

Think City, Dream Vancouver:
Policy Brief
Port Mann Bridge & Highway 1

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Executive Summary

This policy brief analyzes three policy alternatives aimed at alleviating the problem of traffic congestion along the Port Mann Bridge and Highway 1 corridor (PMH1) of Metro Vancouver. The PMH1 corridor is congested nearly 14 hours per day and commuting times throughout the corridor have increased by 30% over the past ten years. The current levels of congestion along the PMH1 corridor, in addition to the levels of predicted future population and economic growth in Metro Vancouver, support the premise that the status quo is untenable.

While the policy problem analyzed is increasing traffic congestion along the PMH1 corridor, it is important to recognize that the problem of traffic congestion is not limited to the transportation sector. Congestion results in numerous economic, social and environmental costs. Accordingly, this brief analyzes the problem of traffic congestion in a manner that incorporates the full cost of each proposed transportation policy alternative.

Additionally, it is important to consider the impact of transportation policy on greenhouse gas (GHG) emissions in the context of the B.C. government's pledge to reduce emissions by 33% below current levels by 2020. In 2001 transportation was responsible for 42% of the total GHG emissions in B.C. (B.C. ministry of the Environment, 2001). Consequently, this study analyzes all of the proposed policy alternatives within an environmental sustainability framework.

The three policy alternatives considered are: a transit-only plan that improves transit services throughout the affected area; the B.C. government's PMH1 component of the Gateway program, which incorporates some alternative transportation measures but focuses mostly on roadway

capacity expansion; and a demand management strategy that combines enhanced transportation alternatives with financial incentives – including congestion charges and parking cash-out – aimed at reducing vehicle use.

The study finds the transit-only option is unable to reduce congestion levels to such an extent as to significantly reduce congestion along the PMH1 corridor. The study also finds that the benefit-cost analysis of the B.C. government's PMH1 plan, used to justify the implementation of the Gateway program, is inconsistent with established protocols of full cost transportation accounting and, as a result, does not account for several costs. If all costs were considered, the findings are that the government's PMH1 policy will exhibit a much lower benefit to cost ratio than what is currently being promoted. Additionally, the research shows that increased road capacity leads to higher GHG emissions as additional road capacity correlates with an increase in vehicle use.

Therefore, this brief recommends that the government implement the demand management strategy to address congestion. It is the most effective policy alternative at reducing GHG emissions, inducing positive spillover economic and social benefits and reducing congestion.

Port Mann Bridge & Highway 1

Section 1: Introduction

This paper engages in an analysis of three policy alternatives aimed at addressing traffic congestion along the Highway 1 corridor and the Port Mann Bridge. The alternatives analyzed include the province's PMH1 component of the Gateway plan, a transit-only plan and a transportation demand management plan that includes financial incentives and increased transit services.

The provincial government has presented a policy alternative designed to address the issue of traffic congestion throughout the PMH1 corridor. As part of the Gateway Program the government has proposed highway expansion along the Highway 1 corridor and twinning of the Port Mann Bridge as part of a solution to the problem of traffic congestion. The government recently concluded an environmental assessment and is currently assessing bids from contractors for construction of PMH1 expansion.

1.1 Policy Problem

The policy problem in question is increasing traffic congestion along Highway 1 corridor and the Port Mann Bridge. The problem of traffic congestion is not limited to the transportation sector. Congestion results in numerous economic, social and environmental costs that need to be addressed.

1.2 Background

Congestion along Highway 1 and the Port Mann Bridge (PMH1) has increased and the resultant congestion has led to a variety of costs that are borne by both individuals and businesses.

The PMH1 corridor is congested nearly 14 hours per day and commuting times throughout the corridor have increased by 30% over the past ten years (Gateway Program Definition Report, January 2006). Currently, the AM peak hour demand heading westbound on the Port Mann is approximately 4,800 vehicles, which results in a 1,000 vehicle queue (Gateway Program Definition Report, January 2006). PM peak hour demand also results in a lengthy vehicle queue and changing demographic trends are resulting in an increase in midday traffic on the PMH1.

The Port Mann Bridge acts as a 'capacity bottleneck'. With respect to the Highway 1 corridor, the bottleneck creates traffic queues in both the east and westbound directions (NDLEA, December 2005). Increased economic growth and growing port traffic have contributed to the congestion problem and the volume of container traffic at the Port of Vancouver is expected to quadruple by 2020 (Gateway Program Definition Report, January 2006).

Increased population growth, and the nature of that growth, has exacerbated the congestion. Between 1994 and 2003 Metro Vancouver's population grew from 1.8 million to 2.1 million, where the pace of growth in suburbs outpaced the growth of Vancouver (NDLEA, December 2005). Employment growth is substantially higher in suburban municipalities than in Vancouver. Employment growth is also much higher in the suburbs. Surrey experienced 15.4% growth in

employment between 1996-2001, while Vancouver's employment grew by 0.7% (NDLEA, December 2005).

Additionally, changing demographic trends and land use planning has led to an increase in automobile traffic. There are growing numbers of households with two primary income earners and live-at-home adult children. This demographic shift has resulted in an increase in multiple daily commute destinations (Gateway Program Definition Report, January 2006). Automobile-oriented land use planning has induced growing levels of single-occupancy and short non-work trips (Livable Region Coalition, October 2004).

In its present state the PMH1 corridor is overburdened by vehicle traffic and the resultant congestion creates spillover costs that are incurred by Metro Vancouver residents and other users of PMH1. There are public health and environmental costs, such as increased emissions from vehicles exacerbated by congestion-related idling, increased accident rates and public safety costs (Litman, 2007), and increased stress for drivers leading to higher blood pressure rates and more sick days amongst commuters who drive (Smart Growth BC, 2007).

In addition there are economic costs, some of which are borne by individual travelers and others which are imposed on businesses and consumers by extension.

- Time and productivity losses that are borne by individual travelers and businesses.
- Delays in the transportation of goods, estimated at being \$500 million per year for the Lower Mainland some of which is attributable to congestion on Highway 1 (Gateway Program Definition Report, January 2006).

- Transport Canada currently estimates the total economic costs of congestion in the Lower Mainland at approximately \$1.5 billion per year, which are eventually passed along to consumers (Gateway Program Definition Report, January 2006).

Traffic congestion is a serious problem and is associated with numerous economic, environmental and social costs. The current levels of congestion along the PMH1 corridor, in addition to the levels of predicted future population and economic growth, support the premise that the status quo is untenable.

1.3 Policy Objectives

While the primary goal is the reduction of traffic, transportation policies can have significant externalities that may be either positive or negative. Transportation policy has wide reaching effects and impacts upon the environment, public health, public safety and land use (Litman, 2007). Accordingly, transportation policy should not be narrowly defined. Reductionist transportation policy can limit the potential gains. For instance transportation policy that induces a reduction in traffic congestion does not necessarily result in a reduction of greenhouse gas (GHG) emissions and may result in higher per capita GHG emissions (King County LUTAQH Study, 2004).

The broad implications of changes to transportation policy lead this study to consider more than one policy objective.

- The primary objective is the reduction of congestion in Metro Vancouver.

- The secondary objective is to maximize the benefits of congestion reduction; by ensuring that congestion reduction reduces GHG emissions, improves public health and adheres to Metro Vancouver’s Livable Region Strategic Plan (LSRP).¹

Additionally, it needs to be recognized that transportation policy can impact upon all four of the LRSP’s guiding principles. As such, policy decisions regarding congestion along the PMH1 should be sensitive to Metro Vancouver’s mandate. They should also incorporate and accommodate the concerns and framework established by Metro Vancouver.

Furthermore, the province outlined a number of additional specific policy objectives it wants to achieve through the Gateway program. Their stated objectives will be considered for the purposes of this study and they are:

- I.** Reduce travel/commute times throughout MetroVancouver.
- II.** Reduce vehicle emissions that arise from congestion related idling.
- III.** Improve the quality of life through alleviating congestion on local streets by focusing travel onto regional roads.
- IV.** Improve access to key economic gateways.
- V.** Facilitate better connection to other modes of transportation (public transit, cycling and walking).
- VI.** Increase public safety via the alleviation of congestion.

¹ Metro Vancouver’s LRSP involves four key tenets:

- i. Protect the Green Zone
- ii. Build Complete Communities
- iii. Achieve a Compact Metropolitan Region
- iv. Increase Transportation Choice

Section 2: Proposed Policy Alternatives and Assessment Criteria

The policy alternatives discussed range from addressing the congestion problem through the province's proposed PMH1 expansion as a part of the Gateway program, a transit only solution and a Transportation Demand Management (TDM) strategy. The transit only option is derived from analysis by the Gateway Program (Gateway Program Technical Memorandum, 2006) and analysis by Halcrow Consulting (Halcrow Consulting Ltd., 2006). The TDM alternative incorporates financial incentives and transit priority measures, and analysis of the impacts is based in part on other cases where TDM strategies were implemented.

2.1 Improve transit options along the PMH1 corridor

The transit only alternative incorporates the measures proposed by the Gateway program. It involves:

- Establishing transit priority measures – specifically transit queue jumper and priority lanes – that grant public transit better access along the PMH1 corridor.
- Introducing several rapid bus routes that connect the Vancouver, Metrotown, Brentwood, Lougheed, Coquitlam, Port Moody, New Westminster, Surrey and Richmond town centres and the Millennium SkyTrain line.

2.2 Gateway Program's PMH1 plan

The province has outlined a number of measures in its Gateway plan that are directed at addressing congestion along the PMH1 corridor. The province's PMH1 plan is taken from (Gateway Program Issue No. PMH1-4, June 2007) involves:

- Widen Highway 1 from the McGill interchange in Vancouver to 216th Street in Langley, and upgrade interchanges over the same area.
- Introducing HOV lanes, transit and commercial vehicle priority access, and re-establish a bus service that crosses the Port Mann Bridge.
- Twinning the existing Port Mann Bridge, then tolling the bridge.
- Invest in cycling infrastructure that would span the bridge.

2.3 Comprehensive transport demand management (TDM) initiative:

The TDM initiative incorporates a number of measures proposed in the province's alternative, but also includes the implementation of financial incentives aimed at reducing congestion.

The HOV lanes, transit and commercial vehicle priority access strategies proposed in the province's PMH1 plan are included in the TDM strategy. The proposed TDM initiative includes investment in cycling infrastructure as a means to provide additional transportation options. Including a cycling only bridge that would twin the Port Mann and alleviate safety concerns associated with cycling on the existing bridge.

The TDM initiative expands upon the province's PMH1 transit option and would introduce several rapid bus transit services connecting Surrey/Langley with Vancouver, Burnaby and Coquitlam.

The distinguishing features of the proposed Vancouver TDM strategy are flexible congestion pricing and parking cash-out.

The flexible rate congestion pricing will apply to all major routes entering and departing the Burrard peninsula.

The rate will vary depending upon the time of day. It would be most expensive during the peak AM and PM hours, less expensive during midday periods and free during the overnight and weekend periods.

In support of the application of a congestion charge, the TDM initiative requires the purchase of more buses in order to service the increased transit demand that would be associated with cordon tolling. Additionally, tolling revenues would be reinvested to provide for further improvements to transit.

Parking ‘cash-out’ legislation requires that mid to large employers in Metro Vancouver give employees the choice of taking cash in lieu of a subsidized parking spot. California employs a parking cash-out legislation that requires employers with a minimum of 50 employees adhere to the program (California Environmental Protection Agency, 2006).

2.4 Assessment Criteria of Policy Alternatives

Congestion is the primary policy problem. However, the ability to relieve congestion cannot be the only measure used to assess the policy alternatives as congestion and transportation policy have far reaching affects. Accordingly, the policy alternatives will be assessed on their ability to:

- Meet the policy objectives outlined in section 1.3.
- Provide a positive benefit to cost ratio for Metro Vancouver residents.

- Capture and lock in the benefits that result from a reduction in congestion. This criterion includes reference to both direct economic benefits to both businesses and consumers as well as spillover benefits that impact upon the areas of public health and the environment.

Section 3: Assessment of Policy Alternatives

The following section involves an analysis of the impacts that would occur as a result of the implementation of the policy alternatives listed in section 2.1.

3.1 Assessment of the Transit-only Alternative

The consulting firm Halcrow Consulting Ltd. completed an independent review of a transit-only alternative in March of 2006. Halcrow modeled a transit-only option using two different methodologies and analyzed the potential impacts that the transit-only solution would have on PMH1 congestion levels. Despite the fact that concerns have been raised by the Livable Region Coalition with respect to the methodology used by Halcrow, they were the only ones to produce a review of any ‘transit-only’ option.

The first strategy considered “the effect of a hypothetical 20% transit mode share for relevant market segments on the Port Mann Bridge (Halcrow Consulting Ltd., March 2006).” Halcrow considered that such a mode share was not unrealistic to obtain and would induce a 9% overall mode share for all traffic crossing the Bridge.

The first transit strategy considered the provision of:

- Transit routes between Surrey/Langley and the Northeast Sector

- Transit routes between the Fraser Valley and the SkyTrain at the Lougheed Town Centre (connecting Surrey/Langley with Vancouver and Burnaby).

The second transit strategy considered the provision of:

- Six potential high-frequency express bus routes crossing the Port Mann Bridge that would provide 40 buses per hour during peak hours and would be supported by transit priority measures.

Neither of the transit-only models resulted in a sufficient reduction in vehicle traffic to impact upon the congestion problem throughout the PMH1 corridor. Modeling estimates showed that despite providing high levels of transit service across the Port Mann Bridge, the reduction in vehicular traffic would be approximately 350 vehicles during the AM peak hour. Such a reduction would not significantly alleviate congestion and there would continue to be a queue of approximately 650 vehicles during the AM peak hour (Halcrow Consulting Ltd., March 2006).

Studies showed that increased transit service could increase transit ridership substantially along the Highway 1 corridor heading westbound into Surrey (NDLEA, December 2005). However, the studies that are available suggest that the increase in transit ridership would not be sufficient to reduce congestion substantively. Accordingly, the transit-only option presented fails to meet the criteria of reducing congestion. Given the marginal reductions in congestion, ‘transit-only’ would not have a significant impact on the movement of goods and people throughout the region, nor would it have a significant impact on reducing GHG emissions. With a remaining vehicle

queue, congestion related idling emissions would continue. It may be able to alleviate some of the congestion on local streets; however the level of relief induced is unclear.

While the model considered does not adequately reduce congestion, it meets the criteria of accommodating the LRSP. It increases the choice of transportation available. However, it does not address walkability and cycling concerns, which would further improve the transportation choices available.

Additionally, transit only does not negatively impact upon the remaining three tenets of the LRSP and high-levels of transit are necessary for compact development and Smart Growth.

While the model considered analyzes the impact of implementing solely transit measures, studies show that if transit measures are accompanied with transit-oriented development – meaning compact, mixed-modal land use and enhanced connectivity – there would be significant user benefits (Litman, 2006).

Benefits of Transit Measures

Transit-only strategies induce spillover benefits that can be captured by the general public. Studies show that where public transit is accessible, residents are more likely to meet the minimum required level of physical activity per day (McCormack *et al.*, 2007). A transit-only option would be able to induce public health spillover benefits. Additional benefits from transit have been studied extensively.

Table 1. Transit Benefits (Litman, 2007)

Benefits	Description
User benefits	Increased convenience, speed and comfort to user from transit service improvements.
Congestion reduction	Reduce traffic congestion.
Facility cost savings	Reduced road and parking facility costs.
Transport diversity	Improved transport options, particularly for non-drivers.
Road safety	Reduced per capita traffic crash rates
Environmental quality	Reduced pollution emissions and habitat degradation.
Efficient land use	More compact development, reduced sprawl.
Economic development	Increased productivity and agglomeration efficiencies.
Community cohesion	Positive interactions among people in a community.
Public health	Increased physical activity (particularly walking).
Consumer savings	Reduced consumer transportation costs, including reduced vehicle operating and ownership costs.

No study has attempted to measure these transit related benefits in Metro Vancouver. However, it is unclear how much benefit would accrue with respect to PMH1 given that the transit-only strategy may not be able to induce a significant reduction in congestion. This failure limits the amount of spillover benefits that would arise from a transit-only change in transportation policy.

3.1.1 Summation of Impacts

A transit-only option fails to meet many of the policy objectives because it would not be able to induce a significant decrease in congestion levels throughout the affected areas. However, there

are benefits that would accrue from the transit-only initiative. Increased levels of transit will reduce some congestion and there is potential that different transit models may induce a sufficient congestion relief.

Accordingly, transit needs to be considered as a core component of any congestion relief strategy as there are numerous transit related benefits. While transit services in the PMH1 corridor will reduce vehicular traffic, the potential impact of transit is discounted when considered in isolation from other transportation policies.

3.2 Assessment of the government's PMH1 Gateway Plan

The provincial government has conducted a lot of analysis with respect to the assessment the Gateway Plan on the whole and has also studied various impacts of decisions regarding the PMH1 component of the Gateway program. A large component of this assessment is based on the findings that arise from Gateway Program reports.

3.2.1 Cost-Benefit Analysis

Justification for the Gateway Program arises from a reported high benefit to cost ratio. However, this assessment finds that there are some questions surrounding the method of accounting for the costs and benefits of Gateway. MMK Consulting Ltd. conducted a cost benefit analysis that showed user benefits of the program at \$8 billion and a benefit to cost ratio of 3:1 (MMK Consulting Ltd., September 2005). The MMK study suggests that the estimates with respect to the potential benefits are low as they did not quantify "safety and other benefits" and once quantified would improve the benefit to cost ratio. The only costs that are directly accounted for

are the \$3 billion in capital expenditures associated with Gateway, \$1.5 billion of which are earmarked for the PMH1 component (MMK Consulting Ltd., September 2005). By only considering the capital costs, the MMK study disregards several costs, including those associated with generated traffic. Generated traffic, that results from roadway capacity expansion, reduces the congestion reduction benefits of roadway expansion and increases many external costs (Litman, 17 September 2007).

Additionally, the MMK study states that there are user benefits in the form of reduced vehicle operating costs that accrue as a result of the Gateway program. This runs counter to studies that show that the phenomenon of generated traffic leads to increased vehicle miles traveled (VMT) and adds to vehicle operating costs (Hills, 1996). Increased VMT will also produce increased emissions and result in increased environmental costs (Litman, September 2007). The effects of generated traffic are considered to be extremely important to the calculation of benefit-cost ratios and various studies have shown that “small absolute changes in traffic volumes have a significant impact on the benefit measures” (Mackie, 1996). When taking generated traffic into account, it is clear that the cost-benefit analysis used to justify the expansion of PMH1 is inaccurate.

Transport Canada released a paper on Full-Cost Accounting for transportation costs in a 2003 discussion paper. Transport Canada accounts for capital, environmental, social and user and non-user borne costs. MMK consulting did not account for these costs in the Gateway cost-benefit analysis and their omission discredits the study’s findings.

In a Gateway Program Technical Memorandum, there is an acknowledgement that roadway capacity expansion will induce ‘downstream’ traffic on arterial roads in Vancouver. The study considered the impact of downstream traffic on McGill Street/Dundas Street, Hastings Street, 1st Avenue, Broadway and Grandview Highway. The study shows that there will be a 2-3% increase (150-300 vehicle) in westbound traffic on opening day that would increase over time and a 1-3% increase (100-300 vehicle) increase in eastbound traffic on opening day that would increase over time (Gateway Program, 30 May 2006). Despite the acknowledgement of ‘downstream’ traffic, these costs are not accounted for in Gateway’s cost-benefit study.

There is no doubt that there are a variety of economic benefits to the freer flow of goods and people throughout Metro Vancouver. However, the cost-benefit analysis used by the province does not accurately measure the effects of the PMH1 plan.

3.2.2 Effect on Congestion

The PMH1 expansion will have an immediate impact on congestion upon completion. However, these gains will not be realized until 2013 when completion of PMH1 is expected. During the intervening years, congestion will worsen due to construction efforts and continued lack of transportation alternatives.

The government plans on introducing improved transit service, HOV, transit, commercial traffic priority lanes and tolling of the Port Mann Bridge to help mitigate the effects of generated traffic on Highway 1 itself. Analysis suggests that congestion will be reduced extensively as a result of

the PMH1 plan (Gateway Program, February 2006). However, there are factors that will limit the potential traffic reduction gains that could arise from PMH1 expansion.

- Studies show that even if investment in roadways coincides with transit investment, the car will receive the majority of the benefits. Given that the car receives the majority of the investments, car use increases and congestion returns (Livable Region Coalition, October 2004).
- The tolling of the Port Mann Bridge will help to decrease traffic volumes on the Port Mann, but would increase traffic on the Patullo and Alex Fraser Bridges and result in increased overall traffic on the three bridges both immediately and over the long term as a result of generated traffic (Gateway Program Tolling Analysis, February 2006).

By tolling the Port Mann Bridge and the resultant decrease in traffic on the Port Mann coupled with increases on the Patullo and the Alex Fraser, the policy alternative fails to meet the objective of focusing traffic onto regional roads and off of local roads.

3.2.3 Assessment of the Gateway Plan in relation to the Policy Objectives

PMH1 plan would reduce travel/commute times in the short term, but those gains would be less evident over the long run as generated traffic effects are experienced.

Reduced vehicle queue would reduce congestion-related idling. However, increased vehicle use would increase emissions and studies show that long term emissions increase significantly after roadway expansion (Williams-Derry, October 2007). The Williams-Derry study calculates the increase at approximately 116,500-186,500 tons GHG/additional mile over 50 years.

The plan includes a \$50 million investment in cycling infrastructure as well as increased transit service. As such the PMH1 plan does facilitate better connection to other modes of transportation.

The PMH1 strategy would increase public safety initially via a reduction in congestion and an increase in transit service and usage. Although, these gains are dependent on the length of time before generated traffic results in increased congestion. Additionally, the increased VMT by vehicle users results in a decrease in public safety. The net effect in the long term on public safety is negative, and may be positive or negative in the short term depending on the level of increased VMT and the initial congestion reduction. Further study would be required to determine the impact on public safety in both the short and long term.

The PMH1 fails to meet a number of the tenets of the LRSP. While it does provide an increase in transportation choice, it does not protect the green zone, assist in the building of complete communities or assist in achieving a compact metropolitan region.

Roadway expansion creates development pressure on the urban fringe and agricultural green space as newly expanded roadway make areas further from the centre of metropolitan areas more accessible to automobiles. A Washington D.C. case study indicates that a 12-mile roadway expansion led to an increase in vehicular use, reduced greenspace and a massive suburban housing development in the major community at the fringe of the roadway expansion (Livable Region Coalition, October 2004).

3.2.4 Summation of impacts

Overall the province's PMH1 plan produces mixed results.

- The Gateway's PMH1 expansion plan fails to meet a number of the stated policy objectives.
- Provides short term congestion reductions, with congestion returning in the long run.
- Highway expansion will influence the location and form of growth in a manner that is inconsistent with the LRSP.

3.3 Assessment of the Transportation Demand Management Initiative

The assessment of the TDM alternative is based on theory and case studies that have documented the effects of TDM policies. Some of the TDM elements are similar to the province's PMH1 plan.

The cycling infrastructure expenditure would increase transportation options and fit with the LRSP.

The strategy includes increased transit measures – rapid buses accessible to park and ride facilities – the construction of HOV lanes, and commercial and transit priority access. The initiatives will:

1. Reduce congestion.
2. Provide increased transportation options.
3. Increase connectivity throughout Metro Vancouver.
4. Reduce GHG emissions.

However, these measures alone may not achieve significant congestion reductions, thereby limiting the stated benefits.

Comprehensive TDM measures actively seek to enhance the impact of alternative modes of transit and HOV/transit priority measures. Flexible congestion pricing and parking ‘cash-out’ are designed to enhance congestion reduction, encourage transportation mode shifts and lock in spillover benefits.

The flexible rate congestion pricing will apply to all routes entering and departing the Burrard peninsula. The purpose of applying the road pricing to all routes is to avoid the consequences associated with increased traffic on ‘free alternatives’. The rate will vary depending upon the time of day. It would be more expensive during the peak AM and PM hours, less expensive during midday periods and free during the overnight and weekend periods, thereby targeting work place commuting trips and avoiding the potential economic costs of trip suppression.

Parking ‘cash-out’ legislation will be based on California legislation that requires employers with a minimum of 50 employees provide employees with an option of taking a parking spot or the cash equivalent value of the parking spot.

3.3.1 Effect of Flexible congestion pricing

Road pricing can have significant impacts upon traffic congestion. A 2000 study of tolling in Dublin showed empirically that time based pricing reduced peak period trips by 22% (O’Mahony, Geraghty and Humphreys, 2000). Additionally, the effects of road pricing have

been studied extensively and where implemented each case has resulted in a drop in congestion (Steer Davies Gleeve, July 2005).

To determine the potential impact along the PMH1 corridor, a 20% reduction in peak period vehicle trips – not unrealistic – will be considered. Gateway traffic modeling showed a 4800 AM peak hour Demand at the Port Mann Bridge with a 3800 vehicle capacity.

A 20% reduction would reduce vehicle traffic during the peak hour by approximately 960 vehicles. Additional transit priority measures and HOV lanes would further reduce peak period vehicle traffic and eliminate the traffic queue.

The general effects of road pricing are summed in Table 2 and would be expected if applied in Metro Vancouver.

Table 2. Effect of congestion pricing (Litman, 2007)

Travel Impact	Degree of Impact	Comment
Reduces total traffic	Moderate/High	Impact varies with price structure and quality of alternatives.
Reduces peak period traffic	Extremely High	Fixed tolls cause more moderate peak reductions.
Shifts peak to off-peak periods	Extremely high	Fixed tolls provide no incentive to shift.
Improves access	Neutral	No effect
Increases ridesharing	Extremely High	Encourages ridesharing and may fund ridesharing programs.
Increases public transit	Extremely High	Encourages transit use and may fund transit improvements.
Increases cycling	Moderate/High	Encourages cycling and may fund cycling improvements.
Reduced freight traffic	Low	May have some effect.

Benefits of Flexible Congestion Pricing

Flexible congestion pricing would effectively reduce congestion and would also provide an increase in revenue, despite the fact that there are capital costs associated with the implementation of tolling.

In terms of revenue generation versus operational costs, while the numbers will vary dependent upon the project, it is clear that London’s congestion charging produced a net revenue gain. Annualized net revenue per operating year for London is estimated at £60 million (Litman, 2006). However, it is import to consider that the generation of positive net revenue is dependent

on the fare charge, capital cost of implementation of tolling infrastructure, the elasticity of automobile travel during peak periods and the level of trip suppression.

With respect to the effect of congestion charging on congestion, the London case showed a direct correlation between charging and congestion reduction. The London congestion charge resulted in a 12% reduction in total vehicle kilometres traveled and a 28% reduction in accidents (Richards, 2006).

The application on congestion tolling to the Patullo, Golden Ears, and Alex Fraser Bridges would capture the gains of road pricing without creating a ‘free alternative’.

The general benefits of flexible congestion pricing are summed in Table 3.

Table 3. Benefits of Congestion Pricing (Litman, 2007)

Objectives	Rating	Comments
Congestion Reduction	Very High	Reduces peak-period demand.
Road & Parking Savings	Very High	Reduces total vehicle travel and eliminates cost of adding capacity.
Consumer Savings	Moderately negative	Increases consumer direct costs, but overall impacts depend on how revenues are used.
Transport Choice	Very High	Increases transportation choice and improves alternatives.
Road Safety	High	Reduced vehicle crashes.
Environmental Protection	High	Reduced vehicle travel emissions.
Efficient Land Use	Moderate	Reduced vehicle travel may reduce sprawl.

Costs of road pricing

While there are many benefits to congestion pricing, there are potential costs that need to be addressed and accounted for in any cost-benefit analysis.

Congestion charging induces a moderately negative effect on consumer. However, given the flexible nature of the proposed pricing scheme, it is important to account for consumers who are able to mitigate the impact by traveling during off-peak hours.

Retailers hold concerns that the reduction in vehicle trips induced by road pricing will negatively impact their revenues. However, the less expensive midday tolling proposed would induce less severe drops in vehicle trips and mitigate the potential loss of revenue.

There is the potential for an increase in traffic along the borders of the tolling area thereby mitigating the overall congestion reduction and would have to be considered. Although, case studies from cities employing congestion pricing showed that this impact is minimal (Steer Davies Gleeve, July 2005)

The scheme should be accompanied by an effective transit service and TransLink would need to increase the size of its bus fleet, thereby incurring a capital cost. However, the expected annualized net revenue from the tolls could cover the costs of transit expansion.

While an effective and expanded transit service is proposed, the option of road pricing should not be discounted due to the current level of transit service. The O'Mahony study showed that an

under serviced transit system did not adversely affect the program and the revenue generated has since improved transit (O’Mahony, Geraghty and Humphreys, 2000).

Another cost that needs to be considered is the variable congestion tolling equipment.

Cost-Benefit Analysis

No cost-benefits of the proposed Metro Vancouver TDM initiative have been done. However, a study in Washington, D.C. performed a cost-benefit analysis that would result from the alleviation of congestion from a traffic bottleneck. The study analyzed the use of similar TDM mechanisms – flexible congestion charging, high levels of rapid transit accessible to park and ride facilities across the bottlenecked region with HOV lanes, and transit priority access – and provided analysis of a comparable congestion problem. (DeCorla-Souza, November 2003).

Table 4. Cost-benefit of Congestion Pricing in Washington, D.C.

Project Costs and Benefits	Low (estimated current travel speed of 30mph through the bottleneck area) (millions)	High (estimated current travel speed of 20mph through the bottleneck area) (millions)
Annualized Costs	\$271.9	\$271.9
Annual Social Benefits	\$703.8	\$1,383.5
Net Annual Benefits	\$431.6	\$1,111.3
Revenues after Credits	\$290.3	\$580.6
Benefit-Cost ratio	2.6	5.1
Excess of Revenues over Costs	\$18.4	\$308.7

The study concluded that a TDM strategy employed to address a ‘bottleneck’ congestion problem would achieve a 2.6:1 benefit to cost ratio in somewhat congested regions and a 5.1:1 ratio in heavily congested areas, with millions of dollars in annual benefits and revenues.

3.3.2 Effect of Parking ‘Cash-out’

Parking cash-out legislation can significantly reduce traffic congestion and will help to address some of the equity issues surrounding road pricing.

Congestion charging can induce trip suppression (O’Mahony, Geraghty and Humphreys, 2000) which can inconvenience commuters. Parking cash-out would compensate commuters who choose an alternative mode of transit and give further incentive to individuals to choose alternative modes. Workplace travel plans typically reduce car driving by between 10% and 30% (Department for Transport UK, 2004).

3.3.3 Summation of effects

The TDM initiative meets all the criteria outlined in Section 2.2. Additionally, it significantly reduces congestion and ‘locks in’ spillover benefits.

There would also be capital cost savings resulting from the cancellation of the PMH1 expansion could be expended on improving current transit services and existing infrastructure.

3.4 Summation of Impacts and Trade-offs

Table 5 summarizes the impacts and trade-offs that are associated with each policy alternative.

Table 5. Policy Alternative Implications

Criteria	Transit-only	Gateway PMH1	TDM Initiative
Congestion Reduction/Reduction of travel time	➔ Depends on the level of transit provided.	✓ Initial reduction ✗ Induced traffic over time increases congestion.	✓ Significant and sustained congestion reduction.
Reduce vehicle emissions	✓ Slight reduction (congestion related idling may not be eliminated).	✗ Induced traffic will induce more VMT and emissions.	✓ Significant reduction in VMT and emissions.
Alleviate congestion on local streets	➔ Unclear effect.	➔ Mixed. Tolling of the Port Mann may drive traffic onto local streets to connect with ‘free alternatives’.	✓ Positive. Increased mode share reduces traffic in all areas.
Improve access to economic gateways	✗ Slight congestion reduction may not improve access.	➔ Mixed. Initial gains followed by the return of congestion.	✓ Positive. Decreased congestion along with commercial priority measure increases access.
Improve connection to other modes of transportation	✓ New transit connections to SkyTrain.	✓ New transit connections to SkyTrain. Cycling option provided.	✓ New transit connections to SkyTrain. Cycling option provided.
Increase public safety	✓ Slight increase due to minimal reduction in vehicle traffic.	➔ Mixed. Initial congestion reductions are beneficial. Increased VMT increases crash rates.	✓ Reduced congestion and reduced VMT increases public safety.
Positive benefit to cost ratio	➔ Unclear and depends on ridership.	✗ Full cost accounting shows that PMH1 is a high cost initiative.	✓ Road pricing increases revenue. Reduced traffic lowers costs.

Ability to ‘lock in’ spillover benefits	√ May spur transit-oriented growth, which would lock in benefits.	× Initial congestion reductions decrease over time and overall vehicle dependency increases. Benefits are not locked in.	√ Spurs compact development. Increases health benefits. Revenue stream fosters further transit development.
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Based on the above table, it is clear that the TDM initiative is the most effective strategy at meeting the objectives and assessment criteria. However, comprehensive TDM initiatives that include some measure of congestion pricing are rarely implemented. The resistance to congestion pricing needs to be addressed.

Consideration of Resistance to TDM

1. Building new physical infrastructure may provide more immediate political gain, as people see ‘progress’. However, it is important to consider the total costs of infrastructure.

With respect to the PMH1 initiative, roadway/bridge expansion as both a capital cost and an opportunity cost. The opportunity cost stems from the decision to spend \$1.5 billion on infrastructure over other causes, such as transit improvements and roadway infrastructure maintenance.

The opportunity costs are important to consider in the current environment. At present there is a multi-billion dollar transportation and transit infrastructure deficit in Canada’s large municipalities (Mirza, November, 2007). PMH1 expansion incurs a higher economic cost beyond the \$1.5 billion accounting cost given the current infrastructure deficit.

While the building of new infrastructure provides generally positive media coverage, policy decisions should not be swayed by the glitz of new infrastructure; especially when considered in the context of a municipality where a great deal of the existing transportation systems is nearing or has reached the end of their service life.

- The capital costs of PMH1 expansion restrict the funds available for the provision and implementation of transit and TDM initiatives.
 - TDM and transit strategies would address the transit infrastructure deficit and generate revenue to further address the transportation system infrastructure deficit.
2. Retailers are often opposed to TDM initiatives for fear that reduced vehicle travel will result in a decrease in their revenue.

The evidence does not support their fear. Revenue for retailers in Stockholm experienced an increase in revenue despite a reduction in traffic volume as individuals tended to shop at retail outlets closer to their residence (Daunfeldt, Rudholm and Rämme, November 2006). London and Trondheim studies showed minimal impacts upon retailers and shoppers (Steer Davies Gleeve, July 2005). Additionally, retailers benefit from the reduced congestion as the flow of goods is improved (Swedish National Road Administration, 2002).

Some businesses that are dependent on vehicle trips will be more affected than other businesses. However, the proposed road pricing scheme seeks to address these equity

implications by reducing the midday charge and eliminating the evening and weekend charge. The variable charge would mute the negative impacts on certain businesses.

3. There are equity considerations to the implementation of road pricing.

Road pricing is interpreted by some as being regressive and placing an unfair burden on low-income road users. However, the equity considerations also need to consider the quality of alternatives and the use of generated revenues. The provision of high quality transit services and the reinvestment of toll-generated revenue into transit discount the equity critique of TDM strategies.

Additionally, roadway expansion also has equity considerations.

Non-motorists subsidize road expansion and may not receive any benefits from roadway expansion. Driving costs in the Lower Mainland currently received \$2.65 Billion in subsidies (B.E.S.T., 2006). TDM strategies result in benefits that are accrued by both motorists and non-motorists.

When comparing the equity considerations of roadway expansion and road pricing, the equity gains of non-road users offsets the equity losses of road users. Additionally, motorists with high-value trips will benefit from road pricing and the resultant decrease in congestion will decrease time delays.

4. Public opinion is often resistant to the implementation of road pricing schemes.

However, evidence shows that opposition to road pricing can be muted provided that the benefits of road pricing policies are communicated effectively (Gerrard, Still and Jopson, 2001).

Additionally, case studies in London, Stockholm and Trondheim show that public opposition to road pricing decreased over time, in large part because the revenue was spent on increased transit development (Litman, 4 September 2007) (Steer Davies Gleeve, July 2005).

When considering the resistances to TDM strategies, it is important to consider that the evidence shows that concerns regarding negative impacts are overstated or unfounded. In order for a TDM strategy to be successful, there needs to be a communication strategy that clearly outlines the benefits of TDM as well as the costs of roadway expansion. It is possible that the implementation of TDM on a trial basis, accompanied with a full explanation of the process and consequences, may result in public support for congestion pricing.

Section 4: Recommendations

The study recommends the implementation of a comprehensive TDM initiative with a caveat that takes into consideration the political implications of the plan and the potential equity concerns.

The policy alternative will be implemented on a 1 year trial basis. The transit measures and parking cash-out would be implemented immediately, while the congestion charging would be implemented 6-months after the approval of the TDM initiative. This would allow residents to prepare for the change. It would also allow time for the implementation of a communications

strategy that clearly outlines the purpose of the TDM initiative and addresses all of the resistance associated with congestion pricing. Following the 1 year trial, Metro Vancouver would hold a referendum that would determine whether or not the TDM strategy would remain in place.

TDM strategies do not need to be implemented on a permanent basis in order to be successful. Stockholm introduced congestion charging on a temporary basis and held a referendum after a pre-determined time. Stockholm voted to keep the congestion charge in place after the trial period. The trial period is an important part of the recommendation as it alleviates concerns that road pricing is simply a new taxation measure, while allowing for the program to produce the numerous benefits associated with it.

The province's current PMH1 is short sighted given the limited traffic congestion relief and the existing transportation and transit deficit. Additionally, given that the province has stated that it is committed to reducing GHG emissions in the long term, any transportation policy initiative must take emission levels into consideration. The TDM initiative provides the maximum benefit with respect to reduced GHG emissions. The province's PMH1 initiative will increase GHG emissions and run counter to the environmental objectives of the government on the whole.

The TDM initiative provides congestion reduction in a manner that maximizes spillover benefits. Additionally, the initiative locks in the benefits by virtue of the long run congestion relief that results from TDM. The proposed TDM initiative addresses the inequitable distribution of the subsidy through financial incentives. Both proposed financial incentives – congestion pricing and parking 'cash-out' – reduce congestion through a more fair distribution of the cost of driving.

The study also recommends that prior to continuing the PMH1 plan, the province performs full cost accounting with respect to highway expansion and vehicle use. It is important the province undertake these measures in order to better determine the most effective policy alternative.

Transportation policy has broad implications. As such, it cannot be considered and development in isolation from other governmental agencies and institutions. The TDM initiative is consistent with the objectives outlined in Metro Vancouver's LRSP and can assist municipal governments pursue more compact development that protects green zones.

Ultimately, the TDM policy alternative is the most effective in terms of achieving the objectives identified by the province and it generates more spillover benefits than the alternatives.

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