



FINAL REPORT

**Ministry of
Transportation**



Lions Gate to Highway 1 Connector Planning Study TECHNICAL REPORT



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The *Lions Gate to Highway 1 Connector Planning Study* was prepared for the Ministry of Transportation in consultation with staff of the District of West Vancouver, District of North Vancouver, City of North Vancouver and the Squamish Nation. This *Technical Report* includes support material for the *Summary Report* which highlights existing and forecast conditions, key issues, candidate improvements that were considered, and an evaluation of those short-listed improvement concepts.

For each of the short-listed improvement concepts, the *Technical Summary* report outlines the key issues being addressed, describes the improvement concept and provides a summary of the option assessment using the Multiple Account Evaluation framework. As described in the Summary Report, the improvement concepts have been separated into two groupings for the purpose of discussion and evaluation. The *Tier 1* improvement concepts include a series of base level enhancements that are generally considered to obtain reasonable benefits from other improvement concepts. For example, lengthening the left-turn and right-turn lanes at Marine Drive and Taylor Way moderately reduces delays to other traffic through the intersection and will enhance the effectiveness of other candidate options. *Tier 2* improvement concepts include all other short-listed improvement options that were examined in the study. The base condition for the purpose of measuring travel time benefits includes the combination of all Tier 1 concepts.



Tier 1 Concept A – Capilano Intersection Improvements

Project Description

- **Condition Summary.** The Marine Drive and Capilano Road area network experience the delays caused by the Lions Gate Bridge. During both the morning and afternoon peak periods, the back-ups from the bridge restrict traffic from progressing through the areas, even if they are not destined to the Bridge.

In the long-term, development plans for the “Capilano Triangle” north of Marine Drive will potentially result in significant growth in local traffic to the area. Neighbourhood plans for the area include the following changes in land use patterns projected to be built by 2021 (Table 1).

Table 1 – Study Area Planned Land Uses

Location	Type of development	Potential Build-Out	Projected Development by 2021
Evelyn Drive	Medium-density residential	<ul style="list-style-type: none"> • 500 townhouse and apartment units 	100%
Clyde Avenue	Medium-density residential	<ul style="list-style-type: none"> • 90 townhouse/ apartment units • 17-unit senior's oriented housing 	100%
Capilano Triangle	Mix of commercial and residential	<ul style="list-style-type: none"> • 230 residential units (21,180 m²) • Retail (8,204 m²) • Office (1,235 m²) • Service (50,081 m²) • Possible uses include entertainment complex, additional hotel rooms, and a community centre 	50% assumed
Marine Drive	Mix of commercial and residential	<ul style="list-style-type: none"> • 1,470 residential units (136,370 m²) • Retail (29,900 m²) • Office (9,130 m²) • Service (9,130 m²) 	50% assumed
Capilano IR No. 5 (east)	Residential and community use for Squamish nation members	<ul style="list-style-type: none"> • Single-family housing (180 additional units) • Townhouse and apartment housing (about 300 units) • Community facilities (including additional 9.8 ha for community use, 3.5 ha for traditional use, and 2.0 ha for park) • Squamish Business use (10-14 units in 550 m² building) 	50% assumed
Capilano IR No. 5 (west)	Commercial and high-density residential	<ul style="list-style-type: none"> • High density market residential housing (possibly 1740 units) • Low density market residential housing (possibly 520 units) • Commercial and mixed commercial/ residential uses 	50% assumed

Note: Planned land use information was based on information available at the outset of this study.



- **Improvement Concept.** With increased side street traffic along Capilano Road, growth in other traffic along the Marine Drive corridor, minor improvements have been identified through background studies completed for the District of North Vancouver. Figure 1-A illustrates the potential improvements which are briefly summarized as follows:
 - Revised signal timing at Capilano Road and Fullerton Avenue
 - New traffic signal at Capilano Road and Curling Road with minor changes to laning
 - Protected phase for southbound traffic at the intersection of Capilano Road and Marine Drive

Project Evaluation

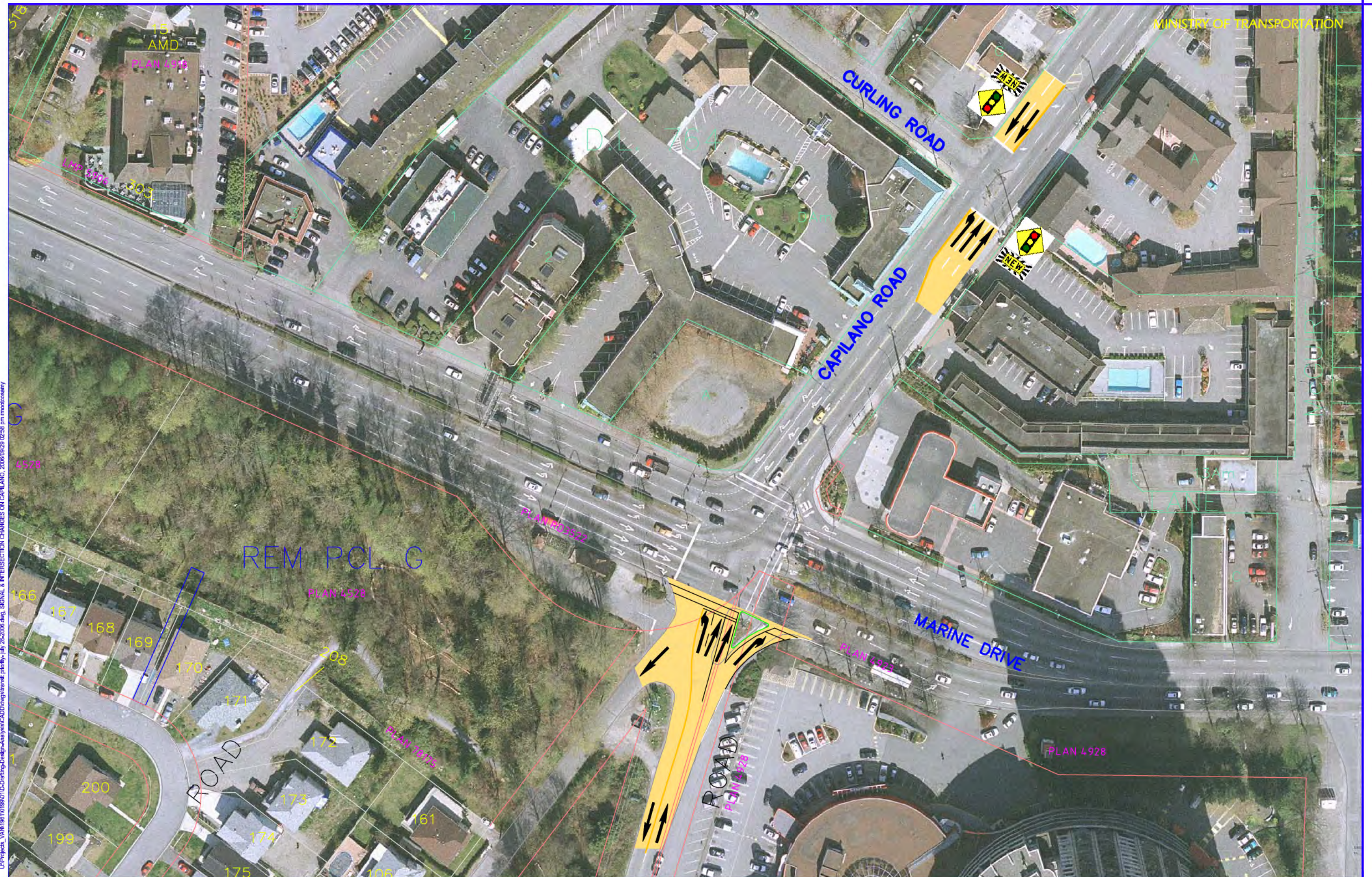
- **Financial Performance, Customer Service and Economic Indicators.** The total cost of the improvement concept is estimated to be \$0.25 million with a discounted incremental cost of \$0.21 million. Other costs include operating and maintenance, and salvage which are low in comparison.

The Capilano Road signal and intersection improvements would accommodate traffic growth projected for the planned developments in the “Capilano Triangle” area north of Marine Drive.

A B/C ratio of 27.4 and a positive net present value of \$5.5 million indicate that the benefits of this improvement do offset the costs.

EVALUATION ACCOUNT	CONCEPT
FINANCIAL (\$millions)	
Total Cost	\$ 0.25
Discounted Capital Cost (PV)	\$ 0.24
Operating & Maintenance Cost (PV)	\$ 0.01
Salvage Costs (PV)	(\$ 0.04)
Total Incremental Cost	\$ 0.21
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$ 5.52
Vehicle Operating Savings (PV)	\$ 0.19
Accident Savings (PV)	n/a
Total Benefits (PV)	\$ 5.70
ECONOMIC	
Net Present Value (in \$millions)	\$ 5.5
B/C Ratio	27.4

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period





A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$5.5 million to \$4.7 million (difference of approximately \$1 million). The net present value further decreases to \$4.0 million at a discount rate of 10%.

- **Transportation.** The provision of a new signal at Curling Road and revised signal timings at Fullerton Avenue would enhance the safety and operation for minor street traffic and improve local access. In the long-term, vehicle queues on southbound Capilano Road are anticipated to increase. However, transit services on Capilano Road (south of Fullerton Avenue) would experience slight delays (short- and long-term) due to the new signal. North of Fullerton Avenue, transit services would continue to use the designated bus lane.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	▪ Long-term vehicle queues on southbound Capilano Road	○
Collision Proneness	▪ Improves safety performance of traffic on Curling Road	●
Operation	▪ Reduced delays for traffic on Curling Road	●
Local Connectivity	▪ Improves access between Curling Road, Fullerton Avenue and Capilano Road	●
Transit	▪ Slight delays to transit service along Capilano Road as a result of a new signal at Curling Road	○
Pedestrians & Cyclists	▪ Facilities for pedestrians would be maintained ▪ No existing bicycle facilities on Capilano Road	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from a wider westbound bridge and widened eastbound bridge are negligible.



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	▪ No residential property impacts	0 properties
Commercial Properties Impacted	▪ No commercial property impacts	0 properties
Squamish Nation Land Impacts	▪ No Squamish Nation Land impacts	0 m ²
Noise Impacts	▪ No additional noise impacts	●
Aesthetic (Visual) Impacts	▪ No additional visual impacts	●
Impacts to Access	▪ No impacts to access	●
Supportive of Land Use Plans	▪ Generally supportive of land use plans	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

Environmental. No environmental impacts are anticipated for this concept.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ No watercourse impacts	●
High Value Wildlife Habitat and Vegetation	▪ No impacts to wildlife and vegetation	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** The minor laning changes at Capilano Road and Curling Road may require temporary lane closures that can be managed.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Requires temporary partial lane closure	●

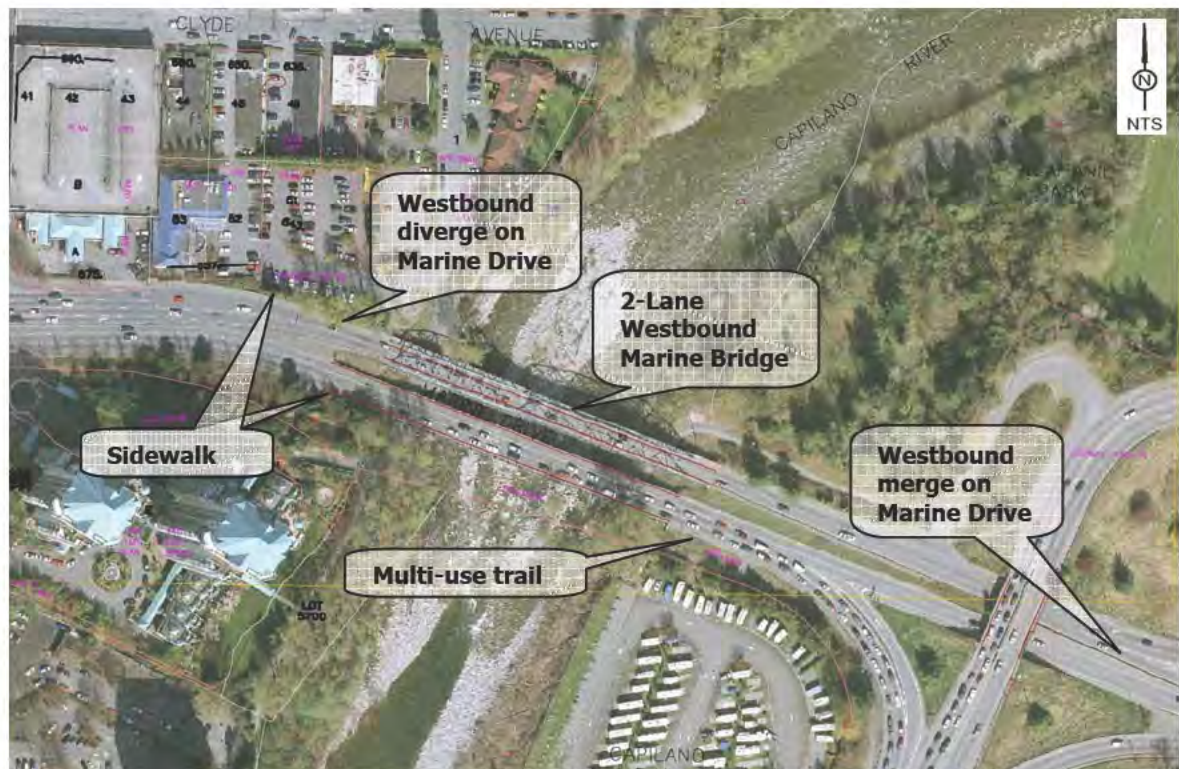
● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 1 Concept B – Widening Westbound Marine Bridge (with expanded eastbound bridge)

Project Description

- **Condition Summary.** Today, Marine Drive over the Capilano River is two lanes in the westbound direction, and three lanes on the other side of the Bridge. Northbound traffic from Lions Gate Bridge (approximately 840 vehicles and 1,700 vehicles in the existing AM and PM peak hours respectively) is forced to merge from two lanes to a single lane on Marine Drive across the Capilano River Bridge. Although the theoretical capacity of the Lions Gate Bridge is assumed to remain unchanged for the purpose of this study in the long-term, modelled 2021 PM peak hour volumes from the bridge are forecast to increase modestly, resulting in further delays from the existing merge along Marine Drive.



Westbound PM peak hour traffic volumes crossing the Capilano River are projected to increase from 2,625 to 3,210 vehicles on Marine Drive toward Taylor Way in 2021. Without changes to the network, the projected vehicle queues during the afternoon peak hour will extend further east to approximately 200 metres east of the Taylor Way intersection, or onto the Capilano River Bridge. This vehicle queue will impact overall access to turn lanes and increase overall



delays through the Marine Drive and Taylor Way intersection. In fact, the benefits derived from any improvements that further increase the flow of westbound traffic along Marine Drive will be limited with the current two lane bridge configuration.

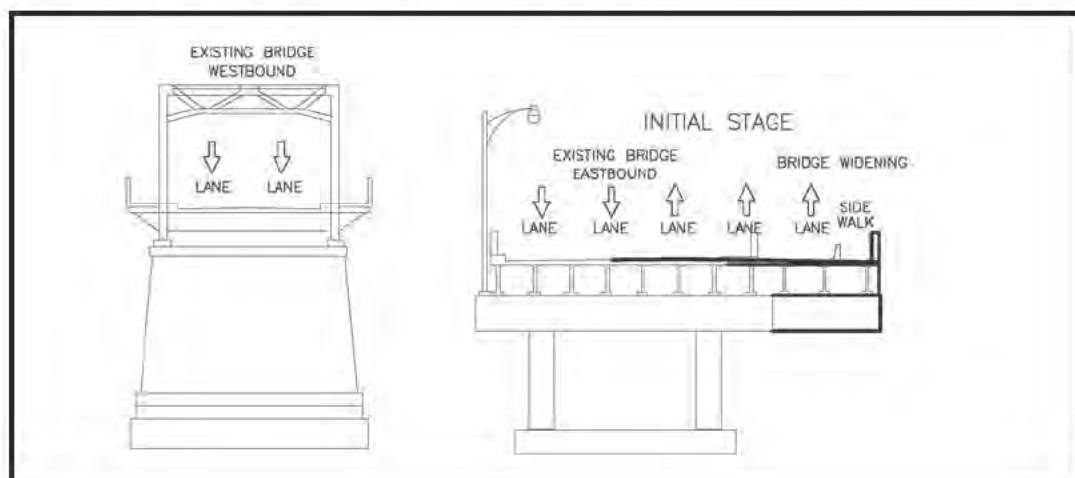
Cyclist and pedestrian facilities through the area include a multi-use trail system that extends along the north and south sides of Marine Drive, east of the Capilano River. An underpass of Marine Drive is provided alongside the river to connect pedestrians and cyclists to the facilities along the Lion's Gate Bridge. Sidewalk facilities are only provided on the south bridge structure over the Capilano River. Cyclists and pedestrians on the north side of Marine Drive must access this facility at Taylor Way. Most cyclists and pedestrians crossing the Lion's Gate Bridge will utilize the route south from Taylor Way and across the Capilano River Bridge.

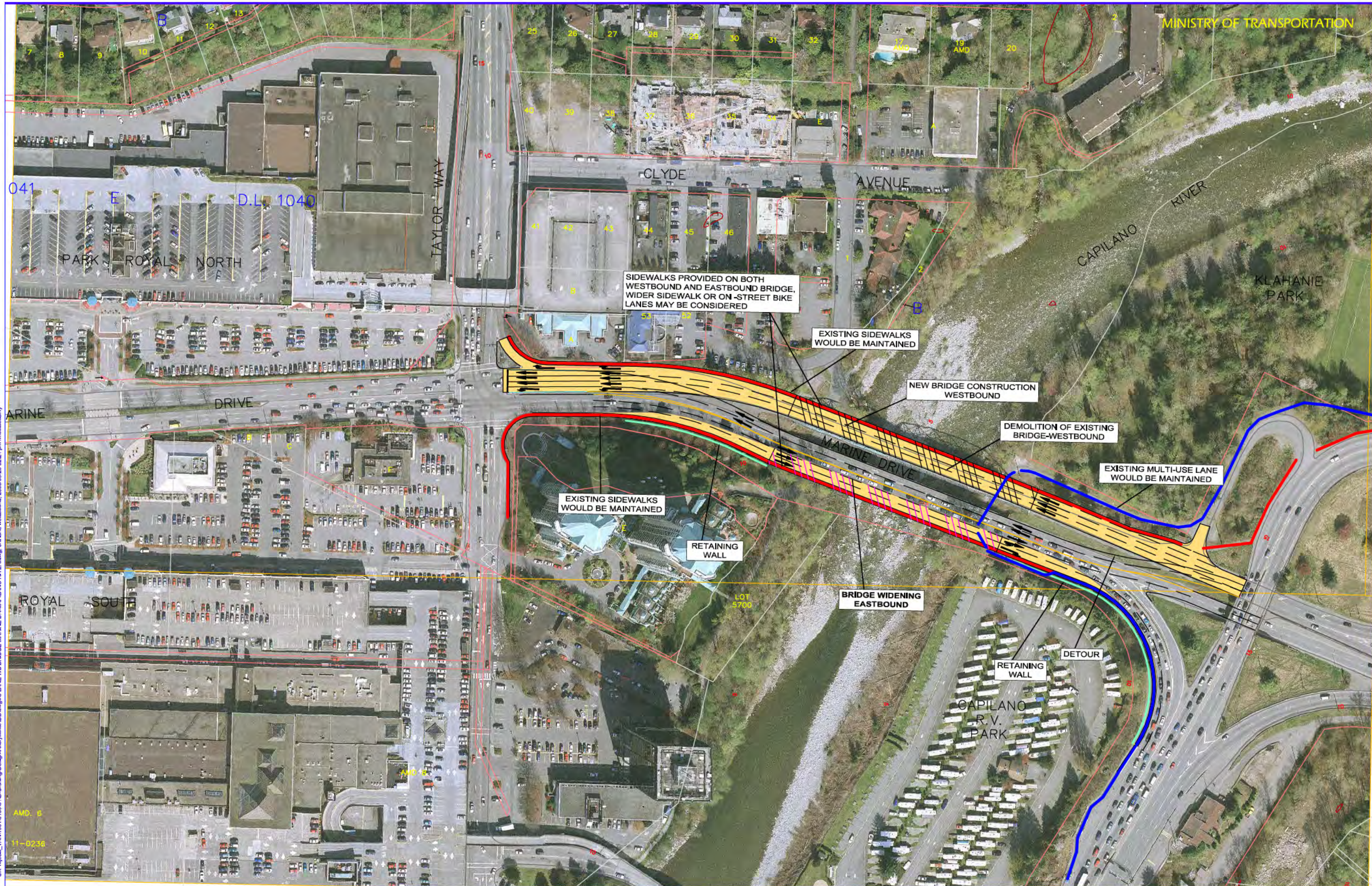
- **Improvement Concept.** The widening of the westbound lanes on Marine Drive across the Capilano River Bridge from two to three lanes is required to address forecast growth in traffic along the corridor and to support other improvements in the study area that may increase the flow of westbound traffic. An additional westbound lane along Marine Drive over the Capilano River requires a new bridge structure to replace the existing overhead steel truss bridge which is approximately 65 years old.

Consistent with previous studies, this improvement would be achieved in two stages as outlined below.

Stage 1

- Widen the existing eastbound precast concrete girder bridge to accommodate five lanes and permit westbound traffic to utilize two lanes during construction.
- Demolish existing westbound bridge





WIDENING WESTBOUND MARINE BRIDGE

FIGURE

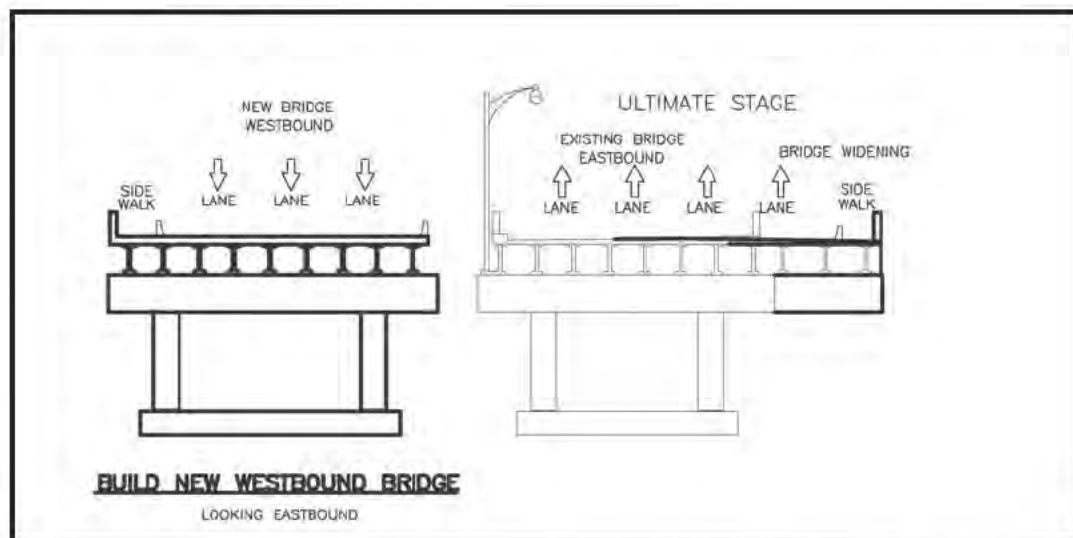
1-B

U:\Projects_VAN\18610169\01\Drawings\Design\Analysis\CAD\Drawings\1 LANE WB BRIDGE MARINE DR-CAPILANO RIVER.dwg, 3rd line westbound, 2006/09/28 02:24 pm mmodestany



Stage 2

- Replace existing westbound bridge with a three-lane two-span continuous steel girder bridge to serve westbound traffic along with a sidewalk. The total structure length of the new bridge would be approximately 145 metres, with ultimate travel lane and sidewalk widths of 3.6 metres and 2.0 metres, respectively. Abutment and pier locations would match those of the existing westbound structure. Cyclists would share the sidewalk with pedestrians. Alternatively, consideration may be given toward either a wider sidewalk area or bike lanes of 1.5m on the new bridge.
- Reconfigure the eastbound bridge to four travel lanes – two lanes to the Lions Gate Bridge and two lanes along Marine Drive along with a 2.0m sidewalk for pedestrians and cyclists. Consideration may be given toward the provision of either a wider sidewalk or on-street bike lanes across the widened bridge to connect with the multi-use pathway. The bicycle facility that crosses Marine Drive underneath the existing westbound and eastbound bridges would be maintained.



It should also be noted that this concept would likely include eliminating the existing westbound access to the transit loop on the north side of Marine Drive (see section 3.2.1). Consideration may be given toward either providing left-turn access to the existing transit priority lane for eastbound transit to the Lions Gate Bridge or sharing existing westbound general purpose lanes between Capilano Road and the Bridge.



If the existing westbound bridge is not replaced, the aging bridge will continue to deteriorate, and require repairs. Several rehabilitation options are identified and described in the next improvement concept.

Project Evaluation

- **Financial Performance, Customer Service and Economic Indicators.** The total cost of the improvement concept is estimated to be \$25.7 million with a discounted incremental cost of \$20.1 million. Other costs include operating and maintenance, and salvage value which are low in comparison.

The widening of the westbound Marine Bridge would increase the capacity on the bridge and eliminate the merge conflict for traffic entering westbound Marine Drive from northbound Lions Gate on-ramp. This results in travel time savings, as well as moderate improvement in the safety performance which has not been considered in this review.

A B/C ratio of 1.1 and a positive net present value of \$2.8 million indicate that the benefits of this improvement make it a reasonable investment.

EVALUATION ACCOUNT	CONCEPT
FINANCIAL (\$millions)	
Total Cost	\$ 25.68
Discounted Capital Cost (PV)	\$ 24.23
Operating & Maintenance Cost (PV)	\$ 0.03
Salvage Costs (PV)	(\$ 4.14)
Total Incremental Cost	\$ 20.12
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$22.12
Vehicle Operating Savings (PV)	\$ 0.77
Total Benefits (PV)	\$ 22.89
ECONOMIC	
Net Present Value (in \$millions)	\$ 2.8
B/C Ratio	1.1

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, these results indicate that, at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$2.8 million to -\$3.0 million (absolute difference of approximately \$5.8 million). The net present value further decreases to a negative value of \$6.9 million at a discount rate of 10%.



- **Transportation.** The provision of a widened westbound bridge across the Capilano River eliminates the merge for westbound traffic from the Lions Gate Bridge and reduces the delay for westbound trips along Marine Drive. The additional capacity also reduces merging conflicts and improves the safety performance moderately.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> No impacts to vehicles queues at intersection of Taylor Way and Marine Drive 	●
Collision Proneness	<ul style="list-style-type: none"> The increased capacity would reduce merging conflicts and improve the safety performance moderately 	●
Operation	<ul style="list-style-type: none"> Slight reduction in delays from the Lions Gate Bridge by removal of merge for westbound traffic Reduced delays at Taylor Way and Marine Drive intersection Weave for transit vehicles is unchanged and problematic 	●
Local Connectivity	<ul style="list-style-type: none"> Slightly enhanced connection between Lions Gate and Taylor Way / Marine Drive 	●
Transit	<ul style="list-style-type: none"> Impacts on transit services are considered to be modest 	●
Pedestrians & Cyclists	<ul style="list-style-type: none"> Existing bicycle and pedestrian facilities will be preserved New sidewalk provided on the westbound bridge 	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from a wider westbound bridge and widened eastbound bridge are negligible as summarized below.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	<ul style="list-style-type: none"> No residential property impacts 	0 properties
Commercial Properties Impacted	<ul style="list-style-type: none"> No commercial property impacts 	0 properties
Squamish Nation Land Impacts	<ul style="list-style-type: none"> No Squamish Nation Land impacts 	0 m ²
Noise Impacts	<ul style="list-style-type: none"> No additional noise impacts 	●
Aesthetic (Visual) Impacts	<ul style="list-style-type: none"> No additional visual impacts 	●
Impacts to Access	<ul style="list-style-type: none"> No impacts to access 	●
Supportive of Land Use Plans	<ul style="list-style-type: none"> Generally supportive of land use plans 	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



- **Environmental.** The Marine Drive bridges cross the Capilano River which is classified as an environmentally sensitive area, as it is an important salmon and trout producing stream. The pier locations for the new westbound bridge would be consistent with the old structure. Appropriate mitigation measures to manage the impacts of constructing a new bridge, or widening the eastbound bridge would be provided. No other impacts on wildlife or vegetation are anticipated with this improvement.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ No additional impacts ▪ Construction impacts are mitigable	●
High Value Wildlife Habitat and Vegetation	▪ No impacts	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** Two additional lanes on the eastbound bridge will serve to manage construction impacts on the traffic along Marine Drive during the demolition and construction of the new westbound bridge over the Capilano River. Although vehicle speeds through the construction area will be reduced, widening and use of the eastbound bridge is temporary.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Impacts of construction on traffic are manageable	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 1 Concept C – Rehabilitation of Westbound Marine Drive Bridge

Project Description

- **Condition Summary.** The old Capilano River Bridge is a two lane, two-span overhead steel truss structure that carries westbound traffic along Marine Drive. CH2M Hill undertook an assessment of both bridges in November 2005 which is contained in the Appendix of the Summary Report. Based on this inspection and a review of the Ministry's inspection report, the following summarizes the current condition of the westbound bridge.
 - **Substructure.** The Ministry report indicates that the substructure is found to be almost exclusively rated 'fair' with some aspects of the pier columns rated as 'poor' and some bearings rated as 'very poor.' The east pier was the only one accessible for visual inspection.
 - **Superstructure.** The Ministry inspection report indicates that this is in the best state of condition, in that the majority of the structural elements were rated as 'good' or 'fair.' Further investigation indicated that the condition of the steel of the overhead trusses was typically fairly good, but was compromised with extensive peeling and delamination in some locations.
 - **Bridge Deck.** On average, the bridge deck was found to be in "fair" condition, with the sidewalks rated as 'excellent,' the deck joints and wearing surface mostly rated as 'good,' and railings rated as 'poor' and the coating of the railings rated as 'very poor.' The visual inspection indicates significant wearing on the roadway surface in some areas.
- **Improvement Concept.** If the existing westbound bridge is not replaced, the aging bridge will continue to deteriorate, and already requires repairs. Several options were developed by RKTG Associates Ltd. in April 2004 for the rehabilitation and painting of the steel bridge. These options and costs were reviewed by CH2M Hill as part of this assignment and used to compare with the widening options. Escalation of the initial cost estimates (to 2006 dollars) was included in this review. The following discussion highlights the rehabilitation options for the westbound bridge which are estimated to require 7 to 9 months:
 1. **Painting only**, with provision for traffic control. The works included in this assessment includes:
 - a. Sandblast all exposed surfaces of the steel structure
 - b. Preparation work will special detailing at specific locations
 - c. Guardrail removal and replacement



- d. Repair most serious corrosion damage to the deck stringers
2. **Rehabilitation and painting** includes the works described above, with additional rehabilitation work to provide a service life expectation of 10 years as summarized in a February 2003 letter prepared by RKTG Associates. The scope of the rehabilitation included:
- a. Confinement reinforcing for Piers 1 and 2;
 - b. Repair the deteriorated portions of structural deck of the original 250 ft. span and the approach jump span;
 - c. Repair of longitudinal deck stringers
 - d. Roller bearings on Pier No. 2 repair
 - e. Deck joints repair

Project Evaluation

The following discussion summarizes the project evaluation for rehabilitation of the westbound Marine Drive bridge:

- **Financial Performance, Customer Service and Economic Indicators (see Table 1 below).** These cost of these rehabilitation options were reviewed by CH2M Hill as part of this assignment. Escalation of the initial cost estimates (to 2006 dollars) have been included in this review. The following discussion highlights those options for the westbound bridge which are estimated to require 7 to 9 months:
 - **Painting only**, with provision for traffic control is approximately \$3.5 million
 - **Rehabilitation and painting** is estimated to be \$4.4 million. This option does not include detours, but permits occasional lane closures as required. The rehabilitation elements were outlined in February 24, 2003 letter prepared by RKTG Associates. If the eastbound lanes were widened to permit traffic to detour, the cost of this work would decrease to \$3.9 million (not including the cost of widening the eastbound structure).

No customer service benefits are anticipated with either rehabilitation options. The net present value of this concept is -\$4.1 million.

**Table 1 - Old Capilano Bridge Rehabilitation**

EVALUATION ACCOUNT	Concept
FINANCIAL (\$millions)	
Total Cost	\$ 4.4
Discounted Capital Cost (PV)	\$ 4.1
Operating & Maintenance Cost (PV)	\$ 0
Salvage Costs (PV)	\$ 0
Total Incremental Cost	\$ 4.1
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$ 0
Vehicle Operating Savings (PV)	\$ 0
Accident Savings (PV)	\$ 0
Total Benefits (PV)	\$ 0
ECONOMIC	
Net Present Value (in \$millions)	- \$4.1
B/C Ratio	n.a.

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

- **Transportation.** No benefits or impacts on the transportation system anticipated.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	▪ No change	●
Collision Proneness	▪ No change	●
Operation	▪ No Change	●
Local Connectivity	▪ No impacts	●
Transit	▪ No change	●
Pedestrians & Cyclists	▪ No change	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** No community benefits or impacts anticipated.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	▪ No residential property impacts	0 properties
Commercial Properties Impacted	▪ No commercial property impacts	0 properties
Squamish Nation Land Impacts	▪ No Squamish Nation Land impacts	0 m ²
Noise Impacts	▪ No additional noise impacts	●
Aesthetic (Visual) Impacts	▪ No additional visual impacts	●
Impacts to Access	▪ No impacts to access	●
Supportive of Land Use Plans	▪ No impacts on land use patterns	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



- **Environmental.** Potential environmental impacts from bridge rehabilitation can are manageable.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ Potential impacts can be managed	●
High Value Wildlife Habitat and Vegetation	▪ No impacts are anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** It is anticipated that the rehabilitation on the underside of the bridge could not occur without lane closures. Night time lane closures should likely be considered and are manageable.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Night time closures are expected and manageable.	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



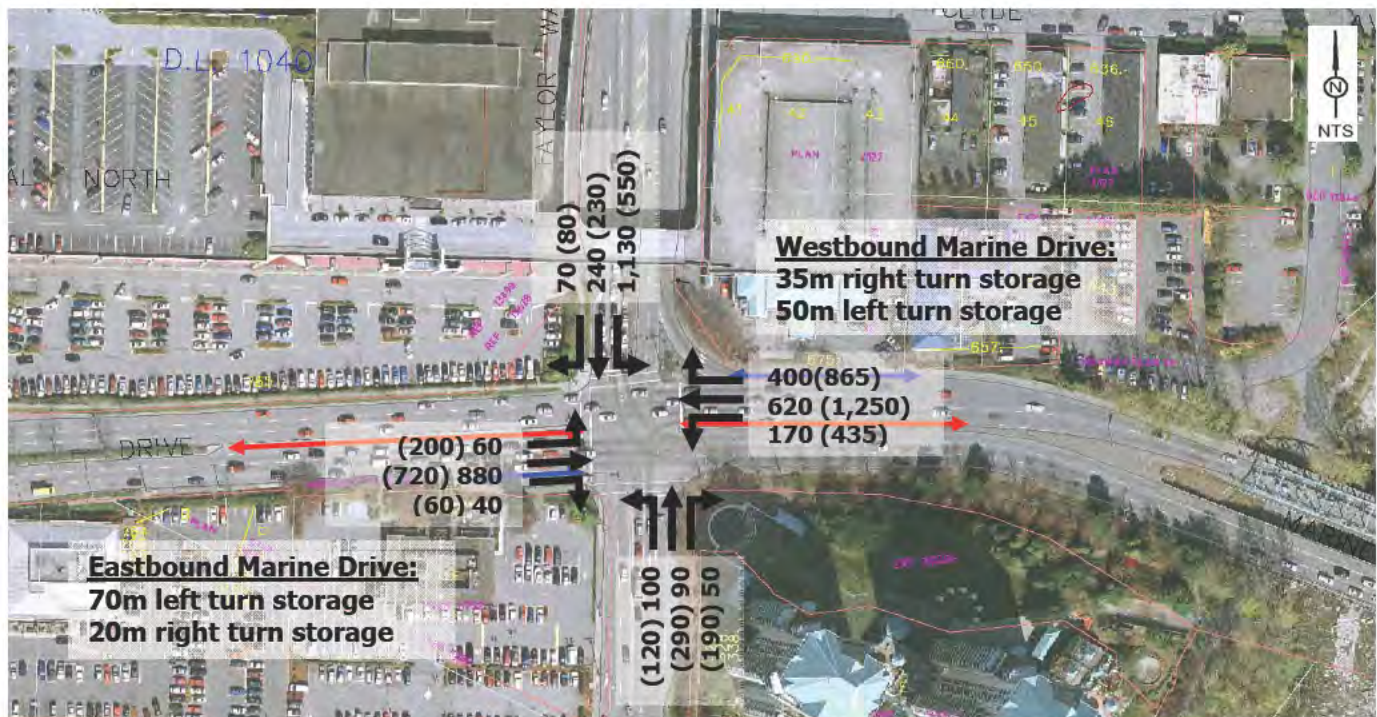
Tier 1 Concept D – Lengthen Turn Lanes at Marine Drive / Taylor Way

Project Description

- **Condition Summary.** Today, the vehicle turn movements at the intersection of Marine Drive and Taylor Way are significant as summarized in Figure 1 below. In particular, the westbound right turns from Marine Drive to Taylor Way accommodate approximately 865 vehicles during the afternoon peak hour. Because the westbound vehicle queues often extend beyond the entry to the right turn lane, vehicles travelling westbound on Marine Drive to Taylor Way are blocked by the through traffic queues.

Similarly, the eastbound and westbound left turn demands are also significant and occasionally spill back into the through lanes. Without a finer grid of north-south streets that connect to Marine Drive, the demands for these left turn movements will continue to grow in the long-term. As experienced today, these vehicle queues impact through traffic and the effectiveness of the signal operation at Marine and Taylor Way.

Figure 1
Existing AM/PM Peak Hour Traffic Volumes
(Marine Drive / Taylor Way)





To determine the queues along Marine Drive for the existing AM and PM peak hours, a queue analysis was prepared by using the software program, Synchro Trafficware. Results indicate that during the PM peak hour, the westbound through queue length (95th percentile) is approximately 110 metres, which blocks the entry to both the left- and right-turn lanes. Similarly, in the eastbound direction, the queue length for left turn movement is approximately 95 metres spilling back into the through travel lane.

- **Improvement Concept.** Extending the storage and entry areas to the westbound right turn and left turn lanes as well as the eastbound left turn lane will serve to both store more vehicles and allow earlier access to reduce the impacts of through traffic. This improvement concept includes the following changes to the turn lanes:
 - Westbound left turn lane (storage and taper) is increased from 110 to 150 metres to reduce the frequency of spillback into the through traffic lanes.
 - Westbound right turn lane (storage and taper) is increased from 70 to 150 metres to provide earlier access for traffic proceeding north along Taylor Way.
 - Eastbound left turn lane (storage and taper) is increased from 105 metres to 160 metres to accommodate additional traffic and reduce spillback into through travel lanes.

This improvement concept is illustrated in Figure 1-D.



1:2000



LENGTHEN TURN LANES AT MARINE - TAYLOR

FIGURE
1-D

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Project Evaluation

- **Financial Performance, Customer Service and Economic Indicators.** The total cost of the improvement concept is estimated to be \$0.18 million with a discounted incremental cost of \$0.15 million. Other costs include operating and maintenance, and salvage which are low in comparison.

The lengthening of turn lanes on Marine Drive would result in operation improvements and reduced delays at the intersection.

A B/C ratio of 232 and a positive net present value of \$33.8 million indicate that the benefits of this improvement make this a very attractive transportation investment.

EVALUATION ACCOUNT	CONCEPT
FINANCIAL (\$millions)	
Total Cost	\$ 0.18
Discounted Capital Cost (PV)	\$ 0.17
Operating & Maintenance Cost (PV)	\$ 0.004
Salvage Costs (PV)	(\$ 0.03)
Total Incremental Cost	\$ 0.15
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$ 32.75
Vehicle Operating Savings (PV)	\$ 1.18
Accident Savings (PV)	n/a
Total Benefits (PV)	\$33.93
ECONOMIC	
Net Present Value (in \$millions)	\$ 33.8
B/C Ratio	231.7

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$34 million to \$27 million (difference of approximately \$7 million). The net present value further decreases to \$22 million at a discount rate of 10%.

- a. Transportation.** Extension of the eastbound left-turn lane and the westbound right- and left-turn lanes would permit storage of more vehicles and/or early access to reduce impacts on through traffic. As expected, these improvements slightly reduce the impacts of vehicle queues on through and turning traffic at the intersection, thus reducing overall delays.



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	▪ Slightly reduces impacts of vehicle queues on through traffic	●
Collision Proneness	▪ Similar to existing conditions	○
Operation	▪ Reduced delays at Marine Drive/Taylor Way intersection	●
Local Connectivity	▪ Slightly enhanced connection between Marine Drive to Taylor Way	●
Transit	▪ Vehicle queue impacts of Marine Drive on transit service would be slightly reduced	●
Pedestrians & Cyclists	▪ Facilities for pedestrians and cyclists would be maintained	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from extension of turn lanes are negligible.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	▪ No residential property impacts	0 properties
Commercial Properties Impacted	▪ No commercial property impacts	0 properties
Squamish Nation Land Impacts	▪ No Squamish Nation Land impacts	0 m ²
Noise Impacts	▪ No additional noise impacts	○
Aesthetic (Visual) Impacts	▪ No additional visual impacts	○
Impacts to Access	▪ No impacts to access	○
Supportive of Land Use Plans	▪ Generally supportive of land use plans	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Environmental.** No environmental impacts are anticipated for this concept.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ No watercourse impacts	○
High Value Wildlife Habitat and Vegetation	▪ No impacts to wildlife and vegetation	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse



- **Constructability.** The extension of the turn lanes on Marine Drive may require temporary lane closures that can be managed.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Requires temporary partial lane closure	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 2 - Concept Ai & ii – Eastbound Marine Drive Storage Lanes (4 and 6 lanes)

Project Description

- **Condition Summary.** The section of Marine Drive east of Taylor Way is currently three lanes in the eastbound direction with one through lane, a shared through/right middle lane, and a right lane to the Lions Gate Bridge. East of the on-ramp to the bridge, Marine Drive is two lanes. Existing peak direction of travel is eastbound during the morning peak hour with approximately 2,060 vehicles of which 80 percent travel towards the bridge. Similarly, during the evening peak hour, there are approximately 1,460 vehicles, with half of the traffic destined towards the bridge.

Vehicle queues on the west side approaches toward the Lions Gate Bridge in the morning and afternoon during both peak periods are approximately the same length. However the speed at which traffic moves during the afternoon is approximately half that of the morning because of the merge to a single lane onto the Bridge. During both peak periods, vehicle queues regularly extend beyond the intersection of Marine Drive and Taylor Way. Table 1 below summarizes existing and forecast 2021 vehicles queues along Marine Drive and Taylor Way leading toward the Lions Gate Bridge during the afternoon peak hour.



**Table 1 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	2005 Existing		Forecast 2021	
	Average	Maximum	Average	Maximum
Marine Drive (West of Taylor Way)	130 m (east of the pedestrian crossing near the Keg Restaurant)	250 m (west of the pedestrian crossing near the Keg Restaurant)	540 m (east of Main Street)	650 m (west of Main Street)
Taylor Way (north of Marine Drive)	620 m (north of Keith Road)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)

As noted above, the average and maximum vehicle queues are longest along Taylor Way north of Marine Drive. In fact, the maximum queue length can extend almost to the eastbound off-ramp of Highway 1. With further growth and development in the area, it is anticipated that the average queue length along Taylor Way during the afternoon peak hour could extend onto the off-ramp and potentially onto Highway 1.

It should be recognized that although the delays and vehicle queues are created by the limited capacity of the Lions Gate Bridge, the length of vehicle queues are affected by the combination of local area and bridge traffic. As a result, all traffic moving through the study area will be impacted by the shared storage area with Lions Gate Bridge traffic.

It should be recognized that most cyclists accessing the Lions Gate Bridge either utilize the existing underpass of Marine Drive and pathway, or utilize the route south on Taylor Way through to the Capilano River bridge as previously illustrated.

- Improvement Concept.** In an effort to reduce the impacts of the Lions Gate Bridge queues on other travel on the North Shore (including the eastbound along Highway 1), two concepts involving a storage area along Marine Drive east of Taylor Way were considered as illustrated in Figures 2-A(i) and 2-A(ii). The two concepts essentially involve the provision of four or six eastbound travel lanes that extend from immediately east of Taylor Way on Marine Drive through to the merge with traffic arriving from the east side of the Bridge. After proceeding through the storage area, traffic could either merge through drop lanes or be controlled by "metering" traffic onto the bridge as illustrated. On the west side of Taylor Way, a new eastbound through lane would be developed to allow for two through lanes to the bridge. The leftside through lanes would be directly aligned with the non-bridge traffic lanes along the Marine Drive. On the east side of the intersection, these two lanes would be separated from the Lions Gate Bridge traffic using a narrow median island or barriers. With this option, it is anticipated that buses could continue to utilize the non-bridge lanes to get to the transit priority lane which could be extended further south toward the bridgehead. It is essential that



the existing merge activity between the eastbound and westbound traffic to go south onto the bridge does not change with either improvement concept.

It should be recognized, that a gradual merge or metered control from four or six lanes to one is unconventional for either an urban roadway or highway facility. A complete review of the design and operation of this concept would be required before being implemented.

The proposed widening over the Capilano River is achieved with a multi-span continuous precast girder bridge that would be separated from the existing structure currently carrying the eastbound traffic. The new structure would either be 4 or 6 lanes and match the abutment and pier locations of the existing eastbound structure. These bridges would be crane erected and construction would require a staging area at the abutments of the structures.

Consistent with the existing eastbound bridge structure, a 2.0 m sidewalk would be provided on the south side of the new bridge for pedestrians and cyclists. Alternatively, consideration may be given toward a wider sidewalk or an on-street bike lane connecting Taylor Way with the multi-use trail toward the Lion's Gate Bridge. The existing multi-use trail beneath Marine Drive, along the Capilano River would be extended and preserved to connect with the existing connections to the bridge.

As summarized in Table 2 below, the four and six lane storage areas significantly reduce vehicle queues along Marine Drive and Taylor Way. These and other observations are briefly highlighted below:

- Existing vehicle queues would be significantly reduced with the four and six lane concepts.
- Forecast 2021 bridge queues will be comparable to today's conditions.
- The four and six lane bridge queues are not significantly different, particularly for the 2021 conditions.

**Table 2 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	Existing Network				Improvement Concepts (i & ii)			
	2005 Volumes		2021 Volumes		2005 Volumes		2021 Volumes	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Marine Drive <i>(west of Taylor Way)</i>	130 m (east of the pedestrian crossing near the Keg Restaurant)	250 m (west of the pedestrian crossing near the Keg Restaurant)	540 m (east of Main Street)	650 m (west of Main Street)	30-50 m (White Spot Restaurant)	50-100m (between White Spot and the Keg Restaurants)	220-410 m (west of pedestrian crossing near the Keg Restaurant)	300-500 m (Park Royal South)
Taylor Way <i>(north of Marine Drive)</i>	620 m (north of Keith Road)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	30-40m (Park Royal Overpass)	80-100 m (Clyde Avenue)	360-900 m (between Keith Road and north of Inglewood Avenue)	1,100 m (eastbound Highway 1 off-ramp)

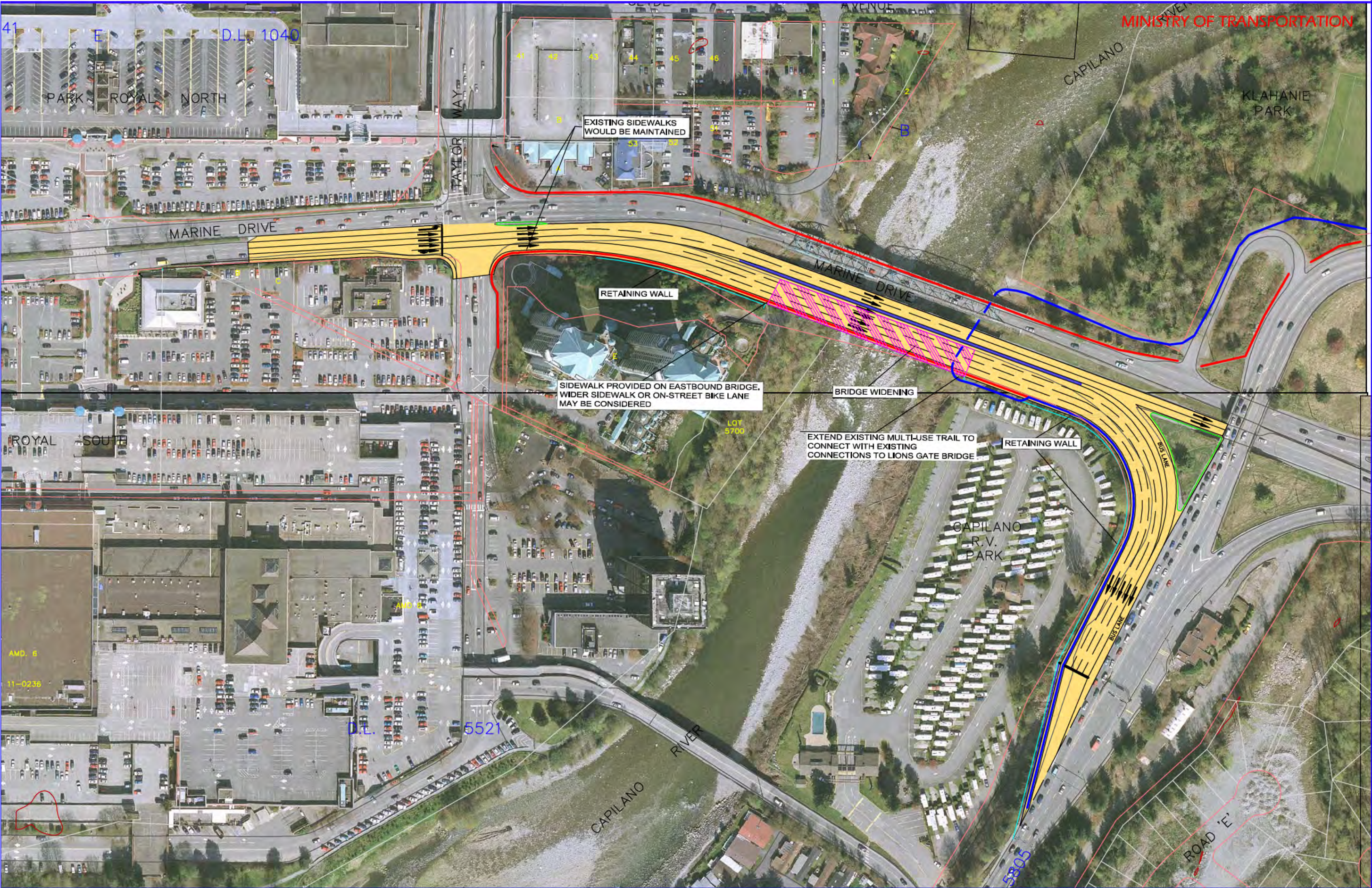
Project Evaluation

The following discussion details the evaluation of the four and six storage lane concepts.

- **Financial Performance, Customer Service and Economic Indicators (see Table 3 below).** The total cost of the four and six lane improvement concepts are estimated to be \$19.02 and \$28.43 million respectively.

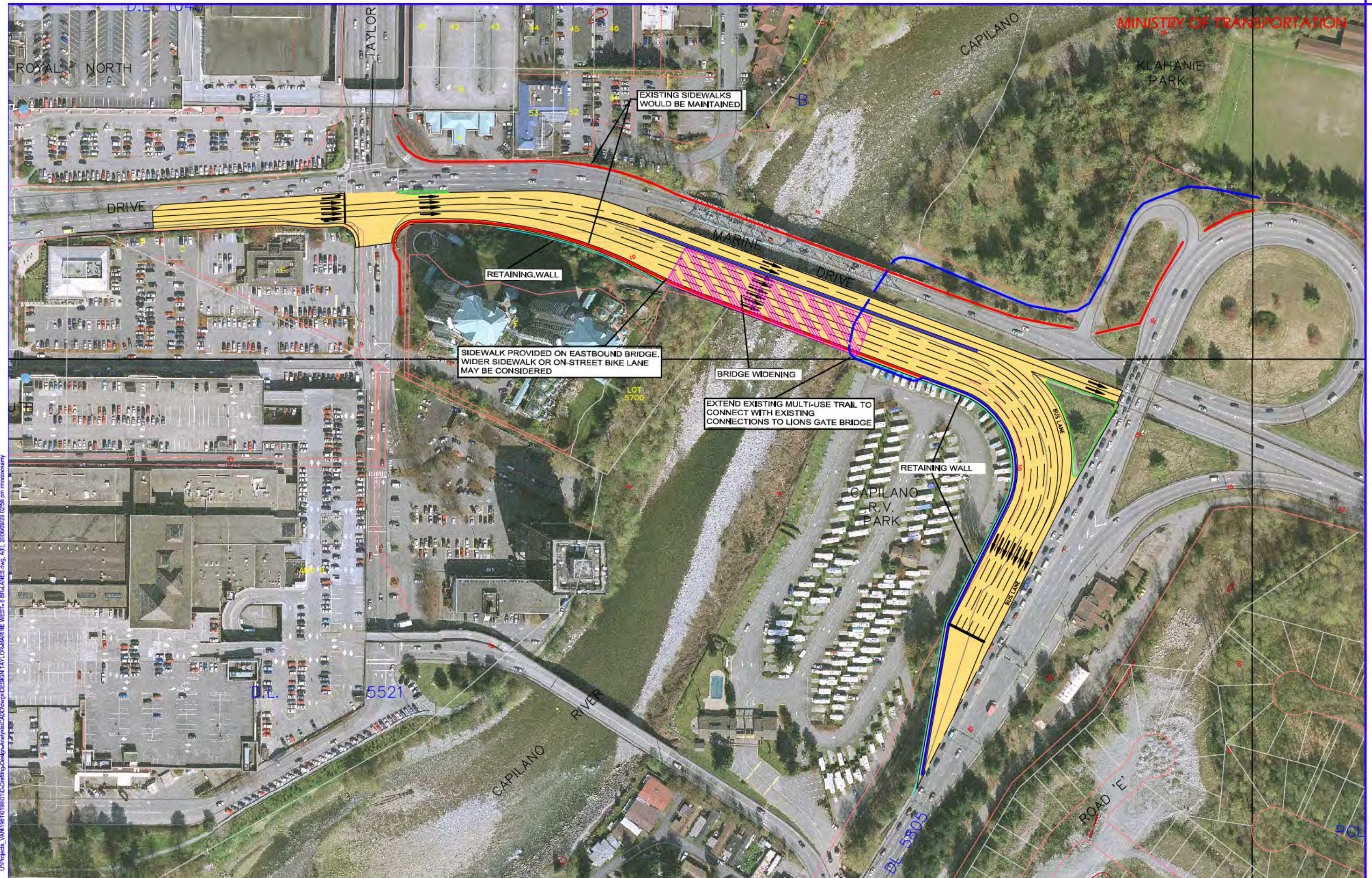
In the short- to medium-term, the additional storage lanes significantly reduce vehicle queues along Marine Drive and Taylor Way. Although the travel times to the bridge do not theoretically change with either concept, other trips being made throughout the study area (including along Highway 1) experience reduced delays. For example, vehicle trips along Marine Drive to, from and within the study area would experience slightly less delay due to the reduced impacts of Lions Gate Bridge queues. Further, eastbound traffic along Highway 1 from west of Taylor Way through to Capilano Road would also experience less delay if the 2021 vehicle queues forecast onto the highway were reduced. The present value of the total travel time and vehicle operating benefits for the four and six lane concepts are estimated to be \$122 and \$160 million respectively.

The B/C ratios of for the four and six lane concepts are estimated to be 8.3 and 7.2 respectively, with a positive net present value of \$107 and \$137 million, respectively. These results indicate that the benefits of this improvement will significantly offset the costs. As noted, the B/C ratio derived from the six lane option does not exceed that of the four lane option.



EASTBOUND STORAGE FOR LIONS GATE - 4 LANES

FIGURE
2-A(i)



**Table 3 - Eastbound Storage Lane Financial Summary**

EVALUATION ACCOUNT	4 Lane	6 Lane
FINANCIAL (\$millions)		
Total Cost	\$ 19.02	\$ 28.43
Discounted Capital Cost (PV)	\$ 17.94	\$ 26.82
Operating & Maintenance Cost (PV)	\$ 0.20	\$ 0.28
Salvage Costs (PV)	(\$ 3.36)	(\$ 4.96)
Total Incremental Cost	\$ 14.78	\$ 22.14
CUSTOMER SERVICE (\$millions)		
Travel Time Savings (PV)	\$ 116.28	\$ 152.37
Vehicle Operating Savings (PV)	\$ 5.69	\$ 7.11
Accident Savings (PV)	n/a	n/a
Total Benefits (PV)	\$ 121.97	\$ 159.48
ECONOMIC		
Net Present Value (in \$millions)	\$ 107.2	\$ 137.3
B/C Ratio	8.3	7.2

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$107.2 million to \$82.3 million for 4 lanes (difference of approximately \$25 million), and \$137.3 to \$104.3 million (difference of approximately \$33 million). The net present values further decrease to \$64 million (4 lanes) and \$80 million (6 lanes) at a discount rate of 10%.

- **Transportation.** The provision of a storage area in the eastbound direction along Marine Drive east of Taylor Way would reduce impacts of the Lions Gate Bridge queues on other travel within the North Shore. In general, it would improve travel times of through traffic along Marine Drive, and enhance the operation at the intersection of Taylor Way and Marine Drive. The primary challenge with these improvement concepts – particularly the six lane option, is the merge at the Lion's Gate Bridge head. Although traffic controls, or a merge condition could be examined at subsequent stages of design, either option slightly increases conflicts and collision proneness.

In addition to the travel time savings to general purpose traffic, the reduced vehicle queues in the westbound direction along Marine Drive will also reduce delays to transit vehicles. West of Taylor Way, buses will be able to easily access the left side lane along Marine Drive.



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> Storage area accommodates existing bridge traffic reducing the impact for trips between West Vancouver and North Vancouver Forecast 2021 average vehicle queues along Marine Drive and Taylor Way would be reduced 	●
Collision Proneness	<ul style="list-style-type: none"> The four or six lane merge may increase vehicle conflicts 	○
Operation	<ul style="list-style-type: none"> Reduced impact of the bridge queues improves travel times of through traffic along Marine Drive Reduced delays at Taylor Way and Marine Drive intersection 	●
Local Connectivity	<ul style="list-style-type: none"> Local area travel is greatly enhanced particularly along Marine Drive, as well as Highway 1 (eastbound) 	●
Transit	<ul style="list-style-type: none"> Reduced eastbound vehicle queues along Marine Drive will reduce delays on transit services from West Vancouver today and in the long-term Long-term vehicle queues along Marine Drive west of Capilano Road are still expected 	●
Pedestrians & Cyclists	<ul style="list-style-type: none"> Pedestrian and cyclist facilities would be maintained 	●

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from the eastbound storage lanes on Marine Drive are significant. Overall, partial takings would be required from one multi-family and three commercial properties.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	<ul style="list-style-type: none"> Residential property impacts at West Royal Apartments 	1 high-rise property (partial take)
Commercial Properties Impacted	<ul style="list-style-type: none"> Commercial property impacts along the south side of Marine Drive 	3 properties (partial takes)
Squamish Nation Land Impacts	<ul style="list-style-type: none"> Squamish Nation Land impacts (Capilano RV Park) 	1,250 m ² (4 lanes) 2,200 m ² (6 lanes)
Noise Impacts	<ul style="list-style-type: none"> No additional noise impacts 	●
Aesthetic (Visual) Impacts	<ul style="list-style-type: none"> No additional visual impacts 	●
Impacts to Access	<ul style="list-style-type: none"> No impacts to access 	●



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Supportive of Land Use Plans	<ul style="list-style-type: none"> Generally supportive of land use plans 	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- Environmental.** The Marine Drive bridges cross the Capilano River which is classified as an environmentally sensitive area, that is an important salmon and trout-producing stream. The placement of additional piers within the Capilano River would be required with this concept. Although the location of the piers would be aligned with those of the existing eastbound structure, the potential environmental impacts on the river would need to be examined in subsequent stages of design and mitigated.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	<ul style="list-style-type: none"> No parkland impacts 	0 m ²
Watercourse Impacts	<ul style="list-style-type: none"> Potential environmental impacts on the river would need to be examined in subsequent stages of design and mitigated 	○
High Value Wildlife Habitat and Vegetation	<ul style="list-style-type: none"> No impacts anticipated 	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- Constructability.** The new eastbound bridge over the Capilano River would be crane erected with a construction staging area at the abutments of the structure.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	<ul style="list-style-type: none"> The widening of the eastbound bridge structure would be parallel and separate from the existing structure and have minimal impact on existing traffic patterns. 	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

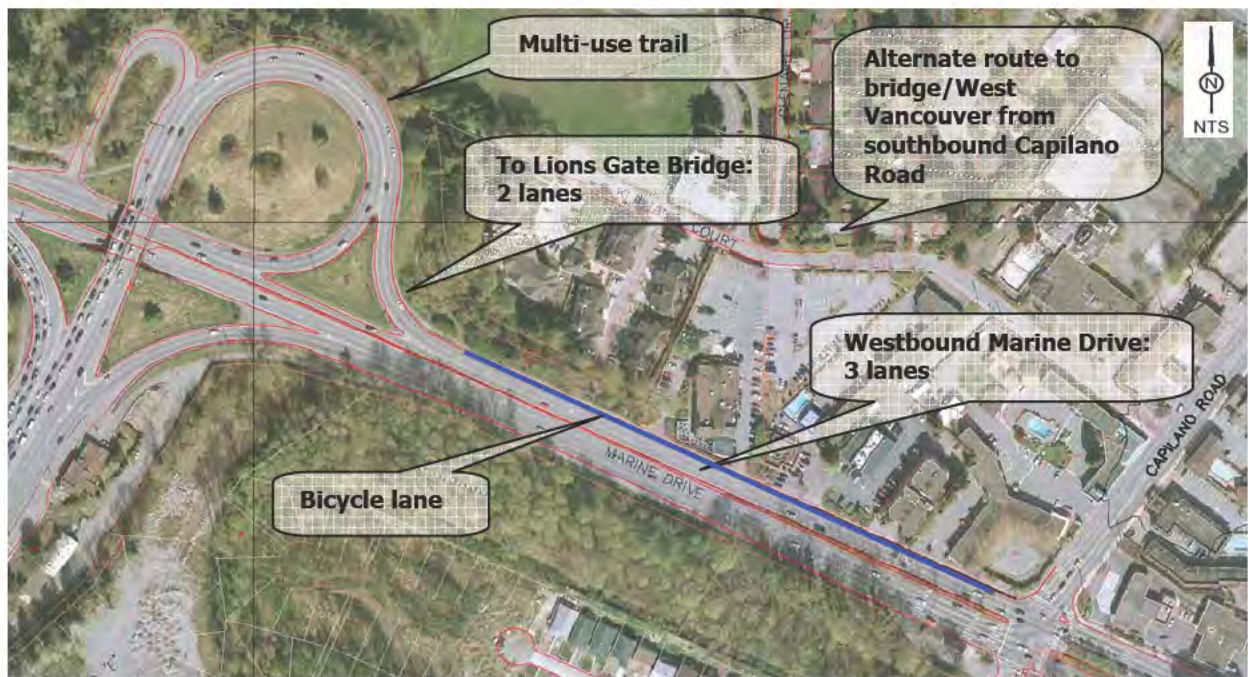


Tier 2 - Concept Bi & ii – Westbound Marine Drive Storage Lanes (4 and 6 lanes)

Project Description

- **Condition Summary.** The section of Marine Drive west of Capilano Road is currently three lanes in the westbound direction with one through lane, and two right side lanes leading toward the Lions Gate Bridge. Today, existing peak direction of travel is westbound during the morning peak hour with approximately 2,230 vehicles of which 80 percent travel towards the bridge. Similarly, during the evening peak hour, there are approximately 1,800 vehicles with half of traffic destined towards the bridge.

Vehicle queues on the east side approaches toward the Lions Gate Bridge in the morning and afternoon during both peak periods are significant and impact non-bridge destined vehicles along Marine Drive and Capilano Road. Although the vehicle queues along Marine Drive east of Capilano and north along Capilano are similar, vehicle speeds toward the bridge during the afternoon are approximately half that of the morning because of the merge to a single lane onto the Bridge. Table 1 below summarizes existing and forecast 2021 vehicles queues leading toward the Lions Gate Bridge during the afternoon peak hour.



**Table 1 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Westbound Approaches)**

Queue Location	2005 Existing		Forecast 2021	
	Average	Maximum	Average	Maximum
Marine Drive <i>(east of Capilano)</i>	360m (Tatlow Avenue)	800 m (Bridgeman Avenue)	750 m (Bridgeman Avenue)	800 ⁺ m (Bridgeman Avenue)
Capilano Road <i>(north of Marine)</i>	120 m (Curling Road)	350 m (Fullerton Avenue)	480 m (north of Garden Avenue)	1,150 m (Highway 1)

Today, the average maximum vehicle queues are most significant along Marine Drive at 360 metres, with a maximum modelled queue length of 800 metres. Capilano Road experiences average and maximum queue lengths of approximately 120 and 350 metres respectively. In the long-term, the forecast 2021 afternoon peak hour queues will more than double as a result of the significant growth forecast in local area traffic, and bridge traffic to a lesser degree. In fact, the Capilano Road vehicle queues extend up to the westbound ramp systems and will likely impact the Highway 1 corridor if patterns are not suppressed or change dramatically to other routes outside the study area.

Existing and forecast vehicle queues on Marine Drive and Capilano Road also make it very difficult for transit services to access the Lion's Gate Bridge or to travel from North Vancouver to West Vancouver. Bus passengers are essentially caught in the same line-ups and delays as general purpose traffic.

On the north side of Marine Drive, a westbound bike lane extends from Capilano Road to the bus loop and multi-use trail along the Capilano River and to the bridge. Marine Drive, east of Capilano Road is part of the municipal bicycle network.

- **Improvement Concept.** The four and six eastbound storage lane concepts are similar to the westbound storage lane concepts. Approximately 240 metres west of Capilano Road, two or four additional lanes would be added to the dedicated westbound lanes toward the bridge. Immediately north of the existing overpass of Marine Drive, traffic heading to the bridge could either merge through drop lanes or be controlled at a single point as shown by "metering" traffic onto the bridge. On the east side of Capilano Road, a new westbound through lane would be developed as part of the right-turn lane and extended through to the two or four lane widened section toward the Lions Gate Bridge. The left side westbound lane would continue to serve non-bridge traffic along Marine Drive through to Taylor Way.



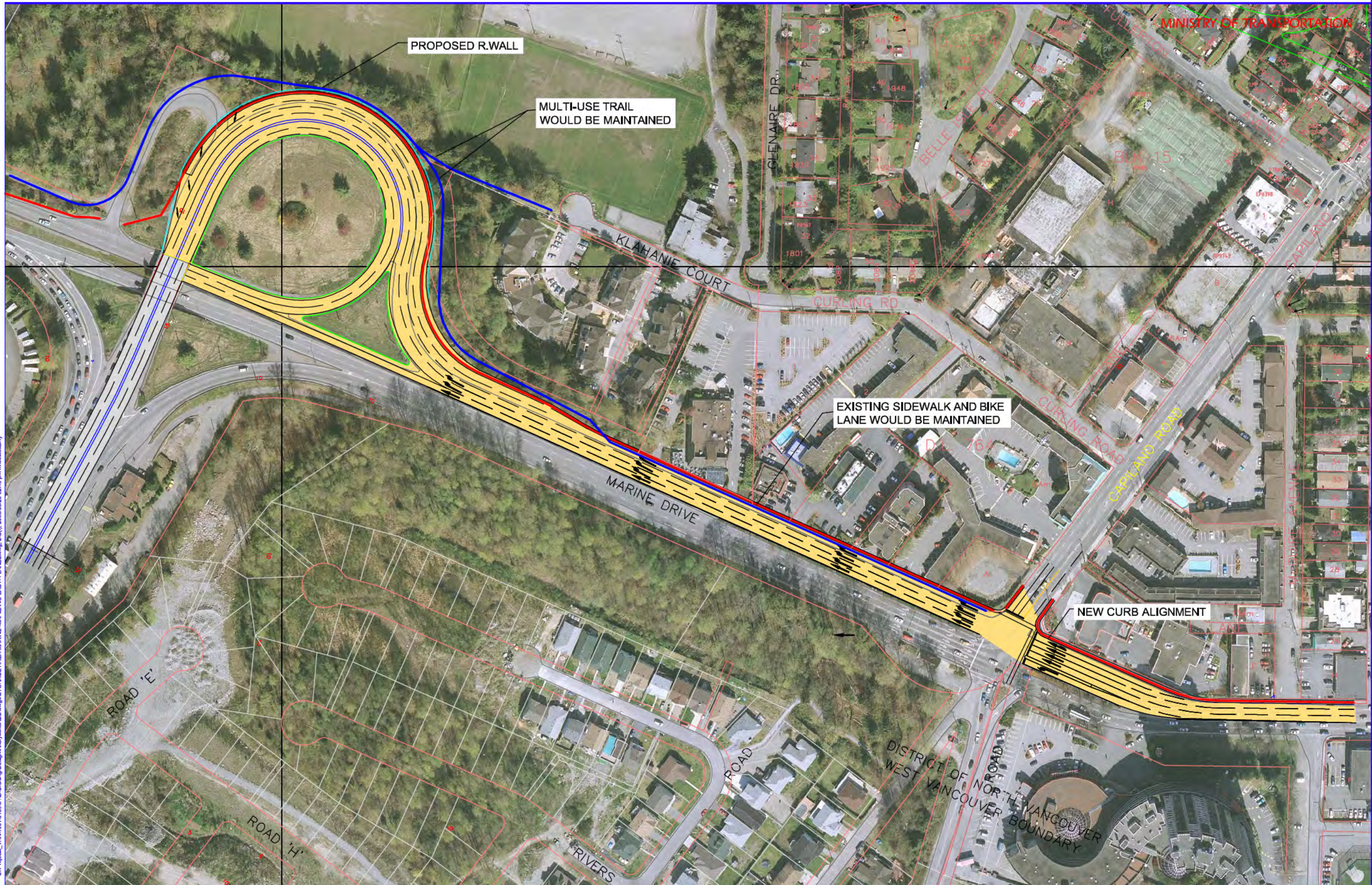
Although not desirable, buses could continue to utilize the existing westbound Marine Drive to southbound loop. Otherwise, buses may either utilize the general purpose lanes or examine options for a left-turn access to the existing transit priority lane to the bridge for westbound buses.

As summarized in Table 2 below, the four and six lane storage areas significantly reduce vehicle queues along Marine Drive and Capilano Road. These and other observations are briefly highlighted below:

- Existing vehicle queues would be significantly reduced with the four and six lane concepts.
- Forecast 2021 bridge queues will also be significantly lower with the four and six lane concepts
- The four and six lane bridge queues are not significantly different for both time frames. In other words, the four lane concept may be sufficient to accommodate existing and forecast 2021 traffic patterns.

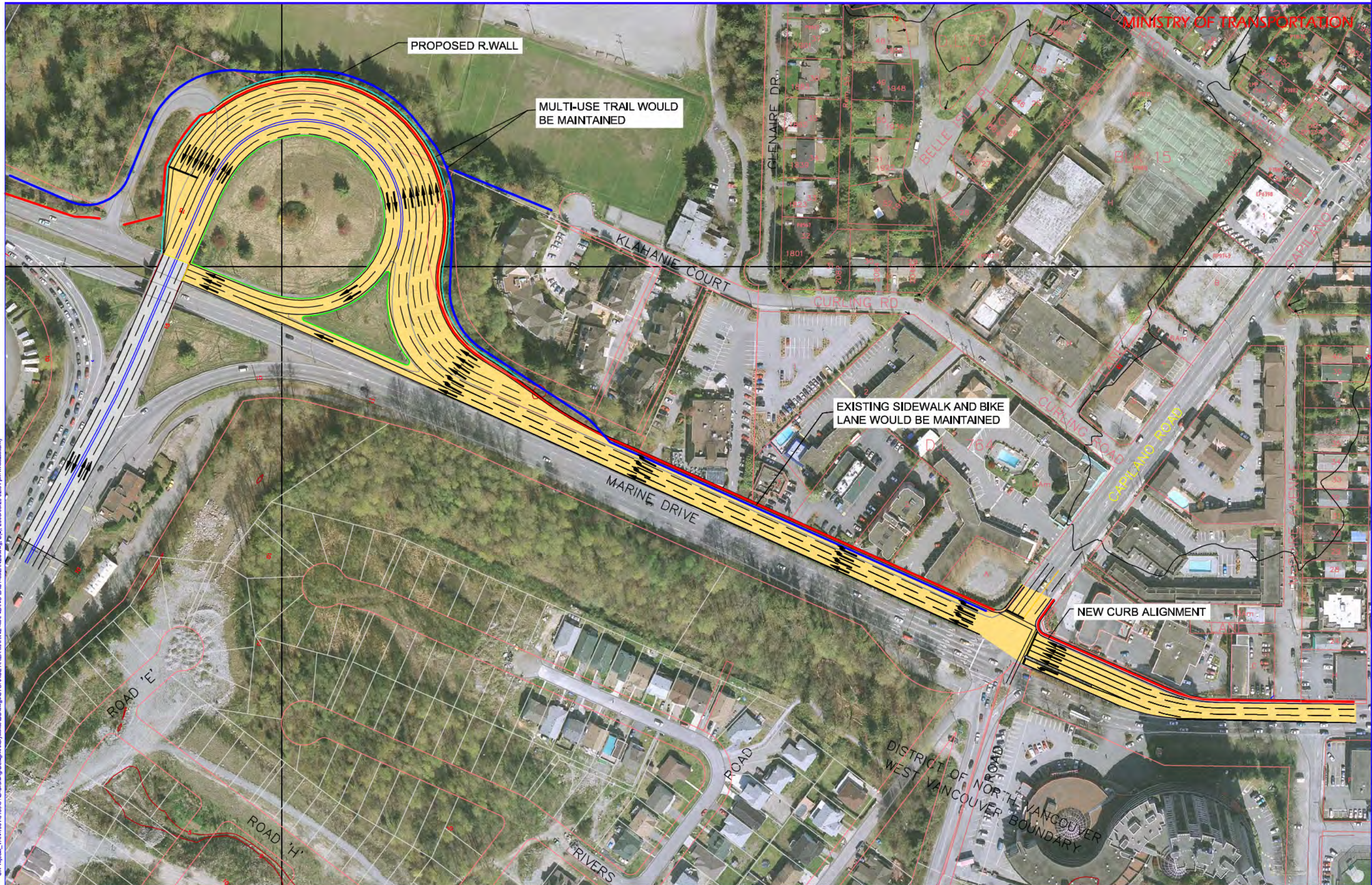
**Table 2 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Westbound Approaches)**

Queue Location	Existing Network				Improvement Concepts (i & ii)			
	2005 Volumes		2021 Volumes		2005 Volumes		2021 Volumes	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Marine Drive <i>(east of Capilano Road)</i>	360 m (Tatlow Avenue)	800 m (Bridgeman Avenue)	750 m (Bridgeman Avenue)	800 ⁺ m (Bridgeman Avenue)	40 m (east of Capilano Road)	80-90 m (west of McQuire Avenue)	70-80 m (west of McQuire Avenue)	100-150 m (Garden Avenue)
Capilano Road <i>(north of Marine Drive)</i>	120 m (Curling Road)	350 m (Fullerton Avenue)	480 m (north of Garden Avenue)	1,150 m (Highway 1)	10 m (north of Capilano Road)	40-50 m (south of Curling Road)	10 m (north of Capilano Road)	40-50 m (south of Curling Road)



WESTBOUND STORAGE FOR LIONS GATE

FIGURE
2-B(i)



WESTBOUND STORAGE FOR LIONS GATE- 6 LANES

FIGURE
2-B(ii)

**Project Evaluation**

The following discussion details the evaluation of the four and six lane storage lane concepts.

- **Financial Performance, Customer Service and Economic Indicators (see Table 3 below).** The total cost of the four and six improvement concepts are estimated to be \$10.96 and \$13.00 million respectively.

In the short- to long-term, the additional storage lanes significantly reduce vehicle queues along Marine Drive and Capilano Road. The travel times to the bridge do not theoretically change with either concept, however other trips being made throughout the study area experience reduced delays. The reduced impact of the bridge queues would significantly reduce delays for non-bridge westbound trips along Marine Drive and from Capilano Road. The present value of the total travel time and vehicle operating benefits for the four and six lane concepts are estimated to be \$96 and \$90 million respectively.

The B/C ratios of for the four and six lane concepts are estimated to be 10.7 and 8.4 respectively, with a positive net present value of \$80 and \$73 million, respectively. These results indicate that the benefits of this improvement will significantly offset the costs. As noted, the additional benefits derived from the six lane option are less than the four lane option. This pattern may be largely impacted by the merge operation as simulated in the model as opposed to being a less effective concept.

Table 3 - Westbound Storage Lane Financial Summary

EVALUATION ACCOUNT	4 Lane	6 Lane
FINANCIAL (\$millions)		
Total Cost	\$ 10.96	\$ 13.00
Discounted Capital Cost (PV)	\$ 10.34	\$ 12.27
Operating & Maintenance Cost (PV)	\$ 0.13	\$ 0.19
Salvage Costs (PV)	(\$ 2.25)	(\$ 2.62)
Total Incremental Cost	\$ 8.23	\$ 9.84
CUSTOMER SERVICE (\$millions)		
Travel Time Savings (PV)	\$ 83.70	\$ 78.26
Vehicle Operating Savings (PV)	\$ 4.18	\$ 4.18
Accident Savings (PV)	n/a	n/a
Total Benefits (PV)	\$ 87.88	\$ 82.44
ECONOMIC		
Net Present Value (in \$millions)	\$ 79.70	\$ 72.60
B/C Ratio	10.7	8.4

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$80 million to \$62 million for 4 lanes, and \$73 to \$56 million for 6



lanes (difference of approximately \$20 million for both options). The net present values further decrease to \$50 million (4 lanes) and \$45 million (6 lanes) at a discount rate of 10%.

- Transportation.** The provision of a storage area in the westbound direction along Marine Drive west of Capilano Road would reduce impacts of the Lions Gate Bridge queues on other travel within the North Shore. In particular, it would improve travel times along Marine Drive and Capilano Road, as well as the operation of the Capilano Road and Marine Drive intersection. However, the increased capacity would have a higher potential for accidents due to the increase in diverging and merging activity within the ramp storage area. With a six lane concept in particular, a safety review of the merge or 'meter' approach to direct all traffic into a two lane overpass off Marine Drive would be required during subsequent stages of planning and design.

The significant reduction in westbound and southbound vehicle queues along Marine Drive and Capilano Road will reduce delays on transit vehicles that remain on Marine Drive to access the bridge or continue through to West Vancouver.

Existing bicycle and pedestrian facilities along Marine Drive would be replaced with this concept.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> Storage area accommodates bridge traffic reducing delays for trips between North Vancouver and West Vancouver 	●
Collision Proneness	<ul style="list-style-type: none"> The increased capacity would increase weaving manoeuvres for traffic diverging from the 3 lanes on Marine Drive to 4 to 6 lanes on the ramp storage area 	○
Operation	<ul style="list-style-type: none"> Reduced impact of the bridge queues improves travel times along Marine Drive and Capilano Road Reduced delays at Capilano Road and Marine Drive intersection 	●
Local Connectivity	<ul style="list-style-type: none"> Local area travel is greatly enhanced along Marine Drive and Capilano Road 	●
Transit	<ul style="list-style-type: none"> Reduced vehicle queues along Marine Drive and Capilano Road would significantly reduce delays to transit passengers 	●
Pedestrians & Cyclists	<ul style="list-style-type: none"> Existing facilities for pedestrians and cyclists would be replaced with this concept 	●

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse



- **Social Community.** The social and community impacts from the westbound storage lanes on Marine Drive are significant. They require partial land acquisitions from approximately seven commercial properties and a multi-family residential property located west of the commercial area.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	▪ Residential property impacts near bridgehead	1 multi-family residential property (partial take)
Commercial Properties Impacted	▪ Commercial partial property takes on the north side of Marine Drive	7 properties (partial takes)
Squamish Nation Land Impacts	▪ No Squamish Nation Land impacts	0 m ²
Noise Impacts	▪ No additional noise impacts	●
Aesthetic (Visual) Impacts	▪ No additional visual impacts	●
Impacts to Access	▪ No impacts to access	●
Supportive of Land Use Plans	▪ Generally supportive of land use plans	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Environmental.** There are no impacts on environmentally sensitive areas with the proposed concepts. As part of the widening of the loop ramp toward the overpass, additional property through Klahanie Park would be required. Based on a conceptual layout of the concepts, they would not impact the active field areas of the park.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ Parkland impacts to Klahanie Park at bridgehead	700 m ² (4 lanes) 2,100 m ² (6 lanes)
Watercourse Impacts	▪ No watercourse impacts	●
High Value Wildlife Habitat and Vegetation	▪ No impacts anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



- **Constructability.** No major construction impacts are anticipated as additional lanes would be added to the existing dedicated westbound lanes toward the bridge.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Existing westbound lanes to the bridge would be maintained	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 2 - Concept Ci & ii – Marine Drive Flyover on Taylor Way (with & without Park Royal Overpass)

Project Description

- **Condition Summary.** North of the ramps to and from Park Royal, Taylor Way is currently two lanes in the southbound direction with turn lanes at each major intersection between Clyde Avenue and Highway 1. The southbound approach at the intersection with Marine Drive includes three lanes with one exclusive left turn lane, a middle shared through/left turn lane and a shared through/right turn lane. Existing AM and PM peak hour volumes are approximately 1,440 and 860 vehicles with a significant portion turning left to eastbound Marine Drive (an average 70 percent).

Vehicle queues on the west side approaches toward the Lions Gate Bridge in the morning and afternoon during both peak periods are approximately the same length. However the speed at which traffic moves during the afternoon is approximately half that of the morning because of the merge to a single lane onto the Bridge. During both peak periods, vehicle queues regularly extend beyond the intersection of Marine Drive and Taylor Way. Table 1 below summarizes existing and forecast 2021 vehicles queues along Marine Drive and Taylor Way leading toward the Lions Gate Bridge during the afternoon peak hour.





**Table 1 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	2005 Existing		Forecast 2021	
	Average	Maximum	Average	Maximum
Marine Drive <i>(west of Taylor Way)</i>	130 m (east of the pedestrian crossing near the Keg Restaurant)	250 m (west of the pedestrian crossing near the Keg Restaurant)	540 m (east of Main Street)	650 m (west of Main Street)
Taylor Way <i>(north of Marine Drive)</i>	620 m (north of Keith Road)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)

As noted above, the average and maximum vehicle queues are longest along Taylor Way north of Marine Drive. In fact, the maximum queue length can extend almost to the eastbound off-ramp of Highway 1. With further growth and development in the area, it is anticipated that the average queue length along Taylor Way during the afternoon peak hour could extend onto the off-ramp and potentially onto Highway 1.

It should be recognized that although the delays and vehicle queues are created by the limited capacity of the Lions Gate Bridge, the length of vehicle queues are affected by the combination of local area and Bridge traffic. As such, all traffic moving through the study area will be impacted by the shared storage area with Lions Gate Bridge traffic.

- **Improvement Concept.** Similar to the eastbound vehicle storage area, a southbound flyover of Marine Drive from Taylor Way and connection with the eastbound approaches to the bridge would be designed to reduce the length of vehicle queues and their impact on the Marine Drive and Taylor Way corridors. This base concept includes the provision of flyover that begins on the southbound, left side lane of Taylor Way, and proceeds as a two lane structure over the Taylor Way and Marine Drive intersection. The new two lanes would continue over the Capilano River by widening the existing bridge, then merge with the two existing Marine Drive bridgebound lanes. The merge could be either designed with drop lanes or a "metering" control for eastbound vehicles to merge with westbound traffic headed to the bridge. The difference between Options (i) and (ii) is that the first concept is 5.5 metres above the existing Park Royal overpass of Taylor Way, whereas the second assumes that overpass is removed and perhaps replaced with an underground connection as part of any redevelopment of the mall. The relocation of the overpass has not been included in the cost estimates for the second concept.



On the west side of Taylor Way, a new eastbound through lane would be developed along Marine Drive to allow for two through lanes to the bridge. The two inside through lanes would be directly aligned with the non-bridge traffic lanes along the Marine Drive. On the east side of the intersection, these two lanes would be separated from the Lions Gate Bridge traffic using a narrow median island or barriers. With this option, it is anticipated that buses could continue to utilize the non-bridge lanes to get to the transit priority lane which could be extended further south toward the bridge. It is essential that the merge activity between the eastbound and westbound traffic headed south on the bridge does not change with either improvement concept.

It should be recognized that this arrangement for a merge or metered control from four lanes to one lane is unconventional. A complete review of the design and operation of this concept would be required during subsequent stages of planning and design.

The proposed Taylor Way flyover concept has the following features:

- The flyover begins from the southbound, left lane along Taylor Way approximately 280 and 225 metres north of Marine Drive for the options with and without the Park Royal Overpass respectively.
- Turning movements at Esquimalt Avenue, Duchess Avenue and Evelyn Drive would be restricted to right-in and right-out only.
- Clyde Avenue could continue to operate with full movements during the off-peak periods.
- No changes to turning movements would be required for all other major intersections, including Taylor Way and Marine Drive.
- The existing Marine Drive and Taylor Way intersection would remain unchanged. The signal operation could be improved with the removal of bridge destined traffic.
- The two lane flyover structure returns to grade on the south side of Marine Drive, then a widened structure carries the two lanes across the Capilano River.
- The existing eastbound structure would be widened to four lanes. A raised concrete median barrier separates bridge and non-bridge destined traffic.
- The existing sidewalk on the south side of Marine Drive could be maintained. However, a pedestrian walkway would be required beneath the new structure to connect with a new sidewalk on the overpass of the Capilano River. The existing multi-use trail alongside the Capilano River would be extended and a modified connector to the Lion's Gate Bridge would be required.

As summarized in Table 2 below, the provision of a flyover significantly reduces vehicle queues along Taylor Way and Marine Drive to a lesser degree. These and other observations are briefly highlighted below:

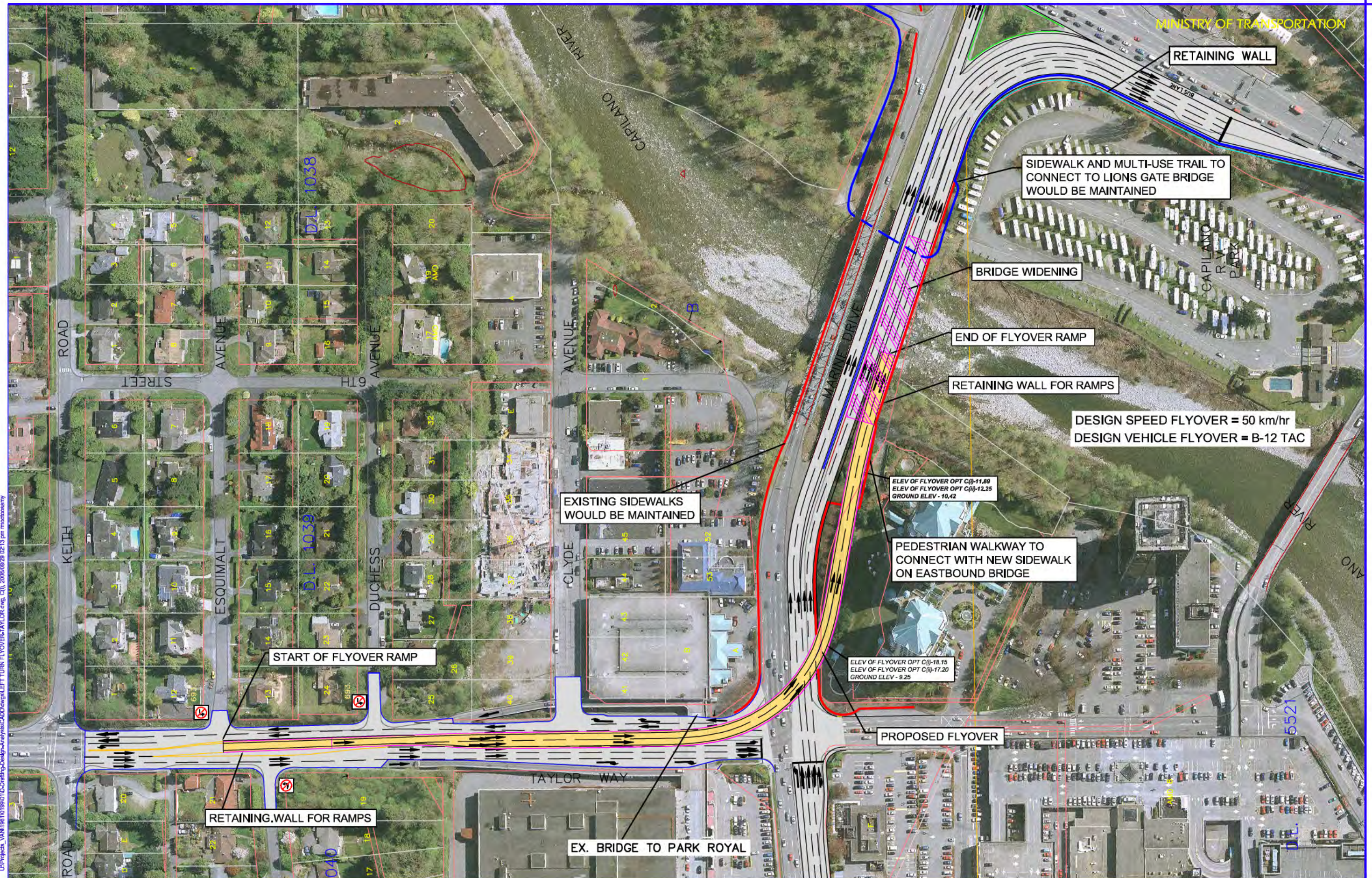
- Existing vehicle queues along Taylor Way and Marine Drive would be significantly reduced with the Flyover concept.

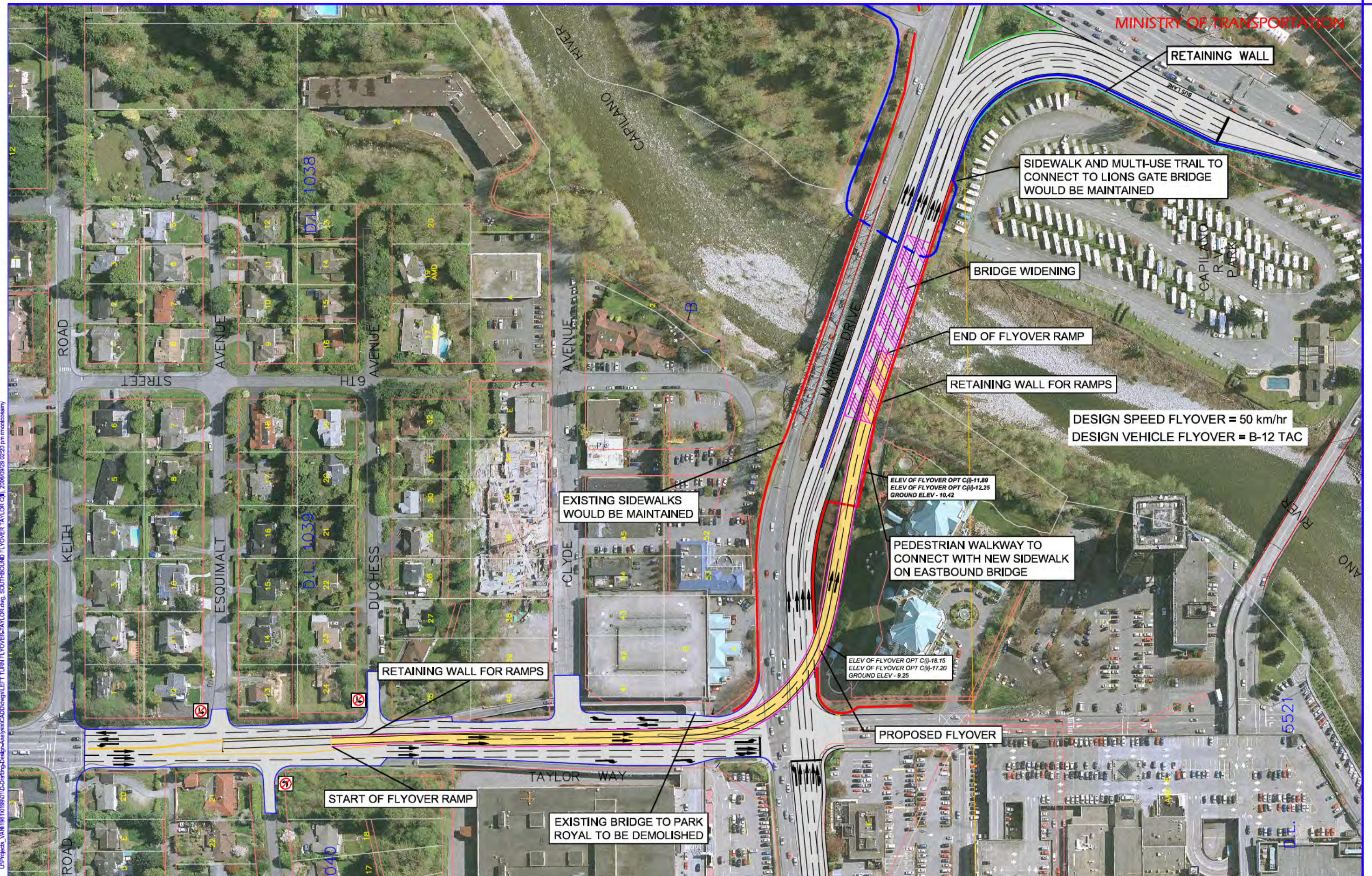


- Forecast 2021 average bridge queues will also be slightly below the projected base conditions without an overpass.
- It is anticipated that the average reduction in vehicle queues will reduce delays to non-bridge traffic.

**Table 2 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	Existing Network				Improvement Concepts (i & ii)			
	2005 Volumes		2021 Volumes		2005 Volumes		2021 Volumes	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Marine Drive <i>(west of Taylor Way)</i>	130 m (east of the pedestrian crossing near the Keg Restaurant)	250 m (west of the pedestrian crossing near the Keg Restaurant)	540 m (east of Main Street)	650 m (west of Main Street)	40 m (White Spot Restaurant)	100 m (between White Spot and the Keg Restaurants)	370 m (Park Royal South)	650 m (west of Main Street)
Taylor Way or on Flyover <i>(north of Marine Drive)</i>	620 m (north of Keith Road)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	0 m	0 m	380 m (Keith Road)	1,100 m (eastbound Highway 1 off-ramp)





**Project Evaluation**

The following discussion details the evaluation of the four and six lane storage lane concepts.

- **Financial Performance, Customer Service and Economic Indicators (see Table 3 below).** The total cost of the two flyover concepts is estimated to be \$50.3 and \$46.8 million with and without the Park Royal overpass respectively.

Separating bridge destined traffic from Taylor Way and Marine Drive has the same benefits of the storage lane concepts, with the additional benefit of removing this traffic from the intersection. In the short-term and long-term, the forecast travel time savings are projected to be significant. In particular, the reduced average vehicle queues on Taylor Way would ensure that potential delays to westbound traffic along Highway 1 are minimized. Additionally, existing and forecast 2021 travel times for most other trips to, from and within the study area decrease with the provision of the flyover. The present value of the total travel time and vehicle operating benefits of the flyover is estimated to be approximately \$160 million.

The B/C ratios of for the flyover concept with and without the Park Lane overpass are estimated to be 4.1 and 4.4 respectively. A positive net present value of \$120 and \$123 million indicate that the benefits of this improvement will significantly offset the costs.

Table 3 - Flyover Financial Summary

EVALUATION ACCOUNT	Flyover WITH Park Royal Overpass	Flyover WITHOUT Park Royal Overpass
FINANCIAL (\$millions)		
Total Cost	\$ 50.3	\$ 46.8
Discounted Capital Cost (PV)	\$ 47.41	\$ 44.11
Operating & Maintenance Cost (PV)	\$ 0.33	\$ 0.30
Salvage Costs (PV)	(\$ 8.75)	(\$8.26)
Total Incremental Cost	\$ 38.99	\$ 36.16
CUSTOMER SERVICE (\$millions)		
Travel Time Savings (PV)	\$ 151.65	\$151.65
Vehicle Operating Savings (PV)	\$ 7.18	\$ 7.18
Accident Savings (PV)	n/a	n/a
Total Benefits (PV)	\$ 158.83	\$ 158.83
ECONOMIC		
Net Present Value (in \$millions)	\$ 119.80	\$ 122.70
B/C Ratio	4.1	4.4

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period



A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$120 million to \$86 million with the Park Royal Overpass, and \$123 to \$89 million without the Park Royal Overpass (difference of approximately \$35 million for both options). The net present values further decrease to \$62 million (with Park Royal Overpass) and \$65 million (without Park Royal Overpass) at a discount rate of 10%.

- **Transportation.** The provision of a southbound flyover along Taylor Way to directly connect with the eastbound Marine Drive approach to the bridge reduces the vehicle queue impacts on Taylor Way and Marine Drive. As the flyover also removes the bridge destined traffic from the intersection of Taylor Way and Marine Drive, intersection operation is greatly enhanced with reduced delays. The weaving conflict between southbound Taylor Way to eastbound Marine Drive would be eliminated however rear end accidents may increase for flyover traffic joining the queues on the approach lanes to the bridge. As was the case with the storage area concepts, the merge activity from four lanes to one across the Lion's Gate Bridge must be examined further during subsequent stages of planning and design.

The reduced vehicle queues along Marine Drive through the Taylor Way intersection also suggest that the existing and forecast delays to transit will also be reduced significantly. Buses will be able to more easily weave from the curb lane to the left lane west of Taylor Way in order to access the transit priority lane to the bridge.

As previously described, access for cyclists and pedestrians through the area could be accommodated on the new structure. Consideration should also be given to direct cyclists south from Taylor Way and Marine Drive to the Capilano River Bridge in order to access the Lion's Gate Bridge.



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> Reduced vehicle queues on Taylor Way and Marine Drive 	●
Collision Proneness	<ul style="list-style-type: none"> Removes weaving activity between southbound left turns from Taylor Way to eastbound Marine Drive, but may increase conflicts at merge toward bridge 	○
Operation	<ul style="list-style-type: none"> Free flow flyover from southbound Taylor Way to eastbound Marine Drive eliminates the southbound left turn signal delay at Taylor Way and Marine Drive intersection Increases capacity for southbound Taylor Way approach to intersection with Marine Drive 	●
Local Connectivity	<ul style="list-style-type: none"> Good connectivity for southbound Taylor Way traffic to Lions Gate bridge 	●
Transit	<ul style="list-style-type: none"> Reduced delays to buses without vehicle queues on Marine Drive 	●
Pedestrians & Cyclists	<ul style="list-style-type: none"> Replacement of existing facilities on new structure 	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- Social Community.** The social and community impacts from a flyover and widened eastbound bridge structure across the Capilano River are significant. Overall, partial takings are required from one multi-family and three commercial properties.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	<ul style="list-style-type: none"> Residential property impacts at the West Royal Apartments 	1 high-rise property (partial take)
Commercial Properties Impacted	<ul style="list-style-type: none"> Commercial partial property takes along the south side of Marine Drive 	3 properties (partial takes)
Squamish Nation Land Impacts	<ul style="list-style-type: none"> Squamish Nation Land impacts (Capilano RV Park) 	850 m ²
Noise Impacts	<ul style="list-style-type: none"> Flyover structure is closer to the West Royal Apartments on the south side of Marine Drive potentially creating increase in noise levels 	○
Aesthetic (Visual) Impacts	<ul style="list-style-type: none"> Flyover contributes to visual impact along the south side of Marine Drive for residents at the West Royal apartments 	○
Impacts to Access	<ul style="list-style-type: none"> Restricted right-in/right-out movement at Esquimalt Avenue, Duchness Avenue, and Evelyn Drive 	○
Supportive of Land Use Plans	<ul style="list-style-type: none"> Generally supportive of land use plans 	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse



- **Environmental.** The Marine Drive bridges cross the Capilano River which is in an environmentally sensitive area, that is an important salmon and trout-producing stream. The new flyover will either require a new or modified bridge structure over the Capilano River. In either case, additional piers will be required at the edge of the river – same location as today. Environmental impacts and potential mitigation measures will be required.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ Potential environmental impacts on the river would need to be examined in subsequent stages of design and mitigated	○
High Value Wildlife Habitat and Vegetation	▪ No impacts anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** During construction of the flyover, lane closures and detours would be required along Taylor Way. For the flyover option with the Park Royal Overpass, adequate clearance would need to be provided between the flyover and overpass. This would result in a longer flyover length.

The new eastbound bridge over the Capilano River would be crane erected with a staging area at the abutments of the structure. It would be parallel and separate from the existing structure.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ The construction of the flyover along Taylor Way would require lane closures and detours which may impact or restrict access to minor streets ▪ Option C (i) would require adequate clearance between the flyover and the Park Royal Overpass, which would lengthen the flyover length	○

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier II - Concept D – Third Southbound Lane on Taylor Way

Project Description

- **Condition Summary.** Between Clyde Avenue and the westbound off-ramp to Highway 1, Taylor Way supports two southbound lanes, with separate turn lanes at each of the major intersections. South of Highway 1, existing AM and PM peak hour volumes are approximately 1,460 and 1,080 vehicles, respectively.

Today, the southbound queues during the morning and afternoon peak periods extend north of the Inglewood Avenue intersection and utilize both southbound lanes. The projected 2021 queue lengths along Taylor Way are expected to grow in the long-term as a result of growing local area and bridge destined traffic and begin to affect the Highway 1 corridor as noted in Table 1 below.



**Table 1 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	2005 Existing		Forecast 2021	
	Average	Maximum	Average	Maximum
Taylor Way (north of Marine Drive)	620 m (south of Inglewood Avenue)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)

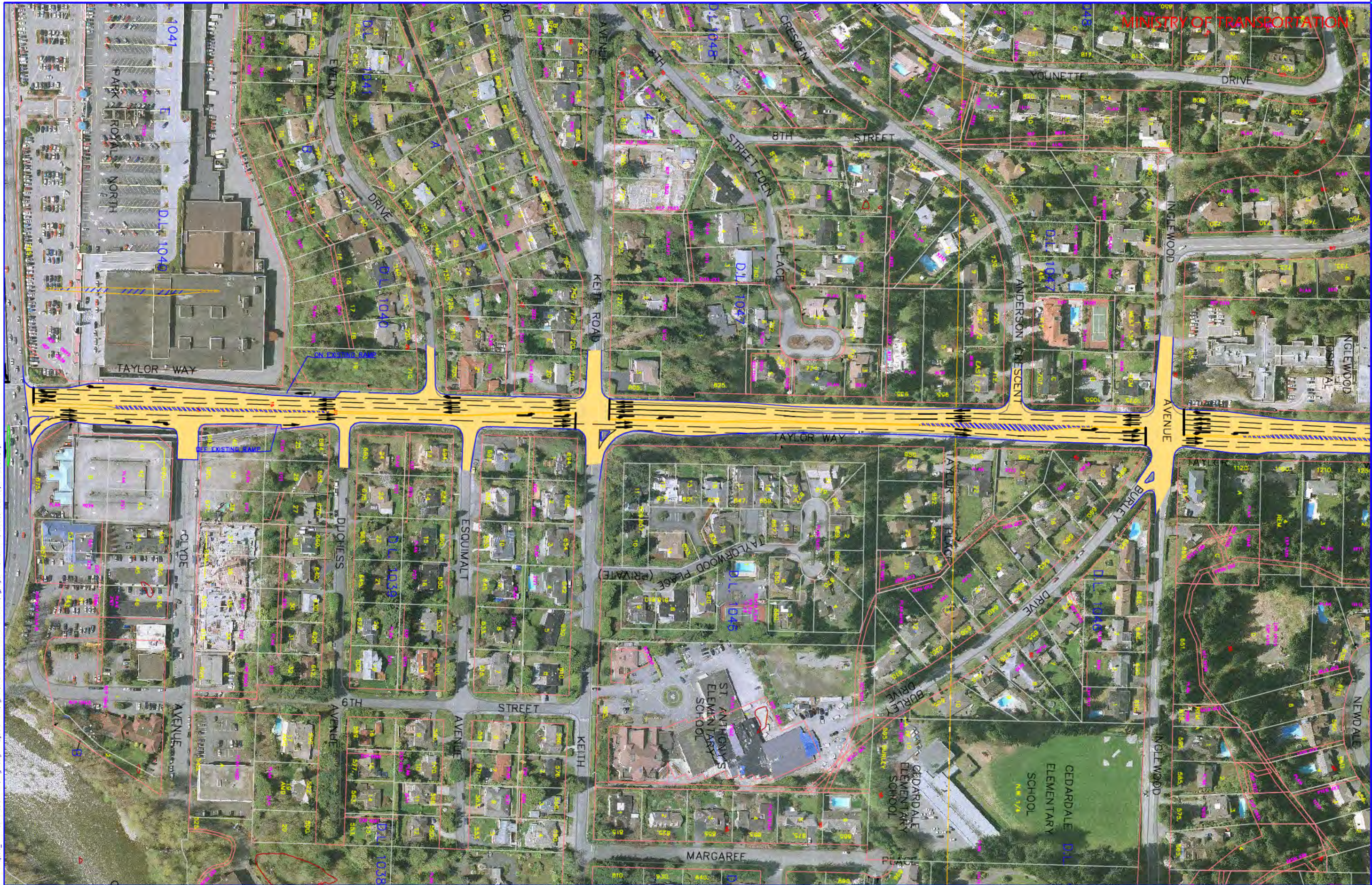
During the peak periods, local area traffic on Taylor Way that would otherwise remain in West Vancouver are impacted by southbound vehicle queues turning left at Marine Drive. For example, southbound traffic on Taylor Way headed to the Park Royal Mall or elsewhere along Marine Drive west is delayed by the southbound queues along Taylor Way.

- **Improvement Concept.** A third southbound lane on Taylor Way designed to serve traffic destined to the Marine Drive area or other areas to the west could possibly remove some local area traffic from the southbound queue, reduce queue length slightly and in turn reduce local area travel times. The additional southbound lane on Taylor Way as illustrated in Figure 2-D would include maintaining the existing turning lanes at all major streets. The additional lane could essentially be achieved within the existing right-of-way by adding a lane to the west side, and retaining the existing east side edge of pavement. The southbound ramp to the Park Royal mall would be reconfigured slightly to permit three southbound lanes on Taylor Way. The intersection of Taylor Way and Marine Drive would remain unchanged.

As summarized in Table 2 below, the additional southbound lane on Taylor Way slightly reduces the southbound vehicle queues under today's traffic patterns. With the additional growth in local area and bridge destined traffic, the long-term vehicle queues on Taylor Way are not expected to improve significantly with the provision of the third southbound lane.

**Table 2 - PM Peak Hour Vehicle Queues to Lions Gate Bridge
(Eastbound Approaches)**

Queue Location	Existing Network				Improvement Concepts (i & ii)			
	2005 Volumes		2021 Volumes		2005 Volumes		2021 Volumes	
	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum
Taylor Way (north of Marine Drive)	620 m (south of Inglewood Avenue)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	1,100 ⁺ m (eastbound Highway 1 off-ramp)	420 m (Keith Road)	800 m (Inglewood Avenue)	1,100 m (eastbound Highway 1 off-ramp)	1,100 m (eastbound Highway 1 off-ramp)



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3rd SOUTHBOUND LANE ON TAYLOR

FIGURE
2-D



Project Evaluation

The following discussion details the evaluation of the four and six lane storage lane concepts.

- **Financial Performance, Customer Service and Economic Indicators (see Table 3 below).** The total cost of the third southbound lane is estimated to be \$2.73 million.

In the short-term, the additional southbound lane on Taylor Way is expected to reduce travel times for local area trips to and from zones on the west side of the study area, and provide a modest overall travel time savings to the network. In the long-term, the primary travel time savings is projected eastbound along Highway 1 between Taylor Way and Capilano Road. In other words, this pattern would suggest that the southbound travel lane will slightly reduce vehicle queues onto the highway. The present value of the total travel time and vehicle operating benefits for the third southbound lane on Taylor Way is estimated to be approximately \$7.7 million.

The B/C ratio for the three-lane Taylor Way concept is estimated to be 3.5, with a positive net present value of \$5.4 million. These results indicate that the benefits of this improvement will significantly offset the costs.

Table 3 - Third Southbound Lane Financial Summary

EVALUATION ACCOUNT	Concept
FINANCIAL (\$millions)	
Total Cost	\$ 2.73
Discounted Capital Cost (PV)	\$ 2.58
Operating & Maintenance Cost (PV)	\$ 0.06
Salvage Costs (PV)	(\$ 0.43)
Total Incremental Cost	\$ 2.21
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$ 6.87
Vehicle Operating Savings (PV)	\$ 0.78
Accident Savings (PV)	n/a
Total Benefits (PV)	\$ 7.65
ECONOMIC	
Net Present Value (in \$millions)	\$ 5.4
B/C Ratio	3.5

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$5.4 million to \$0.4 million (difference of approximately \$5 million). The net present value further decreases to -\$2.9 million at a discount rate of 10%.



- **Transportation.** The third southbound lane on Taylor Way is anticipated to reduce the vehicle queues on Taylor Way and slightly enhance local area traffic and access and circulation in the short-term. Travel times along Taylor Way would be slightly reduced. However, in the long-term with the additional growth in the local area and bridge destined traffic, the increased capacity is not expected to significantly improve delays for the majority of traffic along southbound Taylor Way.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> ▪ No significant change in average queues along Taylor Way when compared to future base conditions 	○
Collision Proneness	<ul style="list-style-type: none"> ▪ Similar to existing conditions 	○
Operation	<ul style="list-style-type: none"> ▪ In the short-term, increased capacity on southbound Taylor Way slightly reduces travel times ▪ No change in delays at Taylor Way and Marine Drive intersection 	●
Local Connectivity	<ul style="list-style-type: none"> ▪ Slightly improves local travel to Marine Drive west of Taylor Way under today's traffic patterns. However, in the long-term, no significant improvement to local traffic is expected due to vehicle queues on Taylor Way. 	●
Transit	<ul style="list-style-type: none"> ▪ In the short-term, vehicle queue impacts of Taylor Way on local area transit service would be reduced ▪ Long-term vehicle queues along southbound Taylor Way are still expected 	○
Pedestrians & Cyclists	<ul style="list-style-type: none"> ▪ Pedestrian and cyclist facilities would be maintained 	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from a widened southbound Taylor Way are negligible.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	<ul style="list-style-type: none"> ▪ No residential property impacts 	0 properties
Commercial Properties Impacted	<ul style="list-style-type: none"> ▪ No commercial property impacts 	0 properties
Squamish Nation Land Impacts	<ul style="list-style-type: none"> ▪ No Squamish Nation Land impacts 	0 m ²
Noise Impacts	<ul style="list-style-type: none"> ▪ No additional noise impacts 	○



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Aesthetic (Visual) Impacts	▪ No additional visual impacts	●
Impacts to Access	▪ No impacts to access	●
Supportive of Land Use Plans	▪ Generally supportive of land use plans	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Environmental.** No environmental impact is anticipated for this concept.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ No watercourse impacts	●
High Value Wildlife Habitat and Vegetation	▪ No significant impacts anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** Construction of the third southbound lane on Taylor Way would require staging and temporary access restrictions.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	<ul style="list-style-type: none"> ▪ Requires staging and temporary access restrictions along Taylor Way ▪ Southbound ramp to Park Royal mall would be slightly reconfigured to allow three southbound lanes on Taylor Way 	●

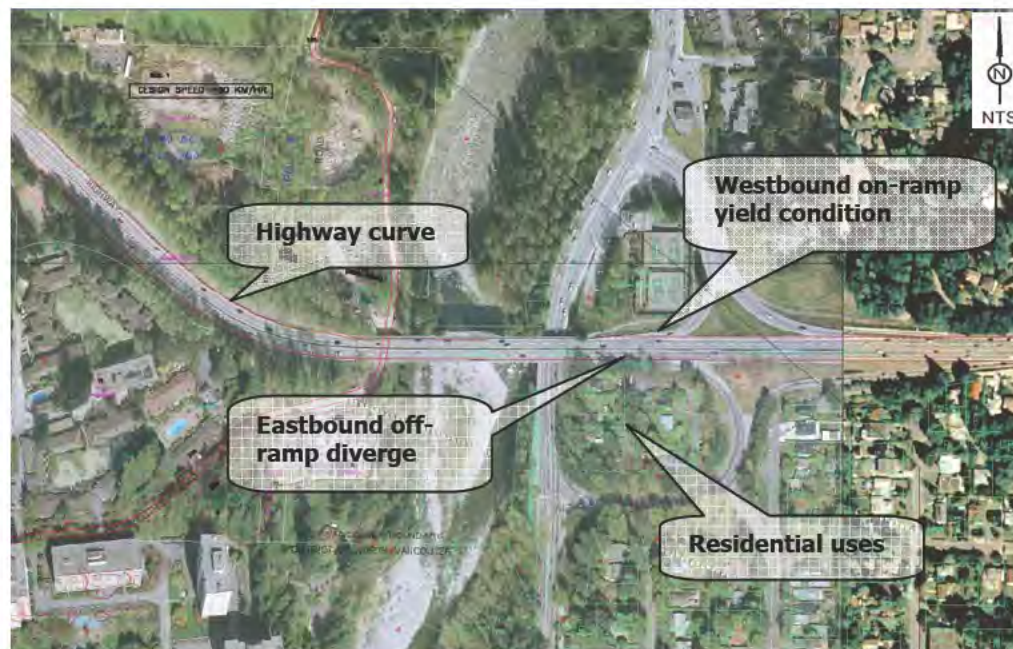
● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 2 - Concept Ei & Eii – Capilano Interchange Modifications (80km/hr & 90km/hr design speed)

Project Description

- **Condition Summary.** The Capilano Interchange is the most westerly connection to Highway 1 in the District of North Vancouver. Because of the proximity of the interchange to the Capilano River, the interchange design is substandard as summarized below and illustrated in the following figure:
 - Eastbound off-ramp diverge and deceleration length from Highway 1 to Capilano Road are inadequate
 - Westbound on-ramp is a yield condition, without sufficient distance for acceleration or merging with highway traffic
 - Highway curve west of the interchange has an advisory speed of 60 km/hr eastbound. In the westbound direction, a curve advisory sign without speed limit indicates an advisory speed of 70 km/hr (10 km/hr below the posted speed of 80 km/hr).
 - Residential uses inside the south side loop ramp system are directly connected with the on- and off-ramps.
 - Keith Road is also connected directly with the on- and off-ramps on the south side loop ramp system.





The historical collision patterns along Highway 1 are based on RCMP records between 1999 and 2004. On Highway 1 at the Capilano Interchange, approximately 21 collisions occurred during the 5 year period. Collision rates and severity indices (urban freeway divided 4 lanes or more) in the vicinity of the Capilano Interchange are above provincial averages, as illustrated below in Figures 1 and 2.

Figure 1
Summary of Accident Rates
(Capilano Interchange)

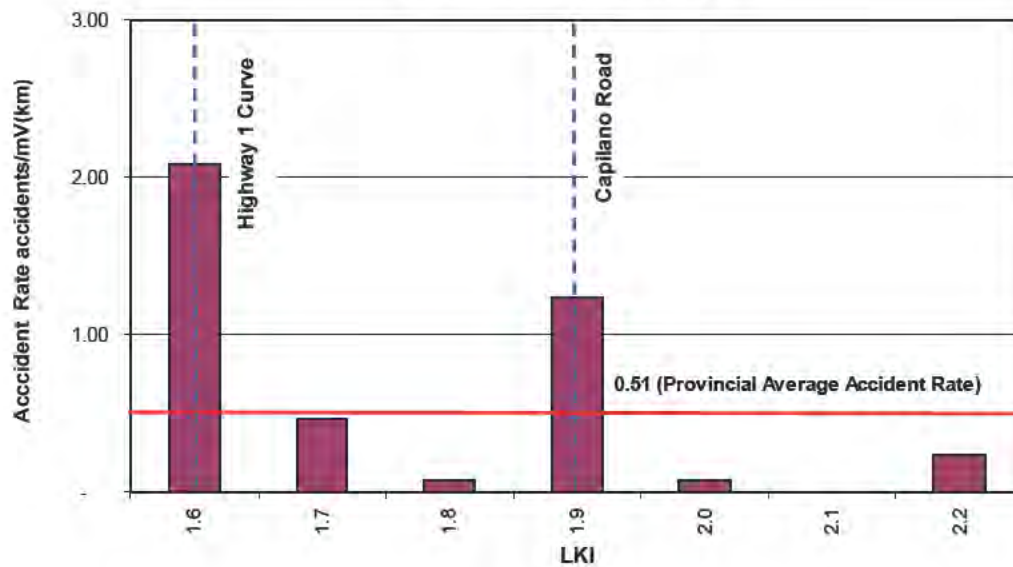
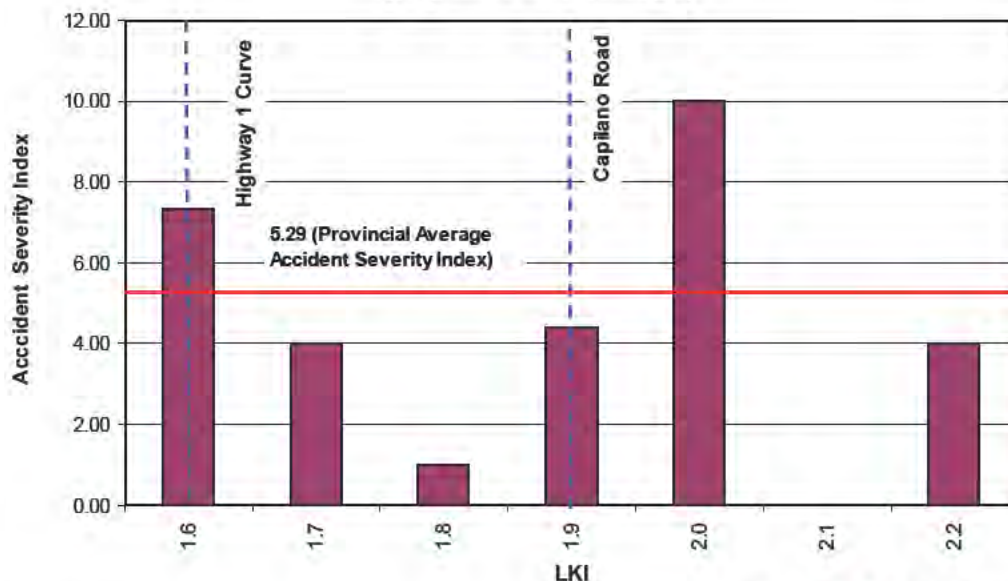


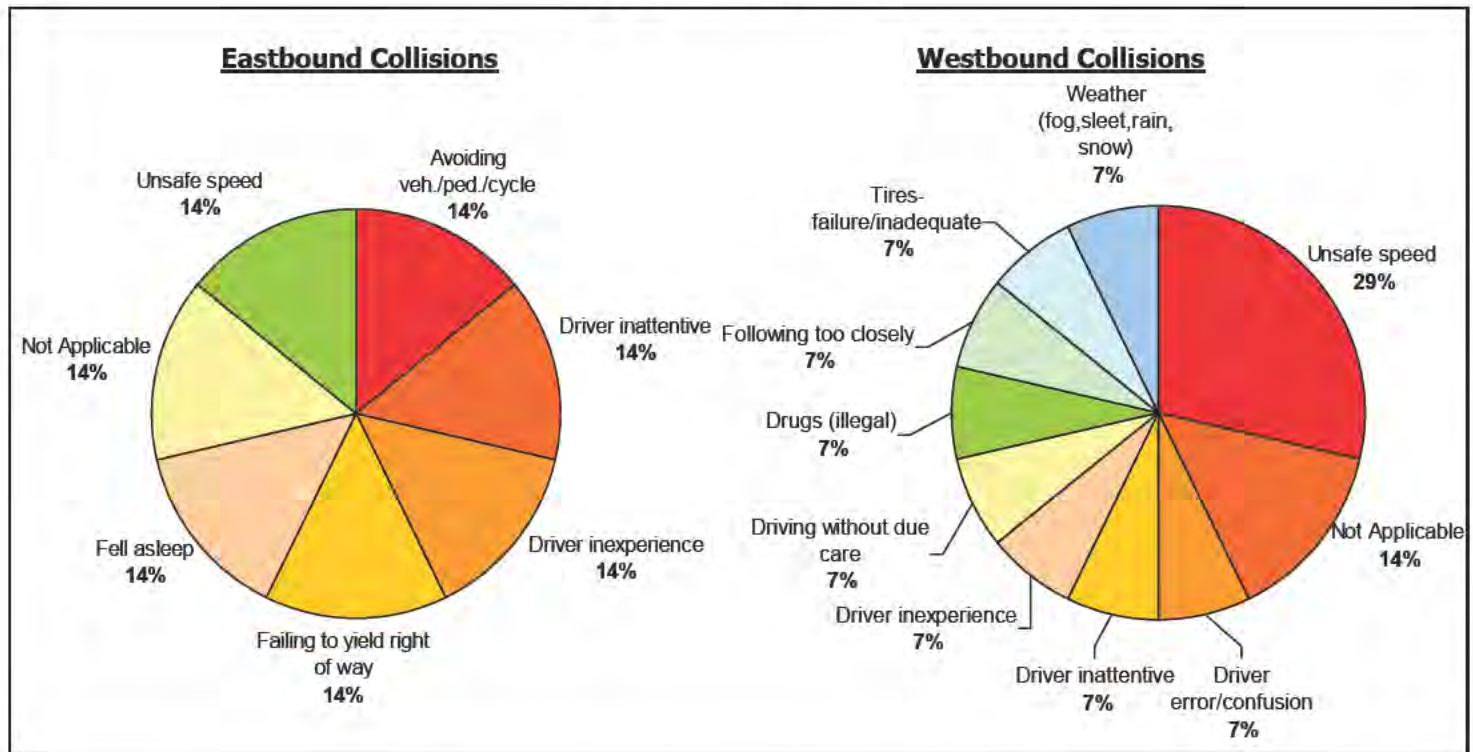
Figure 2
Summary of Accident Severities
(Capilano Interchange)





As expected, the reduced speed curve segment and the substandard geometrics of the on- and off-ramp system are likely highway engineering factors. A high proportion of the collisions occurs during wet weather conditions (approximately 50%) and involves various forms of driver error through the area as summarized below.

Contributing Factors (Capilano Interchange)



In June of 2006, ICBC prepared a safety assessment of the ramps at the Capilano Interchange – *Capilano Road at Highway 1 Ramps Safety Review (Interim Report)*. The key issues identified from this review are briefly summarized as follows and illustrated in the figure below.

- **Westbound ramp issues include:** need for additional signal heads; wide on-ramp shoulder widths that appear like a second lane; northbound right-turns failing to yield; and signal operations not optimized.
- **Eastbound ramp issues include:** additional pavement markings needed for turn lanes; southbound left-turn conflicts with northbound right-turns; improved advanced guide signage; and signal operations not optimized.
- **Other issues include:** the southbound lane width beneath the structure; and access to tennis courts from the southbound direction on Capilano Road.



Improvements to address these safety issues were not identified in the interim report and therefore not included in this study.

- **Improvement Concept.** The primary issues at the Capilano Interchange are largely related to the substandard design of the on- and off-ramps as well as the design of the speed reduction zone on the west side of the Capilano River. Beyond addressing these issues, the Ministry will want to examine the potential long-term changes to the land use in the south side ramp system, the location of the Keith Road connection, as well as improvements identified through the safety review to be complete by ICBC.

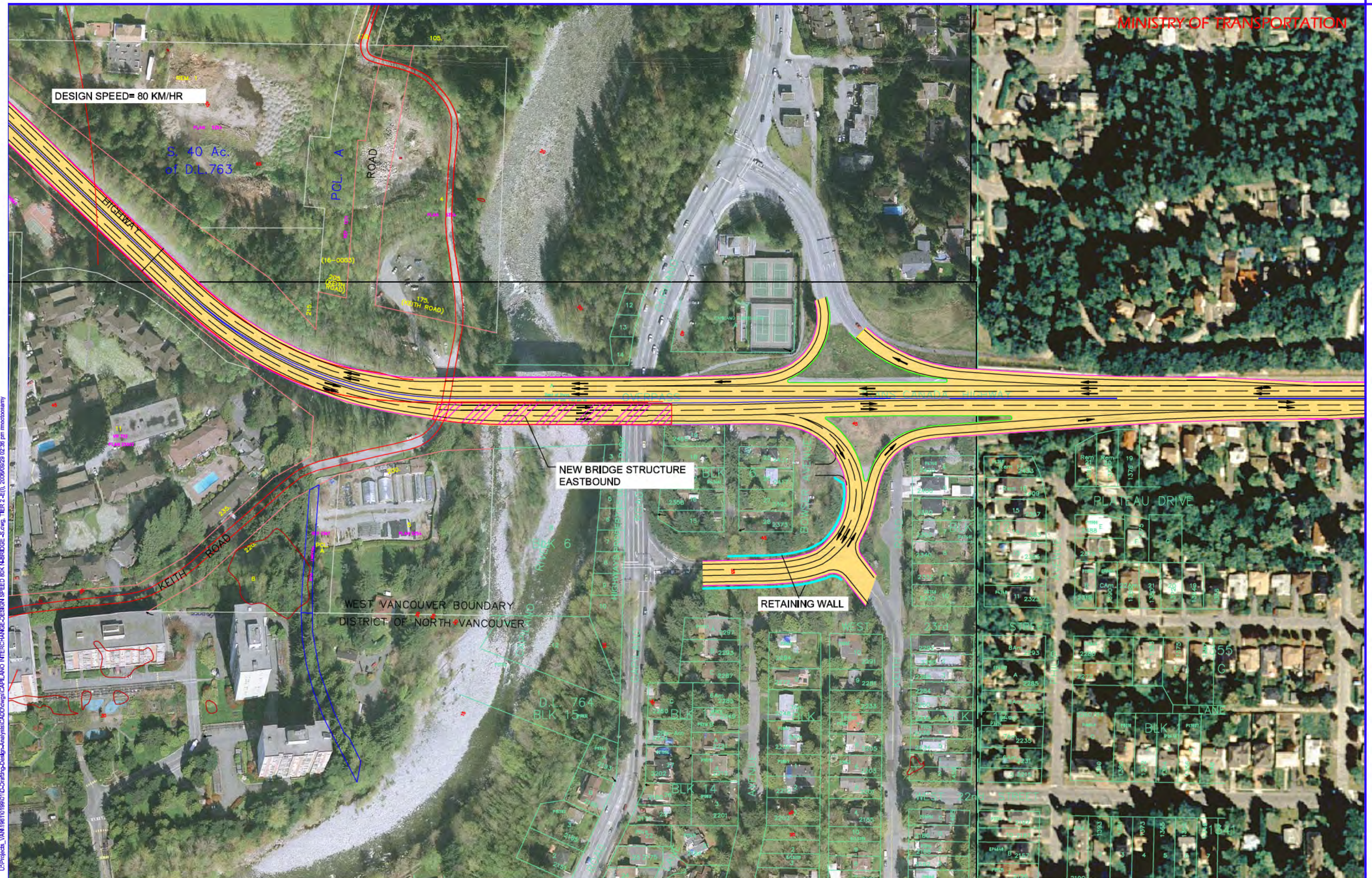
The interchange improvement concepts illustrated in Figures 2-E(i) & 2-E(ii) include a new eastbound bridge over the Capilano River to accommodate two highway travel lanes as well as an extended eastbound off-ramp with diverge and deceleration lengths of 195 metres (80 km/hr design speed concept) and 220 metres (90 km/hr design speed concept). The westbound on-ramp will also be extended to form acceleration and merge lengths of 160 metres (80 km/hr design speed concept) and 170 metres (90 km/hr design speed concept). As part of this concept, the highway speed reduction zone west of the interchange may be eliminated by straightening the curve. This concept is considered as an enhancement to the on-ramp and off-ramp modifications.

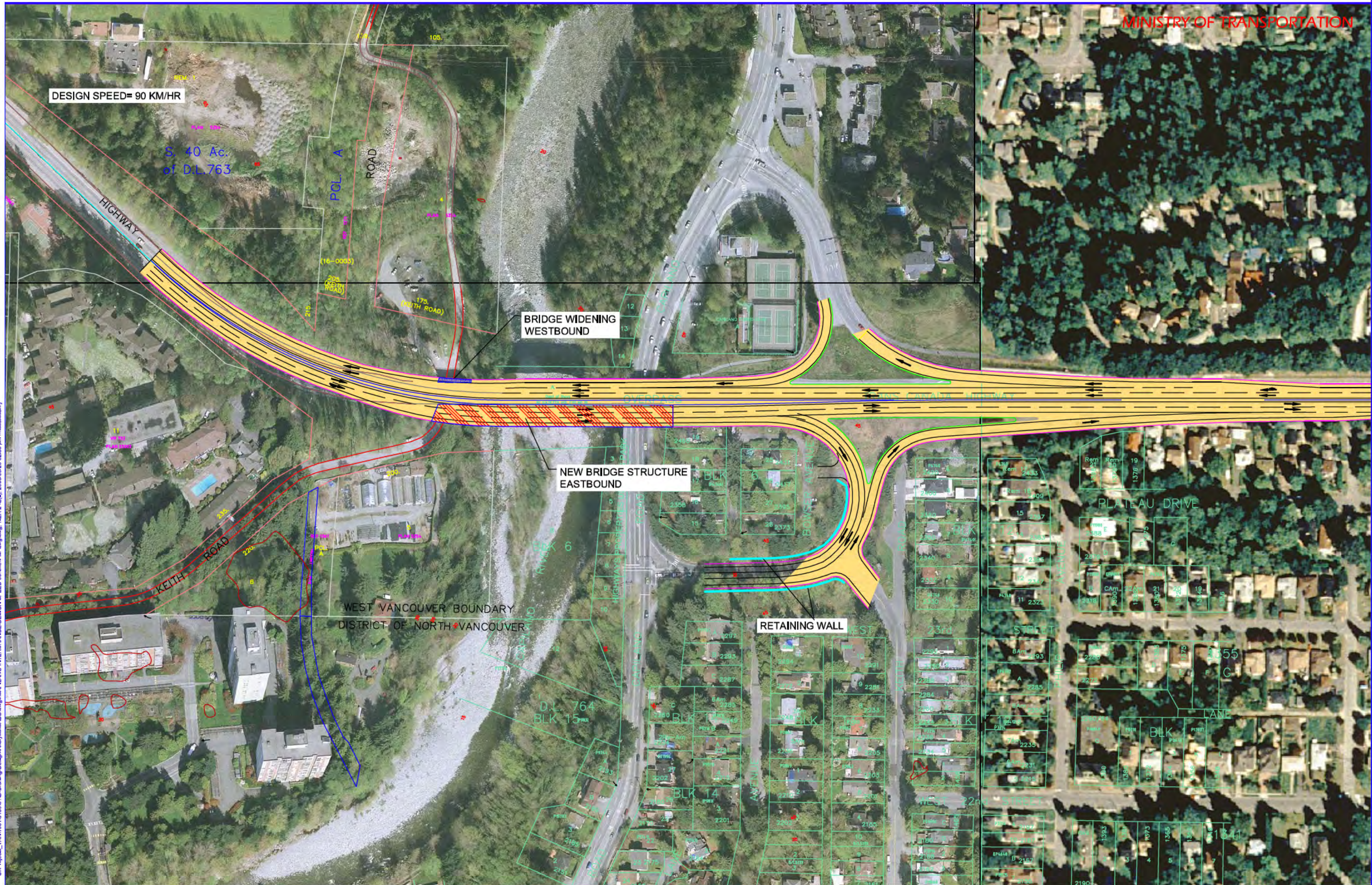
Based on the forecast volumes along the Highway as well as the proposed on- and off-ramp systems improvements, the following levels of service (Table 1) are calculated using Highway Capacity Manual analysis. The measure used to provide an estimate of level of service (LOS) is density. LOS 'F' indicates queuing conditions on the highway segment, or when the demand exceeds capacity for merge and diverge areas. These results indicate that the proposed changes to the on- and off-ramps in the westbound and eastbound directions respectively will function at acceptable levels of service.

Table 1 - Levels of Service with Proposed Improvements

Location	2005 PM Peak Hour		2021 PM Peak Hour	
	Volume	LOS	Volume	LOS
Westbound				
<i>Highway</i>	2,300	C (C)	2,735	D (C)
<i>On-ramp merge</i>	375	C (C)	480	C (C)
Eastbound				
<i>Highway</i>	2,550	C (C)	2,460	C (C)
<i>Off-ramp diverge</i>	550	B (B)	560	B (B)

Note: LOS C (C) = design speed of 80 km/hr (90 km/hr)





CAPILANO INTERCHANGE MODIFICATIONS-DESIGN SPEED 90 KM/H

FIGURE 2-E(ii)

L:\Projects_VAN\18610169\01\CD\Drawings\Capilano Interchange\DESIGN SPEED 90 KM/H\TIER 2 -E(ii). 2008/09/29 02:38 pm mactosary

**Project Evaluation**

The following discussion details the evaluation of the Capilano Interchange modifications for design speeds of 80 km/hr and 90 km/hr.

- **Financial Performance, Customer Service and Economic Indicators (see Table 2 below).** The total cost of the Capilano Interchange modifications for design speeds of 80 km/hr and 90 km/hr are estimated to be \$28.0 million and \$31.3 million, respectively.

In the short- and long-term, the Capilano Interchange modifications are expected to improve the operation and safety performance within the speed reduction zone (west of the Capilano River) and at the on- and off-ramps. The present value of the total travel time and vehicle operating benefits for the modifications at the interchange are estimated to be approximately \$12 million (80 km/hr design speed concept) and \$19 million (90 km/hr design speed concept).

The B/C ratios for the Capilano Interchange modifications for design speeds of 80 and 90 km per hour are estimated to be 0.6 and 0.8, respectively. The negative net present values of \$10 million (80 km/hr design speed concept), and \$6 million (90 km/hr design speed concept) indicate that the benefits of this improvement do not offset the costs.

Table 2 - Capilano Interchange Modifications Financial Summary

EVALUATION ACCOUNT	80km/hr Design Speed	90 km/hr Design Speed
FINANCIAL (\$millions)		
Total Cost	\$ 28.02	\$ 31.28
Discounted Capital Cost (PV)	\$ 26.44	\$ 29.51
Operating & Maintenance Cost (PV)	\$ 0.00	\$ 0.00
Salvage Costs (PV)	(\$ 4.70)	(\$ 5.23)
Total Incremental Cost	\$ 21.74	\$ 24.28
CUSTOMER SERVICE (\$millions)		
Travel Time Savings (PV)	\$ 8.01	\$ 14.24
Vehicle Operating Savings (PV)	(\$ 0.13)	(\$ 1.09)
Accident Savings (PV)	\$ 4.35	\$ 5.42
Total Benefits (PV)	\$ 12.23	\$ 18.57
ECONOMIC		
Net Present Value (in \$millions)	- \$ 9.5	- \$ 5.7
B/C Ratio	0.6	0.8

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of -\$10 million to -\$13 million for the 80 km/hr design speed concept, and -\$6 to -\$10 million for the 90 km/hr design speed concept (difference of approximately -\$3 to -\$4 million for both options). The net present values further decrease



to -\$15 million (80 km/hr design speed) and -\$13 million (90 km/hr design speed) at a discount rate of 10%.

- **Transportation.** The provision of a new eastbound bridge across the Capilano River to accommodate longer acceleration and deceleration lengths, as well the increased curve radius on Highway 1 west of Capilano Interchange improves the overall operation and safety performance both in the short- and long-term.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	<ul style="list-style-type: none"> No significant impacts to network vehicle queues. 	○
Collision Proneness	<ul style="list-style-type: none"> The longer acceleration and deceleration lengths and improved curve radius (for design speeds of 80 km/hr and 90 km/hr) would improve the safety performance significantly 	●
Operation	<ul style="list-style-type: none"> The on- and off-ramps would operate at acceptable levels of service 	●
Local Connectivity	<ul style="list-style-type: none"> Local connectivity is maintained 	○
Transit	<ul style="list-style-type: none"> No impacts as there are no transit services along this section of Highway 1 	○
Pedestrians and Cyclists	<ul style="list-style-type: none"> Existing facilities for pedestrians and cyclists would be maintained 	○

● Good/Favourable/Better ○ Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from the interchange modifications are significant with 13 residential partial property takes and 1 full property take on the south side of Highway 1.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	<ul style="list-style-type: none"> Residential property impacts on the south side of Highway 1 	13 properties (partial takes) + 1 property (full take)
Commercial Properties Impacted	<ul style="list-style-type: none"> No commercial property impacts 	0 properties
Squamish Nation Land Impacts	<ul style="list-style-type: none"> No Squamish Nation Land impacts 	0 m ²
Noise Impacts	<ul style="list-style-type: none"> No additional noise impacts 	○
Aesthetic (Visual) Impacts	<ul style="list-style-type: none"> No additional visual impacts 	○
Impacts to Access	<ul style="list-style-type: none"> No impacts to access 	○



EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Supportive of Land Use Plans	▪ Generally supportive of land use plans	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Environmental.** The bridge crosses the Capilano River which is classified as an environmentally sensitive area that is an important salmon and trout-producing stream. The placement of additional piers within the Capilano River may be required with this concept, as the existing bridge is an arched concrete structure. Although the location of the piers would be aligned with those of the existing eastbound structure, the potential environmental impacts on the river would need to be examined in subsequent stages of design and mitigated.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ Potential environmental impacts on the river would need to be examined in subsequent stages of design and mitigated	○
High Value Wildlife Habitat and Vegetation	▪ No impacts anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** The new eastbound bridge across the Capilano River would require staging and temporary ramp closures to tie in with the road work.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Requires staging and temporary ramp closures at the interchange	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



Tier 2 - Concept F – Transit Priority Lane Enhancements

Project Description

- **Condition Summary.** The line-ups to the Lions Gate Bridge affect buses from both North Vancouver and West Vancouver. Today, approximately eleven bus routes (or 129 buses) cross the Lions Gate Bridge southbound during the morning and afternoon peak periods (6-9am and 3-6pm). For those buses headed to the Lions Gate Bridge from the west, all buses leave the curb side lane on Marine Drive approximately 250 metres west of Taylor Way and cross into the inside lane with non-bridge destined eastbound traffic on Marine Drive (Routes 250, 251, 252, 253, 254, 257, and 258). Once east of the intersection of Taylor Way, buses access the transit priority lane to advance to approximately 210 metres from the actual Lions Gate bridgehead.

In the westbound direction, four bus routes from the Capilano Road area cross the Lions Gate Bridge during the morning and afternoon peak hour (Routes 240, 241, 246 and 247). Buses utilize the left side lane and proceed through the Marine Drive underpass and then through to the right side lane and enter the bus loop north of Marine Drive. Buses then merge with the southbound traffic approximately 320 metres from the Lions Gate bridgehead north of Marine Drive underpass. The travel time to the bridgehead can be significant, and the weave across two lane of traffic exiting the Lions Gate Bridge is an operational and safety concern for TransLink.





The table summarizes the existing morning and afternoon peak period bus activity directed southbound across the Lions Gate Bridge.

Table 1 - Summary of Existing Bus Activity

	Morning Peak (6-9am)		Afternoon (3-6pm)	
Direction	From West	From East	From West	From East
Route Numbers	250, 251, 252, 253, 254, 257, 258.	240, 241, 246, 247.	250, 251, 252, 253, 254, 257.	240, 246.
Number of Buses	32	44	29	24
Number of Passengers¹	1,600	2,200	870	720
Existing Start of Line to Bridge	End of transit queue jump lane	North side of Marine Drive	End of transit queue jump lane	North side of Marine Drive
Distance to Bridgehead	210 m	320 m	210 m	320 m
Average speed to bridge	11.4 km/hr	9.7 km/hr	3.3 km/hr	3.5 km/hr

¹ Average load of 50 passengers per bus for the AM peak period and 30 passengers for the PM peak period based on Translink Screenline transit traffic data for Lions Gate Bridge (November 2004) in the southbound direction.

TransLink will be initiating a transit priority study of the area leading toward the Lions Gate Bridge on the North Shore. The emphasis of this work will link with the directions from this study and concentrate on areas east of Capilano Road and west of Taylor Way.

- **Improvement Concept.** Even if the line-ups to the Lions Gate Bridge can be addressed through other improvement strategies explored within this study, southbound buses merge with bridge traffic well before the bridgehead, causing some further delays to approximately 5,400 passengers during the morning and afternoon peak periods. Recognizing that no additional vehicle capacity will be added to or gained from the bridge, encouraging and facilitating more passengers on buses is the only possible method of improving the carrying capacity of the Lions Gate Bridge. Although TransLink will be considering long-term improvements to address delays east and west of Capilano Road and Taylor Way respectively, the existing transit priority facilities may be improved to reduce delays to passengers. Figure 2-F illustrates the potential changes to the existing transit priority facilities which are summarized as follows:
 - A westbound left-turn lane on Marine Drive immediately west of the overpass may be provided to provide direct access to the existing eastbound transit priority lane for buses from the east. This improvement would eliminate the existing weave for buses to access the bridge and could include closure of the existing transit loop. A traffic signal with bus



activated pre-emption would be required to stop eastbound traffic and permit buses to turn left. Because of the proximity to the bridge pier for the Marine Drive Overpass, and location of the existing eastbound transit priority lane, the left-turn storage area is approximately 20 metres and could only accommodate one bus at a time.

- Extend the existing transit priority lane further south by approximately 100 metres to move transit vehicles closer to the bridgehead before merging with other traffic.

The operation of the enhanced transit priority lanes are summarized in terms of total travel time in the Table 2. These results demonstrate that during the morning peak period, each bus destined to the bridge would save up to 1 minute, and up to 3.4 minutes in the afternoon as a result of reducing the travel distance to the bridgehead from the west and east (approximately 100 and 200 metres, respectively). In particular, during both the morning and afternoon peak periods, the transit priority lane would provide greater travel time savings for passengers travelling from the east to the bridge than for passengers travelling from the west. Over the entire year, it is estimated that the total person travel time savings from these improvements would be approximately 27,000 hours based on existing services. Obviously, these savings would grow with expanded services.

Table 2 - Summary of Travel Time Savings for Existing Transit Passengers

	Morning Peak (6-9am)		Afternoon (3-6pm)		Annual²	
Direction	From West	From East	From West	From East	From West	From East
Number of Buses	32	44	29	24	13,420	14,960
Number of Passengers¹	1,600	2,200	870	720	543,400	642,400
BASE						
Distance to Bridgehead (m)	210 m	320 m	210 m	320 m	---	---
Average speed to bridge (km/hr)	11.4 km/hr	9.7 km/hr	3.3 km/hr	3.5 km/hr	---	---
Average travel time (min/veh)	1.28 min	2.32 min	3.99 min	5.83 min	---	---
Total person travel time (min)	2,040 min	5,103 min	3,470 min	4,195 min	1,212,231 min	2,045,374 min
IMPROVEMENT CONCEPT						
Distance to Bridgehead (m)	115 m	115 m	115 m	115 m	---	---
Average speed to bridge (km/hr)	11.4 km/hr	11.4 km/hr	3.3 km/hr	3.3 km/hr	---	---
Average travel time (min/veh)	0.97 min	0.94 min	2.45 min	2.42 min	---	---
Total person travel time (min)	1,544 min	2,058 min	2,132 min	1,743 min	808,877 min	836,139 min
TRAVEL TIME SAVINGS						
Total person travel time (min)	496 min	3,045 min	1,337 min	2,451 min	403,354 min	1,209,234 min

¹ Average load of 50 passengers per bus for the AM peak period and 30 passengers for the PM peak period based on Translink Screenline transit traffic data for Lions Gate Bridge (November 2004) in the southbound direction.

² Assuming an average 220 weekdays per year.



MODIFY LIONS GATE TRANSIT PRIORITY LANE

FIGURE

2-F



Project Evaluation

The following discussion details the evaluation of the transit priority lane concept.

- **Financial Performance, Customer Service and Economic Indicators (see Table 3 below).** The total cost of the transit lane enhancements is estimated to be \$0.25 million.

Based on observed and modelled travel speeds, alterations to the transit priority facilities to the Lions Gate Bridge could reduce southbound travel times during the morning and afternoon peak periods. The present value of the total travel time and vehicle operating benefits for the transit priority lane enhancements to southbound Lions Gate Bridge is estimated to be approximately \$6 million.

The B/C ratio for the transit priority lane concept is estimated to be 29.5 with a positive net present value of \$5 million. These results indicate that the benefits of this improvement will significantly offset the costs.

Table 3 - Transit Priority Lane Financial Summary

EVALUATION ACCOUNT	Concept
FINANCIAL (\$millions)	
Total Cost	\$ 0.25
Discounted Capital Cost (PV)	\$ 0.24
Operating & Maintenance Cost (PV)	\$ 0.00
Salvage Costs (PV)	(\$ 0.04)
Total Incremental Cost	\$ 0.20
CUSTOMER SERVICE (\$millions)	
Travel Time Savings (PV)	\$ 4.23
Vehicle Operating Savings (PV)	\$ 0.97
Accident Savings (PV)	\$ 0.00
Total Benefits (PV)	\$ 5.20
ECONOMIC	
Net Present Value (in \$millions)	\$ 5.00
B/C Ratio	26.2

Note: in 2006 dollars based on a discount rate of 6% over a 25-year period

A sensitivity analysis was also undertaken using discount rates of 8% and 10%. In general, results indicate that at higher discount rates, future benefit streams are discounted heavily and yield lower present values. At a discount rate of 8%, the net present value decreases from the baseline value of \$5 million to \$4 million (difference of approximately \$1 million). The net present value further decreases to \$ 3.5 million at a discount rate of 10%.



- **Transportation.** The provision of a westbound left turn bus lane on Marine Drive to directly access the bridge, and southward extension of the existing transit priority lane would overall improve the safety performance and reduce delays for passengers. The existing weave for westbound buses to the bridge via the transit loop would be eliminated and the transit priority lane would be closer to the bridgehead.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Network Vehicle Queues	▪ Vehicle queues along Marine Drive are still expected	●
Collision Proneness	▪ The new westbound left turn to the existing eastbound transit priority lane would eliminate the existing weave for buses accessing the bridge	●
Operation	▪ Average bus travel times would be reduced	●
Local Connectivity	▪ Local connectivity would be maintained	●
Transit	▪ direct access to the eastbound transit priority lane would reduce delays to transit passengers	●
Pedestrians and Cyclists	▪ Pedestrian and cyclist facilities would be maintained	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Social Community.** The social and community impacts from a transit priority lane bridge are negligible.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Residential Properties Impacted	▪ No residential property impacts	0 properties
Commercial Properties Impacted	▪ No commercial property impacts	0 properties
Squamish Nation Land Impacts	▪ No Squamish Nation Land impacts	0 m ²
Noise Impacts	▪ No additional noise impacts	●
Aesthetic (Visual) Impacts	▪ No additional visual impacts	●
Impacts to Access	▪ No impacts to access	●
Supportive of Land Use Plans	▪ Generally supportive of land use plans	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse



- **Environmental.** No environmental impact is anticipated for this concept.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Parkland Impacts	▪ No parkland impacts	0 m ²
Watercourse Impacts	▪ No watercourse impacts	●
High Value Wildlife Habitat and Vegetation	▪ No impacts anticipated	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse

- **Constructability.** Construction of the transit priority lane may require temporary lane closure.

EVALUATION ACCOUNT	DISCUSSION	SUMMARY
Construction Challenges	▪ Requires temporary lane closure	●

● Good/Favourable/Better ● Fair/Neutral ○ Poor/Unfavourable/Worse