Appendix I

Economic Impacts of Proposed Service

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steer davies gleave

Economic Impacts of Proposed POF Services for Kitsap Transit

Draft Report
September 2014

KPFF Consulting Engineers

Our ref: 22691101
Client ref: 114144

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1 Introduction

Expanding a public transportation system can be expected to affect travel behavior and influence businesses that place importance on accessibility. The resultant ridership will reflect the fact that the service has increased accessibility over the existing base of transportation. These direct user benefits are not the only impacts, and we could expect that the accessibility benefits provided by a new or even an expanded transit service could have more far-reaching indirect impacts.

One effect that has been studied extensively is the impact of transit accessibility as reflected in higher real estate values near stations or major stops. For residential real estate, the simple fact that households living near transit stations can often enjoy faster and more convenient travel is a real benefit that has been found to increase home prices.

Another effect of transit accessibility is on productivity. Improving accessibility provides workers with a greater choice of potential employers, and employers can draw on a wider pool of potential workers. This can be expected to lead better meet the needs of both parties, and also allows for other labor market benefits such as increased worker specialization as well as various productivity benefits from agglomeration, the co-location of similar businesses.

These two major benefits can be described as real estate benefits and wider economic benefits, respectively. A third, and somewhat distinct, benefit of transit expansion is the potential for increased system redundancy. This can be a considerable benefit of increased service in emergencies, for example: New York City's ferry system has, in the last 14 years, played a crucial role during the attacks of September 11, 2001, as well as following the devastation of Hurricane Sandy.

In the current report we assess the potential economic impacts of three proposed passenger-only ferry (POF) services between Kitsap County and Seattle:

- **Bremerton to Seattle:** A proposed service will utilize a high speed vessel that produces little wake, enabling it to operate at high speeds without harming the coastline and complete the crossing in less than half the sailing time of current ferry service
- **Kingston to Seattle:** A proposed route to downtown Seattle will have a crossing time of 33 minutes
- **Southworth to Seattle:** A proposed route to downtown Seattle will have a crossing time of 23 minutes

What could be the economic benefits of these proposed POFs? As a first step in answering this question the current Report summarizes various findings from the fields of regional economics and transportation planning.

2 Literature Review

2.1 Real Estate Benefits

In addition to traditional user benefits such as travel time savings, public transportation can also bring real estate benefits to the communities it provides access to. As these benefits are localized in nature, they are predictably capitalized into real estate values. A number of studies have consistently shown evidence of this capitalization effect with respect to residential and commercial real estate values. While there is extensive research on the impact of the most prevalent modes of public transportation, such as fixed rail, on real estate outcomes, there are very few studies that have examined the impact of ferry services. A recent study by Steer Davies Gleave and Econsult Corporation (2013) estimated the real estate impact of the East River Ferry service in New York City. The study found:

- Residential property values within 1/8 mile of the closest ferry stop increased by 8.0%
- For all residential properties within one mile of a ferry stop, the ferry service increased total property values by $0.5 billion
- Higher real estate values also coincided with an increase in new residential and commercial building space of over 600,000 square feet, a 4.9% increase of space within 1/4 mile. This includes:
  - An increase in the nearby supply of residential housing by 487,238 square feet, or over 7%; and
  - An increase in the supply of retail space within 1/4 mile by over 20,000 square feet, or 4.2%.

This recent work is apparently the only empirical analysis of real estate benefits attributable to passenger ferry service, and is therefore of particular relevance to the proposed POF services in Kitsap County. A considerable number of other studies exist, with the focus being other transit modes. These studies focusing on other public transportation modes can also provide guidance on the general approach and magnitude of impacts associated with ferries, due to commonalities across public transportation impact studies.

2.2 Case Studies Using Hedonic Methods

A large number of studies have used hedonic modeling to estimate the impacts of public transportation on real estate (see the Appendix). Hedonic models relate the price paid for a good (such as housing) to it's an explicit listing of characteristics. For real estate this would mean that a property's characteristics would be accounted for in explaining its price (location, square footage, number of rooms, etc.) The characteristics then explain the value of property as a whole, and this modeling approach enables the user to separate out the effects of housing characteristics from the impact of location. Voith (1991) studied the 678 census tracts in five counties in Pennsylvania and New Jersey with radial rail service to the CBD of Philadelphia in 1980. The study showed though hedonic analysis that suburban areas with good commuter rail access to the CBD have significantly greater fractions of their labor force working in the CBD, owning fewer cars and having higher house prices than similar neighborhoods and housing in census tracks without transit services. Specifically, the study found a house-value premium of over 6.4% ($5,594, out of the 1980 median house value of $87,455), implying the increase in suburban housing value associated with transit service was about $1.45 billion. Voith (1993) then conducted another hedonic analysis and estimated house-price premiums associated with CBD accessibility in the case of

Montgomery County near the city of Philadelphia. He found premiums of 8.1% on the average housing sales price. A more recent study by Voith (2014) showed the single family property value premium for being close to a Region Rail station in Southeastern Pennsylvania rose up to 10% and with an aggregated value of $6.0 billion.

Lewis-Workman and Brod (1997) analyzed and compared the transit impact within one mile from selected station areas in three transit systems around the U.S.: BART in the San Francisco Bay Area, MTA in New York City, and MAX light rail in Portland. In general, they concluded that transit access increased assessed property values as long as properties are within one mile but more than 2,000 feet from the major roadway and transit line. In particular, they observed that property values increase by approximately $15.78 and $23 for every foot closer to the transit stations in San Francisco and New York respectively. In Portland, the property values increase dropped to $0.76 for every foot closer to light rail within the range of 2,500 to 5,280 feet to transit station. The premium for an average single family home was over $23,000 (9%) in San Francisco and $37,000 (13%) in New York, but is much lower in Portland. This is likely the result of lower performance service in Portland and the lower property values in the Portland region compared with San Francisco and New York City. This interpretation could be validated by a study in Buffalo, New York that the estimated property value increase in every foot closer to a light rail station was $0.99 (Hess and Almeida, 2007). Therefore, a general conclusion is the price premium may well be much higher in a metro area with a strong housing market and a reliable transit system that effectively connects residents with jobs and other destinations.

In a detailed study of light, heavy, and commuter rail transit, and bus rapid transit (BRT) in Los Angeles County, Cervero and Duncan (2002a) separately analyzed the impact of those transit systems on single-family housing, multi-family housing, condominiums, and commercial property in 2000. They found that single family homes within a half-mile radius of the Blue Line, a light rail line run by Los Angeles Metro, commanded a 3.4% premium. Somewhat inconsistent results were found for another light rail line in Los Angeles, the Green Line, where the authors found a 1.8% reduction in real estate values for properties accessible to the service. Similar inconsistent impacts were also found for multi-family housing and condominiums. According to this study, the greatest discount occurred around the BRT lines, which authors theorized as due to other factors associated with BRT stops, such as being near a freeway.

Cervero and Duncan (2002b) replicated the L.A. study in San Diego County and found that residential properties within a 0.5 mile radius of the LRT stations commanded positive price premiums. Specifically, multi-family homes and condominiums near the LRT East Line commanded a 17.3% premium (equivalent to a value-added of $104,827) and a 6.4% premium (equivalent to a value-added of $11,917), respectively. However, the San Diego LRT was found to have very little positive impact on single-family homes, with only the South Line associated with a price premium of 0.6%.

Real estate premiums associated with commuter rail were significant, however: Single-family homes within a half mile of a non-downtown commuter rail station exhibited a price premium of around 17% compared to similar properties that were not accessible to the service, and condominiums within proximity to commuter rail stations were associated with an even higher, 46% premium.

Interestingly, price impacts did not apply to multi-family housing, as distinct from single-family or condominium-type dwellings. According to these findings, the impact from transit on housing value may vary based on both the types of transit (e.g., LRT and commuter rails) and the types of housing (single-family housing, multi-family housing or condominiums, all distinct categories in the Cervero and Duncan analysis).

Cervero and Duncan (2002c) conducted another study to analyze the effect of LRT proximity to residential (including rental properties and condominiums) sale prices in Santa Clara County. Parcels within a 0.25-mile of the stations commanded a $9 per square foot premium, which translated to a 45% premium on average.

Similar property value premiums were observed in London as well. Gibbons and Machin analyzed properties within a 3 km radius of the the Jubilee Line Extension and Docklands Light Railway during a study period from 1997 to 2001. Here housing price increased by 9.3% within 2 km of the train stations and a 1 km reduction in distance in the study area was associated with price premia of 1.5% to 8.9% on average (Gibbons and Machin, 2004).

Focusing on nonresidential values, Weinberger (2001) studied the relationship between commercial office rental and sales prices and proximity to LRT in Santa Clara County, CA. Using lease transaction data from 1984 to 2000, she showed that the highest premium for properties took place within 0.25 miles of the LRT stations. Beyond the 0.5-mile boundary (which is roughly an upper limit on a comfortable walking distance), she found no statistical relationship between the distance from transit stations and the prices associated with those properties.

Cervero and Duncan (2002d) conducted a similar study in Santa Clara and found that within a 0.25 mile radius of LRT station, commercial properties commanded an average price premium of about 23% and more than 120% for commercial land in business districts within a 0.25-mile of a commuter rail station. In Los Angeles, the premiums for commercial properties were 91% for parcels near downtown commuter rail stations and 72% for parcels near LRT stations (Cervero and Duncan, 2002a).

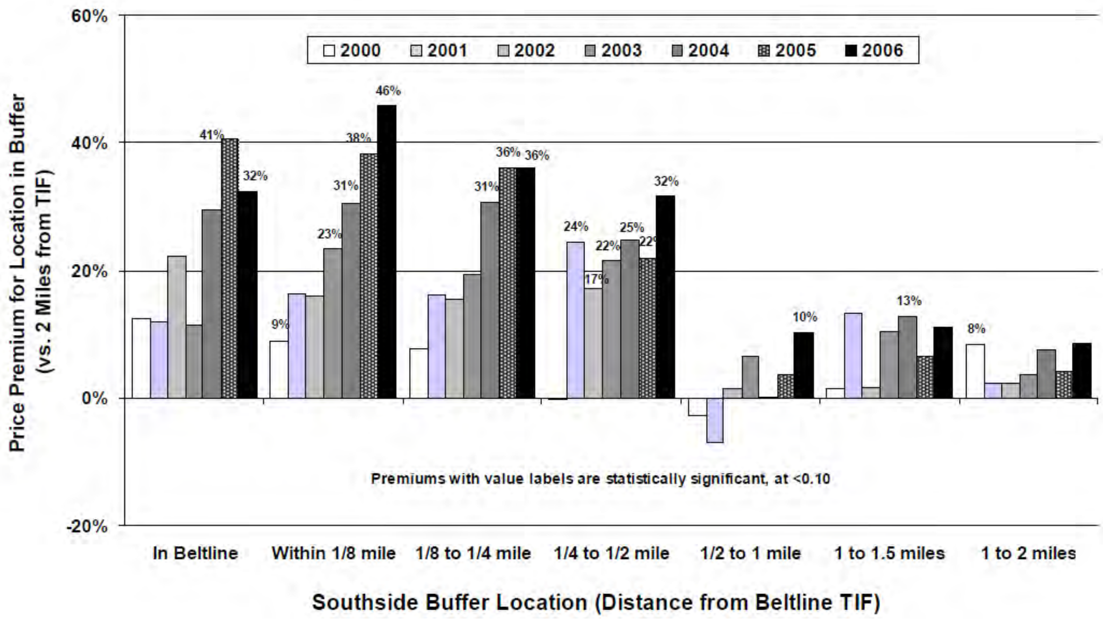
2.3 Case Studies Comparing "Before and After"

In addition to hedonic price models, there is another method to assess real estate price changes after public transportation service was added or expanded. This "before and after" methodology requires data over a long period of time but can be very informative for areas considering transit service expansion. Some before-and-after studies and their findings are summarized below.

Atlanta's Beltline project involves the redevelopment of a 22-mile freight rail line into a light rail system encircling the city, linking a system of planned mixed-use projects and green spaces. Immergluck (2009) found that:

- Between 2002 and 2005, as project plans began to take shape and media attention increased, single-family homes within one-quarter mile of the planned loop sold at a 15% to 30% premium compared to similar properties located more than two miles away.
- The impact fell sharply after approximately a quarter mile.
- Price premiums extended one-half mile from the project before falling off.
- The impacts of the Beltline on nearby property values occurred primarily in lower-value and lower-income buffer areas, which are located primarily on the city's Southside.

Figure 1: Southside price premium for being located near the Beltline, compared to being more than 2 miles, 2000-2006



Source: Immergluck, 2009

Goetz et. al. (2010) analyzed home sale price before and after the completion of the $715 million Hiawatha Light Rail Line running between downtown Minneapolis and the Mall of America in Bloomington in 2004, finding that:

- Locations closer to the LRT stations are associated with higher property values, an effect that extends beyond a half-mile
- Significant value gradients extended outward from the stations, roughly $115 per foot
- Development of the Hiawatha Light Rail Line has produced an average 4% ($5,229) price premium per single family home and 10% ($15,755) per multifamily property in the station areas
- The aggregate increase in property value for single family and multifamily properties that have sold between 2004 and 2007 were $18.3 million and $6.9 million respectively
- Applied to all homes in the station areas, the Hiawatha Line has produced an aggregate premium of $47.1 million
- The property-value premiums were not observed on the east side of the Hiawatha Line due to a four-lane highway on the east side of the Hiawatha Line and a strip of industrial land use immediately adjacent to the highway on the east, which created a barrier between the residential properties on the east and the Hiawatha Line
- There is also a negative, nuisance effect (of a smaller magnitude) for properties that are very close to the LRT tracks
- 67 residential properties were constructed within 300 feet of the light rail tracks after funding for the Hiawatha project was announced in 1997
- Building permit along the neighborhood corridor accounted for 6% of aggregate residential value at the quarter mile scale, suggesting that station areas saw larger-scale building activity than the comparison area for the 2000-2007 period

As can be seen from previous research results, although it is widely agreed that proximity to public transportation does lead to higher home values in most cases, researchers found varying magnitudes of the impacts. A summary of the literature on public transportation impacts from Fogarty et. al. (2008) reports a range of impacts for single-family homes from 2% to 32%, and 2% to 18% for condominiums. Cervero et. Al. (2004) came with a range of average housing value premium from 6% to 45% across the U.S.[1] In addition, the meta-analysis of Debrezion et. al (2007) showed that the effects varied by type of railway station. Table 1 shows the average estimated impact from the sampled studies on real estate prices within a quarter mile of each station. The impacts range from a low of 1.7% for bus rapid transit (BRT) to a high of 18.7% for commuter rail transit (CRT).

Table 1: Average Price Impact of Transit Stations by Type

Station type	Average Impact
Light Rail Transit	7.1%
Heavy Rail Transit	2.1%
Commuter Rail Transit	18.7%
Bus Rapid Transit	1.7%

Source: Debrezion et al, 2007

2.4 Conclusions: Real Estate Benefits

In general, several conclusions can be drawn from the literature:

- The property value impacts of public transportation typically range from the single digit percentages to the mid-teens
- The most significant housing price premium takes place within 0.25 to 0.5-miles of a station
- The impact of transit on housing often falls off after half a mile from stations
- A discount might happen to properties that are too close to the station due to negative externalities from the station (noise, pollution, traffic etc.)
- The price premium may be much higher than average in a metro area with a strong housing market and a reliable transit system that effectively connects residents with jobs and other destinations
- The price premium or discount varies by type of transit, especially for those that might have other factors associated with them (e.g., alignment of rail/bus line might be very close to freeway)
- The most common empirical approach taken in the literature is the use of hedonic regression that measures the log of property sale prices as a function of building and neighborhood characteristics and a measure of transit access

It is of interest to note that a relationship has been observed in a number of real estate benefit studies and the actual user benefits (in particular travel time savings) that the transit services provide. In particular, relating the potential travel time savings per household to the housing premium generates the following formula:

[1] Studies over the past two decades show average housing value premiums associated with being near a station (usually expressed as being within 1⁄4 to 1⁄2 mile of a station) are 6.4% in Philadelphia, 6.7% in Boston, 10.6% in Portland, 17% in San Diego, 20% in Chicago, 24% in Dallas, and 45% in Santa Clara County.

$$Real\ Estate\ Premium = \frac{Annual\ Travel\ Time\ Savings}{Discount\ Rate}$$

The discount rate in empirical studies has been found to be in the range of 9% to 15% (Appleseed and Louis Berger Group (2005)). This suggests that knowledge of the potential travel time savings for a proposed transit service could be the basis for a “back of the envelope” estimate of real estate price increases within proximity to a station.

2.5 Wider Economic Benefits

Wider economic benefits (WEBs) refer to productivity effects of accessibility improvements. It is widely accepted that transit investments can bring about improved productivity as a result of easier interactions between firms, higher-density employment clusters, and more accessible labor forces. Such clustering activity may provide increased efficiency through reduced labor cost, improved communication, lower infrastructure costs, and increased interaction with similar businesses. Clustering provides an opportunity for more face-to-face contact and access to specialized labor, which result in higher productivity and economic growth. This effect is known as agglomeration. Until recently there was limited empirical research on the level of linkage and statistical relationships between accessibility and the resulting productivity improvements. There has been a growing body of research that has produced guidance material from the National Academy of Sciences as well as the UK Department for Transport (DfT) on how to evaluate and estimate WEBs.

The methods used to assess public transportation impacts on agglomeration economies concentrate on statistical analysis, using regression techniques. These techniques relate measures of the effective labor or customer market size to measures of business concentration, output level or productivity measures. The effective market size is often measured as the population living within a given travel time (e.g., 45 minutes) of a given business center location.

A variety of studies in the United Kingdom have determined measures of the agglomeration effects. The UK Department for Transport estimated wider economic benefits of Crossrail, the commuter rail in London, as shown in

Table 2. They listed the economic welfare benefits from conventional appraisal and the estimated wider economic benefits. The right-hand column also identifies the associated GDP effects.

Table 2: Summary of Crossrail's welfare and GDP impacts (Net Present Value, discounted over 60 years)

Benefits	Welfare(£m)	GDP (£m)
Business time savings	4,847	4,847
Commuting time savings	4,152	
Leisure time savings	3,833	
Total transport user benefits -- conventional appraisal	**12,832**	
Increase in labor force participation		872
Move to more productive jobs		10,772
Agglomeration benefits	3,094	3,094
Reduced Imperfect competition	485	485
Exchequer (or tax) consequences of increased GDP	3,580	
Additional to conventional appraisal	**7,159**	
Total (excluding financing, social and environmental costs and benefits)	**19,991**	**20,069**

The Crossrail results compare conventional user benefits (in this case, travel time savings) to other benefits identified in the research. These include agglomeration benefits due to a denser work environment and increased interactions between firms and workers. They also include labor market benefits from workers being able to access different employment opportunities better suited to their skill set (defined as moves to more productive jobs) as we as a reduction in monopoly power for certain firms due to increased access by buyers to other sellers (reduced imperfect competition). As shown in

Table 2 these benefits, at least in the case of the Crossrail analysis, are of similar magnitude to the standard direct time savings benefits that are the main component of cost-benefit analysis.

The National Academy of Sciences (NAS) research found there to be strong statistical associations between transit capacity and two measures of agglomeration: employment density and total population, as well as relationships between those measures and wages and GDP. Large metropolitan areas exhibited stronger associations. However, there is likely a significant time lag between the transportation investments and the benefits realized, and it is not recommended to compare these benefits directly with the values of travel time and/or cost savings. Additional case studies of transit improvements in the Dallas-Fort Worth, Salt Lake City and Los Angeles areas did not find significant evidence of agglomeration that could be attributed to those improvements.

Besides NAS's research, a wide range of local economic impact studies have estimated the regional economic impact of various alternative public transportation investment scenarios. These studies relied on regional economic models to estimate the impacts of public transportation enhancements on travel times and costs, workforce access and/or business market agglomeration. In doing so, they have demonstrated the substantial magnitude of impacts that public transportation investment can have on regional economies. Examples of these local studies and their findings include the following:

Chicago, IL
Regional Transportation Authority (RTA and Metra) (EDR Group, 2007)

- Estimation made under the scenario of investing to maintain system ($1.68 billion cost) relative to disinvestment scenario
- 11,400 jobs, $2.0 billion in net annual business output and household cost savings gain as of 2020
- If investing to expend system ($2.40 billion cost) relative to disinvestment scenario
- 16,900 jobs, $3.2 billion in net annual business output and household cost savings gain as of 2020

Atlanta, GA
Metropolitan Atlanta Rapid Transit Authority (MARTA) (University of Georgia, 2007)

- Estimation made under the scenario of MARTA continue operation ($660 million/year) relative to cease operations
- 31,700 jobs will be created by 2021 (12,000 additional jobs since 2011)
- $4.8 billion worth of Atlanta's total sales ($2.8 billion increase since 2001)
- $109 per Atlanta-area resident on real disposable personal income per year by 2021

Capitol Region, CT
Regional Transit Strategy (RTS) (University of Connecticut, 2001)

- Estimation made under the scenario of the High Capital development ($400 million capital cost and $16.45 million annual operating and maintenance cost) relative to no-build scenario
- Population will increase by an average of 1,100 each year
- 633 jobs will be created average per year
- $415 million personal income increase over 25 years ($36 million annually)
- $333 million disposable income increase over 25 years ($29 million annually)
- $726 million gross state product increase over 25 years ($69 million annually)
- $23 million local tax revenue gain over 25 years ($2.5 million annually)

Oakland, CA

Alameda-Contra Costa Transit District (AC Transit) (Crain, 1999)

- Estimation made under the scenario of reduction in service 1,000 weekday platform equivalent hours ($4.8m) relative to continued service
- 7.4% of the riders lost $2.2 million in job income as a result of the cuts, and 4.2% were continuing to lose income one year later, amounting to an additional $8.5 million a year
- $48.1 million total annual costs to the community from the service reductions

Los Angeles, CA

Los Angeles County Metropolitan Transportation Authority (LACMTA)

(Cambridge Systematics and EDR Group, 1999)

- Estimation made under the scenario of system investment with rail/bus improvements ($24 billion capital cost and $50 billion operating cost over 20 years) relative to no investment scenario
- 131,200-261,700 jobs will be created as of 20^{th} year, 2020
- $9-16 billion in personal income gain as of 2020

New York City, NY

Metropolitan Transportation Authority (MTA) (Cambridge Systematics and EDR Group, 1997)

- Estimation made under the scenario of a 50% reduction in spending for capital needs relative to system investment needed to maintain service
- 319,800 loss in jobs as of 20^{th} year, 2016
- $18.9 billion loss in business sales as of 20^{th} year, 2016

Philadelphia, PA

Southeastern Pennsylvania Transportation Authority (SEPTA)

(Urban Institute and Cambridge Systematics, 1991)

- Estimation made under the scenario of immediate shutdown of rail transit relative to funding to continue operation
- 175,000 loss in employment as of 2010
- $10.1 billion loss in annual personal income as of 2010
- $16.3 billion loss in annual business sales as of 2010
- $632 million loss in combined state and local revenues as of 2010

At a national level, a recent study by American Public Transportation Association (APTA, 2014) estimated the economic impact over the next 20 years under the scenario of investing an additional $13 billion per year in public transportation, and increasing the ridership growth from 2.4 percent to 3.5 percent per year. The estimated long-term economic impacts on income and productivity nationwide are shown in Table 3.

Table 3: Estimate of Scenario Impacts on the Economy, 2030 (effect of investing $13 billion per year)

Form of impact	Annual Magnitude of Change after 20 years (in 2012 $)
Household: Disposable Income	**+$18.4 billion**
from cost savings to public transportation passengers	*(+$6.8 billion)*
from savings in auto user operating cost	*(+$6.2 billion)*
from savings in auto ownership costs	*(+$5.4 billion)*

Form of impact	Annual Magnitude of Change after 20 years (in 2012 $)
Business: Productivity	**+$10.1 billion**
from labor market access enhancement	*(+$5.0 billion)*
from auto/truck operating cost reduction	*(+$5.1 billion)*
Tax impacts	**+$4.4 billion**
from federal tax revenue	*(+$3.3 billion)*
from state and local tax revenue	*(+$1.1 billion)*
Economic impact	
Total household and business impact	**+$28.5 billion**
Equivalent job benefit	**410,820**

2.6 Conclusions: Wider Economic Benefits (WEBs)

Conclusions drawn from the literature include:

- Public transportation increases the accessibility of a region and generates various WEBs, mostly as a result of productivity improvements
- The typical study period is 20 years since there is significant time lag between the transportation investments and the benefits realized
- WEBs include employment gains, ranging from a few hundred to tens of thousands per year
- Findings also relate public transportation investments to local economic growth, primarily as a consequence of a more productive workforce

A conservative assumption derived from observed relationships suggests that WEBs could be on the order of magnitude of 25% to 50% of traditional user benefits. Such a simplified formula could be useful as estimating WEBs prior to a project coming on line is uncertain since research following project completions shows a wide range in estimates. User benefits, on the other hand, are rooted in relationships between transportation capacity, levels of service and travel time – relationships that are better understood than relationships between capacity and WEBs. Therefore a conservative relationship between user benefits and WEBs would arguably be helpful in assessing WEBs one could anticipate from a planned investment.

2.7 System Redundancy

Passenger ferry service such as the proposed POF offers potential for system redundancy. In particular, the proposed POF would supplement not only existing ferry services operated by Washington State Ferries but also other transit and even auto commutation. In its analysis for *Kitsap Transit Passenger-Only Ferry Business Plan and Long Range Strategy,* Steer Davies Gleave (2014) identified the various existing route options between Bremerton, Kingston, Southworth and Seattle. For all three proposed routes it is clear that the POF service would add depth to the current transportation system and increase travel options in cases of emergencies.

The benefit of redundancy provided by passenger ferries has been shown to be of incalculable value in the case of New York City's transportation system: During the terrorist attacks of September 11, 2001, the Northeast blackout of August 14, 2003, or the emergency Hudson River landing of US Airways Flight 1549 on January 15, 2009, passenger ferries played an essential role in providing emergency assistance. More recently, following Hurricane Sandy and its devastation of parts of the transit system, passenger ferry services to Staten Island and parts of the Brooklyn waterfront provided temporary transit access for thousands of affected commuters.

The potential value of ferry service in terms of system redundancy or emergency preparedness is difficult to quantify as events such as those mentioned previously are rare and essentially impossible to predict with any accuracy. However, any increase in the density of the regional passenger ferry fleet and service network will provide a greater the potential ability to respond to emergency situations.

2.8 Transit System Benefits

Several recent passenger ferry studies have proposed another economic benefit of passenger ferry services, namely benefits to existing transit services (Halcrow (2010) and Steer Davies Gleave (2013)). In particular, passenger ferries may play a positive role as providing feeder service to existing transit services, reducing overall trip costs and increasing demand on the remainder of the transit network.

Alternatively, in addition to connecting new riders to other transit systems, ferries can also divert ridership from other transit lines. If the alternative transit lines, or the stations that serve them, are overcrowded, then ferries create a benefit by easing peak load on the alternative services.

In a recent study of passenger ferries in the New York City region, it was found that reducing crowding on the Port Authority Trans Hudson (PATH) service was the major external benefit attributable to cross-Hudson ferry services (Halcrow (2010)). More recently, analysis of New York City's East River Ferry Service revealed that the ferries had reduced crowding at several subway stations by a measurable amount.

Quantifying such transit system benefits in the case of the POF services is beyond the scope of the present analysis. One area where peak period crowding would be reduced is, of course, the Washington State Ferry service from Bremerton to Seattle. Whether the proposed services would generate significant peak load easing is of interest, however, and worthy of further investigation.

3 Estimate of User Benefits from the POF

While real estate impacts and WEBs are really indirect effects of a new service such as the POF, there is a direct impact to the users of the POF. User benefits include:

- Travel time savings to users who opt to take the POF
- Safety benefits to users who opt to take the POF
- Benefits of increased accessibility for users who opt to remain on an existing transit service or roadways

As outlined in a recent ridership analysis of the POF (Steer Davies Gleave (2014)[2]), the estimated ridership for the POF comes primarily from existing ferry or rail service, which suggests that there will not be a significant increase in safety from transferring users from autos to (safer) passenger ferries. Given this fact, the analysis of POF user benefits focuses primarily on travel time and accessibility benefits for POF users and those remaining on alternative modes or services.

3.1 Approach to Estimating User Benefits

User benefits are most frequently estimated in the context of a cost-benefit analysis (CBA) but are increasingly used as a measure of a transportation project's economic value. For travel time savings, one approach used is to measure the travel time gains from a transport project such as the POF, estimate the number of users, and attribute a value of time (VOT) to these time savings.

Another approach, and one which is increasingly used, is to rely on a mode choice model to estimate the *willingness to pay* of users for the new service[3]. This approach has several advantages: It ensures that user benefits are consistent with the assumptions contained in the ridership forecasts in terms of service characteristics and their attractiveness relative to competing modes. The other advantage is that calculating user benefits from the mode choice models is fairly easy, requiring little additional modeling work that completed for a ridership analysis.

The disadvantage of the approach is that there may not be a mode choice model available, as this pre-supposes a fairly sophisticated ridership analysis. In the case of the POF, however, a mode choice model was developed for the three proposed routes, and the models were used to develop estimates of user benefits.

The mode choice models are described in Steer Davies Gleave (2014). The basic premise of these models is that they predict a service's share based on its price and characteristics (fare, travel time, frequency, and access time) relative to the other options. For each option a *travel utility* experienced by users is

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[2] Steer Davies Gleave, 2014. Economic Impacts of Proposed POF Services for Kitsap Transit. *Report Submitted to KPFF Consulting Engineers.*

[3] For details, see Small, K A and H S Rosen, 1981. "Applied Welfare Economics with Discrete Choice Models". *Econometrica*, Vol. 49 No. 1 , pp. 105-130.

calculated, and this travel utility can be easily converted into a monetary amount. This monetary value has been shown to be a very good estimate of the user benefits derived from the mode for users[4].

3.2 Findings

3.2.1 User Benefits for Bremerton to Seattle

In Steer Davies Gleave (2014) ridership estimates for the proposed POF included service assumptions of 28 minutes sail time, $11 round trip cost and, in one service scenario, 6 round trips per day. How the POF compares to the existing options (the existing Washington State Ferry and another transit option using a ferry from Southworth and auto or transit) is detailed in Table 4. Resulting ridership estimates for the POF under these service assumptions are detailed in Table 5.

Table 4: Bremerton – Seattle Alternative Routes Level of Services

Alternative Routes LOS	Proposed POF Service	Existing WSF Bremerton Ferry	Existing Southworth Ferry + Auto/Transit
Travel time	28 minute crossing	60 minute crossing	70 minute travel time (drive time + crossing)
Round trip cost	$11	$8	$19.85
Frequency	6 round trips/day	15 round trips/day	24 round trips/day

Table 5: Bremerton – Seattle Ridership Estimates

Scenario	Total Market Demand 2013	Annual POF Ridership	Annual Revenue ($2014)
6 Round trips/day	1.37M	212,544	$1.2M

Applying the same mode choice model to calculate the change in user benefits for users (both those opting for the POF and not choosing it) yields **an annual estimate of $3.2 million in user benefits**, with most of the utility change coming from the users opting for the service. This means that the 212,544 estimated annual trips generate $15.30 in user benefits per trip[5].

[4] As shown in Small and Rosen (1981, op. cit.) the mode choice model calculates both the benefits to users opting for the service as well as the other users who opt not to use the service. The users not using the service also have a higher utility as their travel choices have increased, irrespective of whether or not they actually choose to avail themselves of the new service.

[5] We would expect that the user benefits would be at least as great as the ticket price, as a user has to derive at least as much utility (in monetary terms) as the monetary cost of the service. At $11 round trip cost, this means a $5.50 trip fare is well below the $15.27 estimate in user benefits.

3.2.2 User Benefits for Kingston to Seattle

The proposed Kingston to Seattle POF is detailed in

Table 6, including its various existing service alternatives, and the ridership estimates in Table 7.

Table 6: Kingston – Seattle Alternative Routes Level of Services

Alternative Routes LOS	Proposed POF Service	Existing WSF Vehicle Ferry King - Edmonds + Drive to Sea	Existing WSF Vehicle Ferry King - Edmonds + Transit to Sea	Drive + Existing WSF Vehicle Ferry Bainbridge - Sea
Travel time	32 minute crossing	60 minutes	80 minutes	35 minutes
Round trip cost	$15	$47.80	$15	$17.95
Frequency	6 round trips/day	15 round trips/day	4 round trips/day	21 round trips/day

Table 7: Kingston – Seattle Ridership Estimates (Method 2 – 2010 Data)

Scenario	Total Market Demand 2013	Annual POF Ridership	Annual Revenue ($2014)
6 Departures/day	1.07M	167,325	$1.3M

Applying the Kingston to Seattle mode choice model to calculate the change in user benefits for users yields **an annual estimate of $2.2 million in user benefits**. This means that the 167,325 estimated annual trips generate over $13 in user benefits per ferry trip.

3.2.3 User Benefits for Southworth to Seattle

The proposed Southworth to Seattle POF is detailed in Table 8, including its various existing service alternatives, and the ridership estimates in Table 9.

Table 8: Southworth – Seattle Alternative Routes Level of Services

Alternative Routes LOS	Proposed POF Service	Existing WSF Vehicle Ferry Southworth - Fauntleroy + Drive to Sea	Existing WSF Vehicle Ferry Southworth - Fauntleroy + Transit to Sea	Existing WSF vehicle Ferry Southworth-Fauntleroy + Water Taxi to Sea	Drive + Existing WSF Vehicle Ferry Bremerton - Sea	Drive all the way to Seattle
Travel time	23 minutes	60 minutes	80 minutes	50 minutes	60 minutes	70-90 minutes
Round trip cost	$11	$55.40	$11.25	$11.00	$17.95	$30-35
Frequency	6 round trips/day	24 round trips/day	24 round trips/day	6 round trips/day	15 round trips/day	N/A

Table 9: Southworth – Seattle Ridership Estimates

Scenario	Total Market Demand 2013	Annual POF Ridership	Annual Revenue ($2014)
6 Departures/day	0.67M	138,805	$0.8M
12 Departure/day	0.67M	257,804	$1.4M

Applying the Southworth to Seattle mode choice model to calculate the change in user benefits for users yields **an annual estimate of $2.1 million in user benefits**. This means that the 167,325 estimated annual trips generate over $14.8 in user benefits per ferry trip.

3.3 Potential Wider Economic Benefits and Real Estate Benefits

As discussed in this report, we can infer from the literature that there are some relationships between user benefits and both WEBs and real estate benefits. For the purpose of the present analysis, we apply these relationships to the user benefits calculated above, but suggest that these are estimates that must be considered very preliminary.

The relationships to user benefits assumed are the following:

- WEBs are equal to 25% of user benefits
- Real estate values in the aggregated Census Tracts immediately contiguous to the ferry landings could see a premium equal to annual user benefit / 0.15 (with the 0.15 equal to the most conservative values for the discount rate as identified in past studies. We assume that only properties within these Census Tracts will see an increase in property values.

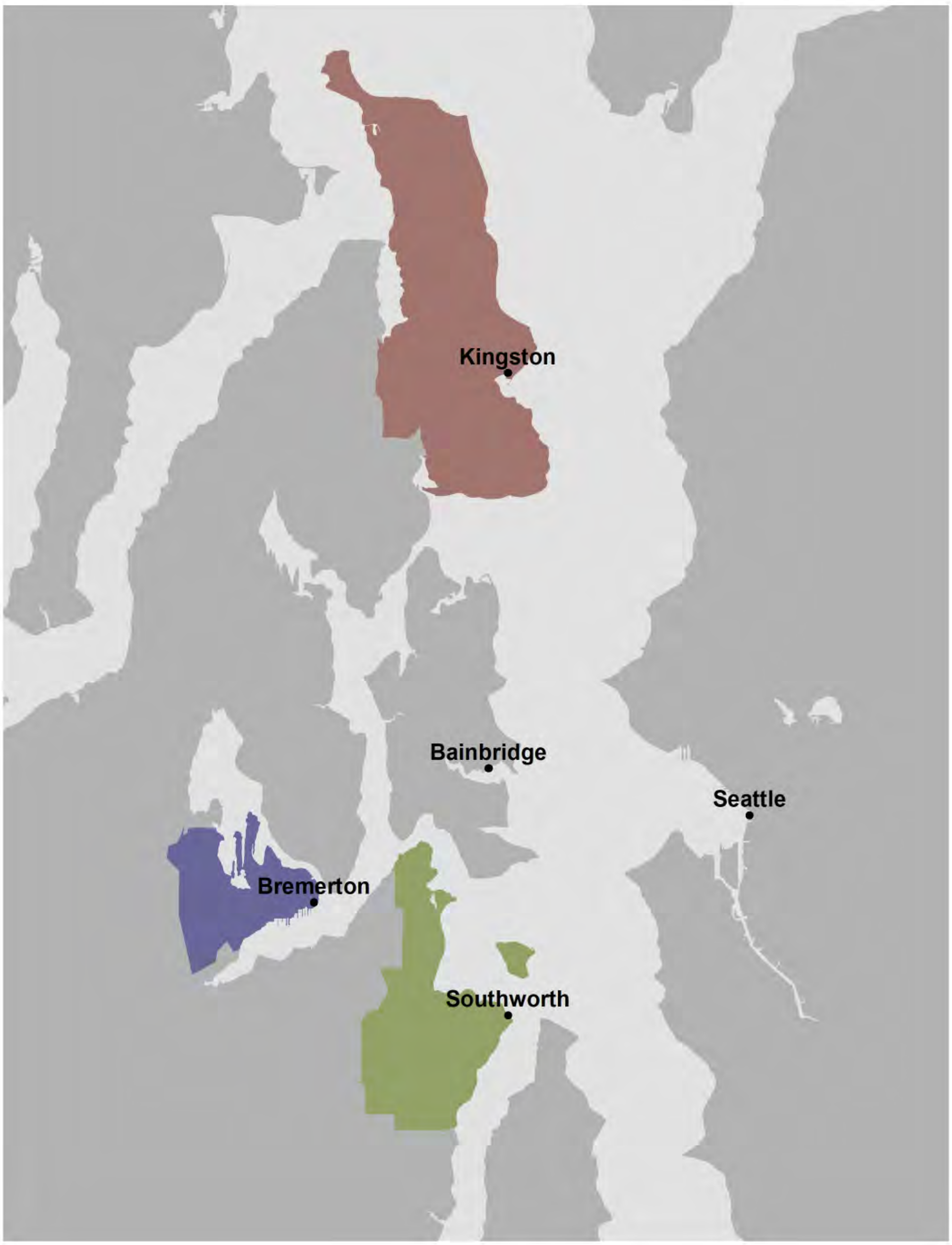
Taking these factors into account we can summarize estimates of economic impacts of the three POF routes in Table 10.

Table 10: Total Economic Impact Estimates for the Proposed POF Services

Benefit Category	Bremerton to Seattle	Kingston to Seattle	Southworth to Seattle
User Benefits / Year	**$3.2M**	**$2.2M**	**$2.1M**
Wider Economic Benefits / Year	**$810,000**	**$540,000**	**$513,000**
Total Real Estate Value Created	**$3.8M**	**$3.6M**	**$2.1M**

The aggregated Census Tracts that were used to define the immediate catchment areas are outlined in Figure 3.1 below. These zones are sub-areas of the larger market areas used for ridership modeling as described in Steer Davies Gleave (2014)[6].

Figure 3.1: Aggregate Census Tracts Used to Define Market Areas



[6] The aggregated Census Tracts around Southworth were reduced by one-half to reflect concentrations of populations that were within a Tract but too distant to benefit from real estate impacts.

4 Conclusions

In the present analysis an extensive review of the relevant literature confirms that the proposed POF services could well generate considerable economic impacts. Estimates of user benefits alone reveal that these benefits are close to three times the magnitude of predicted ticket revenues, a finding in keeping with expectations.

A very simple estimate of WEBs and real estate values was also developed, relying on a relationship identified from the reviewed literature. These suggest additional benefits of the POF, with WEBs estimated at 25% of the value of user benefits, and real estate benefits a capitalization value reflecting a capitalization of user benefits into properties within proximate Census Tracts to POF pier locations.

WEBs and real estate benefits should be considered indicative, as the scope of the present study could not allow for more than a very rough approximation of what these benefits could be.

Appendix: Hedonic Methods

While there are variations in the specifics of the models used, the most common econometric approach in the literature is hedonic regression (Rosen, 1974). The hedonic price model is used to explore the impact of transit on real estate values; the model enables the user to separate out the effects of housing characteristics from the impact of location. This approach treats a certain property as a composite of characteristics to which value is attached. The value of characteristics explains the value of property as a whole. In order to estimate public transportation's impact on property value, the hedonic model puts property value as a general function f of:

$$p_h = f(S_i, N_i, L_i, E_i)$$

where S_i= the set of $\boldsymbol{i}$ structural characteristics

N_i= the set of $\boldsymbol{i}$ neighborhood/environment characteristics

L_i= the set of $\boldsymbol{i}$ location specific characteristics

E_i= the set of $\boldsymbol{i}$ economic characteristics

Square footage of a building and the number of bedrooms are common structural characteristics used in these studies, and the Census Tract or zip codes are common neighborhood variables. The economic characteristics are associated with macro-level housing market and could be considered as fixed during a short period of time.

In the hedonic model, the impact of public transportation is captured by including measures of transit access as independent variables falling in the category of location specific characteristics. A simple analytical approach would be to include this distance measure as an independent variable in the hedonic model to capture the value of being close to a ferry stop on house prices. The following equation illustrates this simple model:

$$ln(p_i) = f(X_i) + \beta_1 \frac{1}{D_i} + \varepsilon_i$$

Where p_i is the price of housing unit i, X_i is a vector of property characteristics for unit i, $\varepsilon_i$is an error term, and D_i represents the distance between unit i and the closest transit station. In this formula, if the estimated coefficient β_1 has a positive coefficient in the regression, it would suggest that those housing units farther away from the transit stations have lower prices, all else equal, and therefore being near a transit station has a positive impact on prices. This implies that transit is a positive amenity, and β_1 indicates the marginal value of being closer to a transit station.

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