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Destination 2030 – Taking an Alternative Route

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Destination 2030 – Taking an Alternative Route

"Transport is civilization" – R. Kipling

FOREWORD

As highlighted by author and poet Rudyard Kipling, transportation is the underpinning of our economy, lives, and civilization. Roads remain the principal means of transportation, whether for use by cars, buses, or trucks, and will remain so because of their flexibility. As the King County and Puget Sound region becomes more prosperous and the population grows, demand for road use increases. Unfortunately, the regional roadway network and urban centers are congested with traffic at peak times; several are congested frequently outside of the peak commute periods. This congestion imposes costs on everyone in the forms of wasted time, wasted fuel, delayed deliveries, environmental degradation, and deteriorating quality of life.

Although there is no easy, "silver bullet" to solving congestion, congestion relief is possible. However, it requires the participation of everyone involved in the situation. King County alone can identify $25 billion in investment needed to support transportation projects to address congestion. The Puget Sound region has identified $40 billion worth of transportation needs, and the state transportation requirements equal nearly $80 billion. Funding these projects is the key to solving our identified transportation problems. However, simple expansion of the roadway system without actions to restrain demand simply results in larger traffic jams. Global examples abound to re-emphasize that we cannot build ourselves out of congestion, and, as mentioned, we cannot afford to feed the supply side of the equation without also managing the demand side.

Various ideas for funding through "traditional" means have been proffered. The proposed sales tax, motor vehicle excise tax (MVET) stipends, and gas tax measures could generate approximately $0.9 billion per year. To meet our local needs, even the statewide 9-cent per gallon gas tax comes up well short in funding the necessary $40 billion of

documented transportation needs. And it has been adopted at a time when fleet fuel efficiency is increasing by 2.2 percent per annum. Compounding these project funding problems is the uncertainty of fuel costs that are again exceeding $60 per barrel and the inflation of steel prices, which may erode the ability to deliver the high-profile projects identified in the estimated budgets that describe how the generated tax revenue will be spent.

What is necessary is some “out-of-the-box” thinking, which this report attempts to do. The report identifies a transportation improvement fee (TIF) concept for the Puget Sound region that can produce $1.1 to $1.6 billion in “user fees” per year, resulting in $36 billion net revenue or approximately $24 billion net present value (NPV) over the next 20 years, without statewide contributions or sales tax measures that degrade the economic competitiveness of the region. Rather than simply taxing goods and services in an unending stream of incremental increases to supply portions of necessary projects, the TIF is an alternative route to achieving a sustainable transportation system.

The concept is based on charging a TIF for access to and use of the regional freeway network. It places responsibility for travel choices squarely in the hands of the individual traveler, where it can best be decided and managed. There is considerable scope in the TIF concept to encourage people to make smarter travel choices. The car is often the most convenient means of transportation; however, with a little encouragement, people may find it attractive to change their travel habits, whether through consolidating trips, car-sharing, using public transit, or simply traveling at less congested times. Transportation can benefit from the use of proven and practical demand management pricing that we freely apply to every other utility. Using a pricing mechanism for our roads is the fundamental basis of the TIF conceptual approach. Through usage and access fees, the region can build a fund that supports a sustainable transportation system while decreasing congestion and improving the environment. The conservative estimate of approximately $24 billion (NPV) over 20 years can pay for the vast majority of the unfunded improvements needed for the transportation network in the Puget Sound region and can continue to maintain that transportation network into the future.

We are entering a period of consequences. Dithering half-measures that produce incremental or fiscally bound partial “solutions” to our transportation problems are eroding confidence in public stewardship and trust. The application of the TIF would provide the opportunity to solve the regional transportation and sustainability problems without state funding. The size of the resulting Transportation Improvement Fund would allow the region to address its road and public transportation projects with confidence and determination. It

would also eliminate the need for further gas tax, sales tax, or MVET increases now or in the future.

Current Strategy

The strategy that our region has traditionally applied to the road network has tended to focus on three key elements:

- Providing more road space where that makes sense
- Improving the way roads are managed
- Promoting smarter travel choices through improved public transit.

These are good approaches to transportation. However, by ignoring the basic laws of supply and demand when it comes to the transportation system, we continually fight a losing battle against congestion.

A large program of new construction already exists, but we cannot continue to build new roads. In urban areas, there is very often no space for new roads at the most congested places. There are limits to the amount of road building people are prepared to accept for environmental and social impact reasons. There will, of course, still be a place for improving the roads and increasing capacity in some places, but new capacity, especially in urban areas, often fills up quickly. In addition, each old and new lane-mile of road requires servicing and maintenance, and as roads grow in size and age, the funding required for repair and maintenance increases. Therefore, we must focus more on making the best use of what we have and managing our assets wisely.

Good personal travel choices and traffic management can help ensure that the maximum number of people can complete their journey in a reasonable time. Traffic management measures can range from simple changes, such as giving priority to key movements at intersections, to sophisticated phasing of traffic lights, or the adoption of active traffic management systems that help restore traffic flows after incidents on the road network. But better management works only as long as the supply of the available road space is not exceeded by our demand for that space. Under current and future traffic forecasts, without demand management these better management measures, while very helpful, will not solve the problem alone.

Even with the funding approaches identified, and assuming current trends continue, congestion will continue to worsen. Thus, a TIF offers the best potential to manage demand

for the network. It will both provide a monetary incentive to help manage demand and fund a package of measures that will allow individuals to make better, more sustainable travel choices.

Why User Fees?

A well-designed, local "user fee" package has the potential to reduce congestion significantly in the local area. As a result of an imposed user fee, regional residents can expect to see reduced travel times, improved travel time reliability, and significant improvements in the provision of public transportation. This would be beneficial to all sectors of the economy, whether shoppers, workers, or businesses.

The federal government is currently considering the feasibility of introducing road pricing mechanisms, but the region does not have to wait for a national policy to begin accruing some of the benefits this report proposes. Therefore, this study focuses efforts and resources on local projects where congestion is already, or soon will be, a problem. As the U.S. Department of Transportation (DOT) Urban Partnership (UP) Program suggests, local demand management pilot studies will be invaluable in learning lessons for the design and implementation of any future state or national approach to the subject.

Local "user fee" concepts must be well designed, and the production of this base concept could begin the process. This involves looking closely at the extent to which the TIF concept for the three-county region can help develop more sophisticated and widespread solutions. Such evaluation includes demonstrating the benefits of user fees as part of building public acceptance, as well as improving understanding of the system design, technology, and measures necessary to gain greater public acceptance. This report is a conceptual start to that process, not a final definition of the numerous options and variables that demand greater study. It provides a conservative estimate of what could be accomplished with user fees, where such fees would be applicable, how the fees could be assessed, how much revenue could be generated, and what it would cost. The report is based on the "best practice" from worldwide sources and applies a rigorous and disciplined approach that has been proven on similar projects.

While the development and appraisal of such packages would be a complex and costly process for the Puget Sound region, the U.S. DOT offers financial assistance to a limited number of local authorities to help with concept development in advance of considering substantive demand management. The concept presented here of a TIF is in step with the latest U.S. DOT guidance and is supportable by the nearly $135 million in

grant funds available under the U.S. DOT program. This is an opportunity to secure a long-term and self-sufficient solution to our transportation needs without adversely diminishing our limited resources. It is also the chance to pioneer a concept of self-sufficiency and deterministic actions to solve the congestion problems that we have created for ourselves.

Conclusion

This report is an alternative route to the future. It is a conceptual first step, not a complete plan of action. Much needs to be done to plot the course and map the direction to be taken. Doing nothing is not an option; it will only condemn future generations to gridlock. Addressing the strategic, long-term, and sustainable growth of the region will be a controversial and mentally stimulating journey. One alternative is the supply-side transportation funding that has been used to date and that has created the backlog of projects and growing list of infrastructure in need of repair and maintenance. A different approach is necessary to continue to support regional growth and stimulate economic vitality for a sustainable future. Self-sufficiency, as we have learned in our own lives and the chronicles of our region, is not easy—but is well worth the journey.

1. INTRODUCTION

The transportation system in the Puget Sound region is in crisis. Regional transportation infrastructure and services are not keeping pace with population, employment, and travel demand growth. This gap is widening because the current transportation finance system—both statewide and within the region—is not generating enough revenue to repair and replace aging facilities, let alone add the capacity needed to meet current and projected demands.

Over the next 20 years, the state of Washington faces approximately $80 billion in transportation investment needs. The Puget Sound region accounts for approximately $40 billion of that total. King County's share alone equals roughly $30 billion. Within the Puget Sound region, even if all of the proposed funding packages pass this November (2007), we will be well short of the funds necessary to meet these needs (see Figure 1).

Because the available funding is small in comparison to the obvious needs, a contentious political battle is being waged over which facilities will be repaired, replaced, expanded, or built. These battles frequently devolve into debates regarding which facilities will be improved and who is responsible for funding these improvements.

Unfortunately, the high cost of the required regional transportation projects will make it difficult to raise the taxes we have traditionally used to pay for transportation improvements (i.e., gas tax, sales tax, motor vehicle registration tax). Large segments of the public have voted against these taxes because of their belief that they would be subsidizing projects that would primarily benefit others. What is necessary is some "out-of-the-box" thinking, which this report aims to do.

Rather than asking the general public to pay for projects to benefit limited segments of the region, this report proposes the introduction of market forces so that those doing the traveling pay for the costs of that travel.

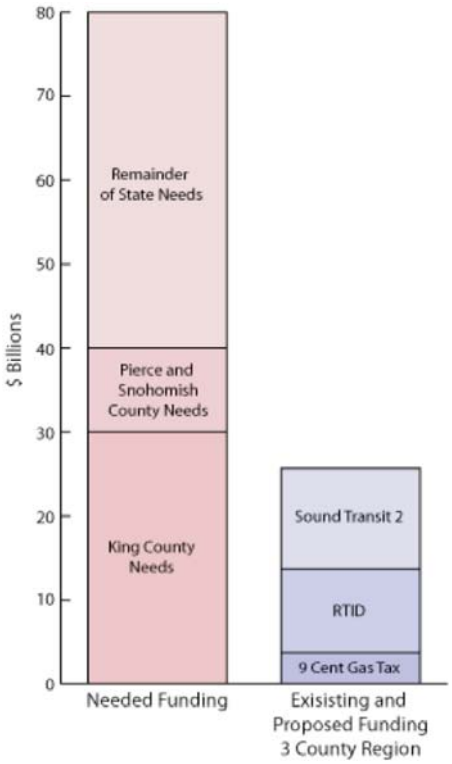

Figure 1. Transportation Needs and Proposed Funding (20 Years)

Using market forces and spending the revenue within the travel markets that generate those funds creates a sustainable system. Users generate the funding required to pay for the services they use. If demand warrants expansion, the use of that facility or service pays for the expansion. As use wears out a facility, the users pay for its repair or replacement.

1.1 The Transportation Improvement Fee (TIF)

This report recommends a sustainable, regional TIF concept for King County. The TIF would be able to produce $1.1 to $1.6 billion of "user fees" per year, or approximately $36 billion in net revenue over the next 20 years, without statewide contributions or regressive sales tax measures. The net present value (NPV) of the TIF would be $24 billion over that same period.

The TIF concept is based on the idea that the users of the overburdened, underfunded, regional highway facilities should pay for the repair, replacement, and expansion of the transportation infrastructure they actually use. Furthermore, those payments should be in proportion to their use of, and impact on, those facilities.

The improvement fee paid by a traveler would vary according to congestion levels. To add certainty to trip making decisions and to make system use easy to understand, the TIF would vary by time of day (and day of week) and by distance traveled.

Fees would be highest where congestion was highest. This would generate the funds needed to expand transportation capacity and encourage travelers to use less expensive (and less congested) times of the day for lower valued trips, thus reducing congestion, gasoline consumption, and pollutant emissions.

Fees would be lower where congestion was lower. However, fees would be present throughout the day. In this manner, all roadway users would help pay the operation, maintenance, and rehabilitation costs of these transportation facilities.

1.2 Use of the TIF

The revenue generated by the TIF should be reserved entirely for the transportation system within the TIF region. **It is very important that the people paying the improvement fees be the direct beneficiaries of the their transportation system improvements and services.** Transportation improvement revenues could be used to

preserve and operate existing facilities, expand transportation capacity, and invest in alternative modes of travel that serve the TIF-affected corridors.

"Capacity expansion" would include funding of services and infrastructure from any and all modes of travel that would increase mobility in the congested corridors. All modal capital and operations costs would be eligible for the regional TIFs.[1] It is recommended that TIF-funded system improvements focus on four key elements:

- Rehabilitating existing transportation facilities
- Providing more roadway lanes where economically logical
- Improving the way that roads are operated and managed
- Promoting smarter journey choices through improved public transportation.

1.3 Organization of the Report

The following chapter explores the benefit of the TIF to the Puget Sound region, articulates TIF program objectives, and recommends a general system design for the Puget Sound. Chapter 3 describes system design elements, supporting technologies, and system costs related to the recommended Closed System option. Chapter 4 presents estimates of system revenue and future net benefits. Chapter 5 provides an overview of the region's unfunded transportation needs. Finally, Chapter 6 identifies the next steps, including project definition and planning, needed to advance this program.

[1] This project has not examined the regional governance structure that would be needed to collect and allocate these funds.

2. REGIONAL TRANSPORTATION IMPROVEMENT FEES IN THE PUGET SOUND

2.1 *Why the TIF?*

There are a number of reasons why the state and the region should adopt the TIF. However, the best reason is that the TIF is the fairest way to fund the region's desired transportation improvements. Moreover, it may be the only way to fund these improvements. The region wants transportation system improvements, less congested roads, and better transit service. And, it is willing to help pay for those improvements. However, the region's residents do not want to pay for improvements that they will not use. **The great advantage of the TIF is that those who pay the TIF will gain the benefit**. Those who do not use the system will not be required to pay for it.

The proposed TIF will also provide a large number of other benefits. A well-designed user fee package has the potential to reduce congestion significantly. The Puget Sound region can expect to see reduced travel times, improved travel time reliability, and significantly improved public transportation services. This will be beneficial to all sectors of the economy, whether shoppers, workers, or businesses.

Because the TIF will rise during congested periods, travelers will have an economic incentive, as well as a travel-time incentive, to travel when the road is less congested. The result will be lower volumes on the regional freeways during congested time periods, making travel faster, less stressful, and less harmful to the environment.

Because the TIF will generate sustainable revenues, transportation improvements can be made that support transportation-friendly land uses, creating the "virtuous circle" of land use and transportation improvements that are the hallmark of sustainable development.

Importantly, with the TIF, travel decisions will still be in the hands of the public. Travelers will still choose their travel options—such as route, time of departure, and mode. However, their choices will be effectively guided by market-based price signals that more accurately reflect the true costs of travel. **Additionally, the economic behavior that the TIF creates will result in improved mobility, reduced congestion, faster travel times, a financially healthier and environmentally sustainable transportation**

system, and greater transparency in the use of revenues for the benefit of those paying the fees.

An additional key reason to adopt the TIF now is federal funding. The U.S. Department of Transportation (DOT) is currently looking to fund pilot projects that support the market-based strategies inherent in a TIF system. The U.S. DOT has $135 million to allocate in grant funds through the Urban Partnership Program, which could provide a large portion of the initial capital funding required to implement the TIF—thus, an even greater amount of TIF revenue could be applied to transportation system improvements.

2.2 Program Objectives

The TIF program will meet several key objectives:

- **Address the regional transportation funding deficit** – The revenue generated by the TIF would be spent to improve travel conditions for the corridors within which fees were collected. Transportation improvement revenues could be used to preserve and operate existing facilities, expand transportation capacity, and invest in alternative modes of travel. **The people paying the improvement fees would be the direct beneficiaries.**
- **Provide immediate congestion relief** – In response to a fee, travel volumes would be affected in three ways: 1) motorists would shift from single-occupancy vehicles to shared-ride modes (carpools and transit), 2) motorists would shift their discretionary trips to off-peak periods when the fee would be lower, and 3) some vehicle trips would be diverted or eliminated as a result of traveler sensitivity to price. By charging a fee that reflects the true costs of travel, it is possible to reduce congested conditions and improve travel times throughout the day.
- **Support alternative modes of transportation** – This program would support multimodal transportation capacity enhancements as part of a regional transportation management package. The TIF program revenues could be used to support light rail expansion, express bus rapid transit, transit fleet expansion, park-and-ride expansion, transit-oriented joint development efforts, bicycle lane and trail facilities, and pedestrian enhancements.
- **Enhance environmental sustainability** – The TIF program would result in a substantial reduction in single-occupancy vehicle miles of travel and would encourage carpooling, transit use, and other alternative modes of transportation.

Associated reductions in mobile-source emissions would improve air quality and the environment.

2.3 System Design Options

Regional user fee systems fall within one of two basic categories: 1) facility-based pricing systems and 2) area pricing systems. The purpose of this section is to describe each automated user fee application and to establish screening criteria to assess the comparative suitability of each potential application (and corresponding technological attributes) to the Puget Sound region.

Both approaches offer considerable flexibility in the use of dynamic pricing to manage traffic conditions by time of day and by location. Advanced fee collection systems are sophisticated enough to manage traffic by varying the fee rate by time of day, location, distance traveled, and other operational parameters. The following sections describe these approaches.

Facility-Based Pricing

In this approach, automated charging of fees is retrofitted to a fixed distance of a single highway segment or over a larger highway network. Motorists choosing to use the facility are charged a user fee based on total distance traveled through the network. The user fee structure may assign differential rates by time of day. The highway facilities included are typically major interstates, highways, or state route segments that suffer significant peak-period traffic congestion.

Central Puget Sound boundaries for a facility-based fee system would likely include Everett and Marysville to the north, Redmond and Issaquah to the east, and either Tacoma or Olympia to the south. Given current and future traffic conditions, the north-south facilities that are candidates for user fees include I-5, I-405, SR 99, SR 599, and SR 167. East-west facilities likely include I-90 and SR 520.

Facility-based systems require gantry-mounted user fee collection devices at the point of entry and at downstream locations throughout the facility. User fees may be collected on the basis of trip length. For long systems (beyond 8 miles), gantries can be placed at all entrance ramps within the facility and at entrance and exit ramps over the mainlines at the beginning and end of each freeway segment. When a vehicle enters the facility, the gantry reads the vehicle's electronic tag or license plate. When the vehicle exits

the facility, the appropriate fee amount is debited from the user's account on the basis of total distance traveled and time of day.

Area Pricing

The second regional user fee system is based on an area pricing model, which is typically applied to major metropolitan cities where a dense central business district (CBD) attracts a substantial share of the region's daily auto trips from outlying communities. To alleviate severe traffic conditions within the CBD, a boundary is drawn around the congested district. All vehicles entering the pricing "zone" must pay a fee that may vary by time of day. Internal trips may also be charged.

Under this scheme, electronic user fee collection gantries are placed at entry points located at the edge of the pricing zone. All vehicles entering the zone are charged a time-of-day fee based on time of entry. Fees are higher during the AM and PM peak periods and lower during off-peak times of day. These area pricing systems can be structured to charge through-trips differently than trips with end points inside the zone. The intent is to charge less to those who have fewer alternative transportation options (i.e., those who are not traveling to major activity centers that are well served by transit). Trips passing through the zone (e.g., entering and exiting the zone within a specified window of time) may be exempted from paying a fee or may pay a lesser fee.

2.4 What Is the Best Fit for the Puget Sound Region?

The Puget Sound region possesses a unique urban geography. Lake Washington and the Puget Sound waterway represent major physical barriers that orient King County's development along two major north-south axes represented by I-5 and I-405. The city of Seattle is connected to eastern King County via two floating bridges, State Route 520 and I-90, and generates many highway trips destined for locations within the central business district, eastern King County, and beyond. While Seattle continues to grow, even greater growth has occurred in the northern, southern, and eastern suburbs. Suburban growth includes both people and jobs.

Travel Demand

The resulting travel patterns in the region suggest that while the city of Seattle is a major regional trip attractor, the highways serving Seattle (I-5, I-90, and SR 520) and major arterial roads also distribute a high volume of trips among multiple communities throughout the Puget Sound region. Seattle is the largest attractor of regional trips but

represents only one among many subregional economic hubs that include Tacoma, Renton, Bellevue, Redmond, Kirkland, and Everett, among others. The polycentric nature of the Puget Sound region suggests that an area pricing scheme overlaid onto Seattle's CBD would not be effective in relieving traffic congestion in the counties of King, Pierce, and Snohomish, which are outside the zone.

Another key consideration is the intensity of traffic congestion on the region's highway network, which is severe because of the high share of automobile trips throughout the region loaded onto the highway system. Currently, the supply of highway capacity simply cannot accommodate continued growth in regional automobile trips. Coupled with higher truck volumes, several of the region's major highways are gridlocked in the AM, midday, and PM peak periods, with recurring bottlenecks at numerous chokepoint locations throughout the regional highway network. As a system management tool, an area pricing scheme would not be as effective in addressing highway congestion as a facility-based option.

Mass Transit Capacity Requirements

The existing regional mode split, and the ability of alternative modes of transportation to absorb trip deflection caused by road pricing, is another important consideration. In cities where area-pricing schemes have been implemented, there has been a high pre-existing transit mode share. Cities such as London and Singapore have extensive mass transit assets that include subways, passenger rail, light rail, and fixed-route bus services. By comparison, the Puget Sound region's existing transit mode share is low. While this share is comparable to that of other U.S. metropolitan regions, it is much lower than the transit mode share of international cities that have implemented regional user fees.

Importantly, while much of the travel occurring in the region is in single-occupant automobiles (see Table 1), work trips made to these regional centers are twice as likely to share rides in comparison to work trips bound for destinations outside of these centers (25 percent to centers and 12 percent outside of centers). In addition, growth management legislation encourages further development within these centers, meaning that significant potential exists for a mode shift to transit as the region grows—as long as the necessary transit infrastructure can be provided.

Table 1. AM Peak Mode Share

Mode		% Share in AM Peak
SOV	Auto	76.4%
HOV	Transit	16.4%
	Vanpool	7.1%
	Bicycle	0.1%
	Walk	0.1%
	Truck	0.1%

International experience suggests that the ability of the mass transit system to absorb this mode shift is a necessary precondition to program success. This is true for both the area pricing and facility-based systems. One of the major challenges facing the Puget Sound region would be the expansion of mass transit capacity in order to adequately absorb trips deflected from the roadways on which a regional user fee system has been imposed.

Recommended System Design

To summarize, the determination of the type of automated user fee system that is the most appropriate fit for a given urban geography is subject to several important considerations, including the following:

- Geography (natural barriers, waterways, peninsulas, bridges)
- Street network configuration
- Existing travel demand (temporal and spatial)
- Baseline modal capacity (automobile, high-occupancy vehicle, transit, ferry, bicycling, walking).

Given the unique characteristics of the Puget Sound region, we chose to investigate a facility-based fee system, which we believe is a more appropriate fit than area pricing. Such an approach would be better able to alleviate traffic congestion relief where it occurs most—on the region's highways. An area-based system works most effectively where a very large percentage of trips are destined for a single, concentrated destination. The Puget Sound region does not fit that description. In addition, a regional facility-based system would be more effective in generating the revenues needed to address the region's broader transportation needs.

The next chapter provides a more detailed discussion of the design of the regional fee collection system.

3. SYSTEM DESIGN AND COSTS

The following section describes the conceptual design for a facility-based system intended to optimally address the specific challenges presented by the Puget Sound region.

3.1 System Design Issues

A facility-based approach has been chosen to directly target congestion across the highway network. This network would include the majority of the limited access routes in the Puget Sound region, from Everett in the north to Lakewood in the south, as well as a range of multi-lane sections, reversible roadways, and the freeway ramp metering system (see Figure 2).

Some of the key issues considered in the development of the concept design include the following:

- The need to maintain acceptable operating standards that do not introduce additional capacity constraints
- The flexibility to vary charges by location, time, and distance
- Ease of understanding for the public
- The ability to implement operational strategies that minimize localized diversions to avoidance charges
- A system based on proven technologies
- Restriction of operating costs to an acceptable level
- A scheme that would be feasible for implementation by the 2010 assumed design year and, therefore, be based on currently available and affordable technologies.

Figure 2. Proposed Transportation Improvement Fee Network

3.2 System Design Options

Given the assumed design criteria described in Chapter 3.1, two general system design options are available:

- **Closed System** – A fully closed system across the defined highway network in which all entrance and exit points across the network are monitored. Each individual trip is recorded at the entry and exit point.
- **Open System** – An "open" system is based on a series of specific revenue collection points at strategic locations across the network that charge vehicles when they pass these defined points.

If cash transactions are allowed at each tolling point, these two approaches are only appropriate for fundamentally different revenue systems (trip-based versus point-based). If electronic revenue collection systems are employed (as recommended), it is possible to use either design to calculate and apply trip-based user fees by combining the locations and times at which a given account ID is observed using the system. The primary difference between the two approaches thus becomes the cost of system deployment and operation.

The following section presents a design overview of the Closed System, which we recommend as the preferred option based on its lower cost of implementation, the ease with which the system can be expanded (if the TIF region were to be expanded to cover the cost of further roadway expansion), and the inherent "fairness" of a system that covers an entire roadway, not just "arbitrary" points on the road. The appendices to this report provide more detailed information about the Open System option.

3.3 Recommended TIF System – Closed System

The recommended TIF charging scheme is based on the concept of a fully closed charging system, with data collection points at every on- and off-ramp across the limited access highway network. Data collection points would be established at all entry and exit points to record each vehicle entering and leaving the strategic network. These data would pass through a centralized facility where the respective entry and exit transactions would be matched, producing a specific trip record that would be charged a fee based on the specific parameters of the system. For example, a trip from Lynnwood to Renton during the AM peak might pass through several defined geographic zones and be charged a combined fee

based on: 1) these zones and 2) the direction of travel for that time of day. This approach is very similar to what is used by transit systems in this region. In addition to the required entry and exit points, some mid-block toll checkpoints could also be established at key locations to provide additional trip data (such as whether the majority of the trip described in the above example actually used I-5 or I-405) and to assist in identifying any vehicles not identified at the main ramp locations.

Charges under the Closed System would be set for a fixed period (likely three to six months) on the basis of a defined formula that would include specified zones. The charges would vary by time of day based on the congestion routinely present on those facilities (e.g., average speed). This approach would allow for the publication of a differentiated time-of-day fee structure that would apply for the next three- to six-month period. In this way, user fees would rise or fall on the basis of changes in demand for the facility during peak travel. (That is, if effective transit service was available as an alternative and sufficient individuals chose to use it, demand would drop on the roadway, congestion would ease, and the user fees on that facility would decline.)

We recommend that the TIF also vary charges by vehicle type (e.g., passenger vehicles versus commercial trucks), with provisions made for exemptions and/or special discounts. For the purposes of this concept design, it is assumed that only buses and emergency vehicles would be exempt.

General System Issues

Figure 3 illustrates the basic operation of this type of scheme. It offers flexibility to target specific congestion locations by periodically altering zone- and time-based charging packages, without the need for any physical changes to the data collection infrastructure. Full network coverage also reduces the potential for users to bypass the system on a regular basis and provides the potential to develop charging mechanisms that can be more easily modified or shifted to future technologies as part of the ongoing U.S. DOT-sponsored Intelligent Vehicle Initiative (IVI) and Vehicle Infrastructure Integration (VII) programs.

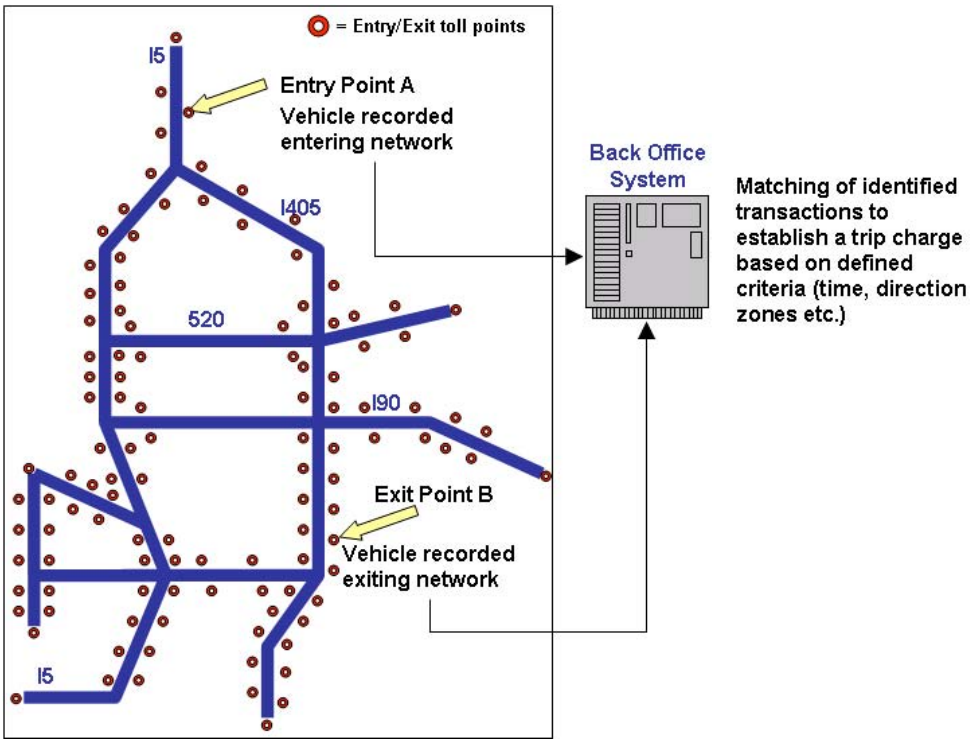

Figure 3. Closed System Design

System Design

There are two major sets of facilities required by the assumed system design: 1) roadside facilities used to record vehicle movements entering and leaving the network; and 2) back-office systems used to process this information, collect the relevant charges, and manage administrative functions. These facilities dictate how the user fee system will function and thus what operations and maintenance costs can be expected from the system. Factors that must be considered in the system design include the key scheme functions listed at right.

KEY SCHEME FUNCTIONS

- Information – Providing adequate information to users and potential users on the charging regime and payment options.
- Detection – Detecting, and in some cases measuring, each individual instance of use (e.g., vehicle entering and leaving the system).
- Identification – Identifying the user, vehicle, or in some cases numbered account.
- Classification – Measuring the vehicle to confirm its class, aligned with the classification framework for the scheme.
- Verification – Cross-checking processes and secondary means of detection to assist in confirming transactions, reducing processing costs, and providing a backup for potential enforcement.
- Payment – Pre- and post-use collection of payment from users based on verified use.
- Enforcement – Providing the means to identify and prosecute violators and/or pursue violators for payment of charges and/or fines.
- Exemptions – Providing the facility to manage a range of exemptions within the context of the scheme.
- System Reliability and Accuracy – Providing all of the above through cost-effective systems and technologies that can meet the required levels of reliability and accuracy, and minimize revenue leakage and fraud.

The concept design is based on the use of a combination of technologies, including vehicle-based transponders or on-board units (OBUs) that use industry standard, dedicated short-range communications (DSRC) technology and cameras that incorporate licence plate recognition technology (automatic number plate recognition or ANPR) for enforcement. These technologies form one of the most commonly used combinations for electronic free-flow roadway charging around the world, and thus provide a well-established base for the proposed scheme. (The selection of these types of technologies is addressed in more detail in Chapter 4).

OBUs can be supplied to system users through mail and assigned agents (e.g., post offices). They would be installed by the user. Fees would be deducted, on the basis of recorded trips, from pre-paid accounts assigned to these OBUs. (Later evolutions might be developed to include OBUs with the ability to draw payments directly from smart cards currently being developed for use on the Seattle transit network, thus eliminating the need for accounts and optimizing the level of privacy for users.) Users would be able to "add value" to their OBU at their discretion through a number of different mechanisms and locations.

Casual users (i.e., those who used the network less frequently and did not have an OBU, including those who lived within or outside the state) would be identified by the system through license recognition. Chargeable trips would be identified by matching relevant entry and exit points. "Casual trips" would be subject to an additional administration charge to cover the additional costs, with payment options provided, including casual user accounts or the purchase of a "use pass" on the day of travel.

Taxis and other non-exempt "fee-for-service" vehicles that use the freeway network would be fitted (by trained technicians) with a more advanced unit integrated with the taxi meter and connected to the vehicle's main power supply. These units would be "dual mode," incorporating the ability to operate as a card payment device or as an account-based payment device linked to the taxi meter. Eligible organizations and individuals would be provided with exemption cards that could be used in place of future payment cards when appropriate. This privilege would be monitored by regular reports on the use of these cards provided to the management of the respective organizations.

Enforcement of the system would be accomplished through the secondary ANPR and image capture system. Any vehicle passing a charge point that was not recognized as a valid transaction (for reasons that could include insufficient funds or incorrect class of payment) would be recorded as a violation, and an image of the vehicle and its license plate read would be recorded. These would then be used to pursue payment from the registered owner of the vehicle.

Back-office facilities and operations would be set up to process the required level of transactions and violations and would include all of the processes required to distribute and maintain OBUs, manage contracts, and process transactions through to billing. Other required elements that have been assumed within the cost of the system include a database of registered account users linked to the back-office systems; secure access to the motor vehicle registry for violation processing; and a dedicated, secure communications system to connect these components.

Roadside Facilities

A review of the routes planned for inclusion in the network, including the number of locations and traffic lanes at each site, has been undertaken to provide a basis for evaluating the Closed System. Table 2 lists the routes planned for inclusion, summarizing the number of planned fee collection points and of lanes, and includes provisions for five mid-block points.

Table 2. Fee Collection Points by Segment

Routes	Access/Egress Points	Lanes
I-5	167	239
I-90	32	38
SR 99 and 599	30	34
SR 509	25	33
SR 518	12	15
I-405	75	135
SR 167	34	42
SR 520	40	61
Additional mid-block sites	5	15
Total	**415**	**597**

Data collection point designs have been developed for lane configurations of from one to six lanes, and these have been assigned to each required data collection location on the basis of the number of lanes at that location. Each site would provide the ability to detect that a vehicle was passing (i.e., entering or exiting the TIF network), classify that vehicle as a car or truck, communicate with the DSRC-based OBUs to determine whether a valid OBU was present in that vehicle, collect and process license plate images from vehicles that did not have a valid OBU, and communicate these data to the central transaction processing facility. An independent verification system has also been assumed to provide a basis for checking and auditing the system.

Back-Office

The back-office systems required for a Closed System would include the following components:

- **Revenue Collection Central System (RCCS)** – This would be used to process the individual roadside transactions into defined trips, address transactions that had been misread or incorrectly assigned, and assign charges based on the rates table for the defined scheme. This system would also manage all relevant accounts and OBU management functions.
- **Internet/Mail Center** – This system would manage Internet and mail payments and inquiries, as well as the distribution of bills, notices, and OBUs.
- **Customer Service Center** – This facility would provide the main interface with the public, relying on many of the functions of the RCCS and the Internet/Mail Center in the processing of accounts and OBU distribution and management.
- **Monitoring System** – This system would provide continual monitoring of the roadside and back-office systems to ensure consistent operation of all related systems and sub-systems, providing cross checks for key data streams and monitoring the operation of critical systems.
- **Systems Integration** – This system would ensure effective integration of the main back-office facilities with the relevant roadside systems.

Operations and Maintenance

The operations and maintenance processes would include a range of functions, including the following:

- Handling user inquiries
- Processing payment notices and debt collection
- Processing casual user transactions
- Processing incomplete transactions and failed license plate reads
- Processing system violations
- Maintaining systems and equipment.

The concept design for these elements is based on an assessment of likely transaction volumes drawn from current traffic data at each of the entry and exit points included within the scope of the Closed System option.

3.4 System Technology

The requirements of a Closed System fee collection program constrain the potential technology choices for a cost-effective and reliable system.

Technology Options

Candidate technologies for the Closed System, based on consideration of a combination of currently operating systems, development of new technologies, and the scale of the proposed schemes, include the following:

1. **DSRC Radio Frequency Identification (RFID) Schemes** (with ANPR enforcement) – DSRC is the most common form of primary electronic road pricing technology in general use and is the standard on most free-flow toll facilities. The technology is based on the use of OBUs, sometimes referred to as transponders, which communicate with gantry-mounted equipment at defined charge or check points. These units can also incorporate a smart card facility for payment. The roadside equipment identifies and verifies each vehicle's OBU and, depending on the type of system, either processes a charge from its designated account or confirms its rights of access. In most systems, the DSRC system also

locates the vehicle within its detection zone by using an array of DSRC transceivers.

2. **Vehicle Positioning Systems (VPS)** – VPS (e.g., Global Positioning System [GPS] and Galileo) use a satellite location system (generally, a GPS) to determine the vehicle's position and measure location and distance travelled for the purposes of charging and access control. A limitation of vehicle-based systems is that, in addition to the position system itself, they require an external communications system to periodically report the vehicle's required charges. Germany's truck toll system (the only adopted GPS-based system currently in operation) uses cellular telephone technology, and its associated charges, to perform this task.

3. **Image-Based or ANPR Systems** – Image-based ANPR technology is based on images taken of vehicle number plates and processed through optical character recognition software to identify the vehicle.

4. **Other RFID Systems (including passive, pico-cell, and other technologies)** – In-vehicle RFID identifiers are read by roadside detectors to record vehicles passing defined points. These are similar to the OBUs described above but do not use the DSRC standards being developed by the U.S. DOT. Instead, they use other communications standards and have different price, performance, and capabilities in comparison to the DSRC-based RFID systems.

Urban streetscape "clutter" can be a concern with any technology that requires roadside equipment; although, with good design, any unsightliness can be kept to a minimum, as illustrated by Figure 4. Any of the above technology choices generally accomplishes enforcement by using roadside cameras and ANPR technology—and thus, to a certain extent, all of the technologies being examined must address the question of roadside clutter.

Figure 4. Examples of ANPR Equipment

Recommendation: A Combination System

The most appropriate technologies for the Closed System option would be a combination comprising DSRC OBUs as the primary payment and identification technology and ANPR technology for enforcement and casual user transactions. This combination would allow operators to benefit from the higher accuracy and lower operating costs of DSRC, while the ANPR would accomplish both the casual user management and enforcement tasks. This package would also allow interoperability with the Tacoma Narrows toll bridge operations and the Washington State Department of Transportation (WSDOT) SR 167 HOT lane system, as well as limit the use of the less accurate and more costly ANPR technology to a reduced number of transactions. For more detailed information on DSRC and ANPR systems, see the appendices to this report.

The proposed system is based on current industry standard OBU communications technologies to capture their cost and security benefits. Because the technologies that can be used to perform the required transaction processing are evolving rapidly, costs for system changeover to emerging national standards have been included in future year expenses for the TIF system as part of the NPV calculation for this project.

At present, CEN 278 standard units use a 5.8 GHz frequency, but they would potentially shift to a higher 5.9 GHz frequency as international standards evolve. This standard is specifically designed for multi-lane, free-flow applications and differs from other passive OBUs currently used around the nation in dedicated toll lanes.

Although a DSRC/ANPR package that uses OBUs linked to account-based payments has been identified as the most suitable for this application, this could soon be changed to a system that uses OBUs with integral smart card facilities (see Figure 5). This would reduce back-office processing, improve user convenience, and benefit from smart card payment facilities being developed for the transit system.

VPS may also be attainable in the future, providing a more effective means of measuring location and distance travelled for the purposes of charging. These systems (e.g., GPS) offer greater flexibility in varying charges to influence more aspects of travel and transport choice.

Although, to date, the cost of VPS units has limited their use to major heavy vehicle application, their costs are decreasing. Once they have been established, VPS-based systems have the advantages of wide coverage and far fewer checkpoints than other technologies. A gradual shift from a DSRC/ANPR system to this type of system could be achieved, as the back-office systems and much of the roadside equipment would be

consistent with the required enforcement systems. Initially, VPS units could be added alongside the existing DSRC units and integrated with same smart card accounts and payment systems.

Figure 5. Example DSRC System Using OBU with Smart Card

3.5 System Costs

Cost Estimates

Total project implementation costs are estimated at $88 million with the cost of electronic tags and smart cards (that is, if it is assumed that the base cost of electronic tags will be borne by the system, not the individual user), and at $65 million without them.

Total annual operating costs are estimated to be approximately $148 million (with an 80-percent to 20-percent split of transactions between electronic tags and license plate recognition, respectively), or approximately 9 percent to 10 percent of the operating revenues.

Concept Design and Cost Model

To develop the above estimates, a cost model has been developed for both the Open and Closed concept designs. This subsection describes that cost model and its assumptions. The same model structure is applicable to both the Open and Closed concept designs. However, the input details of these two concepts differ markedly.

The model is based on the application of similar technologies for similar systems and facilities currently in operation around the world. The technology and systems costs are

based on an international market. Because of the specialist nature of these systems, it has been assumed that an experienced international supplier would provide the main system. Where available, local costs for key elements such as structures (e.g., the gantries and poles needed to hold the data collection electronics) have been incorporated into these estimates based on known pricing from other procurements of similar systems.

The cost model includes two main elements: capital costs and operating costs. Figure 6 illustrates the basic components in the cost model and shows how the transaction costs are linked to the revenue model. The basic design of the capital and operating cost components is described below.

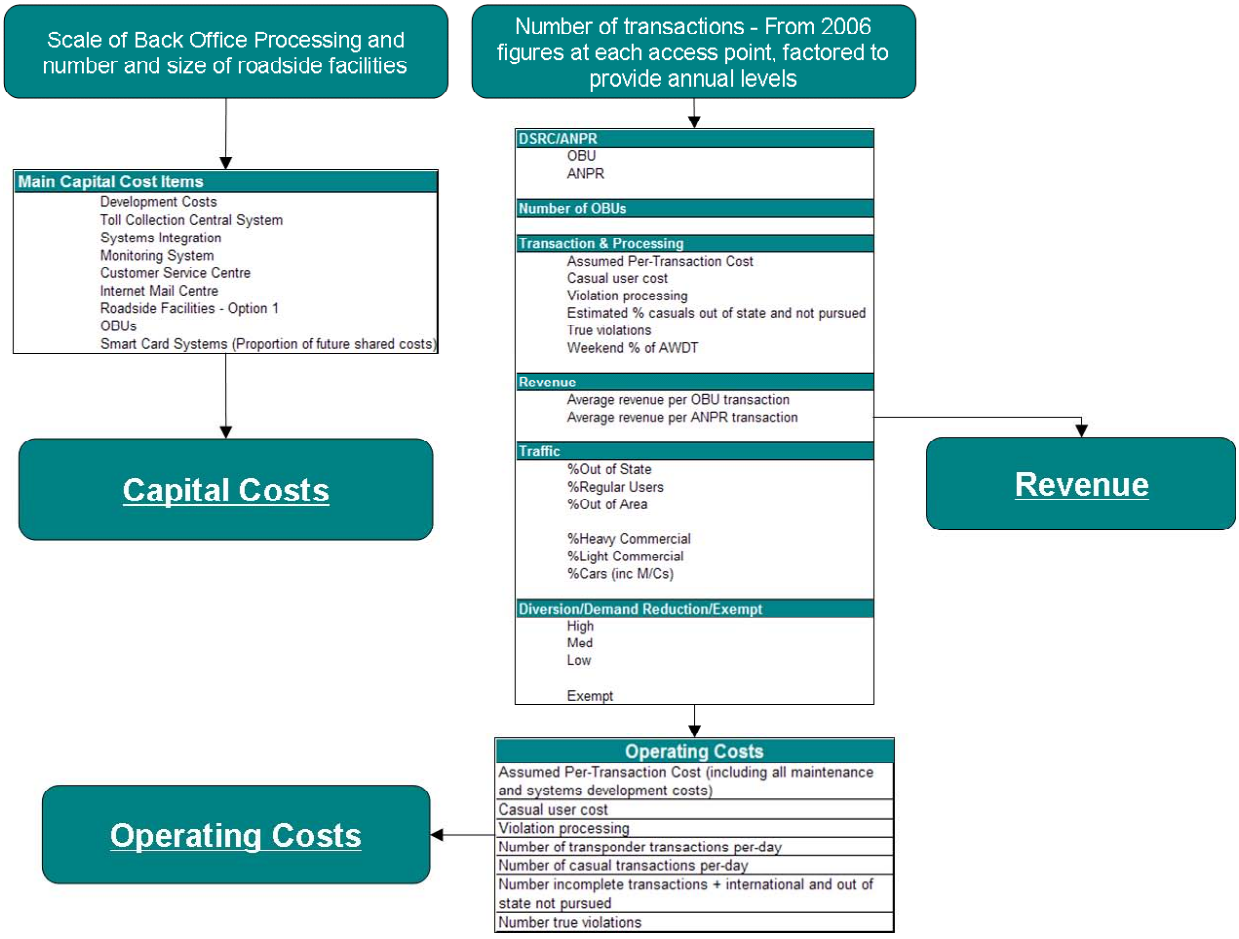

Figure 6. Cost Estimation Methodology Summary

Capital Costs

Capital costs include back-office facilities scaled to accommodate the levels of transactions expected and roadside facilities based on the number and size of revenue collection points. Elements of capital costs include the following:

- Development costs
- Revenue collection central system
- Systems integration
- Monitoring system
- Customer service center
- Internet mail center
- Roadside facilities
- Initial distribution of OBUs
- Smart card systems.

The costs of the roadside facilities for each option include all of the relevant equipment necessary to operate a DSRC/ANPR data collection point, along with an independent verification system, and the civil structures and related infrastructure (conduit, wiring, etc.) needed to mount and operate that equipment.

Generic designs and costs have been developed for sites with between one and six lanes, and the costs for each generic design have been applied to each Puget Sound site on the basis of the number of lanes present at each site. Within the model, the number of sites of each type has been summarized by route. The following routes are included in the initial cost estimate presented above: I-5, I-90, SR 99, SR 599, SR 509, SR 518, I-405, SR 167, and SR 520.

A cost has been included for the initial OBU base and for preliminary alignment of the TIF revenue collection system with planned smart card systems. At this stage, it is assumed that all sites would require the construction of a new structure specifically to hold the data collection electronics, but it is expected that at least 30 percent of sites would utilize existing structures, reducing overall system costs.

Operational Costs

The estimated costs of operating the TIF are based on a per-transaction cost factored up to an annual operation cost, including costs for all regular operations and

maintenance. Excluded from this operational cost rate are the costs associated with revenue enforcement. The processes involved in identifying noncompliant users, issuing notices, and chasing outstanding debts are considered part of a separate system, the cost of which would be more than covered by administration charges imposed on those users. Excess revenue from these charges would assist in offsetting any losses from charges that could not be recovered. The revenue estimate presented in this report assumes that enforcement costs and losses from non-payment of debts would be canceled by these administrative fees, resulting in no net-revenue loss or gain due to required enforcement actions.

The cost model is based on a defined number of transponder transactions per day (these differ considerably between the Closed and Open system designs) and assumes a defined split of regular user and casual user transactions per day. The assumed levels of incomplete transactions[2] and violations have been developed as a proportion of this split. The number of transactions is based on an assessment of each of the identified sites, factored to provide an annual average transaction figure.

Key Assumptions

In developing the cost estimates, a range of assumptions related to system design and operations have been made:

- A cost per site has been included for the provision of communications and power. This cost assumes that the majority of sites will be located within accessible range of an existing communications network and power supply but that some additional communications infrastructure and technologies will be required.
- The OBUs that will be required at the time of commissioning have been included within the back-office capital costs. Two types of OBU have been assumed: one for general users that will be installed by the user, and the other for taxis and buses that will require trained installation. The number of units required has been based on forecast vehicle fleet figures derived from the reported number of state-registered vehicles.
- Gantry costs have been estimated on the basis of advice from local WSDOT staff.
- Other infrastructure costs have been calculated on a per-installation basis for both the generic gantry types and pole-type installations.
- Back-office costs include development, design, integration of data collection points, and commissioning (e.g., system testing and verification, training).

[2] An incomplete transaction is one in which a vehicle is observed only entering or exiting the system, but not both, because of some technical malfunction.

- Where poles sites are used in place of gantry equipment, two poles will be required for front and rear images and for vehicle detectors and classifiers.
- One control box has been assumed for each site.

4. SYSTEM REVENUES

The purpose of this chapter is to describe the methodology that was used to estimate the annual revenue figures, presented earlier in this report, that could be generated from a TIF. Chapter 4.1 describes the methodology used to estimate TIF revenues. Chapter 4.2 suggests future modifications to the revenue model.

4.1 Revenue Estimation Methodology

The study team developed a high-level methodology for estimating the annual revenue generated from a sustainable transportation program that features the system design described earlier in this report. Figure 7 illustrates the basic four-step revenue estimation methodology.

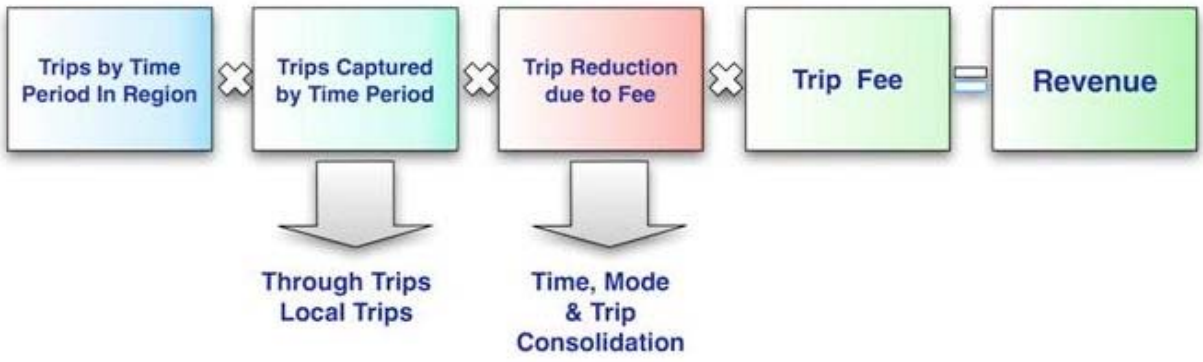

Figure 7. Revenue Estimation Methodology

The revenue model makes the following assumptions:

- Charges are applied to passenger cars and light-duty trucks accessing the network at a rate of $2.00 per zone during the AM and PM peak periods and $1.00 per zone during the midday period. (Zones correspond to the Puget Sound

Regional Council travel demand model's forecast analysis zones, illustrated in Figure 8.)

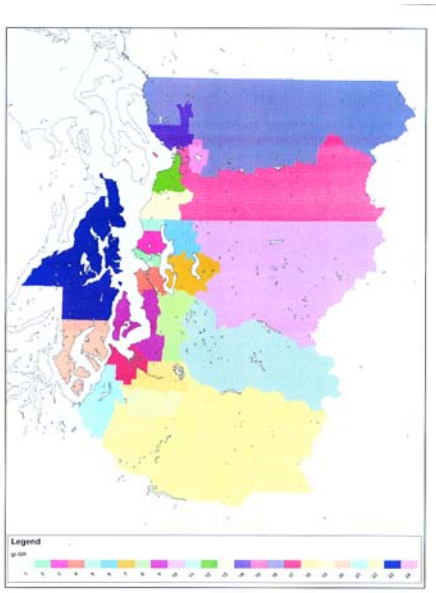

Figure 8. Analysis Zones Used for Revenue Estimation

- The fee system has a cap of $8.00 per trip during the AM, midday, and PM periods.
- Medium- and heavy-duty trucks are charged at twice the rate of passenger cars and light trucks.
- Vanpool and transit trips are not charged, but otherwise no exemptions or discounts have been applied for modeling purposes.
- A base charge of $1.00 per trip, regardless of trip length, is applied during late-night hours and on Sundays.
- Sunday travel volumes are 50 percent of weekday travel volumes.
- Violations are assumed to be revenue neutral (i.e., violators will be pursued to a level that ensures that fines recovered equate to lost revenue). This includes revenue leakage factors such as unreadable license plates and untraceable owners.

- No evaluation has been undertaken of the consequential effects on public transport system revenues.
- No evaluation has been made of trip re-timing effects.
- No evaluation has been undertaken of secondary revenue effects, such as business sector impacts.
- No attempt has been made to optimize revenue streams.

Step 1: Trips by time period in the region

The Puget Sound Regional Council (PSRC) provided origin-destination trip matrices according to the 24-zone scheme used in its regional travel demand model, as shown in Figure 9, for a variety of travel modes. The 24x24 zone configuration has 576 zone pairs.

Using a spreadsheet model, vehicular trips were aggregated as follows. Single-occupant autos, high-occupancy autos, and light-duty trucks each counted as one vehicle trip, while large trucks counted as two vehicles (to reflect the fact that large trucks would pay twice the fee rate of autos). Total vehicular trips were estimated for each zone pair according to the following time periods:

- 7:00 AM – 10:00 AM (AM peak)
- 10:00 AM – 4:00 pm (midday)
- 4:00 PM – 7:00 PM (PM peak)
- 7:00 PM – 7:00 AM (off-peak)

Note that the PSRC did not perform any additional or new model runs as part of this analysis.

Step 2: Trips captured

The second step in the methodology involved estimating the share of trips between zone pairs that would access the current highway network. An accessibility factor, defined as the percentage of trips assigned through any portion of the TIF network, was derived for each zone pair. An accessibility factor matrix was developed on the basis of a visual inspection of the current network and zone configuration. This factor allowed for an estimate of the number of trips captured by the network before implementation of a user fee.

Figure 9. Map of TIF Network

Step 3: Trip reduction due to fee

This step involved estimating the proportion of network trips that would be diverted away from the network after implementation of a user fee. This trip reduction factor served as a proxy for non-equilibrium trips deflected under the price conditions described in Chapter 3. These factors were developed on the basis of empirical evidence from similar user fee schemes in cities worldwide, which suggest approximately 20 percent of trips would be diverted from the network.

Step 4: Trip fee

Step 4 of the methodology involved calculating revenues on the basis of the fee structure shown in Table 3. Motorists entering the TIF network would be charged a distance-based, time-of-day fee. The total time-of-day charge paid by the motorist would increase on the basis of the total number of zones traversed. Given the short timeframe for this study, no attempt was made to predict the dynamic effect of various price conditions on travel demand per empirical travel time coefficients. Moreover, no attempt was made to optimize the fee structure by zone segment. Rather, a simple zone fee structure was derived on the basis of the general value of the travel time assumptions. By using this fee structure, together with trip matrices and the distance between zones, it was also possible to compute a rough estimate of the average fee rate per mile charged to users by time period, as reflected in Table 3.

Table 3. Fee Structure by Time of Day

Time Period	Time-of-Day Fee	Average Cost Per Mile
AM Peak	**$2.00 per zone**	**$0.43**
Midday	**$1.00 per zone**	**$0.24**
PM Peak	**$2.00 per zone**	**$0.41**
Night	**$1.00 systemwide**	**$0.10**

Step 5: Calculation of total system revenues

Step 5 involved calculating revenues by time of day, and then determining total daily and annual revenues. The fee was assumed to be in effect 300 days per year. For the remaining days (Sundays and holidays), the model assumed that each vehicle would be charged a flat fee of $1.00 for access to the system and that baseline travel volumes (prior to fee implementation) would be equal to 50 percent of weekday volumes.

Table 4 provides a preliminary estimate for weekday revenues by time of day, average weekday revenues, and total annual revenues.

Table 4. Daily and Annual Estimated System Revenues

Time Period (2006)	Revenue
AM Peak	$1.4 million
Midday	$1.6 million
PM Peak	$1.7 million
Evening	$0.5 million
Total Daily Revenue	**$5.1 million**
Total Annual Revenue	**$1.6 billion**

The TIF system would generate an estimated $5.1 million on an average weekday, with the highest share (33 percent) of daily revenue coming from the PM peak period. By annualizing weekday revenue and adding Sunday revenues (with a $1.00 base fee), we estimate total annual revenue (in current dollars) of $1.6 billion.

To assess the potential return on investment of a TIF program, the stream of future net benefits was discounted to today. Annual TIF revenues were escalated at a rate of 2.5 percent per year. Project costs were likewise escalated at a rate of 2.5 percent. Costs include the following:

- One-time system implementation costs
- Annual operating costs
- Asset depreciation costs incurred at seven-year intervals.

By using a discount rate of 4.0 percent, it was estimated that the NPV of the TIF program would be approximately $24 billion. Detailed explanations of the revenue modeling assumptions and calculations are shown in the appendices.

4.2 Future Direction

Note that this analysis is a broad first-order evaluation based on existing data and is not a substitute for dynamic travel demand modeling efforts calibrated to revealed preference surveys. The figures presented here are initial estimates, consistent with the strategic investigative nature of this study.

To undertake a full analysis of the potential revenue, a comprehensive approach should be undertaken that includes the following activities:

- Construction of a transport model suitable for detailed analysis
- Data collection to support development of such a model
- Surveys to establish local values of time
- Detailed assessment of trip diversion factors, including trip re-timing and mode shift
- Establishment of the future potential network improvements
- Evaluation of future year network conditions
- Development of a detailed sustainable transport fee structure addressing issues such as vehicle classification (e.g., commercial vehicles, high-occupancy vehicles), discounts, and exemptions
- Assessment of secondary economic impacts

- Assessment of social cost changes
- Assessment of environmental costs
- Sensitivity testing around key assumptions.

The PSRC has recently invested in the development of improved methodologies for analyzing the impact of regional tolling projects on traffic and revenue forecasts. The PSRC updated its regional travel demand model for use in the Congestion Relief Analysis Phase 2. The updated model is designed to reflect changes when people travel in response to congestion and pricing. It also incorporates recent research on elasticity of demand to toll prices.

In addition to addressing time of travel, the model also considers changes to travel patterns and travel modes. Regional changes in vehicle miles and vehicle hours of travel can be discerned. The next phase of a more comprehensive conceptual planning effort will involve a more detailed investigation of the behavioral impacts of a regional user fee program via the regional travel demand model. The addition of these updated features will enable the regional model to incorporate the aforementioned activities.

5. ADDRESSING PUGET SOUND REGIONAL TRANSPORTATION INVESTMENT NEEDS

The transportation system in the Puget Sound region is in crisis. Infrastructure owners and service providers face major expenditures for the preservation of an aging asset portfolio. In addition, critical locations in the existing network must be expanded to relieve traffic congestion in what has become one of the nation's most congested regions. The needs for preservation and expansion across all modes of travel far outpace the demands of users and compete for limited financial resources. This chapter summarizes what it will take for the Puget Sound to close its transportation funding deficit and improve the transportation system.

5.1 Transportation Decision Making in the Puget Sound Region

Decision making for transportation in the Puget Sound region involves multiple stakeholders at the local, regional, and state levels. Locally, counties and cities are responsible for maintaining, operating, and expanding their own highway, street, transit, pedestrian, bicycle, and other transport networks. King County, Snohomish County, Pierce County, and the city of Everett provide local and some regionally oriented bus service. Sound Transit provides regional mass transportation (commuter rail, light rail, and express bus), while airports, seaports, and railroads provide other conduits for major movements of freight and people.

The PSRC is responsible for establishing a strategic investment framework through the long-range transportation planning process. Figure 10 summarizes this multi-stakeholder relationship.

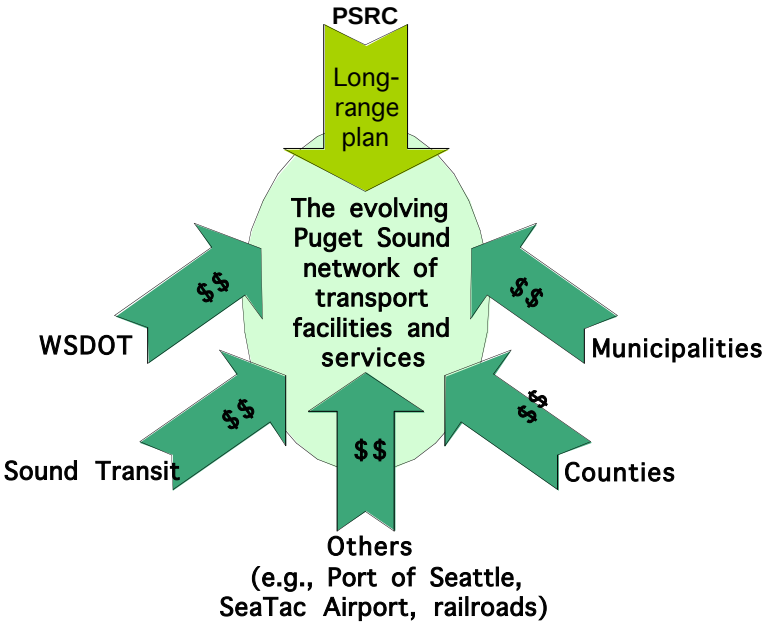

Figure 10. Puget Sound Regional Transportation Agencies

At the state level, WSDOT distributes resources for the maintenance, preservation, operation, and expansion of state-owned highway assets and various other transportation-related needs in the region, including grants to local owners and operators of transportation infrastructure and services. WSDOT also operates one of the nation's most extensive ferry systems.

WSDOT, counties, and cities share responsibility for maintaining and operating the 15,000-mile network of highways, arterials, and local streets, as shown in Figure 11. Although the state owns a disproportionately small share of the lane-miles that make up the road network in the region, it operates all of the interstates and approximately half of the principal arterial routes, while cities and counties oversee most of the minor arterials, collectors, and local roads.

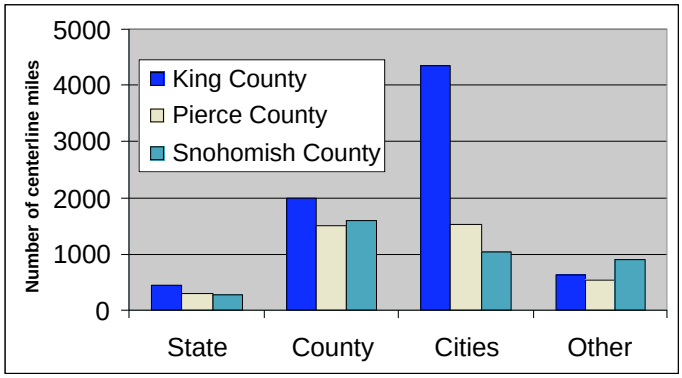

Figure 11. Ownership of Regional Roadway Network

5.2 Regional Investment Needs

Over the past decade, the Puget Sound region has made a substantial capital investment in developing commuter rail, light rail, and express bus service as alternatives to automobile travel. Table 5 summarizes current mass transit services in the region. WSDOT's long-range plan; the Regional Transportation Investment District's Blueprint for Progress; Sound Transit's ST2; and the capital plans and needs estimates of King County, the city of Seattle, and other municipalities indicate a total statewide investment requirement over the next 25 years of approximately $80 billion.

Table 5. Summary of Regional Mass Transit Service Characteristics

Travel Mode	Route-miles served	Fleet size	Number of stations/terminals	Annual ridership (millions)
Bus	4,000	2,000	200	**124.1**
Light Rail	30	3	6	**0.8**
Commuter Rail	200	10	9	**1.0**
Vanpool	n/a	1,750	n/a	**3.0**
Paratransit	n/a	600	n/a	**2.3**
Ferry	n/a	30	20	**24.6**
Monorail	2	8	2	**0.8**
Total	**4,230**	**4,663**	**235**	**155.8**

Of that $80 billion in statewide need, approximately half, or $40 billion, is targeted for the Puget Sound region. Of that, $30 billion ($2007) in investments has been identified over the next 25 years for inside King County alone. The majority of the regional need is to provide for major investments in roadways (approximately $30 billion) and mass transportation (approximately $13 billion), with several billion dollars identified for other needs. This level of investment would address the following:

- Surface Transportation
  - Preservation, rehabilitation, and/or replacement of major roadway and bridge facilities (including projects such as the replacement of the SR 520 floating bridge and Alaskan Way Viaduct)
  - Preservation and maintenance of pavements, bridges, and other roadway-supporting assets such as signs, signals, striping, earthwork, drainage, maintenance facilities, support vehicles, and rest areas
  - Upgrade of existing intersections, interchanges, and arterials to accommodate more free-flowing traffic and adding lanes to existing routes such as I-405
  - Improvement and expansion of the regional HOV network
  - Upgrade and expansion of advanced technologies (intelligent transportation systems) to support roadway operations such as transportation management centers, advanced arterial signal coordination implementation, and weather information systems
  - Basic maintenance and operations of the entire network to ensure safe, efficient levels of service.
- Mass Transit
  - Maintenance upgrade and regular replacement of the region's existing mass transit vehicles, guideways, stations, vessels, and terminals
  - Extension of rail infrastructure and configuration of bus priority lanes to reach new destinations, including major projects under consideration such as southward extensions of commuter rail to Lynnwood, eastward extensions of light rail to Redmond, and northward extensions of light rail to Everett
  - Expansion of vehicle and vessel fleets

  - Upgrade of technology to improve convenience, safety, and security of riders, including implementation of a regionally integrated farecard (One Regional Card for All or "ORCA")
  - Expansion of capacity at park-and-ride and other multimodal transfer facilities.

- Other Modes
  - Maintenance, upgrade, and expansion of pedestrian facilities, including sidewalks and trails
  - Investment in bicycle facilities such as dedicated bikeways and trails
  - Provision of upgrades to facilities and services that will support travel to and from Vancouver when that city hosts the 2010 Winter Olympic Games
  - Support for the development of telecommuting infrastructure through, for example, publicly provided wide-area Wi-Fi
  - Support for local emergency responders and law enforcement where relevant to transportation.

5.3 Regional Investment Principles

Extensive consensus-building efforts will be needed to establish a solid framework for prioritizing and programming capital needs funded through TIF program revenues. Some principles to consider for revenue expenditure include the following:

- Maintenance and preservation of the highway network on which user fees are charged should be one of the highest priorities. The revenue estimates presented in this report account for the capital and operations costs of maintaining the fee charging system but do not reflect the other, basic needs of the infrastructure, including such investment areas as resurfacing, striping, rehabilitation, technology maintenance and upgrades, and safety. Users paying for a service will demand high quality of service, and the credibility of the user-pay system will be enhanced by appropriate investments in a quality network of charged highway facilities.
- Many of the trips deflected from the network after implementation of the user fee will utilize alternative modes of travel, including local and express buses, light and regional rail, and non-motorized transport (e.g., walking and biking).

Consequently, regional mass transit and non-motorized facilities will require additional investments. These additional investments should focus on maintaining the comfort and convenience of transit services while expanding the capacity and extent of transit networks to reach new riders.

- Other deflected trips will utilize alternative auto travel routes. Utilization of the arterial network will increase, leading to additional investment requirements for the maintenance and operation of secondary facilities. Maintaining the local, collector, and arterial networks is essential. In addition, updating operations of those networks will become priorities for highly traveled arterial corridors in a post-fee environment. Regularly updated signal timing schemes, for instance, will play an important role in ensuring the efficient utilization of the non-highway network.

- Other priorities that maintain the integrity and improve the efficiency of the regional transportation system can also be addressed by investing the revenues generated by system users.

These principles should be considered, along with other regional priorities, to develop a credible and systematic investment plan.

6. RECOMMENDED WAY FORWARD

Internationally, several cities have pursued transportation management strategies similar to the one outlined in this report. Although a number of North American cities are exploring similar options to provide congestion relief and enhanced revenues through user fees, none has implemented a regionally scaled system. Prior to implementation of any system, however, Puget Sound's regional leaders must study alternative user fee program designs in detail, refine cost and revenue estimates, and agree to a regional governance structure and revenue distribution strategy. Overarching these steps is the need for a communications plan that explains the complete package of user fee-based travel in order to increase support from the public, regional agencies, and other stakeholder organizations.

6.1 Detailed Study of User Fee Programs and Governance

The fee scheme developed for this study is emblematic of various system designs that could be deployed in the Puget Sound region. Although relatively detailed assumptions were made, the purpose of these assumptions was to support estimation of costs and revenues, rather than to suggest a particular user fee configuration. Consequently, future efforts to develop a user fee scheme must begin with a more detailed study for Puget Sound. A more detailed study would accomplish the following:

- Examine conditions in the Puget Sound region, including existing temporal and spatial congestion profiles, existing network configuration, future growth projections, and future network expansion plans
- Examine the suitability of various corridors and facilities for inclusion in or exclusion from the user fee scheme based on the geometric configuration of the infrastructure; proximity to other portions of the network under consideration; and existing traffic flows, land uses, and projected growth rates of population, employment, and traffic
- Conduct focused stated-preference surveys to better capture price points and user behavior responses to pricing

- Model the effects of various user fee schemes on traffic flows to refine the fees to be charged and ensure the fee rates can appropriately affect traffic levels in localized corridors and network segments
- Estimate the impacts of travel pattern changes on the greater network, including mode shifts, travel time shifts, and route changes
- Outline the specific components of the fee charging scheme needed for implementation, and refine the cost estimates presented here
- On the basis of modeling results and cost findings, design and refine a complete system, including fee rates by location, distance, and time of day
- Identify and select technologies to be used and plan the procurement and installation methods for the system
- Based on the system design, refine the revenue estimates presented here.

In addition to studying the technical elements of the system as outlined above, the region must explore the regional governance framework for implementing and operating the user fee program. Several proposals are currently being explored, and TIF governance should also be considered. Because the user fee would be a regional program, spanning municipalities and counties, it would require regional cooperation from its inception. In particular, the regional governance plan should provide mechanisms by which a regional authority could implement the fee program; manage the scheme by updating the technologies, fee structures, and network coverage over time; and distribute revenues generated by the system to various transportation needs within the region.

A major lesson learned from international experience is that the TIF program must be transparent to the public. The collection and allocation of funds requires an annual third-party audit to show the efficiency and effects of the user fees. The fund, once established, would need to be "ring fenced" or dedicated only for transport, with maintenance and upkeep of all infrastructure a priority. Improvement projects would need to be individually approved on the basis of an objective measure, such as a benefit-cost criterion. Likewise, the governing body would need to be held responsible for managing the fund in accordance with the guidelines for transparency and objectivity in allocation of its projects. Lastly, a project audit or asset management plan would need to be established to ensure that both old and new projects delivered the benefits promised. Funding transparency, dedication, objectivity, and asset management would be key pillars to support the implementation of a regional governance organization.

6.2 Develop a Regional Transportation Investment Plan

Regardless of the particular user fee scheme and governance plan chosen, net revenues would be substantial. Under the system design assumptions presented in this study, for example, a mid-range estimate of annual net revenues is roughly $1.6 billion, with a 20-year net total revenue of over $24 billion (NPV). However the region decides to manage the scheme, the use of revenues should be guided by principles that the region collectively determines before implementation.

Chapter 5 presented a summary of the types of projects for which revenues could be made available, given existing needs identified by Puget Sound regional stakeholders. These needs include investment in the preservation and expansion of roadway infrastructure, transit services, non-motorized modes, technology, emergency management, and the environment. The revenue generated by a user fee could cover a large portion of the region's transportation investment deficit.

6.3 Resources Available to Support User Fee Strategies in Puget Sound

The U.S. DOT's Urban Partnership (UP) Program allows for selection of up to five urban areas nationwide as preferred recipients of federal grants to demonstrate regional user fee systems. Approximately $135 million in grant funds are available, which would be more than sufficient to cover implementation of the regionally scaled user fee system described in this report.

The UP program requires the submission of a grant request by the end of April 2007. This is a tight timeframe, but on the basis of this study, a UP grant could be submitted to secure a portion of the funding necessary to offset the cost of further study and implementation of a pilot scheme. A grant submission would provide the region with an opportunity to test and benefit from the TIF concept while postponing a final vote on the concept until after people have been given the opportunity to see and better understand the benefits of such a project firsthand.

APPENDICES

Appendix A: Worldwide Experience with Road Pricing Mechanisms

Appendix B: Bank Payments in Transportation

Appendix C: Open System Concept Design Details (Option 2)

The appendices have been removed from this copy to reduce the size of the report.

Full copies of the report can be obtained from the Washington State Transportation Center at the following URL:

http://depts.washington.edu/trac/pdf/RegionalTolling.pdf