic Operations Model

Figure A-3 PM Peak Hour Intersection Level of Service (2006)



City of Seattle Travel Demand Model (2005) and City of Seattle Syncho Traffic Operations Model

In addition to increased vehicle volumes on city surface streets, the Toll C scenario is projected to cause backups on the SR 99 mainline approaching the portal area ramps.

> *"Drivers using the bored tunnel for 2015 Bored Tunnel Toll Scenarios A and C are projected to have slightly longer travel times than they would for the 2015 Bored Tunnel due to expected backups on the SR 99 mainline. These back-ups would be due [to] heavier off-ramp volumes just before the bored tunnel, which would increase delay at intersections at the ramp termini."*[2]

The SDEIS analysis of I-5 mainline travel times suggests there is little impact to travelers from traffic diverted to I-5; this is likely due to already high levels of congestion. The more significant impacts may occur on surface streets feeding I-5 ramps, which are already the most congested areas of the Center City. In fact, the SDEIS analysis shows that Fourth Avenue would have the greatest increase in travel time. Other streets such as Fifth Avenue and streets east of I-5 are not analyzed.

Figure A-4 shows the impacts on I-5 as projected in the SDEIS tolling analysis. The change in travel time for Toll Scenario C is the difference in travel time from the No Toll tunnel case, shown here only for the PM peak.

Figure A-4 Traffic Diversion to I-5 from SR 99 Tolling; Change in Travel Times on I-5 and SR 99 Due to Tolling

Bored Tunnel With:	I-5 (2015 Average Daily Traffic)	Additional I-5 Trips per Weekday	I-5 PM Peak Travel Time (Additional Minutes Northgate to Boeing Field)		SR 99 PM Peak Travel Time (Additional Minutes Travel Time Woodlawn Park to S Spokane Street)	
			SB	NB	SB	NB
No Toll	263,900	0	-	-	-	-
Toll Scenario C	279,100	15,200	2	1	2	-1

Source: AWVRP SDEIS, Exhibit 9-8 (Travel Times), p. 212, and Exhibit 9-13 (Traffic Volumes) p. 214.

[2] *AWVRP 2010 SDEIS, Chapter 9, p. 209.*

Increased Delay and Reduced Reliability for Critical Transit Services

Transit performance and the transit system's future contributions to mobility have the potential to be impacted by a SR 99 deep bored tunnel and tolling project. Traffic congestion on surface streets in particular has the potential to impact numerous transit users in Seattle Center City. Increased transit travel times due to congestion counteract the impact of planned service investments, consume valuable operating resources, and have the potential to reduce ridership growth over time. Transit connections to the SR 99 mainline are generally well conceived and transit has been provided priority lanes for most connections in the North Portal area. However, significant diversion from tolling can impact transit operations in the portal areas, particularly in the vicinity of the south portal where transit lanes have yet to be planned.

Reliable, fast transit access to downtown is critical to Seattle's ability to accommodate projected growth and ensure vulnerable populations have reliable access to downtown jobs and services.

The City of Seattle and King County Metro are making significant investments in transit in the Center City and planning is underway that could lead to future surface-running high or intermediate capacity transit investments. Design and management of the AWVRP could have a significant impact on surface street demands, particularly in corridors that are designated for surface street transit operations (for example, transit operational impacts from increased traffic on Jackson Street and First Avenue). The City plans to construct a new streetcar line that will operate primarily in mixed traffic on Jackson. Traffic volumes increase significantly on this street in a tolled tunnel scenario and key intersections become more congested. City plans have identified First Avenue as the potential future streetcar corridor. First Avenue also has potential to carry light rail service connecting outer neighborhoods such as Ballard into downtown. The City may want to ensure that transit priority treatments for streetcar operations on the First Hill line are included in the project if needed to ensure that anticipated levels of speed and reliability can be met. Further analysis of potential impacts on future Center City transit is needed.

Two specific concerns related to transit that arise from a tolled tunnel are:

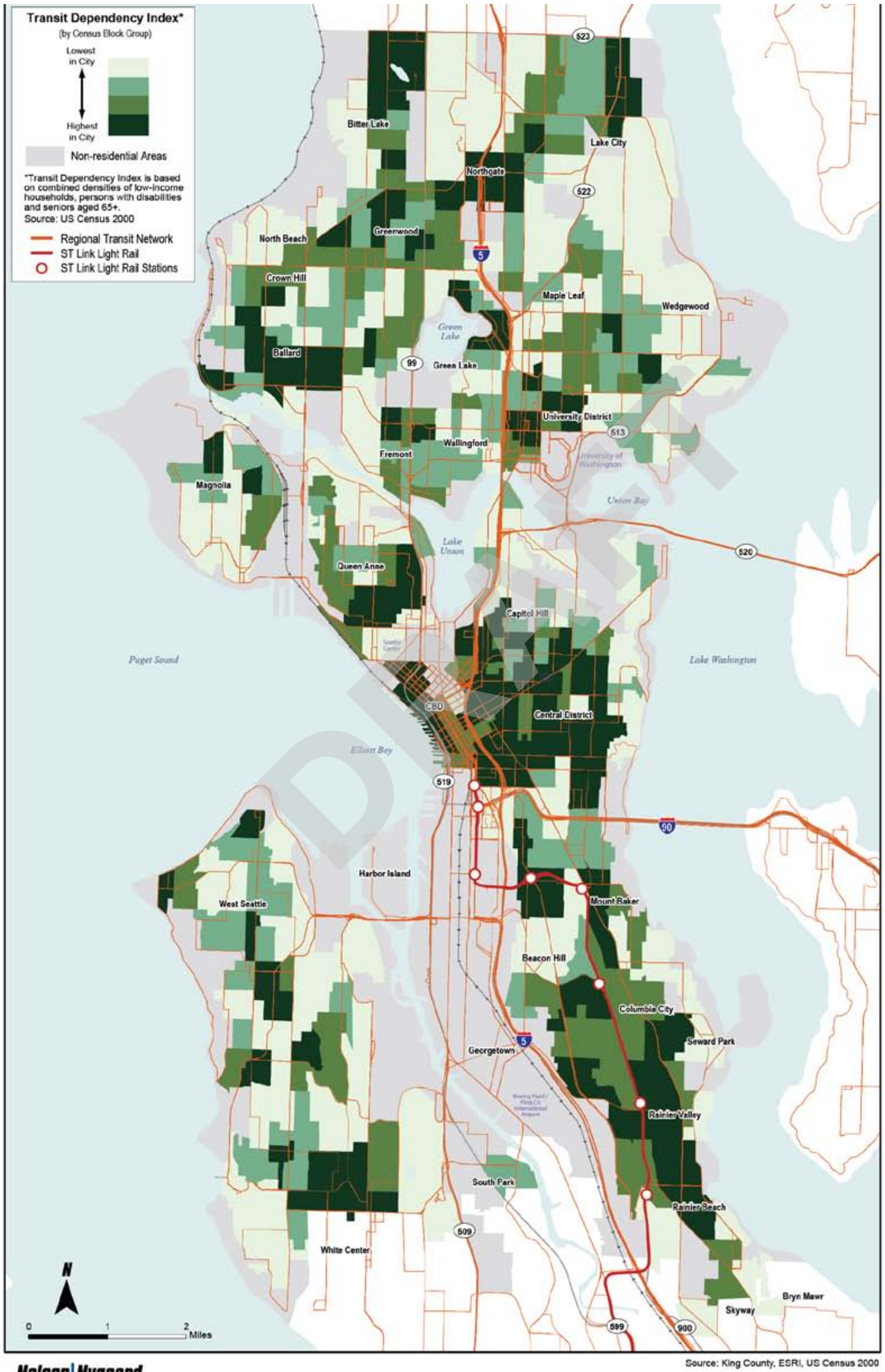
- Retaining transit as an affordable, reliable alternative mode of access for non-drivers and low-income persons traveling to and through the Center City.
- Mitigating financial impacts on transit operations due to excessive delay and lack of reliability in the connecting corridors.

Each of these concerns is discussed below.

a. Impact on Low-Income and Vulnerable Populations

The SDEIS identifies disproportionately high impacts of a tolled tunnel on low-income users as a "not acceptable" outcome. Analysis from the City of Seattle's Transit Master Plan, included in Figure A-5, shows that the SR 99 corridor travel markets include a number of areas with high concentrations of low-income people, people with disabilities, and seniors over the age of 65. Vulnerable populations living in the SR 99 corridor may also be among those in the city most likely to face challenges accessing transit.

Figure A-5 Transit Dependency Index



Nelson\Nygaard consulting associates

Transit improvements including increased service frequency, access improvements, shorter travel times, and single-seat trips through downtown could be a meaningful way for the project to address impacts on vulnerable populations. No such improvements are recommended in the SDEIS.

b. Financial Protection of Transit

This report is being written at a time when King County Metro is facing one of the most difficult financial periods of its existence as a transit provider. Any increase in operating costs to maintain existing levels of service (e.g., due to increased delay on transit-carrying streets over the next decade), will mean less service is provided in some other part of the Metro system. The SDEIS establishes that surface street conditions, particularly at the tunnel portals, will be sub-optimal as a result of the project and the need to toll the project as a financial tool. The SDEIS clearly states that optimization of surface traffic will be required.[3]

The SDEIS finds that a tolled tunnel would create an additional one to two minutes of delay for buses operating on Second and Fourth Avenues between SODO and Belltown. This finding seems like a low estimate given that transit operates in dedicated transit lanes that share turning movements with vehicles. Additional auto queuing in these lanes will increase transit delays. Nonetheless, considering that over 250 buses use these corridors during a peak hour,[4] even small increases in delay will have a substantial impact on operating costs.

To simply illustrate the relationship between delay and transit operating costs one can imagine a transit route that takes 30 minutes to operate from end to end (or 60 minutes round trip). If the route runs at 5-minute headways, it would require 12 vehicles to be in operation at any time. Adding just a few minutes of running time to this route would require the addition of another vehicle to maintain the current headway. Conversely, reducing its travel time by five minutes would allow for a vehicle to be eliminated. Therefore, a seemingly minor difference in travel time for transit could carry significant costs—as much as $1500 per day ($330,000 per year) on a route that provides 18 hours of service. Considering the number of transit routes that enter downtown each day, even a half minute delay for each bus would carry a significant annual cost.

If a tolled tunnel is constructed, programmatic efforts to reduce surface street traffic (e.g., TDM measures and more effective downtown parking management) and transit capital investments to protect transit from traffic delay would be required to ensure transit remains timely, reliable and cost effective.

Reduced Access to Center City Businesses

The deep bored tunnel proposed in the SDEIS is a downtown bypass facility. It provides access to downtown at two portals and is designed primarily to carry longer distance trips bypassing the Center City. Once traffic reaches the Center City it is distributed on surface streets.

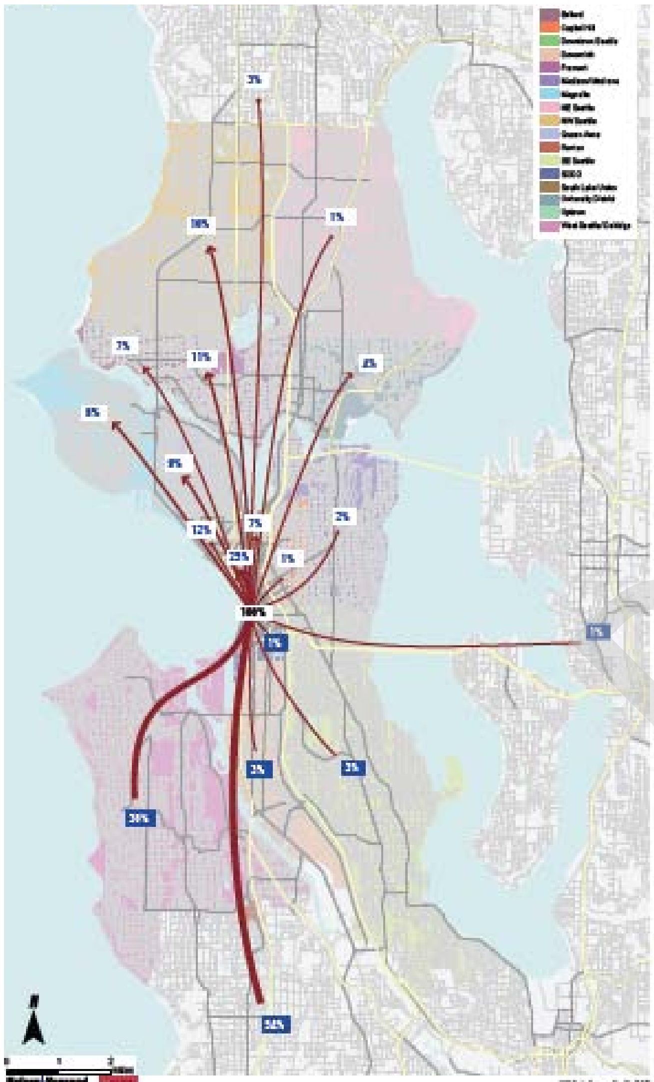
[3] E.g., p. 215 of the SDEIS.

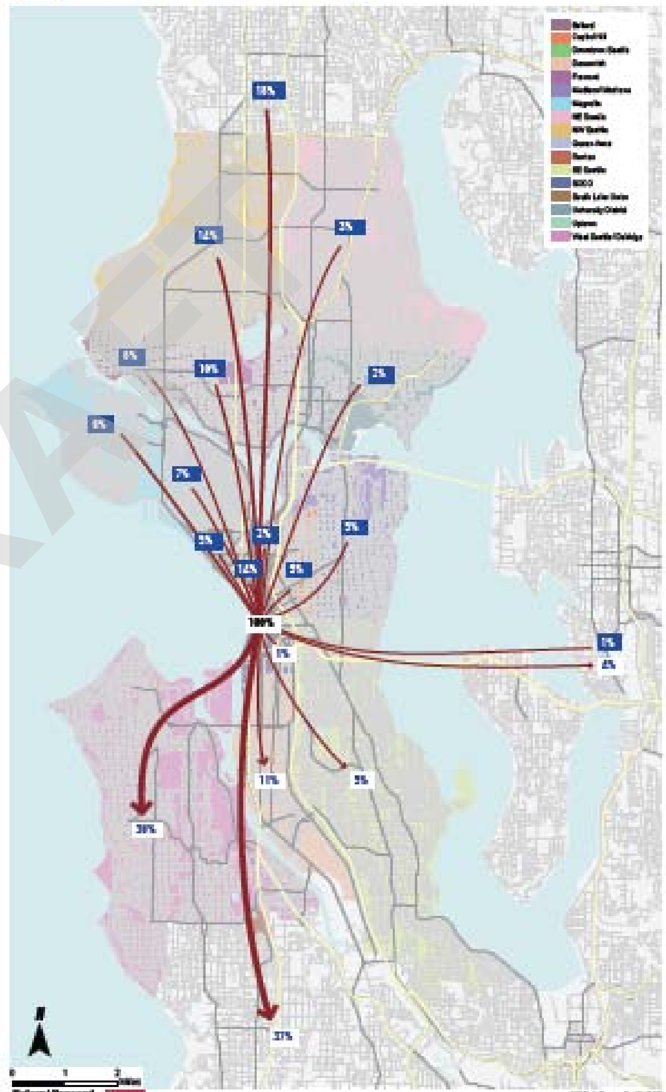
[4] Based on 2007 data collection by Nelson\Nygaard at 2nd Avenue & Marion Street and 4th Avenue & Pike Street, between 4:30 pm to 5:30 pm.

Access to Center City businesses and services is more important for the Seattle economy than vehicle throughput. Transportation system performance should not be measured by the ability for vehicles to move freely, but rather on the ability for people to access goods and services, and for goods and freight to move reliably. To maximize economic benefit of transportation infrastructure, downtown streets should carry trips destined for downtown businesses and venues. One effect of a tolled tunnel, diverting single occupant vehicles from a deep bore tunnel to use surface streets to bypass downtown en-route to through destinations, is a questionable use of Seattle's most valuable street rights-of-way.

Various analyses and modeling efforts have shown that somewhere in the range of 70% to 80% of trips on the Alaskan Way Viaduct have at least one end in the Center City. In other words, the current highway is used largely for access to the Center City. To a lesser degree it acts as a surface arterial providing short circulation trips within the Center City and provides long distance trips with two ends outside the City of Seattle. Based on the 2005 analysis depicted in Figure A-6, of all northbound trips on the Viaduct (between Columbia Street and First Ave S. ramps), just 15%of travel north of 85th Street North and just 3% pass the Seattle city limits. For southbound traffic on the Viaduct (same location), there is more through downtown traffic bound for West Seattle and points south of the City limits. Most of these trips originate in the Center City area or just north of the Ship Canal.

Figure A-6 AM Peak Period (3-Hour) Origins and Destinations on SR 99: Northbound (left) and Southbound (right)

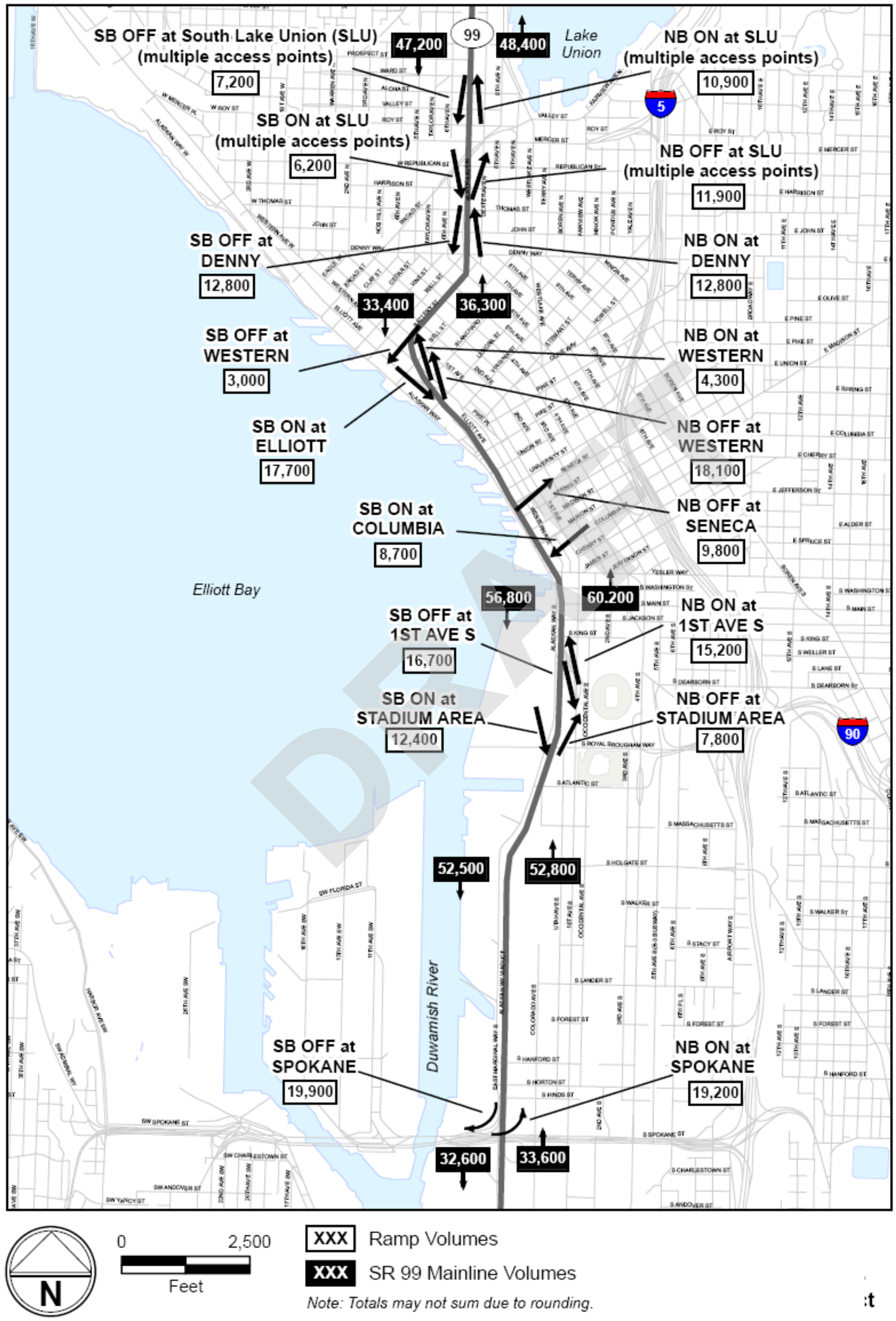




The AWVRP 2010 SDEIS helps to illustrate that more SR 99 travelers access the Center City than bypass it. Figure A-7, reproduced from the SDEIS, shows that with the Viaduct in place, projected 2015 traffic levels of nearly 53,000 daily vehicles approach downtown from the south. Approximately 36,000 vehicles exit the Viaduct's three northbound downtown off-ramps. Assuming that a relatively small amount of vehicles would make very short trips on the Viaduct entering at the First Avenue ramp and exiting at Western Avenue, this represents about 68% of directional trips. In the opposite direction, over 52,000 daily vehicles are projected southbound between the Stadium Area ramp and Spokane Street. Since about 39,000 vehicles enter the three southbound ramps in the downtown with no opportunity to exit, at least 74% of this volume has an origin in downtown. In addition, there is likely a significant amount of turnover at the multiple South Lake Union area access points. A similar analysis of 2015 ramp volumes during peak periods shows an even higher percentage of trips using the Viaduct to enter or exit downtown.[5]

[5] See AWVRP 2010 SDEIS, Appendix C, p. 154 (AM Peak) and p. 160 (PM Peak).

Figure A-7 2015 Mainline and Ramp Volumes, Existing Viaduct



Source: 2010 AWVRP SDEIS, Appendix C (Transportation Discipline Report), Exhibit 5-16, p. 182

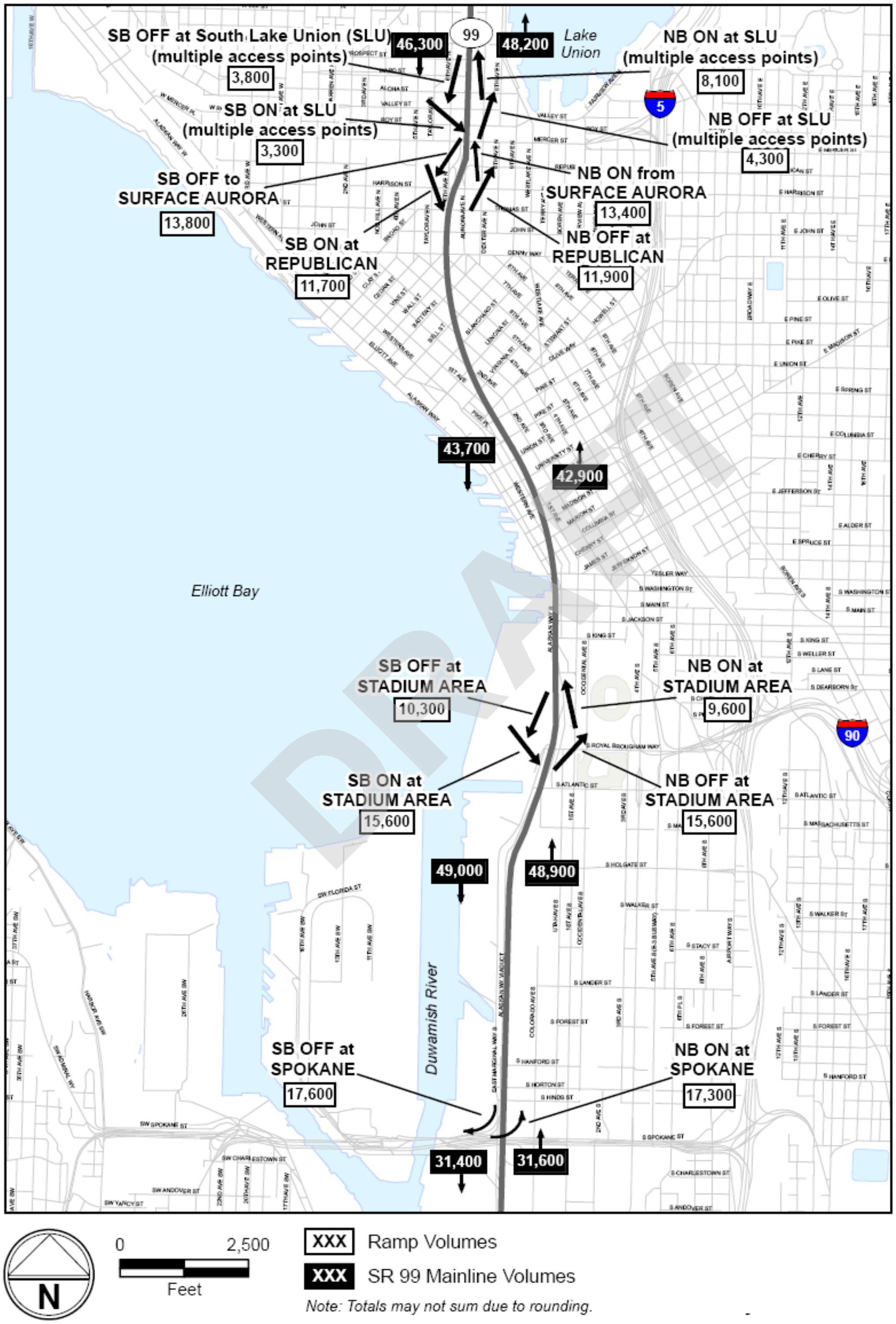
It is worth noting that the construction of a deep bored tunnel would replace a freeway segment designed as part of a larger system planned at the peak of the highway building era, but never connected to the system. In fact, the original facility, completed in 1953 between Battery Street and Dearborn Street, did not have downtown on-ramps. The Seneca Street off-ramp and Columbia Street on-ramp were added in 1961,[6] shortly following completion of the southern extension to Spokane Street in 1959, illustrating the utility downtown access provided for travelers on SR 99.[7]

The change in downtown access patterns can be seen in the map of 2015 daily traffic volumes on SR 99 with a bored tunnel (Figure A-8). Without direct access to downtown between the tunnel portals, the deep bored tunnel becomes most attractive for trips that bypass downtown. This differs from current use of the AWV and may be part of the reason for high projected diversion levels when tunnel tolling is analyzed. Given that a high percentage of users on the AWV today are traveling to/from the Center City, it is not surprising that tolling diversion from a bored tunnel is projected to be high for a tolled tunnel replacement. Some travelers who would use a non-tolled tunnel are likely currently traveling past their destination and doubling back on surface streets due to the high speed connection provided by the tunnel. For example, a commuter traveling to the Denny Triangle from West Seattle might choose to travel through the tunnel, exit at the north portal and drive back southbound on surface streets to save a small amount of travel time. The value of this tunnel trip is marginal since it increases VMT and still uses surface street capacity, just on a different path. Offered for free, the marginal travel time savings is enough to encourage such a trip into the tunnel. In a tolled tunnel scenario, this traveler would likely exit in the Stadium area and approach through downtown.

[6] http://content.lib.washington.edu/cgi-bin/viewer.exe?CISOROOT=/imlsmohai&CISOPTR=1736&CISORESTMP=&CISOVIEWTMP=&CISOMODE=thumb

[7] WSDOT – SR 99 Project Photo Gallery

Figure A-8 2015 Mainline and Ramp Volumes, Bored Tunnel



Source: 2010 AWVRP SDEIS, Appendix C (Transportation Discipline Report), Exhibit 5-17, p. 167.

Downtown Access Will Be Particularly Challenging during Later Phases of Construction

There will be heightened access challenges during the 18 to 24 month time period between opening of the deep bored tunnel and the opening of the new Alaskan Way surface street, including the connection to Elliott and Western. Although the linking of the new SR 99 deep bored tunnel to surface highway segments will be relatively seamless, a fully connected Alaskan Way will not be available until approximately two years later. Alaskan Way is a critical path to providing vehicular, bicycle and pedestrian and possibly transit access to and from SR 99 south to downtown. While the Stage 8 construction phase will require 13 months, the completion of the Elliott/Western connector will require another 6 to 11 months (as estimated by the City of Seattle). A detailed traffic management plan has yet to be developed; however, it can be assumed that:

- The limited availability of this key facility will reduce functionality of the street network around the south portal
- Higher traffic volumes will occur on First, Second, and Fourth Avenues
- Transit routing may need to be established through south downtown (First or Fourth Aves rather than SR 99)
- A significant mitigation program will be needed to shift trips to transit or other high occupancy modes

SR 99 is an Important, but not Heavily Used Freight Route

Of the over 100,000 daily trips at the peak travel point on the AWV, approximately 5,000 are truck trips.

The Partnership Process focused significant analysis on the role of AWV for carrying freight and the tradeoffs with various replacement options for freight travel. It was found that only freight using SR 99 between the stadium area and Mercer is impacted by the choice of an alternative to replacing SR 99. Freight traffic bound to and from Port of Seattle facilities at Terminal 46 and to the south is enhanced by the "Moving Forward" projects currently under construction and is essentially unaffected by the choice of a Central Waterfront replacement alternative. The freight pathways most impacted by differing alternatives on SR 99 are those that connect the SODO/Duwamish Industrial area, along with I-5, I-90 and SR 99 to the south, with the Ballard/Interbay Industrial area. For this particular freight route, the Deep Bored Tunnel produced travel time results closest to the Surface and Transit Alternatives in Partnership Process analysis. This is primarily due to the fact that the Elliott/Western connection can only be reached by surface Alaskan Way in the Deep Bored Tunnel Alternative as well as ST5 alternatives. It should be noted, however, that travel times for the Alaskan Way and Elliott/Western corridor were not evaluated for a *tolled* Deep Bored Tunnel as part of the Partnership Process.

Finally, it must be recognized that SR 99, as a freight route, is very different than I-5. I-5 has a very high percentage of trucks, many full sized semis. SR 99 has a much lower percentage of truck traffic with very few semis. For example, as illustrated in Figure A-9, the AWV mainline south of Seneca Street carries just over 5,000 trucks per day comprising 5% of daily traffic, while I-5 at Olive Way carries about three times as many trucks making up over 7% of daily traffic volumes. In addition, most freight traffic on SR 99 is local in nature and is accommodated on lightweight trucks, including many vans and small commercial vehicles. Trucks traveling in the Battery Street Tunnel daily total 1,900, signifying that many of the 5,000 trucks at the Seneca measurement point enter from Elliott/Western or are making deliveries to downtown. Many of these trucks are likely to use Alaskan Way if a deep bored tunnel is constructed.

Figure A-9 Truck Trips to and from Seattle

Truck Market	Count Location	Trucks per Day (Average Weekday)	% of Daily Traffic
Through Trucks on I-5	I-5 at Olive Way* I-5 at N 185th Street*	15,800 12,700	7.2% 6.7%
Through Trucks on AWV	AWV mainline south of Seneca Street* Elliott Ave & Western Ave Ramps* Battery Street Tunnel Columbia & Seneca Street Ramps	5,200 2,600 1,900 700	5.0% 7.8% 3.2% 4.1%
Port Truck Trips **Total Port Trips** **Dray Trips to Rail yards** **Trips to/from Region**	Terminal trip estimates*	 5,950 1,950 4,000	 n/a n/a n/a
Deliveries to Downtown Businesses	Sample of downtown access points Stewart Street south of Denny Way* 4th Avenue north of James Street* Seneca Street off-ram rom AMV* Boren Avenue north of 12th Ave.*	 810 1,630 500 1,570	 6.1% 11.1% 5.6% 13.6%
Construction Trucks	Volume depends on location and quantity of construction projects	Up to 170 trucks per day per downtown highrise site	n/a
Over-dimension Trucks	Volume varies daily. The City issues annual permits to some companies, and cannot track the number of times the permit may be used.		

Source: Seattle Urban Mobility Plan Briefing Book, Transportation in the Center City Today, p. 3E-2, http://www.seattle.gov/transportation/briefingbook.htm.

Detailed Source Notes: [a] AM and PM peak period manual classification counts performed in September 2003 by Parametrix, Inc. The six hours of peak period data were expanded to a 4-hour volume using detailed count information on I-5 at NE 185th (see reference b.). [b] Truck classification counts performed by WSDOT Permanent Traffic Recording Station P-3 (I-5 at NE 185th Street), October 2003. These counts were compiled for the "I-5 Pavement Reconstruction Projects Final Existing Transportation Conditions Technical Report," Washington State Department of Transportation (WSDOT) and Parametrix, March 2005. [c] SR 99: Alaskan Way Viaduct & Seawall Replacement Project. "Memorandum: Updated SR 99 Truck Volumes, September 6, 2006." Counts were performed in June 2006 using video and visual survey. Vans and "similarly sized small delivery trucks" are not included in the counts because it was unknown whether such vehicles were in commercial use. [d] "Port of Seattle Container Sustainable Growth Plan, Draft Transportation Analysis," Heffron Transportation, Inc. May 17, 2006. The truck volumes reflect an annual average condition for 2002. [e] Truck Needs Assessment for City of Seattle, Truck Volume and Classification Data Base, Heffron Transportation, Inc., September 20, 2007. All counts performed in May 2007.

APPENDIX B

TRAVEL DEMAND MODELING AND TRANSPORTATION SYSTEM ADAPTABILITY

This appendix provides a brief overview of the travel demand models in use in Seattle and the region; these are key tools used to evaluate alternatives for replacing the Alaskan Way Viaduct. It then discusses the importance of incorporating the dynamic relationship between land use and transportation into modeling practice, a key issue affecting the model's analysis of the AWVRP alternatives. Finally, the appendix describes two research efforts, summarized briefly:

- A local study where a dynamic land use modeling process was applied to SR 99/AWV travel time analysis. Based on the results, the researchers suggest that simply removing the Viaduct with no improvements would create no to relatively insignificant travel time changes for many important regional trips. Their model predicted that SR 99/AWV corridor trips are likely to have a higher travel time in such a scenario, but model variability suggests the possibility that the difference could be small.
- A study released by the Oregon Transportation Research and Education Consortium (OTREC), evaluated two hypothetical scenarios of freeway investment and an arterial street network investment in the Twin Cities region and concluded that "a 'No-More-Freeway' policy is more efficient from a mobility point of view than invests in more freeway capacity."

Finally, the appendix presents findings from a review of modeling work performed for the 2010 SDEIS.

Overview of Traffic Modeling in Seattle and the Region

The Seattle travel model is based on the one used by the Puget Sound Regional Council (PSRC). These models have been enhanced to address many of the limitations of the basic four-step model, [1] including:

- The PSRC model uses additional trip purpose classifications to account for work, school, college, shopping and "other" trips from home as well as trips not originating at home and commercial vehicle trips.
- PSRC makes extensive use of household surveys which accurately measure current behavior on the regional level. The sample size of these surveys may not allow for more subtle analysis of differences in behavior in smaller areas, such as downtown Seattle, compared to other parts of the region.
- The PSRC model has a component called the Time of Day module, which accounts for "peak spreading" when trips cannot be accommodated on a given facility at the busiest times of day.
- The Seattle model has reduced TAZ sizes. This allows the model to be smarter about mode choice, particularly for short-distance trips that people are more likely to make by walking or cycling.
- The Seattle model has recently adjusted future parking cost increases, particularly in areas that are increasing in density and undergoing redevelopment.

[1] These steps are: (1) Trip Generation, (2) Trip Distribution, (3) Mode Choice, and (4) Route Assignment. The Seattle Urban Mobility Plan Briefing Book provides a more detailed overview. See http://www.seattle.gov/transportation/briefingbook.htm, Chapter 4: What Do We Know About the Future, p. 4C-1

While improvements have been made to the model, it is not a perfect predictor of behavior. For example, the model has predicted increasing traffic volumes on I-5 and on downtown streets, which have both been essentially unchanged for a number of years, despite overall growth.

While the travel demand model is far from perfect, it remains the only analysis tool available to predict future travel behavior that has been subjected to rigorous regional scrutiny. The travel demand model remains an important analysis tool, though not the only tool for evaluating the effectiveness of alternatives in the future.

The Role of Dynamic Land Use-Transportation Modeling

The Seattle metropolitan area does not use a system of modeling that evaluates the dynamic effects of transportation investments on land use and vice versa. The PSRC region's econometric/real estate model, which evaluates the changes in land use created by transportation investments, is not used to evaluate changes in land use allocation for a specific transportation project, such as the Alaskan Way Viaduct Replacement. This is a significant gap in project planning since we know that transportation infrastructure projects change household and employment location choice and affect how and where developers chose to build.

In Portland, the regional governing body Metro, uses such a model (actually a series of models), called MetroScope, in tandem with its travel demand model to evaluate land use changes resulting from investments programmed in the Regional Transportation Plan. MetroScope consists of model elements that include:

- **Economic Model**: predicts region-wide employment by industry and the number of households in the region by demographic category.
- **Travel Model**: predicts travel activity levels by mode (bus, rail, car, walk, or bike) and road segment and estimates travel times between transportation analysis zones (TAZs) by time of day.
- **Real Estate Model**: predicts the locations of households and employment and also measures the amount of land consumed by development, the amount of built space produced, and the prices of land and built space by zone in each time period.

While PSRC is working to incorporate these types of capabilities into its regional model, it will be several years before the results of this effort could be applied to the SR 99 dialogue. Researchers at the University of Washington have employed a similar modeling process to examine some very specific transportation metrics related to the Alaskan Way Viaduct, as discussed below. It is difficult to address questions about project impacts, particularly related to emissions, without fully understanding the land use response to the transportation investment. Transportation market needs change dynamically based on location decisions made by residents and businesses, in which both accessibility to employment and accessibility to population play essential roles.[2] Research shows that a typical city dweller changes home location approximately every seven years; many younger people and urban renters move much more frequently. A Pew Research study shows that each year 10% to 15% of Americans

[2] Hansen, 1959; Guttenberg, 1960; Huff, 1963).

move their place of residence.[3] While industrial job center locations tend to be stable, office employment and retail locations are more transitory and redevelopment of attractive office settings can cause major shifts in employment, as evidenced in South Lake Union.

While finite analysis of these dynamics is not currently available, this "model issue" should be considered in contemplating the outputs of the AWVRP 2010 SDEIS or the Partnership Process evaluation based on current travel demand model outputs.

Dynamic Modeling for the AWV (University of Washington Research)

The 2015 and 2030 land use forecasts used in modeling for the SDEIS and Partnership Process analysis are fixed forecasts, based on a regional transportation network that includes the SR 99 highway corridor. There is no modeling feedback loop that provides indicators of how a deep bored tunnel bypass or a surface and transit solution would alter future land use patterns. If experience from other cities is an indicator, highway investment will promote higher levels of auto use and increase reliance on private vehicles for access to jobs and businesses. Given the heated public policy discussions currently playing out in Seattle around reallocation of limited street rights-of-way (e.g., road diets, bike lane additions, etc), a forward-looking transportation strategy must consider heightened demand for all modes. Basic geometry dictates that use of private single-occupant automobiles in dense urban areas is spatially inefficient, heightens conflicts with other modes, and if retained as the dominant mode, limits access to jobs, businesses, freight mobility, and recreational opportunities.

A study by Hana Ševčíková, Adrian Raftery and Paul Waddell used the Alaskan Way Viaduct to assess the relevance of fixed land use forecasts for modeling future transportation conditions.[4] Importantly, the study also illustrated the uncertainty of travel modeling forecasts, which are often presented as factual outcomes rather than the broad ranges of outcomes that are possible. The research conducted for the report incorporates UrbanSim modeling, an example of the software citied above, into an integrated econometric (real estate location choice) and travel model platform. Much like the Portland process, the UW team was able to predict shifts in residential and employment location choice driven by real estate trends and travel conditions,

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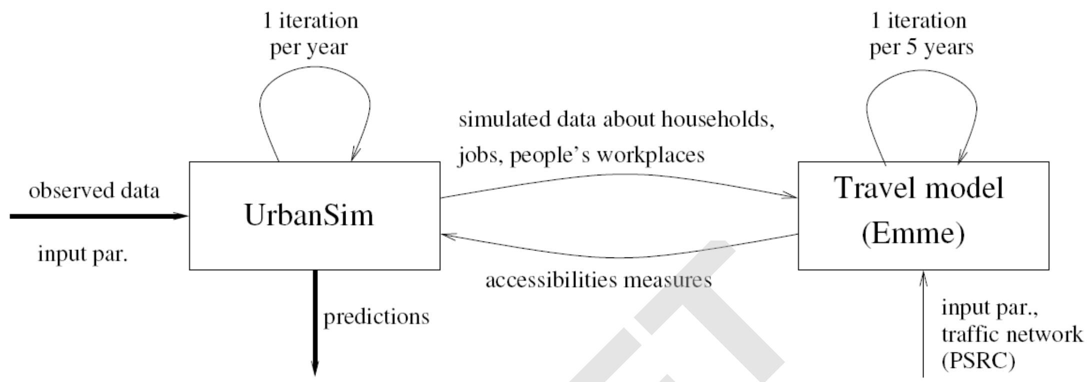
[3] Morin And Cohn, *Who Moves? Who Stays Put? Where's Home?,* Pew Research Center, December, 2008.

[4] Hana Ševčíková, Adrian E. Raftery and Paul A. Waddell, Assessing Uncertainty About the Benefits of Transportation Infrastructure Projects Using Bayesian Melding: Application to Seattle's Alaskan Way Viaduct, 3/26/2009. University of Washington , Center for Statistics and the Social Sciences, Working Paper no. 90.

creating a more realistic 2020 forecast. The report focuses on one important element of project evaluation—end-to-end travel time for representative regional trips.

Figure B-1 is an illustration from the study that describes how real estate and job location choice and travel conditions are jointly considered.

Figure B-1 Illustration of Integrated UrbanSim and Emme Travel Demand Models



Source: Ševčíková, Raftery, and Waddell, 2009.

The study tracks travel times for two transportation scenarios for 14 regional trips both using and not using the SR 99/AWV corridor, illustrated in Figure B-2 and Figure B-3, respectively. The two scenarios include:

- **Capacity-Neutral Replacement.** Uses the travel model networks provided by PSRC for years 2005, 2010, 2015 and 2020. Approximates a Viaduct rebuilt or tunnel. (SHOWN IN GRAY VERTICAL BARS)
- **Worst-Case: Demolish Viaduct in 2010.** Removes links from the 2010, 2015 and 2020 networks that represent the viaduct. This not comparable to a surface and transit alternative since no investments are made to the surface streets, I-5 or transit. (SHOWN IN RED VERTICAL BARS)

At a macro level, the capacity-neutral replacement scenario approximates an untolled Deep Bored Tunnel alternative. The worst case scenario should not be compared to a surface and transit scenario, however, since there is no optimization of other systems. Figure B-2 illustrates travel time ranges estimated by the UW study for regional trips not routed through the SR 99/AWV corridor. Figure B-3 shows the same data for regional trips routed through the SR 99/AWV corridor. Findings are:

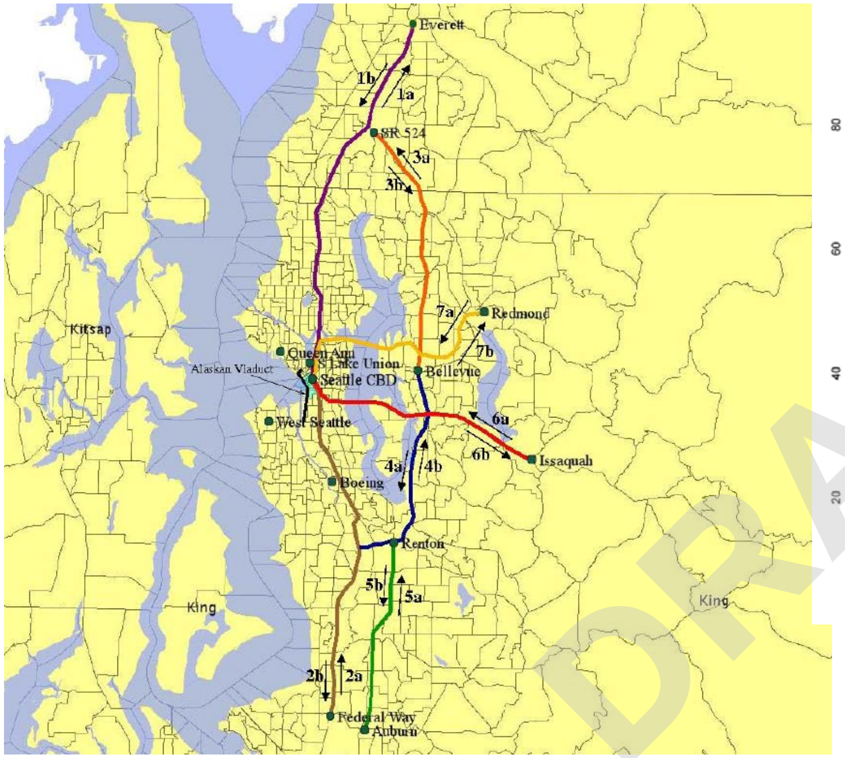
- The range of possible travel times for all modeled trips is significant ranging from up to 2 minutes to 15 minutes between the low and high estimate.
- Regional trips not routed through the SR 99/AWV corridor are not substantially impacted by AWV removal/no replacement. Margins of projected travel time are comparable in range for both options for most trips.
- Regional trips routed through the SR 99/AWV corridor show a wider range of travel time diversity and trips made under the worst case option have wider travel time ranges and higher top-end travel times. However, the low-end estimate for many of the trips falls within the range of the baseline scenario.

The UW research suggests that simply removing the Viaduct with no improvements would create no to relatively insignificant travel time change for many important regional trips. Although the modeling process predicted that SR 99/AWV corridor trips are probable to have a higher travel time, model variability suggests the possibility that the difference could be small. The study's conclusions suggest that changes in land use allocation had a role in the resulting 'no difference' in travel times:[5]

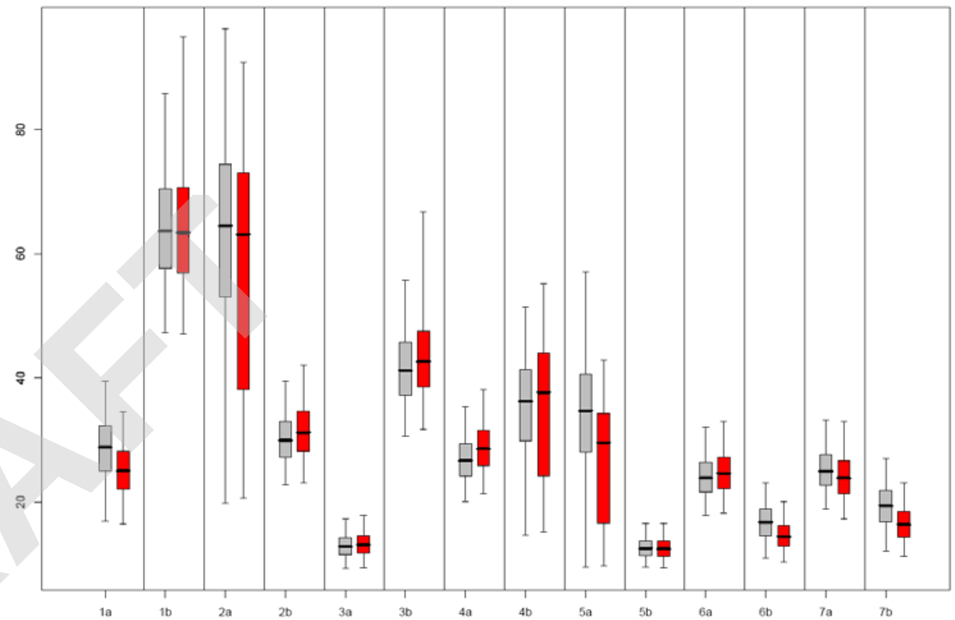
> *What our results suggest, in short, is that even using a worst-case scenario and comparing it to a capacity-neutral replacement of the Alaskan Way Viaduct, the travel time benefits of the higher capacity alternative are modest, and fairly localized to the viaduct corridor. There does not appear to be much effect on longer commutes or on I-5 in the vicinity of downtown, as evidenced by the overlapping distributions of the predicted travel times. Further, our combined analysis of land use and transportation reveals considerably more adaptive capacity than the analysis done by the WSDOT, which considers only travel changes and excludes by assumption any adaptation in location choices of households, firms and real estate development. Accounting for uncertainty, in short, the expectations of benefits from maintaining the current level of extra capacity in the viaduct corridor may be higher than can be scientifically supported by the available models and evidence.*

[5] Ševčíková, Raftery, and Waddell, 2009, p. 17.

Figure B-2 Average 2020 Travel Time Ranges for Regional Trips not using AWV/SR 99 Corridor (UW Study)

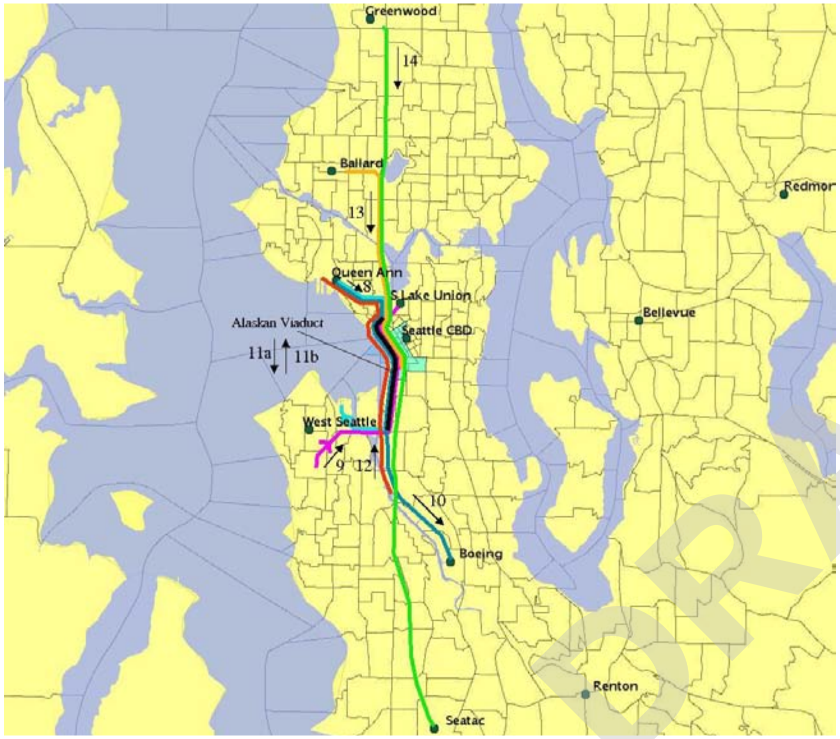


Source: Ševčíková, Raftery and Waddell, 2009.

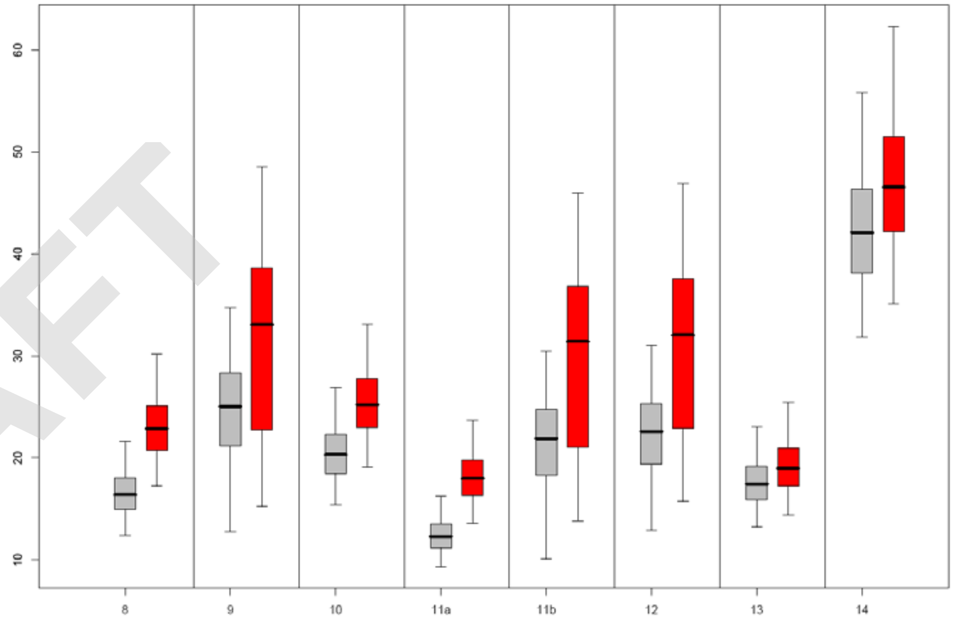


The vertical lines in the chart above illustrate little change in average travel times changes for the seven regional corridors shown on the map above between the baseline, capacity-neutral replacement scenario (grey vertical bars) and a worst-case no-viaduct case with no surface/transit investments (red vertical bars). The horizontal line dividing each gray or red bar indicates the median change in travel time while the caps at the end of the lines indicate the variability in the modeling (95% confidence interval).

Figure B-3 Average 2020 Travel Time Ranges for Regional Trips Routed through SR 99/AWV Corridor



Source: Ševčíková, Raftery and Waddell, 2009.



The vertical lines in the chart illustrate the change in average travel times for trips using the SR99/AWV corridor, shown on the map above. Route 11 is the viaduct itself; 11a goes from north to south while 11b goes from south to north. Grey bars represent the capacity-neutral, baseline scenario while red bars depict a worst-case no-viaduct case with no investment in surface/transit alternatives. The horizontal line dividing each bar indicates the median change in travel time. Trips made under the worst case option have higher top-end travel times and wider travel time ranges. However, even in a worst-case scenario the low-end estimate for many of the trips falls within the range of the baseline scenario.

Evaluation of Freeway Removal (OTREC Research)

As of 2011, many modern cities have undertaken freeway removals. In no case has any of these projects led to significant traffic congestion or loss of business revenue. "Maintaining the status quo," while expensive, is the most politically saleable solution and at least on the surface, seemingly the one that carries the least risk. Altering the status quo direction in the face of concerned citizens and business groups is never easy, but an increasing body of research shows that it could be the solution most responsive to City goals, which presumably respond to the desires of local citizens and stakeholder groups.

In an era of aging infrastructure, constrained funding for transportation, and increased urbanization, decision-makers around the nation face challenging questions about the interaction of land use and transportation; in particular a dilemma exists regarding the need for road capacity expansion as cities grow. A report released in January 2011 by the Oregon Transportation and Research and Education Consortium (OTREC), called No-More-Freeways: *Dynamics Without Freeway Capacity Expansion,* addresses this issue head on: [6]

> *Conventional wisdom appears to suggest that some freeway capacity expansion is necessary to cope with congestion, even when land use and travel demand management strategies are present. Empirical evidence suggests that cities are unlikely to be able to build their way out of congestion. As new freeway capacity attracts even more users, traffic gridlocks persist and attempts to build even more capacity usually become increasingly more difficult and expensive. There are various limitations to freeway capacity expansion in urban areas. As the road network grows, the unit cost of building an extra unit of freeway capacity increases because: (1) land that is cheap and easily acquirable for freeway projects is likely to have already been used for road construction; (2) construction materials, energy and labor costs increase at a much faster pace than the general price index; and (3) building new freeway capacity on an already-mature road network tends to create significant friction between the capacity-expansion projects and the existing built environment. In contrast, the marginal benefit of building additional freeway capacity diminishes over time. Induced demand causes the congestion on newly constructed/expanded freeway sections to reach its pre-construction level within several years. In addition, removing a specific freeway bottleneck with capacity expansion can often create multiple new bottlenecks elsewhere on the road network.*

The OTREC study evaluated transportation system and land use dynamics under two scenarios: a freeway investment scenario and an arterial street grid network investment scenario. In the freeway scenario a singular freeway corridor with new downtown interchanges is evaluated. In the alternative scenario, titled the "No-More-Freeway" scenario, this freeway is replaced by several parallel high-capacity arterial

[6] OTREC, Lei Zhang and Wei Xu, No More Freeways: Urban Land Use Transportation Dynamics Without Freeway Capacity Expansion, 2011, Final Report, OTREC-RR-11-02, http://otrec.us/news/entry/report_explores_the_end_of_the_freeway_era

streets that serve all parts of the urban area. The study summarizes the findings as follows:

> *The resulting land use distribution as measured by the employment and housing distributions in land use cells is also less concentrated under the "No-More-Freeway" policy. This implies more evenly distributed employment and housing opportunities in the urban area. It is also found that the transportation network under the "No-More-Freeway" policy is actually more efficient from a mobility point of view than the current investment policy that invests in more freeway capacity. These conclusions based on the hypothetical urban system need to be tested again in future analyses in real-world urban systems.*

The study also explores whether development of toll highways may be better relegated to the private sector, where financial risk can be assumed by private shareholders rather than the public. The value of this model has played out in Brisbane, Australia where a recently constructed bypass tunnel has attracted only one-third of projected traffic. The tunnel was designed and is operated by a public-private consortium and was financed through a public stock offering. Low toll revenue resulting from underwhelming use has left shares nearly valueless. Private investors have carried the brunt of the poorly conceived project, although the Brisbane City Council is still responsible for some of the financial risk.[7]

Extensive urban planning literature has documented the negative effects of freeway capacity expansion, including excess travel, urban sprawl, unsustainable transportation options, poor quality of life, and socioeconomic disparities. While the induced demand effect is most often applied to freeway expansion projects (the SR 99 project is not an expansion over the existing condition) it also applies in reverse to reduction of highway capacity. Recent research shows that, given the same financial investment, congestion can be more effectively mitigated with a well-connected network of main arterial streets than with a smaller number of freeway lanes.[8]

[7] See a sidebar in Chapter 2 for a more detailed discussion of the Brisbane tunnel.

[8] OTREC, 2011, citing previous research by Lei Zhang and David Levinson, 2005.

Appendix C

COMPARISON OF ST5 AND DBT ALTERNATIVES

The table provided in Figure C-1 details the elements included in the ST5 Scenario B alternative analyzed in the 2008 Partnership Process and compares it to the existing Viaduct and deep bored tunnel alternatives analyzed in the 2010 SDEIS, including Toll Scenario C. The comparison uses ST5 Scenario B because the Alaskan Way design included in this alternative is most consistent with the current City direction.

Figure C-1 Project Elements of Compared Alternatives, 2015

	Existing Viaduct & Surface Street Conditions (2015)	Deep Bored Tunnel – Not Tolled / "Toll C" (2015)	Surface, Transit & I-5 "Scenario B" (2015)
Central Waterfront Alaskan Way Surface Street	No change from existing	4-lane street with two additional lanes south of Madison New connection from Alaskan Way to Elliott and Western	4-lane street with two additional lanes south of Madison New connection from Alaskan Way to Elliott and Western
SR 99 Mainline	Alaskan Way Viaduct/Battery Street Tunnel	4-lane deep bored tunnel	No limited access highway along Seattle Waterfront
SR 99 Tolling	No change from existing	Toll Scenario C Only: Deep bored tunnel tolled at entry with variable toll. Peak toll of $4.21 and average daily toll of $2.44	None
I-5	Variable speed signs	Variable speed signs	Variable speed signs; add managed lane from Seneca to SR-520; Industrial Way Transit Ramps; Southbound HOV from Mercer to Spokane
Battery Street Tunnel	No change from existing	Decommissioned	Reused as connector between Aurora Ave N. and Elliott/Western
City Surface Streets— *North Portal*	No Change	New grid connections at John, Thomas and Harrison; 2-way Mercer w/ widened underpass; new 6th Ave connection	New grid connections at Thomas, Harrison, Republican, and Roy; 2-way Mercer w/ widened underpass
City Surface Streets— *South Portal*	No Change	New Dearborn Street from Alaskan Way to 1st Ave S	4-lane 1st Ave (King – Cherry) Surface street connections at Atlantic New street(s) connecting Alaskan Way to 1st Ave S (e.g., Dearborn) Qwest Field North Lot Connector Street
City Surface Streets— *Other*	No Change	No Change	Additional general purpose travel lane on 2nd Ave and 4th Ave Additional general purpose travel lane on several east-west downtown streets

	Existing Viaduct & Surface Street Conditions (2015)	Deep Bored Tunnel – Not Tolled / "Toll C" (2015)	Surface, Transit & I-5 "Scenario B" (2015)
Freight Routes	I-5 & Alaskan Way Viaduct	I-5, Tunnel & Surface Alaskan Way	I-5, Surface Alaskan Way
Permanent Transit Investments *(Beyond Currently Planned and Funded)*	None	None $190 million projects (Not funded)	Rapid Trolley Network improvements Enhanced service on planned RapidRide routes 3 new rapid ride routes (Delridge, Lake City, & Ballard – UW) Ballard/Fremont, U-District,& First Ave Streetcars Enhanced peak express bus service
Bicycle *(Beyond Currently Planned and Funded)*	No change	Lanes/trails on Alaskan Way, with possible west side cycle track Trails connecting Alaskan Way to East Marginal Way and Mountain to Sound Greenway Trail New east-west connections between Uptown and South Lake Union	Lanes/trails on Alaskan Way Trails connecting Alaskan Way to East Marginal Way and Mountain to Sound Greenway Trail New east-west connections between Uptown and South Lake Union Bicycle lanes eliminated on 2^{nd} and 4^{th} Ave Other Bike Master Plan elements in Center City
Pedestrian *(Beyond Currently Planned and Funded)*	No Change	Improved east-west connections to Waterfront Improved north-south connections along the waterfront Signalized intersections and connectivity improvements on Aurora Sidewalks on Mercer Street (Dexter to Fifth Ave N.) Broad Street removed (Ninth to Taylor)	Improved east-west connections to Waterfront I-5 crossing improvements Improved north-south connections along the waterfront Aurora at grade from Denny to John, with grid connections and additional signalized intersections Sidewalks on Mercer Street (Dexter to Fifth Ave N.) Broad Street removed (Ninth to Taylor)

	Existing Viaduct & Surface Street Conditions (2015)	Deep Bored Tunnel – Not Tolled / "Toll C" (2015)	Surface, Transit & I-5 "Scenario B" (2015)
Transportation Demand Management *(Beyond Currently Planned and Funded)*	No Change	No Change	Aggressive TDM package including: parking management, parking regulation, transit pass programs, employer-based programs, educational programs and policies

Appendix D

PARTNERSHIP PROCESS
SURFACE, TRANSIT AND I-5 HYBRID
FACT SHEET
(DECEMBER 2008)

Alaskan Way Viaduct & Seawall Replacement Program | Central Waterfront

12.08

U.S. Department of Transportation Federal Highway Administration | WSDOT | King County | City of Seattle

I-5/Surface/Transit Hybrid Scenario

WSDOT, King County, and the City of Seattle are working together to find a solution for the Alaskan Way Viaduct and Seawall's central waterfront section. After developing and evaluating eight scenarios, or comprehensive solutions, for the central waterfront, the three transportation agencies created two hybrid scenarios that combine the most promising components of the earlier scenarios. These hybrids include not only investments on the central waterfront, but also investments in I-5, transit, surface streets, and demand management. Further analysis will be done on investigating a bored bypass tunnel.

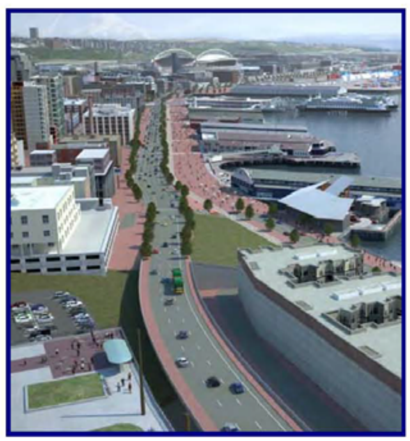
Governor Christine Gregoire, King County Executive Ron Sims, and Seattle Mayor Greg Nickels are committed to reaching agreement on a solution by the end of 2008, and to begin taking down the central section of the viaduct in 2012. Regardless of what solution is chosen, we are moving forward to remove or repair about half of the viaduct in the south and north ends.

The following describes one of the two hybrid scenarios. The other is an SR 99 elevated bypass hybrid scenario.

What is the I-5/surface/transit hybrid scenario?

This scenario would create a pair of north and southbound one-way streets, called a couplet, along the waterfront. Alaskan Way would become a one-way southbound street with three lanes and a bike lane. Starting near Yesler Way, Western Avenue would become a one-way northbound street with three lanes and a bike lane. It would connect to the Battery Street Tunnel at a signalized intersection at Battery Street.

The street grid north of the Battery Street Tunnel would be reconnected with signalized intersections on Aurora Avenue. Examples of other surface street changes include new transit lanes on Madison, Stewart, Olive and Howell streets, among others, and converting Third Avenue to transit-only all day in downtown. Mercer Street would become two-way between I-5 and Elliott Avenue. Sixth Avenue



Aerial view near Victor Steinbrueck Park looking south.

would also become two-way between Westlake Avenue and Denny Way, with a new extension to Mercer Street.

At the south end, the couplet would connect to the new south end project at S. King Street. The Spokane Street Viaduct would also be widened and an off-ramp would be built at Fourth Avenue S.

Transit improvements include more all-day service than the elevated hybrid scenario. This would include increased service on Metro's RapidRide routes for Ballard/Uptown, Aurora Avenue and West Seattle and new RapidRide routes on Delridge Way and Lake City Way. The waterfront streetcar would be replaced with a new First Avenue line between King Street and Seattle Center. Park and rides would be expanded in Burien, White Center and Shoreline. The Rapid Trolleybus Network would be expanded with new connections such as Madison Park to Colman Dock, Queen Anne to Capitol Hill, and Beacon Hill to Capitol Hill. Moderate investment would be made in other express and local routes in Seattle.

Changes to I-5 would allow for more efficient operations through downtown. Northbound, a new lane would be created between Seneca Street and SR 520 using the existing shoulder of the highway. This new lane would be managed and the Cherry Street on-ramp would be closed at night. Other improvements include allowing general purpose traffic to use the southbound HOV lane between Mercer Street and S. Spokane Street during peak periods, automating the express lane switch-over, converting the Stewart Street express lane ramp to HOV only, converting the Cherry Street and Columbia Street express lane ramps to general purpose, and implementing additional active traffic management.

A number of transportation policies and incentives would be introduced to change how people travel. These would include a parking management system; smart, or adaptive, traffic signals; and increased incentives for alternative commutes.

Why is this scenario being considered?

This alternative is put forward for further consideration as it offers a lower-cost SR 99 option that maintains the economic vitality of the city and region while reconnecting the city's historic waterfront with downtown. System-wide improvements maintain regional traffic flows even with expected population growth. Removal of the viaduct in the existing SR 99 corridor creates a unique opportunity to re-envision the city's waterfront, providing quality open space, reducing noise impacts and improving views from downtown and along the waterfront.

This alternative has the lowest construction impacts to the waterfront, and it is expected to have no long-term economic impacts within the waterfront and region. However, there will likely be changes to local businesses as a result of change in transportation access. Travel times on the SR 99 corridor through the central waterfront would take five to 10 minutes longer than the bypass scenarios and 10 to 15 minutes more than today. Most trips to or through the Center City would have minimal changes in travel time. Other advantages include:

- It is a low cost SR 99 option compared to the bypass options studied.

- Substantial improvements to I-5 expected to improve functionality of that critical highway, maintaining primary thru-corridor freight route.
- Substantial transit improvements would improve overall system capacity and reduce use of single-occupancy vehicles.
- Creates a 104-foot-wide promenade along the waterfront.

How much will it cost?

	Capital cost (escalated to year of expenditure)
SR 99 Alaskan Way/Western Avenue couplet and seawall replacement	$ 929 million
Changes to I-5	$ 553 million
Changes to city surface streets	$ 216 million
Transit improvements	$ 476 million
Transportation policies and management	$ 37 million
Scenario total	**$ 2.2 billion**
Construction traffic mitigation	$ 30 million
Alaskan Way Viaduct's Moving Forward projects and prior program expenditures	$ 1.1 billion
Alaskan Way Viaduct and Seawall Replacement Program total	**$ 3.3 billion**

Note: Total annual operating costs for this scenario would be $55 million in 2008 dollars.

What are the potential issues that will need further analysis?

- Additional funding necessary.
- Changes to Western Avenue near Pike Place Market.
- Efficient movement of freight through city center.
- Managing traffic during stadium events.
- Managing traffic near the cruise ship terminals.
- Parking loss partially replaced by 300-space joint use facility on central waterfront.
- Access from West Seattle to downtown.

Further work on the bored bypass tunnel

The bored tunnel was not carried forward due to its high cost. However, it does have advantages associated with avoiding some of the construction on the central waterfront. The agencies will continue to investigate the costs of the bored tunnel as a future project that could be constructed if the I-5/surface/transit hybrid alternative is agreed upon.