

PLANNING LASTING INFRASTRUCTURE



Final Report for:
**NORTH SHORE
TRADE AREA STUDY**
September 30, 2008

Submitted to:
TRANSPORT CANADA



SNC • LAVALIN

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FINAL REPORT

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ACKNOWLEDGEMENTS

The North Shore Trade Area Study was commissioned under the auspices of Canada's Asia-Pacific Gateway and Corridor Initiative (APGCI) launched in October 2006. The study was conducted under the direction of Transport Canada, with full participation of the following study partners and project sponsors:

- Transport Canada
- Port Metro Vancouver (PMV, also known as Vancouver Fraser Port Authority/PMV)
- British Columbia Ministry of Transportation and Infrastructure (BC MoT)
- South Coast British Columbia Transportation Authority (TransLink)
- Greater Vancouver Gateway Council (GVGC)

SNC-Lavalin would like to express our appreciation for the guidance and technical input provided by members of the Steering and Technical Committees since the inception of the study in January 2008. The following committee members are thanked for their time, effort and attention throughout the duration of this study:

Study Steering Committee:

- Ms Helena Borges – Transport Canada
- Ms Mimi Sukhdeo – Transport Canada
- Mr. Peter Xotta - Port Metro Vancouver
- Ms Lisa Gow – BC MoT
- Mr. Gary Vlieg - TransLink
- Mr. Robert Wilds - Greater Vancouver Gateway Council

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- Ms Erin Annis – BC MoT
- Mr. Andrew Hind – TRAN
- Ms Helen Cook - TransLink
- Ms Jemay Zheng – TransLink

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- City of North Vancouver
- District of North Vancouver
- District of West Vancouver
- District of Squamish
- Squamish Nation
- Tsleil Waututh Nation
- Canadian National Railway
- Canadian Pacific Railway
- British Columbia Railway Company
- Western Stevedoring
- Neptune Bulk Terminals
- Cargill Terminal
- James Richardson International
- Kinder Morgan Canada Terminals
- Fibreco Terminal
- Washington Marine Group
- Univar (Dow Chemicals)
- Canexus Ltd.
- Squamish Terminal



EXECUTIVE SUMMARY

E1 Introduction

The North Shore Trade Area Study is part Canada's on-going effort to support the Asia-Pacific Gateway and Corridor Initiative (APGCI). The Trade Area, covering port terminals and industrial activities along the North Shore of the Burrard Inlet, is a critical export gateway to the Asia-Pacific region. In 2007, the area handled 23.8 million tonnes of commodity, with a value of approximately \$7.7 billion. The area is a significant



economic generator of employment in the marine, rail and trucking industries. It also supports employment in various export-based industries, including agriculture, forestry, mining and manufacturing in B.C., throughout western Canada, and across Canada as a whole. Investments in an efficient and effective transportation system in the area will enable the economic benefits of this strategic gateway to be realized to its full potential.

Commissioned by Transport Canada, Port Metro Vancouver (PMV, also known as Vancouver Fraser Port Authority), BC Ministry of Transportation and Infrastructure (BC MoT), the South Coast BC Transportation Authority (TransLink), and the Greater Vancouver Gateway Council (GVGC), SNC-Lavalin has completed the North Shore Trade Area Study to review the transportation infrastructure issues in the area directly adjacent to the port terminals and Canadian National Railway (CNR) corridor, with the objective of enabling and supporting the continued growth of this strategic component of the Asia-Pacific Gateway while addressing some of the transportation issues affecting the local communities.

E2 Study Objectives

Focused on the area directly adjacent to the port terminals, the North Shore Trade Area (NSTA) Study has three key objectives:

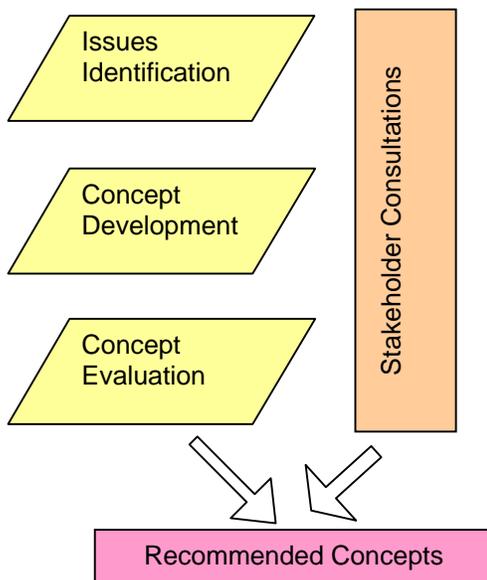
- To review and synthesize previous studies and work that study partners and stakeholders have completed, and conduct new road traffic and road/rail interface analysis;
- To identify key capacity, efficiency, operation, safety and other issues for the current and future scenarios, related to terminal plans, port development, rail and rail yard layouts, the road network and rail/road interfaces; and,



- To develop and recommend effective infrastructure strategies and other important projects within the North Shore Trade Area that would provide greater benefits for all partners and stakeholders.

The study's ultimate goal is to assess the transportation and infrastructure conditions of the NSTA in the current and future base years and to determine the transportation infrastructure improvements required to accommodate and enhance the trade development objectives with the least social, community and environmental impacts.

E3 Study Methodology



The study methodology was based on two parallel and interactive processes: a technical process and a consultation process. The technical process followed a logical problem-solving approach from background review, problem definition, concept development and evaluation, to finally, the recommendation of a list of concepts to best meet the study objectives. The stakeholder consultation process was designed to gather input and feedback from study stakeholders including the North Shore municipalities, First Nations, terminal operators and railway companies. The combination of the two processes ensured that the project issues were fully identified and proposed improvement concepts appropriately evaluated in an integrated and collaborative manner.

E3.1 The Technical Process

A comprehensive technical engineering process was undertaken for the North Shore Trade Area Study. Traffic demand modeling (EMME) and traffic operational analysis (Synchro) were conducted for the area bounded by the Lions Gate Bridge to the west, the Iron Workers Memorial Second Narrows Bridge to the east, and the Trans Canada Highway to the north. Then the study focused on the area adjacent to and including the port terminals and CNR corridor on the North Shore. Road, rail and road/rail interface requirements for the North Shore Trade Area were identified. Conceptual engineering design was undertaken to develop feasible improvement concepts, along with a Class "D" cost estimate. The technical and engineering process for the study included the following key steps:



Base Condition Assessment and Critical Issue Identification

Following a review and synthesis of previous studies and relevant work conducted for the study area bounded by the two bridges and the Trans Canada Highway, a Base Condition Assessment of the North Shore Trade Area was undertaken focusing on the road network and road/rail interface issues. The assessment included a review of the current and projected land use and development, transportation network, and traffic conditions in the study horizon years (2006, 2011 and 2021). In conjunction with the road-focused analysis, a separate Rail Network Assessment was commissioned by PMV, in consultation with the railways, terminal operators and provincial and federal governments, to address existing and long term rail network operations and improvement requirements in the North Shore Trade Area¹. The rail network concept established in the Rail Network Assessment form the basis in defining the footprint available for the road network and road/rail interface elements in the area. Based on the Rail Network Assessment, road and network analysis, as well as stakeholder input, critical rail, road and road/rail interface issues were identified.

Concept Development and Screening

Subsequent to the Base Condition Assessment and with input from the Study Technical Committee, municipalities and industry stakeholders, a list of preliminary improvement concepts for the North Shore Trade Area were identified to meet the objectives of the study. These preliminary concepts were evaluated through a feasibility-level screening process such that concepts which were not supported by the stakeholders, were cost-prohibitive or technically infeasible were eliminated from further review.

Multiple Account Evaluation

A short list of improvement concepts was then evaluated in a comprehensive Multiple Account Evaluation (MAE) framework to establish project recommendations. The MAE framework consisted of six evaluation accounts, including Financial, Customer Service, Social/Community, Security, Environmental, and Economic Impact. The Financial and Customer Service accounts were assessed quantitatively through a Benefit-Cost Analysis while accounts including social/community, security, environmental and economic development impacts were assessed qualitatively by the SNC-Lavalin study team and the Study Technical Committee.

E3.2 The Consultation Process

A two-stage consultation approach was used to engage the key stakeholders in this study. Initial consultation was conducted in small group meetings attended by members of the Study Technical Committee, the SNC-Lavalin study team, and representatives from the

¹ “North and West Vancouver Rail Assessment Study”, submitted to Port Metro Vancouver by MainLine Management Inc., Draft April 30, 2008.



stakeholder groups. Follow-up consultation was conducted in a workshop format where municipal and industry groups attended half-day workshops to discuss the critical issues and the proposed improvement concepts and the implementation strategy for the recommended transportation solution.

E4 Study Findings

E4.1 Critical Rail issues

Findings from the Rail Network Assessment and discussions with terminal operators in the North Shore Trade Area have indicated some common and consistent themes with respect to critical rail issues:

- Three at-grade crossings (Neptune/Cargill terminal access, Pemberton Avenue, and St Andrews Avenue) are recommended for grade separation to remove the existing rail switching and rail/road conflicts, and to enable terminal expansion on the North Shore;
- Rail reconfiguration and infrastructure additions west of the CNR Big Yard will be required to alleviate many of the rail conflicts experienced today and to enable the rail traffic growth anticipated by the terminal operators;
- A proposed Lynnterm container facility would create some additional rail conflicts beyond those experienced today, particularly if container traffic is increased to the levels projected by 2025;
- There appears to be available rail capacity in the western portion of the study area to accommodate the anticipated growth by Kinder Morgan and Fibreco. Much of that capacity is the result of an effective operating plan that has been developed by CNR and a change in business at Kinder Morgan.



E4.2 Critical Road Issues

Lack of Municipal East-West Connectivity

There is a general lack of east-west connectivity in the local road networks as well as through the area connecting the ports and terminals on the North Shore. Except for the Trans Canada Highway, there is no other direct and continuous east-west route between the Lions Gate Bridge and the Iron Workers Memorial Second Narrows Bridge on the North



Shore. Currently, the Marine Drive-3rd Street-Esplanade-Main Street corridor system is the closest alternative.

A continuous Lower Level Route along the waterfront has been envisioned to become a true direct east-west connector on the North Shore. Aside from the sections through the Esplanade and the Indian Reserves, this route is primarily flanked by industrial and port developments on the south side. Upgrading and designating this route as a major east-west corridor would provide significant benefits to the terminal operators as well as the local communities. It would also function as an alternative route to the Trans-Canada Highway and thus provide a much needed redundancy in the North Shore road network from both traffic operations and emergency response perspectives.

Congestion at the Ironworkers Memorial Second Narrows and Lions' Gate Bridgeheads

Most of the critical intersections in the study area are located adjacent to the Ironworkers Memorial Second Narrows and Lions' Gate Bridges on the North Shore. The operations of these two bridges have significant impacts on the operations of the overall North Shore municipal road network. Almost all the major intersections located at the bridgeheads are currently operating at capacity during peak periods due to the capacity constraints approaching and across the bridges.

Even though the connections to both bridges are located in the District of North Vancouver, traffic congestion due to the constrained capacity affect the road network in all three North Shore municipalities. When incidents occur on any one of the bridges, traffic queues spill back on many major roads on the North Shore municipalities as traffic diversion occurs between the two bridges, resulting in major compromises in travel reliability and emergency response.

E4.3 Recommended Concepts

To address the critical issues and to meet the study objectives of the North Shore Trade Area Study, the SNC-Lavalin study team, in consultation with the study partners and stakeholders, has developed six transportation improvement concepts. Table ES-1 summarizes these six concepts with their respective estimated cost and location. The locations of these recommended concepts are also shown in Figure ES-1. The total capital cost for the six concepts and the rail network concept is estimated at \$280 million (including \$205 million for road related improvements and \$75 million for rail infrastructure improvements²).

² Rail improvement cost of \$75 million is provided by PMV for B/C analysis in this study. Road-related improvement costs are provided by SNC-Lavalin based on conceptual design of the improvement concepts. All costs and benefits are shown in 2008 Dollars.



Table ES-1: Recommended Road Improvement Concepts, Costs and Jurisdiction

	Improvement Concepts	Estimated Cost* (2008 Dollar)	Estimated Cost** (2014 Dollar)	Location
Rail/Terminal Access Triggered	Pemberton Avenue Grade Separation	\$27 M	\$36 M	District of North Vancouver
	St Andrews Avenue Grade Separation	\$15 M	\$20 M	City of North Vancouver
	Neptune/Cargill Grade Separation	\$30 M	\$40 M	City of North Vancouver
	Low Level Road Re-Alignment	\$45 M	\$61 M	City of North Vancouver
	Harbour Avenue Grade Separation	\$13 M	\$16 M	District of North Vancouver
Road Triggered	Western Lower Level Route Extension to Marine Drive	\$75 M	\$100 M	Squamish Nation/ District of West Vancouver / District of North Vancouver
Total		\$205 M	\$273 M	

**Note: Estimated cost for road improvements includes construction, engineering and contingency in 2008 Dollar, excluding property and environmental mitigation/compensation costs. Where two design options exist for the improvement concept, the higher cost option is shown in this table.*

*** Cost escalation from 2008 to 2014 is based on a 5% increase per year.*

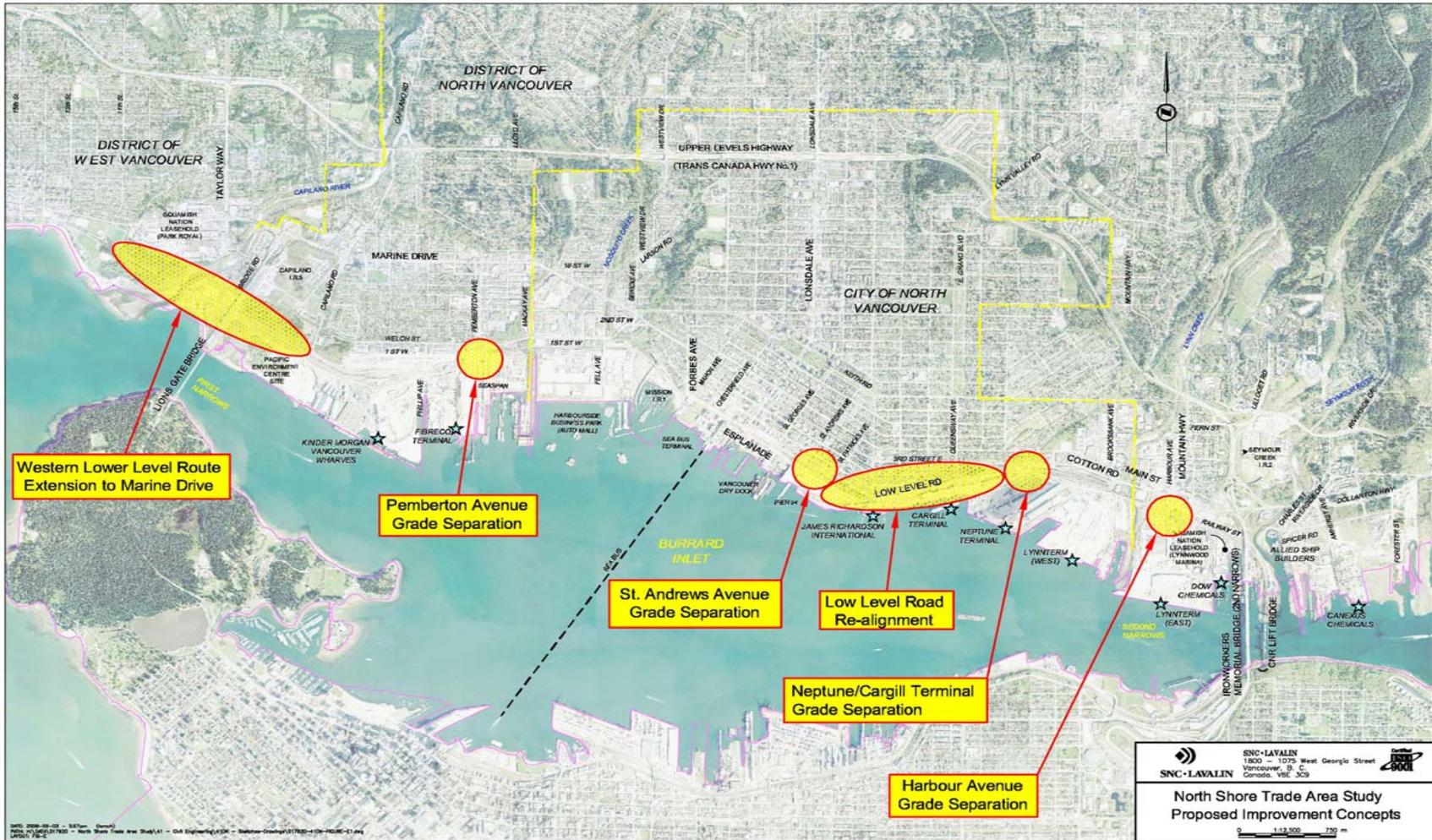
The rail network concept was developed by PMV in conjunction with the railways and terminal operators to enable terminal expansion plans and enhance rail operations on the North Shore. The Rail Network Assessment work indicated that the rail infrastructure improvement would cost approximately \$75 million.



Five of the six improvement concepts are rail or terminal-triggered concepts that are required to support Asia-Pacific Trade on the North Shore. The total road improvement cost for these five concepts is estimated at approximately \$130 million (excluding property and potential environmental mitigation/compensation costs).



Figure ES-1: Recommended Improvement Concepts





Based on the benefit/cost analysis, the rail network concept and the five rail or terminal-triggered concepts combined would cost approximately \$205 million (excluding property and environmental mitigation/compensation costs) and provide a total benefit of \$268-530 million, resulting in an overall benefit/cost ratio of 1.3 to 2.6.

One road-triggered improvement concept (Western Lower Level Route Extension to Marine Drive) was promoted by the North Shore municipalities and the Squamish Nation. The cost of this concept is estimated to be around \$75 million (excluding property and environmental mitigation/compensation costs). This concept is expected to generate an estimated benefit of \$44 million, resulting in a benefit/cost ratio of 0.58.

One fact sheet for each improvement concept is provided at the end of this section. The fact sheet describes the existing conditions, rail/road crossing statistics, the scope and rationale for the proposed improvements, as well as a summary of the Multiple Account Evaluation of the improvement concept.

E4.4 Issues for Further Consideration

In developing road transportation improvement concepts, it was frequently necessary to examine several options to fulfill the purpose of the desired improvement. To move the concepts forward as recommended projects for implementation, it will be necessary, beyond this current study, to undertake the following work for each concept:

- Conduct more detailed engineering and functional design to confirm technical feasibility, constructability, and land requirement;
- Assess in more detail the benefits and impacts to the natural and social environment;
- Further address security issues related to the North Shore terminals and road/rail corridors;
- Conduct value engineering and refine construction, maintenance, and other associated project cost (e.g. environmental assessment, permitting and potential mitigation/compensation);
- Consult with municipalities and stakeholders to ensure that engineering design meets community/stakeholder requirements; and
- Assess financial feasibility and establish project priorities based on needs and available funding of each partner.

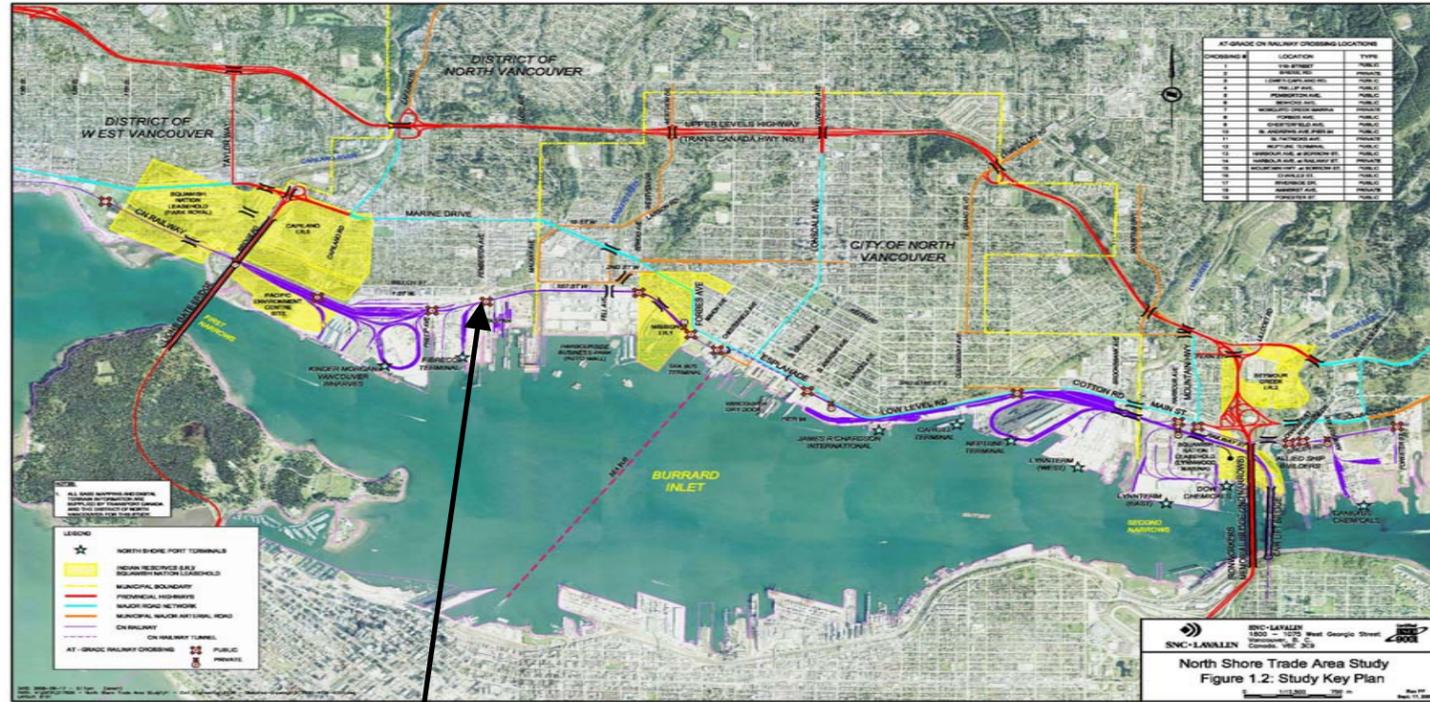


E5 Conclusions

In support of Asia-Pacific trade activities in the North Shore Trade Area, and in enhancing the safe and efficient movement of people and goods within the North Shore communities, Transport Canada, in conjunction with BC Ministry of Transportation and Infrastructure, Port Metro Vancouver, Translink, and Greater Vancouver Gateway Council, launched the North Shore Trade Area Study to review the transportation infrastructure issues in the North Shore Trade Area adjacent to the port terminals and rail corridor, with the objective of enabling and supporting the continued growth of this strategic component of the Asia-Pacific Gateway.

Through a comprehensive technical review with on-going consultation with study partners and stakeholders, six technically sound road transportation improvement concepts were developed to ensure an efficient transportation system in the North Shore Trade Area. Five of the six improvement concepts are rail or terminal-triggered concepts that are required to support Asia-Pacific Trade on the North Shore. These proposed infrastructure concepts will likely serve as a catalyst for private investment on the terminal expansion and business opportunities like Canpotex to use the North Shore as their gateway. This is also a unique opportunity for all North Shore terminal operators and railway companies to collectively resolve rail operation deficiency and to improve the overall rail operations on the North Shore. At the same time, the development of the road infrastructure concepts within the North Shore Trade Area have taken into account some of the municipal issues such as slope stability, cycling facilities, and noise impacts from rail and terminal operations, which would provide a win-win situation for all stakeholders.

Concept Fact Sheet: Pemberton Avenue Grade Separation



Concept Description:

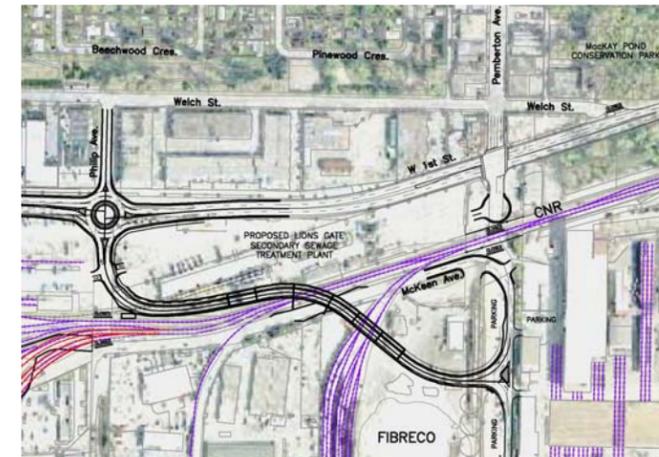
The existing CNR at-grade crossing at Pemberton Avenue is located about 80 m south of the Pemberton/W. 1st Street intersection in the District of North Vancouver. The crossing is currently controlled with flashing lights, bells and gates (FLBG). The Pemberton/W. 1st Street intersection serves as the primary access for the port terminals and industrial land to the south of the tracks. Previous studies have been conducted for grade separation in view of the delay and operating difficulties for rail traffic (N.D. Lea, 2001) as well as the noise complaints by local residents (Delcan, 2007).

The Rail Network Assessment for the North Shore indicated heavy rail usage at this location due to the crossing of all arriving and departing trains between North and West Vancouver, as well as local switching between Fibreco and Northgate terminals. Additional rail occupancy is expected in the 2025 Future Case when operational changes in the Kinder Morgan yard will result in higher volume and longer trains, as well as additional switching to Kinder Morgan and Fibreco.

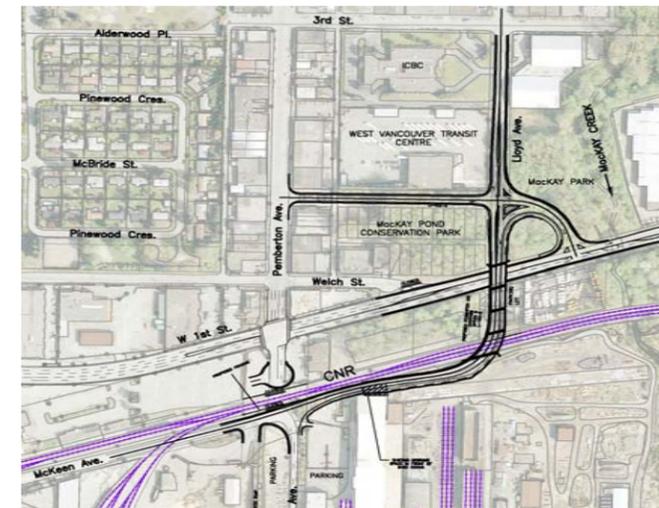
Concept Evaluation:

Concept Evaluation	Option A: Philip Avenue	Option B: Lloyd Overpass
Capital Cost	\$27 M	
User Benefits	Part of rail improvement plan to support port operations and expansion; \$1.6 M in road user benefits (travel time, vehical operating cost and safety)	
Social/Community Impacts	Reduce whistle noise associated with at-grade crossings; improved road access for emergency services	
Property Impacts	May not be compatible with Metro Vancouver wastewater treatment plant	Minimal property impacts
Environmental	Minimal environmental impacts	Impacts to park and Mackay Creek
Security	Increased security for port access	
Economic Impacts	Support Asia Pacific trade; enable longer trains and reduce delay	

Option A: Philip Avenue Overpass



Option B: Lloyd Avenue Overpass



Legend: ● = Positive; ○ = Neutral; ○ = Negative

Note: Concept costs and benefits are shown in Net Present Value in 2008 Dollars over a 25 year study period, excluding property and potential environmental mitigation/compensation.

Improvement Concept:

The Concept will provide grade separation to eliminate the existing Pemberton Avenue and Philip Avenue at-grade crossings. Two overpass options are developed, with overpass connections at Philip Avenue and Lloyd Avenue respectively. It will increase rail and road capacity through this location, thus enabling longer trains, reducing noise impacts to the residential neighbourhood, as well as providing assured road connection to the industries south of the rail tracks.

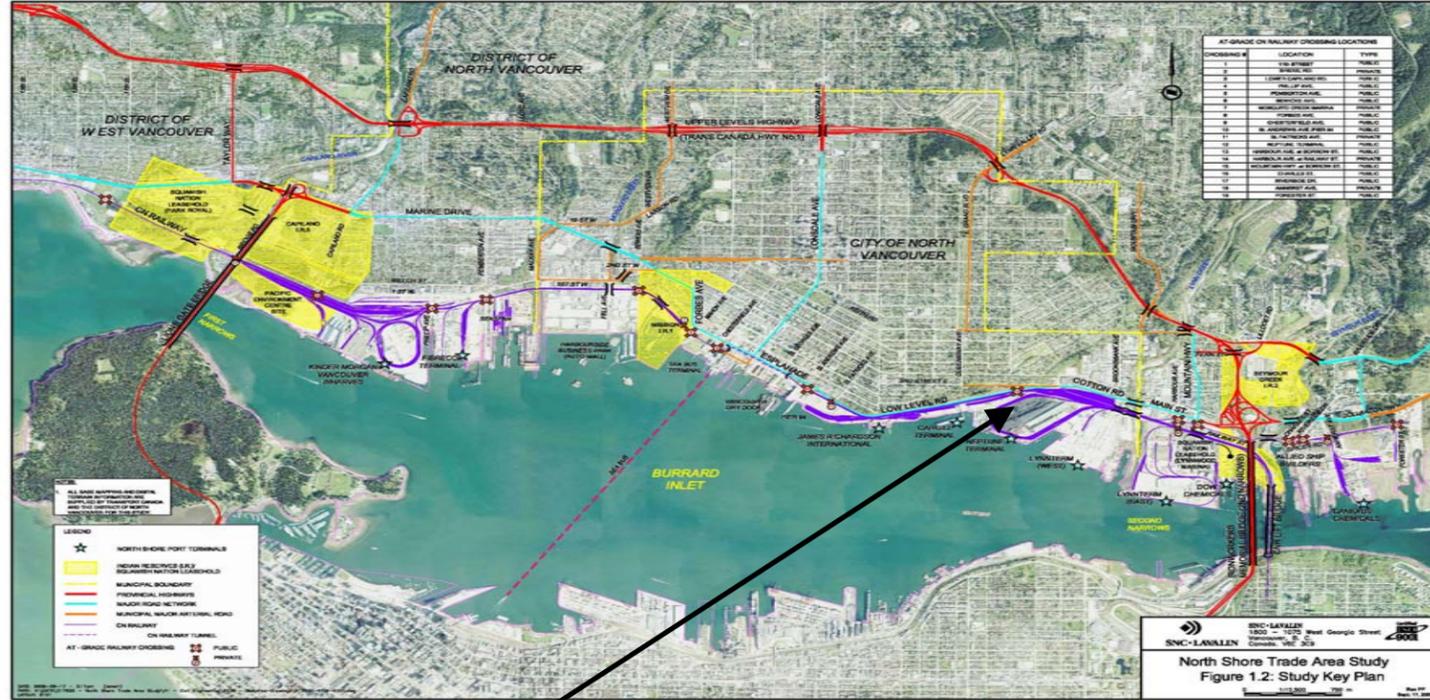


Grade Crossing Statistics: Pemberton Avenue

	Rail				Road	
	Occupancies per Day	Average Blockage	Maximum Blockage	Total Daily Blockage	AADT	% Trucks
Base Case – 2006	38.3	0:04:43	0:18:54	3:00:33	3,450	7%
Future Case – 2025 (Rail) / 2021 (Road)	45.3	0:04:45	0:21:51	3:35:05	6,530	8%

Source: Rail data based on "North and West Vancouver Rail Assessment Study", Mainline Management Inc., Draft April 30, 2008; road data based on North Shore EMM Sub-Area Model and SNC-Lavalin analysis.

Concept Fact Sheet: Neptune/Cargill Grade Separation



Concept Description:

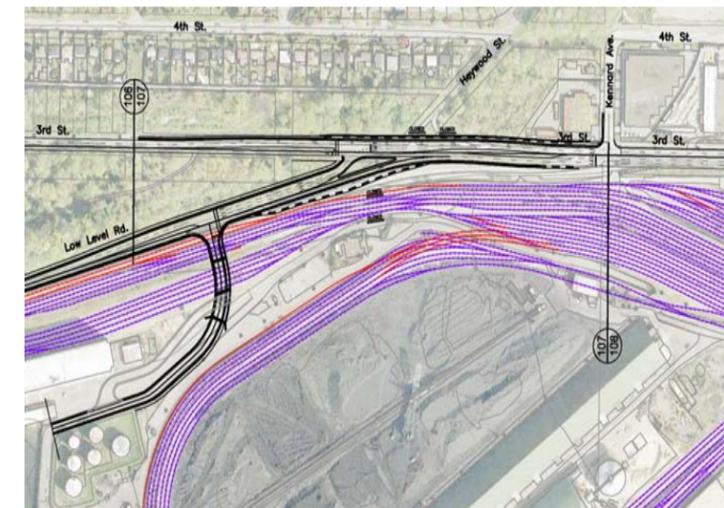
The Neptune/Cargill crossing is located directly west of the CNR's Lynn Creek Yards. This crossing currently experiences the highest number of occupancies per day of any crossing on the North Shore. The location of this crossing affects virtually every yard move in North Vancouver. In addition to all trains moving between North and West Vancouver, heavy rail occupancy is caused by yard switching to the west end, grain switching movements between Small Yard and the two elevators, and all empty movements from the elevators back into CNR's Big Yard. In the 2025 Future Case, switching changes at the Cargill and JRI elevators would decrease the number of occupancies over this crossing. However, rail occupancy and blockages would still be high due to longer trains and heavier volumes through this location.

The Rail Network Assessment believes that Neptune/Cargill Crossing should be considered first for grade separation due to heavy rail usage over the multiple track crossings and the impacts that would result from the planned rail corridor expansion on the North Shore.

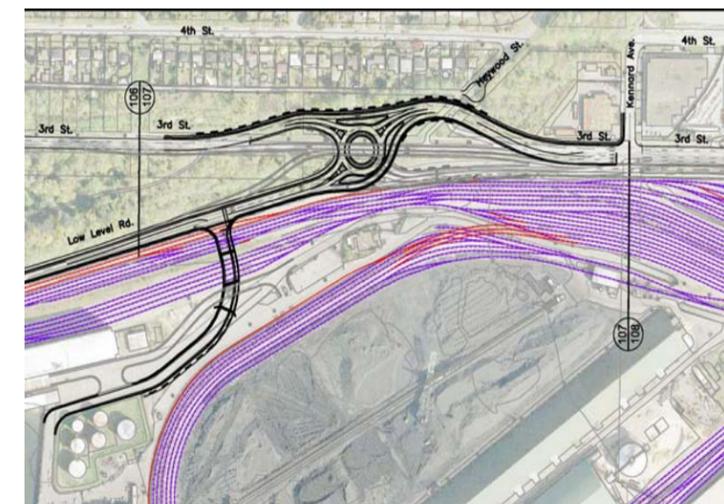
Concept Evaluation:

Concept Evaluation	Option A: Overpass and Improved Intersection	Option B: Overpass and Roundabout
Capital Cost	\$30 M	
User Benefits	Highest priority for grade separation as required by rail improvement plan; \$1.6 M in road user benefits (travel time, vehical operating cost and safety)	
Social/Community Impacts	● Reduce whistle noise associated with at-grade crossing; improved road access for emergency services	
Property Impacts	○ Minimal property impacts	● More property impacts with larger footprint
Environmental	● Affects vegetation along north side of existing Low Level Road	
Security	● Increased security for port access	
Economic Impacts	● Support Asia Pacific trade; enable longer trains and reduce delay	

Option A: Neptune/Cargill Overpass and Improved Intersection



Option B: Neptune/Cargill Overpass and Round-about Connection



Improvement Concept:

The concept would provide grade separation to eliminate the existing at-grade crossing accessing the Neptune and Cargill terminals; two rail overpass options were developed, both providing a rail overpass about 200 m west of the new junction of Low Level Road and 3rd Street East. Option A maintains an at-grade signalized intersection between Low Level Road and 3rd Street East, raised however above existing grade by about 11 m. In Option B, the at-grade signalized intersection between Low Level Road and 3rd Street East is replaced with a modern 3-leg roundabout with a bypass lane for westbound traffic on 3rd Street East. The roundabout is positioned so that a 4th leg could be added in the future connecting to a possible future 2-lane extension of Low Level Road to the east, located between Cotton Road/Main Street and the CNR tracks.

Grade Crossing Statistics: Neptune/Cargill Terminal

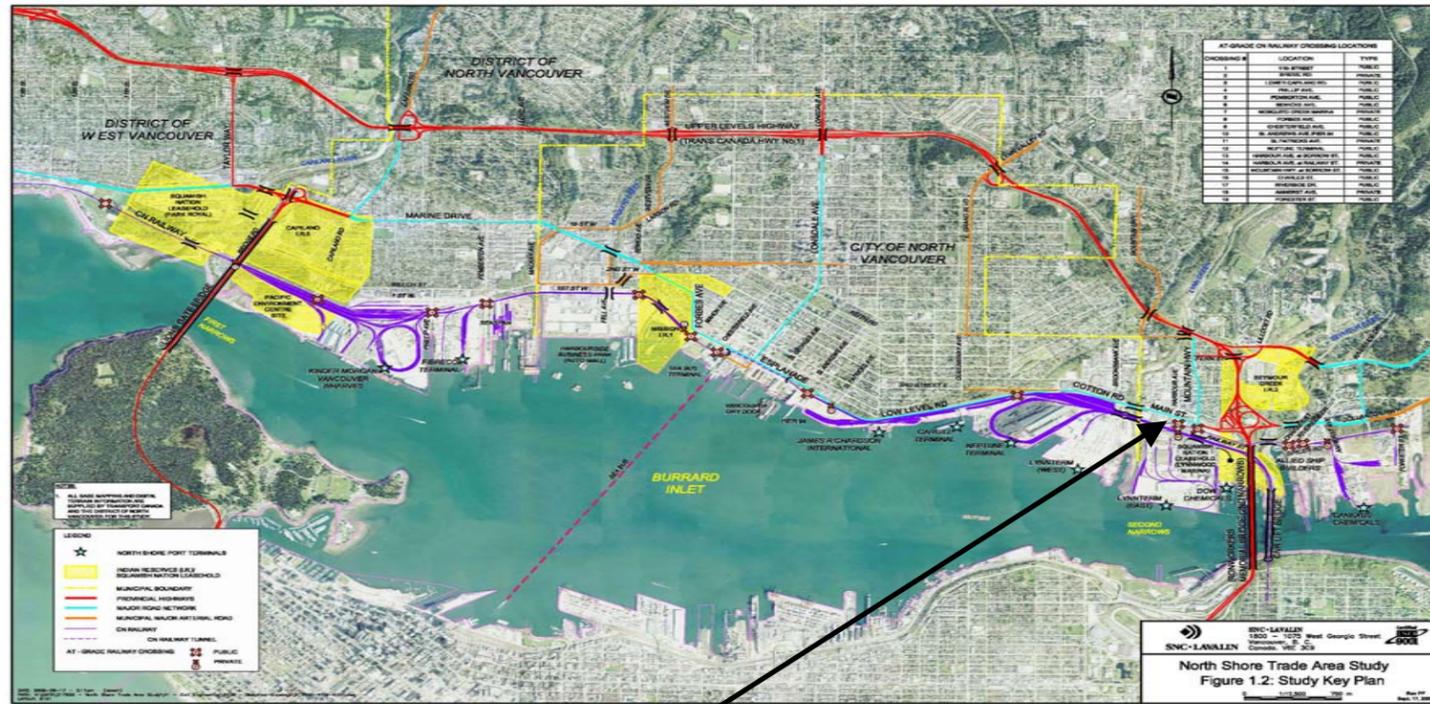
	Rail				Road	
	Occupancies per Day	Average Blockage	Maximum Blockage	Total Daily Blockage	AADT	% Trucks
Base Case – 2006	88.0	0:05:13	1:56:46	7:39:47	2,200	3%
Future Case – 2025 (Rail) / 2021 (Road)	42.3	0:06:18	0:53:05	4:26:53	2,390	3%

Source: Rail data based on "North and West Vancouver Rail Assessment Study", Mainline Management Inc., Draft April 30, 2008; road data based on North Shore EMME Sub-Area Model and SNC-Lavalin analysis.

Legend: ● = Positive; ○ = Neutral; ● = Negative

Note: Concept costs and benefits are shown in Net Present Value in 2008 Dollars over a 25 year study period, excluding property and potential environmental mitigation/compensation.

Concept Fact Sheet: Harbour Avenue Grade Separation



Concept Description:
 Harbour Avenue is located east of CNR's Lynn Creek Yards, near where the lead to Lynnterm diverges from the five arrival/departure/approach tracks accessing the yard and Neptune Terminals. Harbour Avenue intersects the CNR at two locations: one at Borrow Street (Public Crossing) and one at Railway Street (Private Crossing). The Harbour/Borrow crossing was not analyzed by PMV since it is located on a CNR spur line and does not carry rail through traffic.

The Harbour/Railway at-grade crossing is currently closed to road traffic and, from a road access perspective, is not critical for grade separation. From the rail operations perspective, the average blockage of this crossing is the greatest of any crossings in the North Shore because many trains arriving and departing North Vancouver sit on one of the five arrival/departure/approach tracks before being able to proceed. The crossing bisects the only available long tracks that are capable of holding arriving and departing unit trains for Neptune and of picking up Thornton traffic from the CNR Big Yard. The crossing is recommended for grade separation if Harbour Avenue is to be used for future road access in the case of Lynnterm container conversion.

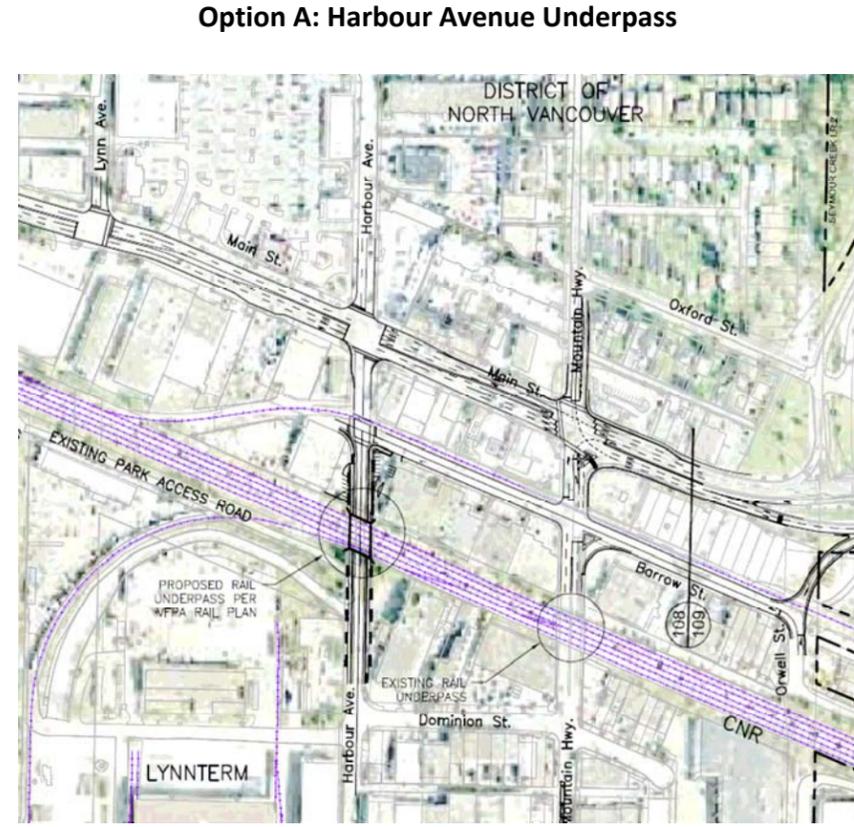
Improvement Concept:
 This concept, as proposed by the MMM Group for the Lynnterm container terminal development, involves the building of a rail underpass along the Harbour Avenue alignment, adding a protected-permitted westbound to southbound left-turn phase at the Main/Harbour intersection, revising the northbound right-turn lane at the Main/Mountain intersection, and closing the existing Brooksbank underpass. This would eliminate the existing at-grade crossing at Harbour Avenue and Railway Street and increase rail capacity through this location. The impacts of additional container traffic on Main Street and the Trans-Canada Highway, however, will need to be further assessed before this concept could be recommended for implementation.



Concept Evaluation:

Concept Evaluation	Option A: Harbour Avenue Underpass
Capital Cost	\$13 M
User Benefits	Part of rail improvement plan to support Lynnterm container conversion; container traffic circulation requires further analysis to minimize road impacts
Social/Community Impacts	Container traffic may impact transit operations along Main Street
Property Impacts	Some property impacts by underpass construction
Environmental	Minimal environmental impacts
Security	No impacts to port security (current at-grade crossing closed to road traffic)
Economic Impacts	Supports Asia Pacific trade and enable Lynnterm container terminal development

Legend: ● = Positive; ○ = Neutral; ○ = Negative



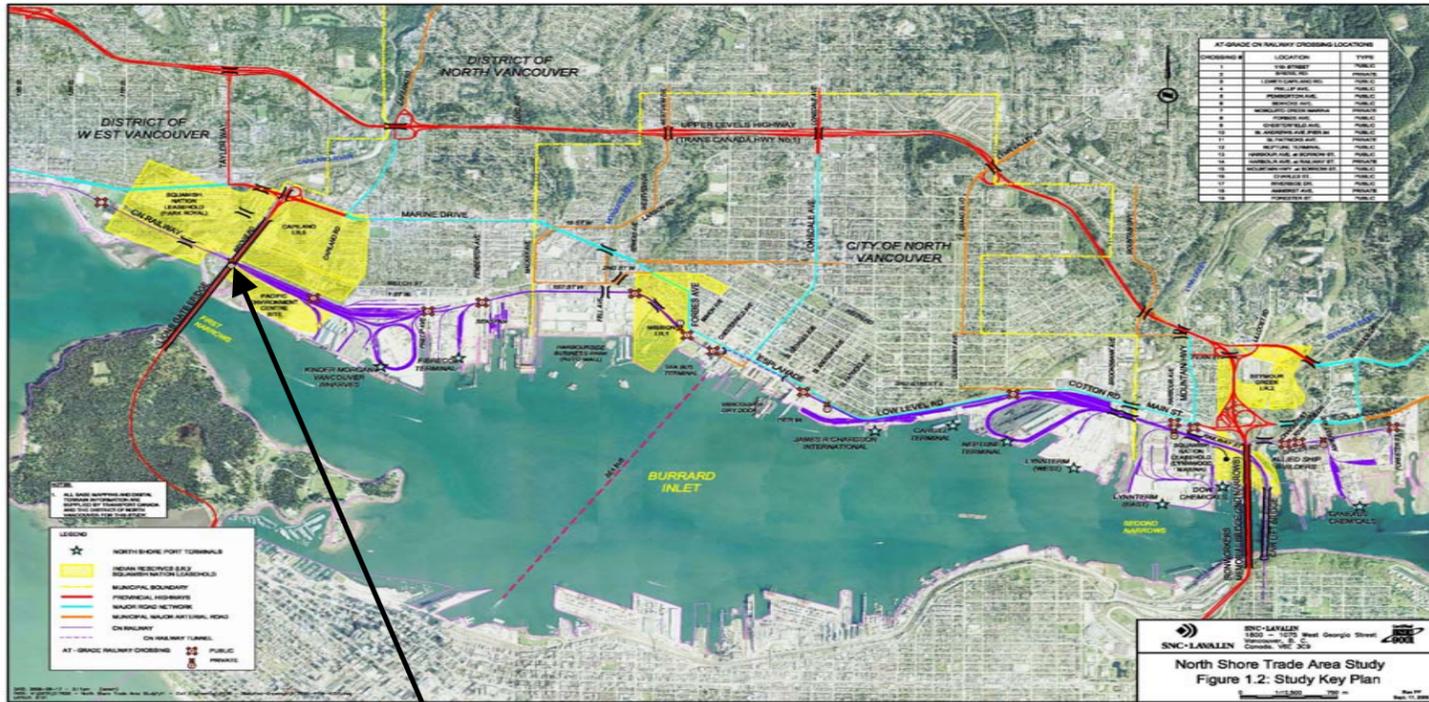
Grade Crossing Statistics: Harbour Avenue

	Rail				Road	
	Occupancies per Day (unit?)	Average Blockage	Maximum Blockage	Total Daily Blockage	AADT	% Trucks
Base Case – 2006	72.3	0:13:49	7:31:21	16:39	N/A	N/A
Future Case – 2025 (Rail) / 2021 (Road)	29.0	0:33:17	6:02:30	16:05:03	N/A	N/A

Source: Rail data based on "North and West Vancouver Rail Assessment Study", Mainline Management Inc., Draft April 30, 2008; road data based on North Shore EMME Sub-Area Model and SNC-Lavalin analysis.

Note: Concept costs and benefits are shown in Net Present Value in 2008 Dollars over a 25 year study period, excluding property and potential environmental mitigation/compensation.

Concept Fact Sheet: Western Lower Level Route Extension to Marine Drive



Concept Description:

A continuous east-west Low Level Road, also referred to as the Lower Level Route, has long been a transportation initiative on the North Shore. Aside from the sections through the Esplanade and the Indian Reserves, this route is primarily surrounded by industrial and port developments on the south side. The lack of direct municipal east-west connections in the North Shore results in traffic having to merge from two major east-west roadways into one major east-west roadway at various junctions.

The potential for a new Low Level Road between North and West Vancouver is being explored by the District of West Vancouver and the Squamish Nation. It is envisioned that this new road will connect W. 1st Street in the District of North Vancouver and Marine Drive in the District of West Vancouver near the Park Royal Shopping Centre. The new road is expected to serve a broad range of functions, including trips destined to the Squamish Nation/Park Royal area, circulation trips to the areas of West Vancouver and North Vancouver in the immediate area of the Lower Level Route, as well as through traffic between the North Shore municipalities.

Along the alignment of this proposed new road, the Bridge Road at-grade crossing is used by all arriving and departing trains running between West Vancouver and Squamish, and is heavily utilized by rail switching movements to/from CNR's West Vancouver Yard. The crossing provides the only road access to the land south of the train tracks, including the MetroVancouver wastewater treatment plant to the west and the Squamish Nation land to the east (also known as the Pacific Environment Centre site). In the future, this crossing may be required to be grade separated, subject to what development occurs at the PEC site. The location of this future grade separation could be to the east of Bridge Road as indicated in Squamish Nation's Capilano IR 5 Master Plan.



Grade Crossing Statistics: Bridge Road

	Rail				Road	
	Occupancies per Day	Average Blockage	Maximum Blockage	Total Daily Blockage	AADT	% Trucks
Base Case – 2006	55.3	0:02:54	0:31:59	2:40:54	N/A	N/A
Future Case – 2025 (Rail) / 2021 (Road)	62.0	0:01:44	0:17:44	1:46:57	N/A	N/A

Source: Rail data based on "North and West Vancouver Rail Assessment Study", Mainline Management Inc., Draft April 30, 2008; road data based on North Shore EMME Sub-Area Model and SNC-Lavalin analysis.

Concept Evaluation:

Concept Evaluation	Option A: 2-lane LLR, Capilano River Bridge and Mathias Overpass
Capital Cost	\$75 M
User Benefits	\$44 M road user benefits with new road connecting North and West Vancouver; relieves congestion on Marine Drive; Some benefits to rail operations with closure of Bridge Rd crossing
Social/Community Impacts	● Provide alternate east-west municipal connection and network redundancy; compatible with Spirit Trail concept; improved access for emergency services
Property Impacts	○ Most road right-of-way located on Squamish Nation land; benefit future development of IR 5
Environmental	○ Impacts to lower Capilano River, river riparian, and forested wildlife habitat; potential archaeological site risk in IR 5
Security	○ No impacts to port security; new overpass within IR 5 may require clearance from Lions Gate Bridge sub-structure
Economic Impacts	○ Not directly related to Asia Pacific trade; IR 5 development may provide economic benefits

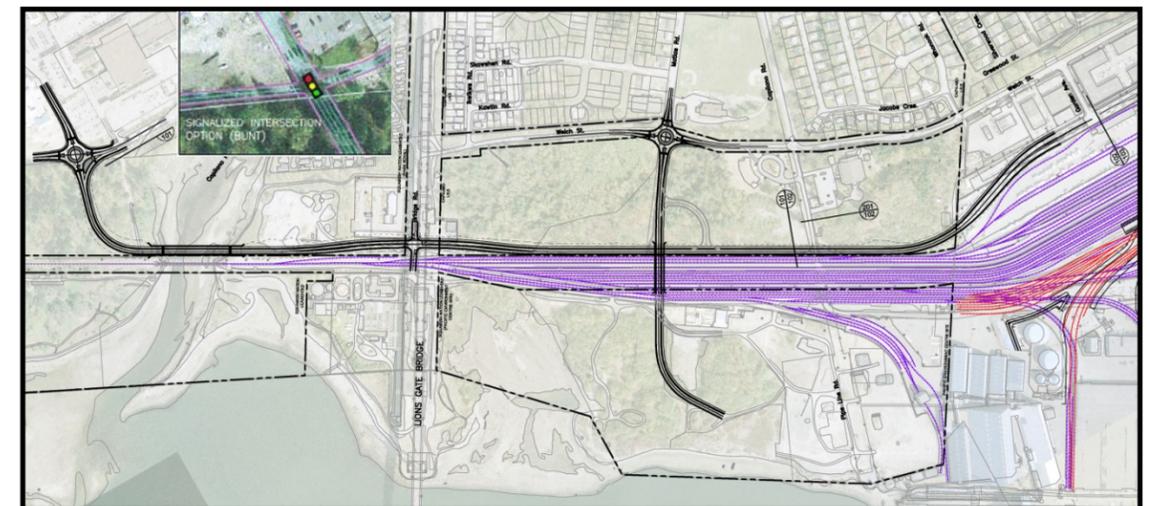
Legend: ● = Positive; ○ = Neutral; ○ = Negative

Note: Concept costs and benefits are shown in Net Present Value in 2008 Dollars over a 25 year study period, excluding property and potential environmental mitigation/compensation.

Improvement Concept:

The proposed extension of the Lower Level Route on the North Shore, will be located between Garden Avenue to the immediate east of Capilano IR 5 and connect to Marine Drive at the west end of the Park Royal Shopping Centre. The road will run north of and parallel to the CNR corridor, most of which is located within the BC Rail and Squamish Nation lands. The new road will provide an east-west alternative route for traffic between North and West Vancouver. The road will provide relief to the congestion on Marine Drive at the Lions Gate bridgehead, and may delay the need to upgrade the existing Capilano River Bridge on Marine Drive. In addition to the new 2-lane road, the Concept consists of a new bridge over the Capilano River to the immediate north of the railway bridge, and an overpass linking the IR 5 to the south of the rail tracks. With this new overpass, the existing Bridge Road crossing can either be closed to road traffic or be reserved for emergency access only. The concept includes a round-about at the Park Royal Shopping Centre where the new Lower Level Route would connect to the street network within Park Royal. An alternate signalized intersection scheme has also been developed by Park Royal Shopping Center (Bunt & Associates) for this junction.

Option A: LLR Connection to Marine Drive





1.0 INTRODUCTION

1.1 Canada's Asia-Pacific Gateway and Corridor Initiative



Canada's Asia-Pacific Gateway and Corridor Initiative (APGCI) is an integrated set of investment and policy measures seeking to boost Canada's commerce with the Asia-Pacific Region, to increase the share of North American-bound container imports from Asia, and to improve the reliability of the Gateway and Corridor for Canadian and North American exports. Following the launch of APGCI in October 2006, the Government of Canada has increased its effort to enhance Canada's trade competitiveness in international commerce by addressing capacity issues in a sustainable manner, with a focus on the infrastructure, policy, governance and operational challenges that exist within an integrated Gateway strategy.

In January 2008, SNC-Lavalin was commissioned to conduct the North Shore Trade Area Study by Transport Canada, along with study partners Port Metro Vancouver (PMV, also known as Vancouver Fraser Port Authority), BC Ministry of Transportation and Infrastructure (BC MoT), South Coast British Columbia Transportation Authority (TransLink) and the Greater Vancouver Gateway Council (GVGC), to review the transportation infrastructure issues in the area directly adjacent to port terminals and rail corridor north of the Burrard Inlet in BC (North Shore Trade Area) with the objective of enabling and supporting the continued growth of this strategic component of the Asia-Pacific Gateway.

1.2 Significance of North Shore Trade Area for Asia-Pacific Gateway

Port Metro Vancouver (PMV) is Canada's largest port, trading more than \$53 billion in goods with more than 100 trading economies annually and generating an estimated \$6.3 billion in Gross Domestic Product (GDP). PMV also ranks No.1 among all North American ports for total foreign exports, with Asia-Pacific trade representing 98% of its total port tonnage in 2006. The North Shore Trade Area (NSTA), which covers port terminals and industrial activities along the North Shore of the Burrard Inlet (see Figure 1.1), is a critical export gateway to the Asia-Pacific trading economies. The area handled 23.8 million tonnes of commodity, with a value of approximately \$7.7 billion, in 2007.



Some of the major commodities being handled in the NSTA include coal, potash, sulphur, agri-product, steel, and forestry products. The area is a significant economic generator of employment in the marine, rail and trucking industries. It supports employment in various export-based industries, including agriculture, forestry, mining and manufacturing in B.C., throughout western Canada, and across Canada as a whole.

Figure 1.1 – Study Location Map: North Shore Trade Area



Significant growth is anticipated at the North Shore terminals as cargo throughput is expected to increase. As an example, Canpotex Ltd., the Saskatchewan potash export agency, is planning to nearly double potash shipments through their two West Coast Canadian ports. Canpotex plans to spend more than \$500 million to increase shipping capacity from 12 to 23 million tonnes per year. Approximately half of this increase will be accommodated by an expansion adjacent to the Port's Neptune Bulk Terminals in North Vancouver. The remaining tonnage will be shipped through a new terminal planned for Ridley Island near Prince Rupert.

The current and forecast economic impacts for the NSTA in 2007 and 2020 are summarized respectively in Tables 1.1 and 1.2 below.⁴ In 2007, including direct, indirect and induced economic impacts, the North Shore terminals are estimated to generate a total of 26,000 jobs in Canada, earning over \$1.2 billion in wages annually, and \$1.7 billion in GDP. By 2020, including direct, indirect and induced economic impacts, the North Shore terminals are forecast to generate a total of 31,000 jobs in Canada, earning over \$1.4 billion in wages annually, and \$2.0 billion in GDP. It

³ See "Report on the National Economic Impacts of the Pacific Gateway", April 2006, prepared by Banjar Management Inc.

⁴ Economic Analysis done by InterVISTAS Consulting, sub-consultant of this study; All monetary figures are expressed in 2007 Dollars; economic impact analysis was based on a 2% annual growth rate projected by PMV for the North Shore terminals.



should be noted that this economic forecast is based on an annual average growth rate of 2%, and is considered a conservative forecast in light of the growth opportunities associated with Asia-Pacific trade in the North Shore Trade Area.

Table 1.1: Current Economic Impact of North Shore Terminals in Canada, 2007

Type of Impact	Jobs	Person Years	Wages (\$ millions)	GDP (\$ millions)	Economic Output (\$ millions)
Direct	11,221	10,516	\$619	\$773	\$1,701
Indirect	8,179	7,664	\$324	\$474	\$1,015
Induced	6,596	6,181	\$262	\$436	\$934
Total Canada	25,996	24,361	\$1,204	\$1,683	\$3,651

Table 1.2: Forecast Economic Impact of North Shore Terminals in Canada, 2020

Type of Impact	Jobs	Person Years	Wages (\$ millions)	GDP (\$ millions)	Economic Output (\$ millions)
Direct	13,305	12,468	\$734	\$917	\$2,017
Indirect	9,697	9,088	\$384	\$562	\$1,204
Induced	7,821	7,329	\$310	\$517	\$1,108
Total Canada	30,823	28,884	\$1,428	\$1,996	\$4,328

The NSTA has experienced and anticipates tremendous future growth as countries seek products produced in Canada. However, the NSTA is facing growing competition from other North American west coast ports for exports of coal, grain and other bulk and break bulk exports. Exporters, importers and shipping lines continue to demand reliable, efficient and low cost service, particularly reliable and adequate rail service. Over the past several years, meeting this demand has been a challenge due to various factors, including the large amount of growth experienced and resulting strain on existing infrastructure.

The sustainability of the economic benefits in the NSTA is contingent upon the efficient movement of goods and people through the Trade Area. Investment in an efficient and effective transportation system on the North Shore Trade Area would not only help the North Shore to achieve the potential growth, but to maintain the existing traffic base in the face of significant competition from other ports and terminals on the west coast. The investment will ultimately not only benefit the North Shore, but the Province of British Columbia and Canada.

In order to meet these challenges, PMV has developed a comprehensive supply chain program and is currently undertaking a comprehensive Rail Network Assessment of rail operations serving the Lower Mainland. The NSTA has been identified as one of the most critical areas in the Lower Mainland rail assessment. The assessment has indicated that current rail yard configurations do not

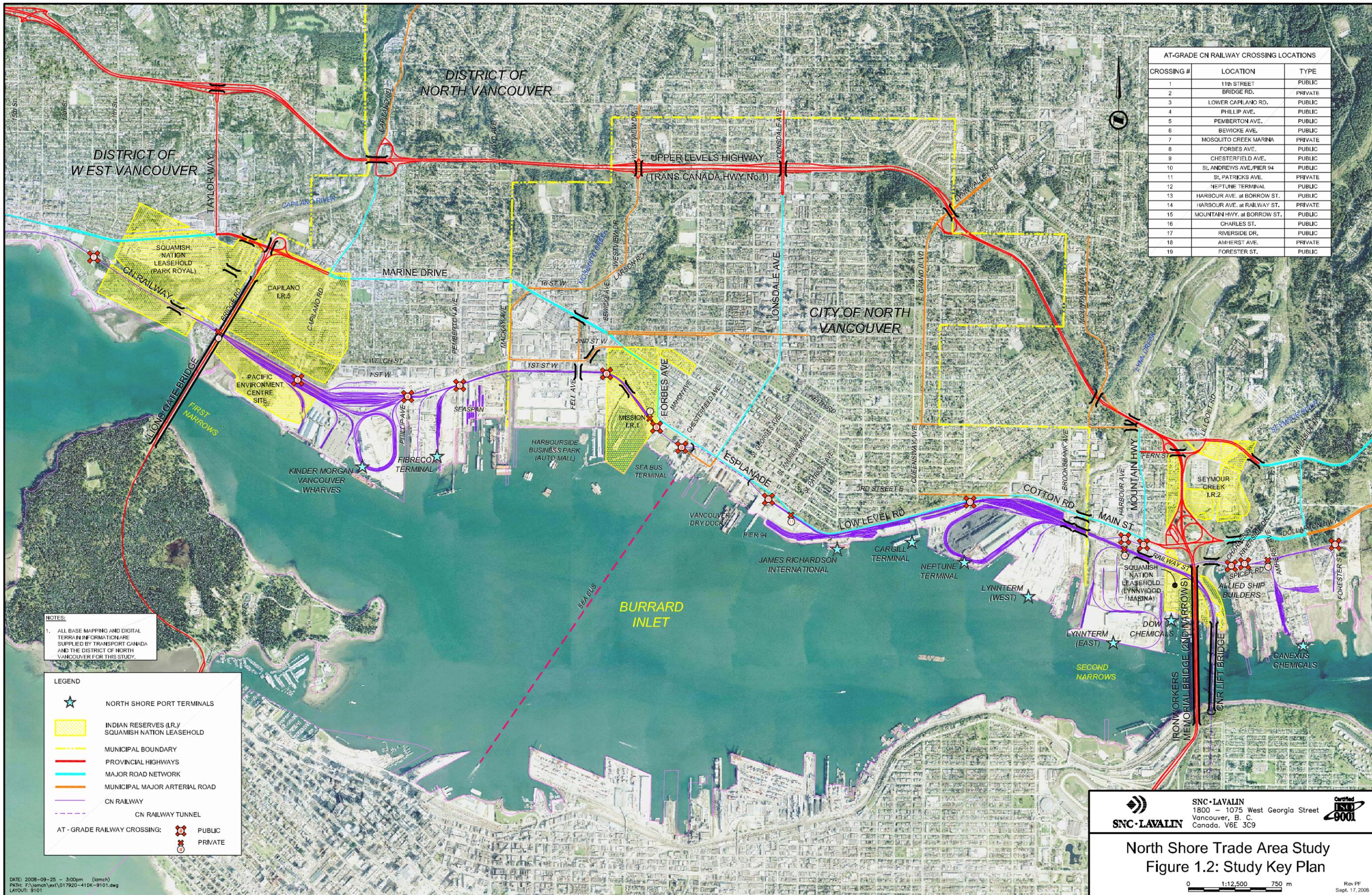


support efficient port operations and future expansion, and that improvements will be required to achieve safe and efficient road access and rail/road interfaces in the corridor.

1.3 Study Area

The North Shore Trade Area is located on the North Shore of the Burrard Inlet and is adjacent to the port terminals and along the rail corridor between the Lions Gate Bridge to the west and the Iron Workers Memorial Second Narrows Bridge (or Second Narrows Bridge) to the east. The area encompasses three municipalities (City of North Vancouver, District of North Vancouver and District of West Vancouver), as well as two First Nations (Squamish Nation and Tsleil-Waututh Nation).

The Trans Canada Highway is the major provincial and regional road corridor connecting the port terminals to the rest of the BC Lower Mainland and Canada. It is also the only truck route serving heavy commercial vehicles to and from the North Shore across the Burrard Inlet. The rail corridor, operated by Canadian National Railway (CNR), runs primarily east-west along the waterfront to the immediate south of major arterial roads (e.g. Marine Drive, Esplanade, Main Street). The land use designation on the North Shore waterfront is primarily industrial and marine port-related, while the area to the immediate north is highly urbanized with residential and commercial development throughout. The co-habilitation of communities and waterfront industries presents challenges to both quality of life in the communities and the operational efficiency of the area's transportation systems. While rail is the dominant surface transport mode for most of the commodities to and from the North Shore port terminals, the current rail network on the North Shore is constrained to service the existing terminal operations.



AT-GRADE CN RAILWAY CROSSING LOCATIONS		
CROSSING #	LOCATION	TYPE
1	11th STREET	PUBLIC
2	BRIDGE RD.	PRIVATE
3	LOWER CAPILANO RD.	PUBLIC
4	PHILLIP AVE.	PUBLIC
5	PEMBERTON AVE.	PUBLIC
6	BEWICKE AVE.	PUBLIC
7	MOSQUITO CREEK MARINA	PRIVATE
8	FORBES AVE.	PUBLIC
9	CHESTERFIELD AVE.	PUBLIC
10	ST. ANDREWS AVE./PIER 94	PUBLIC
11	ST. PATRICKS AVE.	PRIVATE
12	NEPTUNE TERMINAL	PUBLIC
13	HARBOUR AVE. at BORROW ST.	PUBLIC
14	HARBOUR AVE. at RAILWAY ST.	PRIVATE
15	MOUNTAIN HWY. at BORROW ST.	PUBLIC
16	CHARLES ST.	PUBLIC
17	RIVERSIDE DR.	PUBLIC
18	AMHERST AVE.	PRIVATE
19	FORESTER ST.	PUBLIC

NOTES:
 1. ALL BASE MAPPING AND DIGITAL TERRAIN INFORMATION ARE SUPPLIED BY TRANSPORT CANADA AND THE DISTRICT OF NORTH VANCOUVER FOR THIS STUDY.

LEGEND

- ★ NORTH SHORE PORT TERMINALS
- Indian Reserves (I.R.)
SQUAMISH NATION LEASEHOLD
- MUNICIPAL BOUNDARY
- PROVINCIAL HIGHWAYS
- MAJOR ROAD NETWORK
- MUNICIPAL MAJOR ARTERIAL ROAD
- CN RAILWAY
- CN RAILWAY TUNNEL
- AT-GRADE RAILWAY CROSSING:
 - Public
 - Private

SNC-LAVALIN
 1800 - 1075 West Georgia Street
 Vancouver, B. C.
 Canada. V6E 3C9

North Shore Trade Area Study
Figure 1.2: Study Key Plan

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Rev PF
 Sept. 17, 2008

DATE: 2008-09-25 - 3:00pm (tomh)
 PATH: F:\snc\ext\017920-41Dx-9101.dwg
 LAYOUT: 9101



1.4 Objectives of North Shore Trade Area Study

The North Shore Trade Area Study has three key objectives:

- To review and synthesize previous studies and work that the stakeholders and study partners have completed, and conduct new road traffic and road/rail interface analysis;
- To identify key capacity, efficiency, operational, safety and other issues for the current and future scenarios, related to terminal plans, port development, rail and rail yard layouts, the road network and rail/road interfaces; and,
- To develop and recommend effective operational and infrastructure strategies and other important projects within the North Shore Trade Area that would provide greater benefits for all partners and stakeholders.

The study's ultimate goal is to assess the transportation and infrastructure conditions of the NSTA in the current and future base years and to determine the infrastructure improvements required to accommodate and enhance the trade development objectives with the least social, community and environmental impacts. To identify transportation network improvements to support port operation and future growth, while at the same time address some of the community concerns on the North Shore municipalities, the study focused on the area between the Main Street/Low Level Road/Marine Drive corridor and the waterfront.

1.5 Study Methodology: Technical and Consultation Processes

The approach and methodology developed for this study were based on two parallel and interactive processes: a technical process and a consultation process.

1.5.1 Study Technical Process

The Study Technical Process consists of the following key tasks:

- Review Previous Studies – Previous studies and relevant work in the NSTA were reviewed and synthesized;
- Base Condition Assessment – Traffic analysis, road and road-rail interface issues were studied for three horizon years (2006, 2011, 2021). Rail network and operational issues were analyzed in a separate Rail Network Assessment which provided input to the NSTA Study to address existing and long term rail network operations and improvement requirements in the NSTA⁵.
- Issue Identification – A number of key road, rail and road/rail interface issues were identified based on the Rail Network Assessment and the SNC-Lavalin road and network assessment. The issues were reviewed with study partners and stakeholders and the confirmed list of issues served as a base for generating improvement concepts.
- Concepts Development – Preliminary improvement concepts were developed to meet the objectives of the study and to address the identified issues in the Base Condition Assessment.
- Concepts Screening for Multiple Account Evaluation – After a feasibility-level screening process, a short list of improvement concepts was evaluated in a comprehensive Multiple Account Evaluation (MAE) framework to establish project recommendations.

⁵ “North and West Vancouver Rail Assessment Study”, submitted to Port Metro Vancouver by MainLine Management Inc., Draft April 30, 2008.



- Study Recommendations – An implementation strategy was developed to best meet the objectives of the study partners and stakeholders and the Asia-Pacific Gateway and Corridor Initiative.

1.5.2 Study Consultation Process

The stakeholder consultation process was designed to provide input and feedback to the technical engineering process of the study such that the issues could be identified and proposed improvements evaluated in an integrated and collaborative manner. To this end, a two-stage consultation approach was used to engage the key stakeholders in this study. Initial consultation was conducted in small group meetings attended by members of the Study Technical Committee, the SNC-Lavalin study team, and representatives from the stakeholder groups. Follow-up consultation was conducted in a workshop format where municipal and industry groups attended a half-day workshop to discuss the proposed improvement options and the implementation strategy for the recommended transportation solution and projects. Follow up meetings were held to share with stakeholders the study recommendations and improvement concepts.

In addition to the study partner organizations (i.e. Transport Canada, PMV, TransLink, BC MoT, and GVGC), the following stakeholders were identified and consulted as part of this study:

Municipalities and First Nations

- City of North Vancouver
- District of North Vancouver
- District of West Vancouver
- District of Squamish
- Squamish Nation
- Tseil Waututh Nation

Railway Companies

- Canadian National Railway
- Canadian Pacific Railway
- British Columbia Railway Company

Terminal Operators/Waterfront Industries

- Western Stevedoring
- Neptune Bulk Terminals
- Cargill Terminal
- James Richardson International
- Kinder Morgan Canada Terminals
- Fibreco Terminal
- Washington Marine Group
- Unilever (Dow Chemicals)
- Canexus Ltd.
- Squamish Terminal

Initial stakeholder consultations were conducted between January and May 2008 through a series of small group meetings. A total of 16 small group meetings were held with the study partners and stakeholder organizations. The schedule, attendance and summaries of these meetings are documented in the Initial Stakeholder Consultation Summary Report in Technical Memo 2. The key issues raised by the stakeholders have served to inform the study team regarding the critical issues to be addressed as well as potential infrastructure improvements to be developed in the subsequent phases of this study.

Subsequent to the initial stakeholder meetings, two rounds of stakeholder workshops were conducted both with municipalities and industry stakeholders in the concept development and evaluation stages. Input and feedback from stakeholders assisted in identifying and selecting improvement concepts for further evaluation. These workshops were organized in May and June 2008 as follows:

- Consultation on preliminary improvement concepts and evaluation criteria:
 - May 16, 2008: Municipal and First Nations Workshop No. 1



- May 22, 2008: Industry Workshop No. 1
- Consultation on short-listed concepts:
 - June 25, 2008: Industry Workshop No. 2
 - June 26, 2008: Municipal and First Nations Workshop No. 2

1.6 Report Structure

This report provides a summary of the study process, key findings and recommendations from all technical and consultation work conducted in this study. The report is organized as follows:

- Chapter 1 – Introduction
- Chapter 2 – Base Condition Assessment and Critical Issues
- Chapter 3 – Concept Development
- Chapter 4 – Concept Evaluation
- Chapter 5 – Conclusion and Recommendations



2.0 BASE CONDITION ASSESSMENT AND CRITICAL ISSUES

The Base Condition Assessment included the following activities: land use and development review, transportation network analysis, and traffic conditions review in the study horizon years. Based on the technical analysis and stakeholder consultation results, a number of key issues was identified, which would serve as a base for generating improvement concepts.

2.1 Review of Previous Studies

The study team conducted a review and synthesis of previous studies and relevant work conducted by the study partners and stakeholders in the area bounded by the TCH, Lions Gate Bridge, and the Iron Work Memorial Second Narrows Bridge. A list of these studies can be found in Appendix 1 of this report.

2.2 Port Terminals

The land use designation on the North Shore waterfront is primarily industrial. The PMV is the owner of most waterfront industrial sites between Lonsdale and the Second Narrows Bridge in the eastern portion of the study area. Public waterfront access is available in the Lonsdale Town Centre along Esplanade and the Harbourside Business Park between Bewicke Avenue and the City boundary at Mackay Avenue. In the western portion of the study area, land use is dominated by marine industrial use (operated by the Washington Marine Group, Fibreco and Kinder Morgan) on private or provincial lands.

Table 2.1 summarizes the major terminals that currently reside on the North Shore along with the main commodities handled at each facility. Traffic volumes and operations of commodities through these terminals were described in the Rail Network Assessment for the North Shore in both the Base Case and 2025 Case. While most terminals anticipate growth and expansion in their operations, rail will remain the dominant surface transport mode for most of the commodities to and from the North Shore. Increase in road transport (both trucks and vehicles) is anticipated in these locations: proposed Lynnterm container conversion, Kinder Morgan and the future expansion/development at James Richardson International, Vancouver Dry Dock and Pier 94.



Cargill and JRI Grain Terminals on the North Shore



Table 2.1: Major Terminals and Commodities Handled on the North Shore

	Terminal	Major Commodities Handled
1	Kinder Morgan Vancouver Wharves	Sulphur; mineral concentrates; wood pulp; ammonium sulphate; urea; specialty agri-bulk products
2	Fibreco Terminal	Wood chips
3	James Richardson International	Grain products
4	Cargill Terminal (Saskatchewan Wheat Pool)	Wheat, durum, canola, barley and grain by-products
5	Neptune Bulk Terminals	Coal; potash; specialty agri-bulk products; vegetable
6	Lynnterm (Western Stevedoring)	Wood pulp; lumber; panel products; paper; smelter products; machinery; logs; steel; general cargoes
7	Dow Chemicals (Univar)	Caustic soda; ethylene glycol; ethylene dichloride
8	Canexus Chemicals	Salt; caustic soda; chlorine

Road access to the terminals is constrained at a number of locations, as summarized below:

- **Kinder Morgan/Fibreco** – Pemberton Avenue at the existing at-grade CNR crossing provides public access to Kinder Morgan, Fibreco, Vancouver Shipyards and Seaspan, together with a number of other commercial operations. The passage of long mainline trains, along with shunting operations associated with the Kinder Morgan and Fibreco yards, frequently block access for trucks, workers, business trips and emergency vehicles to these sites. The relocation of some of Kinder Morgan’s rail yards to the east from the present western location on Squamish Nation lands will further exacerbate blockages for road traffic. Grade separation of the Pemberton Avenue at-grade crossing has been proposed to improve road access and mitigate community impacts associated with the rail crossings.
- **James Richardson International (JRI) and Vancouver Dry Dock:** The existing at-grade road/rail crossings at St. Andrews and near St. Patricks Avenue currently service Vancouver Dry Dock and the James Richardson International (JRI) grain terminal. The crossing near St. Patricks Avenue has operational and safety concerns because the tracks are too close to Low Level Road (LLR) to allow for storage of vehicles waiting to turn onto the LLR. Also there is no left turn lane on the LLR at this crossing. Alternative vehicle access to the terminals is available via the St. Andrews Avenue single-track crossing with better approach conditions and a left turn lane on Esplanade for westbound to southbound traffic needing to cross the track. Previous traffic studies by the PMV have recommended to provide a grade separation at the St. Andrews/St. Patricks Avenue at-grade crossings and to consolidate the two accesses into one.
- **Neptune/Cargill** – Similar to the JRI/Vancouver Dry Dock access, the existing access road to the Neptune and Cargill terminals crosses the rail tracks at-grade and provides insufficient storage for vehicles waiting to turn onto the LLR. At the eastern end, the LLR intersects 3rd Street East and Cotton Road at a heavily skewed 3-way signalized “Y” junction.
- **Lynnterm** – Existing access to the Lynnterm terminal and other businesses south of Main Street is provided by the Brooksbank and Mountain underpasses. As part of the proposed Lynnterm conversion to container terminal, a proposal was developed by Western Stevedoring to construct a rail underpass along Harbour Avenue (where the existing at-grade crossing is closed to road traffic) to divert inbound container trucks to Lynnterm via Harbour Avenue and outbound via



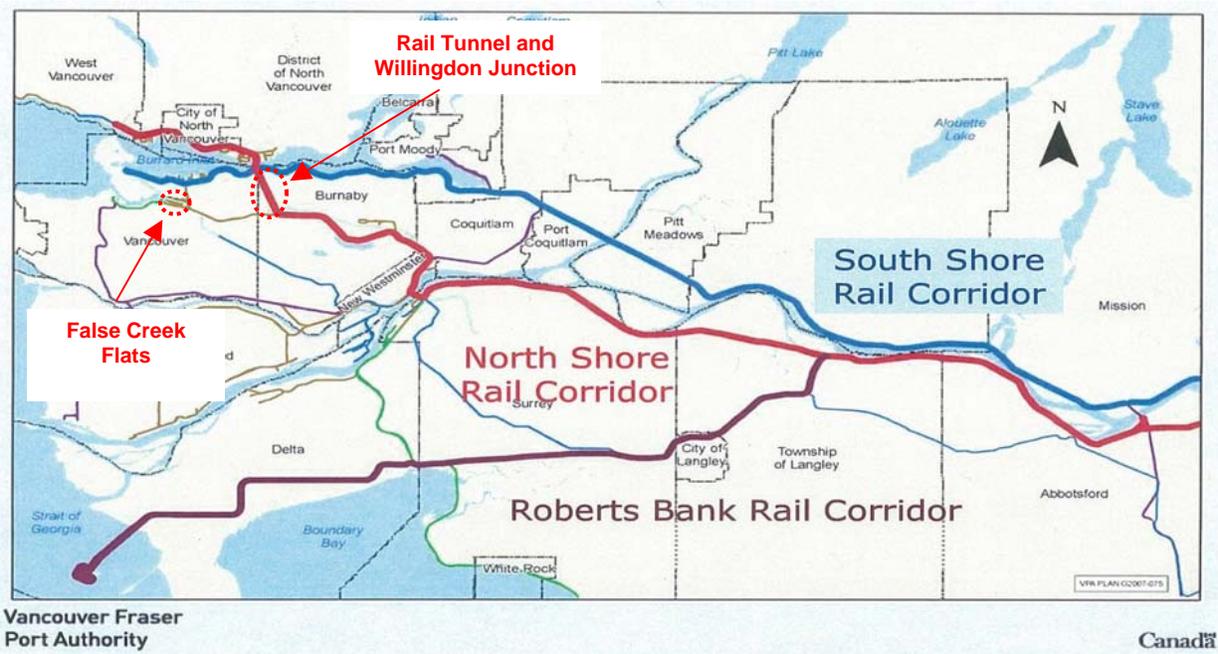
Mountain Highway to the Second Narrows Bridge; traffic destined to other businesses south of the CNR tracks would also be re-routed from Brookbank to the Main/Harbour and Main/Mountain intersections. The impacts on traffic operations associated with this proposal will be discussed further in this report.

2.3 Rail Network Assessment

2.3.1 Lower Mainland Rail Network

The rail corridor on the North Shore Trade Area is approximately 8.6 km in length running east-west paralleling the North Shore of Burrard Inlet and bounded, generally, on one end by the Lions Gate Bridge and on the other by the Second Narrows Bridge. This corridor is part of a larger Lower Mainland rail network that consists of three primary east-west oriented corridors linking the primary port terminal activities and locations in the BC Lower Mainland to the rest of Canada (see Figure 2.1: Major Rail Corridors in the BC Lower Mainland). The three corridors are known as the Canadian Pacific Railway (CPR) mainline, the Canadian National Railway (CNR) mainline, and the Roberts Bank Rail Corridor (RBRC). Generally the CPR mainline corridor services the South Shore of Burrard Inlet; the CNR mainline corridor mainly services the North Shore; and the RBRC consists of a joint section arrangement of multiple railway ownership but with reciprocal usage rights. Co-production arrangements exist between CPR and CNR to help maximize capacity and operations efficiencies. In addition, a north-south rail corridor between Vancouver and the Canada-US border, known as the Burlington Northern Santa Fe (BNSF) mainline, provides railway access to the Greater Vancouver industrial network from the south.

Figure 2.1: Major Rail Corridors in the BC Lower Mainland



Source: Lower Mainland Rail Network Assessment, Port Metro Vancouver



2.3.2 Rail Infrastructure in the North Shore Trade Area

The North Shore rail corridor north of the Burrard Inlet consists of two access points. On the west end, the CNR mainline corridor extends westward and then northerly towards Squamish and beyond, and consists of the former BC Rail which CNR has a long term lease since 2004. On the east end, access to the north shore is provided by a CNR mainline via a major railway lift bridge at the Second Narrows and a tunnel that extends from the Willingdon Junction area of Burnaby. This rail tunnel connects with a joint section corridor owned by BNSF between the Fraser River and False Creek Flats area. The vast majority of rail traffic to and from the North Shore terminals is carried via the eastern connection. All rail switching and train movement activity is carried out by CNR, although CPR and BNSF have market access via joint section and co-production arrangements to service the North Shore port terminals.

Considerable trackage is located within each terminal's geographic footprint to facilitate its own specific and individual rail unloading or loading needs. Some operations (such as those of Neptune Terminals and Kinder Morgan) involve unit train movements of coal, sulphur or potash requiring the facilities to have significant terminal rail trackage in closed loop or spiraling loop track configuration. Other terminals (such as Lynnterm, Cargill and James Richardson International) rely heavily on CNR support trackage and switching services to ensure their ability to process less than unit train blocks of rail traffic.

In servicing its North Shore terminal customers, CNR operates three primary support yard facilities: the CNR Small Yard and Big Yard (near Lynn Creek) generally service the needs of those major terminals east of the Lonsdale rail tunnel, while the CNR West Vancouver Yard (former BC Rail yard at the foot of Pemberton) services those industries and terminals west of Lonsdale (see Figures 2.2 and 2.3). The CNR Small Yard consists of stub-ended tracks, which have created significant operating constraints for train movements in this area. In addition, most support tracks on the North Shore, including the double-ended ones, are considered short by today's train size standards and are often compromised by public and private road at-grade crossings that limit the ability to store rail cars or trains for any extended period of time.

Along the rail corridor on the North Shore, there are numerous road/rail interface locations. Some of these interface locations are already grade-separated:

- Rail Tunnel near the vicinity of the Lower Lonsdale area;
- Road Overpass at Fell Avenue; and,
- Road Underpasses at Brooksbank Avenue and Mountain Highway.

The rest of the road/rail interface locations are currently at-grade crossings in the study area, which is shown in Figure 1.2: Study Key Plan.



Figure 2.2: Location of CNR Yards (Eastern Study Area)



Source: Mainline Management Inc.

Figure 2.3: Location of CNR Yards (Western Study Area)



Source: Mainline Management Inc.



2.3.3 PMV Rail Network Assessment

A series of rail analytical studies are being led by PMV in order to develop a long term understanding of the ability of the rail network in the Lower Mainland area to efficiently handle projected growth over time. As part of this effort, a focused study was conducted on the North Shore Trade Area and the findings are included in a report titled “North and West Vancouver Rail Assessment Study” (NWVRA). In the NWVRA study, two rail computer simulation scenarios for the Base Case and Future Case (2025) were carried out. The Base Case reflects existing rail volumes operated on the existing rail network. The Future Case (2025) reflects projected 2025 rail volumes operated over a projected 2025 network, which included some terminal reconfiguration and improved operating plan. The Future Case (2025) rail network concept was developed jointly by PMV, the rail companies and terminal operators to address the current operation issues and to allow for terminal expansion and growth in the future. One of the key implications of this rail network concept on the road system is the two additional rail tracks that are proposed near the Low Level Road in the City of North Vancouver between St Patricks Avenue and Neptune Terminal. More discussion about this potential impact is discussed in Section 3.0. There are currently 19 at-grade rail/road crossings identified in the North Shore Trade Area and 10 were included for the rail modeling (nine at-grade crossings plus Harbour Avenue, which is currently closed off to traffic). The other crossings were not analyzed due the following reasons:

- Lower Capilano Road and Philip Avenue (currently closed to road traffic);
- Mosquito Creek Marina (limited to marina access in Indian Reserve 1); and,
- Harbour Avenue/Barrow Street, Mountain Highway/Barrow Street, Charles Street, Riverside Drive, Amherst Avenue and Forester Street (located on the CNR spur line, called Seymour Branch, with no through rail traffic and limited crossings).

Table 2.2 summarized the key comparison statistics of the 10 crossings as documented in this rail study.

Table 2.2: Grade Crossing Statistics Comparison

Crossing	HH:MM:SS			
	Train Occupancies per Day (Base)	Train Occupancies per Day (2025)	Average Blockage (Base)	Average Blockage (2025)
11th Street	7.7	7.7	0:02:43	0:02:37
Bridge Road	55.3	62.0	0:02:54	0:01:44
Pemberton Avenue	38.3	45.3	0:04:43	0:04:45
Bewicke Avenue	18.0	24.7	0:08:05	0:08:20
Forbes Avenue	7.0	10.3	0:05:24	0:08:06
Chesterfield Avenue	7.0	11.0	0:06:37	0:07:52
St. Andrews Avenue	14.3	N/A*	0:05:07	N/A
St. Patricks Avenue	26.3	N/A*	0:05:33	N/A
Neptune/Cargill Crossing	88.0	42.3	0:05:13	0:06:18
Harbour Avenue**	72.3	29.0	0:13:49	0:33:17

* Not simulated in rail model; ** Harbour Avenue at-grade crossing is currently closed to road traffic.



Some of key highlights of this comparison included:

- In the Base Case, the highest rail occupancy occurred at the Neptune/Cargill crossing, Harbour Avenue and Bridge Road (the latter two are either currently closed to road traffic or have minimal road traffic). The occupancies level at the Neptune/Cargill crossing is so high that it is impacting the rail operation for the entire North Shore and the only road access into the Neptune/Cargill terminals.
- Even though the rail occupancy at the Neptune/Cargill crossing is expected to decrease in the Future Case due to the reduced number of switching between the CNR Small Yard and the grain elevators, the magnitude of occupancy is still considered significant.
- The rail occupancy at the St. Andrews Avenue and St. Patricks Avenue crossings in the Base Case is not high compared to other crossings; however, the proposed changes to the rail tracks west of the CNR Lynn Creek Yards (Big Yard and Small Yard) to allow the unit grain trains setting out or picking up cars in the Future Case would mean that these two crossings would be occupied almost 24 hours a day.

2.3.4 Rail Critical Issues and Recommendations

As identified in the Rail Network Assessment, the following are pinch points or bottlenecks in the Lower Mainland rail network that have implications on rail capacity and operational efficiency on the North Shore.

1. Limited siding capacity on the Roberts Bank corridor creates backups at the confluence of the CNR's Rawlison and CPR's Page Subdivisions. The Page Subdivision is the CPR's primary conduit to the Thornton Yard and beyond to the North Shore. When congestion occurs in this subdivision, the North Shore rail corridor also suffers. There are some infrastructure improvements being contemplated as part of the Robert Bank Rail Corridor Program that could address this issue.
2. Heavy train volumes, slow transit speeds, and bridge openings for marine traffic create congestion at the Fraser River Rail Bridge and constrain the flow of rail traffic to and from the North Shore.
3. The 3-mile (4.8 km) single-track segment between the Burrard Inlet and the Willingdon Junction in Burnaby creates back-ups north and south of Second Narrows Rail Bridge and results in restrictive fleeting of trains and sub-optimal movement of traffic to and from the North Shore.

Based on the NWWRA study, a number of issues and recommendations related to rail operation and the proposed rail network concept for the North Shore were identified:

1. Three locations (Neptune/Cargill terminal access, Pemberton Avenue and St Andrews / St Patricks Avenue) are recommended for grade separation to remove the existing rail switching and rail/road conflicts and to enable terminal expansion on the North Shore.
2. Rail reconfiguration and infrastructure additions west of the CNR Big Yard will be required to alleviate many of the rail conflicts experienced today and to enable the rail traffic growth anticipated by the terminal operators. This is where two new additional rail tracks along the existing Low Level Road in the City of North Vancouver between St Andrews Avenue and Neptune Terminal were identified in the rail network concept.



3. A proposed Lynnterm container facility would create some additional rail conflicts beyond those experienced today, particularly if container traffic is increased to the levels projected by 2025.
4. There appears to be available rail capacity in western portion of the study area to accommodate the anticipated growth by Kinder Morgan and Fibreco. Much of that capacity is the result of an effective operating plan that has been developed by CNR and a change in business at Kinder Morgan.



Existing rail tracks between Cargill Terminal and Low Level Road in North Vancouver

2.4 Municipal and Community Plans

During the consultation meetings with the North Shore municipalities, First Nations, and other stakeholders, a number of major land use changes, proposed developments and community initiatives were brought to the attention of the study team. These are illustrated in Figure 2.4.

2.4.1 Proposed Developments

- ***Pinnacle “The Pier” Development:*** located on the shipyards site adjacent to the Sea Bus terminal in the City of North Vancouver, the development includes a hotel and convention facility, new public plazas, a heritage precinct with 4 buildings (2 for the National Maritime Centre and 2 for retail), restoration of shipbuilding facilities, additional waterfront walkways and public access.
- ***Evelyn Drive Development:*** bounded by Keith Road, Taylor Way, the north side of Park Royal Shopping Centre, and the Park Royal Tower residential complex in the District of West Vancouver, the Evelyn Drive Development Master Plan involves residential housing consisting of 167 dwelling units in the first phase, and an ultimate build-out of 349 single/multiple family units.
- ***Rodgers Creek and Cypress Village Developments:*** involving an approximate 215 acre parcel of land west of Marr Creek and north of Highway 1 within the District of West Vancouver, the two development sites combined will add about 1,386 single/multiple family housing units in the near future.
- ***Lynn Valley Town Centre:*** approximately 44 acres (18 hectares) in area, the current preferred development concept is to develop Lynn Valley Road as a transit mall providing for pedestrians, bikes, transits and auto movements. The District of North Vancouver expects the development to generate a net addition of about 2,150 residential units at this site, with another 1,650 residential units in the area south of 27th Street.
- ***Fern Street Seylynn Village Development:*** Four re-development options are being considered for the future of the area bounded by the Trans-Canada Highway, Mountain Highway, Keith Road and Main Street in the District of North Vancouver, ranging from single-family development



with noise fencing, to a high-rise, high-density and mixed-use redevelopment. Development proposals could result in a new multi-family neighbourhood with about 3,500 housing units.

2.4.2 Regional Plans and Initiatives

- **Spirit Trail:** A joint initiative by the North Shore municipalities, the Provincial Government, First Nations and other agencies and organizations, the Spirit Trail is conceived as a waterfront-oriented, multi-use greenway that would provide pedestrians, cyclists, inline skaters and people with wheeled mobility aids access across the North Shore. This 35-kilometre fully accessible greenway will potentially connect existing cycle paths and walkways with newly developed trails from Horseshoe Bay to Deep Cove.
- **Marine Drive Improvement Strategy:** the strategy proposes to divert some of the traffic flow on Marine Drive to other routes and/or achieve higher transit ridership and bike usage. This improvement strategy, as well as many other previous studies, indicated that Marine Drive and the Upper Levels Highway are the only two east-west routes between Horseshoe Bay and the Second Narrows Bridge where traffic volumes are understandably high. Transportation options that could effectively segregate the through traffic from local traffic on the Marine Drive should be worth exploring.
- **Disaster Response Routes:** a joint undertaking by emergency planners and transportation engineers from all levels of government, this initiative is an on-going effort to define an integrated, multi-modal Disaster Response Route network that includes designated municipal and provincial roadways, marine connections along the Fraser River and Vancouver harbour, the Lower Mainland rail network and air facilities. The existing east-west Disaster Response Routes are in the upper level routes along the Trans-Canada Highway and Mount Seymour Parkway. As part of the current joint-agency review, there is a desire to move the Disaster Response Routes to the lower level routes closer to the rail and marine facilities along the waterfront, as well as the existing muster stations on the North Shore.

2.4.3 Squamish Nation Plans and Development

- **Capilano IR 5:** The Capilano Master Plan was developed to explore opportunities for potential land use and development of Indian Reserve (IR) 5 in association with Environment Canada's leased site, known as the Pacific Environment Center (PEC) site, located at the southern end of the IR 5. Four land use options on the vacant portion of the Capilano IR 5 were developed. According to this Master Plan, certain transportation improvements are crucial to the long term land use and development at the location, including a new Lower Level Road through the reserve for access to developable lands and a grade separated crossing over the rail tracks to access the PEC site.
- **Mission IR 1:** Development plans are being contemplated on the Mission IR 1 for a 2 million sq. ft. residential and marina development. Transportation infrastructure will be required to support this development including a potential grade separation at Forbes Ave at the west end of the IR. IR 1 currently severs the Lonsdale town centre from the Harbourside Business Park, both highly valued, publicly accessible waterfront areas in the City of North Vancouver.
- **Seymour Creek IR 2:** The proposed Seymour Creek Village Project consists of a retail development similar in size to the Park Royal Village in West Vancouver. Additional residential development is also proposed, resulting in an additional 450,000 sq. ft of commercial/residential



development to the IR. A previous traffic impact study indicated that, by 2020, the Seymour Creek development traffic would represent 14 percent of the total traffic on Fern Street.

- **Other Squamish Nation Plans:** the Squamish Nation holds land interest in the Park Royal Shopping Centre in West Vancouver and the area under the Second Narrows Bridge currently leased to the Lynnwood Marina in North Vancouver. There are proposals to develop an additional 11.5 million sq. ft. residential and commercial development in the Park Royal village. Squamish Nation is also considering regaining the leasehold on Lynnwood Marina and developing a 460,000 sq. ft. commercial/industrial park.

2.5 Road Network Assessment

Road network assessment and traffic analysis in this study were conducted using two transportation models: the EMME regional transportation demand forecasting model and the Synchro operational analysis model. The EMME model was used to generate current (2006) and future base case (2011 and 2021) traffic forecasts in the area bounded by the TCH, Lions Gate Bridge and the Iron Workers Memorial Second Narrows Bridge. From the results of the EMME model forecasts, the traffic pattern changes and growths are derived and are used as inputs to the Synchro model to conduct a microscopic sub-area operation analysis for condition assessment in the base and future years in the NSTA to identify critical movements and problem areas as well as evaluating the improvement concepts in future scenarios.

The base year traffic conditions are evaluated based on standard model outputs including delays, volume/capacity (v/c) ratios, Level of Service (LoS), and length of queues. This base condition assessment was then used to define the deficiencies and operational issues to be addressed for transportation improvements in the NSTA. The traffic volumes and intersection LoS for the critical intersections in the modelled area are summarized in Figures 2.5A to Figure 2.5C respectively for the horizon years 2006, 2011 and 2021. A summary comparison of the intersection performance for the three horizon years is also shown in Table 2.3 below.

Table 2.3: Summary of Intersection Performance (2006, 2011 and 2021)

Intersection		2006 Level Of Service		2011 Level Of Service		2021 Level Of Service	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Main Street	Mountain Highway	C	C	C	C	C	C
	Harbour Avenue	B	B	B	C	B	E
	Brooksbank Avenue**	C	E	D	F	C	D
Marine Drive	Taylor Way	D	E	D	E	D	E
	Capilano Road	B	F	B	F	B	F
Esplanade	Lonsdale Avenue	B	C	B	D	B	F
E. 3 rd Street	Mission Road	B	B	B	B	C	E

** Note: South leg of Main/Brooksbank intersection removed in 2021 Base Case.

Development	Rodgers Creek & Cypress Village
Assumptions	1,386 single/multiple family units
Population Increase	+2,800
Employment Increase	na

Development	Evelyn Drive Development
Assumptions	349 single/multiple family units
Population Increase	+700
Employment Increase	na

Development	Lynn Valley Town Centre
Assumptions	About 3,800 net additional units
Population Increase	+7,500
Employment Increase	na

Development	Fern Street Development
Assumptions	A new multi-family neighbourhood (about 3,500 units)
Population Increase	+12,500
Employment Increase	na

Development	Park Royal Village
Assumptions	An additional 11.5 million sq.ft. residential & commercial development
Population Increase	+12,500
Employment Increase	+1,000

Development	Seymour Creek IR 2
Assumptions	A retail development similar in size to the Park Royal Village (additional 450,000 sq.ft.)
Population Increase	na
Employment Increase	+350

Development	Capilano IR 5
Assumptions	A mix of residential (200 units) & commercial development
Population Increase	+1,500
Employment Increase	+200

Development	Mission IR 1
Assumptions	A 2 million sq.ft. residential & commercial development
Population Increase	+2,000
Employment Increase	na

Development	Pinnacle Development
Assumptions	1,015 residential units, 104 hotel rooms & 70,000 sq.ft. of amenity, office and commercial spaces
Population Increase	+2,000
Employment Increase	+100

Development	Lynnwood Marina
Assumptions	A 460,000 sq.ft. commercial/industrial park
Population Increase	na
Employment Increase	+350

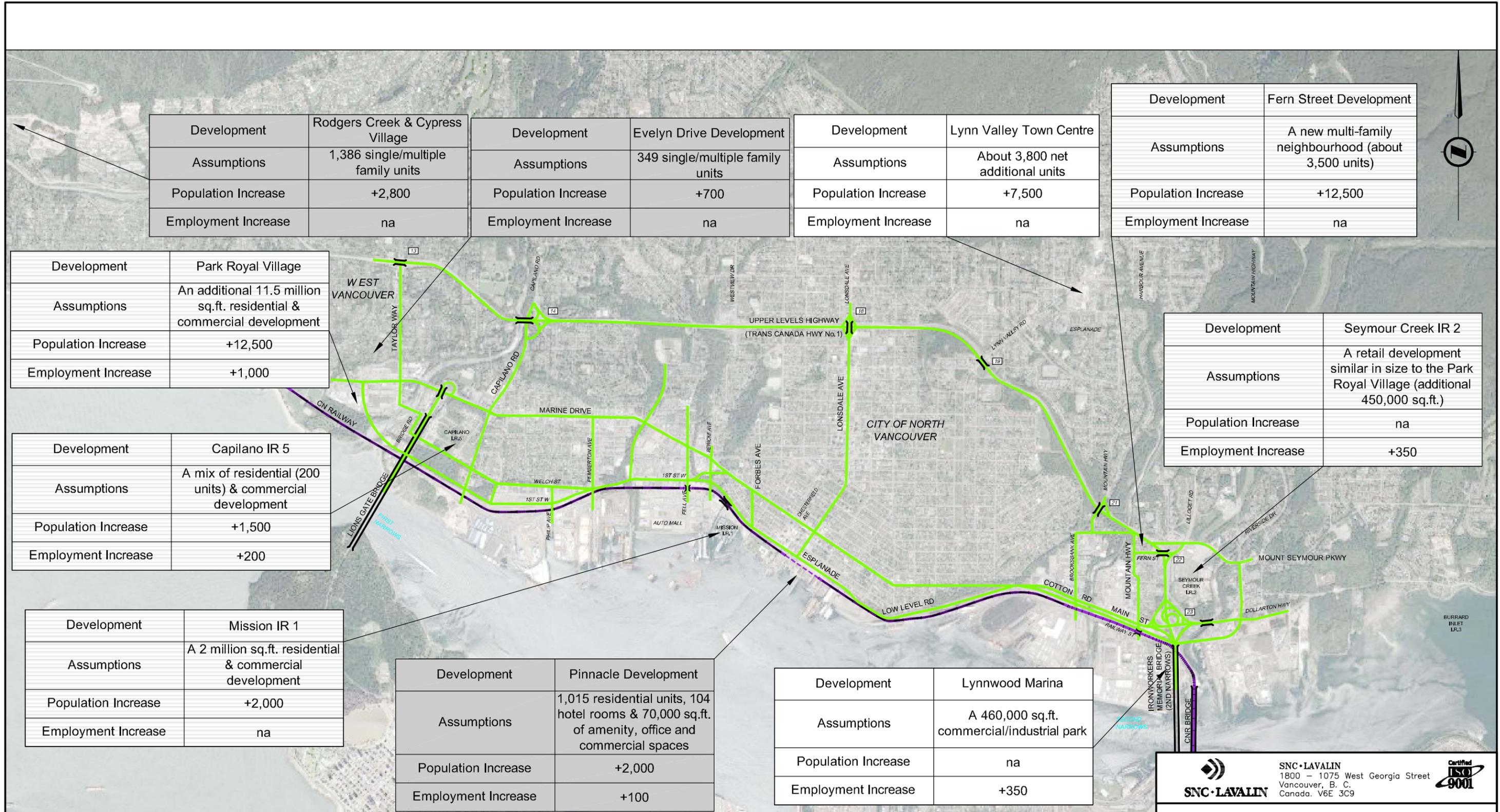
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 [Grey Box] Confirmed Development (Included in EMME Base Models)
 [White Box] Potential Development (To be considered in Sensitivity Analysis)

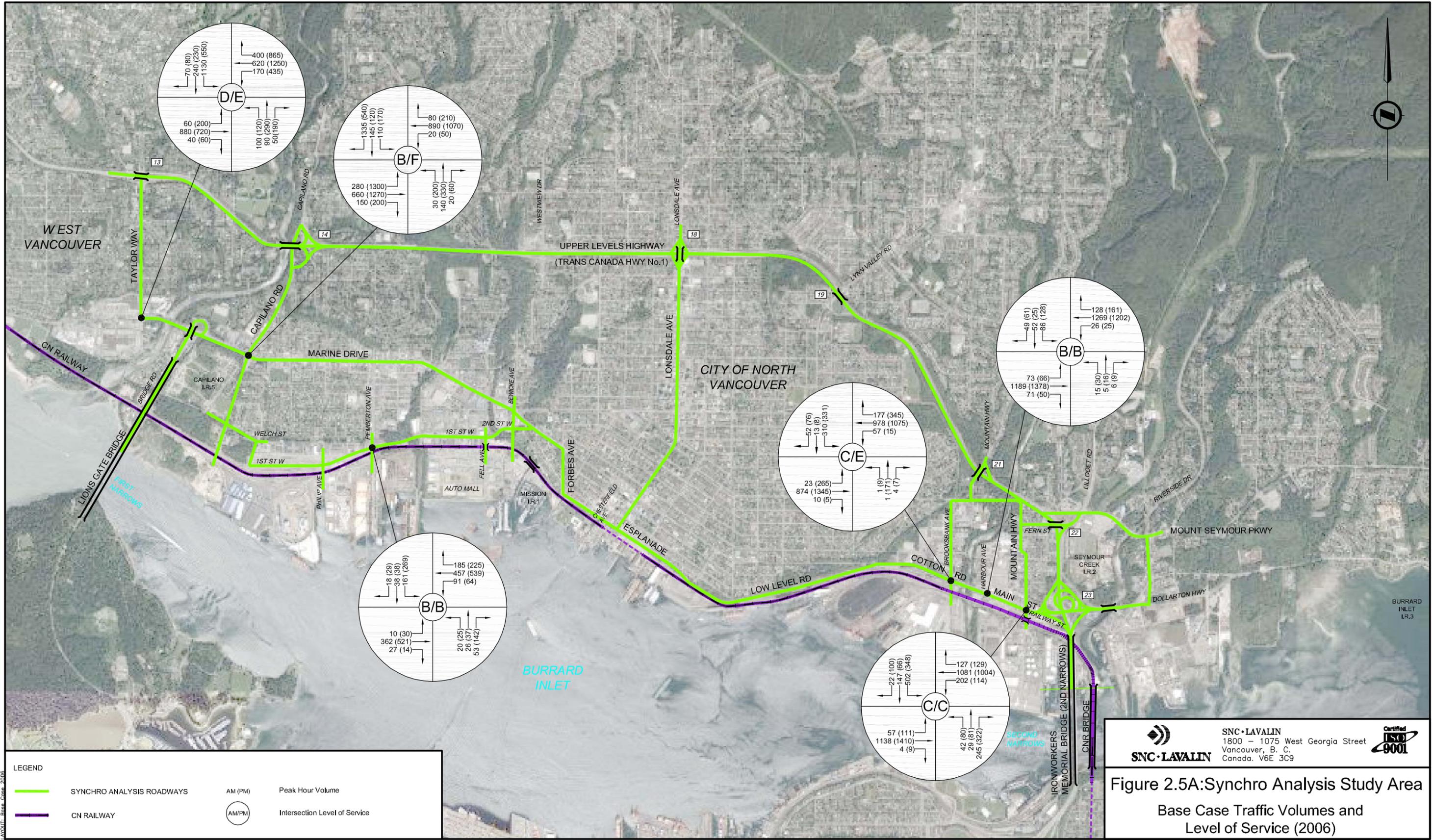
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Figure 2.4: Proposed Municipal and Squamish Nation Development in North Shore



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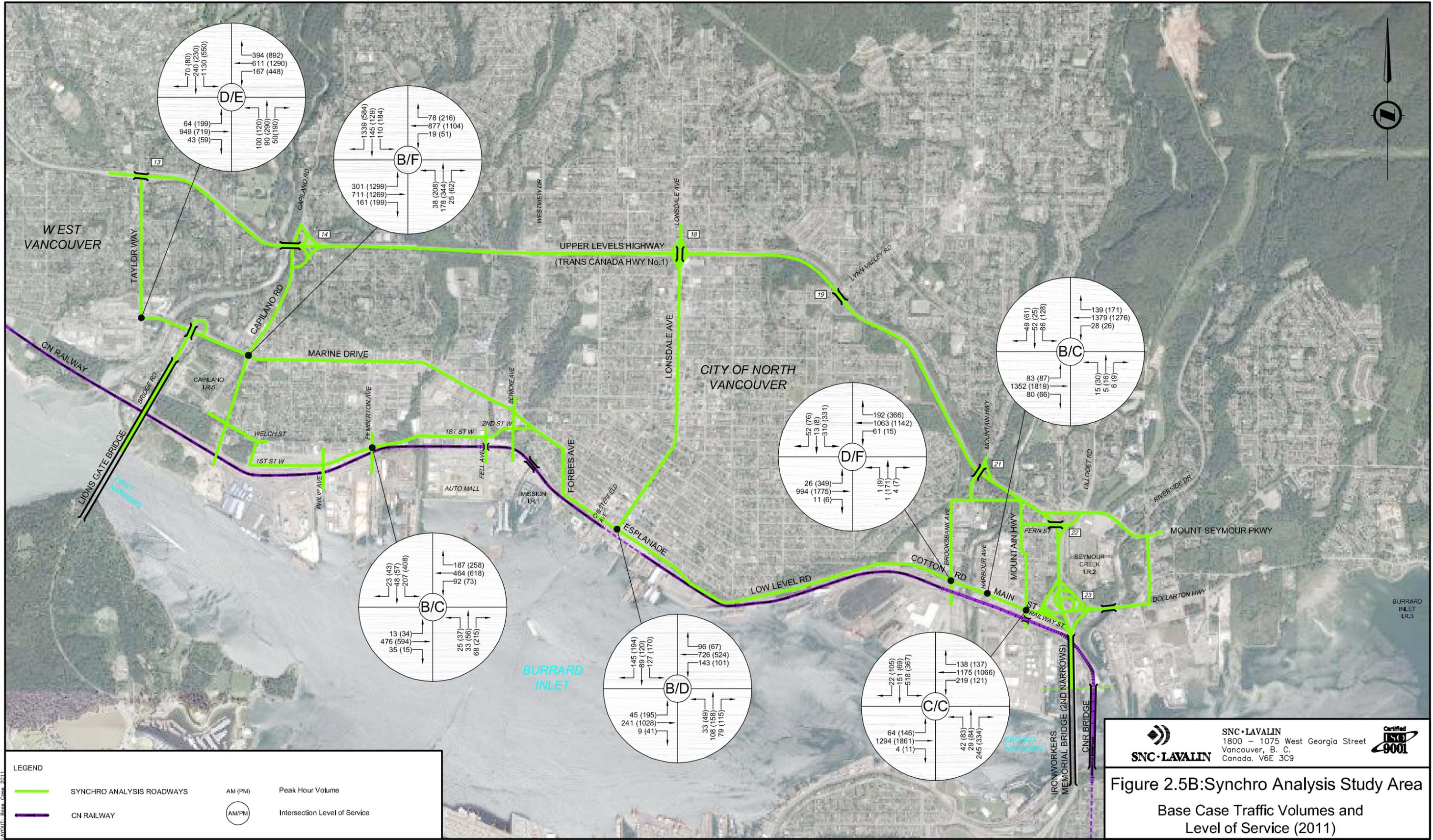


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	SYNCHRO ANALYSIS ROADWAYS		Peak Hour Volume
	CN RAILWAY		Intersection Level of Service

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	<p>Figure 2.5A: Synchro Analysis Study Area</p> <p>Base Case Traffic Volumes and Level of Service (2006)</p>	

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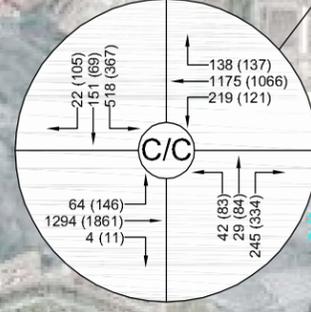
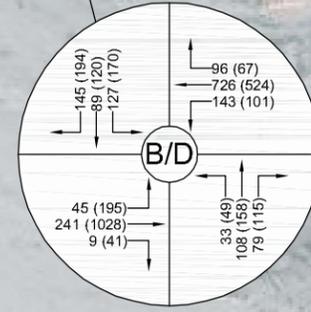
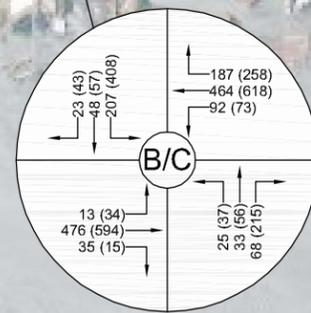
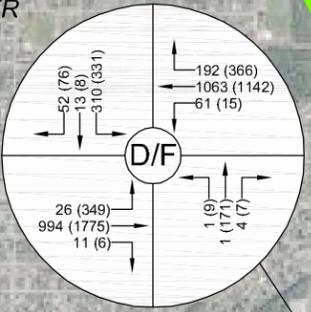
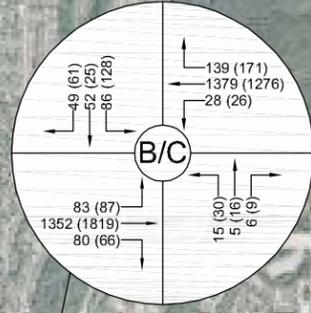
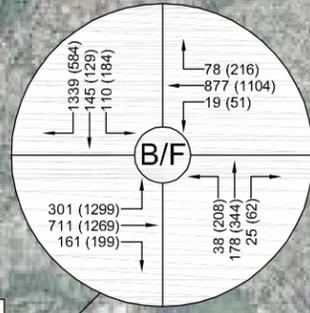
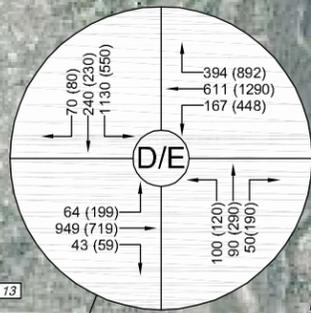
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	SYNCHRO ANALYSIS ROADWAYS		Peak Hour Volume
	CN RAILWAY		Intersection Level of Service

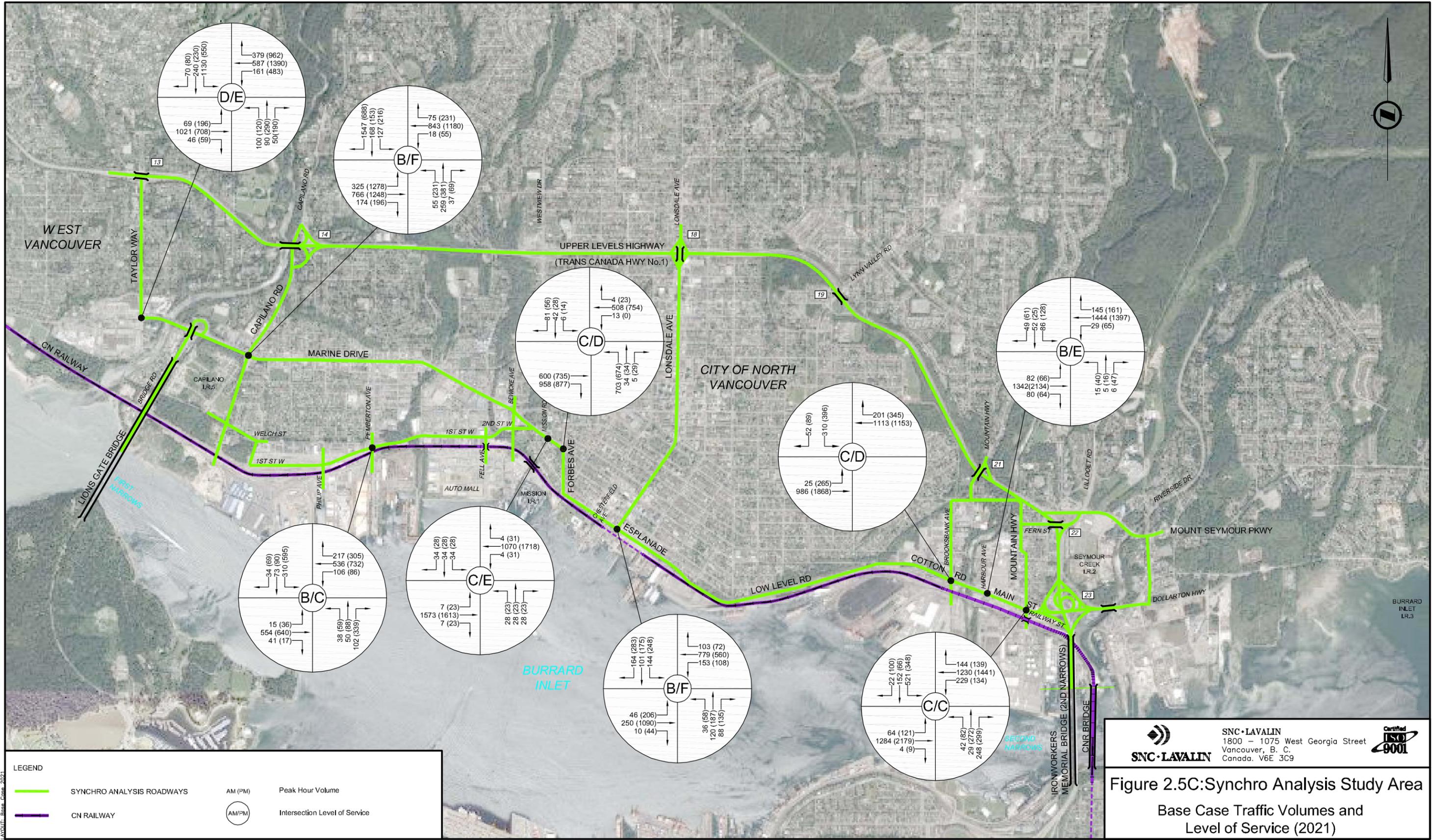
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Figure 2.5B: Synchro Analysis Study Area
 Base Case Traffic Volumes and Level of Service (2011)



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	SYNCHRO ANALYSIS ROADWAYS		Peak Hour Volume
	CN RAILWAY		Intersection Level of Service

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Figure 2.5C: Synchro Analysis Study Area
 Base Case Traffic Volumes and Level of Service (2021)



Based on the traffic assessment, review of previous studies, and on-site visits, a summary of the road critical issues and observations in both the current and future base conditions are presented in the following sections.

2.5.1 Trans-Canada Highway on the North Shore

The Trans-Canada Highway (TCH, or Highway 1) is the only major regional and provincial corridor in the study area serving heavy commercial vehicles on the North Shore. The highway is an urban freeway under provincial jurisdiction, with four lanes north and west of Main Street. Six lanes are provided across the Ironworkers Memorial Second Narrows (or Second Narrows) Bridge south of Main Street.

Provincial, inter-provincial and even international freight movements by trucks to and from the North Shore Trade Area use the TCH to access markets, logistics/distribution, and supply facilities within BC and points east and south of the province. Truck traffic to and from the North Shore is concentrated at the Second Narrows Bridge as heavy trucks are prohibited on the Lions Gate Bridge (13,000 kg limit). Currently, the Second Narrows Bridge carries 130,000 vehicles per day (Average Friday 2006), including 5,500 trucks (1,700 light trucks and 3,800 heavy trucks).

Nine full or partial interchanges are located along the approximately 10 km length of the TCH between Main Street and Taylor Way. The average distance between grade-separated interchanges along the TCH is 1.4 km and is less than the Transportation Association of Canada (TAC) guideline of 2-3 km and the American Association of State Highway and Transportation Officials (AASHTO) guideline of 1.5 km for urban freeways. The close proximity of the interchanges to each other results in over-lapping turbulence in traffic operations, particularly at the Main Street, Fern Street/Mount Seymour Parkway, and Mountain Highway interchanges.

2.5.2 TCH/Main Street Interchange

The existing Main Street interchange is a modified Parclo B4/Diamond with a semi-direct ramp (eastbound to southbound ramp). It accommodates all movements between TCH, Main Street and Dollarton Highway. The Dollarton Highway westbound to TCH southbound on-ramp provides a major east to south connection for the Seymour and Deep Cove communities in the District of North Vancouver. This on-ramp serves approximately 700 vehicles and 370 vehicles during the AM and PM peak hours respectively, with most of the trips to and from south of the Burrard Inlet for work-related purposes. In addition, heavy vehicles originating from the port terminals east of the bridge use this on-ramp to travel south of the Burrard Inlet. Furthermore, a bus exit ramp from the adjacent Phibbs Exchange is directly connected to the on-ramp. This bus interface provides a queue jump route for transit vehicles to enter the southbound direction on TCH without being delayed by heavy traffic volumes further north of the bridge.

A number of operational and safety issues were identified at the existing TCH/Main Street Interchange, including:

- The acceleration length where eastbound to southbound ramp merges with TCH southbound is insufficient (37 m compared to 120-160 m by TAC standard);
- Double exits for northbound traffic exiting from TCH to Main Street and Dollarton Highway, both with insufficient length.



In addition, future traffic from a future proposed Lynnterm container terminal development could put additional pressure on the northbound off-ramp and along Main Street between TCH and Harbour Avenue.

2.5.3 Congestion at Lions Gate and Second Narrows North Bridgeheads

As shown in Table 2.3 and Figures 2.5A to 2.5C, most of the critical intersections in the NSTA are located adjacent to the Lions Gate and Second Narrows Bridges. Almost all the major intersections located near the north bridgeheads of the Second Narrows Bridge and the Lions Gate Bridge are currently operating at capacity. Although beyond the limits of the North Shore Trade Area Study, BC MoT has indicated that the south approaches of the Trans-Canada Highway (TCH, or Highway 1) have capacity issues that emanate from capacity constraints as far south as the Cassiar Tunnel section and that the BC MoT Gateway Program will address these capacity deficiencies.

Lions Gate North Bridgehead

Based on the road assessment, intersections near the Lions Gate north bridgehead operate at or near capacity as traffic from both the North Vancouver and West Vancouver communities share the limited capacity on the Lions Gate Bridge. Both Capilano Road and Taylor Way intersections on Marine Drive experience significant delays during peak periods with southbound queues along these two roads reaching as long as 1 km to the north.

Even though the connections to both bridges are located in the District of North Vancouver, traffic congestion due to the constrained bridge capacity affects the road network in all three North Shore municipalities. When incidents occur on any one of the bridges, traffic queues spill back on many major roads on the North Shore municipalities as traffic diversion occurs between the two bridges, resulting in major compromises in travel reliability and emergency response.

Second Narrows North Bridgehead

At the east end of the study area, traffic heading towards the Second Narrows Bridge utilizes Main Street and Dollarton Highway to access the southbound on-ramp on Main Street. The recent improvements at the Mountain Highway and Main Street intersection have somewhat alleviated the congestion problems at the intersection. However, the Brooksbank Avenue and Cotton Road intersection is still affected by the heavy eastbound and westbound traffic volumes heading to or from the highway on/off ramps. Similar situations occur along the westbound direction on Dollarton Highway, where vehicles originating from the east utilize the same westbound ramp to enter both the northbound and southbound directions on the TCH. From the traffic simulation conducted at this location, it was observed that the end of queue of the westbound traffic could extend past the Riverside Drive East intersection on Dollarton Highway. The section of the TCH between the Mountain Highway interchange and the Main Street/Dollarton Highway interchange also has a number of operational issues resulting from the close interchange spacing (approximately 0.75 km between each of the three interchanges) and the fact that movements permitted at each interchange result in extensive weaving movements. The operational issues on the freeway can be mitigated by configuring the three interchanges so that they act as a distributed system of accesses. This is achievable by rationalizing the permitted access movements at all three interchanges.

2.5.4 Municipal East-West Connectivity

There is a general lack of east-west connectivity in the local road networks as well as through the area connecting the ports and terminals on the North Shore. Except for the TCH, there is no other direct east-west route between the Lions Gate Bridge and the Second Narrows Bridge on the North Shore. Currently, the Marine Drive-3rd Street-Esplanade-Main Street corridor system is the closest



alternative. Traffic between the various elements of the port and industrial area that needs to use this east-west network route are competing with many other demands. This is because the route, as well as providing convenient access to commercial and residential developments along its entire length, is also a preferred route for intra-municipal travel along the North Shore, as well as for longer commuter trips heading to the Lions Gate or Second Narrows Bridges.

The existing Low Level Road is a 1.7 km segment to the immediate north of the CNR rail tracks between St Andrews Avenue and the junction of E. 3rd Street and Cotton Road in the City of North Vancouver. At the eastern end, the road connects to Cotton Road and Main Street which connects with Dollarton Highway on the east side of the Second Narrows Bridge. At the western end, the road connects to Esplanade which terminates at Forbes Avenue at the east end of Mission IR 1. To avoid the heavy traffic on Marine Drive, east-west traffic between West and North Vancouver frequently uses the W. 1st Street /Welch Street corridor as a bypass route. W. 1st Street terminates at Garden Avenue to the east of Capilano IR 5 while Welch Street goes through the IR and connects to the Park Royal Shopping Centre via Bridge Road under and to the immediate west of the Lions Gate Bridge.

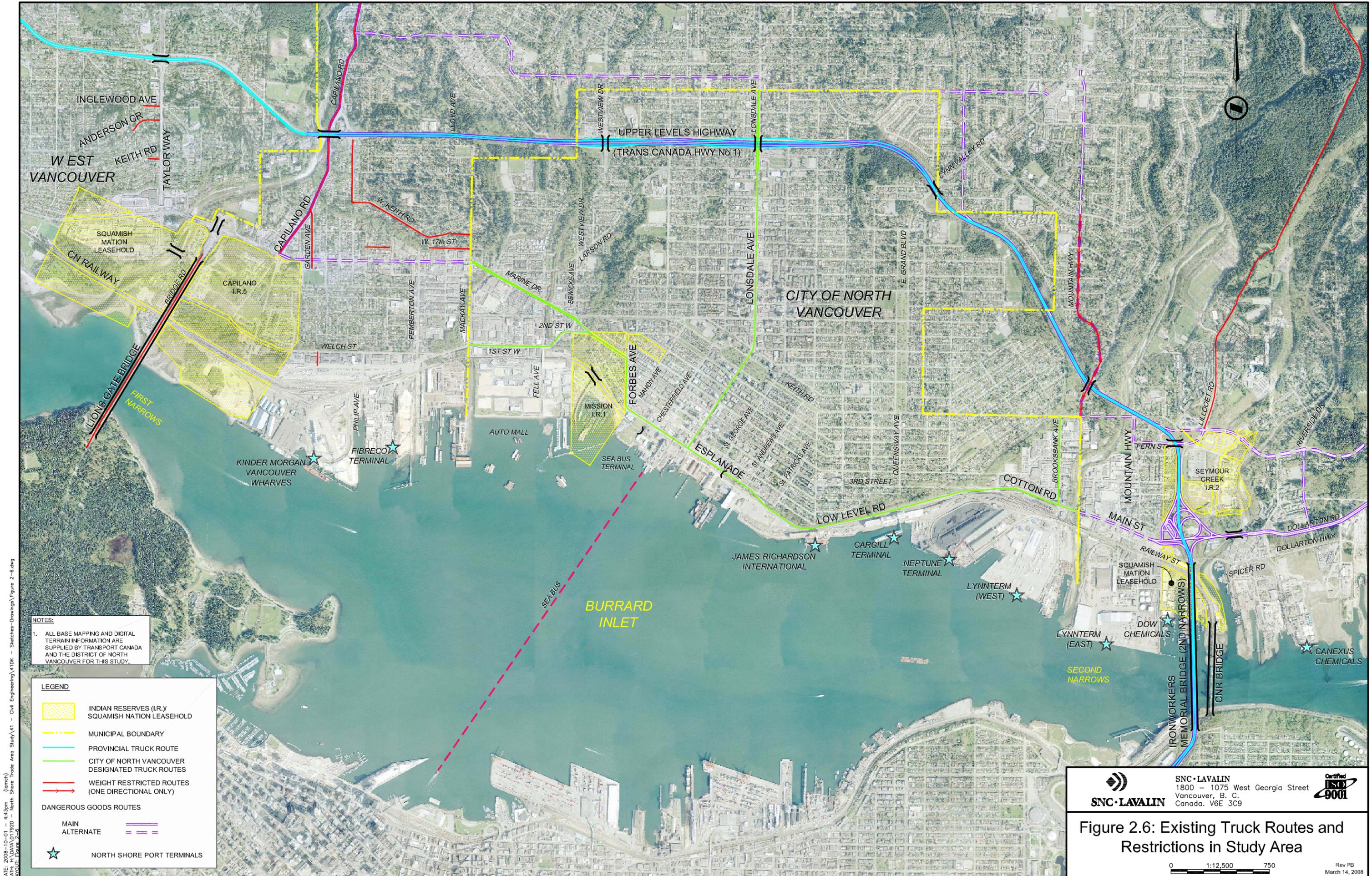
Other east-west roadways on the North Shore are usually classified as local roads, and some of the east-west roadways have mixed road classifications throughout the entire length of the road (e.g., Keith Road is classified as Major Arterial Roadway from Bewicke Avenue to St. Georges Avenue, then becomes a collector road from St. Georges Avenue to the east end of the City's boundary). Upgrading or re-designating one of these east-west roadways to function as a major east-west arterial roadway would be beneficial. However, most of these roadways are in well-developed areas, being surrounded by residential and business developments. The impacts to the abutting properties and businesses would need to be assessed to determine cost feasibility.

A continuous "Lower Level Route" along the Waterfront has been envisioned to become a true direct east-west connector on the North Shore. Aside from the sections through the Esplanade and the First Nation Land, this route is primarily surrounded by industrial and port developments on the south side. Upgrading and designating this route as a major east-west corridor would provide significant benefits to the terminal operators as well as the local communities. It may also function as an alternative route to the Upper Levels Highway and thus provide the much needed redundancy on the North Shore road network from both traffic operations and emergency response perspectives.

2.5.5 Municipal Truck Network

The City and District of North Vancouver manage truck traffic very differently within their jurisdictions. The City specifies certain municipal roads to be designated truck routes and trucks can only use these designated routes for travel. Figure 2.6 shows the corridors that are designated as truck routes for the City. On the other hand, the District applies restrictions on trucks of specific weights to use certain roadways, which means trucks can use any roadways that have no restrictions.

This inconsistency between the City's and the District's approach in managing truck traffic has often resulted in truck drivers using a non-restricted truck route within the District's boundary, continuing on across the City's boundary using the same route without realizing that this same route is not designated for truck traffic. For example, a truck can legally travel westbound on E. Keith Road within the District's boundary; however, the same continuous roadway is not designated for truck traffic within the City's boundary. This could lead to trucks using local or residential roads for convenient travel, resulting in potentially unsafe and inefficient operations for other modes of transport.



NOTES:
 1. ALL BASE MAPPING AND DIGITAL TERRAIN INFORMATION ARE SUPPLIED BY TRANSPORT CANADA AND THE DISTRICT OF NORTH VANCOUVER FOR THIS STUDY.

LEGEND

- INDIAN RESERVES (I.R.) SQUAMISH NATION LEASEHOLD
- MUNICIPAL BOUNDARY
- PROVINCIAL TRUCK ROUTE
- CITY OF NORTH VANCOUVER DESIGNATED TRUCK ROUTES
- WEIGHT RESTRICTED ROUTES (ONE DIRECTIONAL ONLY)
- DANGEROUS GOODS ROUTES
- MAIN
- ALTERNATE
- NORTH SHORE PORT TERMINALS

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Figure 2.6: Existing Truck Routes and Restrictions in Study Area

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3.0 CONCEPT DEVELOPMENT

For improvement concept development and evaluation, a three-step process was employed in this study:

- Develop preliminary improvement concepts based on review of previous studies, initial stakeholder consultation feedback and base condition assessment in study horizon years;
- Conduct feasibility assessment of preliminary improvement concepts based on guiding principles and screening criteria to identify a short list of improvement concepts for detailed evaluation; short-listed concepts were presented to stakeholders for confirmation and additional input; and
- Conduct comprehensive Multiple Account Evaluation (MAE) on the short-listed improvement concepts to identify recommended concepts and establish concept priorities; MAE results were presented to stakeholders for confirmation and additional input.



The following sub-sections describe the guiding principles, screening criteria, and feasibility assessment of the preliminary improvement concepts.

3.1 Guiding Principles and Screening Criteria

The North Shore Trade Area (NSTA) study considers the interaction between the supporting road and rail network and the port terminals on the North Shore. As a result of the Base Condition Assessment and stakeholder consultation findings, guiding principles have been established for concept development. The guiding principles recognize the following essential components of an effective transportation network in the North Shore Trade Area:

- An effective rail corridor serving industries and port terminals on the North Shore; and
- A safe and efficient road network, consisting of highway and municipal road networks, serving goods and people movement within the North Shore Trade Area and between the North Shore and the rest of the Lower Mainland, BC and Canada.

Based on the objectives of the North Shore Trade Area Study and discussion with the Study Technical Committee, the following screening criteria were adopted in order to select a list of improvement concepts for more detailed engineering and evaluation in the MAE:



- Trade Area growth and terminal expansion opportunities/requirements;
- Existing rail network “pinch points” and conflicts;
- Road network, traffic operations and safety considerations;
- Road/rail interface conflicts and issues;
- Community and environmental impacts and benefits;
- Property impacts and benefits;
- Construction cost; and
- Readiness/timing of proposed improvements.

There are three main types of improvements being considered: Rail/Road Grade Separation Improvements, Rail Infrastructure Improvements and Road Infrastructure Improvements.

3.2 Rail/Road Grade Separation Improvements

Based on the Rail Network Assessment and input from the stakeholders, 8 of the total 18 at-grade crossings are considered candidates for grade separation in this study. Table 3.1 summarized the key characteristics of the 18 at-grade crossings and the rationale for screening in or out for more detailed analysis.

Based on the Rail Network Assessment, the following locations were identified as candidates for grade separation:

- Neptune/Cargill Terminal Access: this crossing is considered the highest priority for grade separation due to heavy rail usage over multiple track crossings. It is believed that this crossing must be grade-separated for any terminal expansion to occur on the North Shore.
- St Andrews/St Patricks Avenue: both crossings are forecasted to be blocked off the entire 24 hours in the 2025 Future Case. While both crossings are considered critical, grade separation at one location will enable the closure of both at-grade crossings and provided proper consolidation of accesses into the port terminals and industries to the south.
- Pemberton Avenue: current heavy rail usage creates conflict with road traffic to and from industries and terminals to the south of the train tracks. Increased rail occupancy is forecasted in the 2025 Future Case as a result of the Kinder Morgan terminal reconfiguration, longer trains and higher crossing frequencies to service Kinder Morgan, Fibreco, and Northgate.
- Harbour Avenue: This crossing is currently closed to road traffic. The rail simulation indicated, that if it were open, the average blockage at this crossing would be the highest of any crossings on the North Shore because many trains arriving and departing North Vancouver sit on one of the five arrival/departure/approach tracks before being able to proceed. The crossing bisects the only available long tracks that are capable of holding arriving and departing unit trains for Neptune and the picking up of Thornton traffic from the CNR Big Yard. The crossing is recommended for grade separation if Harbour Avenue is to be used for road access in the case of the proposed Lynnterm container conversion.



Table 3.1: Characteristics of At-Grade Crossings on the North Shore

No.	Location	Municipality/First Nations	Access*	No. of Tracks	Candidate for Grade Separation (Y/N)	Rationale
1	11th Street	District of West Vancouver	Public	1	N	Low rail occupancy and blockage in both 2006 and 2025 Cases; future LLR proposed to terminate east of 11th Street.
2	Bridge Road	District of West Vancouver	Private	3	Y	Heavy rail usage for through traffic and local switching; only access road to land south of train tracks; Grade separation may be required as part of IR 5 development.
3	Lower Capilano Road	Squamish Nation	Public	17	N	Crossing closed and gated to road traffic.
4	Philip Avenue	District of North Vancouver	Public	5	N	Crossing closed and gated; emergency vehicles only.
5	Pemberton Avenue	District of North Vancouver	Public	2	Y	Existing pinch point for rail handling and road access to KM and Fibreco; Whistling noise impacts to local residents.
6	Bewicke Avenue	City of North Vancouver	Public	3	N	Rail blockage not a severe constraint in MLM Rail Assessment; Secondary access to Harbourside Bus. Park could be provided via Forbes/Mahon grade separation
7	Mosquito Cr. Marina	Squamish Nation	Private	2	N	Limited to marina access in IR 1.
8	Forbes Avenue	City of North Vancouver	Public	1	Y	Current access to BCIT Marine Campus; maybe required as part of IR 1 development.
9	Chesterfield Avenue	City of North Vancouver	Public	1	Y	Proposed rail tunnel extension west of Lonsdale Avenue to remove existing at-grade crossing.
10	St Andrews Avenue/Pier 94	City of North Vancouver	Public	1	Y	Existing pinch point for rail handling and road access; grade separation required for future rail expansion and Pier 94 development.
11	St Patricks Avenue	City of North Vancouver	Private	3	Y	Existing pinch point for rail handling and road access; grade separation required for future rail expansion and Pier 94 development.
12	Neptune/Cargill Terminal	City of North Vancouver	Public	7	Y	Highest rail occupancy per day of all crossings in North Shore; highest priority for grade separation to support terminal operations and expansion .
13	Harbour Avenue @ Borrow Street	District of North Vancouver	Public	1	N	CN spur line to Canexus; no through rail traffic and limited crossings.
14	Harbour Avenue @ Railway Street	District of North Vancouver	Private	5	Y	Crossing currently closed off to road traffic; grade separation identified as part of Lynnterm terminal reconfiguration
15	Mountain Highway @ Borrow Street	District of North Vancouver	Public	1	N	CN spur line to Canexus; no through rail traffic and limited crossings.
16	Charles Street	District of North Vancouver	Public	1	N	CN spur line to Canexus; no through rail traffic and limited crossings.
17	Riverside Drive	District of North Vancouver	Public	2	N	CN spur line to Canexus; no through rail traffic and limited crossings.
18	Amherst Avenue	District of North Vancouver	Private	1	N	CN spur line to Canexus; no through rail traffic and limited crossings.
19	Forester Street	District of North Vancouver	Public	1	N	CN spur line to Canexus; no through rail traffic and limited crossings.

Notes:

* Access status of at-grade crossings is based on Transport Canada Integrated Rail Information System (IRIS).

** Candidates for grade separation are highlighted in yellow.



In addition to the Rail Network Assessment, the following at-grade crossings were identified by municipalities and First Nations as candidates for grade separation as well:

- **Bridge Road:** the crossing is used by all arriving and departing trains running between West Vancouver and Squamish, and is heavily utilized by rail switching movements to/from CNR's West Vancouver Yard. This crossing provides the only road access to the land south of the train tracks, including the MetroVancouver wastewater treatment plant to the west and the Squamish Nation land to the east (also known as the Pacific Environment Centre (PEC) site). In the future, this crossing may be required to be grade separated, subject to what development occurs at the Pacific Environmental Centre (PEC) site within the Squamish Nation Indian Reserve 5.
- **Forbes Avenue:** this crossing is located to the immediate south of the Esplanade/Forbes Avenue Avenue intersection; rail crossing frequencies are relatively low (seven train movements per day in 2006, increased to 10 in 2025). The crossing provides the only road access to the BCIT Marine Campus. Squamish Nation considers grade separation at this location to be critical for future development of Mission IR 1 such that road access can be provided to the land to the south of the train tracks.
- **Chesterfield Avenue:** this crossing, located south of the Esplanade/Chesterfield Avenue intersection, is at the west portal of the North Vancouver rail tunnel; rail crossing frequencies are, similar to the Forbes crossing, relatively low (seven train movements per day in 2006, increased to 11 in 2025). The City of North Vancouver considers the existing crossing to be a physical barrier to waterfront access from Esplanade and proposes to re-align the CNR rail tracks and extend the existing rail tunnel along Esplanade to Forbes Avenue at the west. This proposal would then eliminate both the Chesterfield and Forbes at-grade crossings.

3.2 Rail Infrastructure Improvements

As part of the Rail Network Assessment, a proposed rail improvement plan (showing the existing and proposed rail tracks on the North Shore) was developed with input from the terminal operators and railway companies in order to improve the existing rail operation and to accommodate future expansion plans of various terminal operators.

In addition to the grade separations identified in the previous section, the rail improvement plan also proposed two new rail tracks to the north of the existing tracks near the existing Low Level Road, along with other new tracks for storage, switching and industrial movements between terminals, including the rail bridge over Lynn Creek. These proposed tracks would encroach into the existing Low Level Road right-of-way; therefore, a realignment concept for the Low Level Road was developed to address any road/rail interface issues in this area.

3.3 Road Improvements - Lower Level Route

When developing improvement concepts for the North Shore Trade Area, the vision of a continuous Lower Level Route and the benefits it could provide to the transportation network on the North Shore were taken into consideration. Currently, east-west municipal movements are accommodated by a collection of road sections with varying classifications, access controls and design standards in the three municipalities.

A continuous Lower Level Route has been a transportation initiative on the North Shore dating back to the 1980's when the City Engineers of the three North Shore municipalities jointly developed the concept. To date, there are still three missing links to complete this Lower Level Route (Figure 3.1): western extension of Lower Level Route from W. 1st Street to Marine Drive in West Vancouver, road



extension through the Squamish Nation IR 1, and the eastern extension of Lower Level Route between the 3rd Street/Heywood Street junction to the east of the Second Narrows Bridge.

Figure 3.1: Missing Links in Existing Lower Level Route on the North Shore



For the western extension of the Lower Level Route between North and West Vancouver, the District of West Vancouver, District of North Vancouver, and the Squamish Nation are jointly exploring this concept. It is envisioned that this new road will connect W 1st Street in the District of North Vancouver and Marine Drive in the District of West Vancouver near the Park Royal Shopping Centre. The new road is expected to serve a broad range of functions, including trips destined to the Squamish Nation/Park Royal area, circulation trips to the areas of West Vancouver and North Vancouver, as well as through traffic between the North Shore municipalities.

Recognizing the missing links in the Lower Level Route through the Mission IR 1, the City of North Vancouver commissioned a study to identify the best alignment for this road connection to provide east-west connectivity and to relieve the congestion on Marine Drive.⁶ That study identified a “Technically Preferred Option” to develop a new road link between W 1st Street and Esplanade through IR 1. This option was considered a long term initiative to separate the Lower Level Route from the Marine Drive/3rd Street corridor.

For the eastern extension of the Lower Level Route connecting Main Street and Dollarton Highway on both sides of the Trans-Canada Highway, a concept was developed as part of this study to extend the existing Low Level Road at the E. 3rd Street/Cotton Road junction to the east of the Second Narrows Bridge. Due to the extent of development on both sides of the Cotton Road/Main Street corridor, this new road would be located to the immediate north of the CNR between Heywood Street and Harbour Avenue; continue along Barrow Street where the CNR spur line is currently located; and connect to Dollarton Highway to the east of the Second Narrows Bridge via Riverside Drive West.

⁶ “Lower Level Route City of North Vancouver Final Report”, Reid Crowther & Partners Ltd., July 4, 1996.



The implementation of this continuous road is a long-term initiative. For the NSTA study, it is important to have this long term objective in mind when improvement concepts are developed so that they would be compatible with this initiative. Most of the candidate at-grade crossings identified for grade separation are located along this Lower Level Route alignment. The development of grade separation design concepts has to consider the connection to the municipal network while not precluding the possibility of providing a future continuous Lower Level Route on the North Shore.

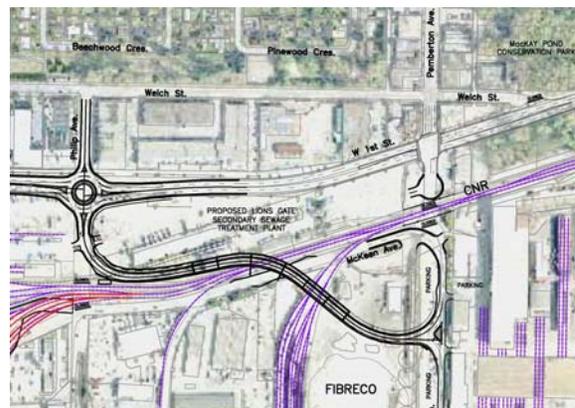
3.4 Short-Listed Improvement Concepts

After a feasibility-level screening process and confirmation with the Study Technical Committee, Study Steering Committee and stakeholders (including local municipalities, railways and terminal operators), six improvement concepts were considered for detailed Multiple Account Evaluation (MAE), as illustrated graphically in Figure 3.2.

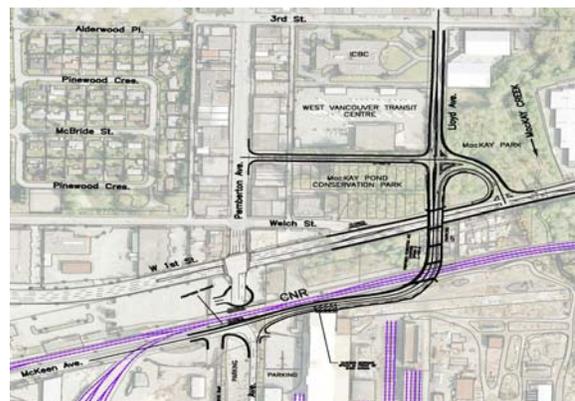
Pemberton Avenue Grade Separation:

Completion of the Kinder Morgan terminal reconfiguration to re-orient their main rail access/storage tracks from the west side to the east side of their facility (scheduled completion by end of June 2009) would likely increase pressure on the existing Pemberton at-grade road/rail crossing, as would any expansion in Kinder Morgan's rail and truck based business. This crossing also serves Vancouver Ship Yard, Fibreco and many other smaller commercial enterprises. Two potential options were developed to provide grade separation in the vicinity of Pemberton Avenue – Option A involves an overpass at Philip Avenue while Option B involves an overpass at Lloyd Avenue. Recent developments precluded a direct extension of Pemberton Avenue over the tracks. Both Philip and Lloyd overpass options will increase safety as well as rail and road capacity through this location, thus enabling longer trains, reducing noise impacts to the residential neighbourhood, as well as providing assured road access to the industries south of the rail tracks.

Option A: Philip Avenue Overpass



Option B: Lloyd Avenue Overpass





St Andrews Avenue Grade Separation:

The existing at-grade road/rail crossings at St. Andrews and near St. Patricks Avenue currently service Vancouver Dry Dock and the James Richardson International (JRI) grain terminal. Based on PMV's traffic projections, significant increase in road traffic is anticipated when vacant lands between Pier 94 and JRI are developed. A potential option was developed to provide grade separation to the east of St Patricks Avenue to eliminate the two at-grade crossings at St Andrews and St Patricks Avenue. With the overpass, road access into the PMV terminals and waterfront industries could be consolidated via a single overpass. Rail operations could be improved and safety and capacity increased through this location.

Overpass East of St Patrick Avenue



Neptune/Cargill Terminals Grade Separation:

The existing at-grade road/rail crossing would likely experience greater rail traffic as a result of the recent expansion plan by Canpotex Ltd in the Neptune Terminal. Increased rail business at Kinder Morgan to the west will also increase rail traffic at this crossing. The proposed concept would provide a grade separation to eliminate the existing at-grade crossing accessing the Neptune and Cargill terminals. Two potential options were developed, with overpass connection to the west of the improved 3rd Street East/Low Level Road intersection (Option A) or to the west of a new roundabout (Option B). According to the Rail Network Assessment, this grade separation is required to permit more efficient delivery of grain to Cargill and JRI, to permit more efficient switching of CNR's Big and Small Yards, and to allow Neptune to expand into a portion of CNR's Big Yard.

Option A: Neptune/Cargill Overpass and Improved Intersection



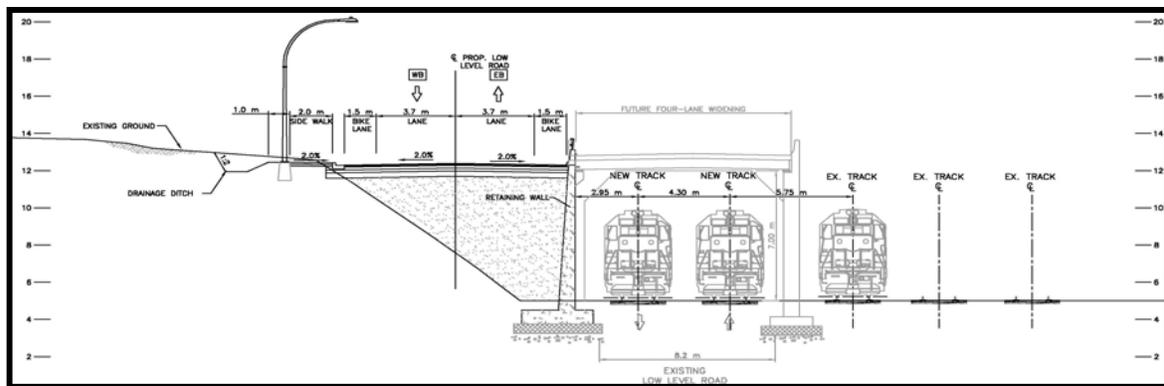
Option A: Neptune/Cargill Overpass and Round-about Connection





Low Level Road Re-alignment: to accommodate the additional two rail tracks identified in the Rail Network Concept along the existing Low Level Road between St Patricks Avenue and the Neptune terminal, the existing two-lane road would need to be re-aligned to the north and elevated to: a) avoid extensive slope cuts along the existing bluff; b) minimize property impacts up the slope; and c) provide for adequate clearance over the rail tracks should a four-lane cross-section through this section of the road be required in the future.

The additional two tracks are essential to improve the rail operations and to enable rail expansion for all port terminals on the North Shore. This Low Level Road re-alignment concept would also provide other benefits to the communities such as provision of bike facilities in both directions, improvement of the slope stability north of Low Level Road, and address any drainage issues currently experienced on the Low Level Road.



Harbour Avenue Grade Separation:

The existing Harbour Avenue/Railway Street at-grade crossing is currently closed to road traffic and is proposed for grade separation to accommodate the future proposed Lynnterm container conversion. The underpass concept, developed by Western Stevedoring, involves the building of an underpass along the Harbour Avenue alignment, adding a protected-permitted westbound to southbound left-turn phase at the Main/Harbour intersection, extending the northbound right-turn lane at the Main/Mountain intersection, and closing the existing Brooksbank Avenue underpass. The impacts of additional traffic on Main Street and the TCH/Main Street interchange as a result of the proposed Lynnterm containerization, however, will need to be further assessed before this concept could be recommended for implementation.

Option A: Harbour Avenue Underpass





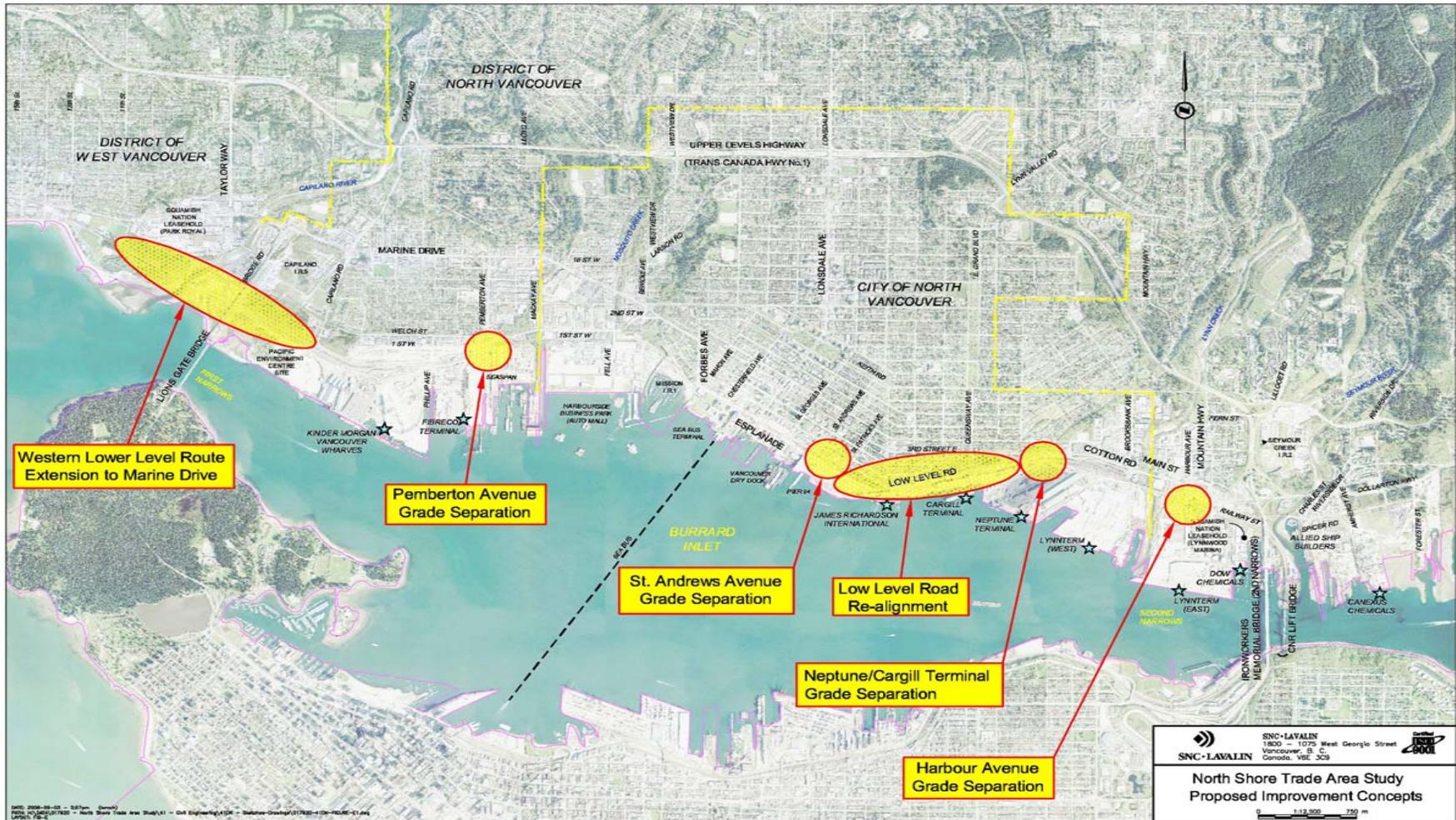
Western Lower Level Route Extension to Marine Drive:

This proposed concept involves a new road link between Marine Drive in West Vancouver and W. 1st Street in North Vancouver, a new bridge over the Capilano River to the immediate north of the railway bridge, and an overpass linking the IR 5 to the PEC site south of the rail tracks. This new link would provide a western extension of the Lower Level Route, and therefore an east-west alternative route for traffic between North Vancouver and West Vancouver to bypass the Lions Gate Bridgehead traffic on Marine Drive. The proposed new overpass in IR 5 is located east of Bridge Road near Mathias Road, thus the existing Bridge Road at-grade crossing can either be closed to road traffic or be reserved for emergency access only. The concept includes a roundabout at the Park Royal Shopping Centre where the new Lower Level Route would connect to the street network within Park Royal. An alternate signalized intersection scheme has also been developed by the Park Royal Shopping Centre (Bunt & Associates) for this junction.





Figure 3.2: Short-Listed Improvement Concepts





3.5 Concepts Not Considered for Further Evaluation

The following preliminary concepts were also developed and, after feasibility assessment and consultation with stakeholders, were not considered for further evaluation:

- Capilano Road Connection to TCH: this proposed concept involves upgrading the Lower Capilano Road through the Capilano IR 5, re-aligning Capilano Road between Marine Drive and the TCH/Capilano interchange, and geometric improvements at the interchange such that Capilano Road could be upgraded to carry truck traffic from the Low Level Road to the TCH. This concept is screened out for further evaluation since Squamish Nation is not supportive of upgrading the Lower Capilano Road within their reserve land for increased truck usage and that terminal operators have indicated that the Capilano alignment is not a desired route for truck access to the TCH.
- New Lower Level Route through Mission IR 1: this proposed concept involves linking up W 1st Street and Esplanade through the Mission IR 1. As discussed in Section 3.4, this would provide a continuous Lower Level Route within the City of North Vancouver to bypass the congestion along the Marine Drive / W 3rd Street corridor. The concept is not supported by local stakeholders as it would increase traffic through the residential area of IR 1 and impact land development potential on both sides of the new road.
- New Lower Level Route at the East End: this proposed concept involves extending the Low Level Road between the E 3rd Street/Heywood Street junction to the east of the Second Narrows Bridge. The road would be located to the immediate north of the CNR between Heywood Street and Harbour Avenue; continue along Barrow Street where the CNR spur line is currently located; and connect to Dollarton Highway to the east of the Second Narrows Bridge via Riverside Drive West. This concept is not supported by the railways and terminal operators, who see the need to preserve the Barrow Street corridor for future rail expansion. The District of North Vancouver, however, considers this new road as an alternate east-west municipal route to bypass the congestion on Main Street and the Second Narrows bridgehead and has suggested to review this corridor for further evaluation. While this concept is not further evaluated in this study, design considerations for the grade separation and municipal connector concepts should be given such that implementation of this corridor would not be precluded in the future.
- Forbes Avenue Grade Separation: grade separation at this location was suggested by Squamish Nation and the City of North Vancouver to eliminate the existing at-grade crossing. The concept for Forbes grade separation would connect the land on both sides of the rail tracks within IR 1. Preliminary benefit-cost analysis of this concept suggested that the capital cost would be in the \$18-20 million range, while benefits for road users in travel time and vehicle operating cost savings was estimated to be \$0.3 to \$0.4 million. Due to the very low benefit-cost ratio and the fact that proposed grade separation would not be required for rail improvements on the North Shore, this concept was not considered further in this study.
- Chesterfield Avenue Grade Separation: This proposed concept, identified by the City of North Vancouver, involved the re-alignment and extension of the existing CNR tunnel along Esplanade such that all three at-grade crossings at Forbes and Chesterfield Avenue could be grade-separated. The proposal would involve the relocation of about 600 m of the existing rail track between Chesterfield Avenue and west of Forbes Avenue in Mission IR1. In the absence of detailed ground surveys, geotechnical conditions surveys under the existing road, foundation and basement conditions of adjacent buildings, the proposed concept could have a very high cost and could be extremely challenging technically. Excluding the cost of right-of-way acquisition,



relocation of utilities and buildings, lifting existing buildings along Esplanade, extension of a tunnel that is currently constructed below sea level, potential compensation for business impacts, and operational impact to both road and rail traffic, capital cost for this proposal could be in the \$40-80 million range. Benefits to the road users would be in the \$0.5 to 0.7 million range. The resulting Benefit/Cost ratio would be less than 0.01. Due to the very low benefit-cost ratio, the current and projected rail crossing frequencies at the existing at-grade crossings (7 train movements per day in 2006, increased to 11 in 2025), and the uncertainties regarding technical feasibility of the proposed tunnel, this concept was not considered further in this study.

- TCH/Main Street Interchange Improvements: As the primary conduit for commercial vehicles accessing terminals on the North Shore and a key connection for regional trips into, out of, and across communities via the TCH, traffic movements at this interchange are highly complex. Capacity limitations on the Second Narrows Bridge further add to the concentration of vehicles using the interchange. In the current study, analysis was undertaken to assess functionality (capacity, efficiency, operation and safety) of the existing TCH/Main Street interchange configuration. From a trade perspective, deficiencies identified include safety and congestion issues associated with the westbound to TCH southbound on-ramp (short acceleration ramp) and northbound TCH off-ramps. Conceptual improvements were proposed to extend westbound to southbound and eastbound to southbound on-ramps to provide for additional storage and opportunities for trucks to increase operating speeds prior to entering the highway to avoid collisions and congestions associated with slow moving vehicles. The proposed dedicated truck exit loop off the TCH would also potentially improve safety and operations. These conceptual improvements were not advanced for detailed evaluation. Improvements identified to date in the current study focused on the Main Street Interchange and do not address broader network deficiencies (e.g. close proximity of Main Street, Fern Street, and Mountain Highway Interchanges and the lack of east-west connectivity for local trips). Further analysis is needed to determine an appropriate solution for this area. Future port development plans and associated traffic implications will need to be considered in more detail as part of this.



4.0 CONCEPT EVALUATION

4.1 Multiple Account Evaluation Framework

The short-listed improvement concepts were evaluated under an MAE framework consisting of six evaluation accounts developed for this study:

Quantitative Accounts

1. Financial
2. Customer Service

Qualitative Accounts

3. Social/Community
4. Security
5. Environmental
6. Economic Impact

The Financial and Customer Service accounts are quantitative accounts evaluated in dollar terms as a life cycle cost. The analysis uses a 25-year planning period, with future benefits and costs discounted at 10% with a sensitivity at 5% consistent with Federal Treasury Board guidelines. The two accounts combined will result in a Benefit-Cost Analysis of the improvement concepts. The other four accounts are qualitative and are evaluated based on a score of positive, neutral or negative compared to the Base Case (no improvement) conditions.

4.2 Quantitative Accounts

Financial Account – This includes the cost of proposed road and rail improvements. Most of the road improvements are necessary to support the added rail capacity projects or to enable terminal development plans related to Asia-Pacific trade. The exception is the Lower Level Road connection to Marine Drive which would improve the road network but does not contribute greatly to rail operations. The capital costs used for project evaluation are:

	<i>\$ Million</i>
<i>Road Projects</i>	
Pemberton Ave Grade Sep.	\$27
St Andrews Ave Grade Sep.	\$15
Neptune/Cargill Grade Sep.	\$30
LLR Realignment	\$45
Harbour Ave Grade Sep.	\$13
Western LLR to Marine Dr	\$75
<i>Rail Project (NSTA only)</i>	\$75

The rail improvement cost of \$75 million is provided by PMV for B/C analysis in this study. Road-related improvement costs are provided by SNC-Lavalin based on conceptual design of the improvement concepts. All costs and benefits are shown in 2008 Dollars.



In developing cost estimates for the road improvement projects, SNC-Lavalin followed the “*Level of Design and Cost Estimates Guidelines*” by the BC Ministry of Transportation (Draft, March 30, 2006). For each of the road improvement concepts, a Class “D” cost estimate was developed corresponding to the level of design for a route study, as described below:

- Graphical development of accurate plans for all feasible locations of roads and/or configurations of interchanges/intersections, and their technical review;
- Single-line sketches at a scale of 1:5,000 initially, followed by conceptual design using a Digital Terrain Model at a scale of 1:1,000;
- Design drawings include the following information:
 - Centerline alignment of each lane and ramp, with accurate curvatures and arrows indicating travel direction;
 - Structure locations;
 - Intersections;
 - Nose Points.
- Technical review of design concepts, including:
 - A site visit for confirmation of local conditions, physical constraints, and environmental/social issues;
 - Computer-based earthwork calculations, using 1-meter terrain data, where possible;
 - General property requirements and impacts on individual parcels;
 - Identification of site-specific environmental and social-economic impacts.

Design concepts were generated based on costs and engineering judgment as to feasibility, physical, environmental and social impacts/acceptability, and accommodation of potential growth or change.

Customer Service Account – For road improvement concepts, this account normally includes direct benefits to road users stemming from reduced travel time, accident and vehicle operating costs. These are quantified using accepted practice, but are only part of the benefits stemming from the larger plan to increase port capacity.

The majority of project benefits accrue to Canadian shippers and manufacturers through reduced logistics costs and increased demand associated with added port capacity. To capture these benefits, the general approach used was to:

- *Estimate what the growth in port traffic and throughput costs might be with and without additional port capacity*
 - With added port capacity in place, the analysis assumes demand will grow at about 2% per annum. Without it, growth is constrained to 0.5% per annum and throughput costs will be higher than they might otherwise be with the added capacity.
- *Assign an economic value to the incremental traffic*
 - The proxy figure used for estimating the value of increased throughput is the amount of GDP generated for each tonne of throughput. In 2007, the NSTA generated on average \$32.50 of



direct GDP for each tonne of throughput⁷. Direct GDP represents the value of goods and services added by the NSTA and the throughput is the tonnes of cargo per year. The resulting incremental changes in GDP are direct benefits to the economy.

- *Attribute part of this benefit to added road and rail capacity*
 - Port capacity is determined by the number of berths, terminal capacity and landside capacity (road and rail). From a capacity perspective, all three are equally important since a limitation in any one component would limit the overall port capacity. For analysis purposes, the landside (road and rail) is assumed to contribute 30% of the port's capacity and hence returns 30% of the benefits of added capacity. The value of increased demand and lower costs are then brought forward to the MAE as benefits in the Customer Service Account.

Table 4.1 summarises the assumptions used for estimating these benefits. Table 4.2 defines the line items used in Table 4.1.

Table 4.1: Total Port Benefits of Added Port Capacity (\$ Million)

	Without Added Capacity	With Added Road and Rail Capacity		
	Background Demand	Background Demand	Induced Demand	Total Demand
<i>NSTA Throughput (millions tonnes)</i>				
2007	23.8	23.8	0.0	23.8
2031	26.6	26.6	8.6	35.2
<i>Annual Growth (linear)</i>	0.50%	0.50%	1.50%	2.0%
<i>NSTA Direct GDP 2007</i>				
<i>\$ Millions</i>	\$773			
<i>GDP/tonne</i>	\$32.5			
<i>GDP attributable to road/rail</i>				
<i>Portion</i>	30%			
<i>GDP/tonne</i>	\$9.75			
<i>Throughput Cost (2007\$/tonne)</i>				
2007	\$9.75	\$9.75	\$9.75	\$9.75
2031	\$14.44	\$9.40	\$9.40	\$9.40
<i>Annual increase (linear)</i>	2.0%	-0.15%	-0.15%	-0.15%
<i>Present Value of Throughput Costs</i>	\$2,518	\$2,158		
<i>Benefit (10% discount rate)</i>		\$359	\$32	\$392
<i>Sensitivity test at 5% discount rate</i>		\$718	\$73	\$791

Note: Incremental Benefit is calculated assuming 30% of Port Direct GDP is attributable to rail and road improvements proposed in this study.

7. Direct GDP generated by the North Shore port terminals is based on InterVISTAS' economic impact analysis conducted for this study.



Table 4.2: Description of Line Items in Economic Benefits Model

<i>Background Demand</i>	This is the cargo demand occurring in the NSTA with or without added capacity and is assumed to grow at 0.5% per annum.
<i>Induced demand</i>	This is the incremental growth above the background demand and is assumed to occur in response to added capacity.
<i>Total Demand</i>	This is the background + induced demand and reflects the demand level assuming capacity is added.
<i>NSTA Throughput</i>	The NSTA handled an estimated 23.8 million tonnes/yr in 2007.
<i>Annual Growth (linear)</i>	The average growth rate over the 25 year forecast period. The growth in total demand is 2% per annum with added rail capacity in place and is the sum of background (0.5%) + induced (1.5%) growth.
<i>NSTA Direct GDP 2007</i>	This is the total direct GDP reported by Intervistas for the NSTA in 2007. GDP/tonne is the total GDP (\$773 million) divided by the throughput (23.8 million tonnes) = \$32.50/tonne. InterVISTAS' economic impact analysis was conducted for this study (see Technical Memo 1 submitted earlier for this study).
<i>GDP attributable to road/rail</i>	For analysis purposes, the landside (road and rail) is assumed to contribute 30% of the port's capacity and hence returns 30% of the benefits of added capacity. The GDP/tonne attributable to rail is then 30% x \$32.50 = \$9.75/tonne
<i>Throughput Costs</i>	GDP is used as a proxy for throughput costs. The throughput costs are assumed equal to the direct GDP/tonne (\$9.75). The base case assumes throughput costs increase 2% annually in the absence of capacity improvements, due to increasing congestion. The proposed case assumes that with the added capacity there is a slight reduction in logistics costs at 0.15% per annum.
<i>Present Value of throughput costs</i>	The present value of throughput costs to background traffic is calculated with and without the added capacity using a 10% discount rate over 25 years.
<i>Discount Rate</i>	This is the real discount rate which excludes inflation. Federal Treasury Board guidelines dictate 10% with a sensitivity test at 5%.
<i>Benefit</i>	For background traffic, this is the incremental reduction in the present value of throughput cost (\$2007 millions). For induced demand, the present value of benefits, using the rules of consumer surplus is: $\text{Induced Benefits} = \text{induced demand} \times (\$/\text{tonne without added capacity} - \$/\text{tonne with added capacity}) \times \frac{1}{2}.$ The total incremental benefit is the sum of background + induced benefits.



Benefit-Cost Analysis: Table 4.3 presents a B/C ratio based on the benefits to road users from an improved road network plus benefits to port users from increased demand and lower shipping costs associated with added port capacity. The costs are the costs of rail and road improvements. The Western Lower Level Route Extension to Marine Drive is identified separately since it is not directly associated with any port capacity improvements.

Sensitivity Test – Road/rail capacity is assumed to contribute to overall port capacity in roughly equal proportion to terminal and waterside (berth) capacities. The baseline assumes road/rail contributes 30% of capacity and hence 30% of capacity related benefit. Figure 4.1 tests the sensitivity of results to this assumption over a range from 10% to 50%. The breakeven point (B/C ratio = 1.0) occurs with about 15% of the ports economic benefits attributable to rail and road improvements. A reasonable range may be 20% to 40% of benefits which returns a range of benefit cost ratios of 1.3 to 2.6 (excluding property costs), as shown in Table 4.3

Table 4.3: Benefit-Cost Analysis: Short-listed Improvement Concepts (\$ Million)⁸

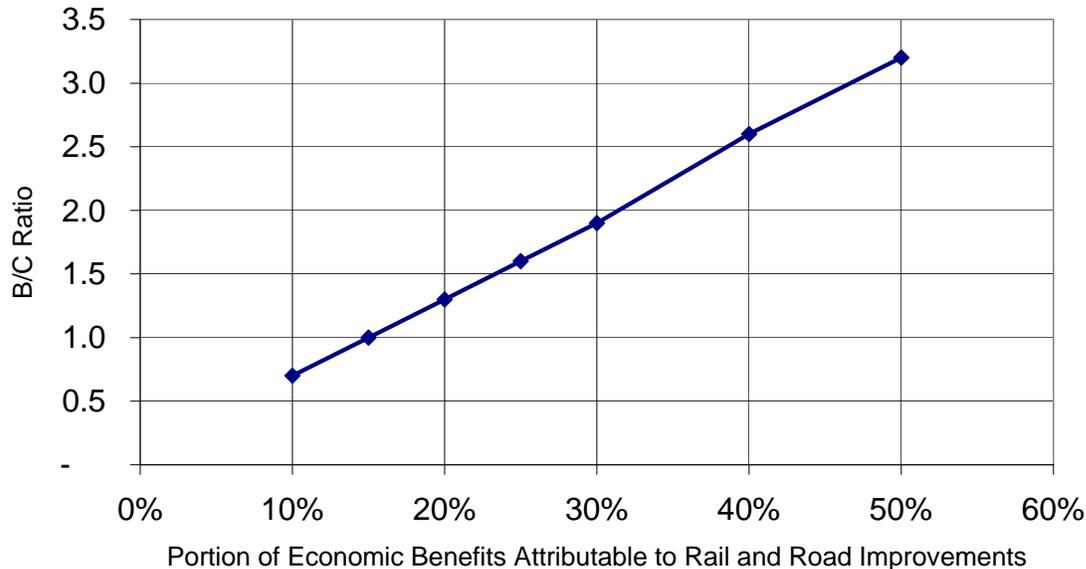
	<i>Pemberton Grade Sep.</i>	<i>St Andrews Grade Sep.</i>	<i>Neptune/ Cargill Grade Sep.</i>	<i>LL Road Realignment</i>	<i>Harbour Ave Grade Sep.</i>	<i>Western LLR to Marine Dr</i>
Project Cost	<i>Quantitative Accounts (\$millions)</i>					
Road Cost	\$27	\$15	\$30	\$45	\$13	\$75
Rail Cost						Not Applicable
Total Cost	\$205					\$75
Project Benefit						
Road Users						
Auto & Bus	\$1.1	\$2.5	\$1.4	\$0.0	\$0.1	\$36.3
Truck	\$0.4	\$0.6	\$0.2	\$0.0	\$0.1	\$2.7
Accident Savings	\$0.03	\$0.04	\$0.02	\$0.00	\$0.00	\$4.5
Total Road Benefit	\$1.6	\$3.2	\$1.6	\$0.0	\$0.2	\$43.5
Port Users						
Total Port Benefit	\$261 - \$523					Not Applicable
Total Benefit (Road + Port)	\$268 - \$530					
Overall B/C Ratio	1.3 - 2.6					
Road B/C Ratio	See Overall B/C Ratio					0.58

Note: Range of Total Port Benefit is calculated assuming 20-40% of Port Direct GDP is attributable to rail and road improvements proposed in this study.

⁸ Rail improvement cost is provided by PMV for B/C analysis in this study. Road improvement costs are prepared by SNC-Lavalin based on conceptual design of improvement options, including construction, engineering and contingency in 2008 Dollars, excluding property and environmental mitigation/compensation. Where two design options exist for the improvement concept, the higher cost option is shown in this table.



Figure 4.1: Benefit-Cost Ratio for Road and Rail Improvements



4.3 Qualitative Evaluation

Social/Community Account – This is the degree to which projects conform to or detract from social values and includes five criteria. These criteria were initially evaluated during the MAE Workshop with the Technical Committee and representatives from the study partners. The evaluation was then presented to the stakeholders in a workshop environment to seek further feedback and input.

- *Property Impacts*: Reflects the number and type of property takings or enhancing/reducing property values.
- *Spirit Trail and Alternate Transport Mode*: The Spirit Trail is the multi-use trail planned to connect along the waterfront through the North Shore communities. This criterion measures the degree to which road concepts enhance or serve as a barrier to the continuity of the trail where it crosses or follows roads. Alternate Transport Mode evaluates how each concept enhances or detracts from transit, pedestrian, cyclist and other modes of transport initiatives.
- *Slope Stability and Drainage*: Measures the impacts and benefits to slope stability and drainage in the affected areas
- *Emergency Services*: Impact on port accessibility during normal operations or for disaster/incident response on the North Shore
- *Noise*: This is the impact on train noise mostly associated with switching operations and to a lesser degree, road traffic noise. The rating reflects the exposure to as well as the degree of noise impact.



Table 4.4: Social/Community Evaluation of Short-listed Improvement Concepts⁹

Evaluation Account	Evaluation Criteria	Pemberton	St Andrews	Neptune / Cargill	LLR ¹ Realignment	Harbour	LLR ² to Marine Dr
Social/Community	Property Impacts						
	Spirit Trail and Alternate Transport Mode						
	Slope Stability / Drainage						
	Emergency Services						
	Noise						

LLR¹ - Low Level Road

LLR² - Western Lower Level Route Extension

Notes: = Positive = Neutral = Negative

Security Account – The Port Authority is mandated to provide security for the port terminals and infrastructure. Based on InterVISTAS’ overview security assessment for this study, three evaluation criteria were used including:

- *Port Access*: The degree to which individual road concepts enhance the ability to control traffic into and out of terminal areas.
- *Rail and Truck Corridor Protection*: Security of rail and truck cargoes while circulating through the rail yards, mainline or road network
- *Critical Infrastructure Protection*: The degree to which road concepts enhance or detract from the security of major infrastructure, specifically the First and Second Narrows Bridges at either end of the port area.

Environmental Account – This was evaluated at an overview level based on a desktop review of published sources conducted by SNC-Lavalin. The evaluation criteria to be adopted and the scoring of individual criteria were conducted by the Technical Committee in the MAE Workshop. Inputs from municipalities were provided at stakeholder workshop. The four criteria include:¹⁰

- *Fish and Wildlife Impacts*: Measures the impact of road works on streams and animal habitat. During construction, the impact on marine habitat is typically negative or at best, neutral. Post construction impacts are potentially positive by creating wetland or improving fish habitat at or near

⁹ For improvement concepts with two design options, the scoring is provided for the option with more potential issues – future design should consider how the issues could be minimized or mitigated.

¹⁰ Note that SNC-Lavalin has included Contaminated Site Risk as a criterion in the Environmental Account (see Appendix 3B of Technical Memo 3). This criteria has been dropped as suggested by the Technical Committee since Contaminated Site Risk was considered a cost issue and that the site could be mitigated or improved upon project completion.



the site to at least return to no net loss. Road projects generally have a negative impact by fragmenting animal habitat and destroying vegetation.

- *Archaeological Risk*: When artifacts of cultural significance are found in the course of construction they need to be dealt with appropriately, which adds delay and cost to a project.
- *Greenhouse Gas Savings*: This is measured by the tonnes of GHG reduced through lower fuel consumption associated with the road projects. Locomotive fuel savings are positive but have not been evaluated.
- *Parks and Recreation*: This reflects the impact on park areas or access.

Economic Impact Account – This account will reflect the economic impacts to the North Shore Trade Area associated with the transportation and logistics activity of the North Shore terminals and is different from the economic benefit identified earlier in the Customer Service Account. While economic impacts are classified into three general types: direct, indirect and induced, this account will capture the indirect and induced impacts to avoid double-counting of direct benefits already captured in the Customer Service account under rail benefits.

- **Direct economic impact** is employment, value-added or economic output that can be attributed to the operation and management of port businesses and associated transportation services.
- **Total economic impact** is the sum of direct, indirect and induced effects on the economy. The multiplier (indirect and induced) economic impacts represent the maximum potential stimulus to the economy resulting from activity of North Shore terminals related businesses.

Indirect Economic Impact: Employment, value-added or economic output created in industries that supply goods and services to port businesses (e.g. a parts distributor that supplies the terminal operators with replacement parts for their container cranes or other equipment would contribute to the indirect economic impact of the North Shore Trade Area).

Induced Benefits: Employment, value-added or economic output generated because of expenditures by individuals employed directly or indirectly by the North Shore terminals (e.g., if a stevedore at one of the PMV's North Shore terminals decides to expand or re-model his/her home, this would result in additional, or induced, employment hours in the general economy).

The evaluation of the short-listed improvement concepts under the Environmental, Security and Economic Accounts are summarized in Table 4.5 below.



Table 4.5: Environmental, Security and Economic Evaluation of Short-listed Improvement Concepts¹¹

Evaluation Account	Evaluation Criteria	Pemberton	St Andrews	Neptune / Cargill	LLR ¹ Realignment	Harbour	LLR ² to Marine Dr
Environmental	Fish and Wildlife Impacts	○	○	○	○	○	○
	Archaeological Risk	○	○	○	○	○	○
	Greenhouse Gas Emissions	●	●	●	○	○	●
	Parks and Recreation	○	○	○	○	○	○
Security	Port access, rail/truck corridor protection and critical infrastructure protection	●	●	●	●	○	○
Economic	Indirect and induced benefits (employment, GDP and economic output related to Asia Pacific Trade)	●	●	●	●	●	○

LLR¹ - Low Level Road

LLR² - Western Lower Level Route Extension

Notes: ● = Positive ○ = Neutral ○ = Negative

4.4 Overall Concept Evaluation

The overall evaluation of each of the improvement concepts is summarized as follows:

Pemberton Grade Separation: With an Average Annual Daily Traffic (AADT) of 3,450 in 2006 and 6,530 projected for 2021, this concept generates moderate road user benefits, mostly attributable to time savings. Currently, westbound to southbound traffic approaching the at-grade crossing on W 1st Street is blocking the through lane, contributing to secondary delay. Accident savings are minor and vehicle operating cost savings stem from reductions in stopped delay at the level crossing. There will be grade separation benefits to rail operations since rail capacity could be increased significantly if the existing grade crossing could be eliminated. Social/community benefits could be expected in whistle noise reduction associated with the existing at-grade crossings, as well as improved road access for emergency services. Port security can be enhanced by grade separation of rail and road corridors and by consolidating multiple road accesses into a single point.

St. Andrews and Neptune/Cargill Grade Separations: Grade separation returns moderate road user benefits associated with reduced delay at the existing at-grade crossings. The primary benefits are to rail operations. These level crossings are often blocked by through train and train switching movements, resulting in standing rail cars for most of the day if proposed yard and mainline expansions proceed. Grade separation at these locations will be an integral part of the rail expansion on the North Shore. The grade separation would also provide safe and efficient road access into the

¹¹ For improvement concepts with two design options, the scoring is provided for the option with more potential issues – future design should consider how the issues could be minimized or mitigated.



port terminals and waterfront industries without waiting at the rail crossings. The grade separation concept is compatible with the Spirit Trail concept being developed by the North Shore municipalities. Other social/community benefits could be expected in whistle noise reduction associated with the existing at-grade crossings, as well as improved road access for emergency services. Port security can be enhanced by grade separation of rail and road corridors and by consolidating multiple road accesses into a single point.

Low Level Road Realignment: The primary benefit of this improvement concept is to rail operations as this is the narrowest part of the rail corridor next to the JRI and Cargill terminals. The existing 2-lane road is realigned further to the north to allow for the addition of the 2 proposed rail tracks. The existing 2-lane road operates reasonably well with few accesses and no signals. The realigned 2-lane replacement would not generate any appreciable benefit in travel time savings. However, the new road will help to address the issues associated with drainage, slope stability, reduction in train switching noise, provision of cycling facilities, all of which are serious issues as expressed by the City and local residents. The separated road and rail facility would also improve both road safety and port security.

Harbour Avenue Grade Separation: This grade separation would be required if the proposal to reconfigure Lynnterm to a container terminal proceeds. Traffic to the Lynnterm terminal is presently accommodated by both the Mountain Highway and Brooksbank Avenue underpasses. The Brooksbank Avenue underpass is proposed to be closed off as part of the Lynnterm reconfiguration and Harbour Avenue is proposed to serve as the new access. There is little net benefit to road users other than some improved circulation due to no net loss/gain in road access. The impacts of additional traffic on Main Street and the TCH/Main Street interchange as a result of the proposed Lynnterm containerization, however, will need to be addressed before this concept could be recommended for implementation. There are no major impacts to port security as the existing at-grade crossing is currently gated and closed to road traffic.

Western Lower Level Route Extension to Marine Drive: This concept extends W 1st Street in the District of North Vancouver to the west over Capilano River and connects to Marine Drive at the Park Royal Shopping Centre in the District of West Vancouver. This has some benefits to rail operations but primarily benefits road users, allowing traffic to bypass the congested Marine Drive corridor between Taylor Way and Capilano Road. Road user benefits stem from reduced travel distance, reduced signal delay and lower accident rate. With an estimated 15,000 AADT using the new route, benefits are reasonably good but the cost of building the road with a bridge structure is high, resulting in an overall B/C ratio of 0.58 for this improvement concept. The concept is not justified purely from a benefit/cost perspective, especially when considering that the costs do not include property acquisition. Though not directly related to Asia-Pacific trade, the new route would enable the development of the Squamish Nation IR 5 as well as the PEC site south of the rail tracks.



5.0 CONCLUSION AND RECOMMENDATIONS

In support of Asia-Pacific trade activities on the North Shore Trade Area, and in enhancing the safe and efficient movement of people and goods within the North Shore community, Transport Canada in conjunction with BC Ministry of Transportation and Infrastructure, Port Metro Vancouver, Translink, and Greater Vancouver Gateway Council launched the North Shore Trade Area Study to review the transportation infrastructures issues in the Trade Area adjacent to the port terminals and rail corridor, with the objective of enabling and supporting the continued growth of this strategic component of the Asia-Pacific Gateway.

Through a comprehensive technical review with on-going consultation with study partners and stakeholders, six technically sound road transportation improvement concepts were developed to ensure an efficient transportation system in the North Shore Trade Area. Five of the six proposed infrastructure concepts will be required for the implementation of the overall rail network concept on the North Shore, which will serve as a catalyst for private investment on the terminal expansion and business opportunities like Canpotex to use the North Shore as their gateway. This is also a unique opportunity for all North Shore terminal operators and railway companies to collectively resolve rail operation deficiencies and improve the overall rail operations on the North Shore as well. At the same time, the development of these infrastructure concepts within the North Shore Trade Area have taken into account some of the municipal issues such as slope stability, cycling facilities, and noise from rail and terminal operations, which would provide a win-win situation for all stakeholders.

5.1 Recommended Concepts

As presented in the MAE results, the following five improvement concepts are associated with rail or terminal improvements in the North Shore Trade Area:

- Pemberton Avenue Grade Separation
- St Andrews Avenue Grade Separation
- Neptune/Cargill Grade Separation
- Low Level Road Re-Alignment
- Harbour Avenue Grade Separation

The other road triggered concept is the Western Lower Level Route Extension.

One fact sheet is provided for each of these improvements concepts at the end of the Executive Summary of this report. Table 5.1 summarizes these six concepts with their respective jurisdiction and estimated cost for road improvements.



Table 5.1: Road Improvement Concepts, Costs and Location

	Improvement Concepts	Estimated Cost ¹² (2008 Dollar)	Estimated Cost ¹³ (2014 Dollar)	Location
Rail/Terminal Access Triggered	Pemberton Avenue Grade Separation	\$27M	\$36 M	District of North Vancouver
	St Andrews Avenue Grade Separation	\$15 M	\$20 M	City of North Vancouver
	Neptune/Cargill Grade Separation	\$30 M	\$40 M	City of North Vancouver
	Low Level Road Re-Alignment	\$45 M	\$61 M	City of North Vancouver
	Harbour Avenue Grade Separation	\$13 M	\$16 M	District of North Vancouver
Road Triggered	Western Lower Level Route Extension to Marine Drive	\$75 M	\$100 M	Squamish Nation/District of West Vancouver/District of North Vancouver

5.2 Project Implementation Considerations

Implementation of the road transportation improvements will, in some cases, be triggered by rail and terminal development and reconfiguration to accommodate rail improvements to better service existing or planned port terminal operations and developments. In other cases, the road improvements will be triggered by the need to improve road access within the North Shore by improving east-west connectivity along the shoreline.

The continued viability of the North Shore Trade Area depends on a balanced surface transportation system that successfully integrates marine, rail and road based elements. The six road improvement concepts are key components of this system.

For advancing these improvement concepts to the implementation stage, the following considerations are provided in terms of the constructibility and possible work packaging.

Technical Considerations:

- Train Volume/Operations: grade separation of crossings with heavier rail usage and imposing greater operational constraints will likely proceed first;
- Vehicle Volume/Operations (AADT): this will provide a measure of the potential benefits brought about by the proposed improvements;

¹² Estimated cost for road improvements includes construction, engineering and contingency in 2008 Dollar, excluding property and environmental mitigation/compensation costs. Where two design options exist for the improvement concept, the higher cost option is shown in this table.

¹³ Cost escalation from 2008 to 2014 is based on a 5% increase per year.



- Safety: improvements to public safety in people and goods movement are considered high priority initiatives; early implementation will provide immediate benefits to the rail/road users as well as the general public;
- Functional Classification of Road/Rail: public crossings are usually considered a higher priority for grade separation than private ones; road projects are also commonly prioritized based on function hierarchy and classification;
- Constructability/Work Staging: improvements are usually packaged such that work can be staged and traffic impacts during construction be minimized.

Other Considerations

- Status of Terminal and Railway Reconfiguration: rail and terminal-related road improvements will depend on the timing of the railway and terminal reconfiguration plans;
- Compatibility with Municipal/First Nations Land Use and Development: the Western Lower Level Route Extension to Marine Drive concept and Harbour Avenue grade separation concept will depend, to a large extent, on the timing and scale of the developments in the respective areas;
- Compatibility with Provincial/Regional initiatives/improvements in North Shore: Trade development plans and associated traffic implications will need to be considered in relation to the broader provincial network and provision of a safe and efficient corridor serving goods and people movement between the North Shore and the rest of the Lower Mainland, BC and Canada.
- Environmental Impacts and Permitting: more detailed environmental studies will be required as design concepts are refined; improvements having a greater environmental footprint (e.g. new Low Level Road connection to Marine Drive) will require a longer and more comprehensive review and permitting process;
- Funding/Fiscal Considerations: the cost-effectiveness of these improvement concepts, the capital investments required, and the access to public and private funds are all crucial considerations as concepts are evaluated for implementation.

Possible Implementation Timing

The following is a suggested timeline to advance the concepts to implementation:

- Years 1-2: Preliminary Design
Public/stakeholder Consultation
Environmental Assessment & Permitting
First Nation Consultation
Acquisition of Right-of-Way
- Year 3: Detailed Design
Relocation of Utilities
- Year 4-5 Construction: Commence Maintenance

5.3 Issues for Further Considerations

In developing the road transportation improvement concepts, it was frequently necessary to examine several options to fulfill the purpose of the desired improvement. To move the concepts forward as recommended projects for implementation, it will be necessary, beyond this current study, to undertake the following work for each concept:



- Conduct more detailed engineering and functional design to confirm technical feasibility, constructability, and land requirement;
- Assess in more detail the impacts and benefits to the natural and social environment;
- Address security issues related to the North Shore terminals and road/rail corridors;
- Conduct value engineering and refine construction, maintenance, and other associated project cost (e.g. environmental assessment, permitting and potential mitigation/compensation);
- Consult with municipalities and stakeholders to ensure that engineering design meets community/stakeholder requirements; and
- Assess financial feasibility and establish project priorities based on needs and available funding of each partner.

It is also noted that some concept options may provide more flexibility than others in facilitating future expansion beyond the current planning horizon of 2021. From the above considerations, it will then be possible to identify and confirm the preferred option to be carried forward as a design and construction project.

The following section discusses recommendations for further consultations, as well as more detailed technical analysis of specific factors for each of the proposed improvement concepts.

Pemberton Avenue Grade Separation

- Consult further with District of North Vancouver; TransLink; PMV; CNR; BCR; Greater Vancouver Regional District (Metro Vancouver) regarding proposed sewage plant; terminal operators and other property owners and stakeholders;
- Undertake detailed assessment of natural environmental values, potential contaminated sites and geotechnical conditions associated with both options; and,
- Carry both options further in terms of preliminary engineering and evaluation before deciding on a preferred option.

St Andrews Avenue Grade Separation

- Consult further with City of North Vancouver, Translink, PMV, CNR, terminal operators, and other property owners and stakeholders to confirm the design option;
- Undertake detailed assessment of natural environment values, potential contaminated sites and geotechnical conditions;
- Identify measures to reduce visual (including illumination and road noise impacts associated with raising Low Level Road in the vicinity of the railway overpass); and,
- Proceed with preliminary engineering of Low Level Road and proposed St. Andrews rail overpass.

Neptune/Cargill Grade Separation

- Explore another option that replaces the existing “Y” junction at the Low Level Road/E 3rd Street with a grade separation. The proposed option would also have the Neptune/Cargill access and railway overpass teeing into E 3rd Street, and passing over Low Level Road as well;



- Consult further with the City of North Vancouver; Translink; PMV; CNR; Neptune and Cargill;
- Undertake detailed assessment of natural environmental values, potential contaminated sites and geotechnical conditions associated with all options; and,
- Carry all options further in terms of preliminary engineering and evaluation before deciding on a preferred option.

Low Level Road (LLR) Re-alignment

- Consult further with City of North Vancouver, TransLink, PMV, CNR, JRI, Cargill, Neptune and other property owners and stakeholders, LLR laning, preferred overpass locations and types at St. Andrews Ave and at Cargill/Neptune; as well the intersection design at E 3rd Street, Low Level Road, and Cotton Road;
- Undertake detailed assessment of natural and social environmental values along the realignment (including fish and fish habitat, riparian areas, wildlife, archaeological resources, existing and projected noise levels, visual impacts (including road illumination), right-of-way impacts and potential contaminated sites). Propose avoidance, mitigation or compensation as necessary; and,
- Undertake preliminary engineering including detailed surveys and geotechnical investigations, value engineering, road safety audit and feasibility of construction staging as well as an associated traffic management plan for the construction period.

Harbour Avenue Grade Separation

- Confirm whether Lynnterm re-development plans are proceeding (discuss potential timing, scope and potential traffic implications);
- Evaluate options to manage proposed container traffic flow in and out of Lynnterm; options could include redirecting bus movements at Main/Mountain intersection such that additional capacity could be made available for container and other traffic on Main Street;
- Potential improvement concepts along Main Street should be evaluated together with potential improvement concepts at the TCH interchanges; and,
- Undertake detailed assessment of natural environmental values along the route – fish and fish habitat, riparian areas, wildlife (flora and fauna) as well as archaeological resources. Propose avoidance, mitigation or compensation as necessary.

Western Lower Level Route Extension to Marine Drive

- Consult with Squamish Nation and BCR regarding the potential timing and scope of future developments in order to confirm the location of the new route, rail overpass, and potential property/environmental issues; and,
- Undertake detailed assessment of natural environmental values along the route – fish and fish habitat, riparian areas, wildlife (flora and fauna) as well as archaeological resources. Propose avoidance, mitigation or compensation as necessary.



**APPENDIX 1:
STUDY BACKGROUND DOCUMENTS**

1. North and West Vancouver Rail Assessment Study, submitted to Port Metro Vancouver by MainLine Management Inc., Draft April 30, 2008.
2. North Shore Access Study, Vancouver Port Authority/UMA, September 17, 2007.
3. Roberts Bank Rail Corridor: Road/Rail Interface Study, Transport Canada/N.D. Lea, February 2007.
4. Terminal Access Study, Phase 2 Report, Transport Canada/ Ward Consulting, November 20, 2006.
5. Port Plan, Vancouver Port Authority, May 9, 2005.
6. BC Lower Mainland Rail Infrastructure Network Study, Greater Vancouver Gateway Council/ IBI Group, December 2004.
7. Lynnterm Container Terminal Road Access Study, Final Report, Port of Vancouver/ND Lea, July 2003.
8. Lynnterm Container Terminal Update Technical Memo, MMM Group, January 2008.
9. Major Commercial Transportation System: Rail Capacity & Regional Planning Issues Overview, Greater Vancouver Gateway Council, February 2003.
10. Squamish Nation Capilano Master Plan: A Guideline for Development of Capilano, Squamish Nation/UMA Engineering, December 2004.
11. Pemberton Crossing Study, Draft Report, BC Railway Company/ND Lea, December 2001.
12. North Shore Interchanges Functional Planning Study, Final Draft, BC Ministry of Transportation/CH2M Hill, December 2007.
13. Capilano Road at Highway 1 Ramps Safety Review, Draft Final Report, ICBC/Delcan, November 2006.
14. Lions Gate to Highway 1 Connector Planning Study, Final Report, BC Ministry of Transportation/Urban Systems, March 13, 2007.
15. Taylor Way/Marine Drive Concept Development Study, BC Ministry of Transportation/ SNC-Lavalin, July 2003.
16. Lions Gate Transit Priority Study, TransLink/ Urban Systems (preliminary draft only; pending study completion).
17. TransLink 2003 Travel Time Survey, TransLink, October 2004.
18. TransLink 10-Year Outlook, TransLink, December 2003.
19. City of North Vancouver Official Community Plan and Transportation Plan, City of North Vancouver/Urban Systems, July 28, 2007/March 2007.
20. City of North Vancouver Spirit Trail Report, Phase 1 Draft, January 2008.
21. District of North Vancouver Official Community Plan, Bicycle Master Plan, Marine Drive Improvement Strategy and Seylynn Village Proposal, District of North Vancouver.
22. Lower Level Route, Final Report, City of North Vancouver/Reid Crowther & Partners, July 4, 1996.